

AGENDA

DATE: Monday, October 16, 2023
TIME: 5:30 PM
PLACE: **By Video Conference and Teleconference**

To facilitate access, members of the public may join a meeting by telephone, Zoom, and/or the City of Norwalk YouTube channel. Specific instructions and links can be found at www.norwalkct.org/meetings.



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Members of the public who wish to provide public comment are encouraged to submit those via email in advance of the meeting. For these comments to be read into the record, they should be submitted at least three hours in advance of the meeting start time. Please email Dilene Byrd at dbyrd@norwalkct.org to provide written public comment prior to a meeting.

WPCA Regular Meeting:

1. Call to Order
2. Public Input - (Guests at WPCA meetings may speak to any item on the agenda. Comments shall be limited to no more than three (3) minutes per speaker.)
3. Approve the minutes from WPCA Special Meeting held on September 14, 2023 and WPCA Meeting held on September 18, 2023. (copies included)
4. Authorize the Chairman or Vice Chairman of the Water Pollution Control Authority to execute an Agreement with Insituform Technologies, LLC in the amount of \$3,363,047.50 for the Sanitary Sewer Rehabilitation Project (Project: WPCA 2023-01). (letter attached)

Account Nos. 09194062-5777-C0361, 09204062-5777-C0361, 09224062-5777-C0361,
and 09244062-5777-C0361

5. Authorize the Chief of Operations and Public Works to issue orders on contract with Insituform Technologies, LLC for the Sanitary Sewer Rehabilitation Project (Project: WPCA 2023-01) for an amount not to exceed \$850,000.
Account No. 09244062-5777-C0361
6. Contract Operations Report:
 - a. Veolia Monthly Operating Report – September 2023
 - b. Smart Sewer Network NEWEA / NYWEA Presentation
 - c. Major Repair or Replacement / Out of Scope Items: None
7. Reports:
 - a. FY23/24 Revenues/Expenditures MUNIS Reports (copy included)
 - b. Touch a Truck & Open House – 10/21/2023 (flyer included)
 - c. Facility Plan Update (copy included)
 - d. Collection System Master Plan Update - Amended (copy included)
 - e. Financial Model Update (copy included)
 - f. Discussion on WPCA Engineering Projects:
 - 1) Catch Basin Disconnect Program
 - 2) Hubbell's Lane Relief Sewer
 - 3) Keeler Brook PS Replacement
 - 4) WWTP – SCADA Enhancements (copy included)
 - 5) CIPP Lining
 - g. Discussion on WPCA Construction Projects (photos included)
 - 1) Collection – Wall Street / 2 Knight Street Relocation and Improvements
 - 2) Collection – Dreamy Hollow Project
 - 3) PS - Five Mile, Old Trolley Way, Karen Dr., and Woodward Ave. Rehabilitation
 - h. Sewer Use Bill Appeals/Adjustments Update
 - 1) Appeal status
 - i. Information Copies: None
8. Adjournment

Next WPCA Meeting: **Monday, November 20, 2023, 5:30 PM**
By Video Conference and Teleconference

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**CITY OF NORWALK
WATER POLLUTION CONTROL AUTHORITY VIA ZOOM VIRTUAL
VIDEOCONFERENCE AND TELECONFERENCE
SPECIAL MEETING
September 14, 2023**

Attendance: Darren Oustafine, Chairman
Barbara Smyth
Greg Burnett
Chris Mannella
John Bovi
Bryan Meek

Staff: Vanessa Valadares, Chief of Operations and Public Works
Chris Torre, DPW, Superintendent of Operations
Ralph Kolb, WPCA Senior Environmental Engineer
Nelya Bauer, WPCA Wastewater Systems Manager

Others: Vanessa McPherson, ARCADIS
Mathew Todaro, Verill Law
Maye Emlein

Eric Muir, Brown and Caldwell

1. CALL TO ORDER

Mr. Oustafine called the meeting to order at 5:30PM.

2. EXECUTIVE SESSION TO DISCUSS DRAFT FACILITY PLAN UPDATE

**** MS. SMYTH MOVED TO ENTER INTO EXECUTIVE SESSION.**

**** THE MOTION PASSED UNANIMOUSLY.**

Executive session began at 5:32PM

Executive session ended at 6:23PM.

There were no motions made and no votes were taken.

3. ADJOURNMENT

**** MR. MANNELLA MOVED TO ADJOURN.**

**** THE MOTION PASSED UNANIMOUSLY.**

The meeting adjourned at 6:24PM.

Respectfully submitted,

Dilene Byrd

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**CITY OF NORWALK
WATER POLLUTION CONTROL AUTHORITY VIA ZOOM VIRTUAL
VIDEOCONFERENCE AND TELECONFERENCE
REGULAR MEETING
SEPTEMBER 18, 2023**

Attendance: Darren Oustafine, Chairman
John Igneri, Vice Chairman
Barbara Smyth
Greg Burnett
Chris Mannella
John Bove
Bryan Meek

Staff: Vanessa Valadares, Chief of Operations and Public Works
Ralph Kolb, WPCA Senior Environmental Engineer
Neyla Bauer, Wastewater Systems Manager
Darin Callahan, Corporation Counsel

Others: Mathew Brown, Asst. Project Manager, Veolia
Jason O'Brien, Veolia
Mat Todaro, Verrill Law
Maye Emlein, Verill Law
Vanessa McPhearson, ARCADIS
Eric Muir, Brown and Caldwell

1. CALL TO ORDER

Mr. Oustafine called the meeting to order at 5:30PM.

2. PUBLIC INPUT- (GUESTS AT THE WPCA MEETING ANY SPEAK TO ANY ITEM ON THE AGENDA. COMMENTS SHALL BE LIMITED TO NO MORE THAN THREE (3) MINUTES PER SPEAKER.)

There was no public participation this evening.

**** MR.IGNERI MOVED TO SUPEND THE RULES TO TAKE THE AGENDA OUT OF ORDER.**

**** THE MOTION PASSED UNANIMOUSLY.**

4. AUTHORIZE THE WPCA CHAIRMAN, DARREN OUSTAFINE, TO EXECUTE ANY AND ALL AGREEMENTS AND OTHER DOCUMENTS NECESSARY TO ENTER INTO A DATA SHARING AGREEMENT WITH THE FIRST TAXING DISTRICT (THE "FTD") WHEREBY THE FTD WILL PROVIDE THE WPCA SUPPLY WATER CONSUMPTION DATA OF THE INDIVIDUAL CUSTOMERS OF THE FTD, INCLUDING TOTAL METERED GALLONS, SERVICE ADDRESS, OWNER'S NAME, ACCOUNT NUMBER, AND ACCOUNT TYPE. (COPY INCLUDED)

Mr. Callahan said there is a confidentiality agreement that treats the consumption data for water use by the water department as outside of public data under the public documents act or FOI however, there is a statute that allows the city to enter into an agreement with water treatment facility for the purposes of billing within the municipal sewers system act. He said they will provide the data and the city will keep it confidential and can only be used for the specific purpose of billing. Mr. Mannella said the agreement states that each subsequent year the rate shall be increased by the district rate increase which is an amount that is determined by the First Taxing District and asked what that rate increase will be. Mr. Callahan said it would be subject to their board's approval on an annual basis but is completely decoupled from their actual water rates.

**** MR.IGNERI MOVED TO APPROVE THE ITEM.**

**** THE MOTION PASSED UNANIMOUSLY.**

5. AUTHORIZE THE WPCA CHAIRMAN, DARREN OUSTAFINE, TO EXECUTE ANY AND ALL AGREEMENTS AND OTHER DOCUMENTS NECESSARY TO ENTER INTO A LONG-TERM DISCHARGE AGREEMENT WITH THE FIRST TAXING DISTRICT (THE "FTD") FOR THE DISCHARGE OF WATER TREATMENT WASTEWATER FROM THE FTD'S FACILITY IN NEW CANAAN INTO THE CITY'S SANITARY SEWER COLLECTION SYSTEM FOR TREATMENT AT THE CITY'S WASTEWATER TREATMENT FACILITY. (COPY INCLUDED)

Mr. Callahan said as it stands right now the water district has a water plant and there is water treatment wastewater that needs to be discharged which gets discharged to the City of Norwalk's wastewater treatment plant by way of a special industrial user permit that is issued by the DEEP and is a five year permit and need to reapply every five years. There is one trunk line from the water plant connecting with the city's collection system that delivers the wastewater to the WWTP for treatment and everything will remain the same and they will continue to discharge under an SIU permit, and they will have the ability to on a long term basis to the extent that they are going to upgrade their facilities and the better the facilities are maintained and updated is a win for Norwalk. He said in addition they were able to craft a few add on items into the agreement that will be helpful to the city and would have not otherwise been in the permit itself and will not receive any less money under this agreement then would have otherwise received under the annual rate structure because the agreement itself requires payment based on the annual rate increases. Mr. Mannella asked how they are charged now. Mr. Kolb said they are charged as a commercial customer based on gallons. Mr. Mannella said if there was not a flow meter how they were charged. Mr. Kolb said it is based on historical flow data that First District had provided the city many years ago so by now having a flow meter installed it will provide representative flow data for billing.

**** MS. SMYTH MOVED TO APPROVE THE ITEM.**

**** THE MOTION PASSED UNANIMOUSLY.**

3. APPROVE THE MINUTES FROM WPCA MEETING HELD ON JULY 17, 2023. (COPY INCLUDED)

**** MR. BURNETT MOVED TO APPROVE THE MINUTES AS SUBMITTED.**

**** THE MOTION PASSED UNANIMOUSLY.**

6. AUTHORIZE THE CHIEF OF OPERATIONS AND PUBLIC WORKS TO SUBMIT THE FACILITY PLAN UPDATE TO CTDEEP (PRESENTATION)

Ms. Valadares said the Facility Plan is due to the DEEP by October 2, 2023, which is part of the Consent Order, and the last Facility Plan was done in 2009. Mr. Kolb said staff put together a strong team to work on the Facility Plan update and includes ARCADIS as the lead for the Wastewater Treatment Plant, Brown and Caldwell for the Collections system, and Verrill Law for legal assistance for items related to the Consent Order.

Attorney Todaro presented a background of the consent order and said the WPCA approved the Consent Order on April 18, 2022, and the mayor signed it on May 5, 2022. He said the Consent Order has two primary deliverables and one addresses the collections system and the second relates to the Facility Plan update and the anticipated filing date is October 2, 2023.

Mr. Kolb said the goals and focus areas of the Facility Plan Update included reviewing existing & estimate future flows and loads, describing site upgrades and enhancements since the previous Facility Plan, reviewing current treatment efficiency and capabilities, reviewing current NPDES permit requirements, developing and evaluating enhancements and recommended alternatives for key focus areas that include Outfall 002-1, aeration system, and final settling tanks.

Ms. McPherson said the wastewater treatment plant continues to have ample capacity and there are no concerns with the WPCF's ability to accommodate projected flows and loads through 2030. She said the design flow for the wastewater treatment plant is 18 MGD and the current 12-month average daily flow is 12.2 MGD so that leaves plenty of capacity even with the roughly 650,000 gallons per day of additional flow that is being projected based on population increases and planned developments through 2030. She also said Secondary Treatment Capacity is 30.0 MGD, and wet weather treatment capacity is 65.0 MGD.

Ms. McPherson said there are no substantial changes in current NPDES permit in the current version of the permit as compared to the last iteration and the wastewater treatment plant is performing extremely well and The WPCF continues to see a downward trend for effluent nitrogen and excellent performance in removal which is a testament to operations and performance of the wastewater treatment plant, and in 2022, Norwalk was ranked 5th in Connecticut for proposed nitrogen credit sharing.

Attorney Todaro said the Consent Order provides two options for compliance that include providing Outfall 002-1 with primary treatment or its equivalent, or to eliminate Outfall 002-1. Ms. Valadares said after looking at the options they had come to a conclusion that approximately \$45 million dollars would need to be invested into Outfall 002-1 and would only be used on an average of 4 times per year. She said they had filed an extension with CTDEEP and over the past 90 days have engaged Brown and Caldwell to see if option two, which is to eliminate Outfall-002-1 can be fulfilled.

Mr. Muir presented the infiltration and inflow analysis and modeling and said that the data had identified 18 sewer shed areas that exhibited excess flow generation and modeled key rehabilitation activities in the 18 sewer sheds that still exhibited high excess flow and the model showed an 80% reduction in overall volume going through Outfall 002-1 in a one-year 24-hour storm and is extreme process towards renewing the assets and reducing flows substantially. He said the total cumulative cost over a 10-year period of almost \$50 million dollars and will provide a renewed asset as opposed to a new asset and there are many benefits that come along with that. Ms. Valadares said the benefits of advance the elimination of Outfall 002-1 include environmental benefits and energy efficient benefits and the investment will preserve the assets and extend the life of the assets.

Ms. McPherson presented the aeration system and said it is one of the biggest energy users at the wastewater treatment plant and found some significant ways to improve the aeration which is the heart of the wastewater treatment plant which is where the nitrogen removal is happening. She said the scope includes comprehensive aeration system upgrades, significant improvements to the electrical systems to the secondary control building, secondary control building upgrades, and relocating the blowers within the building. She said the project cost is approximately \$48 million dollars for the aeration upgrades.

Ms. McPherson said the final settling tanks are the other focus area of the Facility Plan but is not subject to the Consent Order, but are good to keep in mind for capital planning for the operation of the facility and looked at three different options for mechanism replacement and the spiral scraper is the selected recommendation for mechanism replacement and are proposing to move forward with that, and are also looking at doing some modeling to design an energy dissipating inlet which will help with sludge blankets stability and sludge removal and different options for baffles and effluent launder covers to prevent algae for building up. She said they are also recommending some increases to RAS pumping capacity but overall, the recommended improvements for the FST area are \$20 million dollars.

Ms. Valadares said that the Facility Plan will have three components and will include advance elimination of Outfall 002-1 and will also focus on the aeration tanks and the final settling tanks. She emphasized that the investment to advance elimination of Outfall 002-1 is part of the Consent Order and will have a financial obligation after the plan is submitted of \$50 Million Dollars, and that the aeration tanks and final settling tanks are not part of the Consent Order but will be included in the capital budget request in the next few years to achieve that. She also reminded the board that there is a financial model that is followed and as part of this year there has been a placeholder of \$50 million dollars added for the Facility Plan update and will use the financial model in the next coming years for the improvements to the aeration tanks and final settling tanks to see what the financial impact will be on the rates.

Mr. Burnett asked if there have been any pre-discussions with the CTDEEP that they will be in agreement with the Facility Plan. Ms. Valadares said before exploring option two to eliminate Outfall 002-1 staff meet with the CTDEEP and asked if they would consider giving an extension and even though they did not commit to accepting that they understood that this was very favorable because as part of this it will include improving water quality by investing on the collection system which is in line with their environmental goals. Attorney Todaro said that they also believe the language in the Consent Order supports both options.

Mr. Meek asked if the numbers presented are inflation adjusted dollars and if not, how are they forecasted out 10 years. Ms. Valadares said the numbers are based on the information today but there may be some adjustment depending on inflation.

**** MR.IGNERI MOVED TO APPROVE THE ITEM.**

**** THE MOTION PASSED UNANIMOUSLY WITH SIX (6) IN FAVOR AND ONE (1) OPPOSED- MR. MEEK.**

Mr. Meek left the meeting at 6:00PM.

7. CONTRACT OPERATIONS REPORT:

a. Veolia Monthly Operating Report – August 2023 (copies included)

Mr. Brown presented and said the Veolia collection system team completed 3.27 miles of TV inspection along with the cleaning of over 3.51 miles of sewer lines, and one manhole inspection for the month but over 885 have been done this year and the goal is 600 per year so they have stepped back on the manhole inspections and focused more on surveying areas for the WPCA through CCTV and cleaning. He said the IPP inspection program conducted 32 inspections.

Mr. Brown said that the centrifuge for solids handling lost the main hydraulic unit and expects it to be down for most of September and are hauling liquid loads in place of cake until it is back online.

Mr. Brown said the facility was in compliance with all permit requirements for the month of August, and there were two sanitary sewer overflows that were reported to the DEEP. He noted that the facility is running excellent.

b. Blend Tank No. 1 Rehabilitation

Mr. Brown said that blend tank #1 steel structure repairs have been completed.

c. Major Repair or Replacement / Out of Scope Items:

1) Stairs at Bell Island PS (copy included)

Mr. Brown said the stairs will be replaced at the Bell Island pump station.

2) Flygt Mixers (copy included)

Mr. Brown said there are 15 mixers within the facility and run 24/7 and during inventory realized there are only two spares and met with staff and decided to order a couple new ones to have on hand as they are a critical item.

3) WWTP Generator Software (copy included)

Mr. Brown said the generator was installed in 2012 and had to have the software updated.

4) Valves for Keeler Brook and Ft Point PS (copy included)

Mr. Brown said that a brand-new pump was installed at the Keeler Brook pump station.

5) WWTP Blower Control Updates (copy included)

Mr. Brown said if something happens to the SCADA system there is no way to override the blower system which and have worked with Aaron Associates and

they will be presenting a design to run the blowers stand-alone, if necessary, which is crucial in times of emergencies to keep full treatment to the facility.

Mr. Brown shared photos of the new signage and fencing that has been installed at the Wastewater Treatment Plant and DPW Operations Center.

Mr. Brown shared photos of the blend tank repairs and said that they should be put back online by Thanksgiving.

8.REPORTS:

- d. FY22/23 and FY23/24 Revenues/Expenditures MUNIS Reports (copies included)
There was no discussion.
- e. Discussion on WPCA Engineering Projects:
 - 1) Sammis and Bell Island Sewershed Rehabilitation
Ms. Bauer said the project consists of approximately 8.5 miles of CIPP lining and the bid documents were finalized in early August and went out to bid in late August and are due back on September 28th.
 - 2) Catch Basin Disconnect Program
Ms. Bauer said as part of the collection system master plan the catch basins that are significant inflow contributors to the collection system were identified and are currently working with the Brown and Caldwell team to get the field information that was needed, and they are now working to evaluate the feasibility of disconnecting and also evaluating that the storm system that will be connected can handle the flow.
 - 3) Hubbell's Lane Relief Sewer
Ms. Bauer said the project consists of the installation of approximately 1,100 feet of new sewer pipe along Hubbell's Lane and Smith Street and had a design kickoff meeting a few weeks ago and the team is in the process of obtaining approval to perform borings and test pits along the alignment.
 - 4) Keeler Brook PS Replacement

Mr. Kolb said they are still working on Phase I for the existing and proposed site and drawings are being prepared by Wright-Pierce for review by staff.
 - 5) Keeler Brook Force Main Condition Assessment

Ms. Bauer said an investigation was done with Wright-Pierce using smartball technology and there were no defects, air pockets, or leaks found, and the force main is in good shape.

- f. Discussion on WPCA Construction Projects (photos included)
 - 1) Collection – Wall Street / 2 Knight Street Relocation and Improvements
Ms. Bauer said the abandonment of the 30” sewer main under Wall Street was completed on September 6, 2023, and the paving is to be scheduled.
 - 2) Collection – Dreamy Hollow Project
Ms. Bauer said the piles for support of the RCP box culverts along Saddle Road have been installed.
 - 3) PS - Five Mile, Old Trolley Way, Karen Dr., and Woodward Ave. Rehabilitation
Ms. Bauer said the improvements, including architectural, mechanical and electrical, have mostly been completed at the Woodward Avenue pump station. She said the contractor is currently sandblasting, cleaning, and coating at the Five Mile pump station and the contractor is also working on the installation of new piping and pumps on the lower level.
 - 4) WWTP – SCADA Enhancements
Ms. Bauer said improvements to the wet weather screens have been incorporated.
- g. Sewer Use Bill Appeals/Adjustments Update
 - 1) Appeal status
Mr. Kolb said the adjustments to date are \$24,113.
- h. Information Copies: None

9. ADJOURNMENT

**** MR.IGNERI MOVED TO ADJOURN.**

**** THE MOTION PASSED UNANIMOUSLY.**

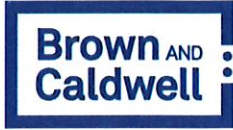
The meeting adjourned at 6:42PM.

Respectfully submitted,

Dilene Byrd

One Tech Drive, Suite 310
Andover, MA 01810-2435

T: 978.794.0336



October 12, 2023

Ralph Kolb, PE
Sr. Environmental Engineer
Norwalk Water Pollution Control Authority
15 South Smith Street
Norwalk, Connecticut 06855

Subject: WPCA 2023-01 Sanitary Sewer Improvements – Summary of Construction Bids/Recommendation for Award

Dear Mr. Kolb,

The bid opening for the Sanitary Sewer Improvements Project WPCA 2023-01 was held on September 28, 2023. A comparison of the bids is attached to this letter.

Summary of Bids

Three bids were received. The apparent low bidder is Insituform Technologies, LLC. The table below summarizes the bids that were received.

Table-1. Summary of Bids Received	
Bidders Company	Total Bid Amount
Insituform Technologies, LLC	\$ 3,363,047.50
Green Mountain Pipeline Services, LLC	\$ 3,659,659.00
National Water Main Cleaning Company (NWMCC)	\$ 3,815,940.00

- Insituform's low bid was \$3,363,047.50 and approximately \$1,785,262.50 less and 35% lower than the engineering estimate of \$5,148,310.00.
- Green Mountain's second-low bid of \$3,659,659.00 is \$296,611.50 more and 8.8% higher than Insituform's bid.
- NWMCC's third-low bid of \$3,815,940.00 is \$452,892.50 more and 13.5% higher than Insituform's bid.
- The average of the three bids is \$3,612,882.17, which is approximately \$1,535,428.00 lower than the engineering estimate.

Overview of the Low Bidder

Insituform Technologies submitted within their bid application: acknowledgment of all four addenda, the 15% Bid Bond and Bid Bond Form, a signed Non-Collusion Affidavit, a signed and notarized Bidder's Qualification Statement, a notarized proof of insurance, State of Connecticut Company Registration, and company information. In addition, they submitted ancillary documentation relative to field management experience, company project history, and other information.

References of the Low Bidder

Brown and Caldwell called eight (8) of the references listed by Insituform Technologies. Two (2) references answered. Both references responded positively regarding their experience with Insituform Technologies, stating they have not had any issues working with Insituform Technologies. The references stated that Insituform has been on or under-budget on their projects, and on schedule with work. The County of Saratoga, NY has used Insituform for many years over many projects and has been happy with their work. The County of Saratoga specifically offered that Insituform has good project management, communicates well and Insituform has successfully worked in sensitive areas/working with homeowners as necessary.

Recommendation of Award

In consideration of the above information, Brown and Caldwell recommends that the WPCA award the contract for the Sanitary Sewer Improvements Project WPCA 2023-01 to Insituform Technologies, LLC based on Insituform Technologies, LLC being the lowest, qualified bidder.

Very truly yours,

Brown and Caldwell



Eric Muir, PE
Senior Vice President

Attachment

- Attachment A: Bid Comparison

City of Norwalk - Water Pollution Control Authority				Apparent Low Bidder		Second Bidder		Third Bidder	
Project: WPCA 2023-01 Sanitary Sewer Improvements				Insituform Technologies 580 Goddard Ave, Chesterfield, MO 63005		Green Mountain Pipeline Services 768 South Main St, Bethel, VT 05032		National Water Main Cleaning Company 25 Marshall St, Canton MA	
Bid Item #	Description	Quantity*	Unit	Unit Price	Total Cost	Unit Price	Total Cost	Unit Price	Total Cost
	General Condition/Administration: includes Mobilization and Demobilization (Max 5% of total contract value)								
1		1	LS	\$ 132,000.00	\$ 132,000.00	\$ 150,067.00	\$ 150,067.00	\$ 75,000.00	\$ 75,000.00
2	Erosion and Sediment control	1	LS	\$ 10,000.00	\$ 10,000.00	\$ 10,000.00	\$ 10,000.00	\$ 10,000.00	\$ 10,000.00
3	Pre CIPP CCTV	45,360	LF	\$ 2.25	\$ 102,060.00	\$ 3.00	\$ 136,080.00	\$ 5.25	\$ 238,140.00
4-A	Heavy Sewer Cleaning: 8"-15" Pipe Diameter	12,000	LF	\$ 0.01	\$ 120.00	\$ 2.00	\$ 24,000.00	\$ 2.00	\$ 24,000.00
4-B	Heavy Sewer Cleaning: 24" Pipe Diameter	1,050	LF	\$ 2.25	\$ 2,362.50	\$ 5.00	\$ 5,250.00	\$ 30.00	\$ 31,500.00
5	8" Pipe Rehabilitation by Cured-in- Place Method (CIPP)	37,350	LF	\$ 29.00	\$ 1,083,150.00	\$ 30.00	\$ 1,120,500.00	\$ 39.00	\$ 1,456,650.00
6	10" Pipe Rehabilitation by Cured-in- Place Method (CIPP)	2,540	LF	\$ 37.50	\$ 95,250.00	\$ 30.00	\$ 76,200.00	\$ 46.00	\$ 116,840.00
7	12" Pipe Rehabilitation by Cured-in- Place Method (CIPP)	2,420	LF	\$ 48.00	\$ 116,160.00	\$ 35.00	\$ 84,700.00	\$ 48.00	\$ 116,160.00
8	14" Pipe Rehabilitation by Cured-in- Place Method (CIPP)	1,000	LF	\$ 42.50	\$ 42,500.00	\$ 60.00	\$ 60,000.00	\$ 51.00	\$ 51,000.00
9	15" Pipe Rehabilitation by Cured-in- Place Method (CIPP)	50	LF	\$ 163.00	\$ 8,150.00	\$ 75.00	\$ 3,750.00	\$ 51.00	\$ 2,550.00
10	24" Pipe Rehabilitation by Cured-in- Place Method (CIPP)	2,000	LF	\$ 136.00	\$ 272,000.00	\$ 175.00	\$ 350,000.00	\$ 133.00	\$ 266,000.00
11	Sewer Manhole Monolithic Cementitious Lining 4ft Diameter	2,450	VF	\$ 178.00	\$ 436,100.00	\$ 175.00	\$ 428,750.00	\$ 270.00	\$ 661,500.00
12	Sewer Manhole Monolithic Epoxy Lining 4ft Diameter	20	VF	\$ 444.50	\$ 8,890.00	\$ 700.00	\$ 14,000.00	\$ 400.00	\$ 8,000.00
	Raise Buried Manhole to Grade and Replace Frame and Cover In Kind, Buried 12 inches or Less Below Grade - Paved Area			\$ 2,335.00	\$ 35,025.00	\$ 5,290.00	\$ 79,350.00	\$ 2,600.00	\$ 39,000.00
13		15	EA						
	Raise Buried Manhole to Grade and Replace Frame and Cover In Kind, Buried 12 inches or Less Below Grade - Paved Area - STATE RIGHT OF WAY			\$ 2,450.00	\$ 24,500.00	\$ 5,520.00	\$ 55,200.00	\$ 2,600.00	\$ 26,000.00
14		10	EA						
	Raise Buried Manhole to Grade and Replace Frame and Cover In Kind, Buried 12 inches or Less Below Grade - Unpaved Area			\$ 3,200.00	\$ 16,000.00	\$ 4,830.00	\$ 24,150.00	\$ 2,800.00	\$ 14,000.00
15		5	EA						
	Sewer Manhole Invert Construction, 4ft Diameter	20	EA	\$ 278.00	\$ 5,560.00	\$ 1,500.00	\$ 30,000.00	\$ 1,500.00	\$ 30,000.00
16		1,200	EA	\$ 306.00	\$ 367,200.00	\$ 300.00	\$ 360,000.00	\$ 0.50	\$ 600.00
17	Grout Lateral Joint at Lateral	1,200	EA	\$ 1.00	\$ 1,200.00	\$ 0.01	\$ 12.00	\$ 10.00	\$ 12,000.00
18	Reconnect Active Service Lateral								

City of Norwalk - Water Pollution Control Authority					Apparent Low Bidder		Second Bidder		Third Bidder	
Project: WPCA 2023-01 Sanitary Sewer Improvements					Insituform Technologies 580 Goddard Ave, Chesterfield, MO 63005		Green Mountain Pipeline Services 768 South Main St, Bethel, VT 05032		National Water Main Cleaning Company 25 Marshall St, Canton MA	
Bid Item #	Description	Quantitv*	Unit		Unit Price	Total Cost	Unit Price	Total Cost	Unit Price	Total Cost
19	Maintenance and Protection of Traffic	1	LS		\$ 30,000.00	\$ 30,000.00	\$ 50,000.00	\$ 50,000.00	\$ 50,000.00	\$ 50,000.00
20-A	Uniformed Police Detail to Support Maintenance of Traffic	1	ALLOW		\$ 240,000.00	\$ 240,000.00	\$ 240,000.00	\$ 240,000.00	\$ 240,000.00	\$ 240,000.00
20-B	Uniformed Flagger: Traffic Person	1	ALLOW		\$ 100,000.00	\$ 100,000.00	\$ 100,000.00	\$ 100,000.00	\$ 100,000.00	\$ 100,000.00
21	Shallow Trenching of Bypass Piping and Temporary Patching (Asphalt Pavement)	7,500	LF		\$ 0.01	\$ 75.00	\$ 1.00	\$ 7,500.00	\$ 1.00	\$ 7,500.00
22	Cut Protruding Lateral (non manned entry)	10	EA		\$ 278.00	\$ 2,780.00	\$ 500.00	\$ 5,000.00	\$ 500.00	\$ 5,000.00
23	Temporary Asphalt Paving, Curbing and Sidewalk	7,500	LF		\$ 0.01	\$ 75.00	\$ 1.00	\$ 7,500.00	\$ 1.00	\$ 7,500.00
24	Permit/ Final Restoration Fees	1	ALLOW		\$ 200,000.00	\$ 200,000.00	\$ 200,000.00	\$ 200,000.00	\$ 200,000.00	\$ 200,000.00
25	Landscaping/Site Restoration	1	ALLOW		\$ 25,000.00	\$ 25,000.00	\$ 25,000.00	\$ 25,000.00	\$ 25,000.00	\$ 25,000.00
26	Surface Restoration - Grass (seed)	100	SY		\$ 31.80	\$ 3,180.00	\$ 44.00	\$ 4,400.00	\$ 10.00	\$ 1,000.00
27	Clearing and Grubbing	100	SY		\$ 37.10	\$ 3,710.00	\$ 82.50	\$ 8,250.00	\$ 10.00	\$ 1,000.00
					Total Amount: \$	3,363,047.50	Total Amount: \$	3,659,659.00	Total Amount: \$	3,815,940.00

* Bid quantities are estimated and not guaranteed

YEAR-TO-DATE BUDGET REPORT

FOR 2024 99

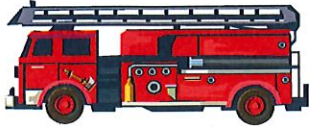
ACCOUNTS FOR:	WATER POLLUTION CONTROL	ORIGINAL APPROP	TRANFRS/ADJSTMTS	REVISED BUDGET	YTD EXPENDED	ENCUMBRANCES	AVAILABLE BUDGET	PCT USED
22								
040	PUBLIC WORKS							
224062	WATER POLLUTION CONTROL							
224062 4051	INTEREST	-65,000	0	-65,000	-20,570.86	.00	-44,429.14	31.6%
224062 4121	NITROGEN	-50,000	0	-50,000	-31,626.00	.00	-18,374.00	63.3%
224062 4451	SEWER PERM	-1,500	0	-1,500	-400.00	.00	-1,100.00	26.7%
224062 4453	SEPTIC LIC	-1,200	0	-1,200	-100.00	.00	-1,100.00	8.3%
224062 4513	SEWER CHRG	-17,940,000	0	-17,940,000	.00	.00	-17,940,000.00	.0%
224062 4516	SPT DIS FE	-175,000	0	-175,000	-64,855.00	.00	-110,145.00	37.1%
224062 4521	WILTON SU	-600,000	0	-600,000	942,949.82	.00	-1,542,949.82	-157.2%
224062 4522	SEWER USE	-45,000	0	-45,000	-46,569.00	.00	1,569.00	103.5%
224062 452C	INDUSTRIAL	-175,000	0	-175,000	.00	.00	-175,000.00	.0%
224062 452D	SEWER CONN	-150,000	0	-150,000	-11,410.00	.00	-138,590.00	7.6%
224062 452E	IPP INTERE	-5,000	0	-5,000	-1,090.48	.00	-3,909.52	21.8%
224062 4807	REIMB EXP	-1,000	0	-1,000	.00	.00	-1,000.00	.0%
224062 4825	BOND PREM	0	0	0	-861,393.83	.00	861,393.83	100.0%
224062 489F	REIMB GF	-136,163	0	-136,163	.00	.00	-136,163.00	.0%
224062 4901	INV INCOME	-110,000	0	-110,000	.00	.00	-110,000.00	.0%
	TOTAL WATER POLLUTION CONTROL	-19,454,863	0	-19,454,863	-95,065.35	.00	-19,359,797.65	.5%
	TOTAL PUBLIC WORKS	-19,454,863	0	-19,454,863	-95,065.35	.00	-19,359,797.65	.5%
	TOTAL WATER POLLUTION CONTROL	-19,454,863	0	-19,454,863	-95,065.35	.00	-19,359,797.65	.5%
	TOTAL REVENUES	-19,454,863	0	-19,454,863	-95,065.35	.00	-19,359,797.65	.5%

7.a.

YEAR-TO-DATE BUDGET REPORT

FOR 2024 99

ACCOUNTS FOR:	WATER POLLUTION CONTROL	ORIGINAL APPROP	TRANSFRS/ADJUSTMTS	REVISED BUDGET	YTD EXPENDED	ENCUMBRANCES	AVAILABLE BUDGET	PCT USED
22								
040 PUBLIC WORKS								
224062 WATER POLLUTION CONTROL								
224062 5110	WAGES & SA	452,914	0	452,914	114,594.13	.00	338,319.87	25.3%
224062 5120	WAGES & SA	100,000	0	100,000	1,285.04	.00	98,714.96	1.3%
224062 5140	WAGES & SA	36,000	0	36,000	4,659.37	.00	31,340.63	12.9%
224062 5150	LONGEVITY	1,150	0	1,150	.00	.00	1,150.00	.0%
224062 5235	MEMBERSHIP	10,000	0	10,000	215.00	.00	9,785.00	2.2%
224062 5241	ELECTRIC	1,553,000	0	1,553,000	255,286.89	.00	1,297,713.11	16.4%
224062 5245	TELEPHONE	2,000	0	2,000	.00	.00	2,000.00	.0%
224062 5252	LEGAL SERV	250,000	0	250,000	32,028.30	.00	217,971.70	12.8%
224062 5258	OMI	10,430,000	1,539,528	11,969,528	2,429,925.21	7,090,481.06	2,449,121.99	79.5%
224062 5286	BUSINESS E	32,000	0	32,000	2,019.54	.00	29,980.46	6.3%
224062 5295	SEMINAR&CO	20,000	0	20,000	.00	.00	20,000.00	.0%
224062 5298	OTHER	250,000	10,638	260,638	4,364.05	.00	256,273.45	1.7%
224062 5418	INSURANCE	140,086	0	140,086	.00	.00	140,086.00	.0%
224062 5428	BENEFITS	241,404	0	241,404	.00	.00	241,404.00	.0%
224062 5521	PRINCIPAL	3,208,420	0	3,208,420	.00	.00	3,208,420.00	.0%
224062 5522	INTEREST	1,011,484	0	1,011,484	.00	.00	1,011,484.00	.0%
224062 5523	BOND EXP	0	0	0	78,363.23	.00	-78,363.23	100.0%
224062 5651	TO G/F	692,807	0	692,807	.00	.00	692,807.00	.0%
224062 5741	IT HARDWAR	60,000	0	60,000	30,250.00	.00	29,750.00	50.4%
224062 5789	RESERVE	963,598	0	963,598	.00	.00	963,598.00	.0%
TOTAL WATER POLLUTION CONTROL		19,454,863	1,550,166	21,005,029	2,952,990.76	7,090,481.06	10,961,556.94	47.8%
TOTAL PUBLIC WORKS		19,454,863	1,550,166	21,005,029	2,952,990.76	7,090,481.06	10,961,556.94	47.8%
TOTAL WATER POLLUTION CONTROL		19,454,863	1,550,166	21,005,029	2,952,990.76	7,090,481.06	10,961,556.94	47.8%
TOTAL EXPENSES		19,454,863	1,550,166	21,005,029	2,952,990.76	7,090,481.06	10,961,556.94	47.8%



City of Norwalk



Touch a Truck & Open House

When: Saturday, October 21

Time: 9:00 am- 12:00 pm

Where: Public Works Center

15 South Smith Street, Norwalk

(Follow the signs!)

- Hands- on activities and demonstrations
- Meet the Firefighters, Police Officers, Public Works staff and EMS medics that keep Norwalk safe.
- Learn about the services and work of different City Departments and Commissions.
 - Great giveaways
 - Wastewater treatment plant tours

- **Halloween Safety tips and giveaways**

For those who celebrate: Come dressed in your costumes!



Please bring non-perishable food items (such as peanut butter, jelly, pasta sauce, macaroni & cheese, tuna and soup) to donate to **Person to Person in South Norwalk**



For More Information contact: 203-854-3200 or

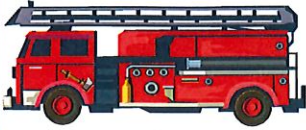
customerservice@norwalkct.gov



Great for all ages. Light refreshments.



7.b.



Ciudad de Norwalk

Gran Apertura Anual



Únase a nosotros para una divertida casa abierta y el evento **Tocar-un-camión**

Cuando: Sábado, 21 de Octubre

Hora: 9:00 am- 12:00 pm

Donde: Public Works Center
15 South Smith Street, Norwalk
(Siga las indicaciones!)

- Actividades prácticas y demostraciones.
- Conozca a los bomberos, oficiales de policía, personal de Obras Públicas y médicos de EMS que mantienen a Norwalk seguro.
- Conocer los servicios y el trabajo de los diferentes Departamentos y Comisiones de la Ciudad.
- Grandes obsequios
- Visitas a plantas de tratamiento de aguas residuales



Consejos y obsequios de seguridad para Halloween.



Para los que celebran: ¡Venid vestidos con vuestros disfraces!



Por favor traiga alimentos no-perecederos (como mantequilla de maní, jalea, salsa de pasta, atún, macarrones con queso y sopa) para donar a la Despensa de Comida de De persona a persona en South Norwalk!



Para más información contactar: 203-854-3200 o

customerservice@norwalkct.gov

Ideal para todas las edades

Refrigerios ligeros



PROFESSIONAL SERVICES TASK ORDER

Task Order Number: 05
Task Order Date: September 22, 2023

Subject to the AGREEMENT FOR ON-CALL ENGINEERING SERVICES BY AND BETWEEN WATER POLLUTION CONTROL AUTHORITY OF THE CITY OF NORWALK AND Woodard and Curran, Inc., (hereinafter referred to as the "Agreement"), WPCA hereby directs ENGINEER to perform the professional engineering services specified in this Task Order in accordance with the Agreement.

1. Project Description:

Project Number: 214728.03
Project Name: WPCA Financial Model Updates
Description: Updates to the WPCA's financial model based on Collection System Master Plan

2. Scope of Work:

The Scope of Work to be performed hereunder consists of updating the WPCA's financial model to incorporate future collection system rehabilitation costs and long-term WWTP costs, and is more fully described in the document entitled Norwalk WPCA – Financial Model Update Scope of Work dated September 22, 2023 attached hereto as Exhibit A.

3. Time Schedule:

Engineer shall complete the work required by this Task Order on or before December 31, 2023.

4. Compensation:

Engineer shall be paid for the proper performance of services described in this Task Order in an amount not to exceed Fifteen thousand, eight hundred and 00/100 (\$15,800) Dollars. Invoices shall be submitted monthly on time and materials basis. Compensation per tasks shall be as listed below:

Task Item	Fee
1. Model Updates	\$11,800
2. Meetings	\$4,000
Total	\$15,800

5. Special Conditions:

This Task Order is subject to the special provisions stated in Exhibit B, attached and incorporated herein as if fully set forth herein.

6. Amendment: NA

ISSUED AND AUTHORIZED BY:
WPCA

By: Ralph Z. Kolt

Title: Sr. Environmental Engineer

ACCEPTED AND AGREED TO BY:
ENGINEER

By: Anthony C. Catalano, PE, BCEE

Title: Senior Principal

7.e.

PROFESSIONAL SERVICES TASK ORDER

Task Order Number: 05

Exhibit A: Scope of Work

Exhibit B: Special Conditions

EXHIBIT A: SCOPE OF WORK



BACKGROUND

Woodard & Curran prepared a financial model for the WPCA to plan capital projects and project future rates. The model incorporates anticipated capital projects to create an accurate projection of future needs. The WPCA is in the process of completing a Collection System Master plan that will identify rehabilitation needs. The collection system work is paired with WWTP upgrades for the City to maintain consent order compliance. This scope will update the model accordingly and present the findings to the WPCA.

SCOPE OF SERVICES

In order to meet the scope of services, Woodard & Curran proposes the following tasks to complete the Task Order:

Task 1 – Report Updates

1. Collect and review latest annual report, budget documents and new consent decree
2. Update model for with FY23 actuals and FY24 budget numbers
 - a. Operations and Maintenance costs,
 - b. Debt Service projections,
 - c. Capital Improvement Plan,
3. Update rates in model to reflect newly approved fee structure
4. Project expenditures and rates needed over 10 year forecast period
5. Recommend future rates/fee structure to cover new costs expectations

Task 2 – Meetings and Presentations

Woodard & Curran anticipates up to two (2) meetings with the WPCA and City finance team to review progress and findings of the model updates. In addition, one (1) meeting and presentation to the WPCA Board is anticipated.

SCHEDULE

The milestone schedule is listed below assuming a contract start date of October 2, 2023, and a maximum contract date of December 31, 2023.

Task 1: Rate Model Updates	10/2/2023 – 11/15/2023
Task 2: Meetings and Presentations	11/15/2023 – 12/31/2023

800 Westchester Avenue
Suite N507
Rye Brook, New York 10573
www.woodardcurran.com

T 800.426.4262
T 914.448.2266
F 914.448.0147

EXHIBIT B: SPECIAL CONDITIONS



In reference to the Agreement between WPCA and ENGINEER, Section 5 Insurance, Article A (2), the requirement for ENGINEER to provide pollution and environmental insurance coverage is waived for this Task Order 05.

PROFESSIONAL SERVICES TASK ORDER

Task Order Number: 07D

Task Order Date: September 26, 2023

Subject to the AGREEMENT FOR ON-CALL ENGINEERING SERVICES BY AND BETWEEN WATER POLLUTION CONTROL AUTHORITY OF THE CITY OF NORWALK AND ARCADIS U.S., INC. (hereinafter referred to as the "Agreement"), WPCA hereby directs ENGINEER to perform the professional engineering services specified in this Task Order in accordance with the Agreement.

1. Project Description:

Project Number: 30001742 (Legacy Number 00867606.0000)

Project Name: SCADA Upgrade at the Norwalk WPCF

Description: Engineering services, Part-Time Resident Project Representation and System Integration Services to implement high priority items for Phase III of the Plantwide SCADA Upgrade.

2. Scope of Work:

The Scope of Work to be performed hereunder consists of continuation of Engineering Services to implement the SCADA Upgrade and is more fully described in the Letter Proposal from Arcadis dated September 26, 2023 attached here to as Exhibit A.

3. Time Schedule:

Engineer shall complete the work required by this Task Order within 180 calendar days of the date of this Task Order first written above.

4. Compensation:

Engineer shall be paid for the proper performance of services described in this Task Order in an amount not to exceed Seven Hundred Sixty Four Thousand Nine Hundred Seventy-Five and 00/100 (\$764,975.00) Dollars. This represents an increase in Thirty Five Thousand and 00/100 (\$35,000.00) Dollars from the amended Task Order value.

5. Special Conditions:

None

6. Amendment: This Task Order amends a previously executed Task Order.

Previous Task Order Number: 7C

Previous Task Order Date: December 7, 2022

ISSUED AND AUTHORIZED BY:
WPCA

ACCEPTED AND AGREED TO BY:
ARCADIS US, INC.

By: Ralph L. Loh

By: Vanessa McPherson

Title: Senior Environmental Engineer

Title: Associate Vice President

7.9.4

PROFESSIONAL SERVICES TASK ORDER
Task Order Number: 07D

Exhibit A: Letter Proposal (consisting of 1 page)

Exhibit B: Special Conditions - None



Ralph Kolb, PE
Senior Environmental Engineer
Norwalk Water Pollution Control Authority
15 South Smith Street
Norwalk, CT 06855

Arcadis U.S., Inc.
44 South Broadway
9th Floor
White Plains
New York 10601
Tel 914 694 2100
Fax 914 694 9286
www.arcadis.com

Subject:

Norwalk Water Pollution Control Facility
On-Call Contract Task Order #7 - SCADA Upgrade
Amendment Request No. 3 for Phase IIIA

Water

Date:
September 26, 2023

Dear Mr. Kolb:

Contact:
Vanessa McPherson

Three additional SCADA items have been identified by the project team which require additional compensation for Arcadis and Arcadis' subconsultant, Aaron Associates, to incorporate. These additional items are summarized below:

Phone:
914.641.2418

1. Addition of a low flow cutoff to the effluent level sensor at Outfall 002-1
2. New Supplemental Treatment Building SCADA Workstation
3. Rehabilitation of TWAS VFD Panels to support remote control of the TWAS pumps

Email:
vanessa.mcpherson
@arcadis.com

In order to complete the additional Phase IIIA items listed above, Arcadis respectfully requests an allowance of \$35,000 be incorporated into the project through this Amendment as detailed in the table on the following page. This allowance will be used exclusively to support the three SCADA work items listed above, as well as any miscellaneous SCADA items that may arise.

Our ref:
30001742

Should you have any questions or wish to discuss any aspect of this request in more detail, please do not hesitate to contact me. We appreciate the opportunity to continue to assist with the implementation of this important project for the WPCA.

Sincerely,

Arcadis U.S., Inc.

A handwritten signature in blue ink that reads 'Vanessa McPherson'.

Vanessa McPherson, PE
Associate Vice President

Mr. R. Kolb. PE
Norwalk WPCA
September 26, 2023

Item	SCADA Item Description	Total Cost	Notes
1	Low Flow Cutoff at Outfall 002-1	\$1,800	Add a new operator adjustable low flow cut off to the Outfall 002-1 level sensor to avoid false wet weather flow readings. False readings have been obtained which have shown "flow" from tank 002-1 when there is no longer water overtopping the effluent weir.
2	New Supplemental Treatment Building SCADA Workstation	\$13,400	Provide a new SCADA workstation in the STB including a SCADA Client PC compatible and consistent with the existing Server/Client System. <i>*Veolia to provide desk and prepare installation location.</i>
3	Rehabilitation of the TWAS VFD Panels	\$16,200	Rehabilitate the existing TWAS VFD Panels to allow for remote operation of the TWAS pumps. VFDs will be remotely controlled via the door mounted keypad, and any other available pushbuttons will be demolished.
4	Misc. Additional Allowance	\$3,600	Allowance for any additional SCADA items, including further modifications to wet weather programming or screens.
	Total Amendment Request	\$35,000	



**Norwalk Water
Pollution Control
Authority**

www.wpcanorwalk.org

WPCA Meeting

October 16, 2023

CAPITAL IMPROVEMENT PROJECTS

7.9

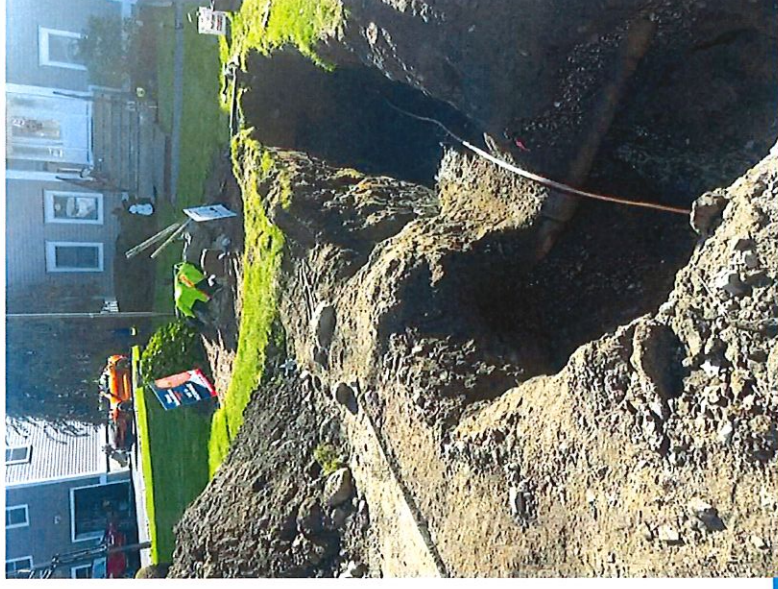
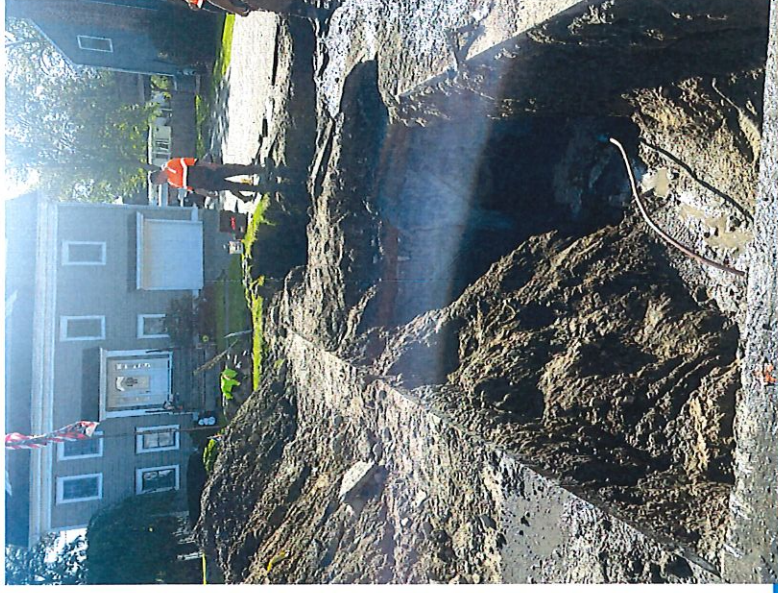
Collection System Updates

- Dreamy Hollow Project



Dreamy Hollow Project

- Installation of water main services along Saddle Rd. Each water service requires a new tap and copper piping from tap to the new curb stop.



Pump Station Updates

- File Mile
- Karen Drive



Five Mile Pump Station

- Coating of upper portion and interior of the Wet Well.

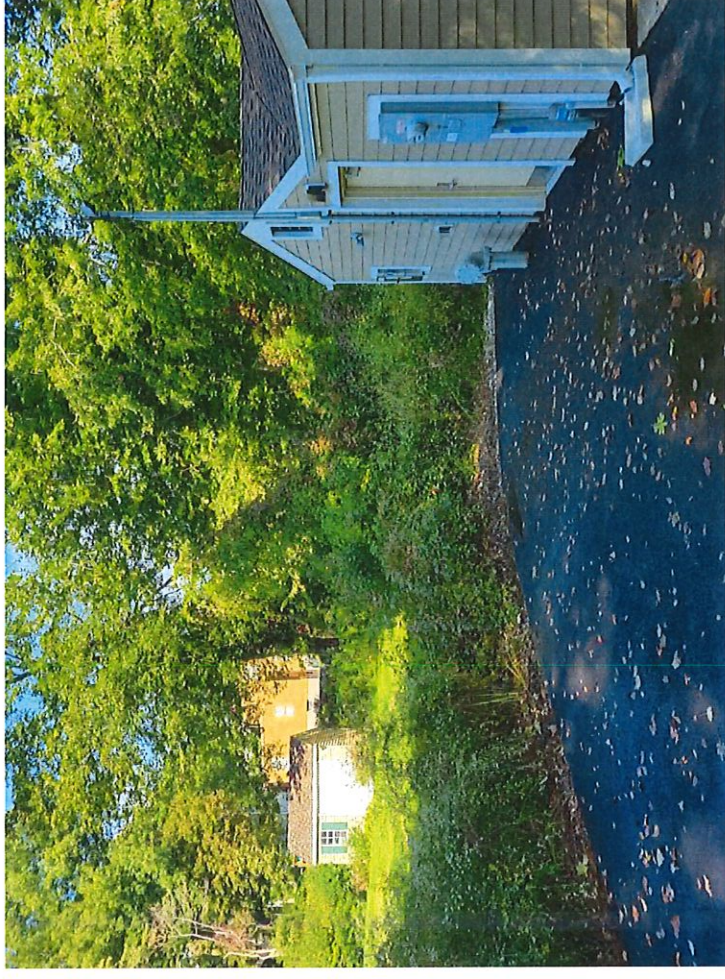


Five Mile Pump Station

- Installation of new pumps and piping. Electrical wiring of the pumps is in-progress.



Karen Drive Pump Station





**Norwalk Water
Pollution Control
Authority**

www.wpcanorwalk.org

September 29, 2023

VIA ELECTRONIC MAIL

Ms. Ann Straut
Sanitary Engineer 3
Department of Energy and Environmental Protection
Bureau of Water Protection and Land Reuse
Water Planning & Management Division
79 Elm Street
Hartford, CT 06106-5127

Subject: City of Norwalk, CT, Consent Order (# COWRMU22001)
Facility Plan Update

Dear Ms. Straut:

In accordance with Section B.4 of the above referenced Consent Order, please find attached the City of Norwalk Water Pollution Control Authority's updated Wastewater Treatment Plant Facilities Plan. Pursuant to an extension request submitted June 22, 2023, this submission is due on or before October 2, 2023.

Should you have any questions, please feel free to contact me at yvaladares@norwalkct.gov.

Sincerely,

A handwritten signature in blue ink, appearing to read "Vanessa Valadares", with a long horizontal flourish extending to the right.

Vanessa Valadares, P.E.
Chief of Operations and Public Works

Copy: Chris Torre, DPW (*via Electronic Mail*)
Ralph K. Kolb, P.E., WPCA (*via Electronic Mail*)
WPCA Board of Directors

City of Norwalk Water Pollution Control Authority

Facility Plan Update

Norwalk Water Pollution Control Facility

September 29, 2023



Facility Plan Update

Norwalk Water Pollution Control Facility

September 29, 2023

Prepared By:*

Arcadis U.S., Inc.

44 South Broadway, Suite 1200

White Plains

New York 10601

Phone: 914 694 2100

Fax: 914 328 3384

Arcadis Project Ref.:

30051745

*Evaluations and recommendations to advance elimination of Outfall 002-1 were performed and prepared by Brown and Caldwell. Content included in the Facility Plan Update on this topic, including Appendix E, is as provided by Brown and Caldwell for the purpose of compiling the information and has not been independently reviewed by Arcadis.

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Appendix B. CT OPM C&D Plan Map for 2018 - 2023

Appendix C. Norwalk WPCF Data Balance PFD

Appendix D. Norwalk WPCF Steady State Model Calibration Results Summary

Appendix E. Comprehensive Wet Weather Flow Reduction Program Technical Memorandum (Brown and Caldwell)

Appendix F. Aeration System Technical Memorandum (Arcadis)

Appendix G. Final Settling Tanks Improvements Technical Memorandum (Arcadis)

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Acronyms and Abbreviations

AT	Aeration Tank
BFP	Belt Filter Press
BNR	Biological Nutrient Removal
BOD	Biological Oxygen Demand
C&D Plan	Conservation and Development Policies Plan
CCT	Chlorine Contact Tank
CEPT	Chemically Enhanced Primary Treatment
CFU	Colony Forming Units
CGS	Connecticut General Statutes
CT	Connecticut
CTDEEP	Connecticut Department of Energy & Environmental Protection
DMR	Daily Monitoring Reports
EHRT	Enhanced High-Rate Treatment
FST	Final Settling Tank
GBT	Gravity Belt Thickener
GPD	Gallons per Day
GT	Gravity Thickeners
HVAC	Heating, Ventilation, and Air Conditioning
I&C	Instrumentation and Controls
I/I	Infiltration and Inflow
LGM	Locational Guide Map
MA	Moving Average
MGD	Million Gallons per Day
MOR	Monthly Operating Reports
NPDES	National Pollutant Discharge Elimination System
OPM	Office of Policy and Management
PC	Primary Clarifier
PFAS	Per- and Polyfluorinated Substances
PFD	Process Flow Diagram
POTW	Publicly Owned Treatment Works

Norwalk WPCF Facility Plan Update

PS	Primary Sludge
PST	Primary Settling Tank
PTB	Preliminary Treatment Building
P&ZD	Norwalk Planning and Zoning Department
RAS	Return Activated Sludge
RCSA	Regulations of Connecticut State Agencies
RSPS	Return Sludge Pump Station
SCADA	Supervisory Control and Data Acquisition
SCB	Secondary Control Building
SoNo	South Norwalk
SSA	Sewer Service Area
STB	Supplemental Treatment Building
SUEZ	SUEZ Water Environmental Services Inc.
TKN	Total Kjeldahl Nitrogen
TN	Total Nitrogen
TP	Total Phosphorus
TPS	Thickened Primary Sludge
TRC	Total Residual Chlorine
TSS	Total Suspended Solids
TWAS	Thickened Waste Activated Sludge
WAS	Waste Activated Sludge
WEF MOP	Water Environment Federation Manual of Practice
WPCA	Water Pollution Control Authority
WPCF	Norwalk Water Pollution Control Facility
WQS	Water Quality Standard

Executive Summary

This report was prepared for the City of Norwalk (City) and its Water Pollution Control Authority (WPCA). The purpose of this report is to update the 2009 Facility Plan for the Norwalk Water Pollution Control Facility (WPCF) and develop a plan for facility enhancements through 2030. This Facility Plan Update was also prepared in satisfaction of the Consent Order entered into by the Connecticut Department of Energy & Environmental Protection (CTDEEP) and the City of Norwalk in May 2022. Prior to entering the Consent Order the WPCA was preparing to update its 2009 Facility Plan.

Since development of the 2009 Facility Plan, the WPCA has been diligently planning and implementing numerous enhancements to the WPCF. Some key enhancements include preliminary treatment system upgrades; main influent pump replacement; WPCF equipment replacement; plant-wide Supervisory Control and Data Acquisition (SCADA) upgrade; enhanced chlorination and dechlorination; aeration tank electrical infrastructure upgrades; and odor control improvements to the Secondary Control Building. See Table 2 in Section 3.2. To further enhance its effort to optimize performance of the WPCF and enhance water quality in the Norwalk River and Long Island Sound, the WPCA initiated this update to the original 2009 Facility Plan.

To provide an updated roadmap for future WPCF enhancements this report includes the following:

- A review of the current National Pollutant Discharge Elimination System (NPDES) permit (CT0101259)
- Current and projected WPCF flows and loads
- An evaluation of current and projected City population and anticipated City development
- A summary of key plant enhancements since 2009
- Recommendations for enhancements to three key focus areas:
 - Outfall 002-1 (technical memorandum prepared by Brown and Caldwell)
 - Aeration system (technical memorandum prepared by Arcadis)
 - Final settling tanks (technical memorandum prepared by Arcadis)

During the Facility Plan Update process, the WPCA maintained communication with the WPCA Board of Directors and general public. A presentation on the process for developing the Facility Plan Update was provided at the October 2022 public board meeting. Monthly updates were provided by the WPCA at subsequent board meetings. The final draft Facility Plan was presented in September 2023 and accepted by the WPCA Board.

Summary of Findings

Advancing Elimination of Outfall 002-1

In the September 2023 Technical Memorandum titled, Comprehensive Wet Weather Flow Reduction Program (included herein as Appendix E), Brown and Caldwell concluded that substantial investment in the Norwalk WPCA collection system, inflow and infiltration (I/I) reduction efforts, and targeted collection system rehabilitation projects are a viable and cost-effective means to advance elimination of Outfall 002-1 by significantly reducing flows to the WPCF. Modeling conducted by Brown and Caldwell of current conditions and expected wet weather flows following implementation of collection system rehabilitation and I/I reduction efforts demonstrates an 80% reduction in volume discharged through Outfall 002-1 for a 1-YR, 24-HR rainfall event. Modeling further demonstrates significant overall reduction in flow to the WPCF and a decrease in the volume and duration of discharges from Outfall 002-1, should they occur. In addition to reducing overall flow from the collection system to www.arcadis.com

the WPCF and advancing elimination of Outfall 002-1, rehabilitation and I/I reduction efforts will also have the following important benefits including:

- **Environmental Benefits:**
 - Enhanced water quality in the Norwalk River and Long Island Sound due to significant reduction in wet weather flows and advanced elimination of Outfall 002-1.
 - Advanced elimination of Ann Street Emergency Overflow Siphon due to decreased flow in the collection system and WPCF.
 - Reduced potential of combined sewer overflows (CSOs) due to decreased flow in the collection system and WPCF.
 - Reduced potential of sanitary sewer overflows (SSOs) due to decreased flow in the collection system and WPCF.
- **Energy Efficiency Benefits:**
 - Reduced WPCF operation and maintenance due to decreased overall flow.
 - Improved process performance through reductions in peak flow and duration of sustained high flows, resulting in more consistent and optimal operation.
 - Advancement of CTDEEP energy efficiency goals by reducing the amount of flow requiring treatment at the WPCF.

Based on modeling of current conditions and predicted flow reductions through collection system enhancements, Brown and Caldwell recommends implementation of a comprehensive wet weather flow reduction program as a means to advance elimination of Outfall 002-1.

Table 1 shows the model-predicted reduction in Outfall 002-1 discharge volume for various recurrence internal rainfall events over the course of the recommended 10-year Comprehensive Wet Weather Flow Reduction Program. This table and additional detail on the predicted outcome of collection system improvements are contained in Appendix E and the Collection System Master Plan, prepared by Brown and Caldwell.

Table 1. Comprehensive Wet Weather Flow Reduction Program Flow Reduction Estimates

Rainfall Recurrence Interval	Outfall 002-1 Discharge Reduction by Program Year (%)					
	0	2	4	6	8	10
1YR, 24HR	-	47	60	73	77	80
5YR, 24HR	-	21	29	44	51	54
10YR, 24HR	-	16	25	37	42	46
25YR, 24HR	-	11	19	31	37	40

Current and Projected Flows and Loads

WPCF flows and loads data was reviewed for a period between January 2017 through September 2022 and also compared to the data from 2004 to 2007 (as presented in the 2009 Facility Plan). The analysis indicates that there has been an overall decrease in both the influent flows and influent loads received at the WPCF. The average annual influent flow for the data review period is 12.2 MGD which is well below the current permitted capacity of www.arcadis.com

18.0 MGD and also below the 2009 reported annual influent flow of 13.9 MGD. Despite population growth and development since 2009, the City's inflow/infiltration (I/I) reduction and water conservation efforts have resulted in this overall decrease in influent flows and loads.

Arcadis engaged in discussions with the City of Norwalk and Norwalk Planning and Zoning Department (P&ZD) to understand the City's planned residential and commercial development. Based on information received from the City as well as expected population growth, it is estimated that an additional 647,000 gallons per day (gpd) can be anticipated to be introduced to the WPCF by year 2030, increasing the average annual influent flow to 12.8 MGD.

In conclusion, based on the analysis, it is clear the WPCF continues to have ample capacity. There are no concerns with the WPCF's ability to handle projected flows and loads through at least 2030. While the WPCF is projected to see a minor increase in influent flows and loads by the year 2030 due to increasing population and planned development, it will still be well below the current permitted capacity of 18 MGD. Future increases can be expected to be minimized due to the City's continued investments in the collection system for I/I reduction and overall water conservation efforts.

Figure 1 below depicts the 180-day moving average (MA) of influent flows between January 2017 and September 2022. At no point over the past 5-year period has the WPCF's influent flow exceeded 90% of the design flows (at 16.2 MGD). For more information, refer to Section 4.1.

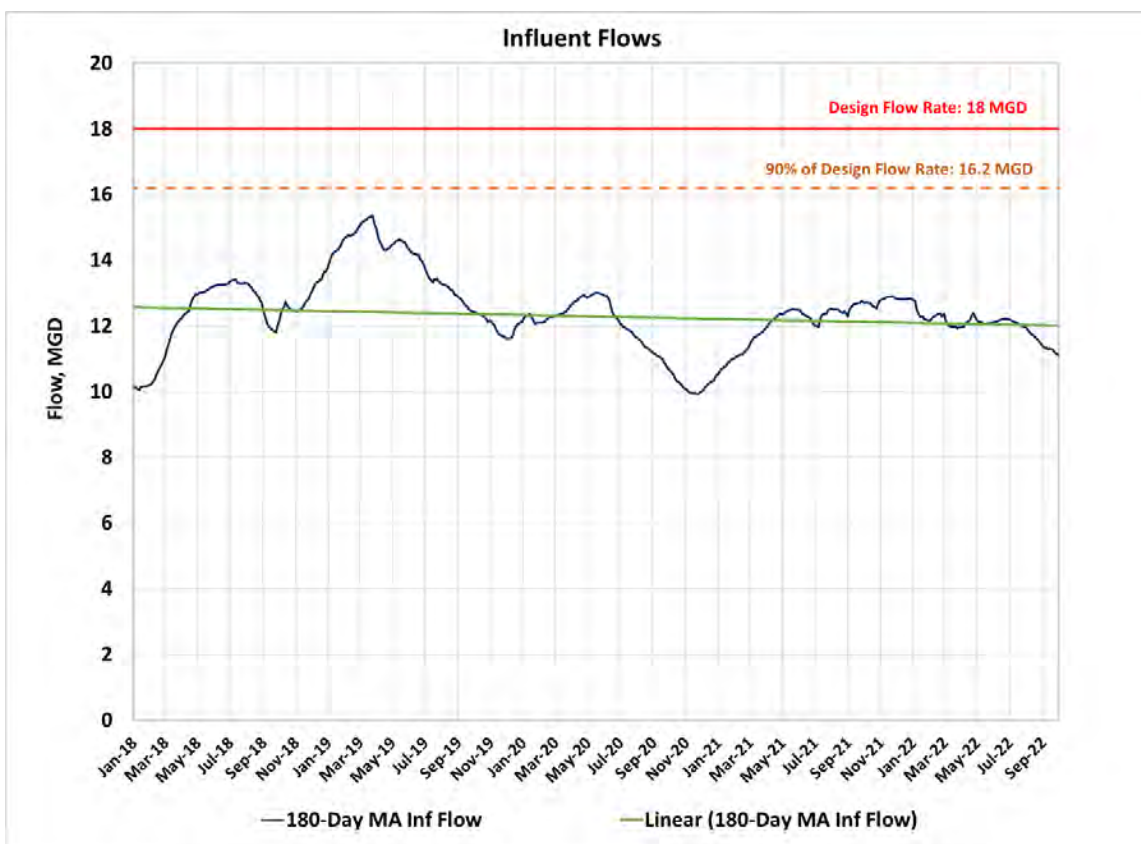


Figure 1. Norwalk WPCF Historical 180-Day MA Influent Flows

Summary of Recommendations

As part of the development of this report, a range of viable and cost-effective alternatives were evaluated for providing Outfall 002-1 with primary treatment or its equivalent (by Arcadis), or advancing elimination of Outfall 002-1 (by Brown and Caldwell). Arcadis also assessed enhancements to two key areas of the WPCF: the aeration system, and final settling tanks. While the WPCF continues to regularly meet or exceed overall effluent quality, critical process equipment is beginning to approach or exceed its useful life. The associated building systems also require enhancements to promote longevity of process equipment and supporting infrastructure. The goal of the assessment was to identify long-term, non-Consent Order Facility investments that will enhance and preserve assets and improve process.

Three technical memoranda were prepared, one for each focus area (Outfall 002-1, Aeration System and Final Settling Tanks), which are included as Appendices to this report. Each memorandum includes a description of the existing equipment, recommended design criteria and enhancements, and a summary of alternatives, as appropriate. Based on an evaluation of applicable alternatives and subsequent discussions with the WPCA, recommended improvements for the three focus areas are incorporated into each technical memorandum.

The recommendations and total probable project costs for the three focus areas are summarized in the sections below and more information is provided in Section 4.2. For non-Consent Order capital improvement projects, the costs reflect additional recommendations for general system-wide and building-wide improvements including structural, architectural, heating, ventilation and air conditioning (HVAC), instrumentation and controls (I&C), and electrical enhancements. All recommended enhancements were considered in the presented probable project costs and schedules which can be used to assist with the City's future capital planning. An initial resiliency evaluation was also completed and is detailed in Section 5.0. In general, all building entrances / first floors are above the 100-year base flood elevation (BFE). However, cost-effective flood protection and resiliency for each treatment area will be considered during detailed design.

Advance Elimination of Outfall 002-1

In compliance with the Consent Order entered into by the City and CTDEEP, the WPCA evaluated a range viable and cost-effective methods to provide Outfall 002-1 with primary treatment or its equivalent, or advance elimination of Outfall 002-1. In furtherance of this analysis, Arcadis evaluated a variety of technologies to provide Outfall 002-1 with primary treatment or its equivalent, and Brown and Caldwell analyzed enhancements to advance elimination of Outfall 002-1. Based on the evaluation, installation of equipment to achieve primary treatment or equivalent for flow discharged from Outfall 002-1 was considered but is not a viable and cost-effective measure at this time and is expected to have minimal long-term benefits to water quality.

Brown and Caldwell conducted an infiltration and inflow analysis to model how during certain wet weather events, excess flow enters the collection system, and moves to the WPCF. Through an excess flow reduction analysis, Brown and Caldwell projects that rehabilitation efforts will substantially reduce flow volume to the WPCF thereby significantly advancing elimination of Outfall 002-1.

As a result of the analysis performed by Brown and Caldwell, the WPCA intends to comply with its Consent Order obligations and achieve significant water quality enhancements to the Norwalk River and Long Island Sound by implementing a 10-year Comprehensive Wet Weather Flow Reduction Program. The Comprehensive Wet Weather Flow Reduction Program includes:

- Completing long-term, non-Consent Order recommendations from the Collection System Master Plan in 10-years rather than 25. This includes rehabilitation of 17 metersheds that have been identified as areas where rehabilitation will have the most significant reductions in flow to the WPCF and Outfall 002-1. Comprehensive rehabilitation efforts will include:
 - Lining public sewer mains with CIPP or similar continuous lining to prevent infiltration through the sewer pipe or joints between pipe segments.
 - Lining sewer manholes with epoxy, cementitious, or other equivalent lining to prevent infiltration through manhole risers or the joints between manhole riser sections.
 - Grouting all pipe to manhole penetrations to create a seal at the joint that is resistant to infiltration.
 - Grouting all lateral to sewer main penetrations to create a seal that resists infiltration.
- Post-Rehabilitation Monitoring and Reporting to assess ongoing flow-reduction and rehabilitation efforts.

Refer to Appendix E for the technical memorandum prepared by Brown and Caldwell which includes the analysis conducted and recommendations for flow reduction to advance elimination of Outfall 002-1. The recommendations for advancing elimination of Outfall 002-1 as prepared by Brown and Caldwell and identified in Appendix E, are projected to cost \$49.9 million over 10 years with an approximate investment of \$5 million annually.

Aeration System

Arcadis evaluated options for enhancing the WPCF's ability to supply, regulate, and optimize dissolved oxygen levels in the Aeration Tanks. This analysis and equipment is not subject to the May 2022 Consent Order.

Three different types of blowers were evaluated for replacing the existing multi-stage centrifugal blowers:

- High-Speed Direct Drive Centrifugal (Turbo) Blowers
- Integrally Geared (Single-Stage) Centrifugal Blowers
- Multi-Stage Centrifugal Blowers

Key criteria for blower comparison were discussed with the WPCA and Veolia. The main criteria used in the blower evaluation were:

- **Location Considerations:** Feasibility of implementing new blowers within the Secondary Control Building (SCB).
- **Capacity Range / Redundancy:** Capacity of the new blowers to provide the required range of air flows with adequate turndown. Minimize the overall footprint requirements to have space for future blower installation.

Based on the preliminary evaluation of process aeration blowers, the following is recommended:

- **Technology:** Turbo
- **Location:** Mezzanine Level
- **Number/Capacity:** 4 Blowers (3 active/ 1 standby) configuration with air flow range of approximately 1,800 scfm to 4,200 scfm per blower and space available for future blower addition.

Additional aspects of aeration system upgrades, including Aeration Tank (AT) equipment (mixers, pumps), air piping layout, diffusers, and process control strategies to support the design of new blowers were also reviewed and presented in the memorandum. For additional information on the technologies considered, recommended alternatives, and other recommended improvements, refer to the full technical memorandum in Appendix F.

The probable total project cost for the conceptual design along with other recommended improvements to the Aeration System, a building-wide electrical overhaul, and engineering fees and contingencies is estimated at \$48 million.

Final Settling Tanks

Arcadis considered three clarifier mechanism technologies for the Final Settling Tanks (FSTs). The recommended FST enhancements are not subject to the May 2022 Consent Order. The following clarifier technologies were selected for review due to their proven application for secondary settling: (1) suction header, (2) draft tubes, and (3) spiral scraper.

Along with clarifier mechanism technologies, other clarifier components and considerations are presented for further evaluation during detailed design. These include energy dissipating inlets, cylindrical baffles, Stamford baffles, effluent launder covers, and drip edges. The pumping capacity of the return sludge pump station (RSPS) is also analyzed and discussed within the memorandum.

Four clarifier alternatives were initially considered for the existing FSTs, including:

- Alternative 1 – Suction Header
- Alternative 2 – Draft Tubes
- Alternative 3 – Spiral Scrapers
- Alternative 4 – Rehabilitate Existing Mechanism

Alternatives 2 and 4 were removed from consideration and, based on subsequent discussions with the WPCA and Veolia at a FST Workshop, Alternative 3 – Spiral Scrapers is recommended. In addition to the clarifier alternatives, a preliminary evaluation of the Return Activated Sludge (RAS) pumping capacity was completed and recommended improvements are provided.

For additional information on the technologies considered, recommended alternatives, and other recommended improvements, refer to the full technical memorandum in Appendix G.

The probable total project cost for the conceptual design of FST enhancements along with other recommended building and tank improvements, engineering fees and contingencies is estimated at \$20 million.

1.0 Introduction

The most recent comprehensive Facility Plan for the Norwalk WPCF was prepared in 2009. That document was prepared for a planning period of 2010 through 2030. There have been numerous changes to existing conditions and future treatment goals since the development of the 2009 Facility Plan.

The purpose of this report is to update specific sections of the 2009 Facility Plan. The report provides a current roadmap for WPCF improvements through 2030.

Included in this update is a summary of major enhancements to the WPCF since the 2009 Facility Plan, an evaluation of existing and future (2030) city population, flows, and loads, and a review of specific process areas at the Facility, including advancing elimination of Outfall 002-1, the aeration system, and final settling tanks.

Specifically, this report serves to update the following sections of the 2009 Facility Plan:

- Section 3 – Basic Planning Criteria, the following subsections
 - Subsection 3.6 – Effluent Requirements → *Updated by Section 2.1.2 of this Report.*
- Section 4 – Existing Conditions, the following subsections
 - Subsection 4.3 – Wastewater Treatment → *Updated by Section 3 of this Report.*
 - Subsection 4.4 – Sludge Management Unit Processes → *Updated by Section 3 of this Report.*
- Section 5 – Population, Flows, and Loads → *Updated by Section 4.1 of this Report.*
- Section 7 – Wastewater Treatment Alternatives and Recommended Improvements, the following subsections
 - Subsection 7.5 – Final Settling Tanks → *Updated by Section 4.2.3 of this Report.*
 - Subsection 7.7 – Reduction in Wet Weather Flows and to Advance Elimination of Outfall 002-1 → *Updated by Section 4.2.1 of this Report.*

2.0 Project Background

This section provides a review of the WPCF's current regulatory standards, National Pollution Discharge Elimination System (NPDES) permit (CT0101259), facility background, and the current facility process flow. These factors are the foundation for identifying the critical facility improvements over the next five to ten years.

2.1 Regulatory Standards

2.1.1 Consent Order Summary

CTDEEP and the City of Norwalk entered into a consent order in May 2022. The Consent Order included a requirement that the WPCF update its Facility Plan on or before June 30, 2023,¹ to describe and evaluate a range of viable and cost-effective measures to provide Outfall 002-1 with primary treatment or its equivalent, or to eliminate Outfall 002-1. Prior to entering the Consent Order, the WPCA intended to update its 2009 Facility Plan.

2.1.2 Permit Review

The Norwalk WPCF maintains a NPDES permit administered by CTDEEP (Permit ID CT0101249). The permit authorizes the WPCF to discharge treated wastewater from the WPCF via two separate outfall locations (Outfall 001-1 and Outfall 002-1). Outfall 001-1 is the final discharge location for wastewater receiving secondary treatment. Outfall 002-1 is the final discharge point for wet weather flows and only activates when facility influent flows exceed 30 million gallons per day (MGD). In recent history, activation of Outfall 002-1 is infrequent as described further in this report.

The NPDES Permit has been revised since the 2009 Facility Plan with the current version effective April 1, 2021 through March 31, 2026. The permit renewal process included robust public engagement efforts including a presentation by the WPCA, public hearing, and written responses to comments received. A copy of the current permit is included as Appendix A. Arcadis performed a review of the current NPDES permit and a summary of this review and considerations for future changes are included below.

- There are no changes to the current permitted discharge limits at Norwalk WPCF and no significant changes are anticipated in the near term. This evaluation is based on an annual average daily flow of 18 MGD and peak secondary treatment capacity of 30 MGD.
 - In general, the WPCF continues to regularly meet the permitted discharge limits and often produces effluent quality well below permitted levels for all criteria including Biological Oxygen Demand (BOD), Total Suspended Solids (TSS), Chlorine, Nitrogen, and bacteria (Fecal Coliform and Enterococci).
- A review of the preceding and current Nitrogen General Permits suggests that no modifications to the total nitrogen (TN) discharge limits are being proposed by CTDEEP. Therefore, no additional changes to the existing TN discharge limit for Norwalk WPCF are anticipated in the next permit cycle.
 - In general, the WPCF maintains excellent TN removal with effluent quality well below the NPDES permit TN limit and Nitrogen General Permit as shown in Figure 2 below.

¹ Pursuant to an extension request submitted June 22, 2023, the Facility Plan Update must be submitted to CTDEEP on or before October 2, 2023.

- Facility data indicates a downward trend for effluent Nitrogen, demonstrating the WPCF's continued excellent Nitrogen removal performance.
- The facility does not currently have any total phosphorus (TP) limits, and none are anticipated.
- The permit has been updated to refer to "primary treatment" in lieu of "microscreen treated" when describing treatment of wet weather flow.
- While the current permit does not require sampling for Per- and Polyfluorinated Substances (PFAS), there may be requirements related to this in the future.

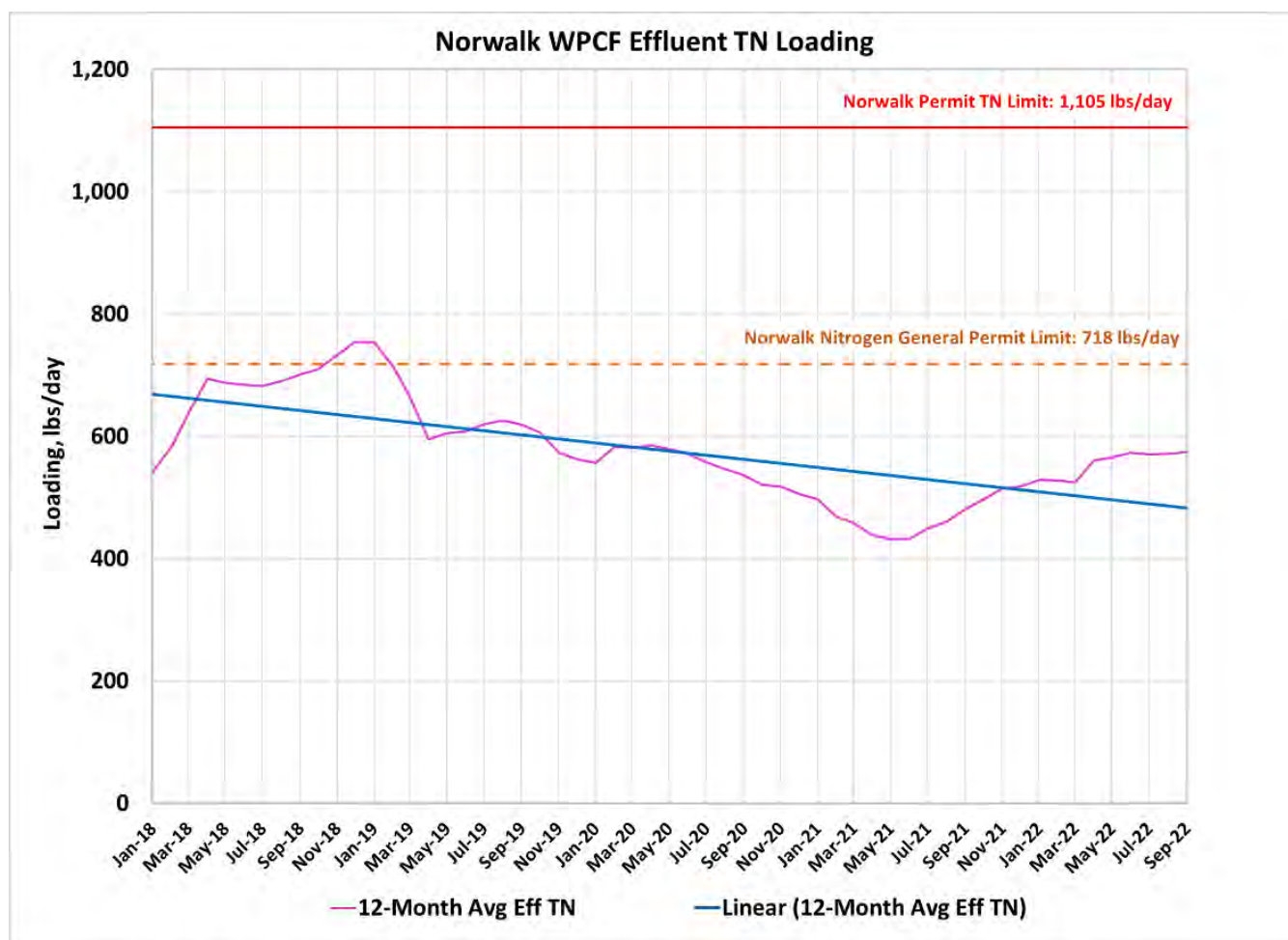


Figure 2. Norwalk WPCF Historical 12-Month Average Effluent Total Nitrogen Loading

2.2 Facility Background

The existing Norwalk WPCF site has been used for wastewater treatment for the City of Norwalk since the early part of the 20th century. The WPCF is located on the east bank of the Norwalk River just upstream of the Norwalk Harbor as shown in Figure 3. Prior to 1950, the Norwalk WPCF consisted of a gravity sewer inlet, gate chamber, main pumping station, two sedimentation tanks, chlorine contact tank, and a sludge management system. Since the original construction, numerous upgrades have been completed at the WPCF to provide a higher degree of treatment, modernize the facility, and enhance overall operations.

Wastewater travels from the Norwalk collection system to the WPCF via 206 miles of gravity mains, 22 pump stations, and seven miles of force mains owned by the City. During dry days the collection system conveys an average of 12.4 MGD of wastewater to the WPCF for treatment.

For additional information on the site history, refer to Section 2.2 of the 2009 Facility Plan (CDM Smith) and Section 2 of the Collection System Master Plan (Brown and Caldwell).



Figure 3. Norwalk WPCF Location

2.3 Existing Facility Process Flow

The WPCF's current general flow schematic is presented in Figure 4. Key focus areas for this Facility Plan update are highlighted.



2.4 Process Evaluation

As part of the Facility Plan update a process evaluation was conducted. The evaluation included review of the WPCF's current wet stream and solids stream unit processes, development of a data balance, and assessment of the existing BioWin™ process model. The process evaluation is described in more detail in this section.

2.4.1 WPCF – Current Data Balance

A process flow diagram (PFD) of the Norwalk WPCF, located in Appendix C, was developed to illustrate the latest conditions of the main wet stream and solids stream unit processes. Using the overall average conditions for flows and loads from September 2020 to September 2022, along with additional plant data and information on the operation of each unit process provided by Veolia, the PFD was populated to establish a plant-wide data balance of the WPCF for this timeframe. This data balance was used as the basis for the process evaluation of the WPCF.

2.4.2 WPCF – Process Model Analysis

Model development and analysis began by reviewing the existing BioWin™ model layout structures and kinetic/stoichiometric parameters developed by Veolia to represent the overall treatment system at the WPCF. This layout was refined based on discussions with the Norwalk WPCA and Veolia on current process operations, updated solids handling processes, and related recycled discharges. The updated process model configuration is shown in Figure 5.

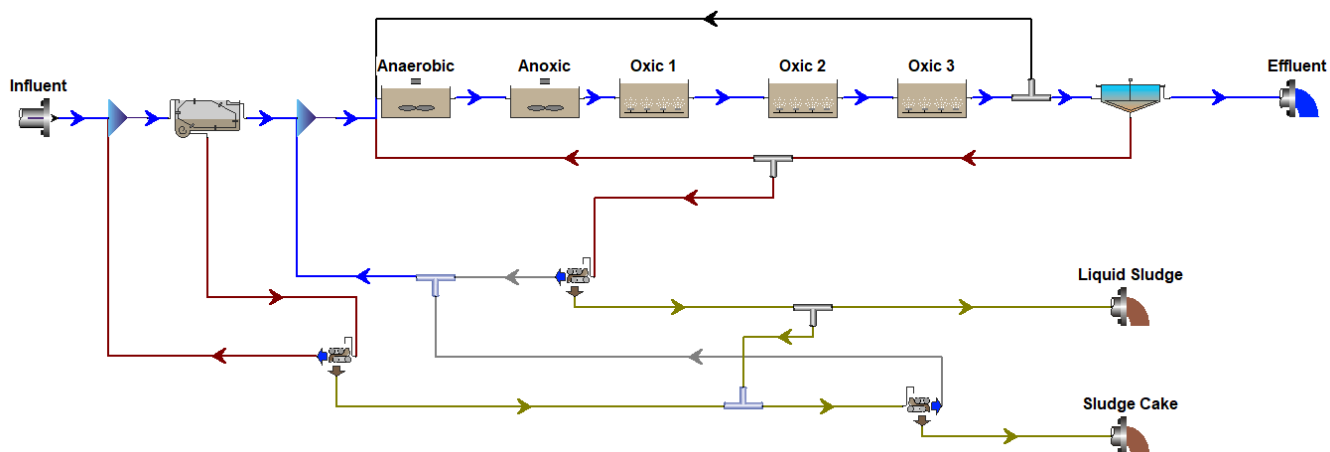


Figure 5. Updated BioWin™ Configuration

2.4.2.1 Model Calibration Assumptions

Calibration of the BioWin™ model entailed a review and adjustment of the influent wastewater fractionation and kinetic parameters. The fractionation information was based on the past model developed by Veolia and was used to support the development of raw influent characteristics. Calibration was conducted using the September 2020 to September 2022 data set, as it is believed to be the most accurate representation of the current operations and influent conditions at Norwalk WPCF.

The model set up was based on the following preliminary assumptions and input conditions:

1. All Primary Sludge Tanks (PSTs), aeration tanks (ATs), and final settling tanks (FSTs) are in service.
2. The activated sludge process will continue to be operated in Modified Ludzack-Ettinger (MLE) mode.
3. The oxic portion of each AT is divided into three grids to evaluate the oxygen demand distribution along the length of the tank. DO profile in each grid was maintained at:
 - a. Grid A: 3.0 mg/L
 - b. Grid B: 2.0 mg/L
 - c. Grid C: 1.0 mg/L
4. Primary sludge (PS) rates were set to match with the Primary Clarifier (PC) performance and Gravity Thickener (GT) solids capture efficiency rates identified through the data balance.
5. RAS rates were set 2.0 MGD higher than the reported data due to a discrepancy identified in the reported values.
6. Waste Activated Sludge (WAS) rates were set to match reported data.
7. Model default biokinetic rates were used (heterotrophic and nitrifiers growth).
8. FST settling characteristics were developed from reported effluent TSS data.
9. Solid's handling process performance was adjusted to match the adjusted solids captures in the thickening/dewatering processes and data balance.

2.4.2.2 Calibration Results

The September 2020 to September 2022 average plant data and steady state calibration results are presented in Appendix D. Process model calibration demonstrated a good overall fit with reported plant data and validated the biokinetics and clarification performance. This verifies growth rates are typical for a municipal water resource recovery facility in the US. The process model calibration results also coordinated well with the WPCF data balance.

Overall, the model showed good alignment with actual plant conditions and is considered calibrated for use in further planning studies and WPCF evaluations. Any long-term improvements, process flow changes, or changes in solids management or dewatering operations should be incorporated in future model evaluations during the detailed design phase.

3.0 Summary of WPCF Changes After 2009 Report

Various upgrades and changes have occurred at the WPCF between 2009 and present day which are not captured in the 2009 Facility Plan. This section provides a description of these upgrades to accompany the existing conditions described in the 2009 Facility Plan.

3.1 Contract Operations Transition

On September 16, 2019, the WPCA executed a Wastewater Treatment System Operations, Maintenance, and Management Services Agreement (Service Agreement) with SUEZ Water Environmental Services Inc. (SUEZ) for an initial term of 10 years with two additional five-year renewal options. In May 2020, the WPCA officially transitioned system operators to SUEZ. On March 17, 2022, SUEZ merged with Veolia Environment S.A. Per the Service Agreement, Veolia will continue to provide operations and maintenance services through 2029.

3.2 WPCF Enhancements

Table 2 lists projects and upgrades completed at the WPCF between 2009 and present day. While this list is not inclusive of all maintenance, equipment replacement, and general repairs performed at the WPCF, it captures notable upgrades that impact the WPCF's process flow, reliability, and/or performance.

Table 2. WPCF Upgrades (2009 – Present Day)

Title	Year	Description
Preliminary Treatment System Upgrade	2009 – 2012	The Preliminary Treatment Building (PTB) was constructed. The building included an influent pump station to raise the hydraulic grade line, as well as aerated grit tanks and 1/2" bar screens for preliminary treatment of up to 95 MGD of flow. The existing headworks in the Supplemental Treatment Building (STB) was decommissioned.
Main Influent Pump Replacement	2015 – 2017	The six main influent pumps within the PTB were replaced to enhance functioning. The pumps have been in successful operation since construction was completed in 2017.
WPCF Equipment Replacement	2018 – 2019	The WPCF underwent a facility-wide equipment replacement program to upgrade components of various process systems. It included complete replacement of critical pieces of equipment across the WPCF. This program included, but was not limited to, the secondary lift pumps, RAS and WAS pumps, primary sludge pumps, AT mixers, AT IMLR pumps, FST drives, and PST scum skimmers.

Title	Year	Description
Plantwide SCADA Upgrades	2018 – present	A new plant-wide Supervisory Control and Data Acquisition (SCADA) was installed to replace the existing control system. The project took place in three phases – Phase I: “Head End” SCADA Systems, Network, Standards and Alarm Framework; Phase II: SCADA System Optimization, Processor Upgrades, and Misc. Improvements; and Phase III: Final Upgrades and SCADA System Maintenance. Phase III is on-going and is on track to be completed by the end of 2023.
Outfall 002-1 Chlorination/Dechlorination Upgrades	2020 – 2021	The wet weather treatment system was upgraded to include an enhanced chlorination system and a new dechlorination system. The upgrade included new chemical metering pumps, high-rate mixers, and a chemical feed control strategy to support the equipment.
Aeration Tanks Electrical Infrastructure Upgrades	2021 – 2023	A new steel overhead conduit rack was constructed at the Aeration Tanks. The conduit and wire feeding the Aeration Tanks equipment, including instrumentation, mixers, and recycle pumps, was replaced and installed in a more readily accessible and protected area. Deck lighting was also provided.
Replacement of Belt Filter Press with Centrifuge and Odor Control Improvements in Secondary Control Building	2021	The belt filter press in the Secondary Control Building (SCB) was decommissioned in 2021 and replaced with a new centrifuge for improved sludge dewatering. A new odor control system was also installed to reduce odors and improve the atmosphere within the sludge processing area of the building.
Rehabilitation of the two sludge blend tanks	Ongoing	The two sludge blend tanks that hold sludge from the gravity thickener tanks and gravity belt thickeners show signs of corrosion and require structural rehabilitation. Veolia is currently coordinating this rehabilitation effort which is expected to be completed by the end of 2023.

4.0 Update to the 2009 Facility Plan

4.1 Population, Flows, and Loads

As part of the effort to update the 2009 Facility Plan, a review of the flow and load projections through the year 2030 was performed. The previous flow and load projections were based on plant operating data between 2004 and 2007. The current conditions were updated using data for the period of January 2017 through September 2022.

To update the flow and loading projections, specific sections of the 2009 Facility plan were reviewed with Norwalk WPCA and the Norwalk P&ZD as listed below. These discussions confirmed growth assumptions and helped to better define future conditions at the WPCF.

Arcadis considered the following in its analysis:

- Previous projection of residential and commercial/industrial development flows.
- Planned future growth and projections.
- Future flows from Town of Wilton and other municipalities.
- Sewer service area expansion including conversion of existing septic to sewer.

4.1.1 Current Influent Flows and Loads

As an initial step in updating flows and load projections, daily operational data from January 2017 through September 2022 was obtained from Norwalk WPCA. The historical data was analyzed for flow trends and to confirm the raw influent characterization data.

4.1.1.1 Current Plant Flows

The WPCF monitors wastewater flows through influent flow monitoring. Historically, effluent flow meter readings (which included the plant water flows) were reported as “Influent Flow” in the monthly operating reports to CTDEEP. The plant effluent flow meter is located downstream of the chlorine contact tank, but upstream of the plant water (internal recycle) connection which is used for various plant processes. Internal recycle flow is estimated at 1 MGD. To approximate final effluent flows and loading to Outfall 001-1, 1 MGD internal plant recycle flow was subtracted from the available effluent flow meter data set for data prior to 2017. As of February 14, 2017, the WPCA has switched over to utilizing the influent flow meter for reporting purposes as it is more representative of actual discharges from Outfall 001-1 and Outfall 002-1. Therefore, flows reported in this section (as well as subsequent load calculations) reflect the true raw influent flows.

Figure 6 summarizes the daily and 30-day rolling or moving average (MA) total influent flows from January 2017 to September 2022. The flow trends indicate that base flows have remained consistent, however, there is some seasonal variation of the flows between winter/spring (wetter months) and summer/fall (drier months), with periodic substantial wet weather events. The historical annual average, maximum (max) month (30-day), max day flows, as well as the associated flow peaking factors from 2017 to 2022 are presented in Table 3.

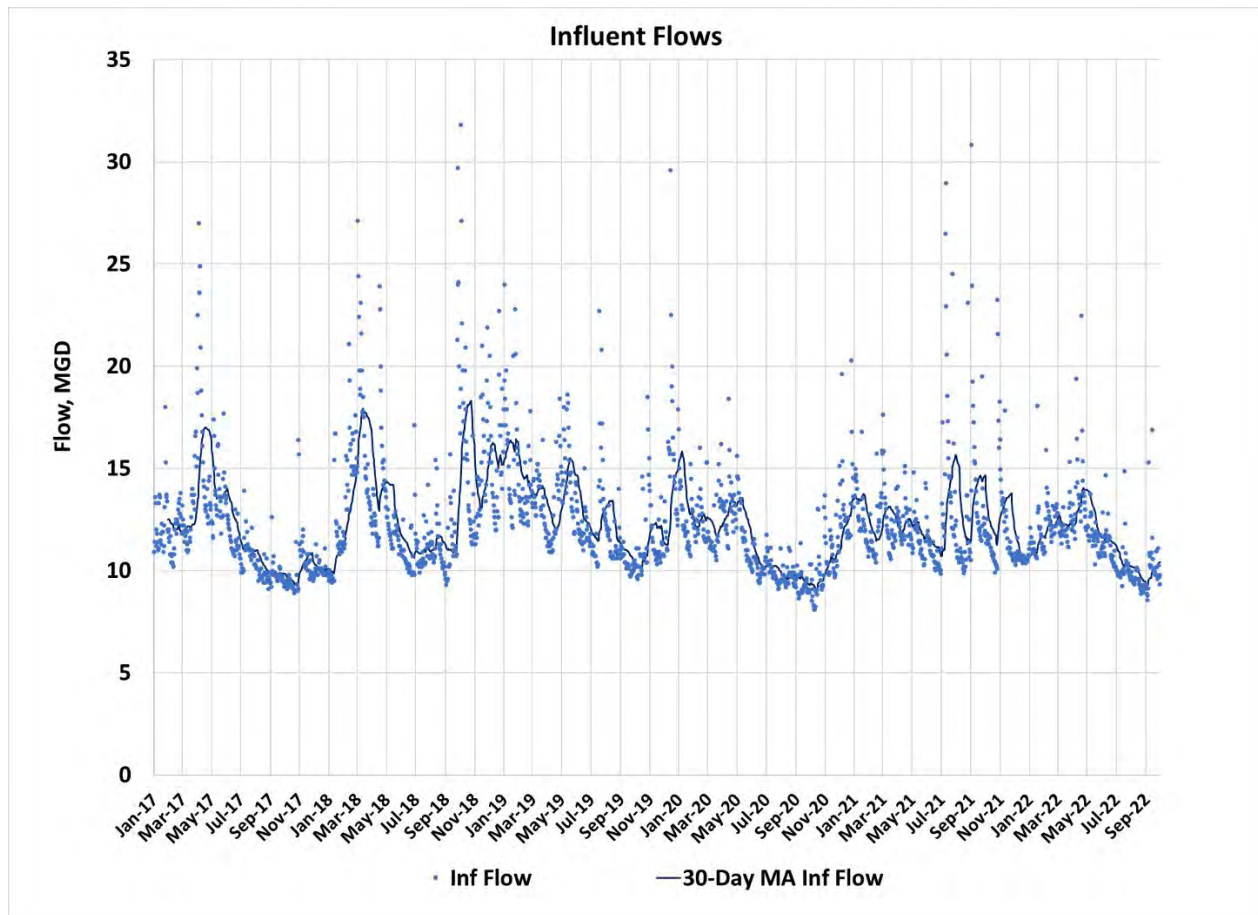


Figure 6. Norwalk WPCF Historical Daily and 30-Day MA Influent Flows

Table 3. Norwalk WPCF Yearly Influent Flows and Peaking Factors (2017 – 2022)

Year	Average Day	Max Month (30-Day)		Max Day*	
	Flow, MGD	Flow, MGD	Peaking Factor	Flow, MGD	Peaking Factor
2017	11.7	17.0	1.5	27.0	2.3
2018	13.6	18.3	1.4	31.8	2.3
2019	13.0	16.4	1.3	29.6	2.3
2020	11.3	15.8	1.4	20.3	1.8
2021	12.4	15.7	1.3	30.8	2.5
2022**	11.5	14.0	1.2	22.5	2.0
Average	12.2	16.2	1.3	27.0	2.2

*Flows in excess of 30 MGD are diverted to Supplemental Treatment Building

**January 1, 2017 to September 30, 2022

The WPCF currently treats an average daily wastewater flow of 12.2 MGD. Per section 4. (L) of the current NPDES Permit issued on April 01, 2021, “when the arithmetic mean of the average daily flow from the Publicly Owned Treatment Works (POTW) for the previous 180-days exceeds 90% of the design flow rate, the Permittee shall develop and submit a plan within one year, for review and approval of the Commissioner, a plan to accommodate future increases in flow to the plant.” 12.2 MGD is well below the WPCF’s permitted design flow rate of 18 MGD. Therefore, no action is required to expand WPCF capacity.

Table 4 and Figure 7 summarize the 180-day moving average (MA) of influent flows between January 2017 and September 2022. At no point over the past 5-year period has the WPCF’s influent flow exceeded 90% of the design flows (at 16.2 MGD). In conclusion, based on the analysis, it is clear the WPCF continues to have ample capacity and there are no concerns with the WPCF’s ability to accommodate projected flow through at least 2030.

Table 4. Norwalk WPCF Historical 180-Day MA Influent Flows

Flow Rate (MGD)	180-Day MA
Average	12.3
Max	15.4
Min	9.9

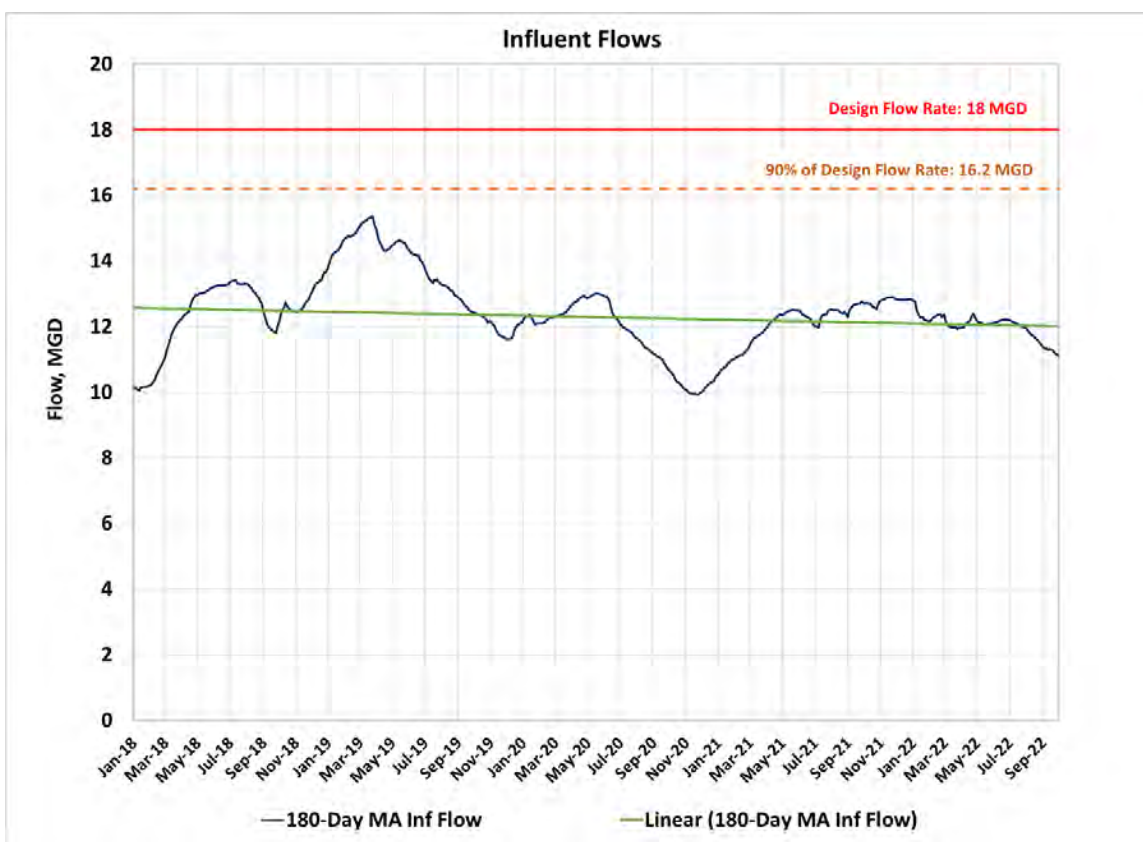


Figure 7. Norwalk WPCF Historical 180-Day MA Influent Flows

4.1.1.2 Current Plant Loads

Observed historical influent concentrations and loadings for biological oxygen demand (BOD₅), TSS, ammonia (NH₃) and total kjeldahl nitrogen (TKN) were analyzed for the available data between January 2017 and September 2022. Data was screened to remove major outliers (exceeding 98th percentile values) and did not include any major wet weather events. In addition to outliers and wet weather events, the data was reviewed for any unusual trends that may indicate sampling or other issues during that time period. Unusual spikes in all the influent parameters data were recorded between September 30, 2019 and October 16, 2019 but higher loadings were not observed in the primary effluent data. Therefore, information from this timeframe was removed from the dataset.

Figure 8 through Figure 11 show the observed influent loadings for BOD₅, TSS, TKN and NH₃ between 2017 and 2022. Table 5 through Table 8 summarize the analyzed and screened annual influent loadings and associated load peaking factors for BOD₅, TSS, TKN and NH₃ from 2017 – 2022.

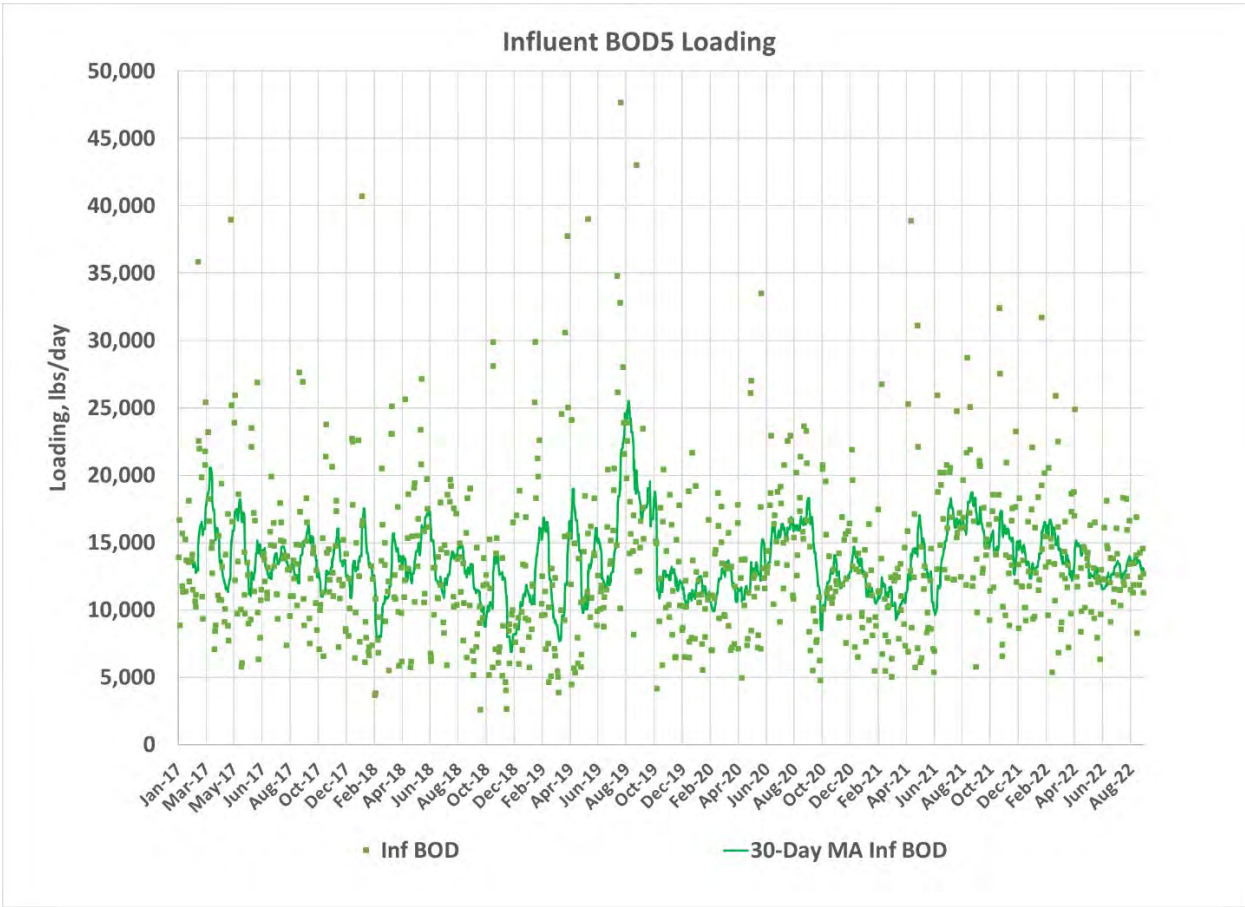


Figure 8. Norwalk WCPF Historical Influent BOD5 Loading

Table 5. Norwalk WPCF Yearly Influent BOD5 Loading and Peaking Factors (2017 – 2022)

Year	Average Day	Max Month (30-Day)		Max Day	
	Load, lbs/day	Load, lbs/day	Peaking Factor	Load, lbs/day	Peaking Factor
2017	14,080	20,550	1.5	38,980	2.8
2018	12,520	17,560	1.4	40,730	3.3
2019	14,290	25,510	1.8	47,670	3.3
2020	13,310	18,290	1.4	33,490	2.5
2021	13,930	18,730	1.3	38,890	2.8
2022*	13,680	16,670	1.2	31,740	2.3
Average	13,600	19,500	1.4	38,600	2.8

*January 1, 2017 to September 30, 2022

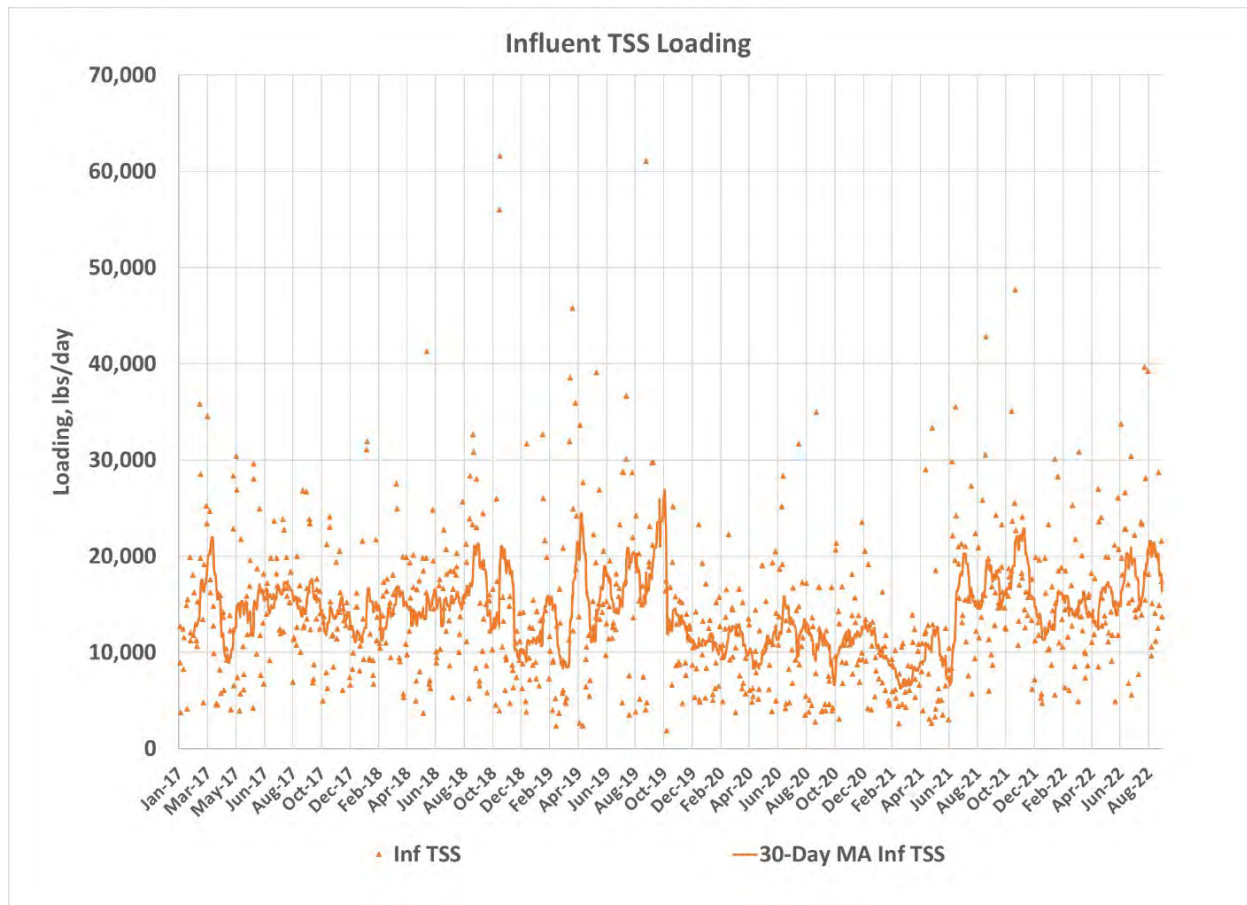


Figure 9. Norwalk WPCF Historical Influent TSS Loading

Table 6. Norwalk WPCF Yearly Influent TSS Loading and Peaking Factors (2017 – 2022)

Year	Average Day	Max Month (30-Day)		Max Day	
	Load, lbs/day	Load, lbs/day	Peaking Factor	Load, lbs/day	Peaking Factor
2017	14,550	21,940	1.5	35,830	2.5
2018	14,830	21,290	1.4	61,600	4.2
2019	15,110	26,890	1.8	61,060	4.1
2020	11,320	15,800	1.4	34,960	3.1
2021	13,390	22,850	1.7	47,720	3.6
2022*	16,650	21,600	1.3	39,630	2.4
Average	14,300	21,700	1.5	46,800	3.3

*January 1, 2017 to September 30, 2022

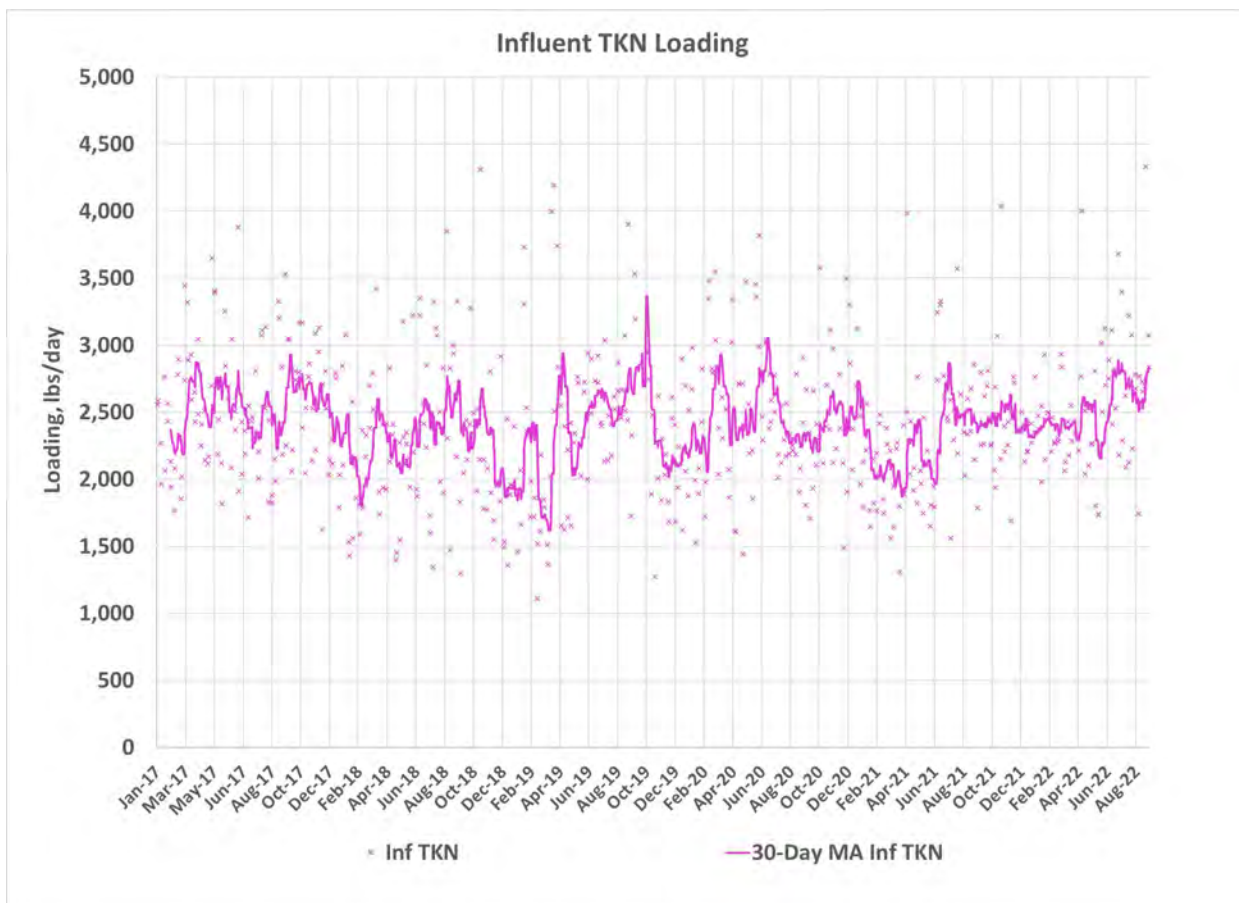


Figure 10. Norwalk WPCF Historical Influent TKN Loading

Table 7. Norwalk WPCF Yearly Influent TKN Loading and Peaking Factors (2017 – 2022)

Year	Average Day	Max Month (30-Day)		Max Day	
	Load, lbs/day	Load, lbs/day	Peaking Factor	Load, lbs/day	Peaking Factor
2017	2,540	2,930	1.2	3,880	1.5
2018	2,300	2,770	1.2	4,310	1.9
2019	2,340	3,360	1.4	4,190	1.8
2020	2,480	3,060	1.2	3,820	1.5
2021	2,310	2,860	1.2	4,040	1.7
2022*	2,550	3,110	1.2	4,330	1.7
Average	2,400	3,000	1.2	4,100	1.7

*January 1, 2017 to September 30, 2022

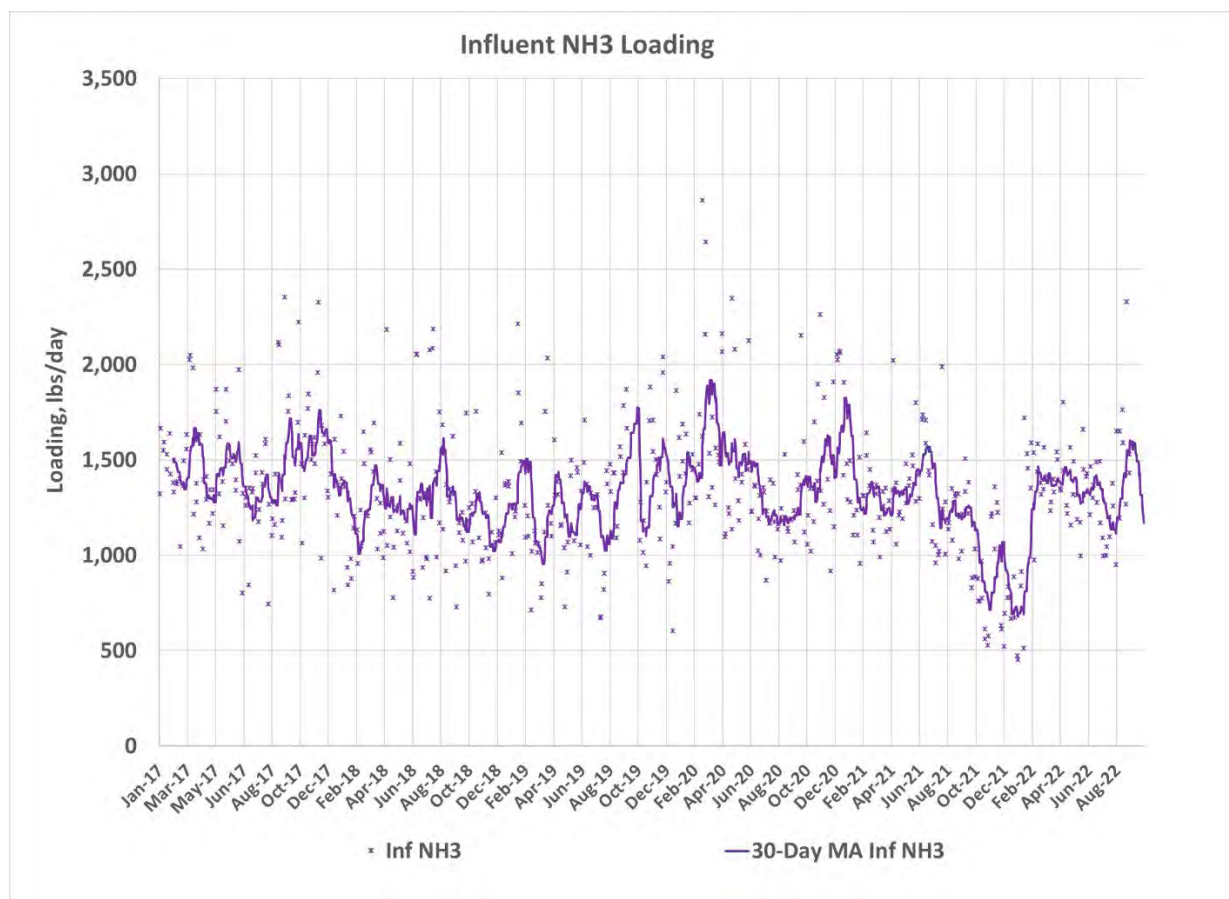


Figure 11. Norwalk WPCF Historical Influent NH₃-N Loading

Table 8. Norwalk WPCF Yearly Influent NH₃-N Loading and Peaking Factors (2017 – 2022)

Year	Average Day	Max Month (30-Day)		Max Day	
	Load, lbs/day	Load, lbs/day	Peaking Factor	Load, lbs/day	Peaking Factor
2017	1,470	1,760	1.2	2,350	1.6
2018	1,260	1,610	1.3	2,190	1.7
2019	1,290	1,780	1.4	2,210	1.7
2020	1,460	1,920	1.3	2,860	2.0
2021	1,180	1,830	1.5	2,020	1.7
2022*	1,310	1,600	1.2	2,330	1.8
Average	1,300	1,700	1.3	2,300	1.8

*January 1, 2017 to September 30, 2022

4.1.1.3 Current Plant Flows and Loads Summary

Current influent flows and loads were compared to the WPCF's operating data from 2004 to 2007 used in the 2009 Facility Plan. The current max-30 day and max day loadings are established based on the average of the yearly peaking factors (2017 – 2022). This comparison is presented in Table 9 below.

Table 9. Norwalk WPCF Influent Flows and Loads Comparison: Current vs 2009 Facility Plan

Current Conditions (2017 – 2022)						
	Average Day		Max-30 Day		Max Day	
Flow (MGD)	12.2		16.2		27.0	
	Concentrations (mg/L)	Load (lbs/day)	Load (lbs/day)	Peaking Factor	Load (lbs/day)	Peaking Factor
BOD	133	13,600	19,500	1.4	38,500	2.8
TSS	139	14,300	21,800	1.5	47,100	3.3
TKN	24	2,400	3,000	1.2	4,100	1.7
NH ₃ -N	13	1,300	1,700	1.3	2,300	1.8
2009 Facility Plan (2004 – 2007)						
	Average Day		Max-30 Day		Max Day	
Flow (MGD)	13.9		20.8		30.0	
	Concentrations (mg/L)	Load (lbs/day)	Load (lbs/day)	Peaking Factor ¹	Load (lbs/day)	Peaking Factor ²
BOD	138	15,300	19,800	1.3	26,500	1.7
TSS	148	16,800	22,300	1.3	27,500	1.6
TKN	23	2,500	3,200	1.3	4,300	1.7
NH ₃ -N ³	-	-	-	-	-	-
As Reported:						
¹ Based on 95 th percentile						
² Max Day based on BOD ₅ peaking factor of 1.7						
³ NH ₃ -N data was not included in the 2009 report.						

As shown in Table 9, there was a 10% and 15% reduction in the BOD₅ and TSS annual loading, respectively, while the max 30-day remained steady. The variation in loadings is likely attributable to the fact that current max day conditions were established using observed data and corresponding peaking factors, whereas the 2009 Facility Plan Max Day conditions were estimated based on applying a BOD₅ peaking factor, which likely explains the variation in loadings. Under current conditions there is also an overall decrease in the influent wastewater flows received at the facility.

4.1.2 Compliance with State Plan of Conservation and Development

The City of Norwalk published a Norwalk Citywide Plan: 2019 – 2029: Plan of Conservation and Development Report in October 2019 which was used as a reference in this evaluation.

Census data was used to estimate population projections which were coordinated with Norwalk P&ZD proposals and buildout analysis detailed in the Norwalk Citywide Plan Report. The existing Sewer Service Area (SSA) map for the City of Norwalk is presented in Figure 12. There are no major changes from the last sewer service area map included in the 2009 Facility Plan.

Arcadis reviewed the latest Conservation and Development Policies Plan (C&D Plan) Locational Guide Map (LGM) for City of Norwalk (2018-2023). The LGM classifications are intended to help state agencies comply with the administrative requirements of State of Connecticut General Statutes (CGS) 16a-24 through 16a-33 (Chapter 297) and be used for general planning purposes and allocation of state funding. The state policy requires projects costing in excess of \$100,000 to comply with the C&D Plan to be eligible for state funding. The City of Norwalk is pursuing Clean Water Funding for this Facility Plan update, and therefore, must comply with the C&D.

The Norwalk P&ZD projected the addition of approximately 3,000 new residential units over the next 10 years in the areas of South Norwalk (SoNo), East Norwalk, North 7 Merritt, along with development planned on Route 1 Corridor and West Ave/Wall St. As shown in Figure 12, all potential development identified by the city is within the existing SSA and therefore will not require sewer extension into unsanctioned areas. The additional development areas further conform with the Connecticut Office of Policy and Management (OPM) C&D Plan Map for 2018 to 2023 included as Appendix B.

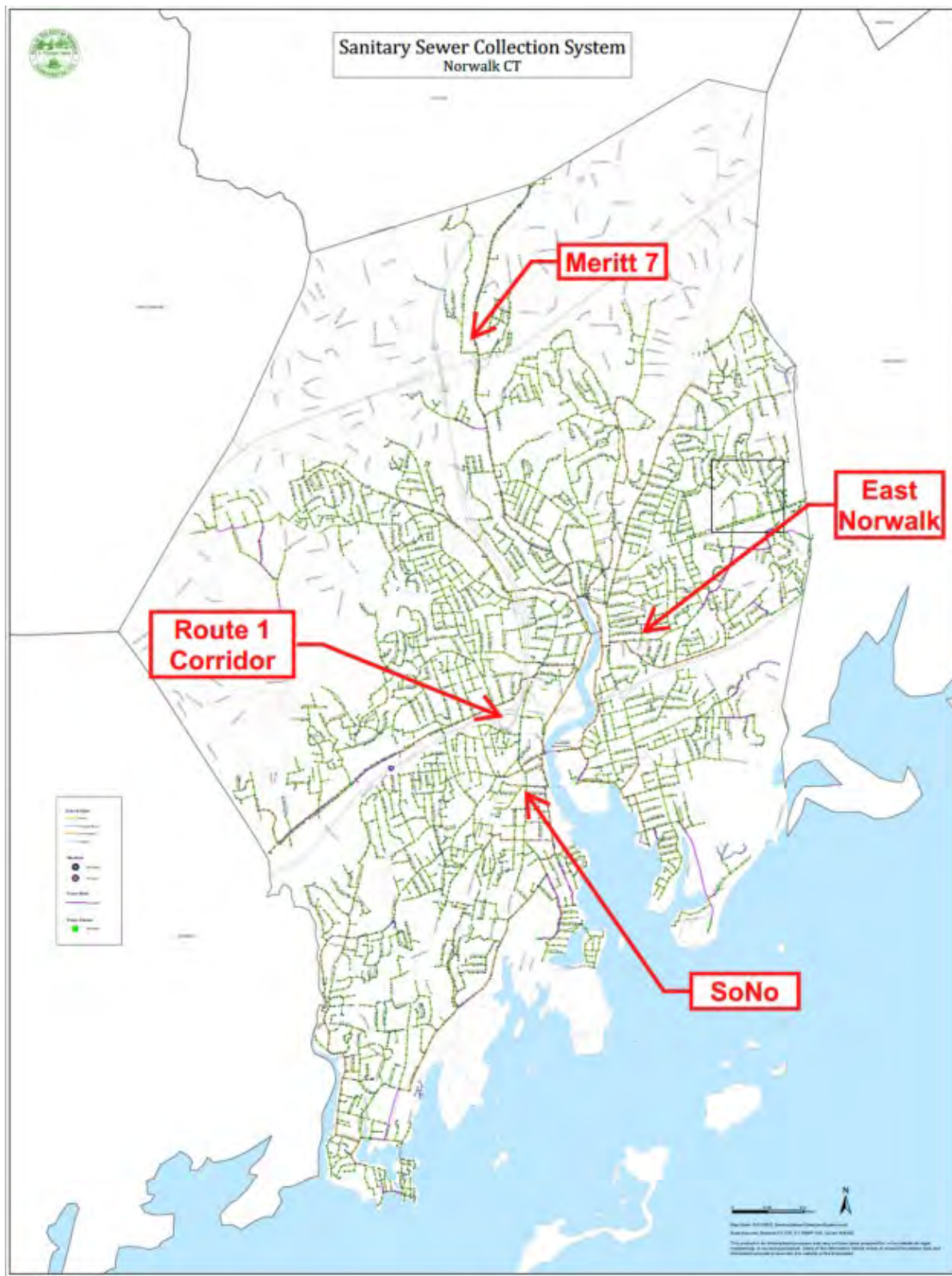


Figure 12. Norwalk WPCF Existing SSA Map

4.1.3 Future Flows and Loads

Future flow and load projections were developed based on assumed flows and loads that could be reasonably anticipated through 2030. These specific flow and load projections were developed for projected growth within City of Norwalk and added to the current influent conditions presented in Table 9.

Factors that are anticipated to contribute future flows and loads include:

1. Population Projections and Residential Flows
2. Septic System Parcels Conversion to Sewer
3. Inter-municipal Flows
4. Commercial/Industrial Flows
5. Infiltration & Inflow

4.1.3.1 Population Projections and Residential Flows

According to the 2020 Census data, the City of Norwalk had a population of 91,143. The wastewater collection system currently serves about 80% of the City's population, which translates to a residential service area population of 72,914. Based on sewer billing records obtained from the 2009 Facility Plan report and a review of new sewer user connections added between 2007 and 2021, there are 1,577 commercial connections and 27,280 residential connections with 2.67 persons per household.

Two sources of data were utilized to obtain population projections for the City: the 2009 Facility Plan and the October 2019 City of Norwalk Plan of Conservation and Development Report. Both sources include population projections through 2030. Based on a review of both sources, and follow-up discussion with the City of Norwalk Planning Department, the population of Norwalk is expected to grow 6% between 2020 and 2030, resulting in a total projected population of 96,643, or an additional 5,500 residents. Although only roughly 80% the City's population is sewered, this report assumes that all future population growth would occur in sewered areas. Assuming 80 gallons per day (gpd) per capital (Water Environment Federal Manual of Practice 8 (WEF MOP 8), this projected growth will result in an additional 440,000gpd to the WPCF.

4.1.3.2 Septic System Parcel Conversion to Sewer

According to sewer billing records, there are 4,175 parcels in the City of Norwalk that use a septic system. Of these parcels, 487 residential units are within the sewered service area in the City and can potentially connect. At present, the City of Norwalk does not have any plans to expand the sanitary sewer system. Thus the only new residential sewer connections from parcels served by septic would come from these 487 units. By the year 2030, it was assumed that all these residences will have been connected to the sewer system. This increases the average daily flow at the Norwalk WPCF by an additional 104,000 gpd, assuming 80 gpd per capita with 2.67 persons per household.

4.1.3.3 Inter-Municipal Flows

The WPCF currently has a formal inter-municipal agreement with the Town of Wilton to treat its conveyed wastewater. The 2009 Facility Plan did not anticipate any sewer expansion or significant additional flows to come from Wilton. There are no plans to expand the agreement with Wilton and therefore, no future flows beyond levels indicated in the 2009 Facility Plan report with respect to Wilton are anticipated.

4.1.3.4 Commercial/Industrial Flows

The Norwalk Planning Department indicated that it expects minimal expansion of commercial/industrial space in the next 10 years of the planning period. It anticipates that the majority of new flows will be from future redevelopment of existing mixed-use spaces with an emphasis on expanding residential units.

Arcadis assumed that the 25% of the total commercial growth that was projected between 2009 and 2015 (resulting in an increase an additional 413,000 gpd) will occur between 2022 to 2030, resulting in additional flows of 103,000 gallons per day (gpd) to the Norwalk WPCF.

4.1.3.5 Infiltration & Inflow

The 2009 Facility Plan identified an annual average infiltration and inflow (I/I) rate of approximately 6.50 MGD. The WPCF is actively addressing I/I through the implementation of a collection system wide program to identify and remove I/I and reduce its impact on the WPCF. Even with the planned development identified by the City, the average I/I can be expected to decrease by 2030 due to the City's robust I/I program and water conservation efforts. Therefore, no future additional contributions from I/I were considered for future flows and load.

4.1.3.6 Summary of Additional Flows

The additional residential and commercial/industrial flow projections through 2030 are summarized in Table 10.

Table 10. Norwalk WPCF Projected New Residential and Commercial/Industrial Flows Summary

Type	Additional Flows (GPD)
Projected Residential	440,000
Conversion of Septic to Public	104,000
Commercial/Industrial	103,000
Total Additional Flows through 2030	647,000

4.1.3.7 Summary of Future Flows and Loads

The projected additional flows were added to the existing flows at the Norwalk WPCF based on the January 2017 through September 2022 data set. The future influent loads were developed based on the average concentration of pollutants at current conditions.

A summary of the short-term flows and loads projections through 2030 along with projections from the 2009 Facility Plan are presented in Table 11. Based on this analysis, the Norwalk WPCF is projected to see a minor increase in wastewater flows and loadings by the year 2030 but will still be well below the current permitted capacity of 18 MGD.

Table 11. Norwalk WPCF Influent Flows & Loads Comparison: Current Estimate vs 2009 Facility Plan

2030 Projected Design Conditions					
	Average Day	Max-30 Day		Max Day	
Flow (MGD)	12.8	17.0		28.4	
	Load (lbs/day)	Load (lbs/day)	Peaking Factor	Load (lbs/day)	Peaking Factor
BOD	14,300	20,500	1.4	40,500	2.8
TSS	15,000	22,900	1.5	49,400	3.3
TKN	2,500	3,100	1.2	4,200	1.7
NH3-N	1,400	1,900	1.3	2,500	1.8
2009 Facility Plan Projected Design Conditions					
	Average Day	Max-30 Day		Max Day	
Flow (MGD)	18.0	27.0		30.0	
	Load (lbs/day)	Load (lbs/day)	Peaking Factor	Load (lbs/day)	Peaking Factor
BOD	20,800	27,000	1.3	35,300	1.7
TSS	22,300	29,000	1.3	35,700	1.6
TKN	3,400	4,400	1.3	5,800	1.7
NH3-N	-	-	-	-	-

4.1.4 Wet Weather Flows Evaluation

4.1.4.1 Existing Wet Weather Flow Capacity

The total capacity of the WPCF's preliminary treatment system is 95 MGD. After receiving preliminary treatment, the screened and degritted wastewater exits the preliminary treatment system and is conveyed via gravity to the primary distribution chamber, where all flows up to 30 MGD receive primary and secondary treatment. Flows above 30 MGD are directed from the preliminary treatment system to the Supplemental Treatment Building and are discharged through Outfall 002-1 after receiving disinfection/dechlorination.

4.1.4.2 Wet Weather Flow Records

Storm flow data from 2017 through September 2022 were examined to evaluate the frequency and duration of wet weather events and high flows recorded at the Norwalk WPCF. Table 12 summarizes the recorded dry weather and wet weather flows at Norwalk WPCF.

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The table includes the maximum and total dry weather flow rate through the primary/secondary facility and the corresponding wet weather treatment train data for flows discharged via Outfall 002-1.

It should be noted that during many storm events, the Chlorine Contact Tank (CCT) No. 2 (reserved exclusively for wet weather flows) is first used as a temporary holding tank to avoid discharges from Outfall 002-1 whenever possible. When total wet weather flow can be contained within the tank, it is redirected to the Preliminary Treatment Facility upon the completion of the wet weather event for full treatment.

Table 12. Norwalk WPCF Wet Weather Flows Summary

Storm Event Date	001-1 Discharge		002-1 Discharge			
	Max Flow (MGD)	Total Volume (MG)	Rainfall (IN.)	Duration (HRS:MIN)	Max. Flow (MGD)	Total Volume (MG)
4/4/17	31.0	27.0	2.1	08:15	17.5	2.1
4/6/17	32.2	24.9	1.0	01:55	0.6	0.1
5/5/17	30.8	17.4	2.2	02:00	15.2	0.6
7/7/17	31.8	13.9	2.2	02:00	16.2	0.8
10/29/17	30.0	16.4	3.6	02:10	14.7	0.8
3/2/18	30.5	27.1	2.2	08:15	14.8	1.9
4/16/18	31.5	23.9	3.9	09:30	37.0	5.0
6/28/18	30.9	17.1	2.3	02:30	37.3	2.1
9/6/18	30.7	12.1	1.5	01:00	18.1	0.4
9/25/18	33.0	21.3	5.7	06:45	42.2	7.9
9/26/18	31.8	29.7	0.0	04:50	9.0	0.8
10/2/18	33.0	18.9	4.1	03:50	44.3	3.7
10/3/18	32.6	31.8	0.1	22:50	29.0	4.5
1/24/19	31.1	22.8	1.8	06:55	10.2	0.9
7/18/19	31.9	22.7	5.0	04:15	9.4	0.3
7/22/19	30.5	16.0	1.6	01:12	4.2	0.1
10/27/19	31.6	18.5	3.0	04:41	37.6	3.0
12/14/19	30.9	29.6	2.7	13:40	14.1	2.1
7/1/20 ¹	32.0	11.7	-	< 01:00	N/A	-
7/2/21	31.1	13.3	2.3	01:55	N/A	0.3
7/9/21	28.3	26.5	6.5	20:59	N/A	13.8
9/1/21	32.8	13.9	7.5	24:30	N/A	15.4
10/26/21	31.6	23.3	4.6	07:08	N/A	1.5
2022	No Storms Events Occurred through September 2022					

¹ Wet Weather flow duration from Outfall 002-1 was less than 1 hour so monitoring was not required.

N/A – Data not available.

4.2 Recommended Improvements

Key process areas at the WPCF were identified to be reviewed as part of the Facility Plan Update. This review will serve as a roadmap for facility upgrades over the next 5 – 10 years. Based on discussions with the WPCA and Veolia, this report focuses on three critical areas:

1. Advanced Elimination of Outfall 002-1 (technical memorandum prepared by Brown and Caldwell)
2. Aeration System and Secondary Control Building (SCB) (technical memorandum prepared by Arcadis)
3. Final Settling Tanks and Return Sludge Pump Station (RSPS) (technical memorandum prepared by Arcadis)

Brown and Caldwell prepared a technical memorandum on wet weather flows, included as Appendix E. Arcadis prepared a technical memorandum for the remaining two focus areas which are included as Appendices F and G. Each memorandum provides background information on the focus area, presents viable treatment technologies and/or rehabilitative efforts to decrease usage of certain technologies, with final recommendations. Project cost estimates have also been included to assist with decision making and for the City's capital planning.

During development of the technical memoranda for each focus area, the WPCA maintained communication with the WPCA Board of Directors (Board) and public. A presentation on the Facility Plan Update was provided at the October 2022 public board meeting and monthly updates were provided by the WPCA at subsequent meetings. In addition, attendance by the WPCA Board at Facility Plan Update meetings and workshops was encouraged. The final draft Facility Plan Update was presented in September 2023 and accepted by the WPCA Board.

4.2.1 Advanced Elimination of Outfall 002-1

In compliance with the Consent Order entered into by the City and CTDEEP, the WPCA evaluated a range of viable and cost-effective methods to provide Outfall 002-1 with primary treatment or its equivalent or advance elimination of Outfall 002-1. In furtherance of this analysis, Arcadis evaluated a variety of technologies to provide Outfall 002-1 with primary treatment or its equivalent, and Brown and Caldwell analyzed enhancements to elimination of Outfall 002-1. Based on the evaluation, installation of equipment to achieve primary treatment or equivalent for flow discharged from Outfall 002-1 was considered but is not a viable and cost-effective measure at this time and is expected to have minimal long-term benefits to water quality.

Based on data modeling, it is recommended that the WPCA implement a Comprehensive Wet Weather Flow Reduction program to:

- Line public sewer mains with CIPP or similar continuous lining to prevent infiltration through the sewer pipe or joints between pipe segments.
- Line sewer manholes with epoxy, cementitious, or other equivalent lining to prevent infiltration through manhole risers or the joints between manhole riser sections.
- Grout all pipe to manhole penetrations to create a seal at the joint that is resistant to infiltration.
- Grout all lateral to sewer main penetrations to create a seal that resists infiltration.

Table 13 shows the model-predicted reduction in Outfall 002-1 discharge volume for various recurrence interval rainfall events over the course of the 10-year Comprehensive Wet Weather Flow Reduction Program. This table and additional detail on the predicted outcome of collection system improvements are contained in Appendix E and the Collection System Master Plan, prepared by Brown and Caldwell.

Table 13. Sewershed Rehabilitation Planning Level Cost Estimates

Rainfall Recurrence Interval	Outfall 002-1 Discharge Reduction by Program Year (%)					
	0	2	4	6	8	10
1YR, 24HR	-	47	60	73	77	80
5YR, 24HR	-	21	29	44	51	54
10YR, 24HR	-	16	25	37	42	46
25YR, 24HR	-	11	19	31	37	40

The recommendations to advance elimination of Outfall 002-1 as prepared by Brown and Caldwell and identified in Appendix E are projected to cost \$49.9 million over ten years with an approximate investment of \$5 million annually.

4.2.2 Aeration System

Arcadis prepared an Aeration System technical memorandum to evaluate blower technology options and present conceptual layout for replacing the existing blowers. This enhancement is not subject to the requirements of the May 2022 Consent Order. The sizing and selection of new process air blowers was determined based on process evaluation and modeling of the existing secondary treatment process to meet the permit requirement and enhance overall operational efficiency. Current and design oxygen demand and process airflow requirements are summarized in Table 14. Along with the blower technologies, other aeration system improvements are also presented for further evaluation in detailed design.

Table 14. Current and Design Oxygen Demand and Process Airflow Requirements

Conditions		Flows (MGD)	Wastewater Temperature (°C)	Oxygen Demand (lbs/day)	Process Airflow Required (scfm)
Current (2017 – 2022)	Min Day	8	12	9,300	3,100
	Min Month (30-Day)	9	12	11,800	4,000
	Average Day	12	18	16,900	6,400
	Max Month (30-Day)	16	24	22,400	9,000
Future (2030)	Average Day	13	18	17,900	6,700
	Max Month (30-Day)	17	24	23,500	9,400
Permit	Average Day	18	18	24,900	9,300
	Max Month (30-Day)	24	24	33,000	13,200

Three different types of blowers were evaluated for replacing the existing multi-stage centrifugal blowers:

- High-speed direct drive centrifugal blowers (turbo) blowers
- Integrally geared (single-stage) centrifugal blowers
- Multi-stage centrifugal blowers

Key criteria for blower comparison were discussed with the WPCA and Veolia. The main criteria used in the blower evaluation were:

- **Location Considerations:** Feasibility of implementing new blowers within the SCB.
- **Capacity Range / Redundancy:** Capacity of the new blowers to provide the required range of air flow with adequate turndown. Minimize the overall footprint requirements to have space for future blower installation.

Based on the preliminary evaluation of process aeration blowers, the following conceptual design is recommended:

- **Technology:** Turbo
- **Location:** Mezzanine Level
- **Number/Capacity:** 4 blowers (3 active/ 1 standby) configuration with air flow range of approximately 1,800 scfm to 4,200 scfm per blower and space available for future blower addition.

Additional aspects of aeration system upgrades, including AT equipment (mixers, pumps), air piping layout, diffusers, and process control strategies to support the design of new blowers were also reviewed. A preliminary condition assessment and design considerations for HVAC, electrical, instrumentation and controls, and structural features improvements for SCB and ATs is also included in the technical memorandum. The electrical system in the SCB requires significant enhancement to support the new blowers and building upgrades.

The probable total project cost is presented in Table 15. The probable total project cost for the conceptual design along with other recommended improvements to the Aeration System, a building-wide electrical overhaul, and engineering fees and contingencies is \$48 million. For additional information on the alternatives analysis, recommended improvements, and project cost, refer to the full memorandum in Appendix F.

Table 15. Aeration System - Probable Total Project Cost Summary

Point Estimate of Construction Costs ¹	Engineering Fees & Contingencies ²	Probable Total Project Cost
\$40,000,000	\$8,000,000	\$48,000,000

¹Point Estimate prepared to AACE Class 4 Accuracy (-30% to +50%)

²Assumed at 15-20% Construction Cost

4.2.3 Final Settling Tanks

Arcadis has prepared a FST technical memorandum to summarize the findings of the existing FST evaluation and present conceptual alternatives for improvements to this process area. Three clarifier technologies were initially considered for the FSTs. These technologies were selected for review due to their proven application for secondary settling and included suction header, draft tubes, and spiral scraper.

Along with the clarifier technologies, other clarifier components and considerations were presented for further evaluation during detailed design. These include energy dissipating inlets, cylindrical baffles, Stamford baffles, effluent launder covers, and drip edges. The pumping capacity of the return sludge pump station (RSPS) is also analyzed and discussed within the memorandum.

Four clarifier alternatives were initially considered for the existing FSTs, including:

- Alternative 1 – Suction Header
- Alternative 2 – Draft Tubes
- Alternative 3 – Spiral Scrapers
- Alternative 4 – Rehabilitate Existing Mechanism

Alternatives 2 and 4 were removed from consideration and, based on subsequent discussions with the WPCA and Veolia at the March 21, 2023, FST Workshop, Alternative 3 – Spiral Scrapers was recommended.

WPCA and Veolia have expressed a desire to increase the RAS system capacity (potentially to 150% of rated WPCF capacity, or 27 MGD) with the goal of improving secondary treatment performance and providing greater operational flexibility. The pumping capacity of the return sludge pump station (RSPS) was modeled and two alternatives for increasing the pumping capacity were reviewed:

- Upsize Existing RAS Pumps
- Upsize Existing RAS Pumps and Discharge Pipe Capacity

Alternative 1 was ultimately recommended due to its lower construction cost and minimal impacts to WPCF operations. Although upsizing the discharge pipe is necessary to significantly increase RAS system capacity, replacement of the discharge piping or installation of a parallel header would be costly, would require replacement of the RAS pumps, and may require significant alteration or expansion of the RSPS. If deemed necessary after post-construction observation, the more robust RSPS improvements as described in Alternative 2 could be considered.

A preliminary condition assessment of and design considerations for HVAC, electrical, instrumentation and controls, and structural features was also included in the technical memorandum and are reflected in the project cost. K.S. Engineers (KSE) performed a visual structural inspection of the interior of FST #1 and the exterior of all FSTs (#1 through #4) and the report is included with the technical memorandum. In general, the concrete is in good condition, but isolated repairs for cracking and spalling are recommended.

The probable total project cost is presented in Table 16. The probable total project cost for the conceptual design along with other recommended building and tank improvements, engineering fees and contingencies is \$20 million. For additional information on the technologies considered, recommended alternatives, other recommended improvements, and project cost, refer to the full memorandum in Appendix G.

Table 16. FSTs - Probable Total Project Cost Summary

Point Estimate of Construction Costs ¹	Engineering Fees & Contingencies ²	Probable Total Project Cost
\$17,000,000	\$3,000,000	\$20,000,000

¹Point Estimate prepared to AACE Class 4 Accuracy (-30% to +50%)

²Assumed at 15-20% Construction Cost

5.0 Resiliency Evaluation

The entirety of the WPCF, with the exception of the SCB, Aeration Tanks and Primary Settling Tanks, is located within the 500-year floodplain (Zone X) according to the Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Map (FIRM) - Map Number 09001C0531G (included as Appendix H), and the Flood Insurance Study (FIS) for Fairfield County, Connecticut. In addition, the WPCF is directly adjacent to the 100-year floodplain (Zone AE). Therefore, an initial resiliency assessment was conducted to compare key site elevations with flood elevations.

Based on the FIRM, the 100-year base flood elevation (BFE) is 10.0 feet North American Vertical Datum of 1988 (NAVD88) along the Norwalk River directly adjacent to the WPCF. The CT DEEP Inland Water Resources Division (IWRD) recommends estimating the 500-year BFE by multiplying the elevation of the 100-year BFE by 1.25. Therefore, the 500-year BFE is estimated at 12.5 ft NAVD88.

The grade elevation on site varies from approximately 9.0 ft NAVD88 to 14.0+ ft NAVD88 with specific building entrance elevations varying based on the adjacent grade. Key site elevations are compared to the 100-year and 500-year BFE for the three critical treatment areas in Table 17 below.

Table 17. Key Site Elevation Comparison

Location	Elevation in NAVD88 (ft.)	Height above 100-year BFE	Height above 500-year BFE
SCB Lower-Level	-2.10	-12.10	-14.60
SCB First Floor	+16.15	+6.15	+3.65
SCB Mezzanine Level	+26.90	+16.90	+14.40
STB First Floor	+11.90	+1.90	-0.60
RSPS Lower-Level	-6.50	-16.5	-19.0
RSPS First Floor	+10.90	+0.90	-1.60

In general, all building entrances / first floors are above the 100-year BFE. TR-16 Guides for the Design of Wastewater Treatment Works (2011 Edition – Revised in 2016) recommends that critical equipment within the 100-year BFE be at least three feet above the 100-year flood elevation where feasible and cost-effective. Given that the structures are above the 100-year BFE and the proposed upgrades to the WPCF are replacement and/or rehabilitation of existing equipment and structures, major flood protection upgrades are not included in this Facility Plan Update. However, considerations for cost-effective flood protection and resiliency measures at each treatment area will be considered during detailed design.

6.0 Overall Project Schedule

To comply with the requirements of the Consent Order, the City will advance elimination of Outfall 002-1 through enhancements to the collection system that will reduce flow to the WPCF. The proposed sequence and schedule for this work as prepared by Brown and Caldwell will take place over the next ten years, as set forth in Appendix E. While outside of the Consent Order, Facility enhancements recommended for the aeration system and final setting tanks are also required for longevity and continued reliable operation of these process areas. These design and construction projects will be programmed into the WPCA's capital plan, and opportunities for Clean Water Funding of these projects will be sought by the City.

Appendix A

Norwalk WPCF 2021 NPDES Permit

NPDES PERMIT

issued to

Permittee:

City of Norwalk
15 South Smith Street
Norwalk, CT 06855

Location Address:

Norwalk WPCF
60 South Smith Street
Norwalk, CT 06855

Permit ID: CT0101249

Design Flow Rate: 18.0MGD

Effective Date:04/01/2021

Receiving Stream: Norwalk River

Permit Expires:03/31/2026

SECTION 1: GENERAL PROVISIONS

- (A) This permit is reissued in accordance with Section 22a-430 of Chapter 446k, Connecticut General Statutes ("CGS"), and Regulations of Connecticut State Agencies ("RCSA") adopted thereunder, as amended, and Section 402(b) of the Clean Water Act, as amended, 33 USC 1251, et. seq., and pursuant to an approval dated September 26, 1973, by the Administrator of the United States Environmental Protection Agency for the State of Connecticut to administer a N.P.D.E.S. permit program.
- (B) The City of Norwalk, ("Permittee"), shall comply with all conditions of this permit including the following sections of the RCSA which have been adopted pursuant to Section 22a-430 of the CGS and are hereby incorporated into this permit. **Your attention is especially drawn to the notification requirements of subsection (i)(2), (i)(3), (j)(1), (j)(6), (j)(8), (j)(9)(C), (j)(10)(C), (j)(11)(C), (D), (E), and (F), (k)(3) and (4) and (l)(2) of Section 22a-430-3.** To the extent this permit imposes conditions more stringent than those found in the regulations, this permit shall apply.

Section 22a-430-3 General Conditions

- (a) Definitions
- (b) General
- (c) Inspection and Entry
- (d) Effect of a Permit
- (e) Duty to Comply
- (f) Proper Operation and Maintenance
- (g) Sludge Disposal
- (h) Duty to Mitigate
- (i) Facility Modifications; Notification
- (j) Monitoring, Records and Reporting Requirements
- (k) Bypass
- (l) Conditions Applicable to POTWs
- (m) Effluent Limitation Violations
- (n) Enforcement
- (o) Resource Conservation
- (p) Spill Prevention and Control
- (q) Instrumentation, Alarms, Flow Recorders
- (r) Equalization

Section 22a-430-4 Procedures and Criteria

- (a) Duty to Apply
- (b) Duty to Reapply
- (c) Application Requirements
- (d) Preliminary Review
- (e) Tentative Determination
- (f) Draft Permits, Fact Sheets

- (g) Public Notice, Notice of Hearing
- (h) Public Comments
- (i) Final Determination
- (j) Public Hearings
- (k) Submission of Plans and Specifications. Approval.
- (l) Establishing Effluent Limitations and Conditions
- (m) Case-by-Case Determinations
- (n) Permit Issuance or Renewal
- (o) Permit or Application Transfer
- (p) Permit Revocation, Denial or Modification
- (q) Variances
- (r) Secondary Treatment Requirements
- (s) Treatment Requirements
- (t) Discharges to POTWs - Prohibitions

- (C) Violations of any of the terms, conditions, or limitations contained in this permit may subject the Permittee to enforcement action including, but not limited to, seeking penalties, injunctions and/or forfeitures pursuant to applicable sections of the CGS and RCSA.
- (D) Any false statement in any information submitted pursuant to this Section of the permit may be punishable as a criminal offense under Section 22a-438 or 22a-131a of the CGS or in accordance with Section 22a-6, under Section 53a-157b of the CGS.
- (E) The Permittee shall comply with Section 22a-416-1 through Section 22a-416-10 of the RCSA concerning operator certification.
- (F) No provision of this permit and no action or inaction by the Commissioner shall be construed to constitute an assurance by the Commissioner that the actions taken by the Permittee pursuant to this permit will result in compliance or prevent or abate pollution.
- (G) Nothing in this permit shall relieve the Permittee of other obligations under applicable federal, state and local law.
- (H) An annual fee shall be paid for each year this permit is in effect as set forth in Section 22a-430-7 of the RCSA. As of October 1, 2009, the annual fee is \$3,005.00.
- (I) The Permittee shall discharge so as not to violate the Interstate Environmental Commission (IEC) Water Quality Regulations promulgated pursuant to the authority conferred upon the IEC by the Tri-State Compact (CGS 22a-294 et seq.) as defined in Attachment 1 Table A.
- (J) This permitted discharge is consistent with the applicable goals and policies of the Connecticut Coastal Management Act (Section 22a-92 of the CGS).

SECTION 2: DEFINITIONS

- (A) The definitions of the terms used in this permit shall be the same as the definitions contained in Section 22a-423 of the CGS and Section 22a-430-3(a) and 22a-430-6 of the RCSA, except for "Composite" and "No Observable Acute Effect Level (NOAEL)" which are redefined below.

- (B) In addition to the above, the following definitions shall apply to this permit:

"-----" in the limits column on the monitoring tables in Attachment 1 means a limit is not specified but a value must be reported on the DMR, MOR, and/or the ATMR.

"**Annual**" in the context of any sampling frequency, shall mean the sample must be collected in the month of July, August or September.

"**ATMR**" means Aquatic Toxicity Monitoring Report.

"**Average Monthly Limit**" means the maximum allowable "Average Monthly Concentration" as defined in Section 22a-430-3(a) of the RCSA when expressed as a concentration (e.g. mg/l); otherwise, it means "Average Monthly Discharge Limitation" as defined in Section 22a-430-3(a) of the RCSA.

"**Bi-Monthly**" in the context of any sampling frequency, shall mean once every two months including the months of January, March, May, July, September, November.

"**Bi-Weekly**" in the context of any sampling frequency, shall mean once every two weeks.

"**Composite**" or "**(C)**" means a sample consisting of a minimum of eight aliquot samples collected at equal intervals of no less than 30

minutes and no more than 60 minutes and combined proportionally to flow over the sampling period provided that during the sampling period the peak hourly flow is experienced.

"Critical Test Concentration" or **"(CTC)"** means the specified effluent dilution at which the Permittee is to conduct a single-concentration Aquatic Toxicity Test.

"Daily Composite" or **"(DC)"** means a composite sample taken over a full operating day consisting of grab samples collected at equal intervals of no more than sixty (60) minutes and combined proportionally to flow; or, a composite sample continuously collected over a full operating day proportionally to flow.

"Daily Concentration" means the concentration of a substance as measured in a daily composite sample, or, arithmetic average of all grab sample results defining a grab sample average.

"Daily Quantity" means the quantity of waste discharged during an operating day.

"Department" means Department of Energy and Environmental Protection.

"DMR" means Discharge Monitoring Report.

"Geometric Mean" is the "n"th root of the product of "n" observations.

"Infiltration" means water other than wastewater that enters a sewer system (including sewer system and foundation drains) from the ground through such means as defective pipes, pipe joints, connections, or manholes. Infiltration does not include, and is distinguished from, inflow.

"Inflow" means water other than wastewater that enters a sewer system (including sewer service connections) from sources such as, but not limited to, roof leaders, cellar drains, yard drains, area drains, drains from springs and swampy areas, cross connections between storm sewers and sanitary sewers, catch basins, cooling towers, storm waters, surface runoff, street wash waters, or drainage. Inflow does not include, and is distinguished from, infiltration.

"Instantaneous Limit" means the highest allowable concentration of a substance as measured by a grab sample, or the highest allowable measurement of a parameter as obtained through instantaneous monitoring.

"In-stream Waste Concentration" or **"(IWC)"** means the concentration of a discharge in the receiving water after mixing has occurred in the allocated zone of influence.

"MGD" means million gallons per day.

"Maximum Daily Limit" means the maximum allowable "Daily Concentration" (defined above) when expressed as a concentration (e.g. mg/l), otherwise, it means the maximum allowable "Daily Quantity" as defined above, unless it is expressed as a flow quantity. If expressed as a flow quantity it means "Maximum Daily Flow" as defined in Section 22a-430-3(a) of the RCSA.

"MOR" means Monthly Operating Report.

"NA" as a Monitoring Table abbreviation means "not applicable".

"NR" as a Monitoring Table abbreviation means "not required".

"No Observable Acute Effect Level" or **"(NOAEL)"** means any concentration equal to or less than the critical test concentration in a single concentration (pass/fail) toxicity test, conducted pursuant to Section 22a-430-3(j)(7)(A)(i) of the RCSA, demonstrating 90% or greater survival of test organisms at the CTC.

"Quarterly" in the context of any sampling frequency, shall mean sampling is required in the months of March, June, September, and December.

"Range During Sampling" or **"(RDS)"** as a sample type means the maximum and minimum of all values recorded as a result of analyzing each grab sample of; 1) a Composite Sample, or, 2) a Grab Sample Average. For those Permittee with pH meters that provide continuous monitoring and recording, Range During Sampling means the maximum and minimum readings recorded with the continuous monitoring device during the Composite or Grab Sample Average sample collection.

"Range During Month" or **"(RDM)"** as a sample type means the lowest and the highest values of all of the monitoring data for the reporting month.

"**Sanitary Sewage**" means wastewaters from residential, commercial and industrial sources introduced by direct connection to the sewerage collection system tributary to the treatment works including non-excessive inflow/infiltration sources.

"**Twice per Month**" in the context of any sampling frequency, mean two samples per calendar month collected no less than 12 days apart.

"**ug/l**" means micrograms per liter

"**Work Day**" in the context of a sampling frequency means, Monday through Friday excluding holidays.

"**Zone of Influence**" means the spatial area or volume of receiving water flow within which some degradation of water quality or use impairment is anticipated to occur as a result of a discharge.

SECTION 3: COMMISSIONER'S DECISION

- (A) The Commissioner of Energy and Environmental Protection ("Commissioner") has issued a final decision and found continuance of the existing system to treat the discharge will protect the waters of the state from pollution. The Commissioner's decision is based on application #201812006 for permit reissuance received on September 19, 2018 and the administrative record established in the processing of that application.
- (B) The Commissioner hereby authorizes the Permittee to discharge in accordance with the provisions of this permit, the above referenced application, and all approvals issued by the Commissioner or his authorized agent for the discharges and/or activities authorized by, or associated with, this permit.
- (C) The Commissioner reserves the right to make appropriate revisions to the permit, if required after Public Notice, in order to establish any appropriate effluent limitations, schedules of compliance, or other provisions which may be authorized under the Federal Clean Water Act or the CGS or regulations adopted thereunder, as amended. The permit as modified or renewed under this paragraph may also contain any other requirements of the Federal Clean Water Act or CGS or regulations adopted thereunder which are then applicable.

SECTION 4: GENERAL LIMITATIONS AND OTHER CONDITIONS

- (A) The Permittee shall not accept any new sources of non-domestic wastewater conveyed to its POTW through its sanitary sewerage system or by any means other than its sanitary sewage system unless the generator of such wastewater; (a) is authorized by a permit issued by the Commissioner under Section 22a-430 CGS (individual permit), or, (b) is authorized under Section 22a-430b (general permit), or, (c) has been issued an emergency or temporary authorization by the Commissioner under Section 22a-6k. All such non-domestic wastewaters shall be processed by the POTW via receiving facilities at a location and in a manner prescribed by the Permittee which are designed to contain and control any unplanned releases.
- (B) No new discharge of domestic sewage from a single source to the POTW in excess of 50,000 gallons per day shall be allowed by the Permittee until the Permittee has notified in writing the Connecticut Department of Energy and Environmental Protection, Bureau of Water Protection and Land Reuse, Water Planning and Management Division, Municipal Wastewater Section, 79 Elm Street, Hartford, CT 06106-5127 of said new discharge.
- (C) The Permittee shall maintain a system of user charges based on actual use sufficient to operate and maintain the POTW (including the collection system) and replace critical components.
- (D) The Permittee shall maintain a sewer use ordinance that is consistent with the most current Model Sewer Ordinance for Connecticut Municipalities prepared by the Department of Energy and Environmental Protection. The Commissioner of Energy and Environmental Protection alone may authorize certain discharges which may not conform to the Model Sewer Ordinance.
- (E) Outside of the Zone of Influence assigned to this discharge, this discharge shall not contain:
 - (1) sludge deposits, solid refuse, floating solids, oils and grease, or scum except as may result from a discharge from a wastewater treatment facility providing appropriate treatment and none exceeding levels necessary to protect and maintain all designated uses;
 - (2) color resulting in obvious discoloration of the surface water;
 - (3) suspended and settleable solids in concentrations or combinations which would impair the designated uses; be aesthetically objectionable; significantly alter the physical or chemical composition of bottom sediments; and/or adversely impact organisms living in or on the bottom sediment;
 - (4) silt or sand deposits other than of natural origin;

- (5) turbidity other than that of natural origin except as may result discharge from a wastewater treatment facility providing appropriate treatment, provided all reasonable controls are used to control turbidity and none exceeding levels necessary to protect and maintain all designated uses; or
 - (6) odor that would impair the designated uses specifically assigned to this Classification pursuant to the Connecticut Water Quality Standards Regulations (RCSA §§ 22a-426-1—22a-426-9).
- (F) No discharge from the permitted facility shall cause acute or chronic toxicity in the receiving water body beyond any Zone Of Influence (ZOI) specifically allocated to that discharge in this permit.
- (G) The Permittee shall maintain an alternate power source adequate to provide full operation of all pump stations in the sewerage collection system and to provide a minimum of primary treatment and disinfection at the water pollution control facility to insure that no discharge of untreated wastewater will occur during a failure of a primary power source.
- (H) The average monthly effluent concentration shall not exceed 15% of the average monthly influent concentration for BOD₅ and Total Suspended Solids for all daily composite samples taken in any calendar month.
- (I) Any new or increased amount of sanitary sewage discharge to the sewer system is prohibited where it will cause a dry weather overflow or exacerbate an existing dry weather overflow.
- (J) Sludge Conditions
- (1) The Permittee shall comply with all existing federal and state laws and regulations that apply to sewage sludge use and disposal practices, including but not limited to 40 CFR Part 503.
 - (2) If an applicable management practice or numerical limitation for pollutants in sewage sludge more stringent than existing federal and state regulations is promulgated under Section 405(d) of the Clean Water Act (CWA), this permit shall be modified or revoked and reissued to conform to the promulgated regulations.
 - (3) The Permittee shall give prior notice to the Commissioner of any change(s) planned in the Permittee' sludge use or disposal practice. A change in the Permittee' sludge use or disposal practice may be a cause for modification of the permit.
 - (4) Testing for inorganic pollutants shall follow "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", EPA Publication SW-846 as updated and/or revised.
- (K) This permit becomes effective on the 1st day of the month following the date of signature of the Commissioner or designee.
- (L) When the arithmetic mean of the average daily flow from the POTW for the previous 180 days exceeds 90% of the design flow rate, the Permittee shall develop and submit within one year, for the review and approval of the Commissioner, a plan to accommodate future increases in flow to the plant. This plan shall include a schedule for completing any recommended improvements and a plan for financing the improvements.
- (M) When the arithmetic mean of the average daily BOD₅ or TSS loading into the POTW for the previous 180 days exceeds 90% of the design load rate, the Permittee shall develop and submit for the review and approval of the Commissioner within one year, a plan to accommodate future increases in load to the plant. This plan shall include a schedule for completing any recommended improvements and a plan for financing the improvements.
- (N) On or before July 31st of each calendar year the main flow meter shall be calibrated by an independent contractor in accordance with the manufacturer's specifications. The actual record of the calibration shall be retained onsite and, upon request, the Permittee shall submit to the Commissioner a copy of that record.
- (O) The Permittee shall operate and maintain all processes as installed in accordance with the approved plans and specifications and as outlined in the associated operation and maintenance manual. This includes but is not limited to all preliminary treatment processes, primary treatment processes, recycle pumping processes, anaerobic treatment processes, anoxic treatment processes, aerobic treatment processes, flocculation processes, effluent filtration processes or any other processes necessary for the optimal removal of pollutants. The Permittee shall not bypass or fail to operate any of the aforementioned processes without the written approval of the Commissioner.
- (P) The Permittee must not introduce any chemicals not indicated as submitted in their latest completed permit application.
- (Q) The Permittee is hereby authorized to accept septage at the treatment facility; or other locations as approved by the Commissioner.

- (R) The temperature of any discharge shall not increase the temperature of the receiving stream above 83°F, or, in any case, raise the temperature of the receiving stream by more than 4°F beyond the permitted zone of influence. The incremental temperature increase in coastal and marine waters is limited to 1.5°F during the period including July, August and September.
- (S) Additionally, the Permittee shall maintain a complaint line, currently available at (203) 854-3212, for receipt of any notification regarding an observed discharge from the Ann Street siphon bypass outfall at any time and shall utilize appropriate best management practices to reduce the impact of the bypass and cease the bypass as expeditiously as possible.
- (T) The Permittee shall at all times maintain an identification sign for the siphon emergency bypass outfall structure located on Ann Street as required by the Commissioner. The sign shall be located at or near the siphon emergency bypass outfall structure so that it is easily readable by the public. This sign shall be a minimum of 12 x 18 inches in size, with white lettering against a green background, and shall contain the following information:

CITY OF NORWALK
SIPHON EMERGENCY
BYPASS OUTFALL

Anyone observing a discharge from this outfall at any time should call and report it to the Permittee at (203) 854-3212, and to the Department of Energy and Environmental Protection at (860) 424-3704 or 424-3338.

SECTION 5: SPECIFIC EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

- (A) The discharge(s) shall not exceed and shall otherwise conform to the specific terms and conditions listed in this permit. The discharge is restricted by and shall be monitored in accordance with Tables A through G incorporated in this permit as Attachment 1.
- (B) The Permittee shall monitor the performance of the treatment process in accordance with the Monthly Operating Report (MOR) incorporated in this permit as Attachment 2.

SECTION 6: SAMPLE COLLECTION, HANDLING and ANALYTICAL TECHNIQUES

(A) Chemical Analysis

- (1) Chemical analyses to determine compliance with effluent limits and conditions established in this permit shall be performed using the methods approved pursuant to the Code of Federal Regulations, Part 136 of Title 40 (40 CFR 136) unless an alternative method has been approved in writing pursuant to 40 CFR 136.4 or as provided in Section 22a-430-3-(j)(7) of the RCSA. Chemicals which do not have methods of analysis defined in 40 CFR 136 or the RCSA shall be analyzed in accordance with methods specified in this permit.
- (2) All metals analyses identified in this permit shall refer to analyses for Total Recoverable Metal, as defined in 40 CFR 136 unless otherwise specified.
- (3) Grab samples shall be taken during the period of the day when the peak hourly flow is normally experienced.
- (4) Samples collected for bacteriological examination shall be collected between the hours of 11 a.m. and 3 p.m. or at that time of day when the peak hourly flow is normally experienced. **A chlorine residual sample must be taken at the same time and the results recorded.**
- (5) The Minimum Levels specified below represent the concentrations at which quantification must be achieved and verified during the chemical analyses for the parameters identified in Attachment 1, Tables A, C and C-1. Analyses for these parameters must include check standards within ten percent of the specified Minimum Level or calibration points equal to or less than the specified Minimum Level.

<u>Parameter</u>	<u>Minimum Level</u>
Aluminum	0.050 mg/l
Antimony, Total	0.010 mg/l
Arsenic, Total	0.005 mg/l
Beryllium, Total	0.001 mg/l
Cadmium, Total	0.0005 mg/l
Chlorine, Total Residual	0.050 mg/l
Chromium, Total	0.005 mg/l
Chromium, Total Hexavalent	0.010 mg/l
Copper, Total	0.005 mg/l

Cyanide, Total	0.010 mg/l
Iron, Total	0.040 mg/l
Lead, Total	0.005 mg/l
Mercury, Total	0.0002 mg/l
Nickel, Total	0.005 mg/l
Phosphorus, Total	0.10 mg/l
Selenium, Total	0.005 mg/l
Silver, Total	0.002 mg/l
Thallium, Total	0.005 mg/l
Zinc, Total	0.020 mg/l

- (6) The value of each parameter for which monitoring is required under this permit shall be reported to the maximum level of accuracy and precision possible consistent with the requirements of this Section of the permit.
- (7) Effluent analyses for which quantification was verified during the analysis at or below the minimum levels specified in this Section and which indicate that a parameter was not detected shall be reported as "less than x" where 'x' is the numerical value equivalent to the analytical method detection limit for that analysis.
- (8) Results of effluent analyses which indicate that a parameter was not present at a concentration greater than or equal to the Minimum Level specified for that analysis shall be considered equivalent to zero (0.0) for purposes of determining compliance with effluent limitations or conditions specified in this permit.

(B) Acute Aquatic Toxicity Test

- (1) Samples for monitoring of Acute Aquatic Toxicity shall be collected and handled as prescribed in "Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms" (EPA-821-R-02-012).
 - (a) Composite samples shall be chilled as they are collected. Grab samples shall be chilled immediately following collection. Samples shall be held at 0 - 6°C until Acute Aquatic Toxicity testing is initiated.
 - (b) Effluent samples shall not be dechlorinated, filtered, or, modified in any way, prior to testing for Acute Aquatic Toxicity unless specifically approved in writing by the Commissioner for monitoring at this facility. Facilities with effluent dechlorination and/or filtration designed as part of the treatment process are not required to obtain approval from the Commissioner.
 - (c) Samples shall be taken after dechlorination for 001-1 and prior to chlorination for 002-1 for Acute Aquatic Toxicity unless otherwise approved in writing by the Commissioner for monitoring at this facility.
 - (d) Chemical analyses of the parameters identified in Attachment 1, Table C shall be conducted on an aliquot of the same sample tested for Acute Aquatic Toxicity.
 - (i) At a minimum, pH, salinity, total alkalinity, total hardness, and total residual chlorine shall be measured in the effluent sample and, during Acute Aquatic Toxicity tests, in the highest concentration of the test and in the dilution (control) water at the beginning of the test and at test termination. If total residual chlorine is not detected at test initiation, it does not need to be measured at test termination. Dissolved oxygen, pH, and temperature shall be measured in the control and all test concentrations at the beginning of the test, daily thereafter, and at test termination. Salinity shall be measured in each test concentration at the beginning of the test and at test termination.
 - (e) Tests for Acute Aquatic Toxicity shall be initiated within 36 hours of sample collection.
- (2) Monitoring for Acute Aquatic Toxicity to determine compliance with the permit condition on Acute Aquatic Toxicity (invertebrate) shall be conducted for 48 hours utilizing neonatal (less than 24 hours old) *Daphnia pulex*.
- (3) Monitoring for Acute Aquatic Toxicity to determine compliance with the permit condition on Acute Aquatic Toxicity (vertebrate) shall be conducted for 48 hours utilizing larval (1 to 14-day old with no more than 24 hours range in age) *Pimephales promelas*.
- (4) Tests for Acute Aquatic Toxicity shall be conducted as prescribed for static non-renewal acute tests in "Methods for measuring the Acute Aquatic Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms" (EPA/821-R-02-012), except as specified below.
 - (a) For Acute Aquatic Toxicity limits, and for monitoring only conditions, expressed as a NOAEL value, Pass/Fail (single concentration) tests shall be conducted at a specified Critical Test Concentration (CTC) equal to the Aquatic Toxicity limit, (100% in the case of monitoring only conditions), as prescribed in Section 22a-430-3(j)(7)(A)(i) of the RCSA.

- (b) Organisms shall not be fed during the tests.
 - (c) Synthetic freshwater prepared with deionized water adjusted to a hardness of 50 ± 5 mg/L as CaCO_3 shall be used as dilution water in the tests.
 - (d) Copper nitrate shall be used as the reference toxicant.
- (5) For limits expressed as NOAEL = 100%, compliance shall be demonstrated when the results of a valid pass/fail Acute Aquatic Toxicity Test indicate 90% or greater survival in the effluent sample at the CTC (100%).
- (C) Chronic Aquatic Toxicity Test for Estuarine or Marine Discharges
- (1) Chronic Aquatic Toxicity testing of the discharge shall be conducted annually during July, August, or September of each year.
 - (2) Chronic Aquatic Toxicity testing shall be performed on the discharge in accordance with the test methodology established in "Short-Term Methods for Estimating The Chronic Toxicity of Effluents and Receiving Water to Marine and Estuarine Organisms" (EPA-821-R-02-014) as referenced in 40 CFR 136 for sheepshead minnow, *Cyprinodon variegates*, survival and growth and mysid, *Mysidopsis bahia*, survival, growth and reproduction.
 - (a) Chronic Aquatic Toxicity tests shall utilize a minimum of five effluent dilutions prepared using a dilution factor of 0.5 (100% effluent, 50% effluent, 25% effluent, 12.5% effluent, 6.25% effluent).
 - (b) Norwalk River water collected immediately upstream of the area influenced by the discharge (with the outgoing tide) shall be used as control (0% effluent) and dilution water in the toxicity tests.
 - (c) A laboratory water control consisting of synthetic seawater prepared in accordance with EPA-821-R-02-014 shall be used as an additional control (0% effluent) in the toxicity tests.
 - (d) Daily composite samples of the discharge (final effluent following disinfection) and grab samples of the Norwalk River, for use as site water control and dilution water, shall be collected on day 0 for test solution renewal on day 1 and day 2 of the test; day 2, for test solution renewal on day 3 and day 4 of the test; and day 4, for test solution renewal for the remainder of the test. Samples shall not be pH or hardness adjusted, or chemically altered in any way.
 - (3) All samples of the discharge and Norwalk River water used in the Chronic Aquatic Toxicity test shall, at a minimum, be analyzed and results reported in accordance with the provisions listed in Section 6(A) of this permit for the parameters listed in Attachment 1, Table C included herein, excluding Acute Aquatic Toxicity organism testing.
 - (a) As part of each toxicity test's daily renewal procedure, dissolved organic carbon, pH and hardness must be measured in the effluent and receiving waters at the beginning and end of each 24-hour period in each test treatment and the control(s).

SECTION 7: RECORDING AND REPORTING REQUIREMENTS

- (A) The Permittee and/or the Signatory Authority shall continue to report the results of chemical analyses and any aquatic toxicity test required above in Section 5 and the referenced Attachment 1 by electronic submission of DMRs under this permit to the Department using NetDMR in satisfaction of the DMR submission requirement of this permit. The report shall include a detailed explanation of any violations of the limitations specified. DMRs shall be submitted electronically to the Department no later than the 15th day of the month following the month in which samples are collected.
 - (1) For composite samples, from other than automatic samplers, the instantaneous flow and the time of each aliquot sample collection shall be recorded and maintained at the POTW.
- (B) Complete and accurate test data, including percent survival of test organisms in each replicate test chamber, LC_{50} values and 95% confidence intervals for definitive test protocols, and all supporting chemical/physical measurements performed in association with any aquatic toxicity test, shall be entered on the Aquatic Toxicity Monitoring Report form (ATMR) and sent to the Bureau of Water Protection and Land Reuse at the address specified below by the 15th day of the month following the month in which samples are collected:

ATTN: Municipal Wastewater Monitoring Coordinator
Connecticut Department of Energy and Environmental Protection
Bureau of Water Protection and Land Reuse
Water Planning and Management Division
79 Elm Street

- (C) The results of the process monitoring required above in Section 5 shall be entered on the Monthly Operating Report (MOR) form, included herein as Attachment 2, and reported to the Bureau of Water Protection and Land Reuse. The MOR report shall also be accompanied by a detailed explanation of any violations of the limitations specified. The MOR must be received at the address specified above in Section 7 (B) of this permit by the 15th day of the month following the month in which the data and samples are collected.
- (D) A complete and thorough report of the results of the chronic toxicity monitoring outlined in Section 6(C) shall be prepared as outlined in Section 10 of EPA-821-R-02-014 for estuarine and marine waters and submitted to the Department for review on or before December 31 of each calendar year to the address specified above in Section 7 (B) of this permit.

SECTION 8: RECORDING AND REPORTING OF VIOLATIONS, ADDITIONAL TESTING REQUIREMENTS, BYPASSES, MECHANICAL FAILURES, AND MONITORING EQUIPMENT FAILURES

- (A) If any Acute Aquatic Toxicity sample analysis indicates toxicity, or that the test was invalid, an additional sample of the effluent shall be collected and tested for Acute Aquatic Toxicity and associated chemical parameters, as described above in Section 5 and Section 6, and the results reported to the Bureau of Water Protection and Land Reuse (Attn: Aquatic Toxicity) via the ATMR form (see Section 7 (B)) within 30 days of the previous test. These test results shall also be reported on the next month's DMR report pursuant to Section 7 (A). The results of all toxicity tests and associated chemical parameters, valid and invalid, shall be reported.
- (B) If any two consecutive Acute Aquatic Toxicity test results or any three Acute Aquatic Toxicity test results in a twelve month period indicates toxicity, the Permittee shall immediately take all reasonable steps to eliminate toxicity wherever possible and shall submit a report, to the Bureau of Water Protection and Land Reuse (Attn: Aquatic Toxicity), for the review and written approval of the Commissioner in accordance with Section 22a-430-3(j)(10)(c) of the RCSA describing proposed steps to eliminate the toxic impact of the discharge on the receiving water body. Such a report shall include a proposed time schedule to accomplish toxicity reduction and the Permittee shall comply with any schedule approved by the Commissioner.

(C) Sewage Right-to-Know Bypass Reporting

- (1) Section 22a-430-3(k) of the RCSA shall apply in all instances of bypass including a bypass of the treatment plant or a component of the sewage collection system planned during required maintenance. The Department of Energy and Environmental Protection, Bureau of Water Protection and Land Reuse, Water Planning and Management Division, Municipal Wastewater, the Department of Public Health, Water Supply Section and Recreation Section, and the local Director of Health shall be notified within 2 hours of the Permittee learning of the event via online reporting in a format approved by the Commissioner. A final incident report shall be submitted to the Department of Energy and Environmental Protection, Bureau of Water Protection and Land Reuse, Water Planning and Management Division, Municipal Wastewater within five days of the Permittee learning of each occurrence of a discharge or bypass of untreated or partially treated sewage via online reporting in a format approved by the Commissioner.

If the online reporting system is nonfunctional for either bypass reporting requirement noted above, then the Permittee shall notify DEEP via telephone during normal business hours (8:30 a.m. to 4:30 p.m. Monday through Friday) at (860) 424-3704 or after hours to the DEEP Emergency Response Unit at (860) 424-3338 and the Department of Public Health at (860) 509-8000 with the final incident report being submitted online.

- (2) The Permittee must notify the Department of Agriculture/Aquaculture Bureau within 2 hours of the Permittee learning of the event by telephone at (203) 209-4023 of each occurrence of an emergency diversion or bypass of untreated or partially treated sewage or the failure of any major component of the treatment facilities which the Permittee may have reason to believe would result in an effluent violation. Notification must be made during evening, weekend and holiday hours in addition to regular business hours.
- (D) Section 22a-430-3(j) 11 (D) of the RCSA shall apply in the event of any noncompliance with a maximum daily limit and/or any noncompliance that is greater than two times any permit limit. The Permittee shall notify in the same manner as in paragraph C (1) of this Section, the Department of Energy and Environmental Protection, Bureau of Water Protection and Land Reuse, Water Planning and Management Division, Municipal Wastewater Section except, if the online reporting system is nonfunctional and the noncompliance occurs outside normal working hours (8:30 a.m. to 4:30 p.m. Monday through Friday) the Permittee may wait to make the verbal report until 10:30 am of the next business day after learning of the noncompliance.
- (E) Section 22a-430-3(j) 8 of the RCSA shall apply in all instances of monitoring equipment failures that prevent meeting the requirements in this permit. In the event of any such failure of the monitoring equipment including, but not limited to, loss of refrigeration for an auto-sampler or lab refrigerator or loss of flow proportion sampling ability, the Permittee shall notify in the same manner as in paragraph C (1) of this Section, the Department of Energy and Environmental Protection, Bureau of Water Protection and Land Reuse, Water Planning and Management Division, Municipal Wastewater Section except, if the online reporting system is nonfunctional and the failure occurs outside normal working hours (8:30 a.m. to 4:30 p.m. Monday through Friday) the Permittee may wait to make the verbal report until 10:30 am of the next business day after learning of the failure.

- (F) In addition to the reporting requirements contained in Section 22a-430-3(i), (j), and (k) of the Regulations of Connecticut State Agencies, the Permittee shall notify in the same manner as in paragraph C (1) of this Section, the Department of Energy and Environmental Protection, Bureau of Water Protection and Land Reuse, Water Planning and Management Division, Municipal Wastewater concerning the failure of any major component of the treatment facilities which the Permittee may have reason to believe would result in an effluent violation.

SECTION 9: COMBINED SEWER OVERFLOWS (CSOs)

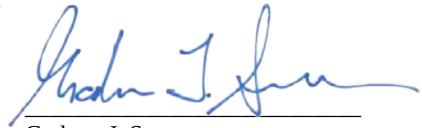
- (A) The Permittee shall continue to maintain the following Best Management Practices (BMPs) to reduce the impact of existing CSOs on the receiving waters. Detailed records of BMP activities shall be kept.
- (1) The Permittee has identified an operations and maintenance manager to be in responsible charge of the wastewater collection system and serve as the contact person for department personnel regarding combined sewer discharges. Within ten days after retaining anyone other than the one originally identified, the Permittee shall notify the Commissioner in writing of the identity of such other operations and maintenance manager.
 - (2) The Permittee shall use, to the maximum extent practicable, available sewerage system transportation capabilities for the conveyance of combined sewage to treatment facilities.
 - (3) When influent flows exceed 30 MGD in response to wet weather flow, i.e. rainfall or snowmelt conditions, the Permittee is authorized to discharge from outfall serial number 002-1, combined sewer wastewater which has received primary treatment and chlorine disinfection.
 - (4) The Permittee shall submit any information on the locations of any CSO outfalls and regulators, in addition to outfall 002-1, to the Commissioner within 30 days of the effective date of this permit or the date the Permittee becomes aware of such information, whichever is earlier.
 - (5) Control Requirements for CSOs
 - (a) Dry weather overflows are prohibited. Any such discharge from outfall 002-1 constitutes a bypass and is subject to the requirements of Section 8 of this permit.
 - (b) The discharge from outfall 002-1 shall not contain septage or holding tank waste.
 - (c) The discharge from outfall 002-1 shall not cause violations of State Water Quality Standards.
 - (6) On or before February 15th, annually, the Permittee shall submit an Annual CSO Monitoring Report on a form and in a manner prescribed by the Commissioner including the results of all monitoring from the previous calendar year for any discharge(s) from outfall 002-1 and the following information:
 - (a) the date, time, quantity and duration of each precipitation event causing each CSO discharge;
 - (b) the date, time, duration, quality and volume for each CSO discharge event from outfall 002-1;
 - (c) a list of Best Management Practices (BMPs) that have been used to reduce the impact of existing CSOs on the receiving waters; and
 - (d) a summary of upcoming CSO mitigation efforts for the next 5 years.
 - (7) The Permittee shall reduce excessive infiltration/inflow to the sewer system.
 - (8) The Permittee shall review its existing Sewer Use Ordinance, to ensure the language required under Section 4 of this permit has been incorporated. A copy of ordinance shall be submitted to the Commissioner for verification. If the ordinance is revised, a copy of the ordinance must be submitted to the Commissioner within 60 days from the effective date of the change for verification, review and approval. The Sewer Use Ordinance shall:
 - (a) prohibit the construction of new combined sewers except in cases where repair or replacement of the existing system is approved in writing by the Commissioner, and
 - (b) prohibit the introduction of new inflow sources to the existing system.
- (B) In the event that the Permittee becomes aware that it did not or may not comply, or did not or may not comply on time, with any requirement of this Section of the permit or of any document required hereunder, the Permittee shall immediately notify the Commissioner and shall take all reasonable steps to ensure that any noncompliance or delay is avoided or, if unavoidable, is minimized to the greatest extent possible. In so notifying the Commissioner, the Permittee shall state in writing the reasons for the noncompliance or delay and propose, for the review and

written approval of the Commissioner, dates by which compliance will be achieved, and the Permittee shall comply with any dates which may be approved in writing by the Commissioner. Notification by the Permittee shall not excuse noncompliance or delay, and the Commissioner's approval of any compliance dates proposed shall not excuse noncompliance or delay unless specifically so stated by the Commissioner in writing.

- (C) Any document, other than a DMR, ATMR or MOR required to be submitted to the Commissioner under this Section of the permit shall, unless otherwise specified in writing by the Commissioner, be directed to:

CSO Coordinator
Department of Energy and Environmental Protection
Bureau of Water Protection and Land Reuse
Water Planning and Management Division
Municipal Wastewater
79 Elm Street
Hartford, Connecticut 06106-5127

This permit is hereby issued on: **March 29, 2021**



Graham J. Stevens
Bureau Chief
Bureau of Water Protection and Land Reuse

ATTACHMENT 1

Tables A through G

TABLE A

Discharge Serial Number (DSN): 001-1					Monitoring Location: 1					
Wastewater Description: Sanitary Sewage										
Monitoring Location Description: Final Effluent										
Allocated Zone of Influence (ZOI): 250.8 cfs					In-stream Waste Concentration (IWC): 10 %					
PARAMETER	Units	FLOW/TIME BASED MONITORING				INSTANTANEOUS MONITORING			REPORT FORM	Minimum Level Analysis See Section 6
		Average Monthly Limit	Maximum Daily Limit	Sample Freq.	Sample type	Instantaneous Limit or Required Range ³	Sample Freq.	Sample Type		
Alkalinity	mg/l	NA	NA	NR	NA	-----	Monthly	Grab	MOR	
Biochemical Oxygen Demand (5 day) ^{1&5} See remarks (C) and (D) below	mg/l	20 mg/l	40 mg/l	3 / week	Daily Composite	NA	NR	NA	DMR/MOR	
Carbonaceous BOD (5 day)	mg/l	-----	-----	Biweekly	Daily Composite	NA	NR	NA	DMR/MOR	
Chlorine, Total Residual.	mg/l	NA	0.07 ⁴	8/ WorkDay	Grab Sample Average	0.50	8/ WorkDay	Grab	DMR/MOR	*
Enterococci ⁵ , See remark (A) below	Colonies per100 ml	NA	NA	NR	NA	500	3/week	Grab	DMR/MOR	
Fecal Coliform ⁵	Percent of samples exceeding 260	NA	NA	NR	NA	≤10	3/week	Grab	DMR/MOR	
Fecal Coliform ⁵ , See remark (D) below	Colonies per100 ml	NA	NA	NR	NA	See remark (B) below	3/week	Grab	DMR/MOR	
Flow	MGD	-----	-----	Continuous ²	Average Daily Flow	NA	NR	NA	DMR/MOR	
Nitrogen, Ammonia (total as N)	mg/l	NA	-----	Weekly	Daily Composite	NA	NR	NA	DMR/MOR	
Nitrogen, Nitrate (total as N)	mg/l	NA	-----	Weekly	Daily Composite	NA	NR	NA	MOR	
Nitrogen, Nitrite (total as N)	mg/l	NA	-----	Weekly	Daily Composite	NA	NR	NA	MOR	
Nitrogen, Total Kjeldahl	mg/l	NA	-----	Weekly	Daily Composite	NA	NR	NA	MOR	
Nitrogen, Total	mg/l	NA	-----	Weekly	Daily Composite	NA	NR	NA	MOR	
Nitrogen, Total	lbs/day	NA	-----	Weekly	Daily Composite	NA	NR	NA	MOR	
Nitrogen, Total (12 month rolling average) ⁶	lbs/day	NA	1,105	Weekly	Daily Composite	NA	NR	NA	DMR/MOR	
Oxygen, Dissolved	mg/l	NA	NA	NR	NA	-----	WorkDay	Grab	MOR	
pH	S.U.	NA	NA	NR	NA	6 - 9	WorkDay	Grab	DMR/MOR	

Phosphate, Ortho	mg/l	NA	-----	Weekly	Daily Composite	NA	NR	NA	MOR	
Phosphorus, Total	mg/l	NA	-----	Weekly	Daily Composite	NA	NR	NA	DMR/MOR	
Solids, Settleable	ml/l	NA	NA	NR	NA	-----	WorkDay	Grab	MOR	
Solids, Total Suspended ^{1&5} See remarks (C) and (D) below	mg/l	20 mg/l	40 mg/l	3/week	Daily Composite	NA	NA	NA	DMR/MOR	
Temperature	°F	NA	NA	NR	NA	-----	WorkDay	Grab	MOR	
Turbidity	NTU	NA	NA	NR	NA	-----	WorkDay	Grab	MOR	

TABLE A – CONDITIONS

Footnotes:

¹ The discharge shall not exceed an Average Monthly Limit of **20 mg/l** or a Maximum Daily Limit of **40 mg/l**. The Maximum Daily Limit of 40.0 mg/l BOD₅ and 40.0 mg/l Total Suspended Solids are waived during periods when the facility's influent flows exceed 30 MGD and it is treating dilute influent due to storm runoff collected by the Combined Sewer System. The Permittee shall state on the monthly Discharge Monitoring Reports and MORs when exceedance of these limits is due to storm induced flows.

² The Permittee shall record and report on the MOR the minimum, maximum and total flow for each day of discharge and the Average Daily Flow for each sampling month. The Permittee shall report, on the DMR, the average daily flow and maximum daily flow for each sampling month.

³ The instantaneous limits in this column are maximum limits.

⁴ The Maximum Daily Concentration to be reported shall be determined by mathematically averaging the results of the eight grab samples required above. The Average Monthly Concentration shall be determined by mathematically averaging the results of the Maximum Daily Concentrations required above over the course of the reporting month.

⁵ When the influent flows exceed 30 MGD due to storm events, the Permittee may bypass secondary biological treatment only for those flows over 30 MGD. Those bypassed flows over 30 MGD shall be treated through primary treatment and chlorination followed by dechlorination. In addition to Table A requirements, during bypass events these parameters shall be sampled daily for the duration of the bypass event in accordance with Table A-1 below.

⁶ The twelve month rolling average limit is defined as the average of the current month's weekly samples in pounds per day (the current monthly average) averaged with the averages from the previous eleven months.

Remarks:

(A) The geometric mean of the Enterococci bacteria values for the effluent samples collected in a period of a calendar month shall not exceed **35 colonies per 100 milliliters**.

(B) The geometric mean of the Fecal coliform bacteria values for the effluent samples collected in a period of a calendar month shall not exceed **88 per colonies 100 milliliters**.

(C) The Average Weekly Discharge Limitation for BOD₅ and Total Suspended Solids shall be 1.5 times the Average Monthly Limit listed above.

(D) In addition to the discharge limits included herein, the following conditions shall apply with the exception of during bypass events for storm induced flows exceeding **30 MGD**:

(i) Biochemical Oxygen Demand shall not exceed 50 mg/l on a 6 consecutive hour average.

(ii) Total Suspended Solids shall not exceed 50 mg/l on a 6 consecutive hour average.

(iii) Fecal Coliform shall not exceed:

(a) 800 colonies per 100 ml on a 6 consecutive hour geometric mean.

(b) No sample may contain more than 2,400 colonies per 100 ml.

TABLE A-1

Discharge Serial Number: 002-1			Monitoring Location: 5			
Wastewater Description: Primary treated, chlorinated/dechlorinated combined sewer wastewater (during wet weather for influent flows over 30 MGD)						
Monitoring Location Description: Supplemental Treatment Facility Effluent						
PARAMETER	Units	FLOW/TIME BASED MONITORING		INSTANTANEOUS MONITORING		
		Sample Frequency	Sample Type	Sample Frequency	Sample Type	Reporting form
BOD (5 day)	mg/l	Daily/event ^{1&3}	Daily Composite	NA	NA	DMR/MOR
Chlorine, Total Residual	mg/l	NA	NA	Daily/event ^{1&3}	Grab	DMR/MOR
Event Duration	Days, hours, minutes	Continuous ²	Time	NA	NA	DMR/MOR
Enterococci, See Remark A	per 100 ml	NA	NA	Daily/event ^{1&3}	Grab	DMR/MOR
Fecal Coliform, See Remark A	per 100 ml	NA	NA	Daily/event ^{1&3}	Grab	DMR/MOR
Flow	MGD	Continuous ²	Daily Flow	NA	NA	DMR/MOR
Solids, Total Suspended	mg/l	Daily/event ^{1&3}	Daily Composite	NA	NA	DMR/MOR
TABLE A-1 - CONDITIONS						
Footnotes:						
¹ For overflow events exceeding one calendar day in duration, sampling shall be performed each day of the event according to the measurement frequency specified. For example, for overflow events exceeding one hour and less than 24 hours in duration, sampling shall be initiated at the start of the overflow event and terminated at the end of the overflow event and analyzed according to the measurement frequency specified. If an overflow event exceeds 24 hours, the Permittee shall take daily composite samples for BOD ₅ and TSS, initiating samples at the start of the overflow event and each subsequent 24-hour period and terminating samples at the end of the overflow event. For example, on an overflow event that lasts for 54 hours, sampling would consist of 2, 24 hour samples and 1, 6 hour sample over the course of 3 days. Samples shall be flow proportional.						
² When the influent flow to the wastewater treatment plant exceeds 30 MGD due to storm events, the Permittee is authorized to discharge those flows exceeding 30 MGD from outfall serial number 002-1, primary treated, chlorine disinfected/dechlorinated combined sewer wastewater.						
³ During short duration overflow events (less than one hour in duration) or during intermittent overflow events (with no one overflow exceeding one hour), this sampling requirement is waived.						
Remarks - Apply to all of Table A-1:						
(A) The Permittee is required to calculate combined effluent characteristics for BOD ₅ , TSS, TRC, Enterococci and Fecal coliform using the overflow event primary effluent sampling data, and the secondary effluent sampling data collected during the overflow. Calculations for composite samples shall be flow weighted using total daily flows. These calculations, supporting data and the resulting data shall be submitted as an addendum to the DMR and MOR.						
(B) The Permittee shall make reasonable efforts to maximize the amount of flow receiving final secondary treatment consistent with achieving NPDES effluent limits at the final secondary effluent discharge as described in the Permit.						
(C) There is no reporting required under Section 8(C) of this permit for discharges from the Supplemental Treatment Facility Effluent.						

TABLE B

Discharge Serial Number (DSN): 001-1			Monitoring Location: K		
Wastewater Description: Sanitary Sewage					
Monitoring Location Description: Final Effluent					
Allocated Zone of Influence (ZOI): 250.8 cfs			In-stream Waste Concentration (IWC): 10 %		
PARAMETER	Units	FLOW/TIME BASED MONITORING			REPORT FORM
		Average Monthly Minimum	Sample Freq.	Sample type	
Biochemical Oxygen Demand (5 day) Percent Removal ^{1/ 3}	% of Influent	85	3/week	Calculated ²	DMR
Solids, Total Suspended Percent Removal ^{1/3}	% of Influent	85	3/week	Calculated ²	DMR
TABLE B – CONDITIONS					
Footnotes:					
¹ The discharge shall be less than or equal to 15% of the average monthly influent BOD ₅ and total suspended solids (Table E, Monitoring Location G). The 15% provision is waived during periods when the facility is treating dilute influent due to storm runoff collected by the Combined Sewer System causing influent flows to exceed 30 MGD. The Permittee shall state on the monthly Discharge Monitoring Reports and MOR’s when exceedance of the 15% provision is due to storm induced flows.					
² Calculated based on the average monthly results described in Table A. Removal efficiency = $\frac{\text{Inf.BOD or TSS} - \text{Effluent BOD or TSS}}{\text{Inf.BOD or TSS}}$ X 100					
³ When the influent flows exceed 30 MGD due to storm events the Permittee may bypass secondary biological treatment. During bypass events these parameters shall be sampled daily during the event. During short duration bypass events (less than one hour in duration) or during intermittent bypass events (with no one bypass exceeding one hour), this sampling requirement is waived. For bypass events exceeding one hour and less than 24 hours in duration, sampling shall be performed each day of the event according to the measurement frequency specified. If a bypass event covers all or part of three calendar days, the Permittee shall take three daily composite samples for BOD ₅ and TSS, initiating samples at the start of the bypass event and each subsequent calendar day and terminating samples at the end of the calendar day or at the end of the bypass event. Samples shall be flow proportional.					

TABLE C

Discharge Serial Number (DSN): 001-1				Monitoring Location: T		
Wastewater Description: Sanitary Sewage						
Monitoring Location Description: Final Effluent						
Allocated Zone of Influence (ZOI): 250.8 cfs			In-stream Waste Concentration (IWC): 10 %			
PARAMETER	Units	Maximum Daily Limit	Sampling Frequency	Sample Type	Reporting form	Minimum Level Analysis See Section 6
Aluminum, Total	mg/l	-----	Quarterly	Daily Composite	ATMR/DMR	*
Antimony, Total	mg/l	-----	Quarterly	Daily Composite	ATMR/DMR	*
NOAEL Static 48Hr Acute D. Pulex ¹	% survival	-----	Quarterly	Daily Composite	ATMR/DMR	
NOAEL Static 48Hr Acute Pimephales ¹	% survival	-----	Quarterly	Daily Composite	ATMR/DMR	
Arsenic, Total	mg/l	-----	Quarterly	Daily Composite	ATMR/DMR	*
Beryllium, Total	mg/l	-----	Quarterly	Daily Composite	ATMR/DMR	*
BOD ₅	mg/l	-----	Quarterly	Daily Composite	ATMR/DMR	
Cadmium, Total	mg/l	-----	Quarterly	Daily Composite	ATMR/DMR	*
Chromium, Hexavalent	mg/l	-----	Quarterly	Daily Composite	ATMR/DMR	*
Chromium, Total	mg/l	-----	Quarterly	Daily Composite	ATMR/DMR	*
Chlorine, Total Residual	mg/l	-----	Quarterly	Daily Composite	ATMR/DMR	*
Copper, Total	mg/l	-----	Quarterly	Daily Composite	ATMR/DMR	*
Cyanide, Amenable	mg/l	-----	Quarterly	Daily Composite	ATMR/DMR	
Cyanide, Total	mg/l	-----	Quarterly	Daily Composite	ATMR/DMR	*
Iron, Total	mg/l	-----	Quarterly	Daily Composite	ATMR/DMR	*
Lead, Total	mg/l	-----	Quarterly	Daily Composite	ATMR/DMR	*
Mercury, Total	mg/l	-----	Quarterly	Daily Composite	ATMR/DMR	*
Nickel, Total	mg/l	-----	Quarterly	Daily Composite	ATMR/DMR	*
Nitrogen, Ammonia (total as N)	mg/l	-----	Quarterly	Daily Composite	ATMR/DMR	
Nitrogen, Nitrate, (total as N)	mg/l	-----	Quarterly	Daily Composite	ATMR/DMR	
Nitrogen, Nitrite, (total as N)	mg/l	-----	Quarterly	Daily Composite	ATMR/DMR	
Phenols, Total	mg/l	-----	Quarterly	Daily Composite	ATMR/DMR	
Phosphorus, Total	mg/l	-----	Quarterly	Daily Composite	ATMR/DMR	
Selenium, Total	mg/l	-----	Quarterly	Daily Composite	ATMR/DMR	*
Silver, Total	mg/l	-----	Quarterly	Daily Composite	ATMR/DMR	*
Suspended Solids, Total	mg/l	-----	Quarterly	Daily Composite	ATMR/DMR	
Thallium, Total	mg/l	-----	Quarterly	Daily Composite	ATMR/DMR	*
Zinc, Total	mg/l	-----	Quarterly	Daily Composite	ATMR/DMR	*
TABLE C - CONDITIONS						
Remarks: ¹ The results of the Toxicity Tests are recorded in % survival. The Permittee shall report <u>% survival</u> on the DMR based on criteria in Section 6(B) of this permit.						
ATMR – Aquatic Toxicity Monitoring Report						

TABLE C-1

Discharge Serial Number (DSN): 002-1				Monitoring Location: T		
Wastewater Description: Primary treated, chlorinated/dechlorinated excess combined sewer wastewater						
Monitoring Location Description: Supplemental Treatment Facility Effluent						
PARAMETER	Units	Maximum Daily Limit	Sampling Frequency	Sample Type	Reporting form	Minimum Level Analysis See Section 6
Aluminum, Total	mg/l	-----	Semiannual	Daily Composite	ATMR	*
Antimony, Total	mg/l	-----	Semiannual	Daily Composite	ATMR	
Aquatic Toxicity, <i>Daphnia pulex</i> ¹	%	-----	Semiannual	Daily Composite	ATMR	
Aquatic Toxicity, <i>Pimephales promelas</i> ¹	%	-----	Semiannual	Daily Composite	ATMR	
Arsenic, Total	mg/l	-----	Semiannual	Daily Composite	ATMR	*
Beryllium, Total	mg/l	-----	Semiannual	Daily Composite	ATMR	*
Cadmium, Total	mg/l	-----	Semiannual	Daily Composite	ATMR	*
Chromium, Hexavalent	mg/l	-----	Semiannual	Daily Composite	ATMR	
Chromium, Total	mg/l	-----	Semiannual	Daily Composite	ATMR	
Chlorine, Total Residual	mg/l	-----	Semiannual	Daily Composite	ATMR	*
Copper, Total	mg/l	-----	Semiannual	Daily Composite	ATMR	
Cyanide, Amenable	mg/l	-----	Semiannual	Daily Composite	ATMR	*
Cyanide, Total	mg/l	-----	Semiannual	Daily Composite	ATMR	*
Iron, Total	mg/l	-----	Semiannual	Daily Composite	ATMR	*
Lead, Total	mg/l	-----	Semiannual	Daily Composite	ATMR	
Mercury, Total	mg/l	-----	Semiannual	Daily Composite	ATMR	*
Nickel, Total	mg/l	-----	Semiannual	Daily Composite	ATMR	
Nitrogen, Ammonia (total as N)	mg/l	-----	Semiannual	Daily Composite	ATMR	
Nitrogen, Nitrate, (total as N)	mg/l	-----	Semiannual	Daily Composite	ATMR	
Nitrogen, Nitrite, (total as N)	mg/l	-----	Semiannual	Daily Composite	ATMR	
Phenols, Total	mg/l	-----	Semiannual	Daily Composite	ATMR	
Phosphorus, Total	mg/l	-----	Semiannual	Daily Composite	ATMR	*
Selenium, Total	mg/l	-----	Semiannual	Daily Composite	ATMR	
Silver, Total	mg/l	-----	Semiannual	Daily Composite	ATMR	*
Thallium, Total	mg/l	-----	Semiannual	Daily Composite	ATMR	
Zinc, Total	mg/l	-----	Semiannual	Daily Composite	ATMR	
TABLE C - CONDITIONS						
Remarks: ¹ The results of the Toxicity Tests are recorded in % survival. The Permittee shall report <u>% survival</u> on the DMR based on criteria in Section 6(B) of this permit.						
ATMR – Aquatic Toxicity Monitoring Report						

TABLE D

Discharge Serial Number: 001-1	Monitoring Location: N
---------------------------------------	-------------------------------

Wastewater Description: Activated Sludge				
Monitoring Location Description: Each Aeration Unit				
PARAMETER	REPORTING FORMAT	INSTANTANEOUS MONITORING		REPORTING FORM
		Sample Frequency	Sample Type	
Oxygen, Dissolved	High & low for each WorkDay	4/WorkDay	Grab	MOR
Sludge Volume Index	WorkDay	WorkDay	Grab	MOR
Mixed Liquor Suspended Solids	WorkDay	WorkDay	Grab	MOR

TABLE E

Discharge Serial Number: 001-1			Monitoring Location: G				
Wastewater Description: Sanitary Sewage							
Monitoring Location Description: Influent							
PARAMETER	Units	DMR REPORTING FORMAT	FLOW/TIME BASED MONITORING		INSTANTANEOUS MONITORING		REPORTING FORM
			Sample Frequency	Sample Type	Sample Frequency	Sample Type	
Biochemical Oxygen Demand (5 day)	mg/l	Monthly average	3/Week	Daily Composite	NA	NA	DMR/MOR
Nitrogen, Ammonia (total as N)	mg/l		Monthly	Daily Composite	NA	NA	MOR
Nitrogen, Nitrate (total as N)	mg/l		Monthly	Daily Composite	NA	NA	MOR
Nitrogen, Nitrite (total as N)	mg/l		Monthly	Daily Composite	NA	NA	MOR
Nitrogen, Total Kjeldahl	mg/l		Monthly	Daily Composite	NA	NA	MOR
Nitrogen, Total	mg/l		Monthly	Daily Composite	NA	NA	MOR
Phosphate, Ortho	mg/l		Monthly	Daily Composite	NA	NA	MOR
Phosphorus, Total	mg/l		Monthly	Daily Composite	NA	NA	MOR
pH	S.U.		NA	NA	Work Day	Grab	MOR
Solids, Total Suspended	mg/l	Monthly average	3/Week	Daily Composite	NA	NA	DMR/MOR
Temperature	°F		NA	NA	Work Day	Grab	MOR

TABLE F

Discharge Serial Number: 001-1				Monitoring Location: P			
Wastewater Description: Primary Effluent							
Monitoring Location Description: Primary Sedimentation Basin Effluent							
PARAMETER	Units	REPORTING FORMAT	TIME/FLOW BASED MONITORING		INSTANTANEOUS MONITORING		REPORTING FORM
			Sample Frequency	Sample Type	Sample Frequency	Sample type	
Alkalinity, Total	mg/l		NA	NA	Monthly	Grab	MOR
Biochemical Oxygen Demand (5 day)	mg/l	Monthly average	Weekly	Composite	NA	NA	MOR
Nitrogen, Ammonia (total as N)	mg/l		Monthly	Composite	NA	NA	MOR
Nitrogen, Nitrate (total as N)	mg/l		Monthly	Composite	NA	NA	MOR
Nitrogen, Nitrite (total as N)	mg/l		Monthly	Composite	NA	NA	MOR
Nitrogen, Total Kjeldahl	mg/l		Monthly	Composite	NA	NA	MOR
Nitrogen, Total	mg/l		Monthly	Composite	NA	NA	MOR
pH	S.U.		NA	NA	Monthly	Grab	MOR
Solids, Total Suspended	mg/l	Monthly average	Weekly	Composite	NA	NA	MOR

TABLE G

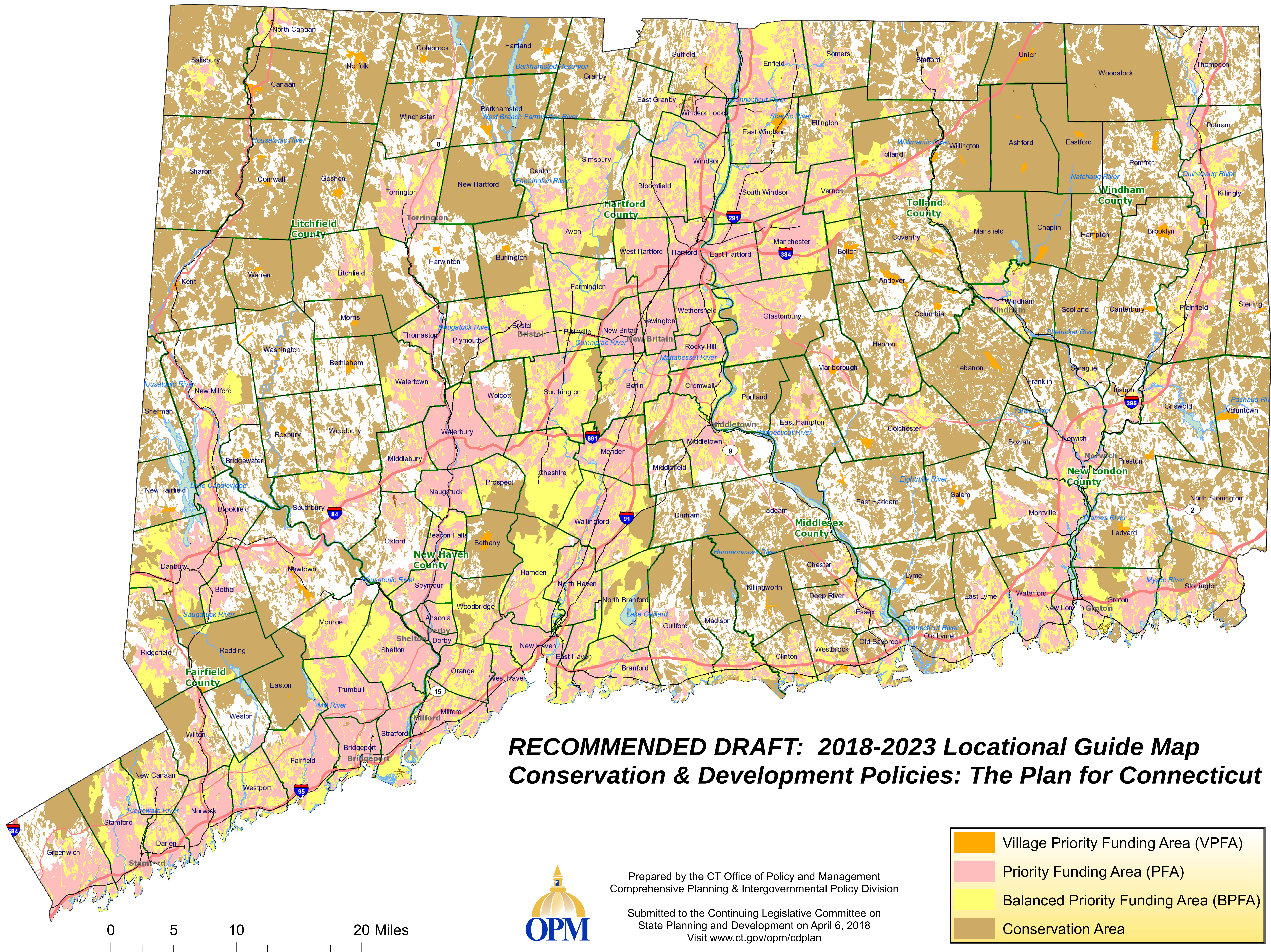
Discharge Serial Number: 001-1		Monitoring Location: SL	
Wastewater Description: Blended Thickened Sludge			
Monitoring Location Description: At sludge draw off			
PARAMETER	INSTANTANEOUS MONITORING		REPORTING FORM
	Units	Grab Sample Freq.	
Arsenic, Total	mg/kg	Bi-Monthly	DMR
Beryllium, Total	mg/kg	Bi-Monthly	DMR
Cadmium, Total	mg/kg	Bi-Monthly	DMR
Chromium, Total	mg/kg	Bi-Monthly	DMR
Copper, Total	mg/kg	Bi-Monthly	DMR
Lead, Total	mg/kg	Bi-Monthly	DMR
Mercury, Total	mg/kg	Bi-Monthly	DMR
Nickel, Total	mg/kg	Bi-Monthly	DMR
Nitrogen, Ammonia *	mg/kg	Bi-Monthly	DMR*
Nitrogen, Nitrate (total as N) *	mg/kg	Bi-Monthly	DMR*
Nitrogen, Organic *	mg/kg	Bi-Monthly	DMR*
Nitrogen, Nitrite (total as N) *	mg/kg	Bi-Monthly	DMR*
Nitrogen, Total *	mg/kg	Bi-Monthly	DMR*
pH *	S.U.	Bi-Monthly	DMR*
Polychlorinated Biphenyls	mg/kg	Bi-Monthly	DMR
Solids, Fixed	%	Bi-Monthly	DMR
Solids, Total	%	Bi-Monthly	DMR
Solids, Volatile	%	Bi-Monthly	DMR
Zinc, Total	mg/kg	Bi-Monthly	DMR
(*) required for composting or land application only			
Testing for inorganic pollutants shall follow “Test Methods for Evaluating Solid Waste, Physical/Chemical Methods”, EPA Publication SW-846 as updated and/or revised.			

ATTACHMENT 2

MONTHLY OPERATING REPORT FORM

Appendix B

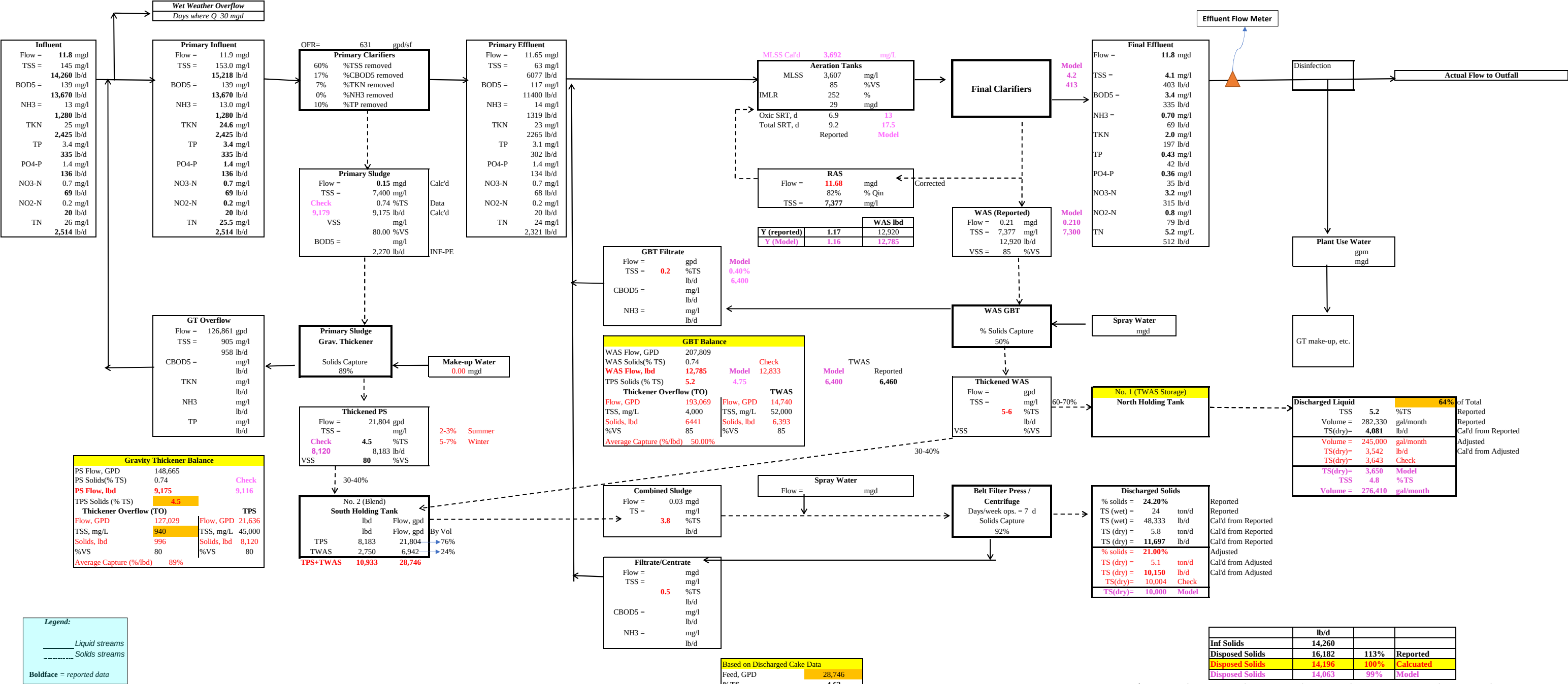
CT OPM C&D Plan Map for 2018 - 2023



Appendix C

Norwalk WPCF Data Balance PFD

Norwalk WPCF Data Balance PFD
(September 2020 - 2022)



NOTE:
This PFD is not drawn to scale and does not include hydraulic details such as pipe sizes and pump stations. It is intended to be a visual aide, developed to illustrate how the processes are connected at the WPCF.

Based on Discharged Cake Data			
Feed, GPD	28,746		
%TS	4.63		
%VS	80		
BFP Inf. Solids, lbd	11,093	Check 11,030	
	10,929		10,880
Cake, %TS (reported)	24.2%		
Filtrate			
TSS, mg/L	4,600	%TS 21%	
%VS	80	Flow, GPD 5,795	
Flow, GPD	22,950	Solids, lbd 10,150	
Solids, lbd	880		
Average Capture (%/lbd)	92%	Solids, lbd 10,000	

	lb/d		
Inf Solids	14,260		
Disposed Solids	16,182	113%	Reported
Disposed Solids	14,196	100%	Calculated
Disposed Solids	14,063	99%	Model

FROM VEOLIA	CAKE		LIQUID				
	%	Wet TN	Dry TN	%	Gal	Dry TN	Loads
		TN/Month	TN/Month		Gal/Month	TN/Month	Loads/Month
2021	23.8	649	156	5.4	324,468	73	50
2022	25.4	894	227	4.7	173,567	35	30
Jan 21 - May 22	24.2	725	178	5.2	282,330	63	44

Appendix D

Norwalk WPCF Steady State Model Calibration Results Summary

Norwalk WCPF Steady State Model Calibration Results Summary

September 2020 – September 2022			Plant Data	Model Calibration
Raw Influent				
Plant Influent Flow	MGD		11.8	11.8
TSS	mg/L		145	144
	lbs/d		14,260	14,200
BOD	mg/L		139	141
	lbs/d		13,670	13,875
NH3-N	mg/L		13	13
	lbs/d		1,280	1,280
TKN	mg/L		25	25
	lbs/d		2,425	2,460
Total P	mg/L		3.4	3.5
	lbs/d		335	345
Ortho-P	mg/L		1.4	1.5
	lbs/d		136	148
Temperature	°C		17.6	17.5
Primary Influent (with Gravity Thickener Recycle)				
Primary Influent Flow	MGD		11.9	11.9
TSS	mg/L		153	153
	lbs/d		15,218	15,200
BOD	mg/L		139	144
	lbs/d		13,670	14,350
NH3-N	mg/L		13.0	13.0
	lbs/d		1,280	1,292
TKN	mg/L		25	25
	lbs/d		2,425	2,527
Total P	mg/L		3.4	3.6
	lbs/d		335	360
Ortho-P	mg/L		1.4	1.5
	lbs/d		136	149
Primary Settling Tanks (PSTs)				
Units Online			5	5
Length X Width	ft	122 X 31		
Depth (SWD)	ft	9		
Total Surface Area	ft²	18,910		
Surface Overflow Rate	gpd/ft²		631	630
Primary Effluent				
Primary Effluent Flow	MGD		11.7	11.8
Primary Effluent TSS	mg/L		63	62
% Removal			57%	60%
	lbs/d		6,080	6,080

September 2020 – September 2022		Plant Data		Model Calibration
Primary Effluent BOD	mg/L	117		112
% Removal		17%		22%
	lbs/d	11,400		11,000
NH3-N	mg/L	14		13
	lbs/d	1,320		1,280
TKN	mg/L	23		22
	lbs/d	2,265		2,100
Total P	mg/L	3.1		2.7
	lbs/d	302		230
Ortho-P	mg/L	1.4		1.2
	lbs/d	134		120
Primary Sludge (PS)	MGD	0.148		0.150
TSS	%TS	0.74%		0.73%
	lbs/d	9,170		9,120
BOD	lbs/d	2,270		3,360
Aeration Influent (with Dewatering Recycles)				
Aeration Influent Flow	MGD			12
TSS	mg/L			133
	lbs/d			13,350*
BOD	mg/L			130
	lbs/d			13,000
NH3-N	mg/L			13
	lbs/d			1,280
TKN	mg/L			25
	lbs/d			2,520
Total P	mg/L			4.7
	lbs/d			470
Ortho-P	mg/L			1.5
	lbs/d			150
BNR Basins				
Units Online		5		5
SWD	<i>ft</i>		15.0	
Vol, Total	<i>MG</i>		3.97	
Anaerobic Zone				
Length X Width	<i>ft</i>		18.5 X 30.5	
Vol, Total	<i>MG</i>		0.317	
Anoxic Zone				
Length X Width	<i>ft</i>		40.5 X 30.5	
Vol, Total	<i>MG</i>		0.693	
Oxic Zone				
Length X Width	<i>ft</i>		172.5 X 30.5	
Vol, Total	<i>MG</i>		2.960	

September 2020 – September 2022		Plant Data		Model Calibration
MLSS	mg/L	3,600		3,600
VSS	mg/L	3,070		2,500
Internal Mixed Liquor Recycle (IMLR)	% of Influent	250%		250%
IMLR	MGD	29.4		29.7
Oxic SRT	days	7.0		13.0
Total SRT	days	9.0		17.5
Final Settling Tanks (FSTs)				
Units Online		4		4
Diameter	ft	110.0		
SWD	ft	15.0		
Total Surface Area	ft ²	38,013		
Surface Overflow Rate	gpd/ft ²	301		310
Solids Loading Rate	lbs/d/ft ²	17.0		18.5
RAS	% of Influent	97%		97%
	MGD	11.40		11.40
WAS	MGD	0.21		0.21
	mg/L	7,380		7,300
	lbs/d	12,920		12,800
Solids Handling				
Gravity Thickener (GT)				
GT Capture		89%		89%
GT Overflow (GTO)	GPD	126,860		130,000
TSS	mg/L	905		938
	lbs/d	958		1,017
Thickened PS (TPS)	GPD	21,800		20,000
TSS	% TS	4.5%		4.5%
	lbs/d	8,180		8,120
Gravity Belt Thickener (GBT)				
GBT Capture				50%*
GBT Filtrate	GPD			193,000
TSS	% TS			0.4%
	lbs/d			7,300
Thickened WAS (TWAS)	GPD			14,750
	%TS	5.2%		4.7%
	lbs/d	9,820		6,400
North Tank (TWAS Storage & Hauling)				
TWAS	%TS	5.2		4.7
Hauled Volume	Gal/Month	282,350		276,400
	lbs/d	4,080		3,650

September 2020 – September 2022		Plant Data	Model Calibration
South Tank (TPS & TWAS Blending)			
TPS	GPD		21,800
	lbs/d		8,180
TWAS	GPD		6,870
	lbs/d		2,750
Dewatering			
Centrifuge Feed	GPD		30,000
	%TS	3.8%	4.6%
	lbs/d		10,000
Centrifuge Capture			92%
Centrifuge Filtrate	GPD		23,200
	%TS		0.5%
	lbs/d		900
Dewatered Cake			
Cake	%TS	24.2%	21.0%
	lbs/d	11,700	10,000
	tons/d	5.8	5.0
Final Effluent			
TSS	mg/L	4.1	4.2
BOD ₅	mg/L	3.4	2.0
NH ₃ -N	mg/L	0.70	0.12
NO ₃ -N	mg/L	3.2	3.50
NO ₂ -N	mg/L	0.8	0.03
TN	mg/L	5.2	5.00
TKN	mg/L	2.0	1.50
TP	mg/L	0.43	0.30
PO ₄ -P	mg/L	0.36	0.15

Notes:

- Total plant influent flows are based on influent flow meter readings.
- The model influent values were adjusted slightly to provide an improved match with the reported primary effluent and plant effluent values.
- Model PST percent TSS removal was set to matched with the reported primary effluent values. The actual primary removal performance would be slightly higher than calculated, considering the additional solids from the gravity thickener overflow that are discharged upstream of the PSTs.
- Model FSTs Vesilind Settling Coefficients: $V_o = 0.470$ ft/min, $k = 0.370$ L/g to match reported effluent TSS values.
- *The model aeration tanks influent solids account for the additional solids that are being recycled due to relatively low solids capture rate in the GBTs, at approximately 50%.

Appendix E

Comprehensive Wet Weather Flow Reduction Program Technical Memorandum (Brown and Caldwell)



175 Capital Boulevard, 4th Floor
Rocky Hill, CT 06067

Technical Memorandum

Prepared for: Norwalk WPCA

Project Title: Comprehensive Wet Weather Flow Reduction Program Evaluation

Technical Memorandum

Subject: Attachment to Facility Plan

Date: September 2023

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Executive Summary

This technical memorandum was prepared for the City of Norwalk (City) and its Water Pollution Control Authority (WPCA). The purpose of this technical memorandum is to evaluate a range of viable and cost-effective measures to advance elimination of Outfall 002-1 at the City's Water Pollution Control Facility (WPCF) thereby maintaining and enhancing water quality in the Norwalk River and Long Island Sound. This technical memorandum was also prepared as part of the WPCA's Facility Plan Update in satisfaction of Section B.4 of the Consent Order entered into by the Connecticut Department of Energy and Environmental Protection (CTDEEP) and the City on May 6, 2022 (Consent Order).

The City's collection system includes 206 miles of gravity mains, 24 miles of gravity interceptors, 22 pump stations, and 7.4 miles of force mains. The total capacity of the WPCF's preliminary treatment system is 95 MGD. After receiving preliminary treatment, the screened and degrittied wastewater exits the preliminary treatment system and is conveyed via gravity to the primary distribution chamber, where all flows up to 30 MGD receive primary and secondary treatment. Flows above 30 MGD are directed from the preliminary treatment system to the Supplemental Treatment Building and are discharged through Outfall 002-1 after receiving disinfection/dechlorination.

Summary of Findings

This technical memorandum demonstrates that substantial near-term investment in the Norwalk WPCA collection system, inflow and infiltration (I/I) reduction efforts, and targeted collection system rehabilitation projects are a viable and cost-effective means to advance elimination of Outfall 002-1 by significantly reducing flows to the WPCF. Modeling of current conditions and projected wet weather flow reductions following implementation of collection system rehabilitation and I/I reduction efforts shows a substantial reduction in wet weather volume utilizing Outfall 002-1. More specifically, the modeling analysis of projected flow reductions shows an 80% reduction in volume discharged from Outfall 002-1 for a 1-YR, 24-HR rainfall event and a substantial overall reduction in Outfall 002-1 discharge volume for all rainfall events.

In addition to reducing overall flow from the collection system to the WPCF to advance elimination of Outfall 002-1, rehabilitation and I/I reduction efforts will also have important benefits including the following:

- **Environmental Benefits:**
 - o Enhanced water quality in the Norwalk River and Long Island Sound due to significant reduction in wet weather flows and advanced elimination of Outfall 002-1.
 - o Advanced elimination of Ann Street Emergency Overflow Siphon due to decreased flow in the collection system and WPCF.
 - o Reduced potential of combined sewer overflows (CSOs) due to decreased flow in the collection system and WPCF.
 - o Reduced potential of sanitary sewer overflows (SSOs) due to decreased flow in the collection system and WPCF.
- **Energy Efficiency Benefits:**
 - o Reduced WPCF operation and maintenance due to decreased overall flow requiring treatment.



- o Improved process performance at the WPCF through reductions in the peak flow and duration of sustained high flows to the WPCF that result in a more consistent and optimal operation of the process units that make up the WPCF treatment train.
- o Advancement of CTDEEP energy efficiency goals by reducing the amount of flow requiring pumping and treatment at the WPCF.

The recommendations in this technical memorandum to advance elimination of Outfall 002-1 are projected to cost \$49.9 million over 10 years with an approximate investment of \$5 million annually. This financial allocation will also allow the WPCA to invest an additional \$68 million in other critical facility projects, including enhancement of the WPCF's Aeration Tanks and Final Settling Tanks. For additional information on the Aeration Tanks and Final Settling Tanks, see Appendices F and G, respectively, of the Facility Plan Update.

Summary of Recommendations

To meet its Consent Order obligations and achieve significant water quality enhancements for the Norwalk River and Long Island Sound, it is recommended that the WPCA implement a Comprehensive Wet Weather Flow Reduction Program. The Comprehensive Wet Weather Flow Reduction Program includes the following components:

- Completing long-term, non-Consent Order recommendations from the Master Plan in 10 years, rather than 25. The Collection System Master Plan identified 18 meter-areas with significant rainfall dependent infiltration and inflow (RDII) rates where cost-effective inflow and infiltration reduction can be achieved. It is recommended that the WPCA expedite completion of rehabilitation efforts in the 17 meter-areas identified in this technical memorandum to significantly reduce wet weather flow to the WPCF and advance elimination of Outfall 002-1. Comprehensive rehabilitation efforts will include:
 - o Lining public sewer mains with CIPP or similar continuous lining to prevent infiltration through the sewer pipe or joints between pipe segments.
 - o Lining sewer manholes with epoxy, cementitious, or other equivalent lining to prevent infiltration through manhole risers or the joints between manhole riser sections.
 - o Grouting all pipe to manhole penetrations to create a seal at the joint that is resistant to infiltration.
 - o Grouting all lateral to sewer main penetrations to create a seal that resists infiltration.
- Post-Rehabilitation Monitoring and Reporting: Progress of sewer rehabilitation project completion will be reported by the WPCA in accordance with the annual progress report requirement set forth in Section 6 of the Consent Order. At the conclusion of Year 5 of the Comprehensive Wet Weather Flow Reduction Program, WPCA will perform a mid-course check-in to assess the reductions in excess flow achieved.

Summary of Projected WPCF Performance Under Comprehensive Wet Weather Flow Reduction Program

Under existing conditions, shown in Table 3-3, peak flows conveyed to the WPCF are predicted to exceed 30 MGD and be diverted to the wet weather treatment facility starting at the 1-year return frequency. To evaluate the projected future performance of the WPCF under the Comprehensive Wet Weather Flow Reduction Program, the model was re-run to account for recommended enhancements to reduce I/I and



decrease overall flow to the Facility. Table ES-1 shows the model-predicted reduction in Outfall 002-1 discharge volume, in two-year increments, for various recurrence interval rainfall events over the duration of the Comprehensive Wet Weather Flow Reduction Program.

Table ES-1. Projected Outfall 002-1 Discharge Volume Reductions						
Rainfall Recurrence Interval	Outfall 002-1 Discharge Reduction by Program Year (%)					
	0	2	4	6	8	10
1YR, 24HR	-	47	60	73	77	80
5YR, 24HR	-	21	29	44	51	54
10YR, 24HR	-	16	25	37	42	46
25YR, 24HR	-	11	19	31	37	40

Based on the Comprehensive Wet Weather Flow Reduction Program's recommended I/I and collection system rehabilitation projects, model results predict a substantial reduction in overall flow to the WPCF, including during wet weather events. This overall flow reduction will significantly advance elimination of Outfall 002-1 by substantially decreasing the duration and volume of flows that exceed the WPCF's secondary treatment capacity of 30 MGD.

Section 1: Background and Objectives

Paragraph B.4.a of the Consent Order requires the WPCA to evaluate a range of viable and cost-effective measures to provide Outfall 002-1 with primary treatment or its equivalent, or to eliminate Outfall 002-1. One such measure that can advance the elimination of Outfall 002-1 and enhance the water quality in the Norwalk River and Long Island Sound is the reduction of excess flow, such as infiltration/inflow (I/I), from the collection system.

1.1 Background

The City of Norwalk's collection system serves an approximate area of 10,625 acres and is comprised of 206 miles of gravity mains, 24 miles of gravity interceptors, 22 pump stations, and 7.4 miles of forcemains. Following conveyance through the collection system, flow is directed to the WPCF for treatment. The WPCF's current 12-month average daily flow is approximately 12.2 MGD. Overall flow to the WPCF is trending downward despite significant growth in the last 10 years, which is attributable to I/I reduction initiatives and overall water conservation efforts.

The total capacity of the WPCF's preliminary treatment system is 95 MGD. After receiving preliminary treatment, the screened and dewatered wastewater exits the preliminary treatment system and is conveyed via gravity to the primary distribution chamber, where all flows up to 30 MGD receive primary and secondary treatment. Flows above 30 MGD are directed from the preliminary treatment system to the STB and are discharged through Outfall 002-1 after receiving disinfection/dechlorination.

A recent upgrade to the wet weather treatment facility was completed 2020 to install an enhanced chlorination system and new dechlorination process allowing Outfall 002-1 to meet water quality standards. When possible, chlorine contact tank No. 2 in the wet weather treatment facility is used as a temporary holding tank. When total wet weather flow can be contained within the tank, it is directed back to the preliminary treatment building upon the completion of the wet weather event for full treatment. An automated sluice gate was added to the process in 2019 to further reduce the use of Outfall 002-1 unless absolutely necessary.

In Tables ES-1 and ES-2 of the Collection System Master Plan ("Master Plan") filed September 30, 2022, as amended on September 29, 2023, Brown and Caldwell modeled discharge volumes throughout the collection system and WPCF for various design events under existing conditions. Under existing conditions, starting at a 1-year return frequency event, peak flows conveyed to the WPCF are predicted to exceed 30 MGD, with flows greater than 30 MGD diverted to the wet weather facility for chlorination/dechlorination before being discharged via Outfall 002-1. In the past five years, there have been 19 wet weather events during which the WPCF has utilized Outfall 002-1. In the last three years, there have been six wet weather events, including hurricanes Elsa and Ida. In a typical rainfall year, Outfall 002-1 activates for a duration of 60-minutes or longer four or fewer times per year. Activations have decreased due to continued influent flow reduction efforts and equipment enhancements.

In section 5.2.4 of the Master Plan, and separate from any obligations under the Consent Order, Brown and Caldwell recommended as a long-term 25-year goal, that the WPCA target rainfall derived infiltration and inflow (RDII) reduction as a collection system rehabilitation strategy to enhance the collection system performance and reduce excess flow from entering the collection system and making its way to the WPCF. Specifically, Brown and Caldwell identified 18 collection system subcatchments in the Master Plan where cost effective I/I reduction could reduce excess flow.

1.2 Objectives

In compliance with the Consent Order entered into by the City and CTDEEP, the WPCA evaluated viable and cost-effective methods to provide Outfall 002-1 with primary treatment or its equivalent, or advance elimination of Outfall 002-1. In furtherance of this analysis, Arcadis evaluated a variety of technologies to provide Outfall 002-1 with primary treatment or its equivalent, and Brown and Caldwell analyzed enhancements to advance elimination of Outfall 002-1. Based on the evaluation, installation of equipment to achieve primary treatment or equivalent for flow discharged from Outfall 002-1 was considered but is not a viable and cost-effective measure at this time and is expected to have minimal long-term benefits to water quality.

To advance elimination of Outfall 002-1, this memorandum utilizes infiltration and inflow analysis to model flow from the collection system to the WPCF that may result in a discharge from Outfall 002-1. This memorandum builds upon this analysis by identifying viable methods of reducing flow to the WPCF. The objective of the Comprehensive Wet Weather Flow Reduction Program is to identify and refine I/I reduction projects and rehabilitation of key subcatchment areas that will significantly reduce flow volume to the WPCF thereby decreasing the usage of Outfall 002-1.

This evaluation further analyzes the impact of cost-effective I/I reduction to determine the expected reductions in excess flow to the WPCF resulting from comprehensive rehabilitation of collection system assets. The refined flows, representing projected post-rehabilitation conditions, were analyzed using the City's calibrated hydraulic model. Model results were then analyzed to assess the reductions in discharge from Outfall 002-1 at the completion of all planned system rehabilitation projects.

This technical memorandum further considers that, in addition to reducing flow in the collection system and advancing elimination of Outfall 002-1, the recommendations will enhance water quality in the Norwalk River and Long Island Sound; reduce the likelihood of CSOs and SSOs during wet weather events; advance elimination of the Ann Street Emergency Overflow; reduce WPCF operation and maintenance due to decreased flow; improve process performance and reduce energy usage at the WPCF; and enable the WPCA to invest in other critical Facility projects that will further enhance and protect water quality.

To achieve the objectives discussed above, it is recommended that the WPCA implement a Comprehensive Wet Weather Flow Reduction Program. The Comprehensive Wet Weather Flow Reduction Program will have the following benefits:

- Provide a structured approach for preparing engineering plans and specifications for rehabilitation projects;
- Provide oversight for required field work and rehabilitation contractor activities; and
- Evaluate post-rehabilitation flow reductions achieved in the collection system and at Outfall 002-1.

The Comprehensive Wet Weather Flow Reduction Program will detail the schedule of activities and rehabilitation projects expected to be completed within a 10-year period, post-rehabilitation flow reduction evaluation, and revision of the plan to perform equivalent work in portions of the collection system where flow reductions can be demonstrated to result in a more significant reduction in discharge duration and volume from Outfall 002-1.



Section 2: Infiltration and Inflow Analysis and Modeling

Flow data shows that during certain wet weather events, excess flow enters the collection system, flows to the WPCF and may exceed the secondary treatment capacity of 30 MGD. As part of the Master Plan work, a temporary flow monitoring program was administered to evaluate the flows entering the collection system from discrete sewershed areas. Locations of the Master Plan temporary flow meters are shown in Figure 2-1.

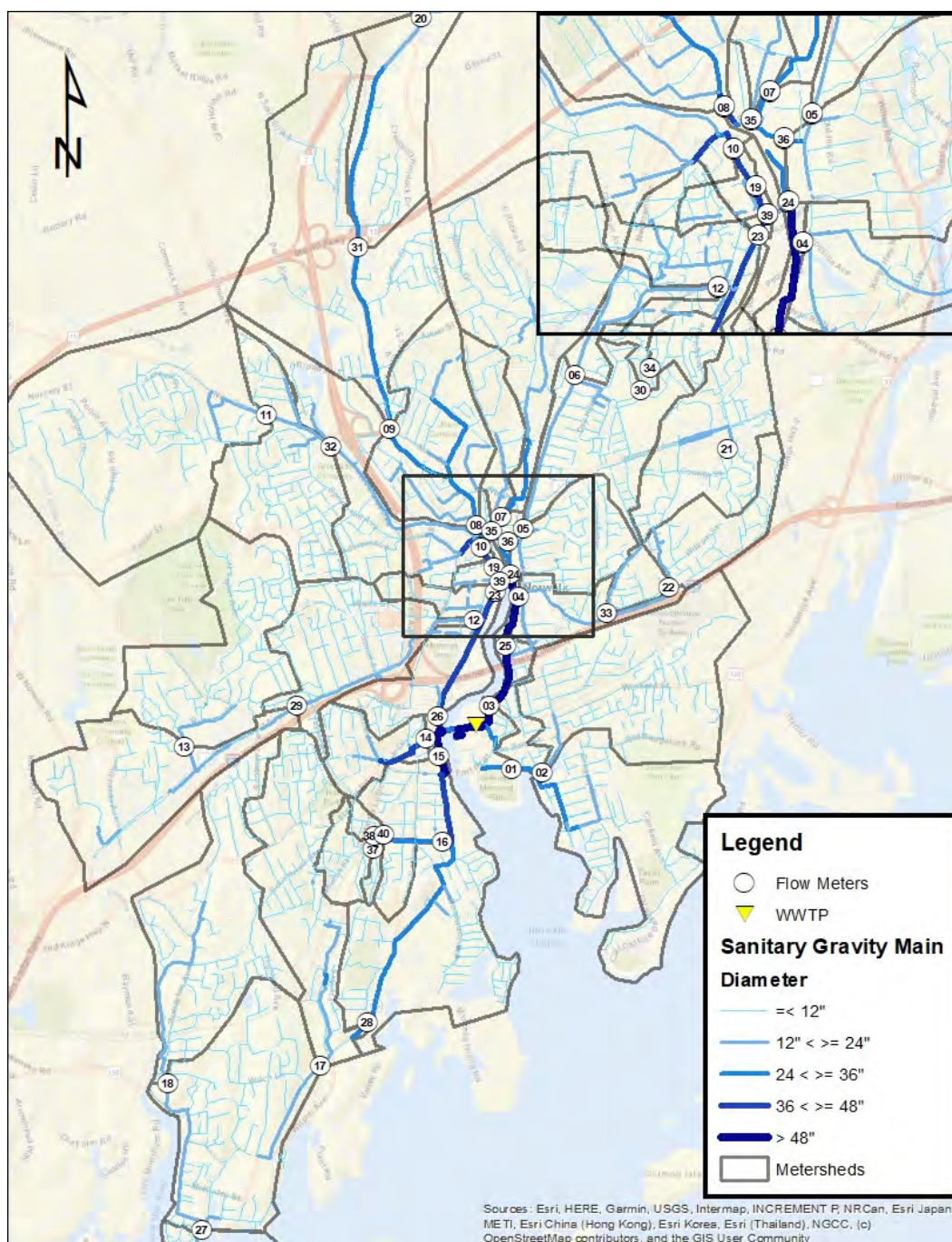


Figure 2-1. Collection System Master Plan Temporary Flow Meter Locations

In the Master Plan, Brown and Caldwell identified targeted infiltration and inflow reduction as a long-term recommendation to reduce excess flow from entering the collection system. This long-term recommendation was not part of the Consent Order obligations, and it was recommended that the WPCF complete these long-term enhancements over a period of 25 years. This memorandum recommends that the WPCA implement the Comprehensive Wet Weather Flow Reduction Program to expedite and complete these long-term recommendations in 10-years, rather than 25, to reduce excess flow to the collection system. By reducing excess flow from entering the collection system, the peak flows conveyed to the WPCF are also reduced, thereby advancing elimination of Outfall 002-1.

As part of the WPCA's analysis of viable and cost-effective measures to provide Outfall 002-1 with primary treatment or its equivalent, or eliminate Outfall 002-1, the targeted RDII reduction recommendations from the Master Plan were further refined and additional hydraulic modeling performed to evaluate the projected reductions in excess flow and volume to the WPCF and Outfall 002-1 resulting from comprehensive rehabilitation of public sewer assets.

2.1 Targeted RDII Reduction Areas

Flow monitoring data from 40 temporary flow meters located throughout the collection system, shown in Figure 2-1, and flow data from the WPCF were analyzed to identify sewershed areas that exhibited excess flow generation. Excess flow in the form of groundwater infiltration (GWI) and RDII were analyzed using a hydraulic model developed and calibrated as part of the Master Plan effort.

The hydraulic model was developed to represent the following flow components:

- Dry Weather Flow – the base sanitary flow plus the minimum GWI flow volume.
- Rainfall Derived GWI – seasonally varied GWI that is present and responds to changes in the soil moisture and groundwater conditions.
- Rainfall Derived Infiltration and Inflow (RDII) – extraneous flow that enters the sanitary collection system through either direct or indirect connections in response to rainfall.

Results from the hydraulic model were used to identify the sewershed areas with the highest rates of excess flow production. The model results were used to quantify the peak RDII flow rates from each metershed, in MGD. These RDII flow rates were normalized by metershed area to facilitate the comparison and prioritization of RDII production rates across the collection system. Figure 2-2 shows the Master Plan normalized RDII production rates by metershed in gallons per acre per day (GPAD).

Areas with higher rates of I/I generation generally represent more cost-effective opportunities for reduction of excess flow. In areas with higher rates of I/I generation, a similar quantity of rehabilitation has a greater potential to remove a larger volume of excess flow than in an area with a low rate of I/I generation. Guidance from the Water Environment Research Foundation (WERF) published report, *WERF 99-WWF-8: Reducing Peak Rainfall-Derived Infiltration/Inflow Rates – Case Studies and Protocol*, was used to identify areas where targeted RDII reduction by sewer rehabilitation could be a cost-effective way to reduce excess flows. Sewershed areas exhibiting peak RDII generation rates greater than 15,000 GPAD were identified in the Master Plan as candidate areas for targeted collection system rehabilitation to reduce excess flow.

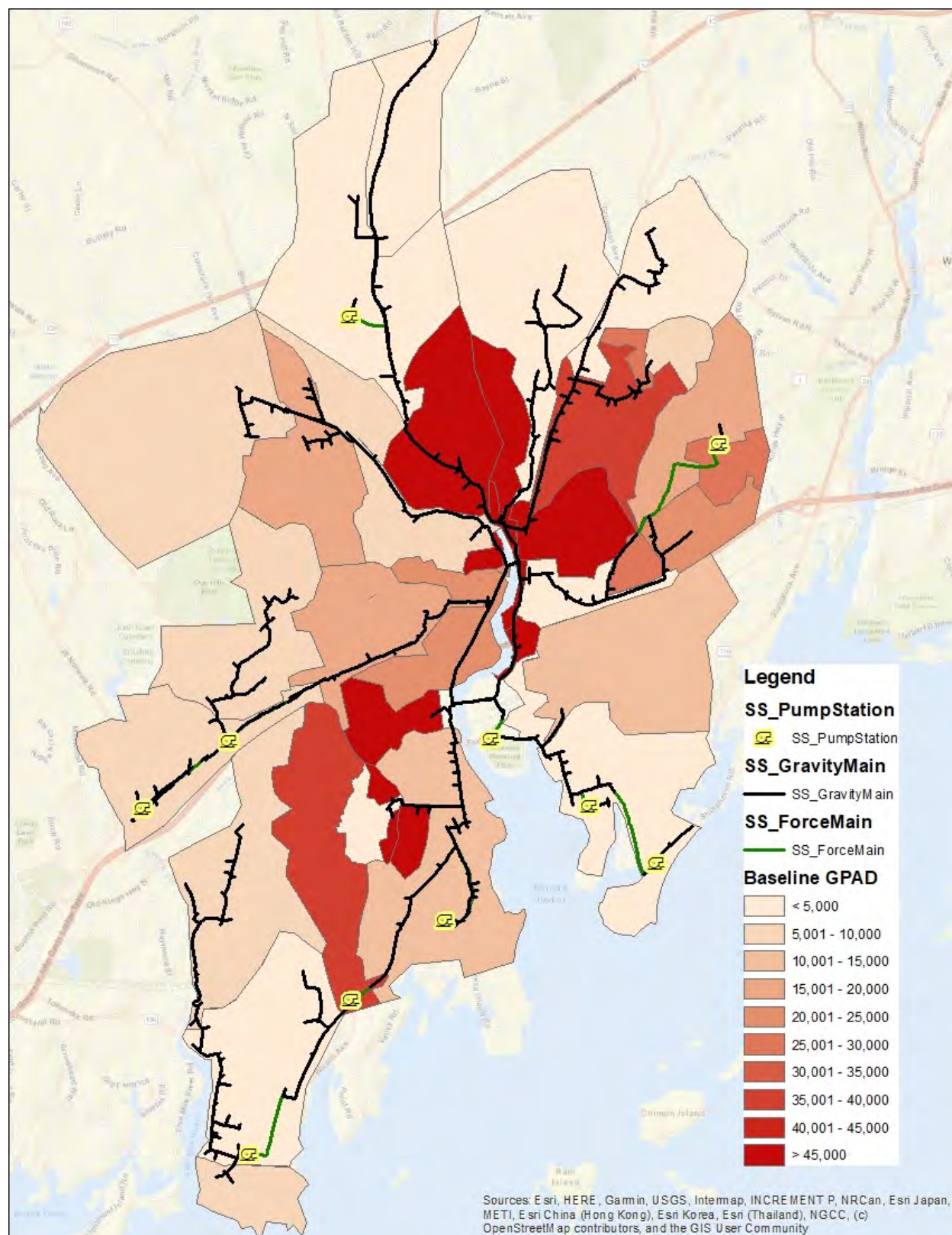


Figure 2-2. Master Plan Existing Conditions RDII Production Rate by Metershed

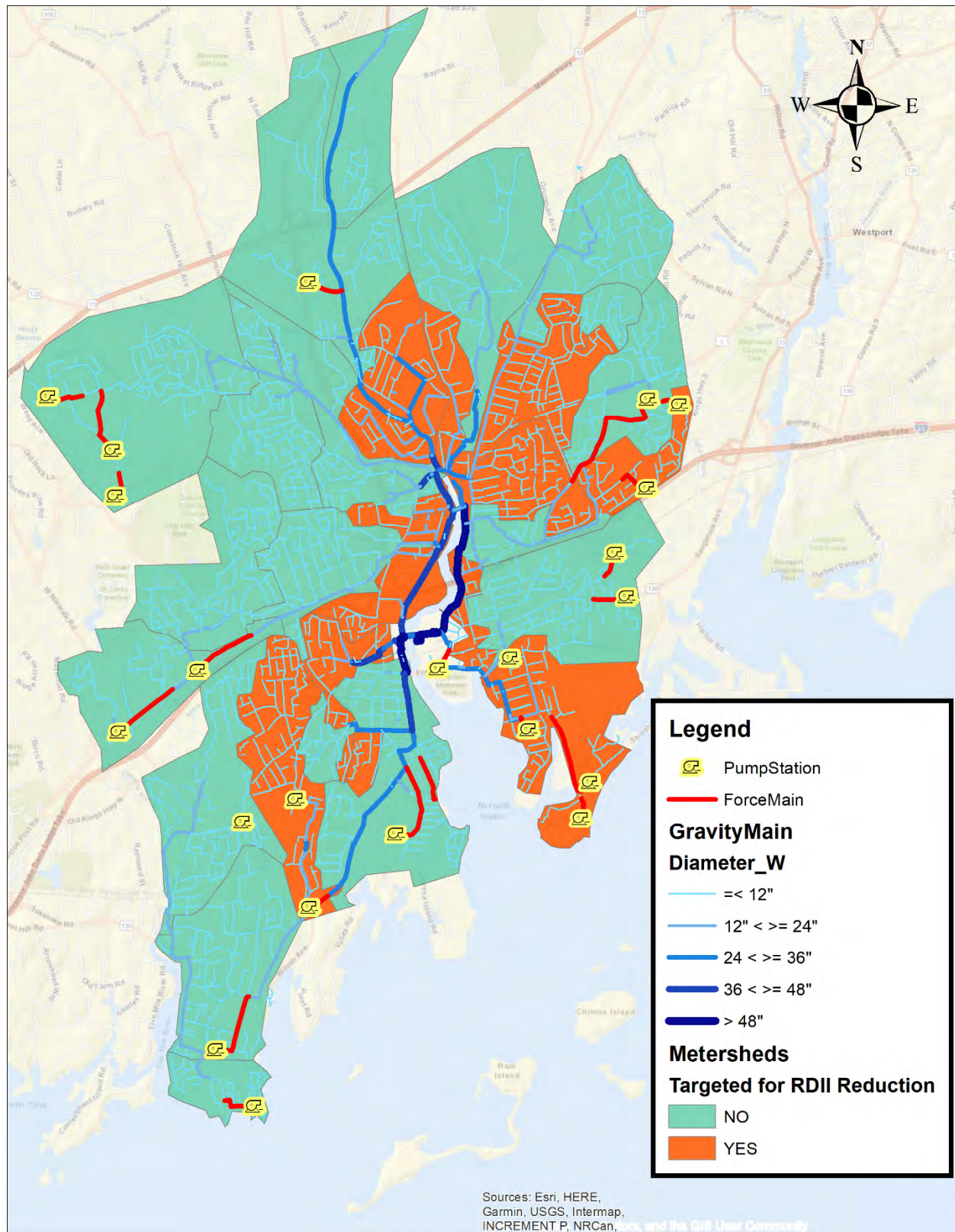


Figure 2-3. Facility Plan Sewershed Areas Identified for Excess Flow Reduction

The 17 metershed areas identified in this Facility Plan for comprehensive rehabilitation of public sewer assets to reduce excess flow to the WPCF are shown in Figure 2-3. The metersheds shown in Figure 2-3 target excess flow reduction from metersheds identified from the Master Plan as having either the highest rates of GWI or metersheds with the highest rates of RDII. By reducing excess flow originating from both GWI and RDII, the WPCA can achieve the largest volume and peak flow reductions from the sewer system rehabilitation performed. These metersheds represent the most significant contributors of excess flow to the collection system and WPCF during wet weather events. Rehabilitation of these areas is expected to be the most cost-effective method of reducing flow to the WPCF and should result in the greatest reduction of excess flow per dollar expended on rehabilitating the collection system.

2.2 System Rehabilitation

Comprehensive rehabilitation of collection system assets, rather than point repair, is typically a more effective method of reducing excess flow from infiltration. In this technical memorandum, comprehensive rehabilitation is defined as rehabilitation of all public sewer assets identified within the sewershed area. Comprehensive rehabilitation addresses defects which may be a source of I/I in sewer mains, manholes, and lateral connections. By rehabilitating all the public sewer assets within a sewershed area, I/I migration can be significantly reduced. This in turn reduces overall flow in the collection system and to the WPCF to advance elimination of Outfall 002-1 by significantly reducing wet weather flows.

The following rehabilitation assumptions were made in evaluating the reduction of excess flow:

- Public sewer mains – all public sewer mains within the identified sewershed area will be rehabilitated by CIPP or similar type of continuous lining. Continuous lining provides an integral barrier to reduce infiltration through defects in the sewer pipe or the joints between pipe segments.
- Sewer Manholes (MHs) – all sewer MHs within the identified sewershed area will be rehabilitated by epoxy, cementitious, or other equivalent lining. Like the sewer main rehabilitation, this provides an integral barrier to reduce infiltration through defects in the manhole riser or the joints between manhole riser sections.
- Pipe to MH connections – all pipe to manhole penetrations will be grouted. Grouting the pipe penetration creates a seal at the joint that is resistant to infiltration.
- Lateral to sewer main connections – all lateral to sewer main penetrations will be grouted. Grouting the lateral to sewer main penetration creates a seal that is resistant to infiltration.

2.3 Infiltration and Inflow Reduction Estimation

To estimate the amount of reduced excess flow projected to be achieved from the Comprehensive Wet Weather Flow Reduction Program, Brown and Caldwell evaluated an industry published case study, a previously prepared sewer rehabilitation study, and the direct experience from WPCA's rehabilitation of the Shady Beach collection system area.

The WERF published the *Flood Grouting for Infiltration on Private Side Sewers* case study to investigate infiltration reductions achieved by flood grouting a sewershed. In the case study, flood grouting was intended to be used to rehabilitate the entire section of the sewer system between two manholes. To determine the amount of excess flow achieved by the rehabilitation, flow meters were installed in the system to document the pre- and post-rehabilitation conditions for modeling analysis. The project results indicate that 56% of the sewer system within the sewer basin was rehabilitated by flood grouting. The reported quantity of rehabilitation completed through flood grouting is similar to the Comprehensive Wet Weather Flow Reduction Program sewer recommended for the WPCA to reduce flow to the WPCF and advance elimination of Outfall

002-1. Table 2-1 (copy of Table 6-2 from the WERF published report) presents the summary of I/I reductions achieved from the *Flood Grouting for Infiltration on Private Side Sewers* report.

Table 2-1. WERF Case Study Reported Summary of I/I Reduction			
Statistic ^a	Before Project	After Project	Percent Reduction
Peak hour I/I (MGD)	0.49	0.28	41%
Peak 24-hour I/I (MGD)	0.25	0.17	32%
Maximum event vol. (MG)	0.76	0.25	66%
Annual average I/I (MGD)	0.03	0.01	68%
Dry weather flow (MGD)	0.03	0.025	15%

^a Values for once-in-10-year recurrence except for annual and dry weather flow.

In addition to the WERF study, Brown and Caldwell also reviewed the *Sewer Rehabilitation Pilot Study*, prepared by CDM Smith in 2016, which documented reduced excess flow achieved by sewer asset rehabilitation in the Hartford, CT collection system. Table 2-2 (copy of Table ES-4 from the *Sewer Rehabilitation Pilot Study* report) lists the reduction ranges from national studies based on several different rehabilitation approaches and the reductions achieved with the pilot study rehabilitation.

Table 2-2. Sewer Rehabilitation Pilot Study Reported National Study Average I/I Reduction Ranges			
ID	Rehabilitation Approach	National Study Average Reduction Range	Pilot Study Reduction Range
1	Mainline Sewer and Manholes	10 – 30%	10 – 40%
2	Lateral Connections	10 – 20%	-
3	Laterals	10 – 20%	-
4	Private Sources	20 – 40%	-
5	1 and 2 Combined	20 – 50%	25%
6	1, 2 and 3 Combined	30 – 70%	20 – 40%
7	1 and 4 Combined	30 – 70%	10 – 40%

In addition to the reductions in excess flow reported in the WERF study and the Hartford, CT study, Brown and Caldwell also reviewed reductions in measured flow at the Norwalk Shady Beach Pump Station. In December 2020, WPCA's contract operator, Veolia, observed I/I entering sewer mains and manholes in the Shady Beach Pump Station Sershed. In 2019, a report prepared by Wright-Pierce, determined the average daily flow at the Shady Beach Pump Station was 193,830 gallons-per-day (gpd). In February 2021, a CIPP lining project was contracted and rehabilitation work was completed in May 2021. Following completion of the CIPP lining work, WPCA analyzed the Shady Beach Pump Station flow data to assess the change in pumped flow volume. Flow data from the Shady Beach Pump Station, in gallons per minute (gpm), representing pre- and post-rehabilitation conditions, and the percent reduction in flows are presented in Table 2-3.

Table 2-3. Shady Beach Pump Station Sewershed Flow Reduction			
Year	Condition	Average Daily Flow (gpm)	Flow Reduction
2019	Pre-rehabilitation	135	-
2021	Post-rehabilitation	56	59%
2022	Post-rehabilitation	62	54%
2023	Post-rehabilitation	56	59%

The reported excess flow reductions from the reviewed sources were used as a guide to develop the projected I/I reductions that could be achieved from the proposed Comprehensive Wet Weather Flow Reduction Program in the Norwalk collection system. In sewershed areas identified for targeted RDII reduction, the following reductions to the modeled excess flow were made:

- Persistent GWI – the model parameters for the dry weather diurnal pattern and flow volume were adjusted to target a 15% reduction in dry weather flow volume. This reduction aligns with the reported values in the WERF study.
- Seasonally varying GWI – the model parameters controlling the rainfall derived GWI response were adjusted to target a 55% reduction in seasonally varying GWI. This reduction aligns with the annual average I/I reductions in the WERF study.
- RDII – the model parameters were adjusted to target a 40% reduction in the rainfall dependent volume. The targeted reduction is conservative when compared to the WERF study, and within the range of reported reductions from the Hartford, CT pilot study for ID 5 rehabilitation approach.

Section 3: Projected System Performance

In the Master Plan, Brown and Caldwell recommended the targeted rehabilitation of public sewer assets as a long-term strategy to reduce the excess flow in the collection system. The recommended targeted RDII reductions are intended to address sources of extraneous flows (from sources other than the known directly connected catch basins) from entering the collection system and making their way to the WPCF for treatment.

These long-term recommendations were separate and apart from the WPCA's Consent Order obligations and Brown and Caldwell recommended that the City implement a long-term RDII reduction and flow management plan over a 25-year period. This technical memorandum includes additional analyses to update the targeted RDII reductions. To meet the WPCA's Consent Order obligations to evaluate a range of viable and cost-effective measures to eliminate Outfall 002-1 this memorandum recommends accelerating the pace of work to complete the recommended rehabilitation work from a 25-year period to a 10-year period and implementing the Comprehensive Wet Weather Flow Reduction Program to significantly reduce excess flow in the collection system and WPCF and significantly advance elimination of Outfall 002-1. The following sections describe the projected reductions in flow volume diverted to Outfall 002-1 as rehabilitation projects are completed.

3.1 Rehabilitation Project Schedule

Rehabilitation projects in targeted sewersheds are scheduled to be completed over a 10-year period. The sequence of rehabilitation projects was developed to achieve the following goals:

- Maximize flow reduction in the early years of the Comprehensive Wet Weather Flow Reduction Program by prioritizing rehabilitation of sewersheds with the highest excess flow generations rates,
- Geographically locate rehabilitation projects near one another, when possible, to minimize community disruption and simplify contractor mobilization, and
- Ensure that rehabilitation work to be completed each year is affordable to the City.

Table 3-1 shows the proposed sewershed rehabilitation schedule and the estimated length of public sewer mains to be rehabilitated in two-year increments. It should be noted that while the WPCA intends to comply with the 10-year obligation in the Consent Order, the specific projects and associated program years are subject to change for, among other reasons, alignment with additional ongoing municipal projects.

Program Year	Sewersheds Rehabilitated	Estimated Length of Public Sewers Rehabilitated (ft)
2	FM_14, FM_16, FM_19, FM_24, FM_33, FM_35, FM_37, FM_38, FM_39	57,269
4	FM_03, FM_25, FM_28	54,036
6	FM_26, FM_36	47,883
8	FM_01, FM_05	87,416
10	FM_08	40,157

Figure 3-1 shows the proposed schedule of sewersheds to be rehabilitated in two-year increments.



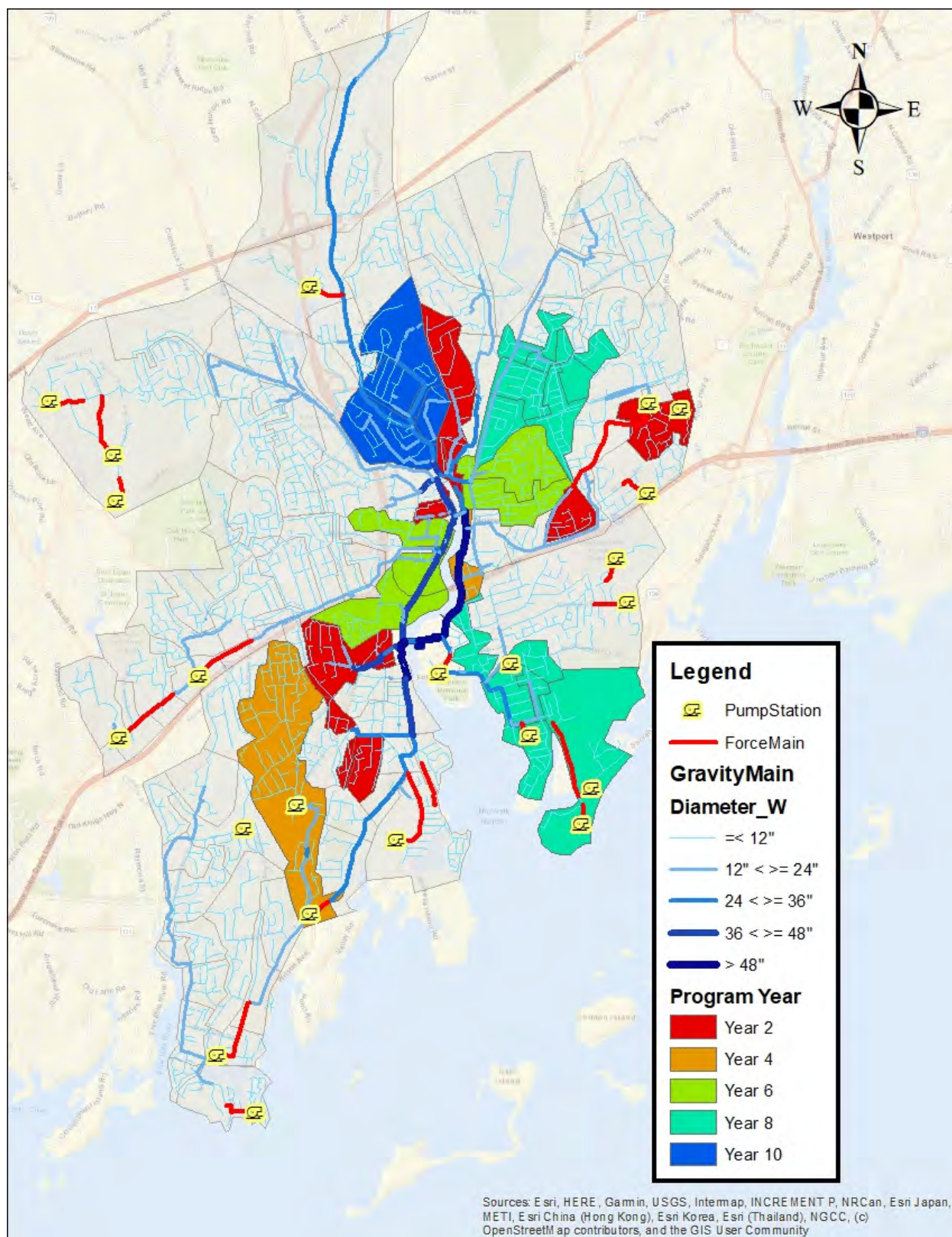


Figure 3-1. Proposed Sewershed Rehabilitation Schedule

3.2 Projected Outfall 002-1 Discharge Reductions

Multiple model simulations with varied rainfall recurrence intervals and projected reductions in excess flow in two-year increments were conducted to assess the projected system performance and reductions in total collection system volume, and volume of discharge from Outfall 002-1. The model simulation matrix is shown in Table 3-2.

Table 3-2. System Performance Model Simulation Matrix				
Program Year	1-YR, 24-HR Rainfall Event	5-YR, 24-HR Rainfall Event	10-YR, 24-HR Rainfall Event	25-YR, 24-HR Rainfall Event
0	•	•	•	•
2	•	•	•	•
4	•	•	•	•
6	•	•	•	•
8	•	•	•	•
10	•	•	•	•

The model-predicted reductions in discharges from Outfall 002-1, projected to result from the rehabilitation of public sewer assets, were analyzed for the 1-YR, 24-HR through the 25-YR, 24-HR rainfall events. The model simulations assumed flow reductions attributable to the removal of direct inflow sources under the catch basin disconnection program, as recommended in the Master Plan, were fully implemented. Model-predicted reductions in discharge volume from Outfall 002-1 for the rainfall recurrence interval simulations are presented in Table 3-3 through Table 3-6.

Table 3-3. Projected Outfall 002-1 Discharge Volume Reductions – 1-YR, 24-HR Design Storm

Program Year	Sewersheds Rehabilitated	Outfall 002-1 Discharge Volume* (MG)	Outfall 002-1 Discharge Volume Reduction* (%)
0	-	3.0	-
2	FM_14, FM_16, FM_19, FM_24, FM_33, FM_35, FM_37, FM_38, FM_39	1.6	47
4	FM_03, FM_25, FM_28	1.2	60
6	FM_26, FM_36	0.8	73
8	FM_01, FM_05	0.7	77
10	FM_08	0.6	80

*Reported flows and volumes assume the Collection System Master Plan Consent Order recommendations have been completed and are operational.

Table 3-4. Projected Outfall 002-1 Discharge Volume Reductions – 5-YR, 24-HR Design Storm

Program Year	Sewersheds Rehabilitated	Outfall 002-1 Discharge Volume* (MG)	Outfall 002-1 Discharge Volume Reduction* (%)
0	-	8.9	-
2	FM_14, FM_16, FM_19, FM_24, FM_33, FM_35, FM_37, FM_38, FM_39	7.0	21
4	FM_03, FM_25, FM_28	6.3	29
6	FM_26, FM_36	5.0	44
8	FM_01, FM_05	4.4	51
10	FM_08	4.1	54

*Reported flows and volumes assume the Collection System Master Plan Consent Order recommendations have been completed and are operational.

Table 3-5. Projected Outfall 002-1 Discharge Volume Reductions – 10-YR, 24-HR Design Storm

Program Year	Sewersheds Rehabilitated	Outfall 002-1 Discharge Volume* (MG)	Outfall 002-1 Discharge Volume Reduction* (%)
0	-	13.6	-
2	FM_14, FM_16, FM_19, FM_24, FM_33, FM_35, FM_37, FM_38, FM_39	11.4	16
4	FM_03, FM_25, FM_28	10.2	25
6	FM_26, FM_36	8.6	37
8	FM_01, FM_05	7.9	42
10	FM_08	7.4	46

*Reported flows and volumes assume the Collection System Master Plan Consent Order recommendations have been completed and are operational.

Table 3-6. Projected Outfall 002-1 Discharge Volume Reductions – 25-YR, 24-HR Design Storm

Program Year	Sewersheds Rehabilitated	Outfall 002-1 Discharge Volume* (MG)	Outfall 002-1 Discharge Volume Reduction* (%)
0	-	22.7	-
2	FM_14, FM_16, FM_19, FM_24, FM_33, FM_35, FM_37, FM_38, FM_39	20.1	11
4	FM_03, FM_25, FM_28	18.3	19
6	FM_26, FM_36	15.6	31
8	FM_01, FM_05	14.2	37
10	FM_08	13.6	40

*Reported flows and volumes assume the Collection System Master Plan Consent Order recommendations have been completed and are operational.

With the excess flow reductions projected from the Comprehensive Wet Weather Flow Reduction Program, it is anticipated that with the progression of the recommended rehabilitation program, the WPCA will observe reduced discharge volumes from Outfall 002-1 for all recurrence interval rainfall events. At the completion of the Comprehensive Wet Weather Flow Reduction Program, relative reductions in Outfall 002-1 discharge volume range from approximately 80% for the 1-YR, 24-HR rainfall event to 40% for the 25-YR, 24-HR rainfall event. It is also anticipated that rehabilitation efforts will result in a reduction in the absolute volume of water discharged from Outfall 002-1 for all rainfall events. The absolute volume reductions in discharges from Outfall 002-1 range from approximately 2.4 MG for the 1-YR, 24-HR rainfall event to 6.2 MG for the 25-YR, 24-HR rainfall event.

In addition to the design storm events, a typical year simulation was performed to assess the projected reductions in activation frequency and discharge volume from Outfall 002-1. To select a typical rainfall year, Brown and Caldwell evaluated cumulative annual rainfall data from 2000 through 2022. The hourly rainfall average and the 95% confidence interval was determined from the 22-year rainfall record, as shown in Figure 3-2. Each year was compared to the average and the 95% confidence interval to select a typical rainfall year timeseries. The 2017 rainfall record was selected to represent the typical year rainfall. As demonstrated by Figure 4-2, 2017 rainfall is slightly above the average rainfall and associated 95% confidence interval for significant portions of the year and is therefore considered a conservative selection for a typical year simulation.

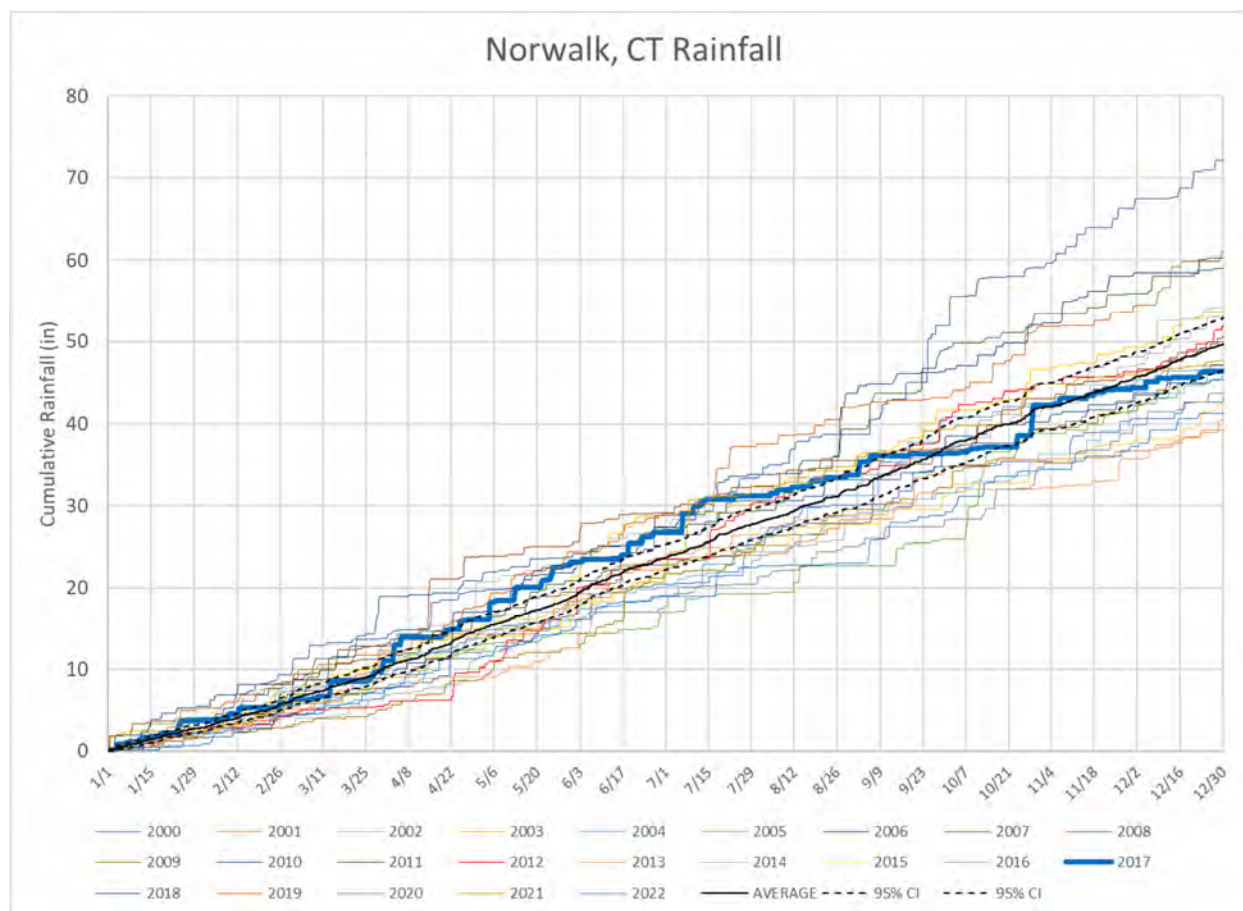


Figure 3-2. Cumulative Annual Rainfall and Typical Rainfall Year

The model-predicted discharge volumes from Outfall 002-1 resulting from the typical year rainfall simulations are shown in Table 3-7. Reductions in projected discharge volume and frequency are presented in two-year increments.

Table 3-7. Projected System Performance – Typical Year (2017)			
Program Year	Sewersheds Rehabilitated	Outfall 002-1 Discharge Volume* (MG)	Outfall 002-1 Discharge Volume Reduction* (%)
0	-	6.0	-
2	FM_14, FM_16, FM_19, FM_24, FM_33, FM_35, FM_37, FM_38, FM_39	2.8	53
4	FM_03, FM_25, FM_28	1.9	68
6	FM_26, FM_36	1.3	78
8	FM_01, FM_05	1.1	82
10	FM_08	0.8	87

The excess flow projected to be removed from the collection system by the Comprehensive Wet Weather Flow Reduction Program in the identified sewersheds reduces both the peak flow and volume of flow

conveyed to the WPCF. In the typical year simulation, a projected reduction in discharge volume from Outfall 002-1 of 87% is predicted by the model.

3.3 Projected Collection System Flooding Reductions

The projected reductions in excess flow in the collection system from the Comprehensive Wet Weather Flow Reduction Program have the potential to also reduce the volume of sanitary sewer overflows (SSOs) across the collection system. The model-predicted reductions in SSO discharges, projected to result from the rehabilitation of public sewer assets, were analyzed for the 1-YR, 24-HR through the 25-YR, 24-HR rainfall events. The model simulations assumed flow reductions attributable to the removal of direct inflow sources under the catch basin disconnection program, recommended in the Master Plan, were fully implemented. Model-predicted reductions in SSO discharge volume for the rainfall recurrence interval simulations are presented in Table 3-8 through Table 3-11.

Table 3-8. Projected SSO Discharge Volume Reductions – 1-YR, 24-HR Design Storm

Program Year	Sewersheds Rehabilitated	System-wide SSO Discharge Volume* (MG)	System-wide SSO Discharge Volume Reduction* (%)
0	-	0.5	-
2	FM_14, FM_16, FM_19, FM_24, FM_33, FM_35, FM_37, FM_38, FM_39	0.4	20
4	FM_03, FM_25, FM_28	0.0	100
6	FM_26, FM_36	0.0	100
8	FM_01, FM_05	0.0	100
10	FM_08	0.0	100

*Reported flows and volumes assume the Collection System Master Plan Consent Order recommendations have been completed and are operational.

Table 3-9. Projected SSO Discharge Volume Reductions – 5-YR, 24-HR Design Storm

Program Year	Sewersheds Rehabilitated	System-wide SSO Discharge Volume* (MG)	System-wide SSO Discharge Volume Reduction* (%)
0	-	2.2	-
2	FM_14, FM_16, FM_19, FM_24, FM_33, FM_35, FM_37, FM_38, FM_39	1.8	18
4	FM_03, FM_25, FM_28	0.7	68
6	FM_26, FM_36	0.7	68
8	FM_01, FM_05	0.7	68
10	FM_08	0.7	68

*Reported flows and volumes assume the Collection System Master Plan Consent Order recommendations have been completed and are operational.

Table 3-10. Projected SSO Discharge Volume Reductions – 10-YR, 24-HR Design Storm

Program Year	Sewersheds Rehabilitated	System-wide SSO Discharge Volume* (MG)	System-wide SSO Discharge Volume Reduction* (%)
0	-	4.1	-
2	FM_14, FM_16, FM_19, FM_24, FM_33, FM_35, FM_37, FM_38, FM_39	3.4	17%
4	FM_03, FM_25, FM_28	2.0	51%
6	FM_26, FM_36	2.0	51%
8	FM_01, FM_05	1.7	59%
10	FM_08	1.7	59%

*Reported flows and volumes assume the Collection System Master Plan Consent Order recommendations have been completed and are operational.

Table 3-11. Projected SSO Discharge Volume Reductions – 25-YR, 24-HR Design Storm

Program Year	Sewersheds Rehabilitated	System-wide SSO Discharge Volume* (MG)	System-wide SSO Discharge Volume Reduction* (%)
0	-	8.8	-
2	FM_14, FM_16, FM_19, FM_24, FM_33, FM_35, FM_37, FM_38, FM_39	7.5	15%
4	FM_03, FM_25, FM_28	5.7	35%
6	FM_26, FM_36	5.7	35%
8	FM_01, FM_05	4.8	45%
10	FM_08	4.8	45%

*Reported flows and volumes assume the Collection System Master Plan Consent Order recommendations have been completed and are operational.

The model-predicted SSO discharge volumes resulting from the typical year rainfall simulations are shown in Table 3-12. Reductions in expected discharge volume and frequency are presented in two-year increments.

Table 3-12. Projected SSO Discharge Volume Reductions – Typical Year (2017)

Program Year	Sewersheds Rehabilitated	System-wide SSO Discharge Volume* (MG)	System-wide SSO Discharge Volume Reduction* (%)
0	-	0.9	-
2	FM_14, FM_16, FM_19, FM_24, FM_33, FM_35, FM_37, FM_38, FM_39	0.9	0%
4	FM_03, FM_25, FM_28	0	100%
6	FM_26, FM_36	0	100%
8	FM_01, FM_05	0	100%
10	FM_08	0	100%

The excess flow projected to be removed from the collection system by the Comprehensive Wet Weather Flow Reduction Program in the identified sewersheds reduces both the peak flow and volume of flow entering the collection system. In the typical year simulation, a projected reduction in wet weather SSO discharge volume of 100% is predicted by the model.

Section 4: Summary and Recommendations

Targeted reduction of excess flow was evaluated to model how strategic rehabilitation of certain sewershed areas in the collection system may substantially reduce overall flow volume to the WPCF, and significantly advance elimination of Outfall 002-1. In the Master Plan, Brown and Caldwell identified targeted infiltration and inflow reduction as a long-term recommendation to reduce excess flow from entering the collection system. This long-term recommendation was not part of the Consent Order obligation, and it was recommended that the WPCA complete these long-term enhancements over a period of 25 years.

This memorandum enhances these non-Consent Order Master Plan recommendations through updated modeling and recommends that the WPCA implement the Comprehensive Wet Weather Flow Reduction Program to expedite and complete the Master Plan recommendations in 10-years, rather than 25, to reduce excess flow to the collection system. Targeted sewershed rehabilitation through the Comprehensive Wet Weather Flow Reduction Program is intended to address sources of extraneous flows entering the collection system originating from sources other than the known directly connected catch basins.¹ By reducing excess flow from entering the collection system, the peak flows conveyed to the WPCF are also reduced, thereby advancing elimination of Outfall 002-1.

4.1 Summary of Findings

Reduction of extraneous flows, beyond those projected to be achieved from the Catch Basin Disconnection Program, can be accomplished through comprehensive rehabilitation of public sewer assets across large sewershed areas. As demonstrated in both the WERF published case study and the Hartford, CT pilot study, comprehensive rehabilitation of public sewer assets can achieve significant reductions in excess flow to the WPCF and extraneous wet weather flow that could result in diversion to Outfall 002-1.

There are 17 sewershed areas identified in the recommended Comprehensive Wet Weather Reduction Program where cost-effective reduction in excess flows are achievable through comprehensive rehabilitation of collection system assets. The infiltration contributions from each of these areas varies due to the differences in sewershed area, linear feet of sewer mains, the condition of the sewer assets, and proximity of sewer assets to the groundwater table. The excess flows generated from these metersheds were estimated using the City's hydraulic model. The projected impact of comprehensive rehabilitation of sewer assets to remove excess flow was estimated using guidance from published case studies.

Based on anticipated flow reduction resulting from the Comprehensive Wet Weather Reduction Program, hydraulic modeling analyses were performed to assess the projected reductions in discharge volume at Outfall 002-1. The model-predicted reductions are shown in Figure 4-1. The model results show a significant trend of reductions in discharge volumes from Outfall 002-1 as sewershed rehabilitation projects are completed. For example, at the 1-YR, 24-HR recurrence interval event, excess flow to Outfall 002-1 is reduced by approximately 80%. For larger storms such as the 25-YR, 24-HR return frequency event, overall flow to Outfall 002-1 is projected to be reduced by approximately 40%.

The projected reductions in excess flow entering the collection system may also reduce the hydraulic grade line in the collection system during wet weather events. The reduced hydraulic grade line can decrease the volume of wastewater that escapes the collection system as a wet weather SSO. The model-predicted SSO

¹ The Master Plan includes a recommendation for the City to implement a Catch Basin Disconnection Program that is specifically designed to address the removal of excess flow originating from directly connected catch basins identified as significant inflow contributors

volume reductions are shown in Figure 4-2. The model results show a trend in reductions in SSO volume as sewershed rehabilitation projects are completed. For example, at the 1-YR, 24-HR recurrence interval event, SSO volume is eliminated. At the 25-YR, 24-HR recurrence interval, SSO volume is reduced by approximately 45%.

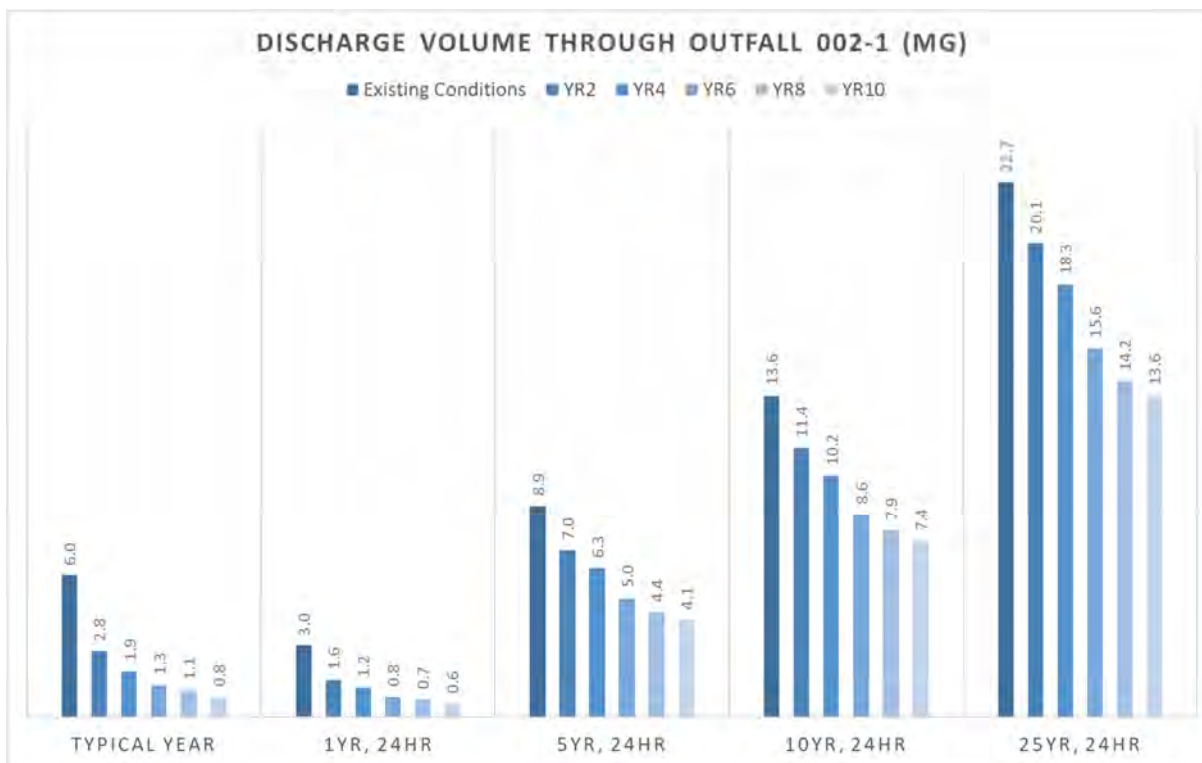


Figure 4-1. Outfall 002-1 Model Simulated Discharge Volumes

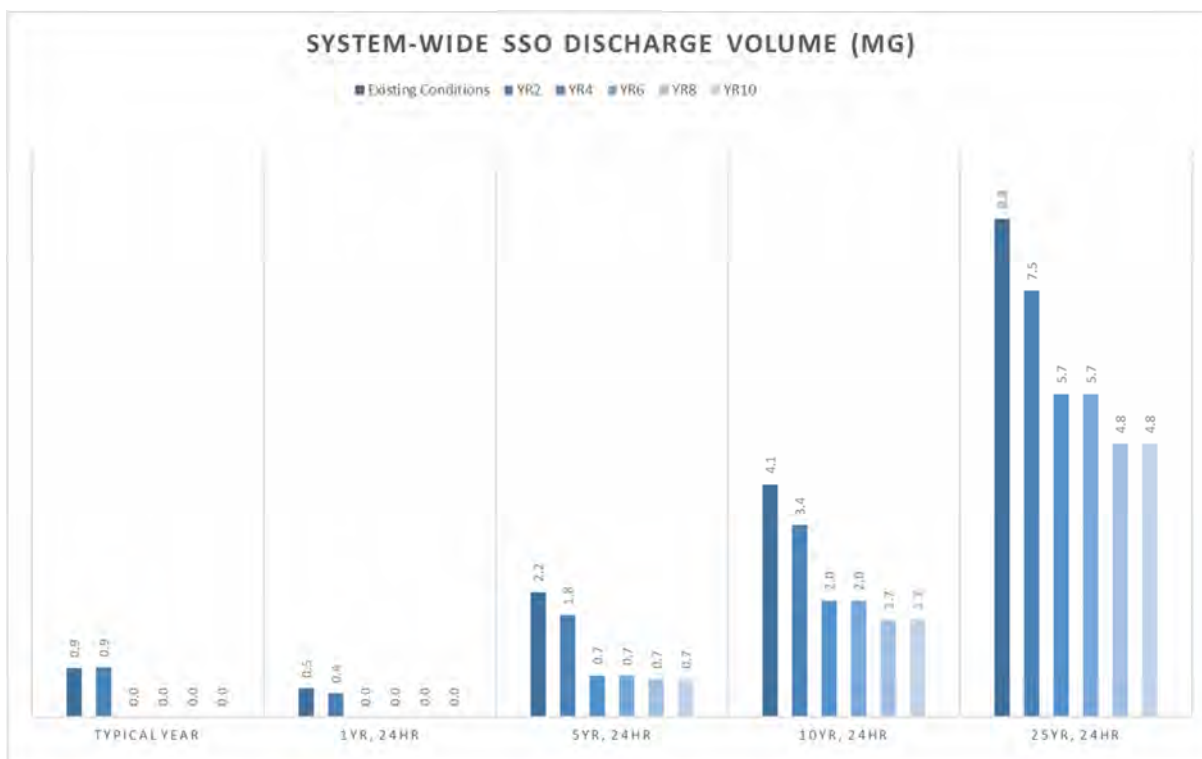


Figure 4-2. SSO Model Simulated Discharge Volumes

As a result of these significant predicted reductions in excess flow to the WPCF, the hydraulic modeling also shows that reduced overall flow from the collection system to the WPCF will advance the elimination of Outfall 002-1 by significantly decreasing the volume of flow to Outfall 002-1 should diversion occur. Additionally, Comprehensive Wet Weather Flow Reduction Program efforts will have the following additional benefits:

- **Environmental Benefits:**
 - Enhanced water quality in the Norwalk River and Long Island Sound due to significant reduction in wet weather flows and advanced elimination of Outfall 002-1.
 - Advanced elimination of Ann Street Emergency Overflow Siphon due to decreased flow in the collection system and WPCF.
 - Reduced potential of combined sewer overflows (CSOs) due to decreased flow in the collection system and WPCF.
 - Reduced potential of sanitary sewer overflows (SSOs) due to decreased flow in the collection system and WPCF.
- **Energy Efficiency Benefits:**
 - Reduced WPCF operation and maintenance due to decreased overall flow requiring treatment.
 - Improved process performance at the WPCF through reductions in the peak flow and duration of sustained high flows to the WPCF that result in a more consistent and optimal operation of the process units that make up the WPCF treatment train.
 - Advancement of CTDEEP energy efficiency goals by reducing the amount of flow requiring pumping and treatment at the WPCF.

4.2 Recommendations

Based on the projected reductions in excess flow in the collection system resulting from comprehensive sewershed rehabilitation efforts, and the consequent projected reductions in discharge volume and frequency from Outfall 002-1, it is recommended that the City implement the Comprehensive Wet Weather Flow Reduction Program to advance the elimination of Outfall 002-1. The Comprehensive Wet Weather Flow Reduction Program would serve to accomplish the following:

- Confirm the sewershed delineation,
- Review SSES data, including CCTV, updated GIS data, PACP and MACP condition assessment data, and flow and level monitoring data collected within the collection system,
- Confirm the locations, quantities, and sizes of public sewer assets to be rehabilitated,
- Perform detailed design and develop rehabilitation plans and specifications for each sewershed area, and
- Perform project bidding, construction management, project close out, and post-rehabilitation flow monitoring.

4.2.1 Comprehensive Wet Weather Flow Reduction Program

The recommendation for comprehensive rehabilitation of public sewer assets includes the following:

- Public sewer mains – all public sewer mains within the identified sewershed area will be rehabilitated by CIPP or similar type of continuous lining. This provides an integral barrier to prevent infiltration through defects in the sewer pipe or the joints between pipe segments.
- Sewer MHs – all sewer MHs within the identified sewershed area will be rehabilitated by epoxy, cementitious, or other equivalent lining. Like the sewer main rehabilitation, this provides an integral barrier to prevent infiltration through defects in the manhole riser or the joints between manhole riser sections.
- Pipe to MH connections – all pipe to manhole penetrations will be grouted. Grouting the pipe penetration creates a seal at the joint that is resistant to infiltration.
- Lateral to sewer main connections – all lateral to sewer main penetrations will be grouted. Grouting the lateral to sewer main penetration creates a seal that is resistant to infiltration.

4.2.2 Schedule of Sewershed Rehabilitation Projects

It is recommended that the WPCA complete the Comprehensive Wet Weather Flow Reduction Program in a 10-year period. The recommended schedule of sewershed rehabilitation projects, total length of public sewers rehabilitated, and the estimated rehabilitation costs are presented in Table 4-1.

Table 4-1. Sewershed Rehabilitation Planning Level Cost Estimates

Program Year	Sewersheds Rehabilitated	Total Length of Public Sewers Rehabilitated (ft)	Comprehensive Public Sewer Rehabilitation Cost (\$M)	Engineering and Program Contingency Cost (\$M)	Cumulative Comprehensive Public Sewer Rehabilitation Cost (\$M)
2	FM_14, FM_16, FM_19, FM_24, FM_33, FM_35, FM_37, FM_38, FM_39	57,269	\$8.2	\$2.5	\$10.7
4	FM_03, FM_25, FM_28	54,036	\$7.6	\$2.3	\$20.6
6	FM_26, FM_36	47,883	\$6.5	\$2.0	\$29.1
8	FM_01, FM_05	87,416	\$9.5	\$2.9	\$41.5
10	FM_08	40,157	\$6.5	\$1.9	\$49.9

The schedule of projects presented in Table 4-1 is subject to change over the course of the Comprehensive Wet Weather Flow Reduction Program. It should be noted that while the WPCA intends to comply with the 10-year obligation in the Consent Order, the specific projects and associated program years presented in Table 4-1 are subject to change for, among other reasons, alignment with additional ongoing municipal projects.

4.2.3 Mid-Course Check-In

The modeled flow reductions that form the basis for the recommendation of the Comprehensive Wet Weather Flow Reduction Program are estimated from published case studies, flow reductions achieved in other communities, and a case study in Norwalk. The analysis recognizes that actual reductions in excess flow resulting from comprehensive collection system rehabilitation may vary from the estimated reductions. In some cases, actual flow reductions may exceed predicted flow reductions, in others the flow reductions may be less than what was projected for the rehabilitated sewershed areas.

A mid-course check-in, at year five of the Comprehensive Wet Weather Flow Reduction Program, is recommended to evaluate and quantify the flow reductions achieved within the Norwalk collection system up to that point. The mid-course check-in will consist of the following:

- Pre-rehabilitation flow monitoring
- Post-rehabilitation flow monitoring
- Hydraulic model update and simulations
- Flow reduction analysis

If the flow reduction analysis shows that comprehensive rehabilitation of the public sewer assets is reasonably meeting projections for reductions in excess flow, the City will continue to administer and implement the Comprehensive Wet Weather Flow Reduction Program.

If the flow reduction analysis shows that the comprehensive rehabilitation of the public sewer assets are not reasonably meeting projections for reductions in excess flow, the City will prepare a performance evaluation plan to describe the methods for investigation and identification of appropriate corrective measures necessary to achieve the projected removal of excess flow from the collection system.

4.3 Implementation

The targeted RDII analysis started under the Master Plan, and further refined under this technical memorandum, identified metersheds where cost-effective RDII reductions can be achieved, and established an estimate of the post-rehabilitation reductions in excess flow and evaluated the associated improved performance of the collection system. The nature and locations of RDII sources, and the specific types and quantities of sewer rehabilitation required to achieve the targeted RDII reductions will continue to be monitored and addressed as part of the Comprehensive Wet Weather Flow Reduction Program recommended in this technical memorandum.

4.3.1 Comprehensive Wet Weather Flow Reduction Program Cost Estimates

Planning level cost estimates for rehabilitation of public sewer assets for each metershed identified for rehabilitation under the Comprehensive Wet Weather Flow Reduction Program are presented in Table 4-2. With an estimated total cost of approximately \$50 million to administer the recommended Comprehensive Wet Weather Flow Reduction Program, an average annual commitment of approximately \$5 million will be necessary to complete the recommended sewer rehabilitation within the 10-year period specified in the Consent Order.

Table 4-2. Comprehensive Wet Weather Flow Reduction Program Cost Estimates

Program Year	Comprehensive Public Sewer Rehabilitation Cost (\$M)	Engineering and Program Contingency Cost (\$M)	Cumulative Comprehensive Public Sewer Rehabilitation Cost (\$M)
2	\$8.2	\$2.5	\$10.7
4	\$7.6	\$2.3	\$20.6
6	\$6.5	\$2.0	\$29.1
8	\$9.5	\$2.9	\$41.5
10	\$6.5	\$1.9	\$49.9

4.3.2 Comprehensive Wet Weather Flow Reduction Program Schedule

An implementation schedule for the activities recommended in the Comprehensive Wet Weather Flow Reduction Program are provided in Figure 4-3.

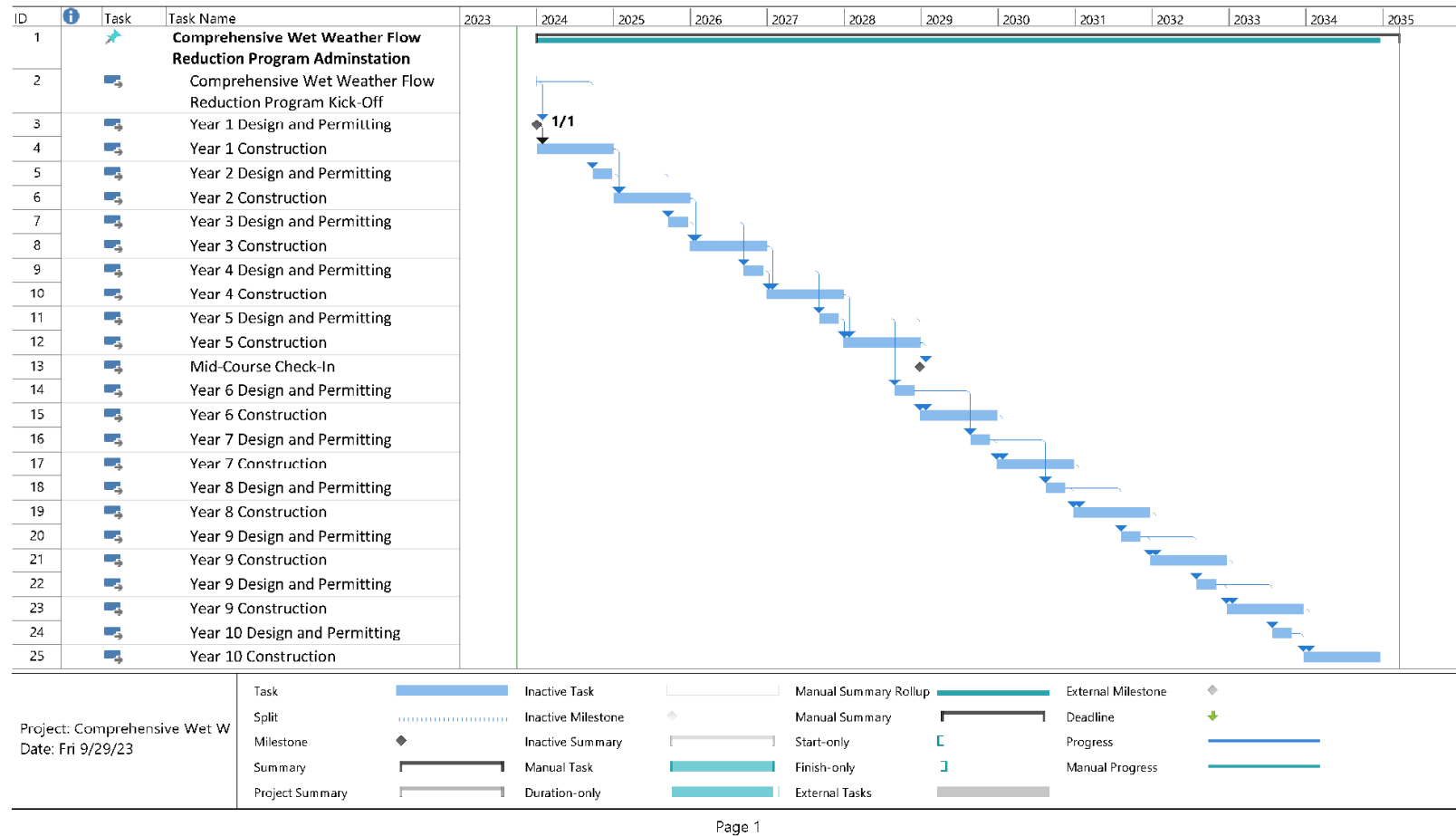


Figure 4-3. Recommended Comprehensive Wet Weather Flow Reduction Program Implementation Schedule

Section 5: References

Reports

Brown and Caldwell, *2022 Norwalk Master Plan*, Norwalk Water Pollution Control Authority, 2022.

Burke, Martha, et. al., *Flood Grouting for Infiltration Reduction on Private Side Sewers*, Water Environment Research Foundation, 2012.

CDM Smith, *Sewer Rehabilitation Pilot Study*, The Metropolitan District Hartford, CT, 2016.



Appendix F

Aeration System Technical Memorandum (Arcadis)

SUBJECT

Norwalk Facility Plan Update
Aeration System Technical Memorandum

TO

Mr. Ralph Kolb, P.E.
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Senior Environmental Engineer
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DATE

September 29, 2023

ARCADIS PROJECT NUMBER

30051745

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1.0 Background and Purpose

1.1 Background

The Norwalk Water Pollution Control Facility (WPCF) has a design flow of 18 million gallons per day (MGD) and a peak hydraulic flow of 30 MGD through the secondary treatment system. Secondary treatment at the WPCF consists of five aeration tanks (ATs) and four circular final settling tanks (FSTs). The City of Norwalk places a high priority on energy efficiency and seeks to replace the existing blowers at the WPCF with new more appropriately sized blowers to support efficient operation at the facility. Detailed process evaluation and modeling was performed to evaluate the secondary treatment process and verify the facility's ability to meet ammonia and total nitrogen standards. The model estimated current and future oxygen demands under different seasonal conditions to evaluate sizing for new blowers and to ensure adequate coverage for a range of airflows.

1.2 Purpose

The purpose of this memorandum is to evaluate options for enhancing Norwalk WPCF's ability to supply, regulate, and optimize dissolved oxygen (DO) levels in the ATs. The analysis and recommendations in this Technical Memorandum are not subject to the Consent Order entered into by the City of Norwalk and the Connecticut Department of Energy and Environmental Protection (CTDEEP) in May 2022. The goal of the memorandum is to:

- Evaluate and determine the sizing and selection of new process air blowers that achieve process design goals and enhance operational efficiency.
- Establish criteria to inform selection of equipment for aeration system upgrades, including air piping, diffusers, aeration tank equipment, process, and SCADA controls.
- Identify a recommended scope of work, impacts to existing facilities and operations during construction, and approach for the subsequent detailed design phases.
- Provide a conceptual level plan and budget for proposed capital improvements.

This memorandum includes a summary of existing conditions, a description and analysis of viable blower technologies and layouts, and final recommendations for overall improvements to the aeration system at the WPCF.

The sections included in this technical memorandum are as follows:

- 1.0 Background and Purpose
- 2.0 Existing Facilities and Treatment Description
- 3.0 Design Criteria
- 4.0 Blower Technologies and Aeration Improvements
- 5.0 Other Considerations for Future Upgrades
- 6.0 Probable Total Project Cost

2.0 Existing Facilities and Treatment Description

Following primary treatment, clarified effluent from the primary settling tanks (PSTs) flows into the common AT influent channel and mixes with the return activated sludge (RAS) from the final settling tanks (FSTs) by means of five submersible channel mixers positioned along the channel. From the influent channel, the mixed liquor enters each of the five ATs through two 24-inch submerged influent sluice gates.

Each AT is relatively long and narrow, which promotes plug flow conditions. Each AT has one anaerobic zone, one anoxic zone, three oxic zones with diffused air, and an exhaust zone for internal mixed liquor recycle. Process air is delivered to the three oxic zones from aeration blowers, located in the basement of the adjacent secondary control building (SCB).

The mixed liquor from the ATs flows into the aeration effluent channel, then into the ATs effluent drop box, and continues downstream to the secondary lift station (SLS) wet well. From the wet well, the SLS has three pumps to convey mixed liquor to the secondary distribution chamber. The chamber splits the mixed liquor flow between the online FSTs. A return sludge pumping station (RSPS) with six RAS pumps and two waste activated sludge (WAS) pumps is located adjacent to the final settling tanks (FSTs). RAS is pumped to the AT influent channel, and WAS is pumped to the gravity belt thickeners (GBTs) at the SCB.

Figure 1 presents an aerial of the WPCF and identifies areas relevant to the aeration system.



Figure 1. WPCF Aerial

2.1 Aeration System Overview

The WPCF's aeration system consists of:

- Five (5) ATs
- Ten (10) 24-inch sluice gates (2 per tank)
- Five (5) influent channel submersible mixers
- Ten (10) internal mixed liquor return (IMLR) submersible propeller pumps (2 per tank)
- Twenty (20) 16-inch butterfly valves for IMLR pumps (4 per tank)
- Ten (10) anoxic/anaerobic submersible mixers (2 per tank)
- Three (3) multi-stage centrifugal (MSC) process air blowers located in the SCB
- Process air header piping from the SCB to the ATs
- Fifteen (15) DO analyzers (3 per tank)
- Fifteen (15) process air thermal mass flow meters (3 per tank)
- Fifteen (15) process air drop leg control valves (3 per tank)
- Fifteen (15) diffuser grids (3 per tank)

Each of the five ATs have three main zones; an initial anaerobic and anoxic zone followed by an aerobic (oxic) zone (grids A, B and C). There is a separate non-aerated (exhauster) zone located within the oxic zone in grid C. The aerobic zone is separated from the anaerobic, anoxic, and exhauster zones by baffle walls. To keep the solids suspended and well mixed, two submersible mixers are installed in each anoxic/anaerobic zone for a total of ten mixers (2 per tank). Refer to Figure 2 for the aeration process flow diagram (PFD).

Fine bubble aeration for the oxic zone is provided via three diffuser grids (grids A, B, and C). The air flow to the grid passes through ceramic (grids A and B) or membrane (grid C) diffusers, which create the fine bubbles. The number of aeration diffusers tapers from the initial aeration zone (grid A) to the last zone (grid C). Each grid of diffusers is designed to meet the DO requirements of a particular section of the tank's oxic zone.

A portion of the mixed liquor from the aeration zone flows over a weir into the exhauster zone, which has two IMLR pumps. The IMLR can be pumped to the beginning of the anaerobic (first) zone, anoxic (second) zone or both. Currently, the IMLR is pumped to the first zone of each AT to operate the system in Modified Ludzack-Ettinger (MLE) mode. Mixed liquor that is not recycled back to the head of the tanks flows over the weir at the end of the aerated region into the AT effluent channel for further treatment.

2.2 Blowers & Controls

Process air at the WPCF is supplied to the five ATs by three MSC blowers that were installed in 1988. The original blowers are model 22207A units manufactured by Hoffman with a design capacity of 6,500 scfm at a design discharge pressure of 7.5 psig and a maximum discharge pressure of 10.0 psig. Each blower is horizontally connected to a 300 HP, 3600 rpm, 2300 VAC, 3 phase motor with a service factor of 1.15. Since the original construction, the blowers at the WPCF have undergone various repairs and rebuilds to maintain operations. Typically, only one blower is required to operate to meet both average and peak process air demands.

Process air from the blowers is discharged into a common air header, and then distributed to the ATs through tank air headers. Once at the tanks, process air is further distributed via tank drop legs with control valves and flowmeters to each of the three oxic zones with fine bubble aeration grids (grids A, B, and C) in each AT.

2.2.1 Dissolved Oxygen Monitoring

A DO analyzer measures the DO concentration in each of the three oxic zones (grids A, B, and C) in each AT. The DO profile is typically set and maintained at 3.0, 2.0, and 1.0 part per million (ppm), Grids A, B, and C, respectively. The air flow control valves are 8, 6, and 4-inch butterfly valves (grids A, B, and C, respectively) with electric motor actuators.

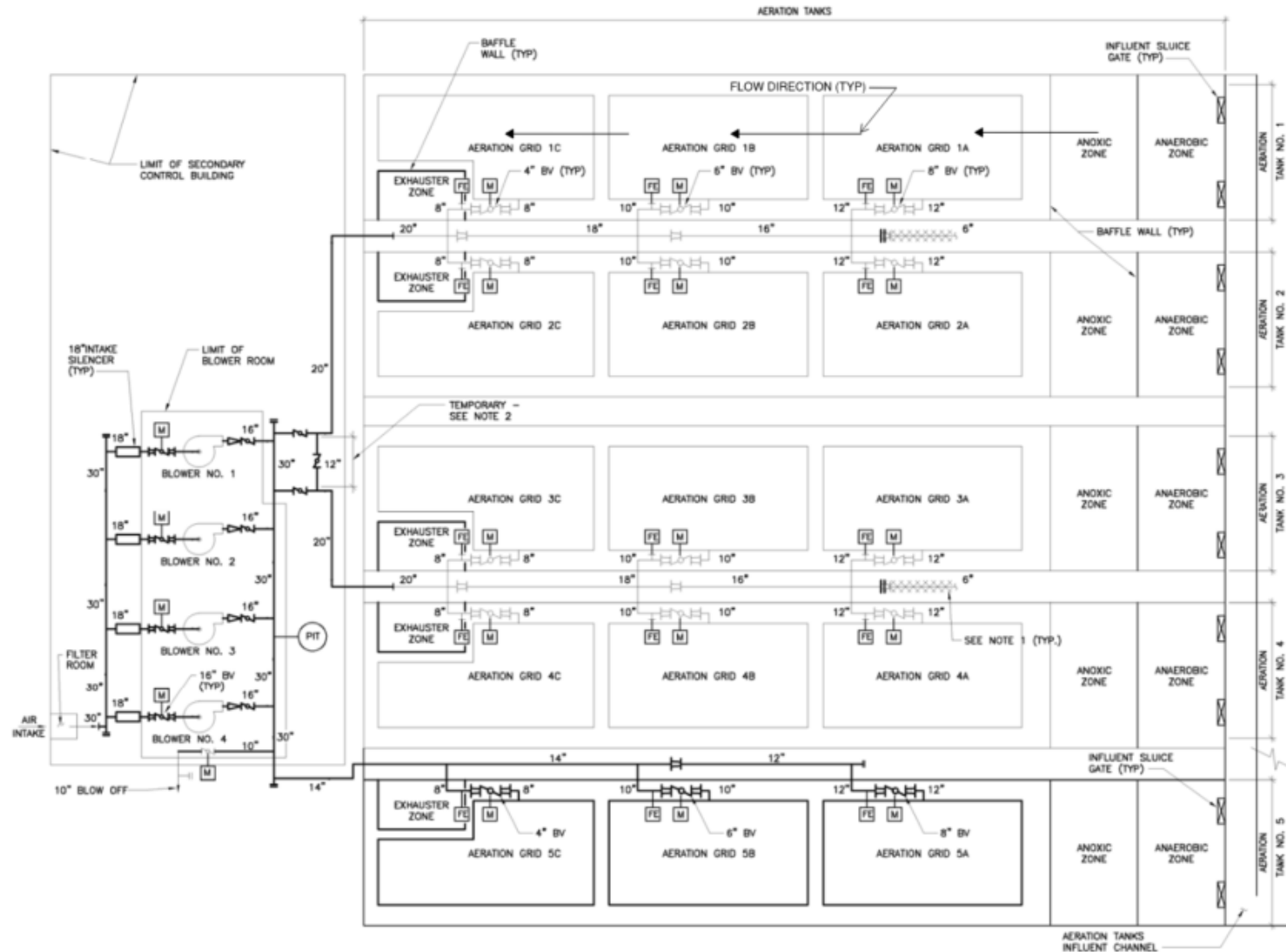


Figure 2. Aeration Process Flow Diagram

2.2.2 Air Flow Control Valves

Prior to the flow control valve on each drop leg pipe, the air flow rate is measured in a horizontal section of 8, 10, and 12-inch (grid C, B, and A, respectively) diameter drop pipe using a thermal mass flow meter.

As designed, the air flow control valves open or close as needed to maintain the required DO setpoint in each oxic zone. When the valves open and close, the air header pressure upstream of the tanks fluctuates and is recorded by a common air header pressure transducer. The process air blowers then adjust the discharge airflow rates as required to maintain an operator-entered common air header pressure setpoint.

3.0 Design Criteria

3.1 Process Air Demand Estimation

As summarized in Section 2.4 of the Facility Plan Update, a framework was developed to model summer and winter seasonal current and design conditions. The modeling considered the following operational scenarios for the plug flow biological nitrogen removal (BNR) evaluation:

1. All solids handling processes (GBTs and centrifuge) recycles, together with gravity thickener (GT) overflows, are being rerouted to the influent of PSTs to reflect future conditions. In addition, the GBTs are expected to have improved solids capture efficiency.
2. All five ATs remain in service.
3. IMLR rate between 200 – 400% of influent flows.
4. WAS rate is adjusted to meet solids retention time (SRT) targets, while RAS is maintained at 80% of influent flows.
5. DO profile in each oxic grid is maintained at:
 - a. Grid A: 3.0 mg/L
 - b. Grid B: 2.0 mg/L
 - c. Grid C: 1.0 mg/L (average conditions); 0.5 mg/L (minimum conditions)
6. The steady state modeled conditions (current and design) are:
 - a. Minimum month flows & loads at winter temperatures.
 - b. Average day flows & loads at average temperatures.
 - c. Maximum month flows & loads at summer temperatures.
 - d. Maximum month flows & loads at winter temperatures were also modeled to check for nitrification performance. This is a critical condition for verifying WPCF's ability to meet its permit requirements for ammonia and total nitrogen.

The modeling conditions reflect the WPCF's typical operational conditions and permitted flow of 18.0 MGD. The above model conditions serve as the basis for estimating the oxygen demand, required airflow range, and blower sizing under average loading and temperature conditions.

3.1.1 Oxygen Demand & Airflow Range

Oxygen demand and the corresponding process airflow requirements based off the modeled conditions are presented in Table 1. Using the oxygen demand data, the process air flow required for various conditions were determined based on specific site conditions at the WPCF. Correction factors for temperature, atmospheric pressure, DO, and wastewater characteristics were used to determine required air flow requirements. The correction factors, alpha (α) and beta (β), are critical when determining air flow requirements. In particular, the alpha factor is the most variable factor, which describes the effect of wastewater characteristics on oxygen transfer. The beta factor accounts for the differences in oxygen transfer between treated and untreated water.

To safeguard against potential peak loads of BOD and ammonia, the aeration system must be designed to handle current maximum monthly loading conditions. In addition, the blowers must have adequate turndown capability to meet the minimum conditions while also being optimized to meet average facility conditions. Accordingly, the model estimated low end (current minimum monthly conditions) and high end (permitted average daily conditions) oxygen demands were included in the blower sizing criteria. This accounts for a current minimum day safety factor of 0.60 and permitted flow maximum month safety factor of 1.33.

Table 1. Current and Design Oxygen Demand and Process Airflow Requirements

Conditions		Flows (MGD)	Wastewater Temperature (°C)	Oxygen Demand (lbs/day)	Process Airflow Required (scfm) ⁴
Current (2017 – 2022)	Min Day^{1,2}	8	12	9,300	3,100
	Min Month (30-Day)	9	12	11,800	4,000
	Average Day	12	18	16,900	6,400
	Max Month (30-Day)	16	24	22,400	9,000
Future (2030)	Average Day	13	18	17,900	6,700
	Max Month (30-Day)	17	24	23,500	9,400
Permit	Average Day	18	18	24,900	9,300
	Max Month (30-Day)³	24	24	33,000	13,200

¹Minimum Day Safety Factor (Min Day/ Average Day) = 0.60

²Minimum Day DO (mg/L) profile in the oxic zones (grids A, B, and C) modeled at 3, 2, and 0.5 respectively

³Maximum Month (30-Day) Safety Factor (Max 30-Day/ Average Day) = 1.33

⁴The Assumptions for Calculation of AOTE and Airflow:

- a. Alpha Value = 0.5
- b. Diffusers Fouling Factor = 1.0
- c. Beta Value = 0.95
- d. Site Elevation = 43
- e. Target DO Concentration = As detailed in Section 3.3
- f. Inlet Air Barometric Pressure = 14.68 psia
- g. Inlet Air Temperature = 25 - 100 °F
- h. Inlet Air Relative Humidity = 30 - 100%

3.1.2 Discharge Pressure Range

With the range of airflow requirements established, the discharge pressure requirements were evaluated. A comparison with the air flow requirements developed in the Norwalk WPCF Blower Design Criteria DRAFT (Arcadis 2017 - Task Order 1) indicated a similar range of air flows at average day and maximum month conditions. A blower discharge pressure range of 7.0 – 7.5 psi was used in this preliminary evaluation based on air hydraulics calculations developed in the previous Arcadis evaluation. As part of detailed design, system changes including relocation of blower(s) and replacement of the existing air headers and piping will be considered in the development of future hydraulic calculations to refine the blower discharge pressure limits.

Table 2 summarizes the recommended minimum, average, and maximum airflow requirements for evaluating process air blower sizing and selections. Based on discussions with the WPCA and Veolia, the WPCA's contract operator, blower turndown is a key requirement to target lower aeration rates towards the end of AToxic zone (grid C). Existing blowers are oversized with limited turndown capability, around 4,000 scfm. Accordingly, the minimum (min.) day air flow requirement was set at <2,000 scfm to select for blowers that, under future improved operation controls, can achieve lower airflow rates.

Table 2. Blower Sizing Summary

Condition	Process Air Flow Required (scfm)	Discharge Pressure (psi)
Min Day	<2,000	7.0 – 7.5
Min Month	4,000	
Average Day	6,700	
Max 30-Day	9,400	
Max Day	13,200	

3.2 Process Air Configuration Scenarios

To meet a wide range of seasonal and operational requirements, the blowers should be sized to handle peak loads and have adequate turndown capability to meet minimum conditions. Using the model estimated airflow requirements and turndown criteria noted above, two process air blower configurations were evaluated for the different scenarios to satisfy reasonable operating conditions and optimize blower operation, as shown in Table 3. The blower configuration scenarios took into consideration the operating range of each blower, turndown and spare capacity. For each option, the blowers are provided in multiple units and arranged to meet the maximum air demand with the single largest unit out of service. This corresponds to an N+1 configuration at maximum air demand.

Table 3. Blower Configuration Scenarios

Condition	Air Flow (scfm)	Option 1 – Three Large Blowers (2 Active/ 1 Standby)		Option 2 – Four Small Blowers (3 Active/ 1 Standby)	
		Blowers Online	Airflow/Blower (scfm)	Blowers Online	Airflow/Blower (scfm)
Min Day	<2,000	1	<2,000	1	<2,000
Min Month	4,000	1	4,000	2	4,000
Current Avg Day	~6,000	1	6,000	2	3,000
Future Avg Day	~7,000	2	3,500	2	3,500
Max 30-Day	9,400	2	4,700	3	4,700
Max Day	13,200	2	6,600	3	4,400

4.0 Blower Technologies and Aeration Improvements

Currently, the WPCF has three (3) MSC units installed and operating to maintain reliable process aeration. Based on the blowers capacity, age and condition, they are oversized, inefficient, and nearing the end of their useful life. Upgrading the blowers will provide improved DO control and process automation. In addition, upgrading the existing air piping, diffuser system, and implementing dropleg control will further optimize treatment processes.

4.1 Blower Technologies Considered

As part of the Arcadis 2017 – Task Order 1 efforts, the WPCA developed a master plan study of alternatives for selecting process air blowers. Based on that evaluation, further analysis using detailed process evaluation and modeling has been performed to further enhance blower sizing and selection.

Based on the blower capacities identified in Table 4, three different types of blowers were evaluated for replacing the existing MSC blowers, including:

1. High-Speed Direct Drive Centrifugal (Turbo) Blowers
2. Integrally Geared (Single-Stage) Centrifugal Blowers
3. Multi-Stage Centrifugal (MSC) Blowers

Another option for blower technology is positive displacement (PD) blowers. PD blowers offer simple technology and have adequate turndown capabilities (achievable with variable frequency drives (VFDs)) but are often used for installations that require smaller blowers and involve frequent on/off cycling. At Norwalk WPCF, the operating blowers will typically run continuously. PD blowers are generally less efficient and much noisier when compared to centrifugal blowers. Based on the process air needs at Norwalk WPCF, it was determined that PD blowers were not a viable alternative.

The subsections below provide an overview of these three centrifugal blower technologies.

4.1.1 Turbo Blowers

Turbo blowers are a newer technology using impellers that spin at speeds in excess of 20,000 revolutions per minute (rpm) and specialized, permanent magnet synchronous motors with VFDs for operating at these speeds. There are two types of turbo blowers distinguished by their bearing design. Air bearing turbo blowers utilize specially designed bearings, which levitate inside the bearing housing due to the creation of an air foil when operating at high speeds. Magnetic (Mag) bearing turbo blowers create an electromagnetic field around the bearing in order to levitate the bearing inside the bearing housing. Turbo blowers are more efficient because they reduce friction between the bearing and bearing housing. A cutaway of a typical turbo blower and associated air and mag bearing design is presented in Figure 3.

Benefits:

- High energy efficiency
- Wide operating range with high turndown capabilities
- Available in compact, sound attenuating enclosures
- Low maintenance
- Air bearing turbo blowers are cost competitive

Considerations:

- Higher degree of complexity, especially electronics and controls
- Not suitable for operating in severe conditions or operations requiring excessive start/stops
- Higher capital costs associated with magnetic bearing type



Figure 3. Typical Turbo Blowers Layout (LPR Global)

4.1.2 Single-Stage Centrifugal Blowers

Single-stage centrifugal blowers are similar to a centrifugal pump and use an impeller to compress air inside the blower housing. They utilize inlet guide vanes and discharge vanes to achieve blower turndown and regulate discharge pressure. A typical single-stage blower along with a cutaway showing the impeller and guide vanes is presented in Figure 4.

Benefits:

- Proven technology with numerous installations
- High energy efficiency
- Wide operating range with high turndown capabilities

Considerations:

- Higher capital costs
- Large footprint requirements
- More maintenance required (lubricating oil station, gear box and settings)
- Loud (w/o sound enclosures)

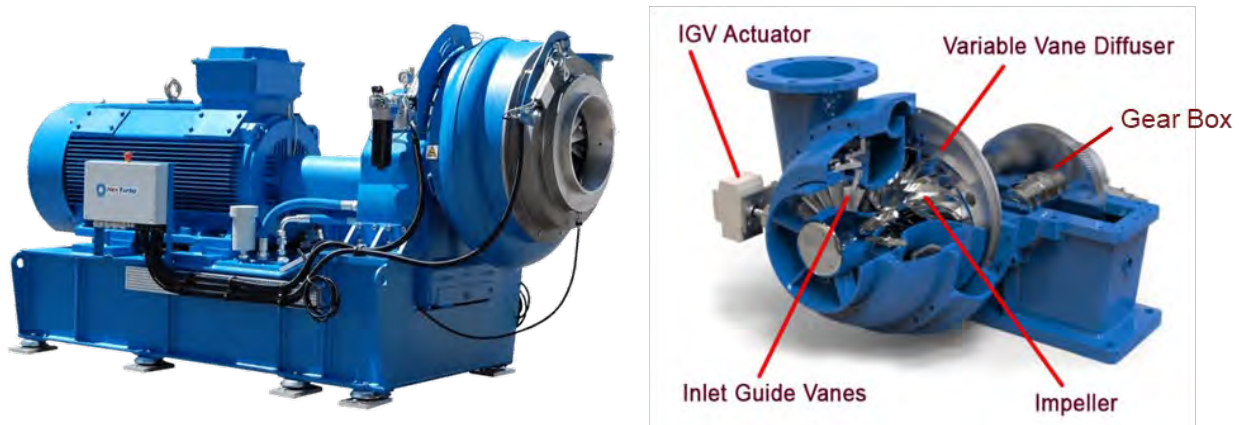


Figure 4. Single-Stage Centrifugal Blower (Next Turbo)

4.1.3 Multi-Stage Centrifugal Blowers

Multi-stage centrifugal blowers consist of multiple compression stages arranged in a series with each stage utilizing an impeller to compress air inside the blower housing. Some may utilize a combination of inlet guide vanes and/or discharge vanes to achieve blower turndown and regulate discharge pressure. Some manufacturers have begun pairing these blowers with VFDs to increase their operating range and cover multiple design points. A typical single-stage blower along with a cutaway is presented in Figure 5.

Benefits:

- Proven technology with numerous installations
- Reliable and durable
- Lower capital costs

Considerations:

- Limited turndown capabilities
- Lower energy efficiency

- Loud (w/o sound enclosures)

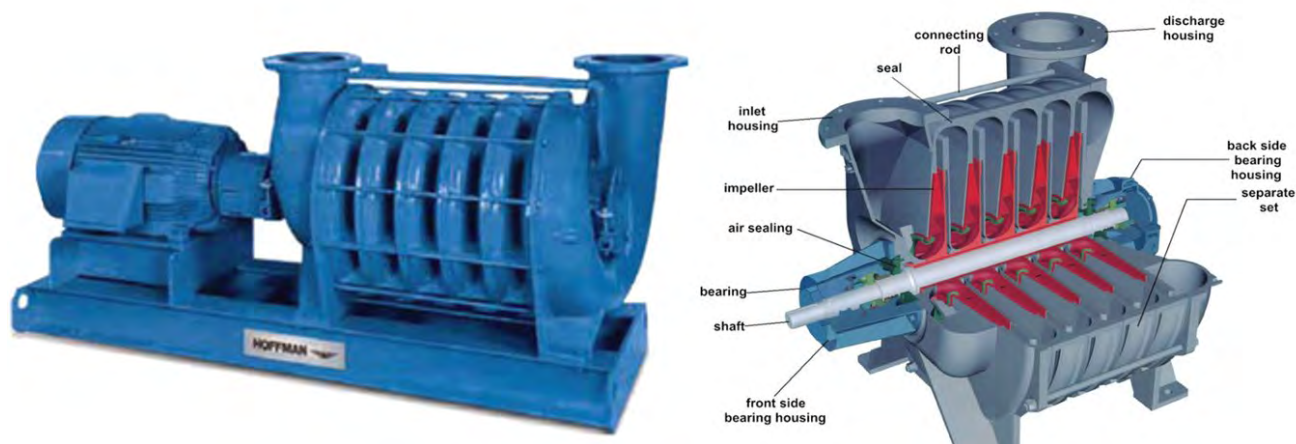


Figure 5. Multi-Stage Centrifugal Blower (Hoffman / Atlas-Copco)

4.2 Blower Layout and Conceptual Evaluation

A preliminary evaluation was conducted to compare the layout for different blower technologies and capacity ranges for blower enhancements at the WPCF. The following criteria for blower comparison were discussed with the WPCA and Veolia and established for selecting the recommended technology:

1. **Location Considerations:** Assess the impact of new blower placement on existing operations, construction sequencing (staging), construction costs, and resiliency planning. Prioritize locating the blowers within the existing SCB.
2. **Capacity Range / Redundancy:** Capacity of the new blowers to provide the required range of air flows with adequate turndown. Minimize the overall footprint requirements to have space available for installing additional blowers to meet future capacity needs.

4.2.1 Criteria 1 – Blowers Location Considerations

The existing blower room is on the lower level (basement) of the SCB and associated controls are located on the mezzanine level. Feasibility for installing new blowers within the SCB, assessments of the impacts on existing operations, and staging considerations are detailed herein. Any major expansion of the SCB or construction of a dedicated blower building was not evaluated as it is not feasible to extend the SCB or construct a new building without substantially increasing overall construction costs and complexity.

Based on the Resiliency Evaluation discussed in Section 5 of the Norwalk Facility Plan Update Report, the existing SCB structure is not located within the 100-year flood plain and thus no specific mitigation steps are required. However, the structure is located adjacent to the 500-year floodplain, therefore flood risk and resiliency were considered in assessing possible blower locations.

4.2.1.1 SCB Lower Level (Basement) Evaluation

The basement of the SCB is below the 100-year and 500-year base flood elevation (BFE). Furthermore, there is an existing subterranean access tunnel (-0.93 feet, NAVD88 Datum) that runs along AT No. 1 and connects the

basement level of SCB to the primary control building and PSTs sludge pump station. Therefore, if the blowers are to remain in the SCB basement, flood protection measures are recommended.

While installing the blowers in the basement may have some capital cost savings, it increases construction complexity, staging concerns, and makes a critical process more prone to future flooding events. At this time, it is not economically viable to floodproof the SCB at grade and sub-grade levels or floodproof the connecting subgrade access tunnel(s). As future flood risk rises due to sea level rise and increased precipitation, it is more prudent to evaluate options to place critical infrastructure, such as aeration blowers, above flood elevations.

Additionally, it is anticipated that room modifications would be required to install the blowers in the existing blower room to increase footprint and/or provide an unclassified space per NFPA 820 (2020).

Should the blowers be installed in a new location within the basement, a new room will need be constructed. This may impact existing equipment clearances and egress. In addition, reusing the existing blower room presents staging and plant operations concerns. Therefore, installation of the blowers in the basement level is not recommended.

4.2.1.2 SCB Upper Level(s)

The upper level(s) of SCB building are better protected against flooding risk and meet the resiliency planning criteria. It would also ease the staging process concerns by keeping all existing blowers operational, while aeration infrastructure is installed. New locations were identified and evaluated based on the existing use of spaces within the SCB. Considerations for the new space include feasibility for installing the blowers, degree of structural modification required, and ability to separate blower technology from other SCB processes while maintaining proper access and egress.

The old common area on the Mezzanine Level of SCB building met these criteria and was chosen for further evaluation, as shown in Figure 6. Initial structural evaluation indicates this location is feasible (with modifications, detailed in Section 5.1). Other considerations for building and support system improvements that would be required to convert the old common area into a blower room are detailed in Section 5.

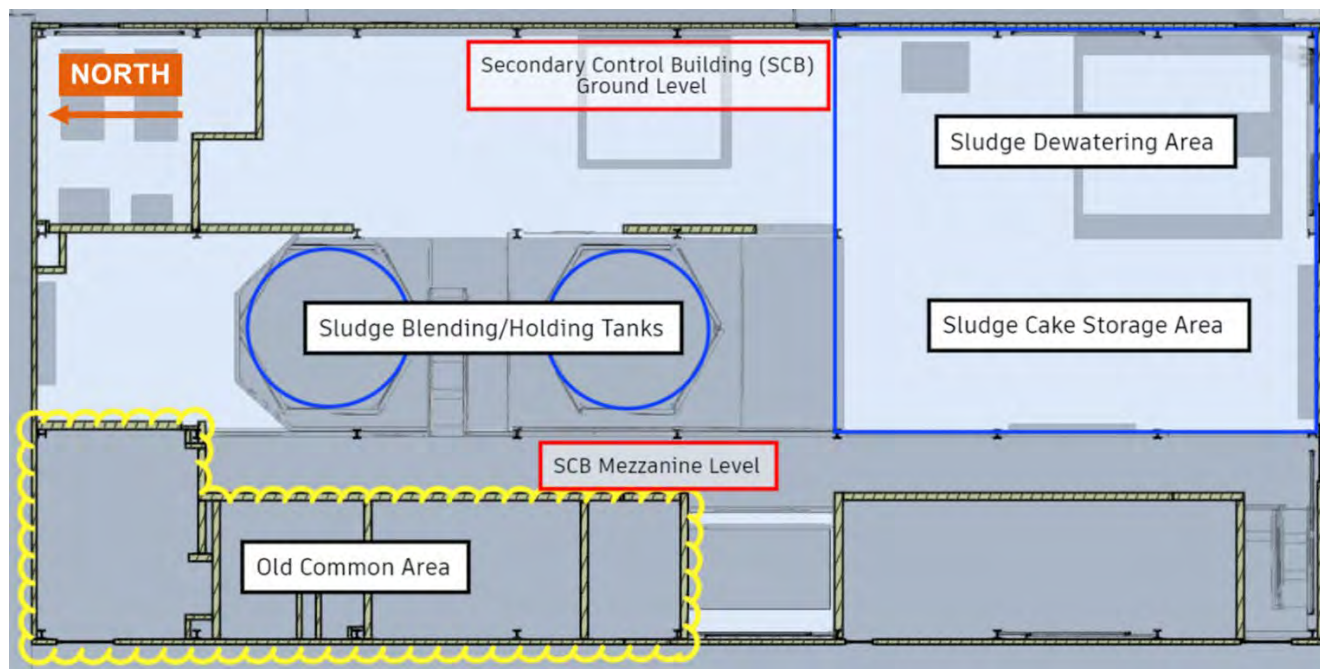


Figure 6. Old Common Area on SCB Mezzanine Level

4.2.2 Criteria 2 – Blower Capacity Range/ Redundancy

As detailed in Section 4.1, two N+1 blower configurations (3-blowers and 4-blowers) were evaluated utilizing the three blower types outlined in Section 4.2. The new blower selections were assessed based on their ability to satisfy all noted operating conditions and turndown potential. Adequate turndown is necessary to meet diurnal variations in flows and loads and supports the WPCA's energy efficiency goals. In addition, the blowers needed to be as compact as possible to locate them in the old common area with space available for installation of additional blowers to meet future peak capacity needs.

The blower manufacturers considered for the alternatives evaluation are summarized below. The blower proposals and technical data are included in Appendix AS-A.

- **Turbo:**
 - **Air Bearing Technology:** Aerzen, Gardner Denver Nash
 - **Mag Bearing Technology:** Atlas Copco, Sulzer
- **Single-Stage:** Howden Turbplex, Next Turbo,
- **Multi-Stage:** Howden Spencer, Gardner Denver Nash

The blower selection's ability to meet the requirements of capacity and redundancy are summarized in Table 4.

Table 4. Blower Selection Summary

Option 1 – 3 Blowers (2 Active/ 1 Standby)			
	Turbo	Single-Stage	Multi-Stage
Motor HP Range	300 – 350	300 – 350	300 – 350
Voltage Range	<480	<480	<480
Air Flow Range/ Blower, scfm (3,000 – 6,600)	3,100 ² – 7,000	3,000 ² – 7,500	2,200 – 5,200 ²
Maximum Footprint/ Blower ¹ , ft x ft	10 X 5	17 X 7	14 X 5
Space Available for Future 4 th Blower	Yes	N/A	No
Option 2 – 4 Blowers (3 Active/ 1 Standby)			
	Turbo	Single-Stage	Multi-Stage
Motor HP Range	200 – 250	200	250
Voltage Range	<480	<480	<480
Air Flow Range/ Blower, scfm (3,000 – 4,400)	1,800 – 4,200 ²	2,000 – 4,400	2,500 ² – 4,400
Maximum Footprint/ Blower ¹ , ft x ft	8 X 6	14 X 6	12 X 5
Space Available for Future 5 th Blower	Yes	No	No

¹ Maximum Footprint/Blower is based on the largest size option for each blower type provided by the manufacturer.

² Flow Numbers (scfm) shown in RED indicate the min/max air flow limits for the blower technology option.

4.2.2.1 Option 1 – 3 Blowers (2 Active / 1 Standby)

- All blowers evaluated under this option operate at a higher HP range (> 300 HP) and have a larger footprint.
- Both single-stage and turbo blowers have a turndown threshold of approximately 3,000 scfm, and can cover the entire operating range. In comparison, multi-stage blowers have a capacity gap. As noted in Section 3, multi-stage blowers have limited capacity to turndown below the current minimum monthly air demand which limits future changes to aeration control strategy.
- Although three (3) single-stage blowers are adequate to meet the range of air flow needs, they have the largest footprint needs and leave no additional space for ancillary equipment or future modifications.
- Under this option, only turbo blowers are compact enough to fit in the old common area and have space available for a future 4th blower.

4.2.2.2 Option 2 – 4 Blowers (3 Active / 1 Standby)

- All blowers evaluated under this option operate at a lower HP range (<250 HP) and have a smaller footprint compared to the three (3) blowers considered in Option 1.

- All blowers have relatively good turndown capability and are better optimized for diurnal variations in flows and loads.
- Both single-stage and multi-stage blowers would be able to cover the entire operating range, while turbo blowers have a capacity threshold of approximately 4,200 scfm.
- Like Option 1, for single-stage and multi-stage blowers, only three (3) blowers can be installed with no space left for adding a future blower, ancillary equipment or any other modifications.
- Only turbo blowers are compact enough to fit in the old common area with space available for a future 5th blower. This 5th turbo blower will help meet the peak capacity needs at future conditions.

4.2.3 Alternatives Analysis Conclusion

Based on the preliminary evaluation of process aeration blowers, the following conceptual design is recommended:

- **Technology:** Turbo
- **Location:** Mezzanine level
- **Number/Capacity:** 4 Blowers (3 active / 1 standby) with air flow range of approximately 1,800 scfm to 4,200 scfm per blower and space available for future blower addition.

Turbo blowers have a greater turndown capability and a smaller footprint while remaining cost effective. Single-stage centrifugal blowers have been eliminated due to their high capital costs and space requirements. While multi-stage centrifugal blowers are favorable from a capital cost standpoint, their lower turndown capabilities will result in greater energy consumption due to potential over-aeration issues. Accordingly, the turbo blower option was the selected blower technology option for detailed design.

Installing the new blowers on the upper level(s) of the SCB mezzanine level old common area makes the process more resilient, provides greater separation from other process areas and a corrosive environment, and allows for simplified staging of the system upgrade construction.

The capital costs are generally lower for installing three (3) blowers compared to four (4) blowers. However, operating more of the lower HP range blowers to cover the entire air flow range, could result in additional energy savings associated with achieving greater overall turndown. Accordingly, a four (4) blower configuration (3 Active/ 1 Standby) with adequate turndown capability to meet current and future conditions, with space for a future fifth (5th) blower is the chosen alternative for design.

A conceptual layout for the selected alternative is shown in Figure 7. The arrangement also depicts a future 5th blower. This turbo blower layout is based on Aerzen USA Corporation (Model AT200 G5plus) which satisfied the requirements of Option 2 (as detailed in Table 6). It should be noted that other turbo blower manufacturers also meet the general requirements of Option 2. A competitive selection process involving review of performance efficiency, turndown, layout flexibility, and operation and maintenance (O&M) considerations will be performed during the detailed design process to make a final determination on the specific type of turbo blower best suited for the facility.

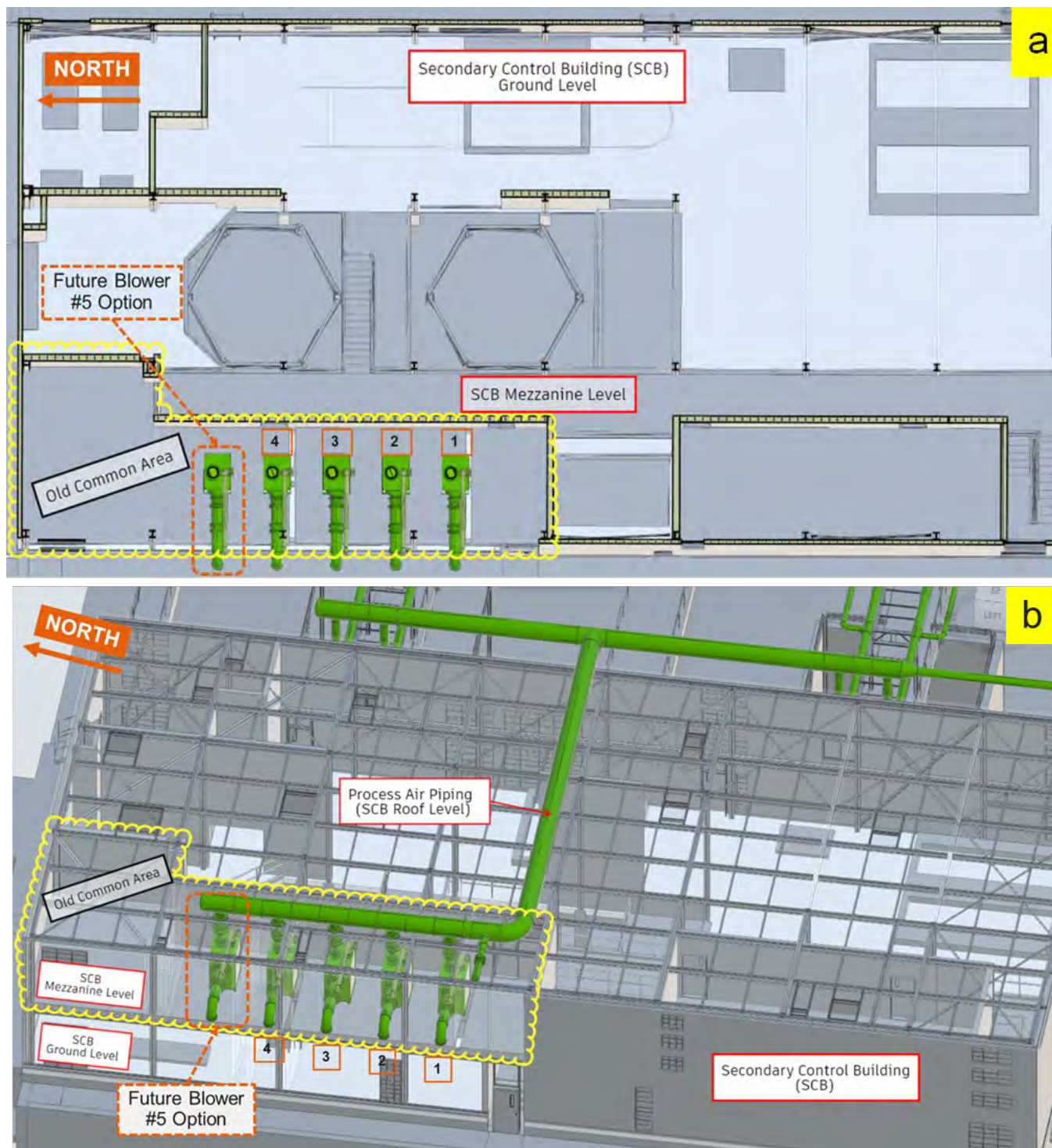


Figure 7. Conceptual Layout of 4 Turbo Blowers with Future 5th Blower. (a) Plan View; (b) Isometric View

4.3 Other Aeration Improvements

This section details enhancements to other aspects of aeration system, including air piping and diffusers, and control strategies to support the operation of new blowers. Selected proposals and technical data for mixers, pumps, diffusers, controls are included in Appendix AS-B.

4.3.1 Aeration Tanks

A thorough condition assessment of all the AT structures, interior baffle walls, influent sluice gates, equipment and pipe supports is recommended during the design phase. Any structural specific repairs required for concrete and steel, and replacement of baffle walls, influent gates and other supports will be evaluated and quantified during detailed design. The replacement or enhancement of existing DO probes and transmitters as well as additional DO probes will also be evaluated at this time.

To better facilitate overall process operations and nitrogen removal performance goals, Veolia is currently installing the following instrumentation in the ATs:

- Ammonia and nitrate probes/transmitters in the oxic zones of each AT to monitor nitrification.
- Oxidation-reduction potential (ORP) probes/transmitters in anoxic zones of each AT to monitor denitrification, and adjust end zone aeration to prevent excess DO carryover.

4.3.2 Mixers

4.3.2.1 AT Influent Channel Mixers

Five (5) submersible mixers are located in the AT influent channel. Each channel mixer is rated at 4 HP (480 VAC, 3 phase) and powered by a constant speed motor starter located in an MCC. The channel mixers were upgraded in 2009-2010 timeframe and replacement with newer adaptive mixers with variable speed motors is proposed.

4.3.2.2 AT Zone Mixers

Two (2) submersible mixers are installed in each anoxic/anaerobic zone for a total of ten (10) mixers. Five (5) submersible adaptive mixers (3-Blade, 23-inch), rated at 2 HP (480 VAC, 3 phase) each, are installed in the anaerobic zone of each AT. Five (5) submersible adaptive mixers (3-Blade, 55-inch), rated at 1.5 HP (480 VAC, 3 phase) each, are installed in the anoxic zone of each AT.

All zone mixers are powered by a variable speed motor starter located in an MCC. The mixers are typically operated at constant speed but have the ability to adapt to changes in mixing requirements with the variable speed motor. All zone mixers were replaced in 2018-2019. The condition and performance of the mixers will be evaluated during the detailed design phase and recommendations on continued use or replacement will be proposed.

4.3.3 IMLR Pumps

Two (2) 4.0 HP submersible propeller type IMLR pumps are located at the end of Zone C in each AT. Each IMLR pump had an original rated capacity of 2,500 gpm (3.6 MGD) for a total maximum recycle capacity of 36 MGD. In 2008, to improve the nitrogen removal performance, the propellers on the IMLR pumps were upgraded to an 11-degree pitch to replace the 5-degree pitch propellers. This enhancement increased the capacity of each IMLR pump to about 3,600 gpm (5.2 MGD) for a total maximum recycle capacity of 52 MGD or approximately 425% of current average flows (12.2 MGD) or approximately 300% of the permitted flows (18 MGD).

The pumps were originally connected to variable speed drives (VFDs), which have been replaced with constant speed motor starters. The IMLR pumps were replaced again in 2018-2019 and currently run at full speed to maximize denitrification. Recycle capacity and the ability to vary the flow to optimize the nitrogen removal performance at the facility using VFDs will be reviewed in the detailed design process. Replacement of all existing piping and associated butterfly valves used for pumping IMLR flow to the anoxic and or anaerobic zones is also proposed.

4.3.4 Aeration Diffusers

Diffused aeration systems in plug-flow ATs are typically designed for tapered aeration, as the spatial distribution of oxygen demand will vary diurnally and daily depending on the flow and load patterns. Hence, the first diffuser zone (grid A), has the greatest diffuser density. For the last zone (grid C), the diffuser count is often dictated by the required mixing energy rather than oxygen transfer requirements. The diffuser grid must be sized to meet the minimum mixing requirements for a given zone (0.05 - 0.09 scfm/ft², WEF MOP8). However, each diffuser requires a minimum amount of air flow rate to keep the pores opened at a minimum mixing air requirement, which may be greater than the actual oxygen needed in that zone at minimum conditions. Under those conditions, the zone will be over-aerated, and operating at low-DO to may not be feasible.

It is recommended that the diffused aeration system in the aeration basins are replaced, given the age and the combination of ceramic (grids A and B) or membrane (grid C) diffusers in use. New diffusers will be sized to provide ample oxygen to the activated sludge system under current and future loading conditions. In addition, these diffusers will be arranged to provide flexibility to operate at lower aeration rates in grid C. This would help the system to optimize aeration supply for diurnal variations in flows and loads and allow the WPCF to implement ammonia-based aeration control (ABAC) if desired in the future.

Two different types of aeration diffusers were evaluated for replacing the existing diffusers, including:

- Fine bubble membrane disc type diffusers
- Fine bubble membrane tube type diffusers

Additionally, there are fine bubble panel type diffusers that utilize a porous membrane with a small opening attached to panels. Although they have similar advantages to tube type diffusers, they require a higher percentage floor coverage area, which makes cleaning and maintenance more difficult. Fine bubble membrane panel type diffusers have been eliminated based on high capital cost and the inherent potential for grit to deposit on top of the flat panel mounted directly to the floor of the tank.

4.3.4.1 Fine Bubble Membrane Disc Type Diffusers

Fine bubble membrane disc type diffusers utilize porous membranes with small openings attached to disc shaped diffuser holders. Air is forced through these openings to create fine bubbles. A main drop leg and feed pipe

supplies air to each pass of disc diffusers, which connect to various distribution headers. The disc diffusers sit on top of the distribution headers.

Benefits:

- Proven technology with a long track record of success
- Lower head loss across diffusers
- Numerous manufactures make similar disc type diffusers which makes this option cost competitive
- Lower floor coverage area, which eases cleaning and maintenance

Considerations:

- Diffusers sit higher from the tank floor than other types of diffuser equipment, which reduces Oxygen transfer efficiency (OTE)
- Higher air flow rate required to meet actual oxygen requirements (AOR)

4.3.4.2 Fine Bubble Membrane Tube Type Diffusers

Fine bubble membrane tube type diffusers utilize porous membranes with small openings attached to tube shaped diffuser holders. Air is forced through these openings to create fine bubbles. A main drop leg and feed pipe feeds air to each pass of tube diffusers, which connect to various distribution headers. The tube diffusers connect to the side of the distribution headers.

Benefits:

- Higher OTE
- Diffusers sit lower to the tank floor than other types of diffuser equipment, which increases OTE.
- Lower air flow rate required to meet AORs
- Lower overall costs

Considerations:

- Higher head loss across diffusers

4.3.4.3 Recommendations

Based on the diffuser equipment evaluated, fine bubble membrane disc type diffusers are recommended. These diffusers have lower head loss requirements, work more efficiently over a wide range of airflows, and are favorable from a capital cost standpoint. In addition, plant operations are familiar with this type of equipment since disc type diffusers are currently installed in the ATs.

4.3.5 Process Air Layout and Controls

The process air system piping will be upgraded to improve operability, enhance DO control, and aid with construction sequencing.

4.3.5.1 Process Air Layout Modifications

The existing common discharge headers for ATs 1 to 4 are within the Y-walls between the tanks. Under normal operations, the facility can take one AT offline for repairs and maintenance. To facilitate construction staging and improve accessibility, new air piping will be installed above the ATs, atop existing conduit structures. Initial

structural evaluation indicates this is feasible (with modifications, detailed in Section 5.1). In addition, the common air header between ATs will be split into dedicated air headers with motor-actuated butterfly valves to isolate airflow to each AT to provide redundancy.

Process Air Controls Modifications

Recommended control modifications for the process air system are summarized below:

- Replace existing thermal mass flowmeters on each aeration lateral header with inline venturi meters for more precise air flow monitoring.
- Replace motor-actuated, modulating high efficiency butterfly valves on each drop leg, with remote operating capability to adjust airflow distribution based on the DO reading in each grid.
- Evaluate during detailed design additional drop leg isolation controls and diffuser grid arrangements with blanks in Zone C for operating at low-DO conditions.

5.0 Other Considerations for Improvements

In addition to installing new blowers and associated air system improvements, there are other recommended building improvements to upgrade the SCB and to ensure longevity of the aeration support systems. The Old Common Area and the AT overhead conduit support structure will require upgrades to accommodate new blowers and air piping. In addition, many of the building support systems including electrical equipment, HVAC equipment, and instrumentation and controls (I&C) are beyond their useful life and need to be modernized.

This section discusses other considerations for building and system improvements broken down by discipline – Structural, Architectural, Electrical, HVAC, I&C.

5.1 Structural

New blowers are proposed at the mezzanine level on the north-west corner of SCB in the old common area. In addition, a new route of process air piping is proposed over the existing roof and above the newly built conduit supports over 'Y' walls of the ATs. The existing roof over these areas must be raised to provide adequate clearance.

A review of the existing 'as built' structural drawings was performed. These drawings were prepared by Albertson, Sharp and Backus of Norwalk, CT, dated 1976. The existing sub-structure consists of concrete walls on pile cap. Per available as-built drawings, piles were designed for 30-ton (60 Kip) capacity. Presently, the SCB mezzanine level - old common area is used for lockers, washroom, and laundry. The SCB ground level under old common area houses electrical switchgear and I&C panels, while the basement area is clear.

Structural modification requirements for housing the new blowers and air piping in the SCB and ATs are detailed below.

New Blower Room

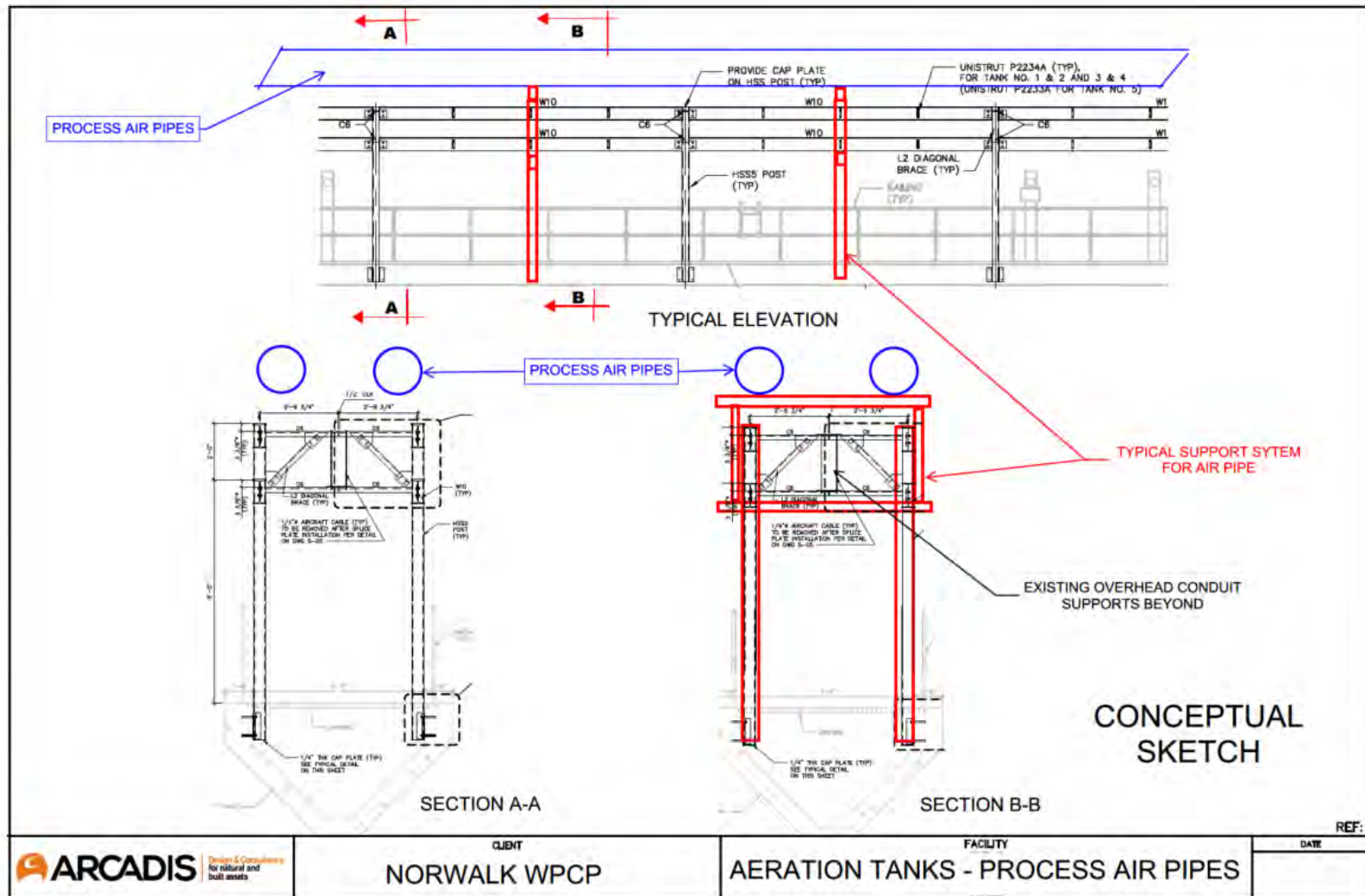
- Part of existing roof will be replaced with new raised pre-engineered metal building.
- Existing mezzanine floor will be strengthened to support loading from new blowers.
- Existing steel columns will be reviewed and strengthened as needed.
- A preliminary analysis of the existing building pile system indicated the proposed changes are acceptable without modification to the existing sub-structure.

Process Air Piping

- Proposed new air pipe from blowers will supply air to existing ATs.
- Proposed air pipe will run on top of the conduit support system near each AT.
- Internal pipe supports will be spaced 20 feet apart at the middle of existing conduit supports.
- As the column lines for both pipe supports and conduit supports are in line, a cross beam will be provided to shift pipe support columns outside.
- At new columns base in Y walls, concrete will be placed to distribute loads on stem of wall.
- A conceptual sketch of the structural modifications proposal for process air piping over ATs is shown in Figure 8.

In addition to modifying the SCB and ATs to accommodate the new equipment, the following design and construction activities are recommended during detailed design:

- Structural analysis to determine the effects of adding new blower equipment on the existing piles.
- Strength tests and petrography of concrete core samples to further understand the condition of existing concrete.
- Detailed visual assessment of all concrete surfaces to quantify and assess necessary repairs.
- Inspection, repair, and painting of structural steel frames supporting the roof.



5.2 Architectural

To accommodate equipment replacement, changes to the SCB layout are anticipated. As shown in Figure 6, the SCB houses sludge blending/holding tanks (in the northern section) and sludge dewatering and cake storage area (in the southern section). The sludge blending/holding tanks area is currently classified as a Class 1 Division 2 location per NFPA 820 (2020). The adjacent sludge dewatering area is currently an unclassified space. However, there is no distinct separation (i.e. airlock) between the two areas on the SCB ground level, and there are multiple access/egress points between all levels of the SCB. Accordingly, the entire SCB area, including the Old Common Area will be classified as either Class 1 Division 2 or Unclassified, with the final classification division dependent on the level of ventilation and proper separation of the areas.

It is recommended that the existing Old Common Area with new blowers, and all existing/future electrical and control rooms, be completely separated from the process areas to locate blowers in an unclassified space (in accordance with NPFA 820). Separate entrance(s) to the new blower room and existing electrical and I&C rooms can be provided on the west side and/or north side of the SCB. Existing entrance(s) to these spaces from within the SCB will be closed off permanently, or some other means of keeping spaces separate would have to be designed and implemented such as a ventilated (pressurized) airlock. The overall building layout and modifications will be discussed and further developed during detailed design.

In addition to modifying the building layout to accommodate the new process, the following design and construction activities are recommended:

- Perform code review and detailed architectural condition assessment of the SCB.
- Install new concrete walls and/or airlocks to separate classified and unclassified spaces (including the SCB Control Room).
- Repair or replace door hardware, as necessary.
- Upgrade or replace building signage in accordance with plant standards.
- Repair windows, building façade, and roof, as necessary.

5.3 HVAC

The SCB includes a hot water heating system consisting of boilers and pumps that supply hot water to heating and ventilating equipment throughout the building. The boilers are fuel oil fired and receive fuel oil from an underground fiberglass tank at the north side of the building on the other side of the road. The fuel oil pumps are located in the basement. Roof and space-mounted heating, ventilation, and air conditioning equipment serve the building. The heating and ventilation units are built up units with hot water heating coils that provide the process area with 100% outdoor ventilation air. The air conditioning equipment are a combination of direct expansion packaged roof top units and split system units. Exhaust fans for removing air from the building are located on the roof.

As part of the Arcadis 2017 – Task Order 1 efforts, a detailed condition assessment of the SCB was developed, and included the following evaluation:

- HVAC systems were in poor condition and require replacement.

- The odor control system, most air handling units, and fans were not operational. The building had insufficient ventilation and no odorous air capture.
- It was recommended that the heating, ventilation, and odor control systems be restored to minimize building and equipment corrosion and to improve the building atmosphere.

During the 2021 SCB dewatering upgrades, heating, ventilation, and odor control systems were upgraded. The two-sludge blending/holding tanks in the north section of SCB have a dedicated odor control system that provides 12 air changes per hour (ACHs). As per NFPA 820 (2020), the tanks and surrounding space is classified as a Class 1 division 2 locations. The sludge dewatering area in the south section of SCB also has a dedicated odor control system that provided 6 ACHs, which make it an unclassified space as per NFPA 820 (2020).

As detailed in Section 5.2, the SCB classified and unclassified area are not separated via ventilated (pressurized) airlock. The old common area with the new blowers and all existing/future electrical and control rooms will need to be separated from rest of the SCB area, to remain unclassified spaces in accordance with NFPA 820. The HVAC system and other ventilation requirements will be re-evaluated during detailed design process.

5.4 Electrical

The SCB electrical distribution consists of multiple motor control centers (MCCs) but most of the loads are powered by MV-MCC#3, MCC-SCB and MCC-BNR. The three MCCs have the following ratings:

- MV-MCC#3 is a 2.4KV motor control center dedicated to powering the 3 existing 300 HP blowers and is in Motor Control Center Room B at Elevation 28.00. This MCC was installed in the 1970's and is in fair condition but the technology is aging and outdated.
- MCC-BNR is a 480V MCC located in Electrical Room #1 at Elevation 17.25. This MCC was installed in 1996 and is in good condition. This MCC provides power to the equipment located at the ATs.
- MCC-SCB is a 480V MCC located in the Electrical Room #2 at Elevation 17.25. This MCC was installed in 1996 and is in good condition. This MCC provides power to most of the equipment located in the SCB.

As discussed in Section 4, when the existing blowers are replaced, it is anticipated that the new blowers will be powered by a 480-volts switchgear instead of the existing 2.4KV. Therefore, the existing 2.4KV switchgear will be decommissioned. The existing 2.4KV feeders presently used to feed the existing switchgear may be re-used and stepped down to 480 volts to feed the new switchgear via 2.4KV-480V transformers. Ideally this new switchgear will be installed in the existing electrical room. The final location of the transformers will be determined during detailed design. New conduit and wire will also be provided within the SCB. Electrical provisions for future blowers will be reviewed and coordinated.

MCC staging and modification requirements include:

- For the installation of new switchgear, transformers, and demolition of existing MV-MCC#3 (2.4KV) gear to be executed, staging will need to be further considered to keep existing blowers operational during replacement. This staging will be developed during detailed design
- Only minor modifications are expected to the MCC-BNR (mixers at existing tanks to be replaced in kind) and it is therefore recommended to re-use this MCC and modify as needed.
- MCC-SCB is not expected to have any modifications as part of this upgrade and is recommended to remain as is.

- Additional existing equipment such as low voltage transformers and panelboard may be removed and replaced. This determination will occur during the detailed design.
- The existing lighting is in poor condition. Therefore, it is recommended that all existing lighting in the building be replaced with energy efficient LED lighting.

5.5 I&C

The existing secondary control building control panel (SCBCP) in the SCB control room, which controls the existing aeration system and other field equipment and processes in the building, is over 25 years old and contains obsolete programmable logic controller (PLC) components and accessories. Therefore, a new PLC control panel will be furnished to replace the existing SCBCP. Given the footprint of the existing Control Room, the new control panel can be constructed while the existing SCBCP remains active, minimizing operational impacts during this upgrade. As noted in Section 5.2, the provision of an airlock or dedicated Control Room access will be reviewed and coordinated during detailed design.

The new aeration system will consist of four blowers each equipped with a dedicated local control panel, as well as a master control panel (MCP), as part of a vendor-packaged system. The master control panel will include a PLC and a panel-mounted operator interface terminal (OIT). The master control panel PLC will support Ethernet/IP communication protocol, either natively or via a local protocol converter module, and will communicate directly with the plant SCADA system to provide plant operation staff with remote monitoring and control capability for the blower system. In addition to direct network communication between new MCP PLC and the plant SCADA system, some critical signals (e.g. permissives, hard interlocks, and critical alarms) will be communicated via hardwired I/O interface between the vendor PLCs and the new SCBCP.

A new secondary control building Network Interface Panel (SCBNIP) will be furnished to house the fiber and copper Ethernet communication devices currently residing inside the SCBCP and will be installed on the western interior wall (behind the existing SCBCP). The new vendor-supplied blower MCP will be connected to the plant SCADA network via Category 6 (CAT6) Ethernet connection between its local Ethernet switch and the new SCBNIP. A new Ethernet switch will be furnished and installed inside SCBNIP to support the required Ethernet connections for the existing “dewatering control panel” and “polymer control panel”.

It is also recommended that a new SCADA operator workstation be furnished inside the SCB control room. This workstation will provide access to the SCADA screens for the entire plant. This computer will communicate with the SCADA network via CAT6 Ethernet connection to the new Ethernet switch inside SCBNIP. The plant SCADA system HMI application will be modified to incorporate graphical interface for the new aeration blower system and other equipment upgraded under the improvements.

Additional Modifications to Existing I&C System

The existing SCBCP will operate in parallel with the new blower MCP during testing and commissioning of the new aeration blower system and will be switched over one AT at a time. The control logic for the aeration blower system will also be moved to the new MCP accordingly. All other secondary treatment and dewatering/thickening field equipment currently hardwired to the existing SCBCP will be disconnected and connected to the new SCBCP via new field wiring.

The switchover of all field equipment from existing to new SCBCP will take place sequentially, while running both control panels in parallel, to minimize impact to plant's operation. Once all field equipment and systems currently

connected to the existing SCBCP are successfully switched over to the new SCBCP and blower MCP and commissioned, this control panel will be decommissioned and demolished.

The two existing older polymer feed system control panels are not being used and it is recommended they be demolished. It is recommended that the polymer system control panel currently serving GBTs and Centrifuges, and the gravity belt thickener (GBT) control panel located in the sludge dewatering process area be moved to the non-corrosive environment of the control room.

6.0 Probable Total Project Cost

A preliminary total project cost estimate was developed as a part of this evaluation and includes an opinion of probable construction cost (OPCC) for the selected alternatives described in Section 4.2 and other recommended upgrades described in Section 4.3 and Section 5.0.

The costs presented herein are considered a preliminary estimate for engineering feasibility/planning purposes only. The construction cost estimate is consistent with a Class 4 estimate as defined by the Association for the Advancement of Cost Engineering (AACE) International. The guidelines for Class 4 estimate per AACE indicate the estimate is typically used for feasibility studies and carries an expected range of accuracy of -30% to + 50%, with approximately 1% to 15% project definition. The OPCC for aeration system upgrades as a point estimate is \$40,000,000. A breakdown of the OPCC can be found in Appendix AS-C.

In addition to the construction cost, an engineering and contingency addition of 15-20% is projected, or a total additional cost of approximately \$8,000,000 for a probable total project cost of \$48,000,000.

Appendix AS-A

Aeration Blower Selections

1. **Turbo:**
 - a. **Air Bearing Technology:** Aerzen, Gardner Denver Nash
 - b. **Mag Bearing Technology:** Atlas Copco, Sulzer
2. **Single-Stage:** Howden Turblex, Next Turbo,
3. **Multi-Stage:** Howden Spencer, Gardner Denver Nash

TURBO BLOWERS



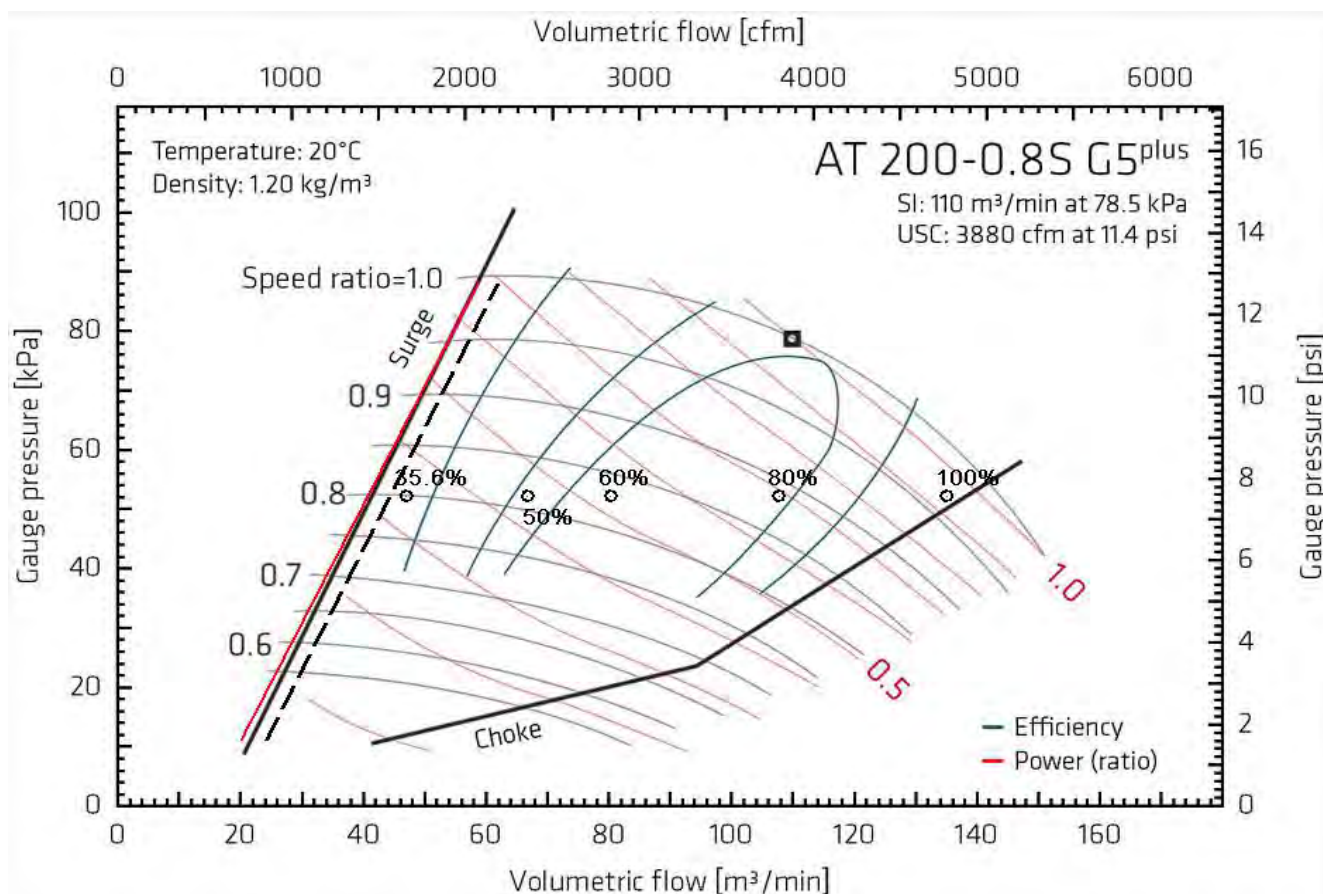
Turbo Option 3 + 1

Performance Data (Per Blower):

Volume, handled at intake condition
 Volume handled at normal condition
 Relative humidity
 Intake pressure (abs.)
 Pressure difference
 Intake temperature
 Discharge temperature
 Rotor speed
 Power consumption at shaft
 Unit Power
 Tolerance on flow
 Tolerance on power
 motor rating
 Sound pressure level w/ enclosure
 measured in free field at 3ft. distance from

AT 200-0.8S G5

	100%	80%	60%	50%	36%
icfm	4890	3912	2934	2445	1741
scfm	4400	3520	2640	2200	1565
%	80	80	80	80	80
psia	14.68	14.68	14.68	14.680	14.680
psig	7.5	7.5	7.5	7.5	7.5
°F	100	100	100	100	100
°F	196	187	185	189	198
rpm	25913	23716	22106	21610	21210
BHP	193	140	103	88	70
kW	170.3	123.3	90.6	77.8	61.7
± 5%					
± 5%					
Hp	200				
dB(A)	80				



AERZEN USA CORPORATION
108 Independence Way
Coatesville, PA 19320
Tel. (610) 380-0244 ~ Fax. (610) 380-0278



AERZEN Reference Number: ENV-346825.R1
Re: Norwalk, CT WPCF

21-Mar-23

Page 4 of 4

To Udayarka Karra Firm - Arcadis e-mail - Udayarka.Karra@arcadis.com phone - (860) 503-1462
AERZEN Representative Info: Name - Chris Shea of Aqua Solutions e-mail - cshea@aquasolutionsinc.net phone - (617) 923-3900

AERZEN Proposal Prepared By: Name - Dan Tavares e-mail - Daniel.Tavares@aerzen.com phone - (484) 784-9077
AERZEN Regional Manager: Name - Scott Trail e-mail - scott.trail@aerzen.com phone - (484) 678-6578

Turbo Option 3 + 1

AT 200-0.8S G5

Aerzen High Speed Centrifugal Blower Package consisting of the following components:

- Twin impeller turbo blower
- Ducted Inlet, flange connection
- Bump air foil bearings
- High speed PM motor
- Inverter
- Sound Enclosure
- PM motor cooling system
- Blow Off Valve
- Internal BOV sound silencer
- Integrated Enclosure Air Filtration system
- CPU
- LCP (MICOM control, Touch Screen)
- Protocol Convertor, Ethernet I/P
- Set of necessary sensors (temp and pressure)
- 12 INCH Bellows style flexible joint, discharge

Scope of Supply

- (4) Compact blower package(s) as listed above
- (4) Nema 1 enclosed passive harmonic filter(s) (ships loose to be installed by others)
- (4) 12 INCH check valve(s) (ships loose to be installed by others)
- (4) 12 INCH discharge isolation valve(s) (ships loose to be installed by others)
- (4) 16 INCH flanged flexible connection(s), inlet
- (4) Blower Anchor Bolt Set(s)

Spare Parts

- (4) Set(s) of spare filter elements

Mfg Services

4 day(s) mfg onsite services for inspection & startup allotted in (1) separate trip(s) for blower services (addl days \$1,800/day)
Factory Testing of (4) Turbo Blower unit (PTC13 wire-to-air)

Freight and Packaging

Freight to jobsite
Domestic packaging

TOTAL for (4)

C/O: Chris Shea of Aqua Solutions (617) 923-3900

Pricing: CIP - Job site

Terms: This offer is subject to Aerzen Standard Terms and Conditions (A2-001-USA January 2009)

Submittals: 4 weeks after receipt of Purchase Order

Payment: 20% upon drawings documentation, 70% upon delivery and 10% upon startup not to exceed 120 day from delivery

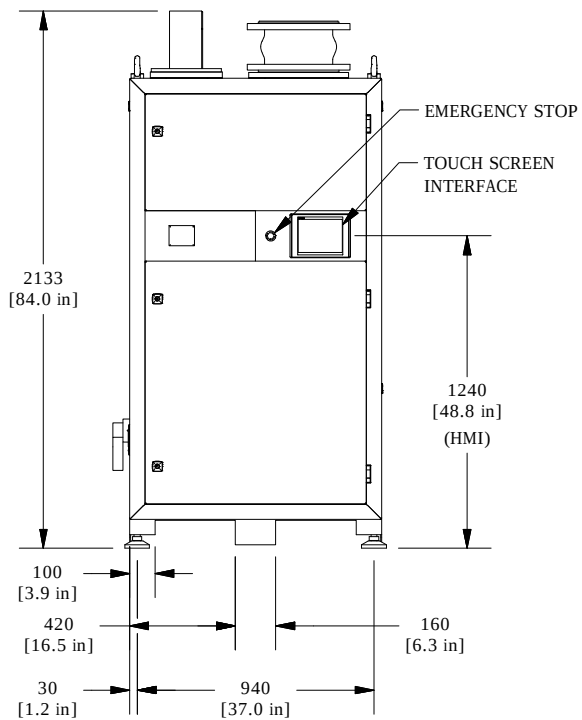
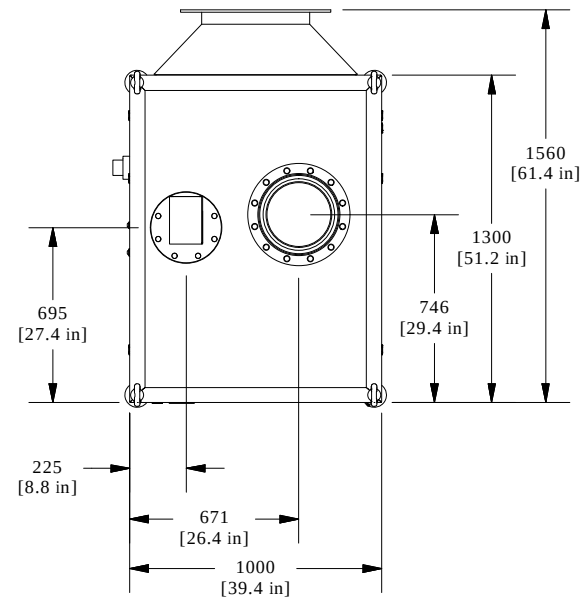
Delivery: presently approx. 26 weeks upon technical release by customer

Warranty: 24 months after start up or 30 months after delivery, which ever comes first*

*Maintenance must be performed per the Instruction Manual using Aerzen spare parts.

*Equipment not manufactured by Aerzen will carry the manufacturer's standard warranty

1. TOLERANCE ON DIMENSIONS: ± 12 mm (0.5")
2. PACKAGE WEIGHT: 870 KG (1,914 LBS.)
3. CONNECTED PIPING TO BE INDEPENDENTLY SUPPORTED
4. LIFTING OF PACKAGE: WITH FORKLIFT FROM FRONT OR REAR OR VIA (4) EYEBOLTS, ONE IN EACH CORNER OF THE PACKAGE
5. REMOVABLE PANELS DO NOT EXCEED 20 KG. (45 LBS.)
6. ALLOW 1067mm (42") FREE SPACE FOR MAINTENANCE ON ALL FOUR SIDES.
7. CUSTOMER TO ENSURE INSTALLATION MEETS ALL NATIONAL AND LOCAL CODES.
8. AERZEN RECOMMENDS INSTALLATION OF A CHECK VALVE ADJACENT TO, AND DOWNSTREAM FROM THE EXPANSION JOINT AT THE DISCHARGE OF THE BLOWER WITH A DOWNSTREAM STRAIGHT RUN OF PIPE AT LEAST 3 TIMES THE PIPE DIAMETER.
9. INSTALLATION OF ALL ANCILLARY EQUIPMENT TO BE IN ACCORDANCE WITH THE PRODUCT IOM.



OPTIONAL
FOOT CLAMP
DETAIL
REFERENCE
ITEM 21-007027

19.1 [.75 in]

50.8 [2.00 in]

98.4 [3.88 in]

101.6 [4.00 in]

15.9 [.63 in]

228.6 [9.00 in]

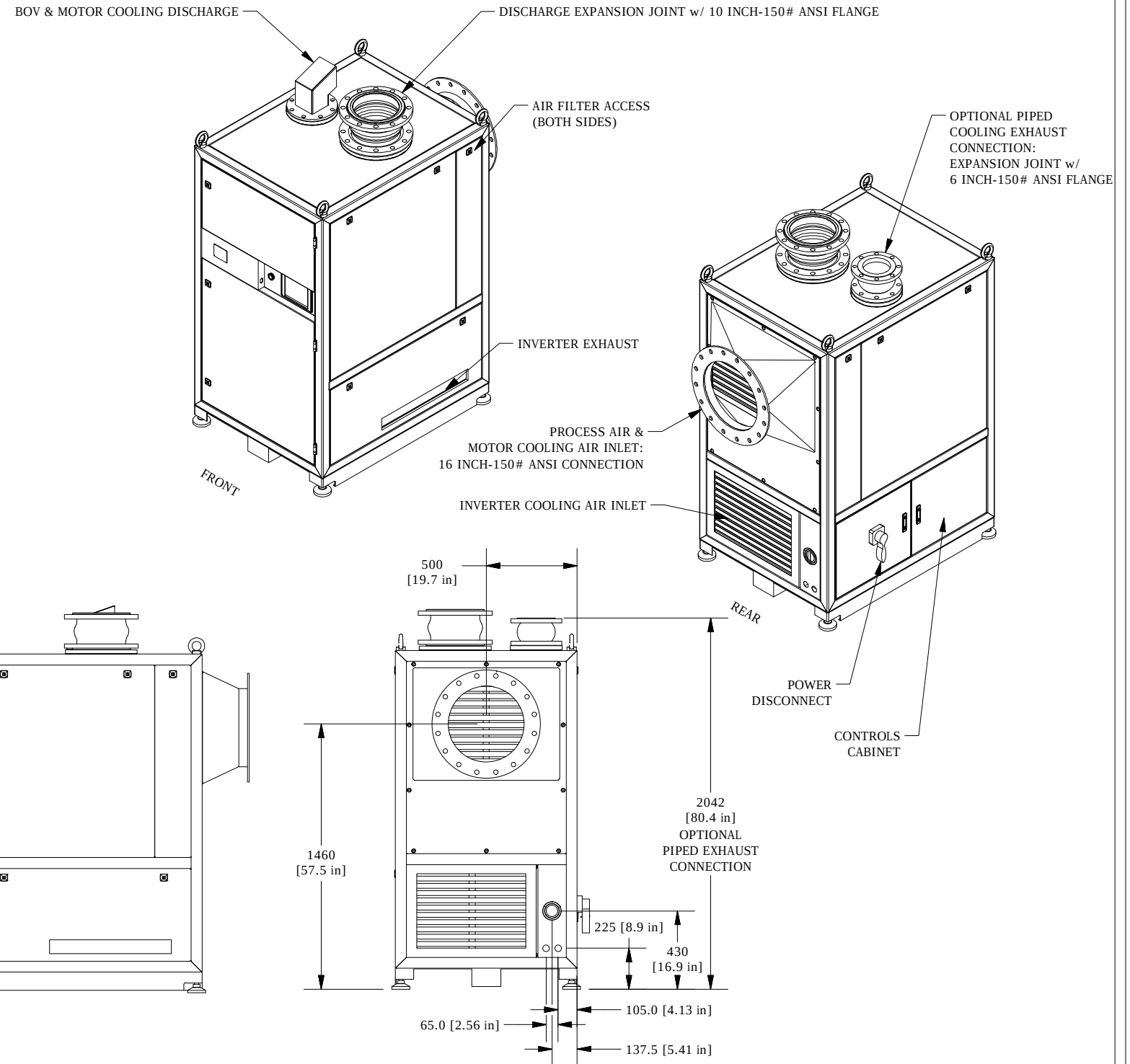
196.9 [7.75 in]

52.4 [2.06 in]

6.4 [.25 in]

Ø14.3 [Ø.56 in]
2 PLS.

M24 LEVELING FOOT



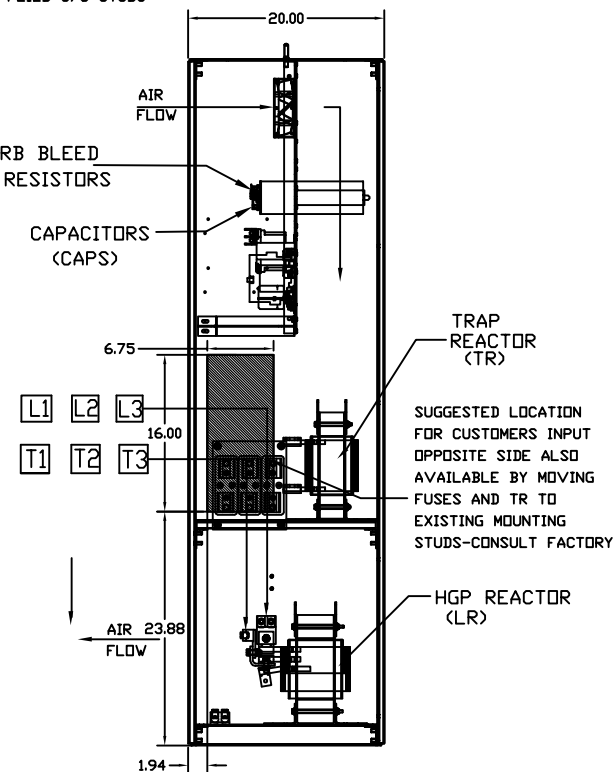
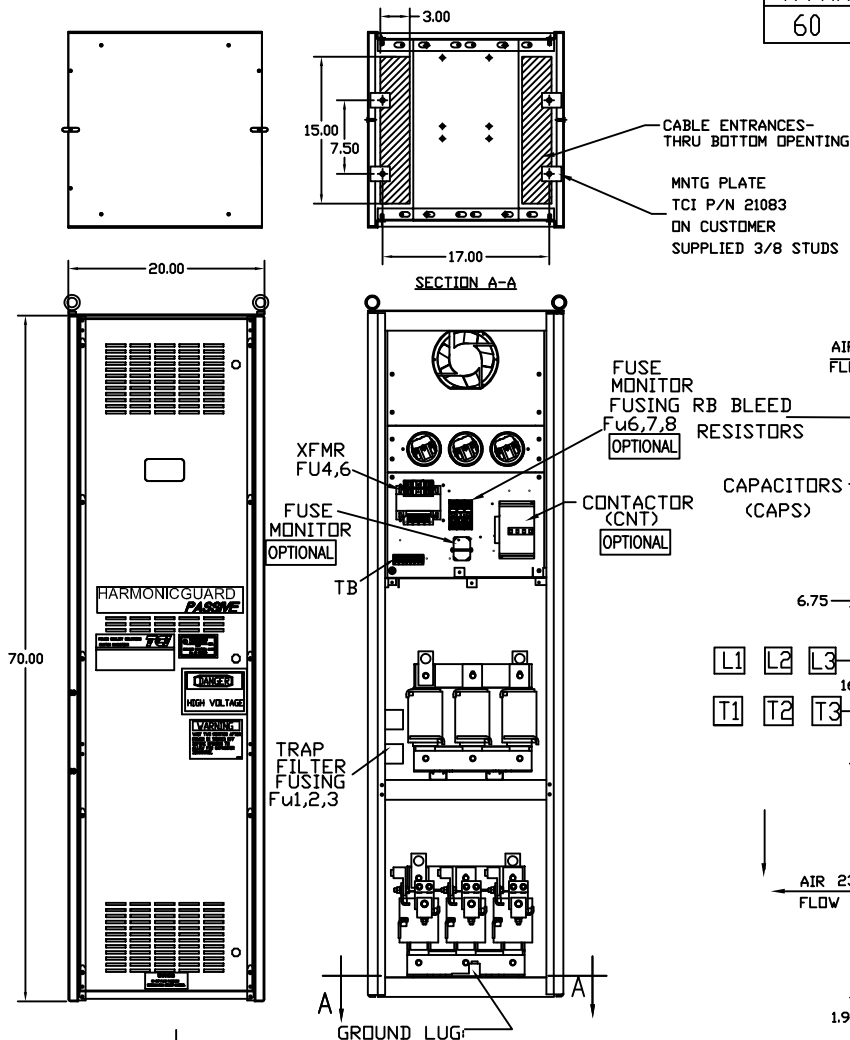
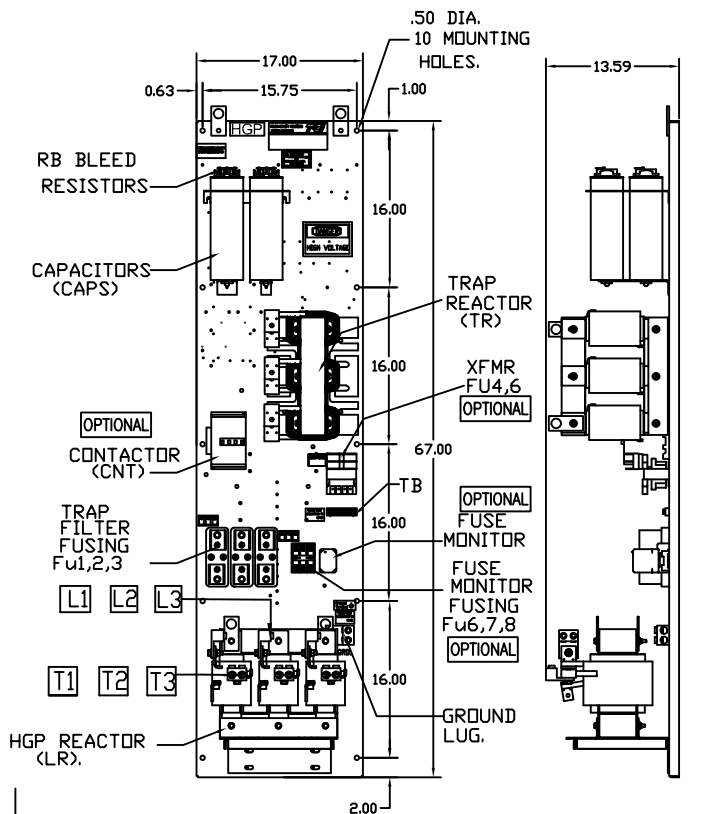
AERZEN			AERZEN USA CORPORATION 108 INDEPENDENCE WAY, COATESVILLE, PA. PH: (610) 380-0244 FX: (610) 380-0278 WWW.AERZENUSA.COM			CLASS: I 																																						
<table><tr><td></td><td>NAME</td><td>DATE</td></tr><tr><td>DRAWN</td><td>JPS</td><td>7/23/2019</td></tr><tr><td>CHECKED</td><td>DFT</td><td>7/24/2019</td></tr><tr><td>APPROVED</td><td></td><td></td></tr></table>				NAME	DATE	DRAWN	JPS	7/23/2019	CHECKED	DFT	7/24/2019	APPROVED			TITLE GENERATION G5plus TURBO BLOWER			<table><tr><td>SCALE: NTS</td><td colspan="2">SHEET: 1 / 1</td></tr><tr><td>REV</td><td>NAME</td><td>DATE</td></tr><tr><td>A</td><td>JPS</td><td>9/5/2019</td></tr><tr><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td></tr></table>			SCALE: NTS	SHEET: 1 / 1		REV	NAME	DATE	A	JPS	9/5/2019															
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DRAWING NO: GB-007722-200-08			AT200-0.8S 10"-150# ANSI DISCHARGE 16"-150# ANSI INLET																																									
NAVISION PN: 041-003211																																												
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GROUND LUG:
WIRE RANGE-TWO 350MCM-2
TIGHTENING TORQUE 375 IN-LB.

L1 L2 L3 T1 T2 T3
CUSTOMER CONNECTIONS:
WIRE RANGE-TWO 350MCM-2
TIGHTENING TORQUE 375 IN-LB.

UNIT SPECIFICATIONS:					
KVAR	HARMONIC	VOLT	HZ	PHASE	HP
60	5TH	480	60	3	200

OPEN VERSION OF HGP0200AW0F0000 SHOWN.



HGP0200AW-----	1S0000	0S0000	0C0000	0G0000	0F0000
STANDARD COMPONENTS					
LINE REACTOR LR	X	X	X	X	X
TRAP REACTOR TR	X	X	X	X	X
CAPACITOR CAP	X	X	X	X	X
TRAP FUSING FU1,2,3	X	X	X	X	X
CONTACTOR CNT			X		X
TRANSFORMER XFMR	X		X	X	X
XFMR FUSING FU4,5	X		X	X	X
FUSE MONITOR				X	X
MONITOR FUSING FU6,7,8			X	X	X

ON OPEN PANELS
CUSTOMER IS RESPONSIBLE FOR PROPER
COOLING OF FILTER COMPONENTS.
CAPACITORS MAXIMUM AMBIENT 50°C

HGP PART NUMBER	SCHEMATIC DRAWING #	APPROX.WT. LBS.
HGP0200AW0S0000	28697-S	345
HGP0200AW0C0000	28697	350
HGP0200AW0G0000	28697-S	347
HGP0200AW0F0000	28697	352
HGP0200AW1S0000	28697-4S	496
HGP0200AW1C0000	28697-4	500
HGP0200AW1G0000	28697-4S	498
HGP0200AW1F0000	28697-4	502

ENCLOSED TYPE1 VERSION OF HGP0200AW1F0000 SHOWN.

CUSTOMER IS RESPONSIBLE FOR INSTALLATION
TO MEET ALL NATIONAL AND LOCAL ELECTRICAL CODES.

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				DECIMAL		HARMONICGUARD PASSIVE	
				.XX ±.03		HGP0200AW-----	
C 3196 CHG PT TERMINAL				9/23/14 DSW		200HP, 480/3/60, TYPE 1	
B REVISED LAYOUT				7/10/14 DSW		DWG NO. 105490DG	
A AS BUILT				10/31/13 DSW		SHT. 1 OF 1	
NO REVISION				DATE BY			
				± 1/2°			

Aerzen Turbo 200G5plus





6 MAINTENANCE

6.1 Safety instructions

6.1.1 Improperly performed maintenance work

	WARNING!
	Risk of injury from improper maintenance work.

Improper maintenance may lead to serious personal or material damage.

- Perform maintenance work when the machine has been taken out of commission
- Secure the machine against restarting
- Allow the machine to cool down to ambient temperature
- Before beginning work, ensure there is enough space for installation work
- Check tidiness and cleanliness of the work area
- Only perform maintenance work with suitable tools
- Ensure removed components are re-installed correctly
- Re-install all fastening elements and observe the screw tightening torques

6.1.2 Securing the machine against restarting

	WARNING!
	An unauthorized or unregulated restart can have fatal consequences. An unauthorized or unregulated restart of the machine can lead to serious or fatal injuries.

There may be people located in the hazard area.

- Before beginning work, switch off the energy supply and secure it against restarting

6.1.3 Electric currents

	DANGER!
	Risk of fatal injury from electric current.

Coming into contact with live components poses an immediate and potentially fatal risk of electric shock. Even apparently harmless electrical components can carry high voltages. Electronic components in the incoming and control cabinet store electrical charges that are retained for some time even after deactivation of the power supply. The circuit breaker carries voltage even with the main circuit breaker set to off. Coming into

contact with these components can lead to fatal injuries. Working on electrical system should only be carried out by qualified electrical personnel.

Prior to beginning work on live parts that do not require to carry voltage for testing, disconnect them from the building's power supply. Secure against restarting.

- After approx. 20 minutes waiting time, check that there is no live current
- When working under power, avoid all contact with surrounding electrical components
- Never use water or high-pressure jets for cleaning in the vicinity of the machine

6.1.4 Requirements for personnel

The maintenance work described here may only be performed by the designated personnel. The personnel entrusted with the respective maintenance tasks are listed in the maintenance plan.

- For preparation of maintenance plan: Service personnel
- For cleaning after maintenance: User
- For commissioning after maintenance work: Service personnel / Authorized person

6.1.5 Protective equipment

For maintenance, following PPE may be necessary.

- Protective work clothing
- Safety shoes
- Hearing protection
- Protective gloves
- Safety goggles
- Industrial hard hat

6.1.6 Special tools

For maintenance purpose, general tools, auxiliary materials, and locking key are required.

6.2 Important reminders

Check regularly to ensure that main blower and cooling fans are operating properly. Do NOT disassemble or reassemble blowers without permission from Aerzen technicians. Repair costs as a result of unauthorized assembly or disassembly will not be covered under warranty. If abnormal operation is observed, shut the blower down and contact an Aerzen technician for assistance. In the event of a blower failure and automatic shut-down, record the Event Log/Error Code and contact an Aerzen technician prior to restarting the blower.



6.3 Maintenance schedule

Table 6-1 Maintenance recommendations

Interval	Maintenance		Authority
Monthly	Check filters for contamination	- Pre-filter - Medium filter	User
Annual	Visual inspection	- Piping system for any leakage - Cleaning the intake and exhaust air covers	User
		- Checking of main inverter and inverter fan - Checking of turbo motor	Authorized personnel
	Cleaning intake and exhaust	- Exhaust air opening of blow off valve (BOV) - Cooling system's exhaust air outlet	User
		Checking emergency stop function	Authorized personnel

6.4 Air filter replacement

Air filters are located at rear-side of the machine. While the machine is stopped, access the filters by opening the hinged door. The main filter elements may be pulled from their sockets to be replaced. The filters for process air are located on upper side and the filters for the VFD cooling air are on lower side. Ensure both sets of filters are clean. Note that the number of medium filters depend on blower machine model.



Fig. 6-1 Position of medium filters

- Open the filter door for motor (upper) and VFD (lower) by pulling door edge
- Replace medium filters

Installation of the filters is the reverse order of removal.

6.5 Pre-filter replacement (optional)

Pre-filter medium has to be replaced regularly at least within 6 months or when necessary depending on surround environments of installation place. The pre-filter frame and filter medium can be installed on the motor room filter area of the package by user. The filter medium can be inserted into the pre-filter frame by user.

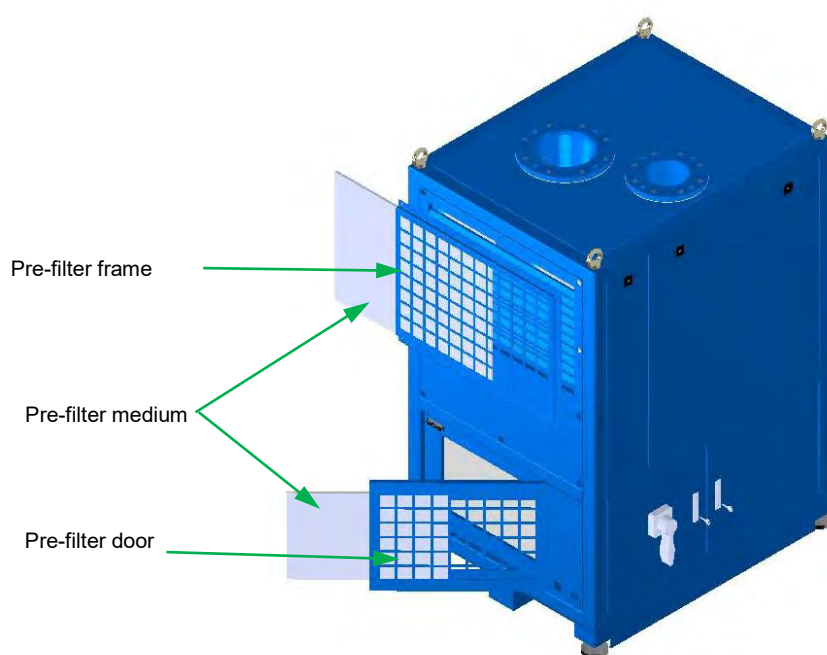


Fig. 6-2 Pre-filter replacement (optional)

6.6 Replacement parts

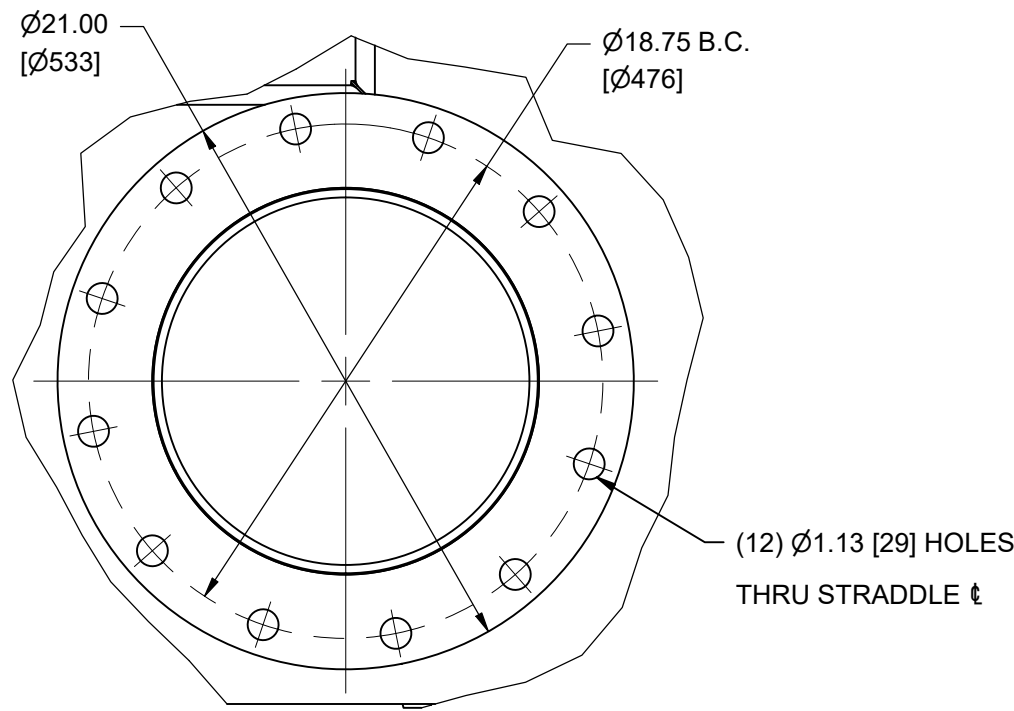
Some parts may deteriorate with age because their structures or physical characteristics, which leads to reduced performance or fault of the machine. For preventive maintenance, following parts must be replaced periodically based on environment conditions.

Table 6-2 Recommendations

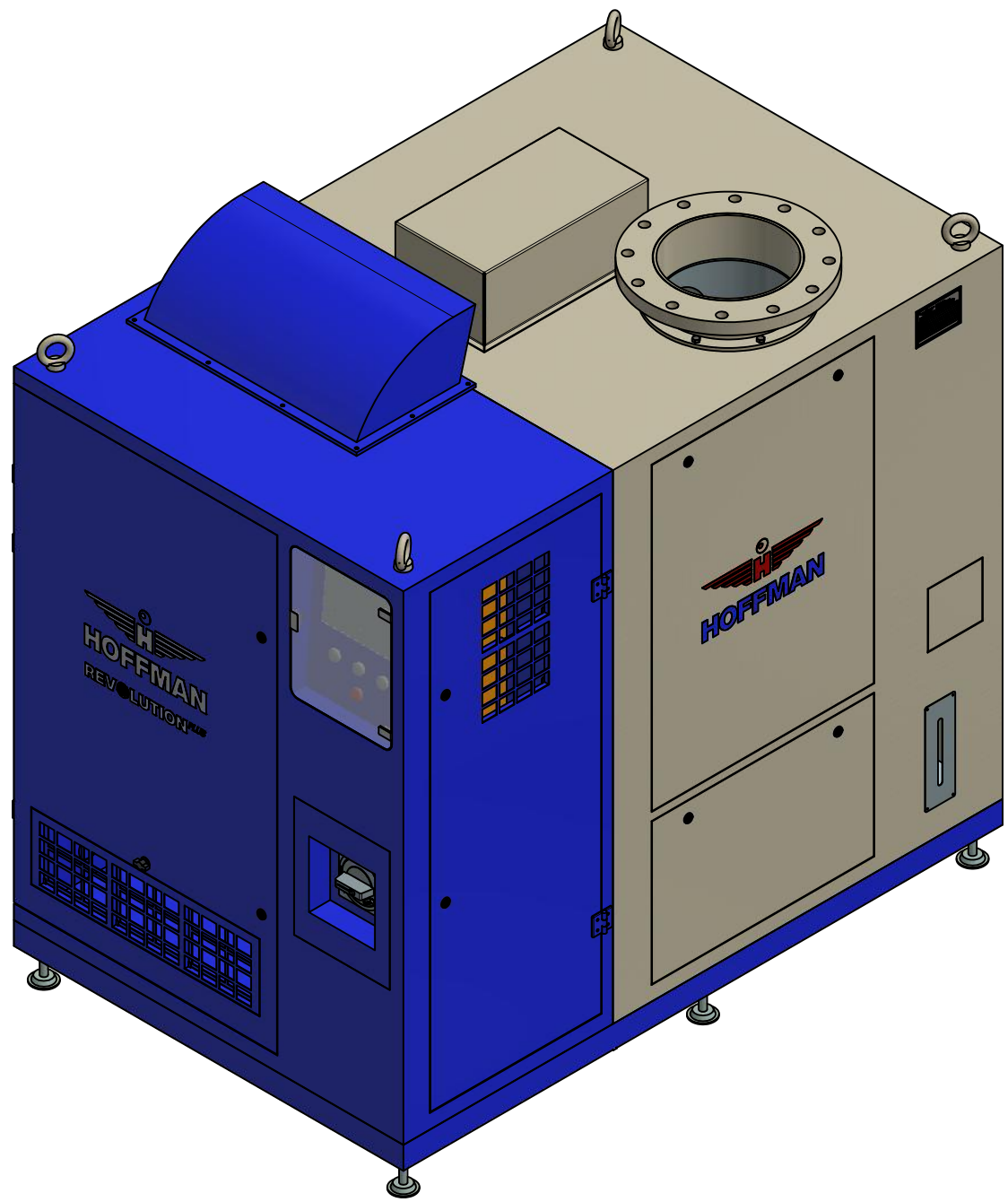
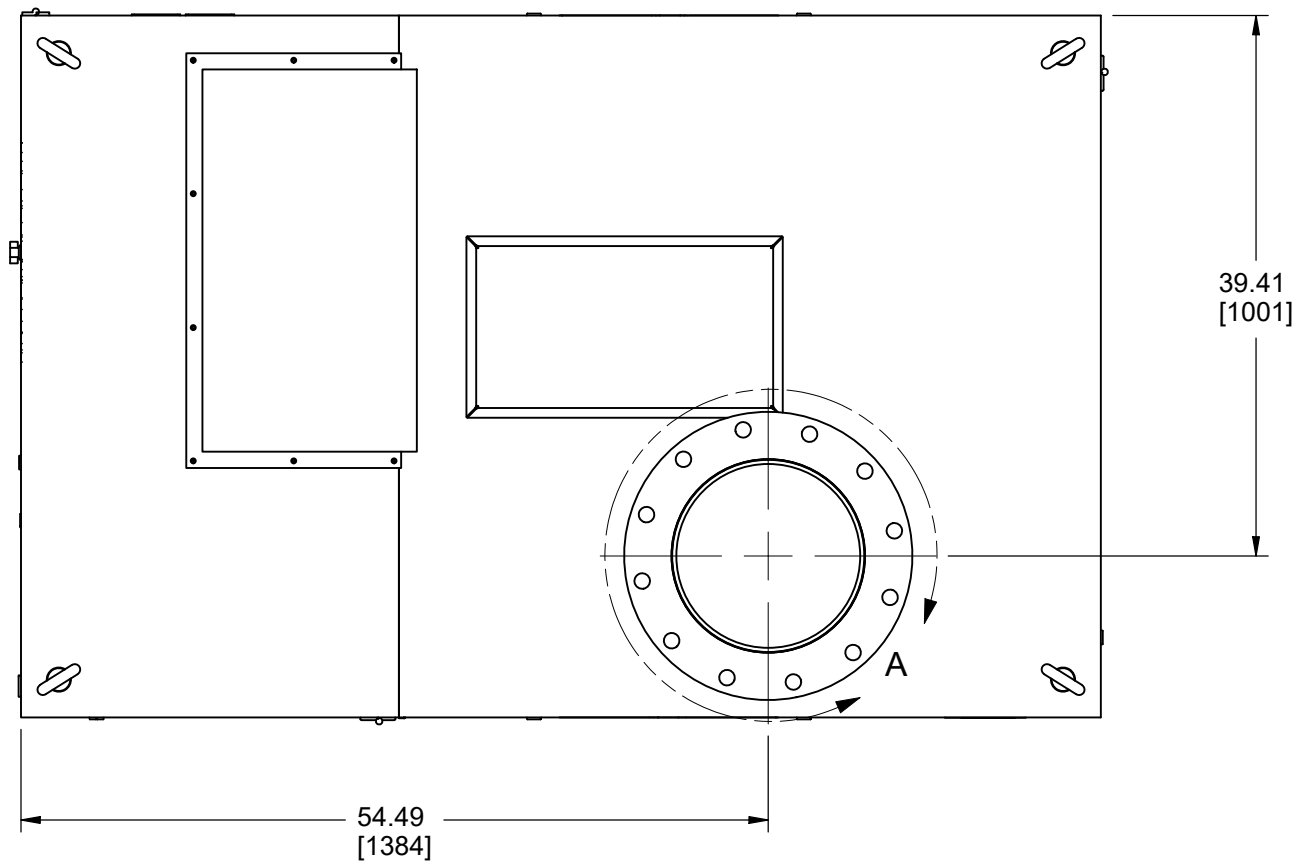
Part Name	Replacement Cycle	Action
Medium Filter	6 months or when necessary	Replace the filter with new one
Cooling fans (of the inverter)	52,600 operating hours or when necessary	Replace the fans with new ones
Pre-filter	2 months or when necessary	Replace the filter with new one

Aerzen Turbo

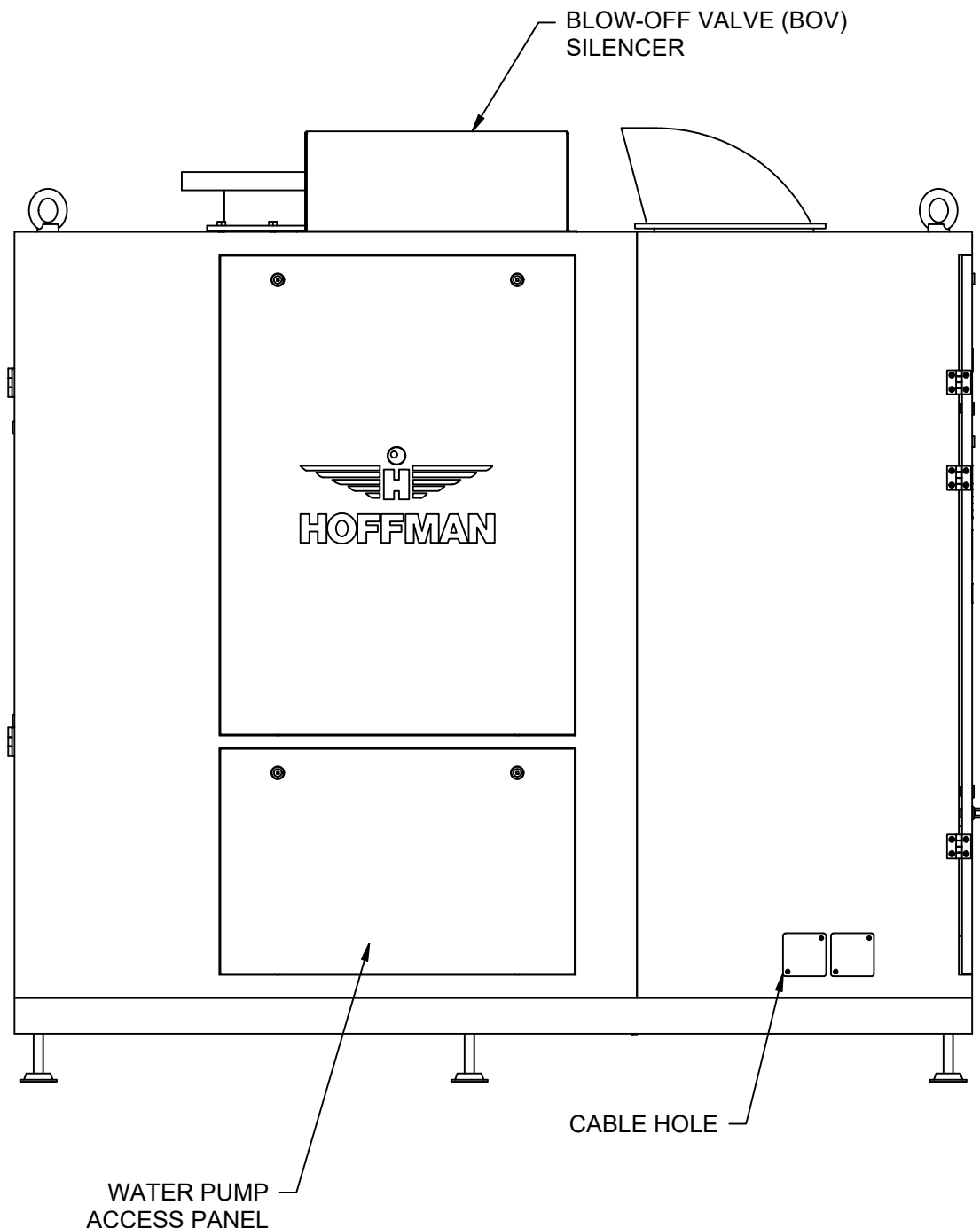
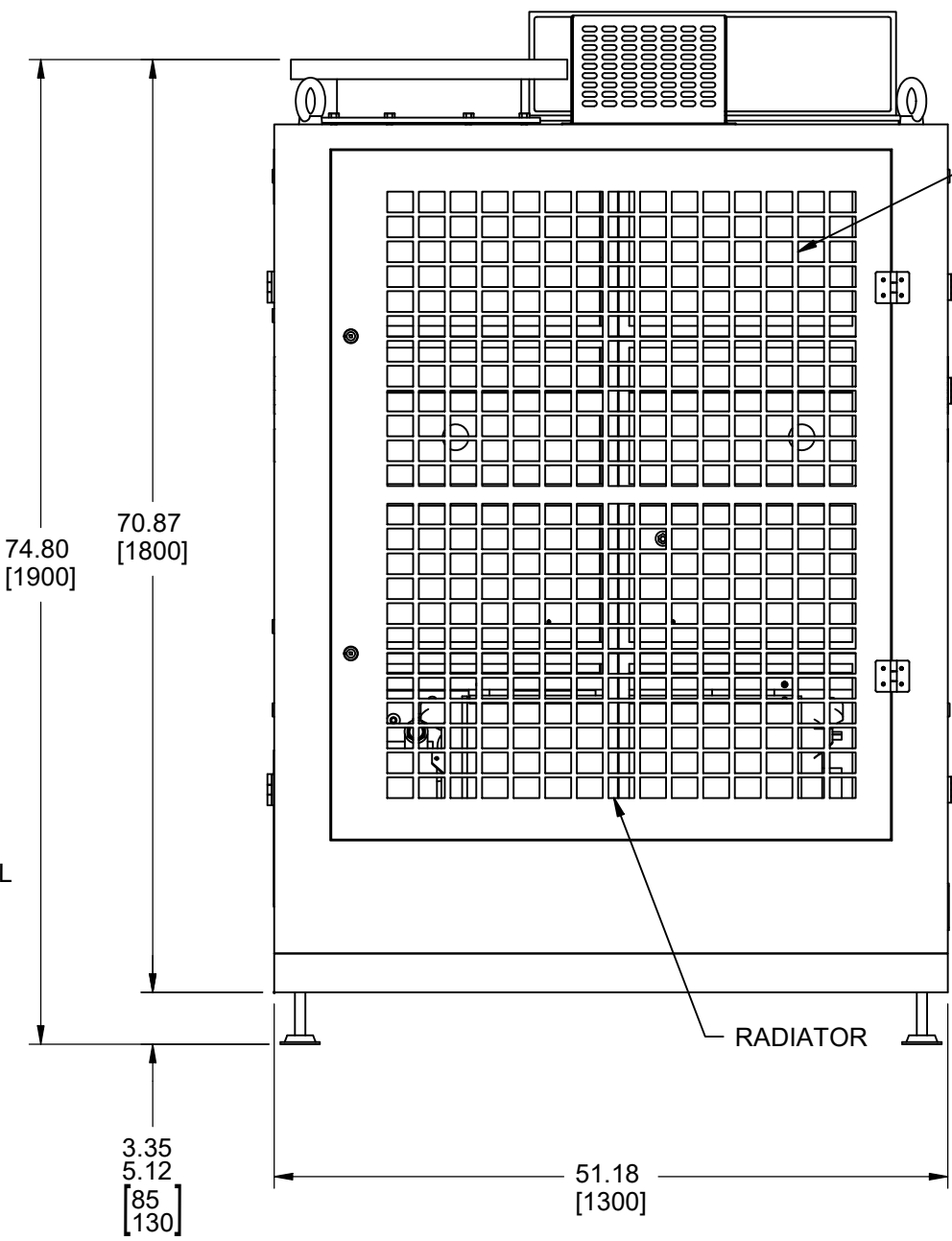
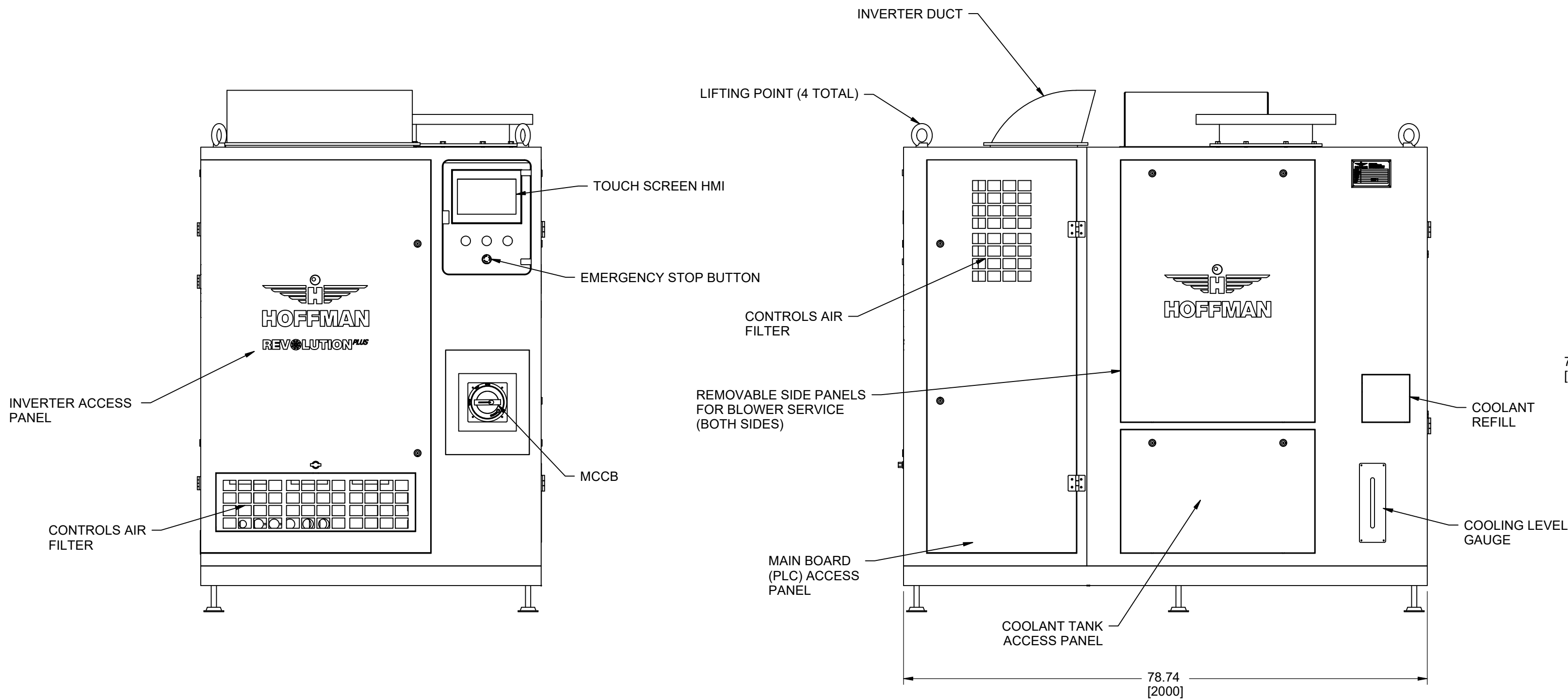
Country/State	Project/City	Startup DATE	Startup YEAR	QTY	MODEL SERIES	MODEL TYPE	RATING [HP]	Flow Rating/unit [cfm]	Rating [PSIG]
USA/New York	City of Beacon	Jun-12	2012	2	AT SERIES	AT 200 - 0.6 T	200	4944	9
USA/New York	Geneseo- Arkema Facility	Sep-12	2012	2	TB SERIES	TB 150 - 0.8 S	150	2825	12
USA/New York	Lewiston WPCC	Sep-12	2012	1	TB SERIES	TB 50 - 0.6 S	50	1236	9
USA/Vermont	Brattleboro	Oct-12	2012	3	TB SERIES	TB 25 - 0.8 S	25	459	12
USA/New York	Village of Stamford	Oct-12	2012	1	TB SERIES	TB 50 - 0.8 S	50	918	12
USA/Massachusetts	Medway- Charles River WWTP	Feb-13	2013	2	TB SERIES	TB 100 - 0.8 S	100	1907	12
USA/New York	Seneca County	Dec-13	2013	1	TB SERIES	TB 75 - 0.8 S	75	1413	12
USA/New York	Newark WWTP	Apr-15	2015	3	TB SERIES	TB 100 - 0.6 S	100	2472	9
USA/Massachusetts	Medway- Charles River WWTP	Jul-15	2015	2	TB SERIES	TB 100 - 0.8 S	100	1907	12
USA/New York	West Point - Target Hill WWTP	Aug-15	2015	3	TB SERIES	TB 50 - 0.6 S	50	918	9
USA/New York	Olean	Oct-15	2015	3	TB SERIES	TB 100 - 0.8 S	100	1800	12
USA/New York	Cold Spring	Feb-16	2016	2	TB SERIES	TB 50 - 0.8 S	50	918	12
USA/Massachusetts	City of Brockton	Sep-17	2017	1	AT SERIES	AT 300 - 0.8 T	300	5686	12
USA/Rhode Island	Newport	Sep-18	2018	2	TB SERIES	TB 100 - 0.8 S	100	1907	12
USA/Massachusetts	City of Brockton	Oct-18	2018	2	AT SERIES	AT 300 - 0.8 T	300	5686	12
USA/Massachusetts	City of Brockton	Jul-20	2020	1	AT SERIES	AT 150 - 0.8 S	150	2600	12
USA/Massachusetts	City of Brockton	Jul-20	2020	1	AT SERIES	AT 200 - 0.8 S	200	3814	12



DETAIL A
14" DISCHARGE FLANGE DETAIL



L1 ENCLOSURE MODELS		
BLOWER MODEL	WEIGHT Lb. [Kg]	DISCHARGE FLANGE
HRP250-06-54	3,086 [1,400]	14"
HRP250-08-54	3,086 [1,400]	14"
HRP250-10-54	3,086 [1,400]	14"
HRP300-06-54	3,263 [1,480]	14"
HRP300-08-54	3,263 [1,480]	14"
HRP300-10-54	3,263 [1,480]	14"
HRP350-06-54	3,307 [1,500]	14"
HRP350-08-54	3,307 [1,500]	14"
HRP350-10-54	3,307 [1,500]	14"



- NOTES:
- DIMENSIONS SHOWN IN INCHES AND [mm].
 - FLANGE DIMENSIONS CONFORM TO ANSI B16.5 150# FLANGE DRILLING.
 - USER MUST MAINTAIN A MINIMUM CLEARANCE OF 59in. [1,500mm] FROM ALL SIDES OF BLOWER.
 - RECOMMENDED FREE SPACE FOR BLOWER MAINTENANCE AND FILTER REPLACEMENT: 79in. [2,000mm].
 - TAKE CARE NOT TO IMPACT BLOWER DURING TRANSPORTATION.
 - AVOID TIPPING DURING TRANSPORT WHEN USING FORKLIFT OR CRANE.

A	RELEASED, C/M 1132691	6/17/21	DJL
REV	DESCRIPTION	DATE	APPVD
REVISION			

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- UNLESS OTHERWISE NOTED -				CHKR	DJL	DATE	3/11/20
DIMENSIONAL UNITS ARE: INCHES				APVD	DSGN		
- TOLERANCES -				APVD	ENGR		
GENERAL				APVD	QA		
± 0.13	± 0.06	± 0.25	± 0.50	PROJECTION			
3.2	1.6	6.4	12.7	1			

NASH		Gardner Denver Nash LLC	
HOFFMAN REVOLUTION PLUS, L1 IP54 ENCLOSURE, OUTLINE		SIZE D	FSCM NO. 42280
DWG NO. HRP-L1-54-OUTLINE		SCALE NTS	SHEET 1 OF 1
REV A			

PERFORMANCE DATA SHEET

■ MODEL : HRP250-08



■ Design Point Performance

Media	Air		Standard Ambient Condition	Temperature	68	°F
Corrected Pressure	11.38	Spsi.g		Humidity	36	%
Pressure Ratio	1.5			Pressure	14.70	psi.a
Inlet FlowRate	4,980.8	Sft³/min	Noise		83	dBA
Package Power	210.0	kW	Blower Vibration		1.4	mm/s
Rated Current	283.4	A	Air-End Vibration		2.3	mm/s
Rotating Speed	28,500	RPM	Lubrication		Air (Oil Free)	
Outlet Temperature	185	°F	Driving Method		VFD (inverter)	
Outlet Velocity	18.0	m/s	Power Supply (V-ph-Hz)		460 - 3 - 50/60	
Flow Range	2,823.8 ~ 4,980.8	Sft³/min				

■ Customer Requirement

Condition	Temperature	Humidity	Altitude	Air Density	Inlet FlowRate (Q1)	Atmospheric Pressure (P0)	Outlet Pressure (DP)	Outlet Pressure (P2)	Pressure Ratio (Pr)
	°F	%	m	Kg/m ³	ft ³ /min	psi.a	psi.g	psi.a	
Normal	32	0	0	1.29	4,335.0	14.70	7.65	22.35	1.5
Standard	68	50	0	1.20	4,667.0	14.70	7.65	22.35	1.5
Actual	85	78	180	1.13	4,961.5	14.40	7.50	21.90	1.5

■ at the STANDARD Condition

Point	Normal	Standard Condition				Performance			
	FlowRate	Temperature	Humidity	Air Density	Inlet FlowRate	Power	Current	Speed	Outlet Temperature
	Nft ³ /min	°F	%	Kg/m ³	Sft ³ /min	kW	A	RPM	°F
Minimum	1,918.0	68	50	1.20	2,064.9	74.5	100.6	19,898	152
Operating	4,335.0	68	50	1.20	4,667.0	143.9	194.2	24,306	152
Maximum	5,634.8	68	50	1.20	6,066.4	208.6	281.6	27,914	152

■ at the ACTUAL Condition

Point	Normal	Actual Condition				Performance			
	FlowRate	Temperature	Humidity	Air Density	Inlet FlowRate	Power	Current	Speed	Outlet Temperature
	Nft ³ /min	°F	%	Kg/m ³	Aft ³ /min	kW	A	RPM	°F
Minimum	1,918.0	85	78	1.13	2,195.2	77.6	104.7	20,216	172
Operating	4,335.0	85	78	1.13	4,961.5	149.7	202.1	24,695	172
Maximum	5,634.8	85	78	1.13	6,449.3	217.1	293.0	28,360	172

■ at the ANOTHER AMBIENT Condition

Point	Normal	Another Ambient Condition				Performance			
	FlowRate	Temperature	Humidity	Air Density	Inlet FlowRate	Power	Current	Speed	Outlet Temperature
	Nft ³ /min	°F	%	Kg/m ³	Aft ³ /min	kW	A	RPM	°F
No. 1	4,335.0								
No. 2	4,335.0								

COMPONENTS DATA SHEET

■ MODEL : HRP250-08



■ Construction

Dimension	51.2 * 78.7 * 74.8	inch	Inlet Type	Door	42.5 * 52.4	inch
Total Weight	3,086.0	lb		Filter	Pre + Medium	
Blower Type	Centrifugal		Outlet Pipe	Diameter	350	A
Rotation	Clockwise			Standard	ANSI	
Bearing Type	Bump Foil Air Bearing		Silencer	Inlet	Resonance type	
Painting	Powder Coating			Outlet	Absorption type	
IP Grade	IP54		B.O.V	Pneumatic Diaphragm Type		
Leg Type	Leveling Foot		Certification	NO		

■ Material

Case	AC4C-T6	Impeller	AL7075-T651
Scroll	AC4C-T6	Shaft	TC4
Enclosure	SS400	Air Bearing	Inconel x-750

■ Motor

Model Name	L3P250	Type	PMSM	
Maker	ACE TURBO	Insulation Class	H	
Output Power	182.3	kW	Cooling Media	Air
Efficiency	96.4	%	Service Factor	1.2

■ Inverter

Model Name	NXP06505A	Input Voltage	380 ~ 500	V	
Maker	VACON	Input Frequency	45 ~ 66	Hz	
Capacity	315	kW	Rated Output Current	530	A
Max Frequency	1,000	Hz	Cooling Media	Air	

* Voltage tolerance is -10% ... +10%

■ PLC Controller

Model Name	X8	Input Power	24	VDC
Maker	RS Automation	Communication	Modbus TCP	Standard

* Communication Protocol can be changed to Modbus RTU upon customer request

* Additional fee for other changes (Profibus-Dp/Net)

■ Touch LCD

Model Name	W910iCDp_U004	Input Power	24	VDC
Maker	RS Automation	Size	10.2	inch

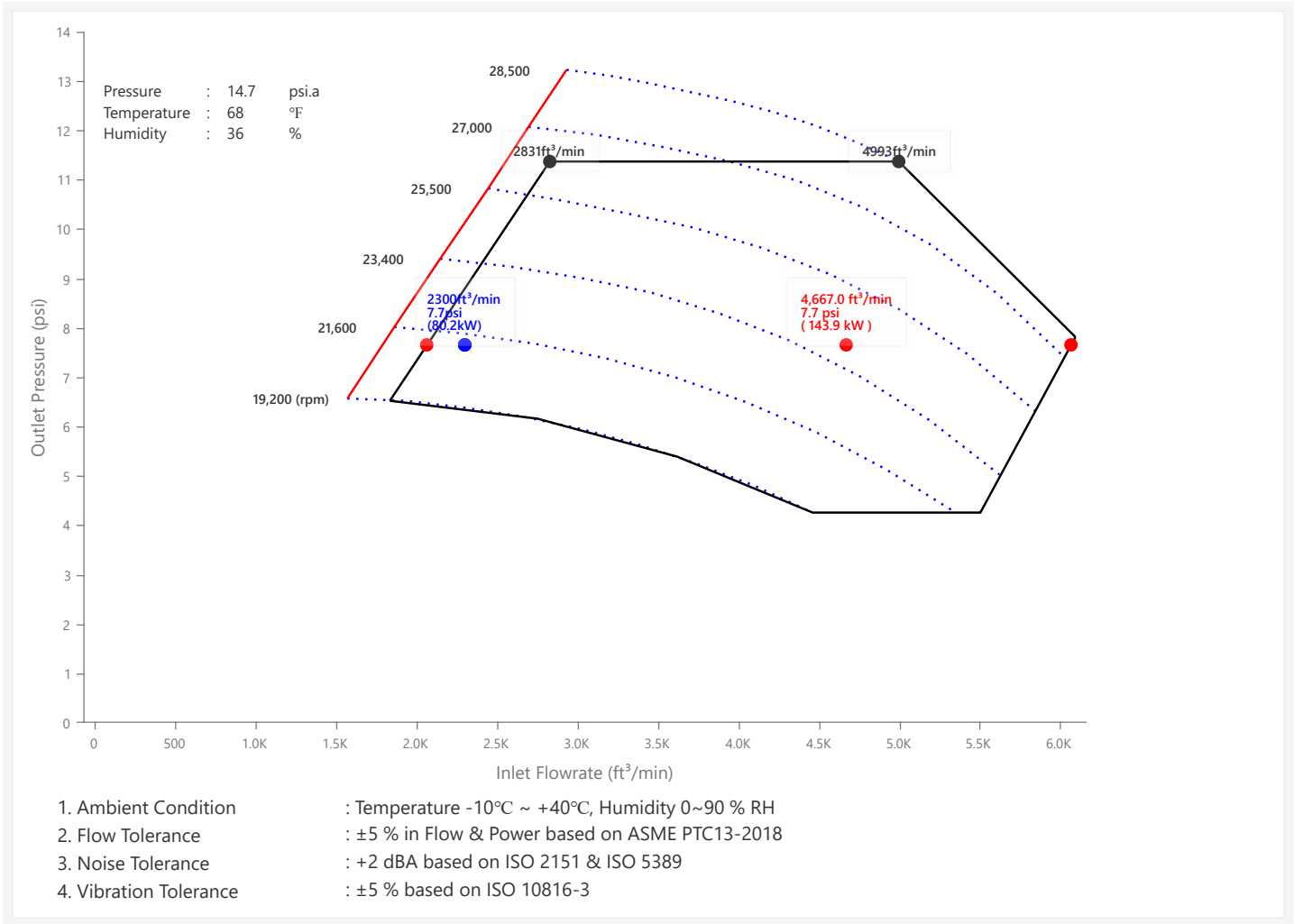
■ Option

Name	Maker	Model Name	Specification	Remark

P-Q CURVE

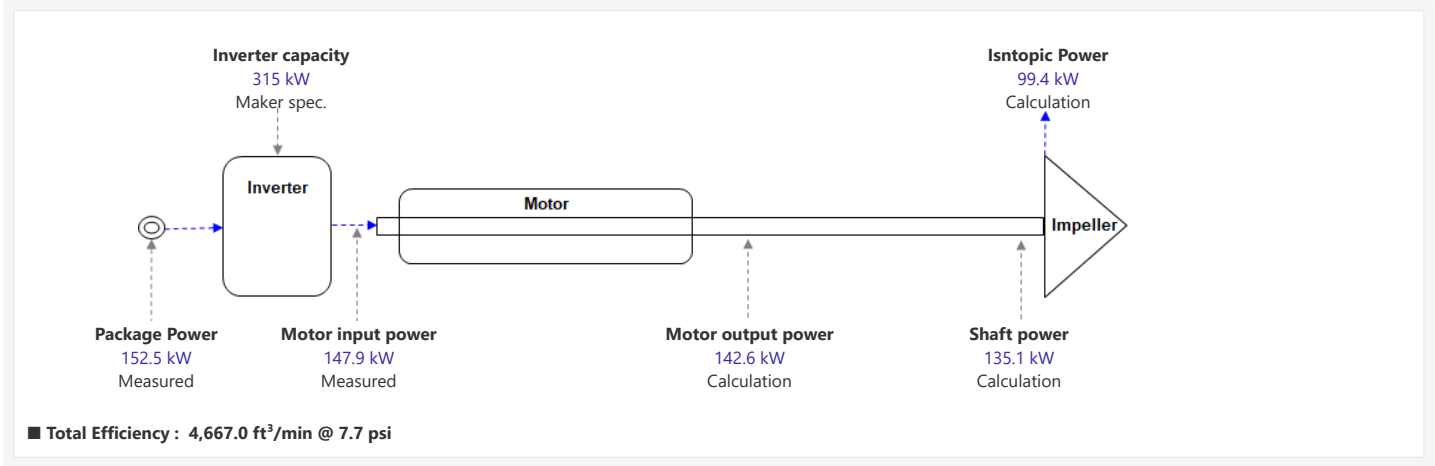


MODEL : HRP250-08

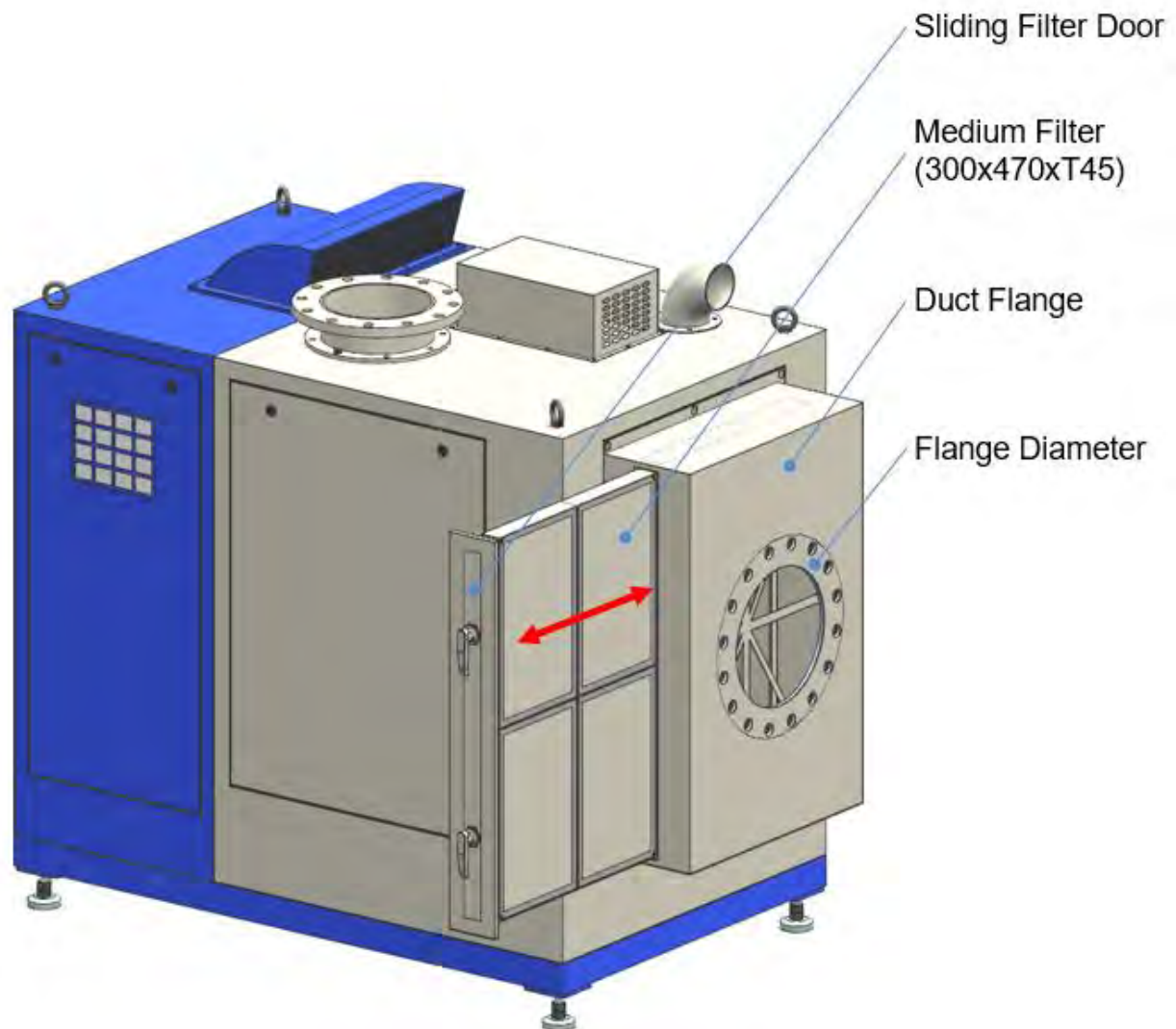


POWER DEFINITION

MODEL : HRP250-08



Ducted / flanged blower inlet configuration:



Gardner Denver Nash Turbo



Customer:
Reference:
Model: ZB 6 VSD+ 250kW J

Date: 4/4/2023
User: lahellums

Customer conditions

Atmospheric pressure 14.620 psi(a)
Inlet pressure 14.400 psi(a)

Inlet temperature 85.0 °F
Relative humidity 78.0 %

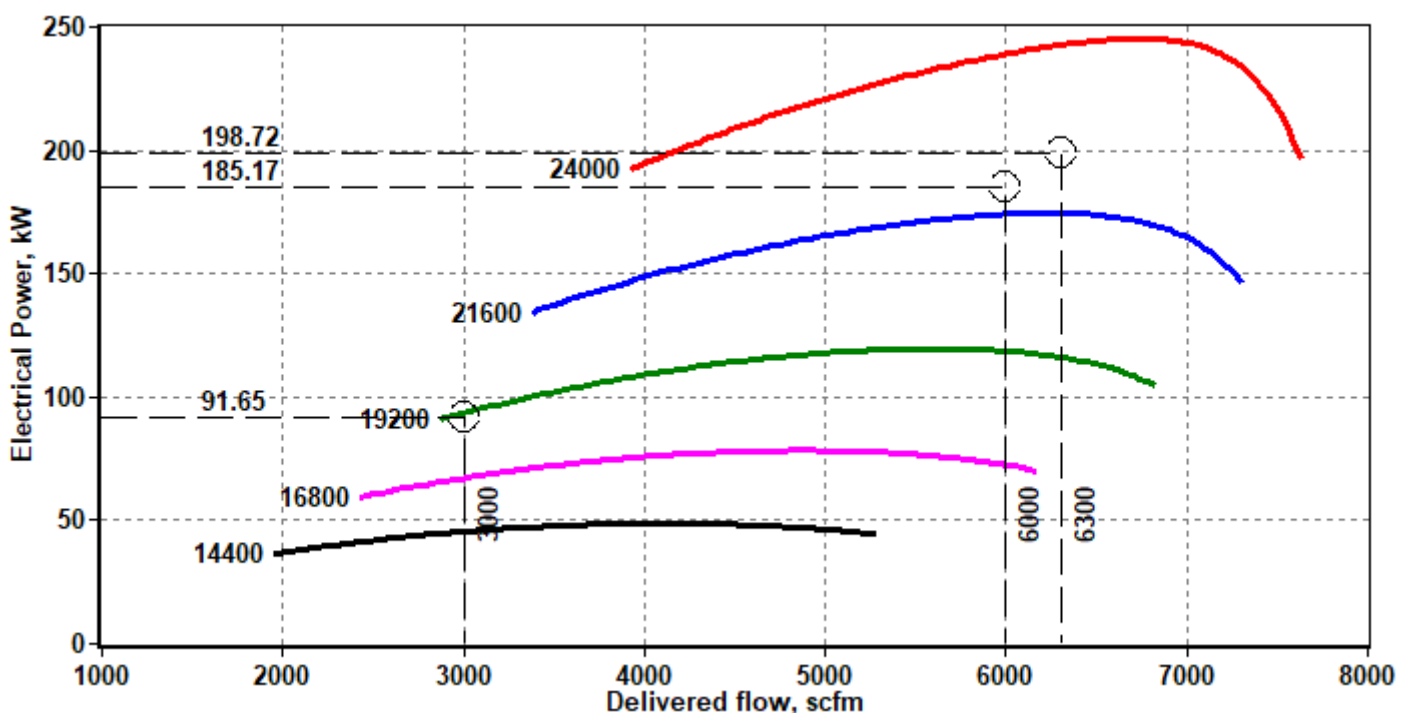
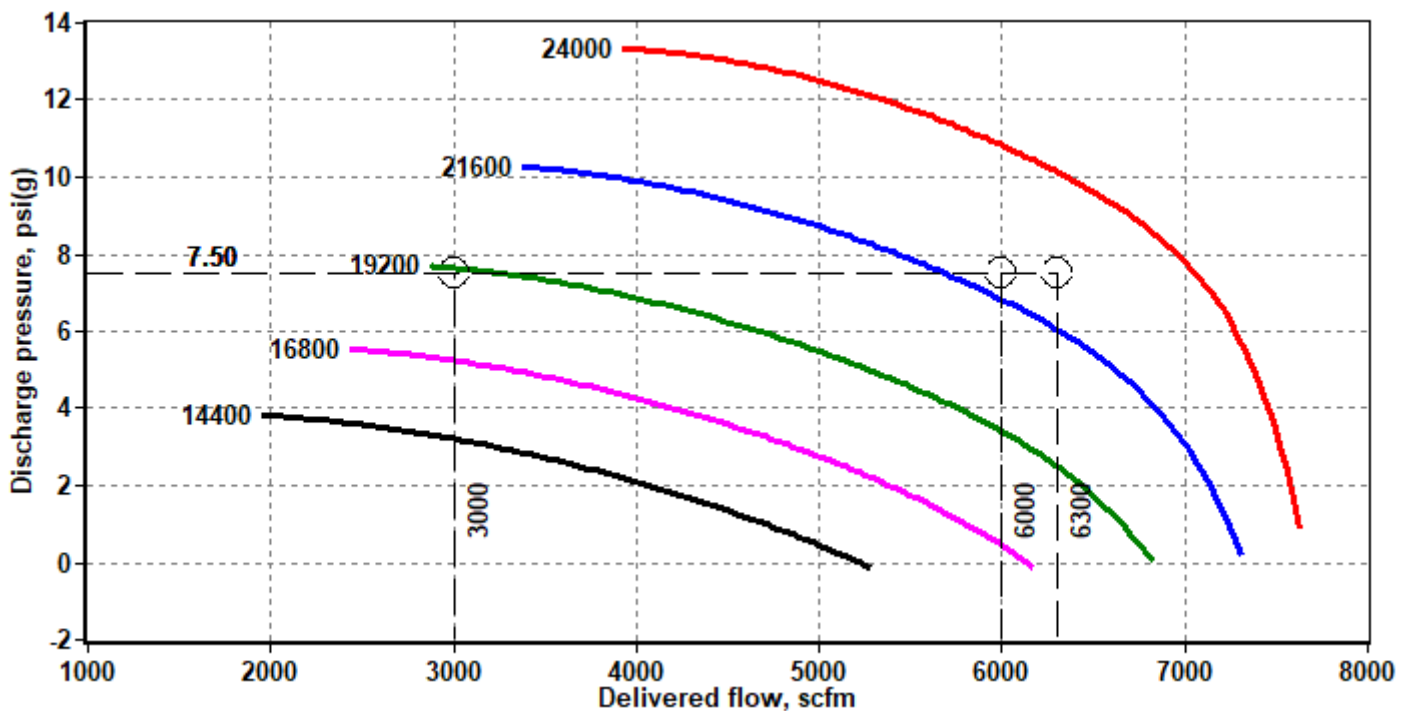
Frequency 60.0 Hz
Gas Air

Reference conditions

Pressure 14.70000 psi(a)
Temperature 68.0 °F
Relative humidity 36.0 %

Acceptance Pt Tolerance

Flow +/- 4 %
SER +/- 5 %
Pressure +/- 0 %
Overrides No





Pasel3 Performance Report

Summary multi points

2/5

V3.3.22 x86 | DB V1.5.2 U40

Customer:
Reference:
Model: ZB 6 VSD+ 250kW J

Date: 4/4/2023
User: lahellums
Case: Multi-point

Global settings

Frequency 60.0 Hz
Gas Air
Aftercooler No
Overrides No

Reference conditions

Pressure 14.7000 psi(a)
Temperature 68.0 °F
Relative humidity 36.0 %

Tolerance

Flow +/- 4 %
SER +/- 5 %
Pressure +/- 0 %

Operating points

Atmospheric pressure	psi(a)	14.620	14.620	14.620
Inlet pressure	psi(a)	14.400	14.400	14.400
Inlet temperature	°F	85.0	85.0	85.0
Relative humidity	%	78.0	78.0	78.0

Discharge pressure	psi(g)	7.500	7.500	7.500
Differential pressure	psi	7.720	7.720	7.720
Flow	scfm	6300.0	6000.0	3000.0
Pressure Rise to Surge	%	26.4	26.4	26.4
Turndown	%	55.2	52.9	5.8
Isothermal Efficiency	%	67.8	69.3	70.0
SER	bhp/100	4.0	3.9	3.9
Electrical power	kW	198.7	185.2	91.7
Run time	hr	1.0	1.0	1.0
Energy consumption	kWh	199	185	92

Price	€/kWh	1.000	1.000	1.000
Electricity cost	€	199	185	92

Total runtime hr 3.0

Total energy consumed kWh 476

Total cost € 476



Pasel3 Performance Report

Summary operating point 1

3/5

V3.3.22 x86 | DB V1.5.2 U40

Customer:
Reference:
Model: ZB 6 VSD+ 250kW J

Date: 4/4/2023
User: lahellums
Case: Multi-point

Customer conditions

Atmospheric pressure 14.620 psi(a)
Inlet pressure 14.400 psi(a)

Inlet temperature 85.0 °F
Relative humidity 78.0 %

Discharge pressure 7.500 psi(g)
Frequency 60.0 Hz

Gas	Air
Inlet Filter	No Control Yes
Aftercooler	No Overrides No
Check valve	Yes
Safety valve	No

Reference conditions

Pressure 14.7000 psi(a)
Temperature 68.0 °F
Relative humidity 36.0 %

<u>Estimated performance</u>	<u>Unit</u>	<u>Surge</u>	<u>Surge @ pr.</u>	<u>Design</u>	<u>Max. flow</u>	<u>Operating</u>
Inlet flow	scfm	3953	2850	7089	7654	6325
Delivered flow	scfm	3921	2825	7063	7632	6300
Std. Outlet Flow	scfm	3921	2825	7063	7632	6300
Discharge pressure	psi(g)	13.35	7.50	7.50	0.84	7.50
Differential pressure	psi	13.57	7.72	7.72	1.06	7.72
Electrical power	kW	192.2	87.5	242.6	196.4	198.7
Isothermal efficiency (electrical)	%	67.5	69.0	62.3	13.7	67.8
SER (electrical)	bhp/100cfm	6.2	3.9	4.3	3.2	4.0

Operating Conditions

Stable pressure rise at open inlet / on operating curve 26.4 % / 17.5%
Estimated theoretical turndown / turnup at operating point 55.2 % / 12.1%

	<u>Unit</u>	<u>Design point</u>	<u>Operating point</u>
Customer specified upstream pressure drop	psi	0.22	0.22
Checkvalve pressure drop	psi	0.5884	0.5079
Discharge temperature	°F	183.9	175.7



Pasel3 Performance Report

Summary operating point 2

4/5

V3.3.22 x86 | DB V1.5.2 U40

Customer:
Reference:
Model: ZB 6 VSD+ 250kW J

Date: 4/4/2023
User: lahellums
Case: Multi-point

Customer conditions

Atmospheric pressure 14.620 psi(a)
Inlet pressure 14.400 psi(a)

Inlet temperature 85.0 °F
Relative humidity 78.0 %

Discharge pressure 7.500 psi(g)
Frequency 60.0 Hz

Gas	Air
Inlet Filter	No Control Yes
Aftercooler	No Overrides No
Check valve	Yes
Safety valve	No

Reference conditions

Pressure 14.7000 psi(a)
Temperature 68.0 °F
Relative humidity 36.0 %

<u>Estimated performance</u>	<u>Unit</u>	<u>Surge</u>	<u>Surge @ pr.</u>	<u>Design</u>	<u>Max. flow</u>	<u>Operating</u>
Inlet flow	scfm	3953	2850	7089	7654	6024
Delivered flow	scfm	3921	2825	7063	7632	6000
Std. Outlet Flow	scfm	3921	2825	7063	7632	6000
Discharge pressure	psi(g)	13.35	7.50	7.50	0.84	7.50
Differential pressure	psi	13.57	7.72	7.72	1.06	7.72
Electrical power	kW	192.2	87.5	242.6	196.4	185.2
Isothermal efficiency (electrical)	%	67.5	69.0	62.3	13.7	69.3
SER (electrical)	bhp/100cfm	6.2	3.9	4.3	3.2	3.9

Operating Conditions

Stable pressure rise at open inlet / on operating curve 26.4 % / 14.9%
Estimated theoretical turndown / turnup at operating point 52.9 % / 17.7%

	<u>Unit</u>	<u>Design point</u>	<u>Operating point</u>
Customer specified upstream pressure drop	psi	0.22	0.22
Checkvalve pressure drop	psi	0.5884	0.478
Discharge temperature	°F	183.9	173.6



Pasel3 Performance Report

Summary operating point 3

5/5

V3.3.22 x86 | DB V1.5.2 U40

Customer:
Reference:
Model: ZB 6 VSD+ 250kW J

Date: 4/4/2023
User: lahellums
Case: Multi-point

Customer conditions

Atmospheric pressure 14.620 psi(a)
Inlet pressure 14.400 psi(a)

Inlet temperature 85.0 °F
Relative humidity 78.0 %

Discharge pressure 7.500 psi(g)
Frequency 60.0 Hz

Gas	Air
Inlet Filter	No Control Yes
Aftercooler	No Overrides No
Check valve	Yes
Safety valve	No

Reference conditions

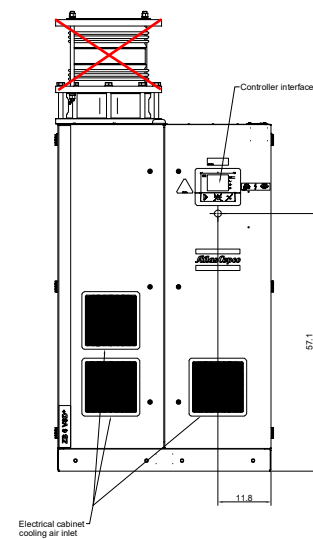
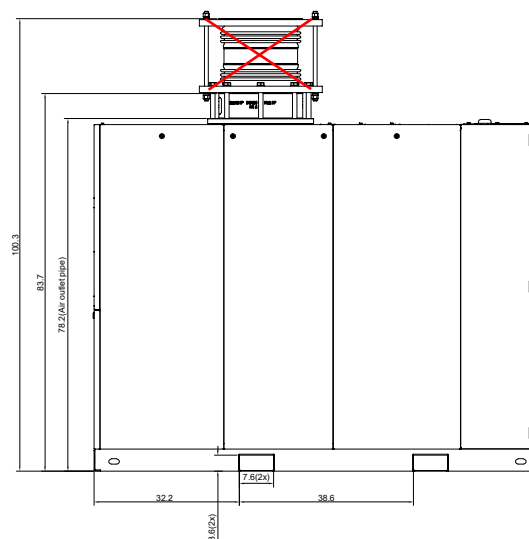
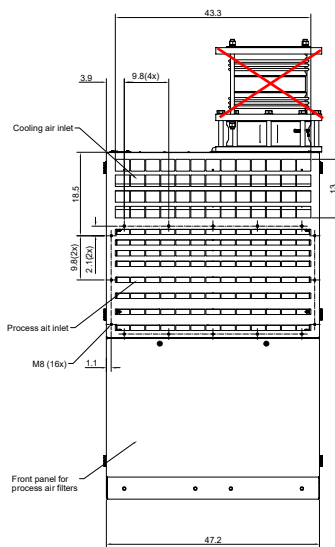
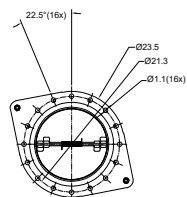
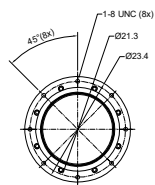
Pressure 14.7000 psi(a)
Temperature 68.0 °F
Relative humidity 36.0 %

<u>Estimated performance</u>	<u>Unit</u>	<u>Surge</u>	<u>Surge @ pr.</u>	<u>Design</u>	<u>Max. flow</u>	<u>Operating</u>
Inlet flow	scfm	3953	2850	7089	7654	3024
Delivered flow	scfm	3921	2825	7063	7632	3000
Std. Outlet Flow	scfm	3921	2825	7063	7632	3000
Discharge pressure	psi(g)	13.35	7.50	7.50	0.84	7.50
Differential pressure	psi	13.57	7.72	7.72	1.06	7.72
Electrical power	kW	192.2	87.5	242.6	196.4	91.7
Isothermal efficiency (electrical)	%	67.5	69.0	62.3	13.7	70.0
SER (electrical)	bhp/100cfm	6.2	3.9	4.3	3.2	3.9

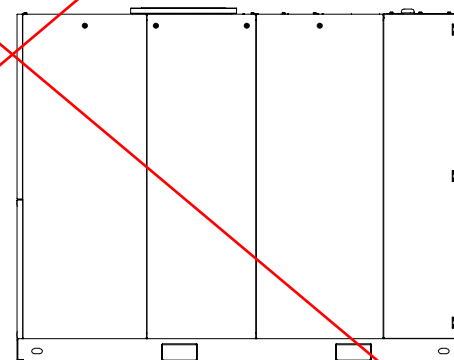
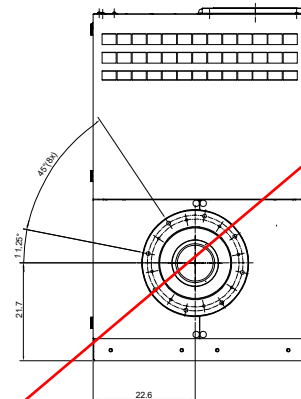
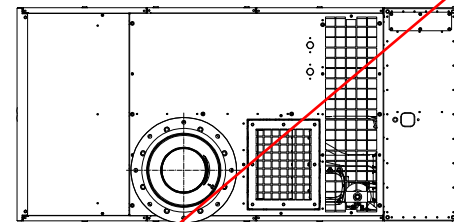
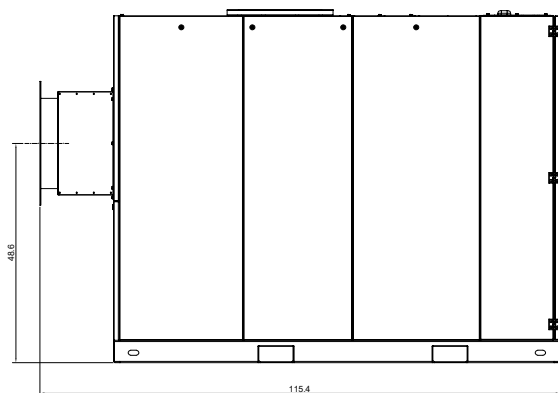
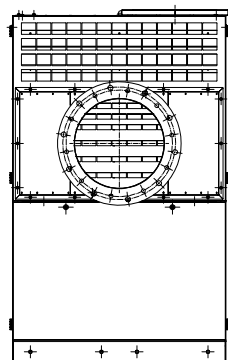
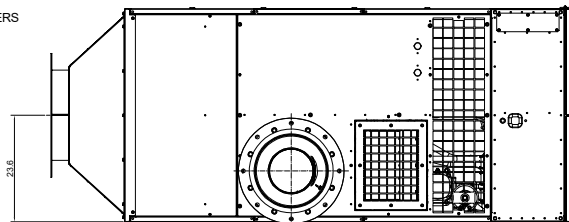
Operating Conditions

Stable pressure rise at open inlet / on operating curve 26.4 % / 0.3%
Estimated theoretical turndown / turnup at operating point 5.8 % / 135.5%

	<u>Unit</u>	<u>Design point</u>	<u>Operating point</u>
Customer specified upstream pressure drop	psi	0.22	0.22
Checkvalve pressure drop	psi	0.5884	0.214
Discharge temperature	°F	183.9	170.1



Tolerances, if not indicated, according to:															
ATLAS COPCO STANDARD CLAS															
Name		DIMENS. DRWG.					ZB 5 VSD+ (ANSI)			Ref. to VSD+					
Material		Not applicable								Confidential					
Treatment		Not Applicable								INV					
		Scale		1 : 10		Family		AC Compa		Drawing name					
		Drawn by		A0114022		Block no.		Employee		APF					
		Revision		Block		Alt		18.10.00		Sheet					



BUDGET QUOTATION

SULZER

Attn: Danielle Hasselberg
Company: Carlsen Systems
Ph No.: (617) 285-6038
E-Mail: dhasselberg@carlensystems.com

Quote No.

2023-Q034A-R0

DATE

4/7/2023

From: John Scavitto
Company: Sulzer Pump Solutions (US) Inc.
Ph No.: (215) 460-6708
E-Mail: John.Scavitto@sulzer.com

Prices are in USD

CPT: Norwalk, CT

Sulzer's Preliminary General
Commercial Comments Apply

Delivery: To Be Advised
on Notice to Proceed

Submittals: 2 - 4 weeks

Validity: 30 Days

Prepared By: Matthew Lisewski
Ph No.: (203) 514-4280

Subject: Norwalk WPCF

Item	Qty	Description	Subtotal
1		High Speed Turbo Blowers	
		Configuration is 2 operating plus 1 standby	
	3	Turbo Compressor HST 30-58-8-U350-48, 480/3/60	
	3	Ethernet/IP (Ethernet) Communication	
	1	Master Control Unit (MCU)	
		Inlet Accessories	
	3	Inlet Filter (INF), Process Air (1200 mm x 1200 mm) - Galv	
	3	Inlet Filter Adapter (used w/ Square INF only) - 500 mm Dia Duct - Galv	
	3	Adapter - 500 mm Dia Duct x DN 500/ANSI 20"	
	3	Inlet Flanged Silencer (used w/ Piping) - DN 500 x DN 500 - Galv	
	3	Inlet Bellows Joint (used w/ Flanged Piping) - DN 500 x DN 500	
	3	Inlet Scrap Trap - Wafer, DN 500/ANSI 20"	
	3	Adapter - 500 mm Dia Duct x 500 mm Dia Duct - NPU 500	
	3	Pressure Differential Switch - US Units	
		Outlet Accessories	
	3	Outlet Flexible Joint - DN 300 x DN 300	
	3	Outlet Combined Diffuser Cone Silencer - SS - DN 300 x DN 400	
	3	Back Flow Barrier, Dual Flapper Type - Wafer, DN 400/16" ANSI	
	3	Manual Outlet Valve - Wafer, DN 400/16" ANSI	
		Other Accessories	
	3	Outlet Cone Insulation - Covers OFJ - DN 300/ANSI 12"	
		Spare Parts	
	3	Inlet Filter Pocket - INF Vert. or Horiz. (3 / blower)	
	3	Cabinet Cooling Air Filters (4 / blower)	
		Factory Testing	
	3	Non-Witness Testing - Per Factory Standard	
	3	Additional Test Points 1 to 8 - Per Factory Standard	
	3	Balancing Report	
	3	Hydrostatic Pressure Test Certificate	
	3	Factory Certificates	
	3	Noise Certificate	
	3	Transport Packaging by Sea	
	3	Accessories Packaging	
2		Start-Up Assistance & Training - Warranty - Freight	
	1	Commissioning (Start up & Training) for HST, 3 Days On Site	
	1	Commissioning (Start up & Training) for HST, 3 Days On Site	
	1	Commissioning (Start up & Training) for MCU, 3 Days On Site	
	3	Standard Warranty (2 years)	
	1	Freight, USA to Norwalk, CT	

SULZER CONFIDENTIAL
SULZER CONFIDENTIAL

BUDGET QUOTATION

SULZER

Attn: Danielle Hasselberg
Company: Carlsen Systems
Ph No.: (617) 285-6038
E-Mail: dhasselberg@carlsensystems.com

Quote No.

2023-Q034A-R0

DATE

4/7/2023

From: John Scavitto
Company: Sulzer Pump Solutions (US) Inc.
Ph No.: (215) 460-6708
E-Mail: John.Scavitto@sulzer.com

Prices are in USD

CPT: Norwalk, CT

Sulzer's Preliminary General
Commercial Comments Apply

Delivery: To Be Advised
on Notice to Proceed

Submittals: 2 - 4 weeks

Validity: 30 Days

Prepared By: Matthew Lisewski
Ph No.: (203) 514-4280

Subject: Norwalk WPCF

Item	Qty	Description	Subtotal
		Please note that start-up trips quoted above assume all blowers quoted will be installed and prepared for start-up at the time of the first visit.	
		Quoted commissioning does not take into consideration a phased or sequenced start-up unless otherwise noted and is not intended for project management or project timeline purposes. Any defects in Sulzer blower's material or craftsmanship that would require additional start-up days or trips will be done at the expense of Sulzer. Any delays in start-up due to influences outside of Sulzer's control that would require additional field services will be billed at a rate of \$2,400 per day.	
		Additionally, note that Start-Up Assistance & Training & Freight must be included in the final price. These items can not be discounted nor commissioned. Additional Field Services are available at \$2,400.00/day	
		Total Air Flow Range (SCFM): 15,000	
		Differential Pressure (psi): 7.50	
		Altitude (ft ASL):	
		Inlet pressure (psia): 14.64	
		Inlet pressure losses (psi): 0.06	
		Process air inlet temp. range (°F): 0 to 105	
		Relative humidity range (%): 0 to 95	
		Site Voltage / Phase / Freq: 480/3/60	
		SULZER ABS will provide the following Type of MCU for this project:	
		A-B CompactLogix PLC and 7" PanelView Plus7 touch screen interface	
		The above MCU shall include the following elements:	
		1) MCU Enclosure, NEMA 4 sheet steel.	
		2) Allen Bradley PLC containing the software to control the HST Blowers	
		3) MCU includes 16 Digital Inputs, 16 Digital Outputs, 4 Analog Inputs, 2 Analog Outputs, 24 VDC Power Supply and UPS @ 3.4 AH	
		4) A-B Ethernet Communications between the PLC and HMI	
		and for Inter-PLC/SCADA communications using CAT5/6 cabling.	
		CAT 5/6 cabling by others. No Fiber Optic Equipment included.	
		5) Ethernet/IP communications between the MCU and the HST Blowers	
		6) Allen Bradley 8 Port Unmanaged Ethernet Switch	
		7) Manifold Pressure Control (Pressure Monitoring Device not included)	
		8) Control of a maximum of Six (6) HST Blowers using a PID controller	
		Total Project NET Price	\$ 678,360.00

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TECHNICAL QUOTATION REMARKS SULZER TURBOCOMPRESSOR HST

Each Sulzer HST Turbocompressor is offered with the following standard package features and accessories included.

- 1) High Speed Unit including with Impeller, Motor, Labyrinth Seal, Magnetic Bearing System mounted on a skid
- 2) Temperature sensors for inlet and outlet, motor, VFD & MBC
- 3) Pressure sensors for inlet and outlet
- 4) Differential pressure switch for inlet filter high pressure notification
- 5) Built in flow (via algorithm) and speed measurement
- 6) Volute with Inlet & Outlet flanges
- 7) Magnetic Bearing Controller, MBC-12
- 8) High Performance Vacon NX VFD
- 9) RFI Filter & AC Choke
- 10) Blow Off Valve, electro-pneumatically controlled plug type
- 11) Control Cabinet with power interlock switch.
- 12) Control Cabinet with local detachable Keypad or with full HMI undetachable Display.
- 13) Acoustic Noise Enclosure (see appendix for guaranteed dB(A))
- 14) UPS for Magnetic Bearing Controller
- 15) Technical Specification, Cut Sheets, Installation Manual, Commissioning, Manual, Operators Manual, Layout Drawings & Accessory Drawings

Factory Performance Test, with each blower, non-witnessed, in conformance with abridged ISO 5389:1992 -Turbocompressors, VDI 2045:1993 – Acceptance and Performance Tests on Turbocompressors & Displacement Compressors. Optional full ISO 5389, ASME PTC-10, or ASME PTC-13 in addition to optional Witness Test.

TERMS AND CONDITIONS: Sulzer Standard Terms & Conditions apply.

TECHNICAL QUOTATION REMARKS SULZER TURBOCOMPRESSOR HST

Comments & Exceptions:

- 1) Above items only; additional accessories available upon request.
- 2) No special tools are required
- 3) Sulzer's standard product is offered.
- 4) Anchor bolts are not included
- 5) Supply and installation of interconnecting communications cabling between each turbocompressor and the MCU (if supplied).
- 6) Installation of compressor units, blower accessories and associated pipe work
- 7) Supply and installation of electrical power and signal cables to each turbocompressor and the MCU (if supplied)
- 8) Provision of any further instrumentation other than that contained within each turbocompressor or the MCU (if supplied). This also excludes the pressure, flow or D.O. transducer required to generate the 4-20ma signal for compressor control.
- 9) Pipe insulation as deemed necessary by the client to prevent contact with hot pipes.
- 10) Reasonable access to the site and working area to enable continuous installation.
- 11) Free access to facilities
- 12) The compressors are to be installed in a compressor room constructed by others.
- 13) The compressor room floor will be flat and level to standard civil tolerances.
- 14) That the Sulzer Turbocompressor HST can be off loaded and placed directly into the compressor building
- 15) Cable tray or ducts to each compressor for the communications cabling will be supplied and installed by others.
- 16) The above price does not include sales tax or other costs unless specifically included in this proposal.

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Appendix

- 1) Performance Graph
- 2) Technical Data Sheet
- 3) Turbocompressor Control Schematic
- 4) Communication with Master Control Unit Options (if provided)
- 5) Typical Sulzer Turbocompressor HST layout drawing
- 6) Compressor Test Code Comparison
- 7) Warranty

High Turbocompressor HST Performance

SULZER

Date: 07-Apr-23

Quote No.: 2023-Q034A-R0

HST 30-58-8-U350-48

Project Name: **Norwalk WPCF**

Total Design Air Flow: **15,000 SCFM**

Air Flow Per Unit: **7,500 SCFM**

Units: **3 Units -**

2 Operating + 1 Installed Spare

Maximum Input Power: **350 HP**

Electric Power: **480 / 3 / 60**

Maximum Motor Speed: **18,900 RPM**

Operating Pressure Ratio: **1.52**

Altitude: **ft**

Ambient Pressure: **14.7 psia**

Differential Pressure: **7.5 psig**

Max Discharge Temp: **194° F**

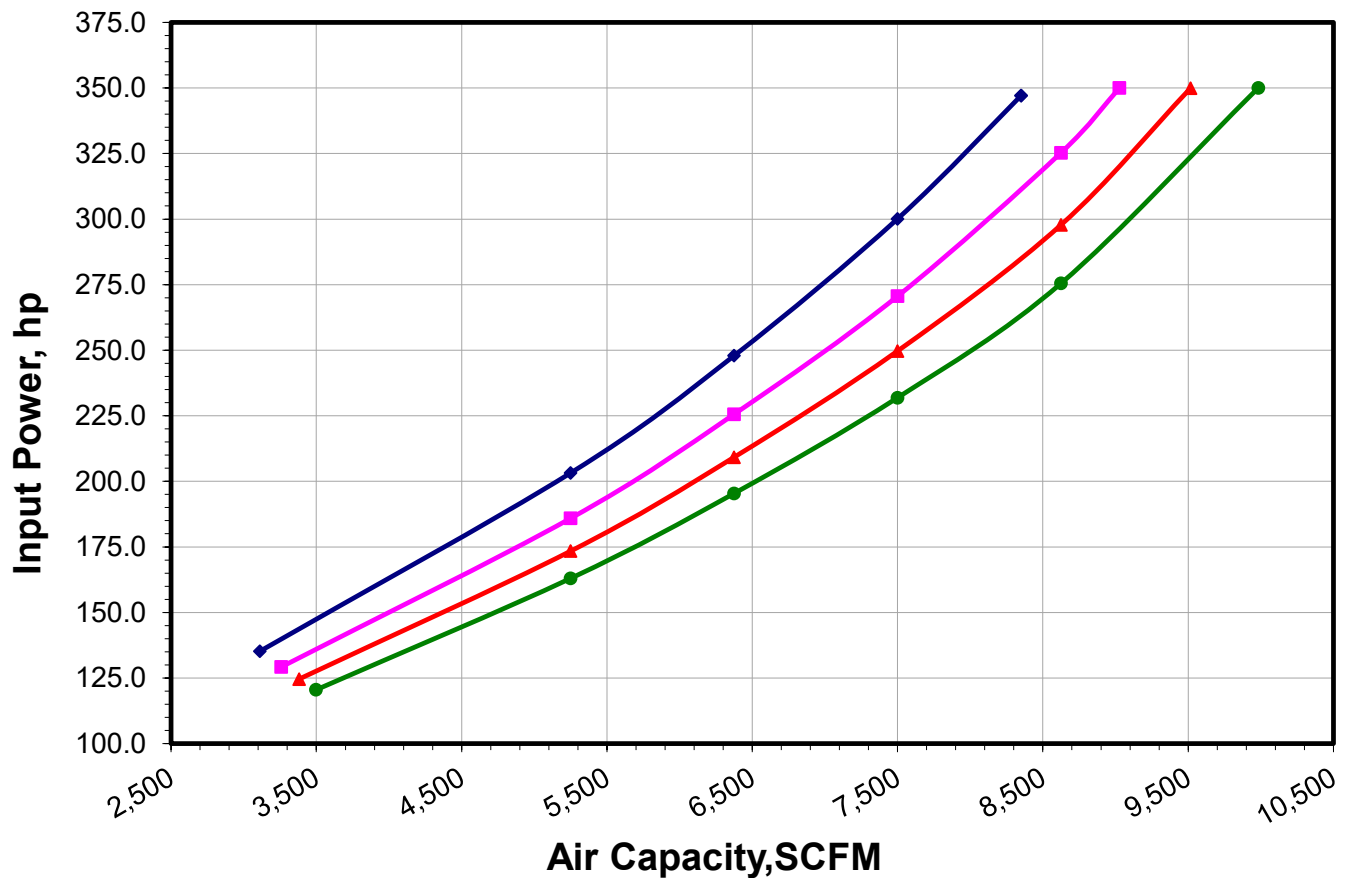
Operating Pressure Ratio Limit: **1.75**

Discharge Pressure: **22.2 psia**

Inlet Losses: **0.06 psig**

Inlet Temp. °F	RH %	Legend
105	95	◆
68	36	■
32	25	▲
0	0	●

Blower Performance



(Standard Conditions: 68 Deg F, 36%RH, 14.7 PSI)

Please note that the input power is the wire to air power and includes all losses associated with the VFD, Motor, Impeller, etc.

HST™ 30 turbocompressor

SULZER

A highly efficient and reliable single-stage centrifugal compressor for the provision of oil-free, low-pressure air.

Construction

High-speed electric motor

A horizontally mounted high-frequency electric motor for variable speed operation. The motor is air-cooled by an integrated shaft mounted fan and the windings are protected by Pt100-sensors monitored by the local control system.

Air end

The impeller has been designed to optimize performance and is machined from a solid piece of high-strength aluminum alloy. The volute and other main components are made from cast aluminum. A non-contact seal between air-end and motor minimizes losses to maintain high efficiency.

Variable frequency drive

Flow control is provided by a built-in variable frequency drive which also accommodates variations in outlet pressure and ambient inlet conditions. The variable frequency drive's soft-start facility eliminates peak starting currents.

Active magnetic bearings

Two radial bearings and two axial bearings support the rotor. The magnetic bearing controller uses data provided by multiple sensors to continuously manage the position of the rotor.

Blow-off valve

The blow-off valve is mounted within the acoustic enclosure with further attenuation provided by an integrated silencer.

Acoustic enclosure

The enclosure provides protection for the electrical and mechanical components and provides efficient noise attenuation for the machine. The enclosure is constructed from zinc-plated steel. It is suitable for indoor use (IP33D, NEMA 2).

Integrated components

The filters for cooling air and the motor cooling air silencers are all integrated into the main assembly.

Compressor Control

Local control

The built-in local Human-Machine-Interface (HMI) provides control and monitoring for the safe and efficient operation of the machine. Flow may be controlled directly by the operator, or alternatively, the turbocompressor can follow a given reference value. The local HMI uses a color touch screen to provide access to the operator.



Connections

Analog and digital control and monitoring connections are built in. Fieldbus connections such as Profibus, Profinet, Modbus RTU, Modbus TCP, and EtherNet/IP are available as options.

Remote connections

A secure connection facilitating service and monitoring can be ordered as an option.

Options

Various options for handling special requirements regarding e.g. temperature, dusty environments and locations with high moisture can be selected.

Accessories

Required accessories for installation such as flexible joints, valves, silencers, and air filters are available from Sulzer.

Performance Testing

Compressor performance tests are performed on every machine manufactured and certificates issued to confirm compliance. The tests are carried out at the Sulzer factory test facility. Performance is guaranteed with a manufacturing tolerance of $\pm 2\%$ and a measurement tolerance according to ISO 5389. Optionally tests can be performed in full accordance with ISO 5389 or ASME PTC 10. The test can be witnessed by the customer or a third party inspector.

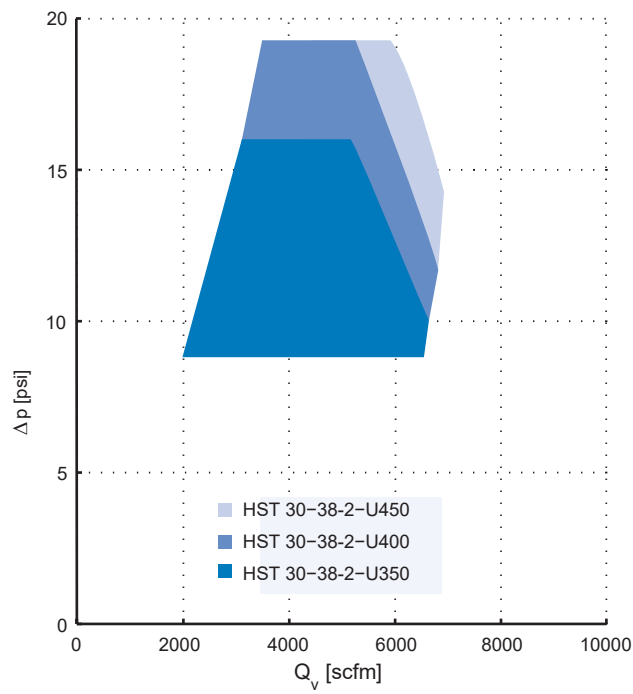
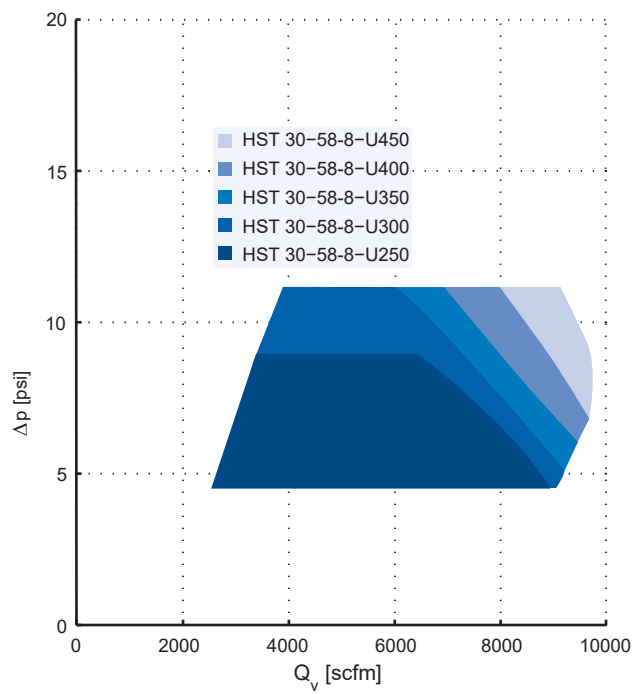
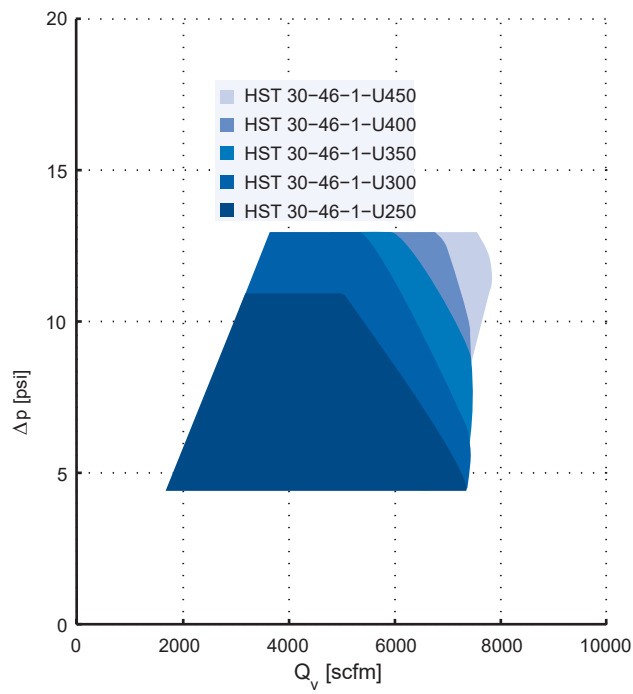
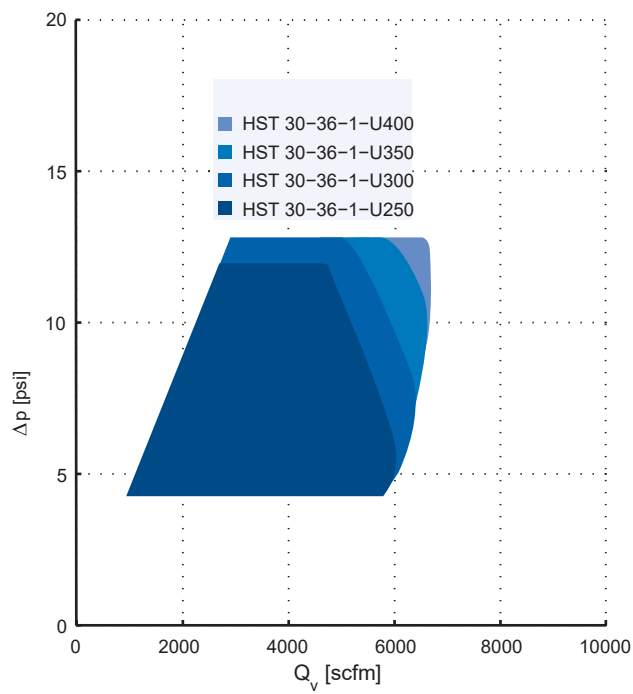
Certification and Standards

The product is certified according to the relevant UL and CSA standards:

- UL 1450
- CSA C22.2 No. 68

The product is designed and manufactured in accordance with EN 61800-3 standard and intended for use in second environment locations, e.g. in industrial areas.

Performance



Compressor Data

HST 30-	36-1-U250	36-1-U300	36-1-U350	36-1-U400
Air flow range [scfm]	1500-6000	1500-6000	1500-6100	1500-6200
Pressure rise [psi]	4.4-12.3	4.4-13.1	4.4-13.1	4.4-13.1
Noise level [dB]	73	73	72	72
Input power [hp]	250	300	350	400
Main supply voltage [V]	460-600	460-600	460-600	460-600
Input power frequency [Hz]	50/60	50/60	50/60	50/60
480 V Max. input current [A] ⁽¹⁾	246	296	345	394
Cable size [AWG or MCM]	2x(3x4/0+4)	2x(3x300+3)	2x(3x350+3)	2x(3x500+2)
Fuse size [A]	250	315	400	400
580 V Max. input current [A] ⁽¹⁾	204	245	286	326
Cable size [AWG or MCM]	2x(3x3/0+4)	2x(3x4/0+4)	2x(3x250+4)	2x(3x350+3)
Fuse size [A]	250	250	315	400
Weight [lb]	3500	3500	3800	3800

HST 30-	46-1-U250	46-1-U300	46-1-U350	46-1-U400	46-1-U450
Air flow range [scfm]	2000-7300	2000-7300	2000-7500	2000-7600	2000-7900
Pressure rise [psi]	4.4-10.9	4.4-13.1	4.4-13.1	4.4-13.1	4.4-13.1
Noise level [dB]	73	73	72	72	75
Input power [hp]	250	300	350	400	450
Main supply voltage [V]	460-600	460-600	460-600	460-600	460-600
Input power frequency [Hz]	50/60	50/60	50/60	50/60	50/60
480 V Max. input current [A] ⁽¹⁾	246	296	345	394	444
Cable size [AWG or MCM]	2x(3x4/0+4)	2x(3x300+3)	2x(3x350+3)	2x(3x500+2)	2x(3x500+2)
Fuse size [A]	250	315	400	400	500
580 V Max. input current [A] ⁽¹⁾	204	245	286	326	367
Cable size [AWG or MCM]	2x(3x3/0+4)	2x(3x4/0+4)	2x(3x250+4)	2x(3x350+3)	2x(3x400+2)
Fuse size [A]	250	250	315	400	400
Weight [lb]	3500	3500-3800	3800	3800	3800

HST 30-	58-8-U250	58-8-U300	58-8-U350	58-8-U400	58-8-U450
Air flow range [scfm]	2500-8700	2500-9100	2500-9300	2500-9400	2500-9500
Pressure rise [psi]	4.4-8.7	4.4-10.9	4.4-10.9	4.4-10.9	4.4-10.9
Noise level [dB]	73	73	73	74	75
Input power [hp]	250	300	350	400	450
Main supply voltage [V]	460-600	460-600	460-600	460-600	460-600
Input power frequency [Hz]	50/60	50/60	50/60	50/60	50/60
480 V Max. input current [A] ⁽¹⁾	246	296	345	394	444
Cable size [AWG or MCM]	2x(3x4/0+4)	2x(3x300+3)	2x(3x350+3)	2x(3x500+2)	2x(3x500+2)
Fuse size [A]	250	315	400	400	500
580 V Max. input current [A] ⁽¹⁾	204	245	286	326	367
Cable size [AWG or MCM]	2x(3x3/0+4)	2x(3x4/0+4)	2x(3x250+4)	2x(3x350+3)	2x(3x400+2)
Fuse size [A]	250	250	315	400	400
Weight [lb]	3800	3800	3800	3800	3800

⁽¹⁾ The maximum input current is calculated using the nominal voltage. The cable and fuse sizes are recommendations and based on the supply current and cables rated to 70 °C [158 °F].

⁽²⁾ The maximum input power of HST 30-46-1-U450-58 can only be reached if the tolerance of the main supply voltage is 580 VAC -5% +10%.

SULZER USA HST INSTALLATION LIST

Project Name	City	State	Blower Model	Quantity	End-User Contact Information	End-User Phone	End-User Email	Current RSM
De Pere WWTP	De Pere	WI	HST 9000-1-H-5	6	Pat Wescott	920-438-1090	pwescott@newwater.us	Tim Ruppert
Fond du Lac WPCP	Fond du Lac	WI	HST 9000-1-H-5	4	Cody Schoepke	920-322-3662	cschoepke@fdl.wi.gov	Tim Ruppert
Downers Grove WWTP - 1st	Downers Grove	IL	HST 9000-1-H-5	1	Nick Meniga	630-969-0664	nmeniga@dgsd.gov	Tim Ruppert
Marquette WWTF	Marquette	MI	HST 6000-1-L-5	3	Curt Goodman	906-225-4055	cgoodman@marquettemi.gov	Tim Ruppert
Livermore WWTP - 1st	Livermore	CA	HST 9000-1-L-5	1	Yanming Zhang	925-960-8100	yzhang@cityoflivermore.net	Rick Barile
Springbrook WRC	Naperville	IL	HST 9000-1-L-5	6	David Today	630-420-4181	todayd@naperville.il.us	Tim Ruppert
Geneva - 1st Blower	Geneva	AL	HST 2500-1-L-5	1	James Dixon	334-684-9554	genevawaterworks0622@gmail.com	Anne Chalmers
Livermore WWTP - 2nd	Livermore	CA	HST 9000-1-L-5	2	Yanming Zhang	925-960-8100	yzhang@cityoflivermore.net	Rick Barile
Wisconsin Rapids WWTP	Wisconsin Rapids	WI	HST 9000-1-H-5	3	Ryan Giefer - Derek Budsberg	715-421-8237	rgiefer@wirapids.org dbudsberg@wirapids.org	Tim Ruppert
Meriden WPCF	Meriden	CT	HST 40-400-1-H-5	2	Frank Russo	203-630-4261	frusso@ci.meriden.ct.us	John Scavitto
Meriden WPCF	Meriden	CT	HST 2500-1-H-5	1	Frank Russo	203-630-4261	frusso@ci.meriden.ct.us	John Scavitto
Star Sewer & Water District - 1st	Star	ID	HST 6000-1-L-5	1	Hank Day	208-631-8588	hday@starswd.com	Rick Barile
Bowling Green - Aeration	Bowling Green	KY	HST 9000-1-H-5	4	Scott Neighbors	270-282-1824	scott.neighbors@bgmu.com	Tim Ruppert
Southwest Regional WRF - 1st	Volusia County	FL	HST 6000-1-L-5	2	Stuart Hemke	386-775-5245	shemke@volusia.org	Anne Chalmers
Grantsville WWTF	Grantsville	UT	HST 9000-1-H-5	3	Markus Seat	435-224-3261	mseat@grantsvilleut.gov	Rick Barile
Bozeman WRF	Bozeman	MT	HST 6000-1-H-4	4	Tom Radcliffe	406-582-2928		Tim Ruppert
Coldwater	Coldwater	MI	HST 2500-2-A-5	2	Jon Foley	517-279-9531	jfoley@coldwater.org	Tim Ruppert
Middle Oconee WWTP	Athens	GA	HST 2500-1-H-5	4		706-613-3486		Dan Davis
Faribault	Faribault	MN	HST 9000-1-H-5	2	Steve McDowell	612-221-7673		Tim Ruppert
Faribault	Faribault	MN	HST 6000-1-H-5	1	Steve McDowell	612-221-7673		Tim Ruppert
Reed City WWTP	Reed City	MI	HST 2500-1-H-5	4	Curt Brackenrich	231-832-5353	curtbrackenrich@gmail.com	Tim Ruppert
Butte-Silver Bow WWTP - Digester - 1st	Butte	MT	HST 9500-200-1-L-5	1	Bill Andrene	406-497-6550	wandrene@bsb.mt.gov	Tim Ruppert
Auburn	Auburn	IN	HST 6000-1-H-5	2	David Lochner	260-925-1714 ext 2301		Tim Ruppert
Auburn	Auburn	IN	HST 2500-1-H-5	1	David Lochner	260-925-1714 ext 2301		Tim Ruppert
Salina	Salina	KS	HST 2500-1-H-5	2	Kurt Williams	785-826-7305	kurt.williams@salina.org	Dan Davis
Pueblo	Pueblo	CO	HST 9500-280-1-L-5	5	John Lindstrom	719-553-2866	jlindstrom@pueblo.us	Tim Ruppert
Morehead WWTP, MUPB - 1st Blower	Morehead	KY	HST 6000-1-H-5	1	Chuck Davis	606-783-1502	cdavis@mupb.com	Tim Ruppert
Bowling Green - Sludge	Bowling Green	KY	HST 6000-1-H-5	3	Scott Neighbors	270-282-1824	scott.neighbors@bgmu.com	Tim Ruppert
Derby	Derby	CT	HST 2500-1-L-5	1	Edward Abel	403-823-1340	eabel@derbyct.gov	John Scavitto
Akron	Akron	OH	HST 40-400-1-L-5	4	Tom Smith	330-375-2963 ext 7126	tsmith@akronohio.gov	Tim Ruppert
Huntsville	Huntsville	AL	HST 9500-280-1-L-5	2	Matt Reynolds	256-883-3722		Anne Chalmers
WSSC - Phase 1	Marlboro	MD	HST 40-350-1-L-5	4	Kevin Selock - Patricia Jones	301-206-8233 301-206-8318	kevin.selock@wsscwater.com - patricia.jones@wsscwater.com	John Scavitto
YCUA	Ypsilanti	MI	HST 40-300-1-L-5	2	Kevin Dupuis	734-544-7236	kdupuis@ycua.org	Tim Ruppert
Pasco - No. 1	Pasco	WA	HST 6000-1-L-5	2	Todd Marden	509-545-3468	mardent@pasco-wa.gov	Rick Barile
Butte-Silver Bow WWTP - Digester - 2nd	Butte	MT	HST 9500-200-1-L-5	1	Bill Andrene	406-497-6550	wandrene@bsb.mt.gov	Tim Ruppert
Burlington	Burlington	WI	HST 2500-1-A-5	3	Donnie Heft	262-539-3646	dheft@burlington-wi.gov	Tim Ruppert
Mundelein	Mundelein	IL	HST 6000-1-H-5	1	Paul Cacioppo	847-949-3275	pw@mundelein.org	Tim Ruppert
Terre Haute WWTP	Terre Haute	IN	HST 40-U400-1-H-48	3	John Rosselli	812-240-9658	johnny.rosselli@terrehaute.in.gov	Dan Davis
Terre Haute WWTP	Terre Haute	IN	HST 40-U400-1-L-48	2	John Rosselli	812-240-9658	johnny.rosselli@terrehaute.in.gov	Dan Davis
Neptune - 1st	Neptune	NJ	HST 20-4500-1-150-50	1	Tina Della Pietra	732-922-3434 ext 3	dellapietra@tnsa-nj.org	John Scavitto
Lexington Zone 2	Lexington	KY	HST 40-400-1-H-5	2	James Worten Sr	859-272-1713	jworten@lexingtonky.gov	Tim Ruppert
Lexington Zone 1	Lexington	KY	HST 40-300-1-L-5	2	James Worten Sr	859-272-1713	jworten@lexingtonky.gov	Tim Ruppert
South Laredo - Phase 1	Laredo	TX	HST 9500-U375-1-H-48	5	Jose Chavarria	956-721-2000	jchavarria@ci.laredo.tx.us	Anne Chalmers
Cornelia	Cornelia	GA	HST 20-4500-1-U150-48	1	Andy Pilgrim	706-894-3085	apilgrim@corneliageorgia.org	Anne Chalmers
Eau Claire	Eau Claire	WI	HST 9500-280-1-H-5	3	Steve Hayden	715-839-4902	steve.hayden@ci.eau-claire.wi.us	Tim Ruppert
Upper Thompson Sanitation District	Estes Park	CO	HST 20-6000-1-U250-48	1	Henry Newhouse	970-586-5389 ext 257	henry@utsd.org	Tim Ruppert
PARCC Side Clean Water Plant	Grand Rapids	MI	HST 20-6000-1-190-50	1	Larry Campbell	616-363-0702		Tim Ruppert
Plymouth	Plymouth	CT	HST 2500-U100-2-L-5	3	Jason Patrick	860-582-4881	jpatrick@plymouthct.us	John Scavitto
Cheshire	Cheshire	CT	HST 2500-U120-1-H-48	2	Scott Hallier	203-272-9105	shallier@cheshirect.org	John Scavitto
Cheshire	Cheshire	CT	HST 9500-U250-1-L-48	2	Scott Hallier	203-272-9105	shallier@cheshirect.org	John Scavitto
San Leandro WWTP	San Leandro	CA	HST 20-4500-1-U150-48	1	Orlando Gianecchini	510-750-6626	ogianecchini@sanleandro.org	Rick Barile
SCWRF - Phase 1	Collier County	FL	HST 20-6000-1-U250-48	2	Chris Farris	239-252-6886	christopherfarris@colliergov.net	Anne Chalmers

Neptune - 2nd	Neptune	NJ	HST 20-4500-1-150-50	1	Tina Della Pietro	732-922-3434 ext 3	dellapietro@tnsa-nj.org	John Scavitto
Pasco - No. 2	Pasco	WA	HST 20-4500-1-U150-48	2	Todd Marden	509-545-3468	mardent@pasco-wa.gov	Rick Barile
Mount Vernon	Mount Vernon	WA	HST 20-6000-1-U200-48	1	Gary Duranceau	360-336-6219 ext 2310	garyd@mountvernonwa.gov	Rick Barile
Monroe	Monroe	WA	HST 2500-U100-1-L-48	2	Donovan Sheppard	425-754-3771	dseppard@monroewa.gov	Rick Barile
Eagle River	Eagle River	AK	HST 2500-U120-1-H-48	1	Cliff Fletcher	907-261-5770	clifford.fletcher@awwu.biz	Rick Barile
Flagg Creek	Flagg Creek	IL	HST 40-U400-1-L-48	1	James Liubicich	630-323-3299	jliubicich@fcwrd.org	Tim Ruppert
Romeoville	Romeoville	IL	HST 20-4500-1-U150-48	2	Tim Zarnowski	815-409-1074	tzarnowski@romeoville.org	Tim Ruppert
Wood Dale North WWTP	Wood Dale	IL	HST 20-4500-1-U150-48	3	Brad Kittilson	630-350-3530	bkittilson@wooddale.com	Tim Ruppert
Plainfield SWWTP	Plainfield	IN	HST 40-U500-1-L-48	1	Dennis Unterreiner	317-339-9297	dunterreiner@town.plainfield.in.us	Dan Davis
Coachella Valley Water District (CVWD)	Coachella	CA	HST 40-U500-1-L-48	6	Jose Pat Medina	760-398-2661	jpatmedina@cvwd.org	Rick Barile
Westside WWTP	High Point	NC	HST 9500-200-1-L-5	4	Kevin Woods	336-822-4730	kevin.wood@highpointnc.gov	Dan Davis
Butte-Silver Bow WWTP - 3rd	Butte	MT	HST 20-6000-1-U200-48	3	Bill Andrene	406-497-6550	wandrene@bsb.mt.gov	Tim Ruppert
Oshkosh	Oshkosh	WI	HST 9500-U300-1-H-48	2	Kevin	920-232-5365		Tim Ruppert
San Angelo WWTP	San Angelo	TX	HST 20-4500-1-U200-48	2	Paul Rodriguez	937-423-2934	paul.rodriguez@daytonohio.gov	Anne Chalmers
Star Sewer & Water District - 2nd	Star	ID	HST 2500-U100-2-L-48	1	Hank Day	208-631-8588	hday@starswd.com	Rick Barile
Dayton	Dayton	OH	HST 40-U400-1-L-48	4	Paul MacCallum	937423-2934	paul.maccallum@daytonohio.gov	Tim Ruppert
Broomfield	Broomfield	CO	HST 40-U400-1-L-48	4	Craig Triezenburg	303-464-5642	ctriezenberg@broomfield.org	Tim Ruppert
Broomfield	Broomfield	CO	HST 20-4500-1-U150-48	2	Craig Triezenburg	303-464-5642	ctriezenberg@broomfield.org	Tim Ruppert
Victoria	Victoria	TX	HST 2500-U120-1-H-48	1	Curtis Davis	361-485-3263	cdavis@victoriatx.org	Anne Chalmers
Downers Grove WWTP - 2nd	Downers Grove	IL	HST 9500-U322-1-L-48	1	Nick Meniga	630-969-0664	nmeniga@dgsd.gov	Tim Ruppert
Sunnyside	Sunnyside	WA	HST 20-4500-1-U150-48	1	Raul Sanchez	509-836-6566	rsanchez@sunnyside-wa.gov	Rick Barile
Coeur d'Alene - Phase 1	Couer D'Alene	ID	HST 2500-1-H-5	2	Casey Fisher	208-769-2346	cfisher@cdaid.org	Rick Barile
Coeur d'Alene - Phase 1	Couer D'Alene	ID	HST 20-4500-1-U150-48	2	Casey Fisher	208-369-2346	cfisher@cdaid.org	Rick Barile
Chesterton	Chesterton	IN	HST 20-6000-1-U150-48	1	Bill Williams	219-926-1032	bwilliams@chestertonin.org	Dan Davis
Clute	Clute	TX	HST 2500-U110-1-H-48	4	William McCart	979-265-3619	william.mccart@brazos.org	Anne Chalmers
North River WWTF (HRRSA)	Mount Crawford	VA	HST 40-U400-1-L-48	3	Sharon G Foley P.E.	540-434-1053 ext 223	sfoley@hrrsa.org	John Scavitto
Trenton	Trenton	MI	HST 20-6000-1-U250-48	3	Jason Tapp	734-626-0646	jtapp@trenton.mi.com	John Scavitto
Pinetop-Lakeside SD WWTP	Lakeside	AZ	HST 20-4500-1-U150-48	2	Dave Smith	928-368-5370 ext 1232	dsmith@plsd.com	Rick Barile
Davis	Davis	CA	HST 20-6000-1-U200-48	3	John Alexander	650-219-8668	jalexander@cityofdavis.org	Rick Barile
Indian Lake WWTP	Logan County	OH	HST 2500-U100-2-L-48	1				Tim Ruppert
Windsor WWTP	Windsor	CO	HST 20-6000-1-U200-48	1	Dennis Markham	970-686-2144	dmarkham@windsorgov.com	Tim Ruppert
Lincoln	Lincoln	NE	HST 20-6000-1-U250-48	1	Steve Schmalken	402-432-8703		Tim Ruppert
Kuna	Kuna	ID	HST 2500-U125-2-H-48	1	Travis Fleming	208-573-7672	tfleming@kunaid.gov	Rick Barile
Tullahoma WWTP	Tullahoma	TN	HST 20-4500-1-U150-48	1	Scott Young	932-571-7106	syoun@tub.net	Tim Ruppert
Gurnee WRF - NSWRD	Lake County	IL	HST 20-4500-1-U150-48	1	Tom Lentz	847-623-6060	tolentz@northshorewd.org	Tim Ruppert
Gurnee WRF - NSWRD	Lake County	IL	HST 9500-U350-1-L-48	1	Tom Lentz	847-623-6060	tolentz@northshorewd.org	Tim Ruppert
Benton Harbor - 1st	Benton Harbor	MI	HST 40-U450-1-L-48	1	James Jonatzke	269-983-7719		Tim Ruppert
Clavey Road WWTP - NSWRD	Lake County	IL	HST 20-6000-1-U200-48	1	I Filipovich	847-623-6060	ifilipovich@northshorewd.org	Tim Ruppert
Clavey Road WWTP - NSWRD	Lake County	IL	HST 9500-U350-1-L-48	1	I Filipovich	847-623-6060	ifilipovich@northshorewd.org	Tim Ruppert
Waukegan WWTP - NSWRD	Lake County	IL	HST 40-U500-1-L-48	1	Eric Daudlin	847-623-6060	erdaudlin@northshorewd.org	Tim Ruppert
Louisville WWTP - Aeration	Louisville	CO	HST 20-4500-1-U200-48	3	Justin Elkins	303-335-4784	jelkins@louisvilleco.gov	Tim Ruppert
Hanover - Phase 1	Hanover	IL	HST 20-6000-1-U200-48	1				Tim Ruppert
Delaware	Delaware	OH	HST 20-6000-1-U150-48	2	Brian Livingston Brad Stanton	740-203-1956 740-203-1903	blivingston@delawareohio.net bstanton@delawareohio.net	Tim Ruppert
Irwin Creek WWTP	Charlotte	NC	HST 9500-U350-1-L-48	2	Mike Lingerfeld - Jacob Bolick - James Antio	704-336-2570	mlingerfeld@ci.charlotte.nc.us - jbolick@ci.charlotte.nc.us - jantio@ci.charlotte.nc.us	John Scavitto
Irwin Creek WWTP	Charlotte	NC	HST 40-U450-1-L-48	2	Mike Lingerfeld - Jacob Bolick - James Antio	704-336-2570	mlingerfeld@ci.charlotte.nc.us - jbolick@ci.charlotte.nc.us - jantio@ci.charlotte.nc.us	John Scavitto
Macomb WWTP	Macomb	IL	HST 2500-U100-1-L-48	2	Josh Peters	309-833-2088		Tim Ruppert
El Toro Water Recycling Plant	Lake Forest	CA	HST 40-U400-1-L-48	1	Mark Pade	949-837-7050 ext 103	mpade@etwd.com	Rick Barile
South Central Regional WRF	Brevard County	FL	HST 20-6000-1-U200-48	3				Anne Chalmers
Southwest Regional WRF - 2nd	Volusia County	FL	HST 20-6000-1-U200-48	1	Stuart Hemke	386-775-5245	shemke@volusia.org	Anne Chalmers
United States Air Force Academy	Colorado Springs	CO	HST 2500-U100-2-L-48	2	James Hester	303-710-3571	jhester1@olgoonik.com	Tim Ruppert
Jerome WWTP	Jerome	ID	HST 20-6000-1-U250-48	2	Brad Henry	208-327-7122	bhenry@ci.jerome.id.us	Rick Barile
Springfield SWCWP	Springfield	MO	HST 20-6000-1-U200-48	4	Brian Wirth	417-874-2873	bwirth@springfieldmo.gov	Dan Davis
Fritz Island WWTP	Reading	PA	HST 40-U500-1-H-48	5	Roger Hillibush - Amy Morriss - Juanita Komoro	610-655-6322	roger.hillibush@readingpa.org - amy.morriss@readingpa.org - juanita.komoro@readingpa.org	John Scavitto

Star City WWTP	Morgantown	WV	HST 20-4500-1-U200-48	4	Charles Nester	304-599-2111	cnester@mub.ord	John Scavitto
Marion	Marion	IN	HST 40-U400-1-L-48	2				Dan Davis
Delhi Township	Delhi Township	MI	HST 2500-U100-1-L-48	2	Sandra "Sam" Diorka	517-712-8771	Sandra.Diorka@delhitownship.com	Tim Ruppert
Louisville WWTP - Digester	Louisville	CO	HST 40-U400-1-H-48	1	Justin Elkins	303-335-4784	jelkins@louisvillico.gov	Tim Ruppert
Eagle Sewer District WWLTF	Eagle	ID	HST 20-6000-1-U200-48	2	RJ Lake	208-938-2027	rjlake@eaglesewer.org	Rick Barile
Coeur d'Alene - Phase 2	Coeur d'Alene	ID	HST 20-6000-1-U150-48	3	Casey Fisher	208-769-2346	cfisher@cdaid.org	Rick Barile
Star Sewer & Water District - 3rd	Star	ID	HST 2500-U100-2-L-48	1	Hank Day	208-631-8588	hday@starswd.com	Rick Barile
Mexico	Mexico	MO	HST 2500-U110-1-H-48	2	Rick Dunker	573-581-8251		Dan Davis
Beaver Dam	Beaver Dam	WI	HST 20-6000-1-U200-48	2	Rob Minnema	920-225-4055	rminnema@cityofbeaverdam.com	Tim Ruppert
Palmer	Palmer	AK	HST 20-4500-1-U150-48	1	Alycia Anderson	907-762-1351	ahowell@palmerak.org	Rick Barile
York	York	NE	HST 2500-U110-1-H-48	3	Aaron Dressel	402-363-2600	adressel@cityofyork.net	Tim Ruppert
South Laredo - Phase 2	Laredo	TX	HST 9500-U375-1-H-48	2	Jose Chavarria	956-721-2000	jchavarria@ci.laredo.tx.us	Anne Chalmers
Michigan City	Michigan City	IN	HST 9500-U300-1-L-48	2	Michael Kuss	219-229-1298	mkuss@mcsan.org	Tim Ruppert
WSSC - Phase 2	Marlboro	MD	HST 40-350-1-L-5	1	Kevin Selock - Patricia Jones	301-206-8233 301-206-8318	kevin.selock@wsscwater.com - patricia.jones@wsscwater.com	John Scavitto
Pecan Branch WWTP	Georgetown	TX	HST 20-6000-1-U200-48	1	Randall Swenson	512-930-6584	randall.swenson@georgetown.org	Anne Chalmers
Fraser	Fraser	CO	HST 20-6000-1-U200-48	2	Joe Fuqua	970-726-9621	jfuqua@town.fraser.co.us	Tim Ruppert
Benton Harbor - 2nd	Benton Harbor	MI	HST 40-U450-1-L-48	1	James Jonatzke	269-983-7719	jjonatzke@qtm.net	Tim Ruppert
Youngstown	Youngstown	OH	HST 20-6000-1-U250-48	3	Gene Lesen	330-742-8820	gleson@youngstownohio.gov	Tim Ruppert
Sugar Creek WWTP	Charlotte	NC	HST 40-U400-1-L-48	5	Hank Lewis - Billy Allen	704-336-7600	hmlewis@ci.charlotte.nc.us - ballen@ci.charlotte.nc.us	John Scavitto
EL Centro	EL Centro	CA	HST 9500-U250-1-L-48	2	Abraham Campos	760-336-8520	acampos@cityofelcentro.org	Rick Barile
Hanover - Phase 2	Hanover	IL	HST 20-6000-1-U200-48	1	Adam Gronski	630-823-5700	GronskiA@mwrd.org	Tim Ruppert
Greeley WPCF	Greeley	CO	HST 9500-U300-1-L-48	3	Sean Cooney	970-336-4248	Sean.Cooney@Greeleygov.com	Tim Ruppert
SWWWRF - West Villages	North Port	FL	HST 2500-U100-1-L-48	3				Anne Chalmers
SCWRF - Phase 2	Collier County	FL	HST 20-6000-1-U250-48	4	Chris Farris	239-252-6886	christopherfarris@colliergov.net	Anne Chalmers
Rifle Range Road WWTP	Mount Pleasant	SC	HST 9500-U375-1-H-48	3	Tom Wright	843-884-9626		John Scavitto
Midland WPCP	Midland	TX	HST 9500-U350-1-H-48	4				Anne Chalmers
South Beloit WWTP	South Beloit	IL	HST 2500-U120-1-H-48	3	Jeff Reininger	815-389-3070	j.reininger@southbeloit.org	Tim Ruppert
Lexington - Retrofit Blower - Zone 1	Lexington	KY	HST 40-300-1-L-5	1	Charlie Begley	859-425-2414	cbegley@lexingtonky.gov	Tim Ruppert
Tapia WWTP, Las Virgenes MWD	Calabazas	CA	HST 40-U400-1-L-48	3	Eric Schlageter	818-251-2142	eschlageter@lvmwd.com	Rick Barile
Largo WWRF	Largo	FL	HST 20-6000-1-U200-48	4				Anne Chalmers
Morehead WWTP, MUPB - 2nd Blower	Morehead	KY	HST 2500-U120-1-H-48	1	Chuck Davis	606-783-1502	cdavis@mupb.com	Tim Ruppert
Dry Creek WWTP	Villa Hills	KY	HST 40-U450-1-H-48	3				Tim Ruppert
Yonkers WWTP	Yonkers	NY	HST 40-U500-1-L-48	5	Vince Kopicki	914-813-5450	vvk2@westchestergov.com	John Scavitto
Alexandria WWTP	Alexandria	VA	HST 20-6000-1-U150-48	6	Felicia Glapion, Jeff Lindsay, Christopher Painter, Nykia Roberson-Ramos		felicia.glapion@alexrenew.com, jeff.lindsay@alexrenew.com, Christopher.Painter@hdrinc.com, nykia.robersonramos@alexrenew.com	John Scavitto
Hart	Hart	MI	HST 40-U400-1-L-48	2	Paul Cutter	231-638-1963	pcutter@cityofhart.org	Tim Ruppert
Geneva - 2nd Blower	Geneva	AL	HST 2500-U100-1-L-48	1				Anne Chalmers
Centennial WWTP (Marcy Gulch)	Littleton	CO	HST 20-6000-1-U250-48	4				Tim Ruppert
Miller Ave WWTP	Jackson	TN	HST 20-4500-1-U200-48	2	Curtis Richards	303-907-6971	crichards@cwsdhrmd.org	Tim Ruppert
Pacific WWTF	Pacific	MO	HST 20-6000-1-U200-48	2				Dan Davis
Windsor WWTP	Windsor	CO	HST 30-46-1-U300-48	1	Dennis Markham	970-686-2144	dmarkham@windsorgov.com	Tim Ruppert
East Peoria WWTP	East Peoria	IL	HST 20-4500-1-U200-48	4	Cord Crisler	309-698-4716	cordcrisler@cityofeastpeoria.cio	Tim Ruppert

	HST 30-	38-2-U350	38-2-U400	38-2-U450
Air flow range [scfm]		2200-6300	2200-6400	2200-6500
Pressure rise [psi]		8.7-16.0	8.7-18.9	8.7-18.9
Noise level [dB]		72	72	75
Input power [hp]		350	400	450
Power supply [V]		460-600	460-600	460-600
Input power frequency [Hz]		50/60	50/60	50/60
480 V	Max. input current [A] ⁽³⁾	345	394	444
	Cable size [AWG or MCM]	2x(3x350+3)	2x(3x500+2)	2x(3x500+2)
	Fuse size [A]	400	400	500
580 V	Max. input current [A] ⁽³⁾	286	326	367
	Cable size [AWG or MCM]	2x(3x250+4)	2x(3x350+3)	2x(3x400+2)
	Fuse size [A]	315	400	400
Weight [lb]		3800	3800	3800

⁽³⁾ The maximum input current is calculated using the nominal voltage. The cable and fuse sizes are recommendations and based on the supply current and cables rated to 70 °C [158 °F].

Installation Conditions ⁽⁴⁾

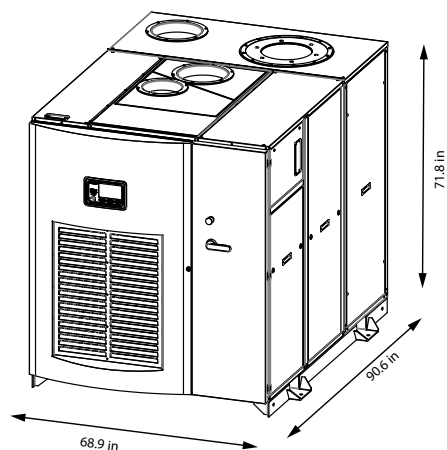
Altitude	
Maximum altitude	8200 ft above sea level ⁽⁵⁾
Air quality	
Permitted chemical vapors	IEC 60721-3-3 class 3C3
Ambient conditions	
Ambient temperature range	Min. -14 °F, max. 113 °F
Ambient relative humidity	< 95 %, non-condensing, non-corrosive, no dripping water
Inlet conditions	
Air temperature range for inlet process air	Min. -22 °F, max. 122 °F ⁽⁶⁾

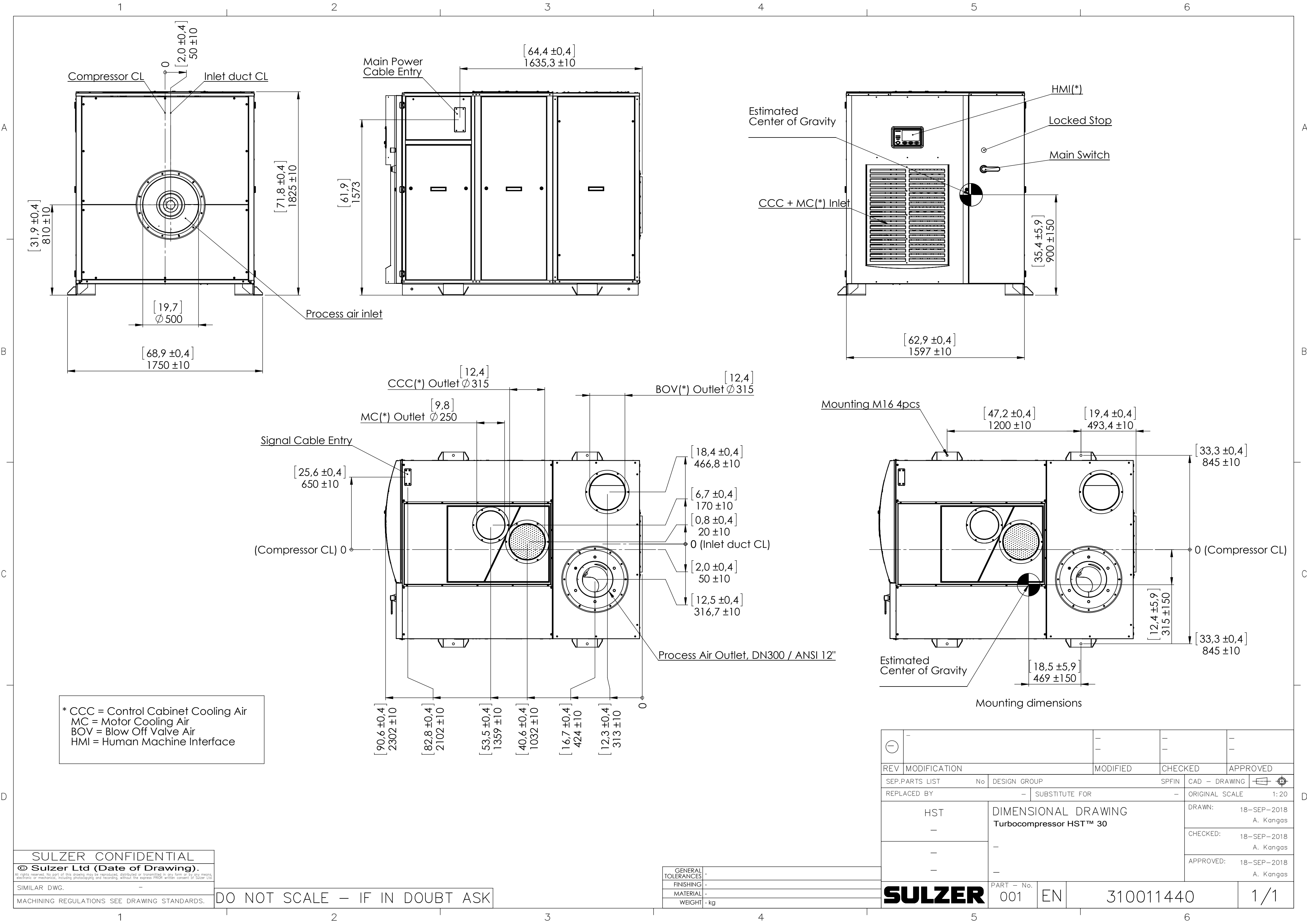
⁽⁴⁾ Sulzer may approve applications outside these criteria.

⁽⁵⁾ 6560 ft above sea level for 580 V compressors.

⁽⁶⁾ Max. 113 °F for HST 30-38-2 compressors.

Dimensions





SULZER CONFIDENTIAL
© Sulzer Ltd (Date of Drawing).
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SIMILAR DWG. -
MACHINING REGULATIONS SEE DRAWING STANDARDS.

DO NOT SCALE – IF IN DOUBT ASK

GENERAL TOLERANCES	-
FINISHING	-
MATERIAL	-
WEIGHT	- kg

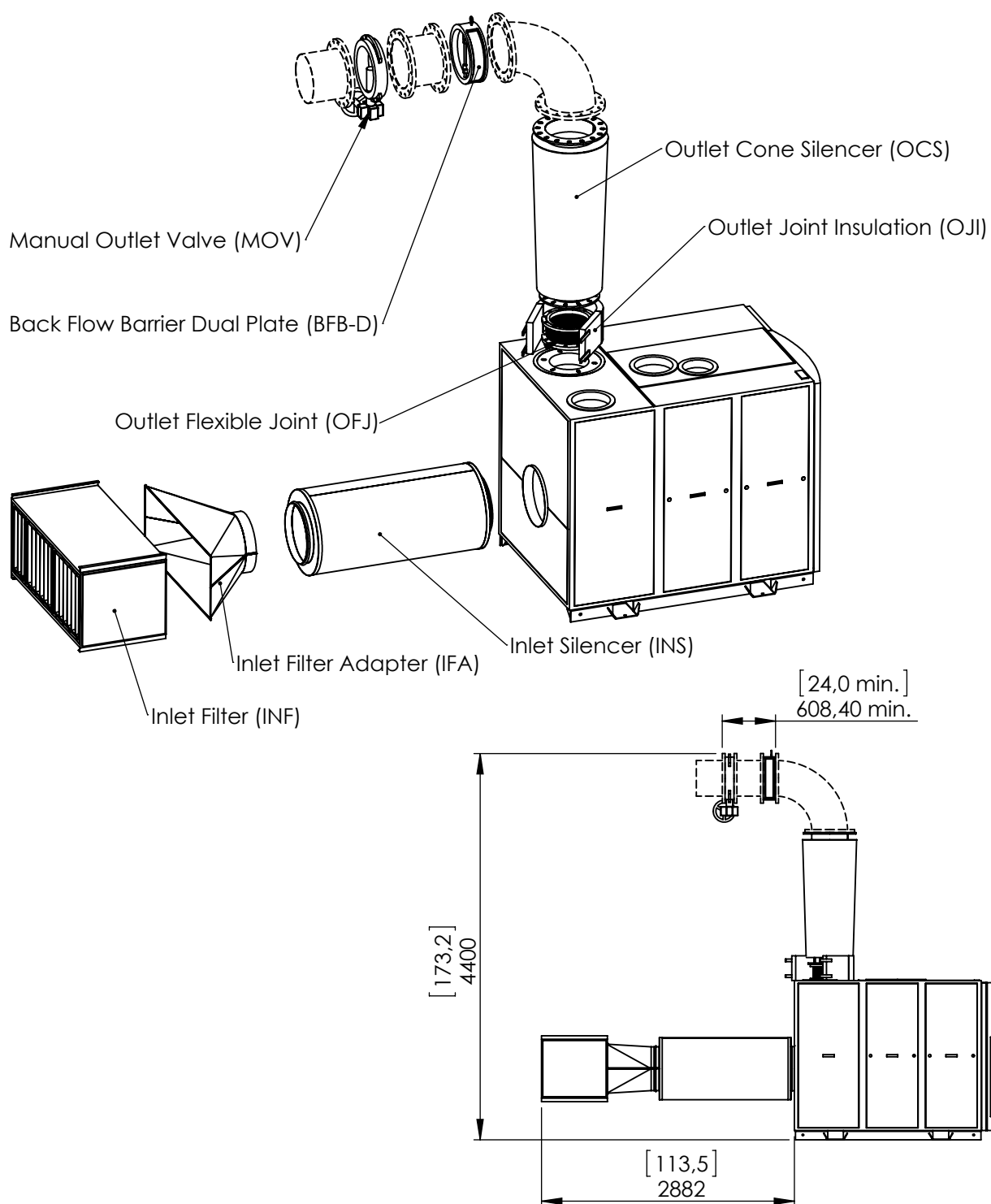
REV	MODIFICATION	MODIFIED	CHECKED	APPROVED
SEP.	PARTS LIST	No	DESIGN GROUP	SPFIN
REPLACED BY	-	SUBSTITUTE FOR	-	ORIGINAL SCALE
HST	DIMENSIONAL DRAWING			DRAWN: 18-SEP-2018
-	Turbocompressor HST™ 30			A. Kangas
-	-			CHECKED: 18-SEP-2018
-	-			A. Kangas
-	-			APPROVED: 18-SEP-2018
-	-			A. Kangas
PART - No.		001	EN	310011440
SULZER		1/1		

HST™ 30 Turbocompressor

Ducted inlet – standard outlet

Layout Example

Sales doc. no: 310011459 Rev.: -

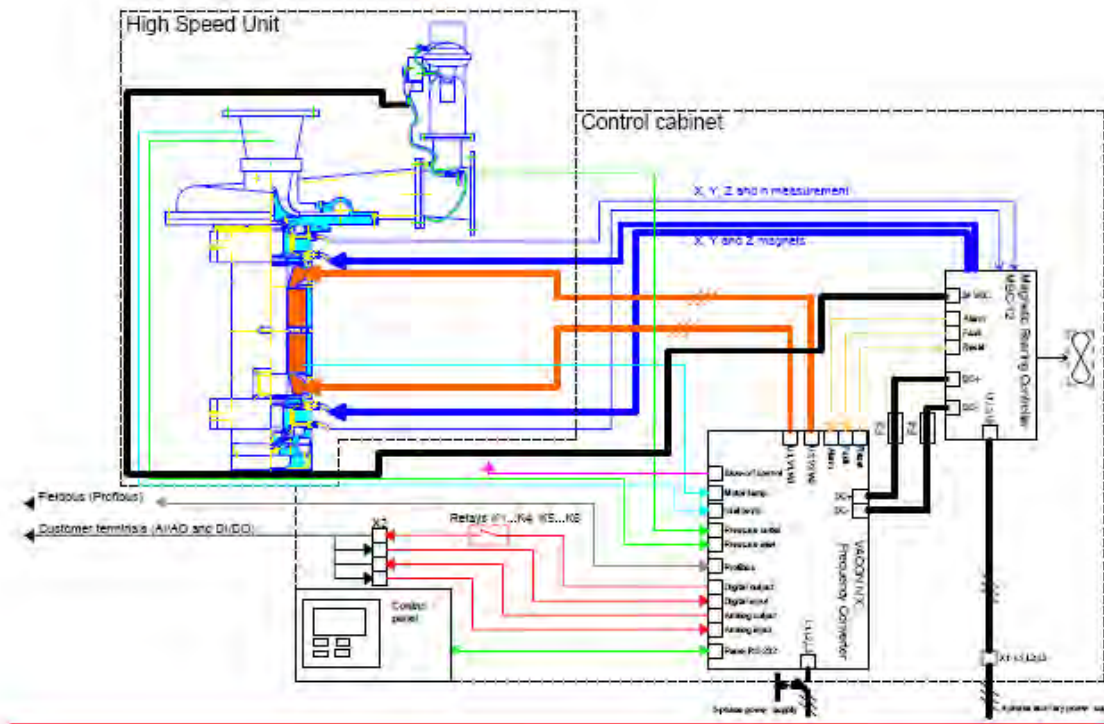


Turbocompressor accessories are applicable for use with HST™ Turbocompressor.

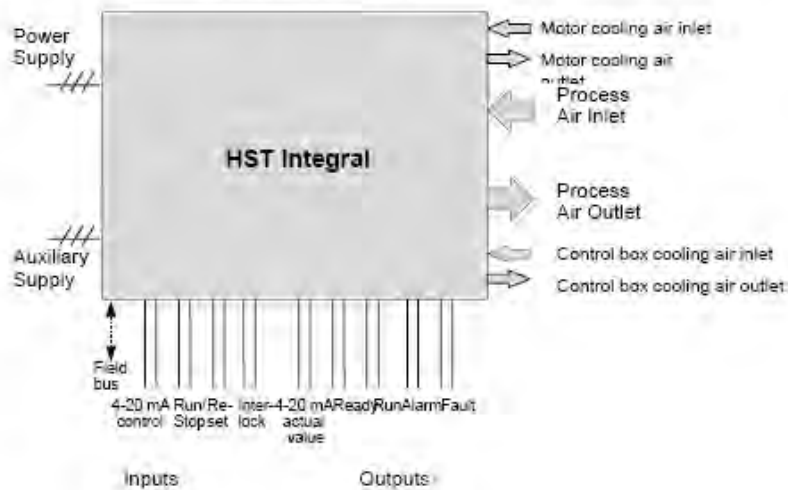
SHEET 1 / 1

Note: Dimensions are shown for DN 400 outlet piping.

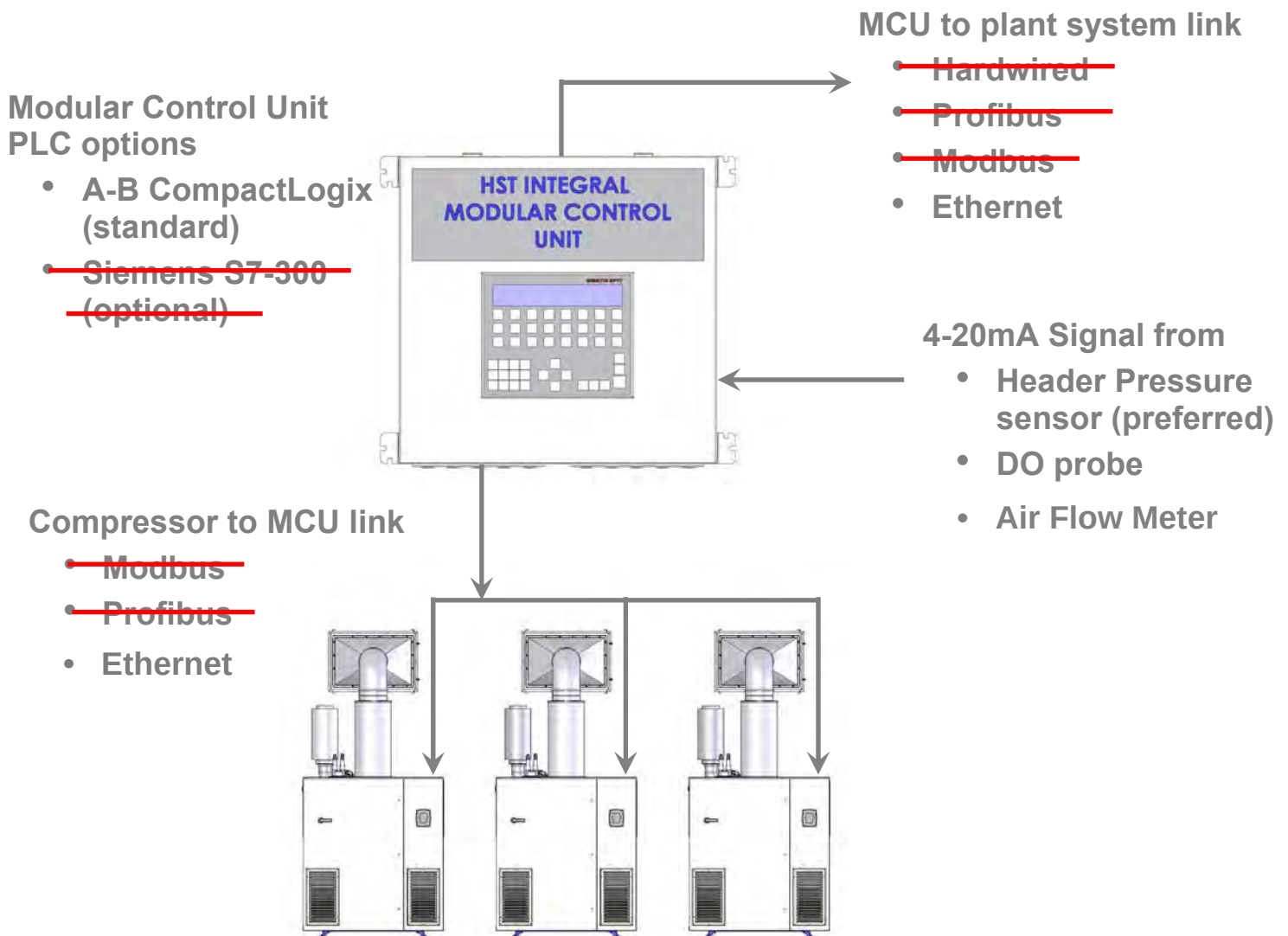
Turbocompressor HST Control Schematic



CONNECTIONS



Turbocompressor HST Modular Control Unit Communication Options



Use with three or more turbocompressors

November 3, 2004

HIGH SPEED COMPRESSOR TEST CODES

The high speed compressors developed by High Speed Tech Oy Ltd have been tested at Laboratory of Fluid Dynamics at Lappeenranta University of Technology and at HST Lappeenranta factory, where similar test loop facilities have been built.

There are no standard test codes applicable for integrated high speed compressors. Therefore, the test following test codes have been applied

- ISO 5389:1992 Turbocompressors
- VDI 2045:1993 Acceptance and Performance Tests on Turbo Compressors and Displacement Compressors
- ASME PTC 10 – 1974 / Reaffirmed 1986 Compressors and Exhausters

Main difference is the compact integration of the compressor and motor. As they can not be separated, the measurement of only the compressor shaft power is not possible and therefore unnecessary to follow within the various test codes.

The main quantities measured and investigated in the tests are:

- overall electric power
- pressure ratio of the compressor
- the capacity of the compressor

Power

The standards put a strong emphasis on the thermal equilibrium of the turbo compressor. The long measurement tests at LUT have shown that the overall power (which power is solely used in declaring the HST performance) reaches quickly a constant level, while the power balance between the motor and the drive (compressor) takes much longer time to be correctly measured (for example ASME PTC 10 requires minimum of 30 minutes between points).

The HST measurement routine allows a longer start time for the first measurement, but the following test points are reached within minutes. The measurement software informs the personnel as an adequate measurement point is achieved and a new valve position can be chosen.

Pressure ratio

The pressures are measured in the pressure measuring stations before and after the compressor. The locations of the four static taps, the distances of flow straightening and the method of the measurements are performed as defined in both PTC 10 and ISO 5389.

The capacity of the compressor

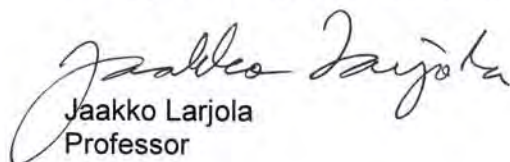
ISO 5389 states that the flow measurements are done according to ISO 5167, which acknowledges both the long radius and ISA 1932 nozzles. By comparison, the uncertainty coefficient of the ISA 1932 is lower than the long radius nozzle. The use of ISA 1932 at the inlet of the compressor enables us to make the flow measurements in almost constant conditions and improves further the reliability of the measurements.

The ASME PTC 10 includes only the long radius nozzle, but states that under bilateral agreements, the interested parties can agree upon the type of metering device suited for the conditions and the

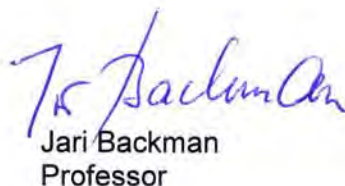
choice shall be stated in the test report. As the chosen device is ISA 1932 mentioned in the international standard, it is our understanding that ISA 1932 also fulfils the requirements of PTC 10.

The flow is measured in the inlet conditions and the only leakage of the machine is through a multi knife radial labyrinth seal between the base of the impeller and compressor base. Due to relative small pressure difference, this leakage is less than 1% and very difficult to measure. The ISO 5389 states that in these circumstances appropriate corrections shall be agreed between the manufacturer and purchaser. PTC 10 states that the capacity is the net rate of flow compressed and delivered. The HST margin covers this difference in measurements.

In Lappeenranta, November 3, 2004



Jaakko Larjola
Professor



Jari Backman
Professor

Limited Product Warranty

Standard | 2 Year

HST™ Turbocompressor *

Sulzer Pumps Solutions Inc. ("Manufacturer") warrants the above referenced Sulzer brand equipment ("Products"):

- i) will be of the kind and quality as described in the contract, and
- ii) will be free of material defects in workmanship and material, and
- iii) will, to the extent required for its functioning, be free from defects in design. However, Manufacturer shall not be held responsible for (i) selection or choice of products for a general or specific use, including quantities or sizing of products; or (ii) the design of the Products (including the selection of the materials) if the design and/or the selection of the materials was not chosen or provided by Manufacturer.

The warranty shall begin upon the delivery of the Products and expire on the earliest of the below dates ("Warranty Period"):

- i) twenty-four (24) months from date of installation of the Products; or
- ii) thirty (30) months from the date the Manufacturer made the relevant Products available for delivery.

This warranty is contingent upon start-up of the Products on site by an authorized Manufacturer's representative, as verified by receipt of start-up reports completed and signed by an authorized Manufacturer's representative, as well as any other documentation required by Manufacturer to support the claim.

In the event that Manufacturer undertakes any repair or replacement of any Products or parts thereof in accordance with its obligations under this warranty, such repaired or replaced part shall be warranted in accordance with this warranty for a period of ninety (90) days from the date of completion thereof or until the end of the Warranty Period, whichever expires later. Such extended Warranty Period shall under no circumstances exceed a period of ninety (90) days after the end of the original Warranty Period.

If during the Warranty Period, any Products or parts thereof fail to meet the requirements set out in this warranty, the purchaser or end user shall immediately provide written notification to Manufacturer stating the reasons therefor. Upon receipt of prior written authorization from Manufacturer, Products shall be transported to Manufacturer's authorized service center, prepaid, at purchaser or end-user's cost. Manufacturer's sole obligation shall be to repair, modify, or replace the affected product(s) or part(s) thereof at Manufacturer's sole option. Manufacturer shall be liable for Manufacturer's own costs incurred as a result of such action only. In no event shall Manufacturer be responsible for the cost of providing access to the Products or parts thereof, or costs of disassembly, removal or reinstallation of any Products or parts thereof. Product(s) or part(s) thereof repaired or replaced under this warranty will be returned with freight prepaid. Products must be repaired by an authorized Manufacturer repair center for warranty coverage to be considered. Explosion-proof or other agency approved Products must be repaired at a Manufacturer's authorized service center in order to retain the agency's approval rating.

This warranty shall not apply and shall terminate immediately if the faults or defects referred to herein cannot be proved to be a result of Manufacturer's failure under this warranty. Such exclusions from warranty shall include, but not be limited to, any Products or parts thereof which have been (i) subjected to misuse, misapplication, accident, alteration, neglect, failure to act in a timely manner to address alarms/warnings, or physical damage; (ii) stored outside and/or in a non-climate controlled environment, installed, operated, and/or maintained in a manner which is contrary to Manufacturer's written instructions as it pertains to installation, operation and maintenance of the Products, including but without limitation to being operated without being connected to monitoring devices supplied with specific products for protection; (iii) used in an application or for pumping liquids other than the use for which it is intended as specified in Manufacturer's product literature; (iv) damaged due to a defective power supply, improper electrical protection, faulty repair, ordinary wear and tear, corrosion, erosion or chemical attack, an act of God, an act of war or by an act of terrorism; (v) damaged resulting from the use of accessory equipment not sold by Manufacturer or not approved by Manufacturer for use in connection with Manufacturer's products; or (vi) repaired or altered without Manufacturer's written consent.

This warranty does not cover costs for standard and/or scheduled maintenance that is performed, nor does it cover Manufacturer's parts that, by virtue of their operation, require replacement through normal wear (aka: Wear Parts), unless a defect in material or workmanship is determined by Manufacturer. Wear Parts are defined as air filters, batteries, VFD, and MBC cooling fans and/or any items deemed necessary to perform and meet the requirements of normal maintenance on all Manufacturer's equipment.

All protection features (such as fuses, motor and VFD over temperature, over pressure, shaft position, etc.) incorporated in the Products must be properly connected to Manufacturer supplied or approved monitoring device(s) for warranty coverage. This warranty is valid only if alarm monitoring components, cables, and/or control components/panels supplied or authorized by Manufacturer are used. If protection feature(s) is(are) not connected, for any reason, it must be approved, in writing, by the Manufacturer, to validate the warranty coverage.

Manufacturer shall not be liable for any special, indirect, consequential, incidental, or punitive damages, or profit loss of any kind. Unless authorized in writing by Manufacturer, Manufacturer shall not be responsible for damages for delay or expenses for rented (replacement) equipment, pump removal, installation, contractors, or repairs.

This warranty shall extend only to the initial end user.

CORRECTION OF NONCONFORMITIES IN THE MANNER AND FOR THE PERIOD OF TIME PROVIDED WITHIN THIS WARRANTY SHALL CONSTITUTE FULFILLMENT OF ALL LIABILITIES OF MANUFACTURER TO PURCHASER WHETHER BASED ON CONTRACT, NEGLIGENCE, OR OTHERWISE, WITH RESPECT TO THE PRODUCTS AND PARTS THEREOF, INCLUDING ANY SERVICES PERFORMED. MANUFACTURER MAKES NO OTHER WARRANTY, GUARANTEE, OR REPRESENTATION IN RESPECT OF THE PRODUCTS AND PARTS THEREOF, INCLUDING ANY SERVICES PERFORMED OTHER THAN AS SPECIFIED IN THIS WARRANTY. ALL OTHER WARRANTIES, CONDITIONS, AND REPRESENTATIONS, EXPRESSED OR IMPLIED BY STATUTE, COMMON LAW, OR OTHERWISE, IN RELATION TO THE SUPPLY OF THE PRODUCTS, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OR MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE EXCLUDED TO THE EXTENT PERMITTED BY LAW.

* This warranty is applicable to Products supplied by Sulzer Pump Solutions (US) Inc. or Sulzer Pumps Wastewater Canada, Inc. for installation in the U.S.A. or Canada, unless specifically indicated otherwise in writing by Manufacturer.

Sulzer Turbo 30-36-1



SULZER USA HST INSTALLATION LIST

Project Name	City	State	Blower Model	Quantity	End-User Contact Information	End-User Phone	End-User Email	Current RSM
De Pere WWTP	De Pere	WI	HST 9000-1-H-5	6	Pat Wescott	920-438-1090	pwescott@newwater.us	Tim Ruppert
Fond du Lac WPCP	Fond du Lac	WI	HST 9000-1-H-5	4	Cody Schoepke	920-322-3662	cschoepke@fdl.wi.gov	Tim Ruppert
Downers Grove WWTP - 1st	Downers Grove	IL	HST 9000-1-H-5	1	Nick Meninga	630-969-0664	nmeninga@dgsd.gov	Tim Ruppert
Marquette WWTF	Marquette	MI	HST 6000-1-L-5	3	Curt Goodman	906-225-4055	cgoodman@marquettemi.gov	Tim Ruppert
Livermore WWTP - 1st	Livermore	CA	HST 9000-1-L-5	1	Yanming Zhang	925-960-8100	yzhang@cityoflivermore.net	Rick Barile
Springbrook WRC	Naperville	IL	HST 9000-1-L-5	6	David Today	630-420-4181	todayd@naperville.il.us	Tim Ruppert
Geneva - 1st Blower	Geneva	AL	HST 2500-1-L-5	1	James Dixon	334-684-9554	genevawaterworks0622@gmail.com	Anne Chalmers
Livermore WWTP - 2nd	Livermore	CA	HST 9000-1-L-5	2	Yanming Zhang	925-960-8100	yzhang@cityoflivermore.net	Rick Barile
Wisconsin Rapids WWTP	Wisconsin Rapids	WI	HST 9000-1-H-5	3	Ryan Giefer - Derek Budsberg	715-421-8237	rgiefer@wirapids.org dbudsberg@wirapids.org	Tim Ruppert
Meriden WPCF	Meriden	CT	HST 40-400-1-H-5	2	Frank Russo	203-630-4261	frusso@ci.meriden.ct.us	John Scavitto
Meriden WPCF	Meriden	CT	HST 2500-1-H-5	1	Frank Russo	203-630-4261	frusso@ci.meriden.ct.us	John Scavitto
Star Sewer & Water District - 1st	Star	ID	HST 6000-1-L-5	1	Hank Day	208-631-8588	hday@starswd.com	Rick Barile
Bowling Green - Aeration	Bowling Green	KY	HST 9000-1-H-5	4	Scott Neighbors	270-282-1824	scott.neighbors@bgmu.com	Tim Ruppert
Southwest Regional WRF - 1st	Volusia County	FL	HST 6000-1-L-5	2	Stuart Hemke	386-775-5245	shemke@volusia.org	Anne Chalmers
Grantsville WWTF	Grantsville	UT	HST 9000-1-H-5	3	Markus Seat	435-224-3261	mseat@grantsvilleut.gov	Rick Barile
Bozeman WRF	Bozeman	MT	HST 6000-1-H-4	4	Tom Radcliffe	406-582-2928		Tim Ruppert
Coldwater	Coldwater	MI	HST 2500-2-A-5	2	Jon Foley	517-279-9531	jfoley@coldwater.org	Tim Ruppert
Middle Oconee WWTP	Athens	GA	HST 2500-1-H-5	4		706-613-3486		Dan Davis
Faribault	Faribault	MN	HST 9000-1-H-5	2	Steve McDowell	612-221-7673		Tim Ruppert
Faribault	Faribault	MN	HST 6000-1-H-5	1	Steve McDowell	612-221-7673		Tim Ruppert
Reed City WWTP	Reed City	MI	HST 2500-1-H-5	4	Curt Brackenrich	231-832-5353	curtbrackenrich@gmail.com	Tim Ruppert
Butte-Silver Bow WWTP - Digester - 1st	Butte	MT	HST 9500-200-1-L-5	1	Bill Andrene	406-497-6550	wandrene@bsb.mt.gov	Tim Ruppert
Auburn	Auburn	IN	HST 6000-1-H-5	2	David Lochner	260-925-1714 ext 2301		Tim Ruppert
Auburn	Auburn	IN	HST 2500-1-H-5	1	David Lochner	260-925-1714 ext 2301		Tim Ruppert
Salina	Salina	KS	HST 2500-1-H-5	2	Kurt Williams	785-826-7305	kurt.williams@salina.org	Dan Davis
Pueblo	Pueblo	CO	HST 9500-280-1-L-5	5	John Lindstrom	719-553-2866	jlindstrom@pueblo.us	Tim Ruppert
Morehead WWTP, MUPB - 1st Blower	Morehead	KY	HST 6000-1-H-5	1	Chuck Davis	606-783-1502	cdavis@mupb.com	Tim Ruppert
Bowling Green - Sludge	Bowling Green	KY	HST 6000-1-H-5	3	Scott Neighbors	270-282-1824	scott.neighbors@bgmu.com	Tim Ruppert
Derby	Derby	CT	HST 2500-1-L-5	1	Edward Abel	403-823-1340	eabel@derbyct.gov	John Scavitto
Akron	Akron	OH	HST 40-400-1-L-5	4	Tom Smith	330-375-2963 ext 7126	tsmith@akronohio.gov	Tim Ruppert
Huntsville	Huntsville	AL	HST 9500-280-1-L-5	2	Matt Reynolds	256-883-3722		Anne Chalmers
WSSC - Phase 1	Marlboro	MD	HST 40-350-1-L-5	4	Kevin Selock - Patricia Jones	301-206-8233 301-206-8318	kevin.selock@wsscwater.com - patricia.jones@wsscwater.com	John Scavitto
YCUA	Ypsilanti	MI	HST 40-300-1-L-5	2	Kevin Dupuis	734-544-7236	kdupuis@ycua.org	Tim Ruppert
Pasco - No. 1	Pasco	WA	HST 6000-1-L-5	2	Todd Marden	509-545-3468	mardent@pasco-wa.gov	Rick Barile
Butte-Silver Bow WWTP - Digester - 2nd	Butte	MT	HST 9500-200-1-L-5	1	Bill Andrene	406-497-6550	wandrene@bsb.mt.gov	Tim Ruppert
Burlington	Burlington	WI	HST 2500-1-A-5	3	Donnie Heft	262-539-3646	dheft@burlington-wi.gov	Tim Ruppert
Mundelein	Mundelein	IL	HST 6000-1-H-5	1	Paul Cacioppo	847-949-3275	pw@mundelein.org	Tim Ruppert
Terre Haute WWTP	Terre Haute	IN	HST 40-U400-1-H-48	3	John Rosselli	812-240-9658	johnny.rosselli@terrehaute.in.gov	Dan Davis
Terre Haute WWTP	Terre Haute	IN	HST 40-U400-1-L-48	2	John Rosselli	812-240-9658	johnny.rosselli@terrehaute.in.gov	Dan Davis
Neptune - 1st	Neptune	NJ	HST 20-4500-1-150-50	1	Tina Della Pietra	732-922-3434 ext 3	dellapietra@tnsa-nj.org	John Scavitto
Lexington Zone 2	Lexington	KY	HST 40-400-1-H-5	2	James Worten Sr	859-272-1713	jworten@lexingtonky.gov	Tim Ruppert
Lexington Zone 1	Lexington	KY	HST 40-300-1-L-5	2	James Worten Sr	859-272-1713	jworten@lexingtonky.gov	Tim Ruppert
South Laredo - Phase 1	Laredo	TX	HST 9500-U375-1-H-48	5	Jose Chavarria	956-721-2000	jchavarria@ci.laredo.tx.us	Anne Chalmers
Cornelia	Cornelia	GA	HST 20-4500-1-U150-48	1	Andy Pilgrim	706-894-3085	apilgrim@corneliageorgia.org	Anne Chalmers
Eau Claire	Eau Claire	WI	HST 9500-280-1-H-5	3	Steve Hayden	715-839-4902	steve.hayden@ci.eau-claire.wi.us	Tim Ruppert
Upper Thompson Sanitation District	Estes Park	CO	HST 20-6000-1-U250-48	1	Henry Newhouse	970-586-5389 ext 257	henry@utsd.org	Tim Ruppert
PARCC Side Clean Water Plant	Grand Rapids	MI	HST 20-6000-1-190-50	1	Larry Campbell	616-363-0702		Tim Ruppert
Plymouth	Plymouth	CT	HST 2500-U100-2-L-5	3	Jason Patrick	860-582-4881	jpatrick@plymouthct.us	John Scavitto
Cheshire	Cheshire	CT	HST 2500-U120-1-H-48	2	Scott Hallier	203-272-9105	shallier@cheshirect.org	John Scavitto
Cheshire	Cheshire	CT	HST 9500-U250-1-L-48	2	Scott Hallier	203-272-9105	shallier@cheshirect.org	John Scavitto
San Leandro WWTP	San Leandro	CA	HST 20-4500-1-U150-48	1	Orlando Gianecchini	510-750-6626	ogianecchini@sanleandro.org	Rick Barile
SCWRF - Phase 1	Collier County	FL	HST 20-6000-1-U250-48	2	Chris Farris	239-252-6886	christopherfarris@colliergov.net	Anne Chalmers

Neptune - 2nd	Neptune	NJ	HST 20-4500-1-150-50	1	Tina Della Pietro	732-922-3434 ext 3	dellapietro@tnsa-nj.org	John Scavitto
Pasco - No. 2	Pasco	WA	HST 20-4500-1-U150-48	2	Todd Marden	509-545-3468	mardent@pasco-wa.gov	Rick Barile
Mount Vernon	Mount Vernon	WA	HST 20-6000-1-U200-48	1	Gary Duranceau	360-336-6219 ext 2310	garyd@mountvernonwa.gov	Rick Barile
Monroe	Monroe	WA	HST 2500-U100-1-L-48	2	Donovan Sheppard	425-754-3771	dseppard@monroewa.gov	Rick Barile
Eagle River	Eagle River	AK	HST 2500-U120-1-H-48	1	Cliff Fletcher	907-261-5770	clifford.fletcher@awuu.biz	Rick Barile
Flagg Creek	Flagg Creek	IL	HST 40-U400-1-L-48	1	James Liubicich	630-323-3299	jliubicich@fcwrd.org	Tim Ruppert
Romeoville	Romeoville	IL	HST 20-4500-1-U150-48	2	Tim Zarnowski	815-409-1074	tzarnowski@romeoville.org	Tim Ruppert
Wood Dale North WWTP	Wood Dale	IL	HST 20-4500-1-U150-48	3	Brad Kittilson	630-350-3530	bkittilson@wooddale.com	Tim Ruppert
Plainfield SWWTP	Plainfield	IN	HST 40-U500-1-L-48	1	Dennis Unterreiner	317-339-9297	dunterreiner@town.plainfield.in.us	Dan Davis
Coachella Valley Water District (CVWD)	Coachella	CA	HST 40-U500-1-L-48	6	Jose Pat Medina	760-398-2661	jpatmedina@cvwd.org	Rick Barile
Westside WWTP	High Point	NC	HST 9500-200-1-L-5	4	Kevin Woods	336-822-4730	kevin.wood@highpointnc.gov	Dan Davis
Butte-Silver Bow WWTP - 3rd	Butte	MT	HST 20-6000-1-U200-48	3	Bill Andrene	406-497-6550	wandrene@bsb.mt.gov	Tim Ruppert
Oshkosh	Oshkosh	WI	HST 9500-U300-1-H-48	2	Kevin	920-232-5365		Tim Ruppert
San Angelo WWTP	San Angelo	TX	HST 20-4500-1-U200-48	2	Paul Rodriguez	937-423-2934	paul.rodriguez@daytonohio.gov	Anne Chalmers
Star Sewer & Water District - 2nd	Star	ID	HST 2500-U100-2-L-48	1	Hank Day	208-631-8588	hday@starswd.com	Rick Barile
Dayton	Dayton	OH	HST 40-U400-1-L-48	4	Paul MacCallum	937423-2934	paul.maccallum@daytonohio.gov	Tim Ruppert
Broomfield	Broomfield	CO	HST 40-U400-1-L-48	4	Craig Triezenburg	303-464-5642	ctriezenberg@broomfield.org	Tim Ruppert
Broomfield	Broomfield	CO	HST 20-4500-1-U150-48	2	Craig Triezenburg	303-464-5642	ctriezenberg@broomfield.org	Tim Ruppert
Victoria	Victoria	TX	HST 2500-U120-1-H-48	1	Curtis Davis	361-485-3263	cdavis@victoriatx.org	Anne Chalmers
Downers Grove WWTP - 2nd	Downers Grove	IL	HST 9500-U322-1-L-48	1	Nick Meniga	630-969-0664	nmeniga@dgsd.gov	Tim Ruppert
Sunnyside	Sunnyside	WA	HST 20-4500-1-U150-48	1	Raul Sanchez	509-836-6566	rsanchez@sunnyside-wa.gov	Rick Barile
Coeur d'Alene - Phase 1	Couer D'Alene	ID	HST 2500-1-H-5	2	Casey Fisher	208-769-2346	cfisher@cdaid.org	Rick Barile
Coeur d'Alene - Phase 1	Couer D'Alene	ID	HST 20-4500-1-U150-48	2	Casey Fisher	208-369-2346	cfisher@cdaid.org	Rick Barile
Chesterton	Chesterton	IN	HST 20-6000-1-U150-48	1	Bill Williams	219-926-1032	bwilliams@chestertonin.org	Dan Davis
Clute	Clute	TX	HST 2500-U110-1-H-48	4	William McCart	979-265-3619	william.mccart@brazos.org	Anne Chalmers
North River WWTF (HRRSA)	Mount Crawford	VA	HST 40-U400-1-L-48	3	Sharon G Foley P.E.	540-434-1053 ext 223	sfoley@hrrsa.org	John Scavitto
Trenton	Trenton	MI	HST 20-6000-1-U250-48	3	Jason Tapp	734-626-0646	jtapp@trenton.mi.com	John Scavitto
Pinetop-Lakeside SD WWTP	Lakeside	AZ	HST 20-4500-1-U150-48	2	Dave Smith	928-368-5370 ext 1232	dsmith@plsd.com	Rick Barile
Davis	Davis	CA	HST 20-6000-1-U200-48	3	John Alexander	650-219-8668	jalexander@cityofdavis.org	Rick Barile
Indian Lake WWTP	Logan County	OH	HST 2500-U100-2-L-48	1				Tim Ruppert
Windsor WWTP	Windsor	CO	HST 20-6000-1-U200-48	1	Dennis Markham	970-686-2144	dmarkham@windsorgov.com	Tim Ruppert
Lincoln	Lincoln	NE	HST 20-6000-1-U250-48	1	Steve Schmalken	402-432-8703		Tim Ruppert
Kuna	Kuna	ID	HST 2500-U125-2-H-48	1	Travis Fleming	208-573-7672	tfleming@kunaid.gov	Rick Barile
Tullahoma WWTP	Tullahoma	TN	HST 20-4500-1-U150-48	1	Scott Young	932-571-7106	syoun@tub.net	Tim Ruppert
Gurnee WRF - NSWRD	Lake County	IL	HST 20-4500-1-U150-48	1	Tom Lentz	847-623-6060	tolentz@northshorewd.org	Tim Ruppert
Gurnee WRF - NSWRD	Lake County	IL	HST 9500-U350-1-L-48	1	Tom Lentz	847-623-6060	tolentz@northshorewd.org	Tim Ruppert
Benton Harbor - 1st	Benton Harbor	MI	HST 40-U450-1-L-48	1	James Jonatzke	269-983-7719		Tim Ruppert
Clavey Road WWTP - NSWRD	Lake County	IL	HST 20-6000-1-U200-48	1	I Filipovich	847-623-6060	ifilipovich@northshorewd.org	Tim Ruppert
Clavey Road WWTP - NSWRD	Lake County	IL	HST 9500-U350-1-L-48	1	I Filipovich	847-623-6060	ifilipovich@northshorewd.org	Tim Ruppert
Waukegan WWTP - NSWRD	Lake County	IL	HST 40-U500-1-L-48	1	Eric Daudlin	847-623-6060	erdaudlin@northshorewd.org	Tim Ruppert
Louisville WWTP - Aeration	Louisville	CO	HST 20-4500-1-U200-48	3	Justin Elkins	303-335-4784	jelkins@louisvilleco.gov	Tim Ruppert
Hanover - Phase 1	Hanover	IL	HST 20-6000-1-U200-48	1				Tim Ruppert
Delaware	Delaware	OH	HST 20-6000-1-U150-48	2	Brian Livingston Brad Stanton	740-203-1956 740-203-1903	blivingston@delawareohio.net bstanton@delawareohio.net	Tim Ruppert
Irwin Creek WWTP	Charlotte	NC	HST 9500-U350-1-L-48	2	Mike Lingerfeld - Jacob Bolick - James Antio	704-336-2570	mlingerfelt@ci.charlotte.nc.us - jbolick@ci.charlotte.nc.us - jantio@ci.charlotte.nc.us	John Scavitto
Irwin Creek WWTP	Charlotte	NC	HST 40-U450-1-L-48	2	Mike Lingerfeld - Jacob Bolick - James Antio	704-336-2570	mlingerfelt@ci.charlotte.nc.us - jbolick@ci.charlotte.nc.us - jantio@ci.charlotte.nc.us	John Scavitto
Macomb WWTP	Macomb	IL	HST 2500-U100-1-L-48	2	Josh Peters	309-833-2088		Tim Ruppert
El Toro Water Recycling Plant	Lake Forest	CA	HST 40-U400-1-L-48	1	Mark Pade	949-837-7050 ext 103	mpade@etwd.com	Rick Barile
South Central Regional WRF	Brevard County	FL	HST 20-6000-1-U200-48	3				Anne Chalmers
Southwest Regional WRF - 2nd	Volusia County	FL	HST 20-6000-1-U200-48	1	Stuart Hemke	386-775-5245	shemke@volusia.org	Anne Chalmers
United States Air Force Academy	Colorado Springs	CO	HST 2500-U100-2-L-48	2	James Hester	303-710-3571	jhester1@olgoonik.com	Tim Ruppert
Jerome WWTP	Jerome	ID	HST 20-6000-1-U250-48	2	Brad Henry	208-327-7122	bhenry@ci.jerome.id.us	Rick Barile
Springfield SWCWP	Springfield	MO	HST 20-6000-1-U200-48	4	Brian Wirth	417-874-2873	bwirth@springfieldmo.gov	Dan Davis
Fritz Island WWTP	Reading	PA	HST 40-U500-1-H-48	5	Roger Hillibush - Amy Morriss - Juanita Komoro	610-655-6322	roger.hillibush@readingpa.org - amy.morriss@readingpa.org - juanita.komoro@readingpa.org	John Scavitto

Star City WWTP	Morgantown	WV	HST 20-4500-1-U200-48	4	Charles Nester	304-599-2111	cnester@mub.ord	John Scavitto
Marion	Marion	IN	HST 40-U400-1-L-48	2				Dan Davis
Delhi Township	Delhi Township	MI	HST 2500-U100-1-L-48	2	Sandra "Sam" Diorka	517-712-8771	Sandra.Diorka@delhitownship.com	Tim Ruppert
Louisville WWTP - Digester	Louisville	CO	HST 40-U400-1-H-48	1	Justin Elkins	303-335-4784	jelkins@louisvillico.gov	Tim Ruppert
Eagle Sewer District WWLTF	Eagle	ID	HST 20-6000-1-U200-48	2	RJ Lake	208-938-2027	rjlake@eaglesewer.org	Rick Barile
Coeur d'Alene - Phase 2	Coeur d'Alene	ID	HST 20-6000-1-U150-48	3	Casey Fisher	208-769-2346	cfisher@cdaid.org	Rick Barile
Star Sewer & Water District - 3rd	Star	ID	HST 2500-U100-2-L-48	1	Hank Day	208-631-8588	hday@starswd.com	Rick Barile
Mexico	Mexico	MO	HST 2500-U110-1-H-48	2	Rick Dunker	573-581-8251		Dan Davis
Beaver Dam	Beaver Dam	WI	HST 20-6000-1-U200-48	2	Rob Minnema	920-225-4055	rminnema@cityofbeaverdam.com	Tim Ruppert
Palmer	Palmer	AK	HST 20-4500-1-U150-48	1	Alycia Anderson	907-762-1351	ahowell@palmerak.org	Rick Barile
York	York	NE	HST 2500-U110-1-H-48	3	Aaron Dressel	402-363-2600	adressel@cityofyork.net	Tim Ruppert
South Laredo - Phase 2	Laredo	TX	HST 9500-U375-1-H-48	2	Jose Chavarria	956-721-2000	jchavarria@ci.laredo.tx.us	Anne Chalmers
Michigan City	Michigan City	IN	HST 9500-U300-1-L-48	2	Michael Kuss	219-229-1298	mkuss@mcsan.org	Tim Ruppert
WSSC - Phase 2	Marlboro	MD	HST 40-350-1-L-5	1	Kevin Selock - Patricia Jones	301-206-8233 301-206-8318	kevin.selock@wsscwater.com - patricia.jones@wsscwater.com	John Scavitto
Pecan Branch WWTP	Georgetown	TX	HST 20-6000-1-U200-48	1	Randall Swenson	512-930-6584	randall.swenson@georgetown.org	Anne Chalmers
Fraser	Frasier	CO	HST 20-6000-1-U200-48	2	Joe Fuqua	970-726-9621	jfuqua@town.fraser.co.us	Tim Ruppert
Benton Harbor - 2nd	Benton Harbor	MI	HST 40-U450-1-L-48	1	James Jonatzke	269-983-7719	jjonatzke@qtm.net	Tim Ruppert
Youngstown	Youngstown	OH	HST 20-6000-1-U250-48	3	Gene Lesen	330-742-8820	gleson@youngstownohio.gov	Tim Ruppert
Sugar Creek WWTP	Charlotte	NC	HST 40-U400-1-L-48	5	Hank Lewis - Billy Allen	704-336-7600	hmlewis@ci.charlotte.nc.us - ballen@ci.charlotte.nc.us	John Scavitto
EL Centro	EL Centro	CA	HST 9500-U250-1-L-48	2	Abraham Campos	760-336-8520	acampos@cityofelcentro.org	Rick Barile
Hanover - Phase 2	Hanover	IL	HST 20-6000-1-U200-48	1	Adam Gronski	630-823-5700	GronskiA@mwrd.org	Tim Ruppert
Greeley WPCF	Greeley	CO	HST 9500-U300-1-L-48	3	Sean Cooney	970-336-4248	Sean.Cooney@Greeleygov.com	Tim Ruppert
SWWWRF - West Villages	North Port	FL	HST 2500-U100-1-L-48	3				Anne Chalmers
SCWRF - Phase 2	Collier County	FL	HST 20-6000-1-U250-48	4	Chris Farris	239-252-6886	christopherfarris@colliergov.net	Anne Chalmers
Rifle Range Road WWTP	Mount Pleasant	SC	HST 9500-U375-1-H-48	3	Tom Wright	843-884-9626		John Scavitto
Midland WPCP	Midland	TX	HST 9500-U350-1-H-48	4				Anne Chalmers
South Beloit WWTP	South Beloit	IL	HST 2500-U120-1-H-48	3	Jeff Reininger	815-389-3070	j.reininger@southbeloit.org	Tim Ruppert
Lexington - Retrofit Blower - Zone 1	Lexington	KY	HST 40-300-1-L-5	1	Charlie Begley	859-425-2414	cbegley@lexingtonky.gov	Tim Ruppert
Tapia WWTP, Las Virgenes MWD	Calabazas	CA	HST 40-U400-1-L-48	3	Eric Schlageter	818-251-2142	eschlageter@lvmwd.com	Rick Barile
Largo WWRF	Largo	FL	HST 20-6000-1-U200-48	4				Anne Chalmers
Morehead WWTP, MUPB - 2nd Blower	Morehead	KY	HST 2500-U120-1-H-48	1	Chuck Davis	606-783-1502	cdavis@mupb.com	Tim Ruppert
Dry Creek WWTP	Villa Hills	KY	HST 40-U450-1-H-48	3				Tim Ruppert
Yonkers WWTP	Yonkers	NY	HST 40-U500-1-L-48	5	Vince Kopicki	914-813-5450	vvk2@westchestergov.com	John Scavitto
Alexandria WWTP	Alexandria	VA	HST 20-6000-1-U150-48	6	Felicia Glapion, Jeff Lindsay, Christopher Painter, Nykia Roberson-Ramos		felicia.glapion@alexrenew.com, jeff.lindsay@alexrenew.com, Christopher.Painter@hdrinc.com, nykia.robersonramos@alexrenew.com	John Scavitto
Hart	Hart	MI	HST 40-U400-1-L-48	2	Paul Cutter	231-638-1963	pcutter@cityofhart.org	Tim Ruppert
Geneva - 2nd Blower	Geneva	AL	HST 2500-U100-1-L-48	1				Anne Chalmers
Centennial WWTP (Marcy Gulch)	Littleton	CO	HST 20-6000-1-U250-48	4				Tim Ruppert
Miller Ave WWTP	Jackson	TN	HST 20-4500-1-U200-48	2	Curtis Richards	303-907-6971	crichards@cwsdhrmd.org	Tim Ruppert
Pacific WWTF	Pacific	MO	HST 20-6000-1-U200-48	2				Dan Davis
Windsor WWTP	Windsor	CO	HST 30-46-1-U300-48	1	Dennis Markham	970-686-2144	dmarkham@windsorgov.com	Tim Ruppert
East Peoria WWTP	East Peoria	IL	HST 20-4500-1-U200-48	4	Cord Crisler	309-698-4716	cordcrisler@cityofeastpeoria.cio	Tim Ruppert

SINGLE-STAGE BLOWERS

KA Series

Technical Data Sheet

Product Type

Single-Stage Integrally-Geared Centrifugal Blower

Product Name

KA Series

Control Methodologies

Single point control uses variable diffuser vanes located at the discharge of the impeller, acting as an extension of the impeller blades. The variable pitch diffuser vanes modify the flow of air in the blower internals, allowing flow modulation from 100% to <45% capacity minimizing losses.

Dual Point Control™ uses inlet guide vanes and variable diffuser vanes, located on the discharge of the impeller, acting as an extension of the impeller blade. The variable pitch diffuser vanes modify the flow of air in the blower internals and independently manage the two variables of power consumption via several continuously monitored process and environmental variables. This control methodology maintains the base isentropic efficiency at or near its maximum relative value across a wider range of flow and inlet temperature conditions, and significantly increases blower stability, allowing for wider turndown without surge. The direction of rotation and shape of the vanes are such that the capacity of the machine can be varied from 100% to 45% with virtually no decrease of efficiency.

Uncompromised Efficiency

All parts are manufactured to minimize noise and vibration, maximize efficiency, and reduce power consumption through aerodynamic design and process variable control. Rather than throttling, like inlet valve or guide vanes,

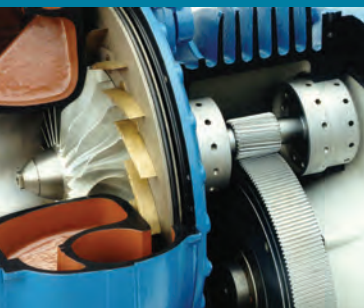


the variable diffusers actually alter the flow pattern of the air exiting the blower. Blower efficiency is not significantly affected, as the capacity is reduced. Our blowers are the industry's most successful high-speed blower with more than 40 years of design evolution, and more than 6,000 working installations.

Integrated Package

The KA Series is driven by an electric motor through a speed increasing gearbox. It is furnished as a complete unit with internal variable control vanes, integral speed increasing gearbox, driver, lubrication system and intuitive controls. Packages are available in standard configuration with pre-designed options or custom configurations.

Geared Blower



Construction Material

Volute Casing
Close-grain cast iron

Gear Drive Housing
Close-grain cast iron
vertically split

Impeller
Forged hiduminium
aluminum alloy material
milled on 5-axis milling
machine

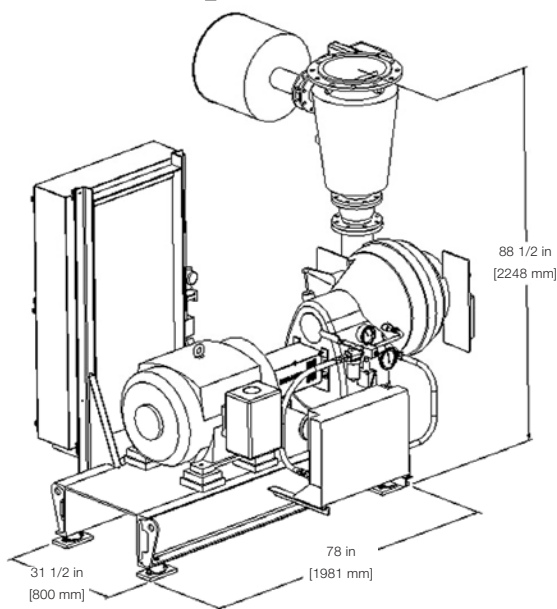
Internal Vanes
Die cast aluminum or
stainless steel

Bearings
Silicon nitride
rolling element

Motor
Horizontal, constant
speed, open drip proof
enclosure

Baseplate
Fabricated from structural
steel, self-supporting and
mounted on rubber
vibration isolators

KA Technical Specification



Technical Parameters

Medium	Air
Design pressure range	0.275 to 0.875 bar(g) / 4 to 12.7 psi(g)
Design flow range	4,082 to 11,461 Nm ³ /hr / 2,600 to 7,300 scfm
Turndown range	100%-45%
Fast shaft operating speed range	12,325 to 20,000 rpm
Motor power rating	120 to 230 KW / 150 to 300 HP
Vibration	<3 mm/s / <0.118 in./sec
Discharge	Rotatable in 90 degree increments
Blow-off valve	Electrically operated
Impeller	Radial type with open and backward leaning blades
Air seals	Non-contact, multi-point and labyrinth type
Bearings	Silicon nitride rolling element
Motor	Two pole (3,600 rpm)
Input power	460 volt, 60/50 Hz
Control panel	Touch panel with integral PLC
Control	Discharge variable diffuser vanes
Cooling	Air
Weight	1,380 kg / 3,700 lbs.
Distance b/t units	1,016 mm / 40 in. clearable 914 mm / 3 ft. on front of inlet

Project: : Norwalk, CT

HV-TURBO Environmental Compressor: KA5SV-GL210

Powersupply : E-motor, Rpm = 3600

with Variable Diffuser Vanes: for Flow Regulation

and with Variable Inlet Guide Vanes : for Minimizing Power Consumption.

Inlet Conditions:

Pressure: see Table, Temperature: see Table, Relative Humidity: see Table.

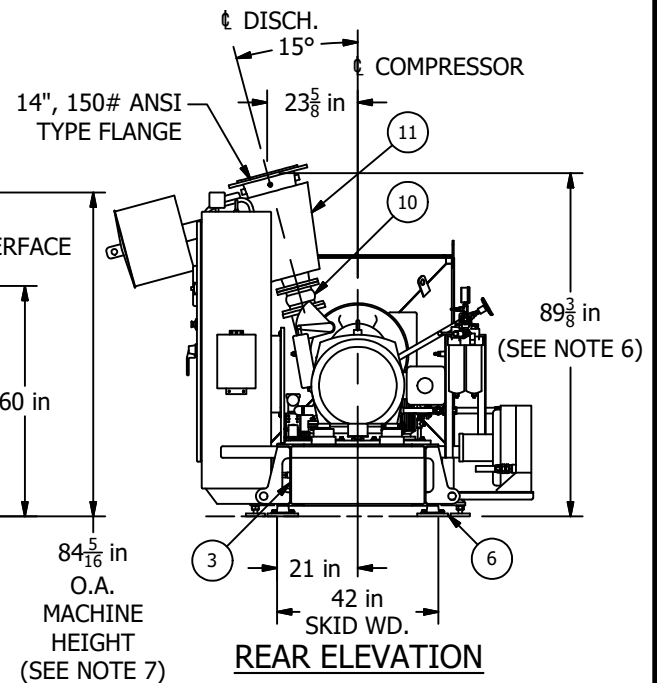
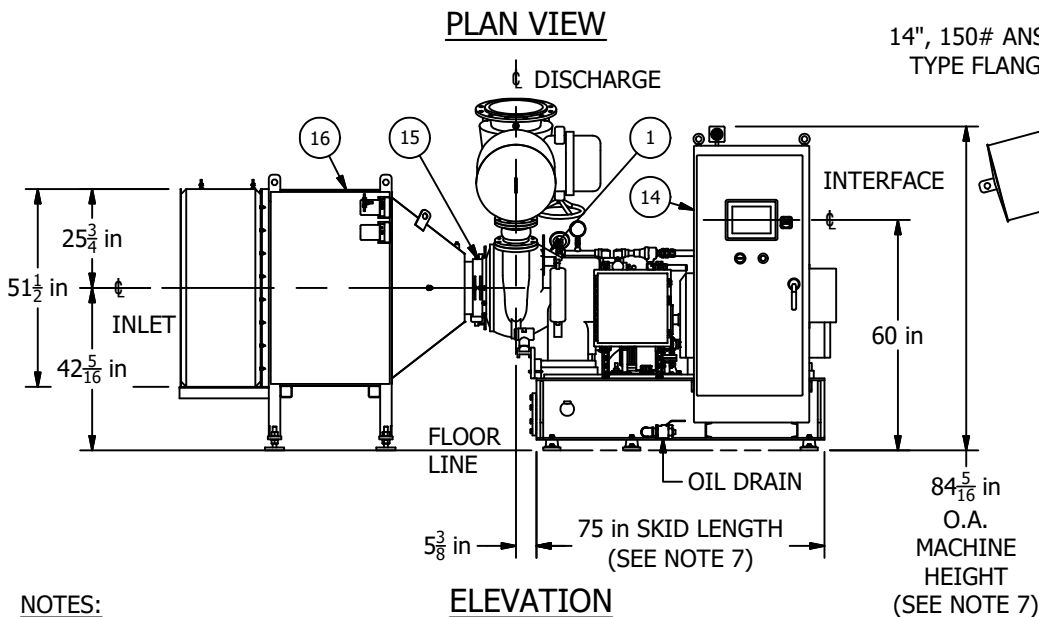
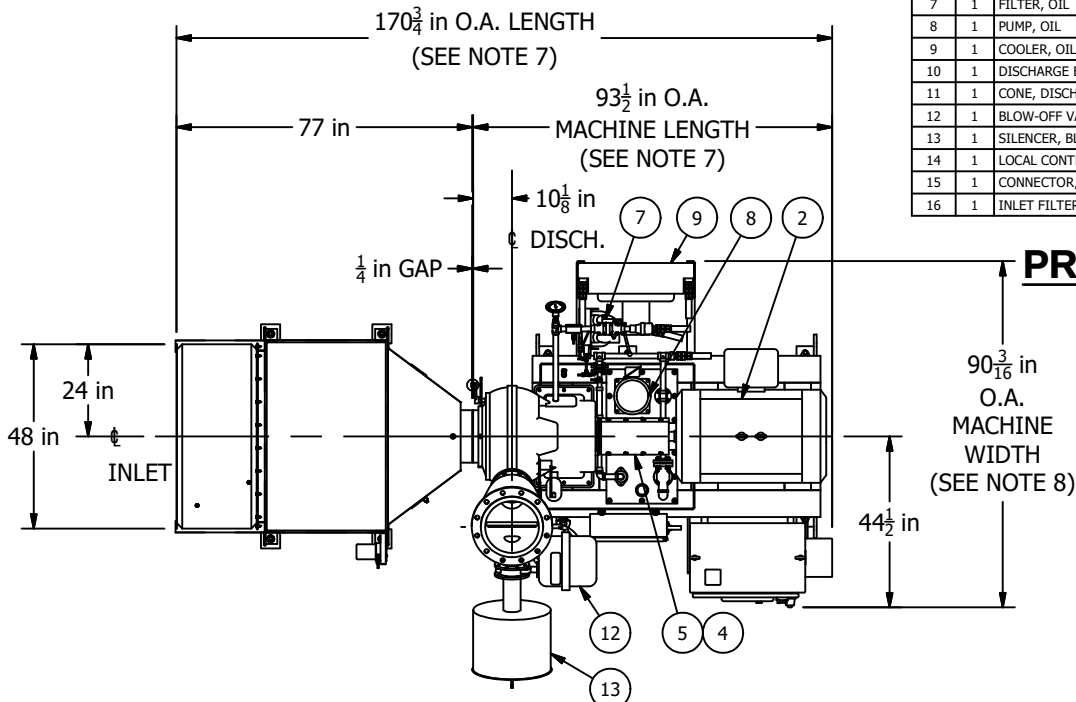
Flow: 4400 scfm (@14.7 psia, 36 % rh, 68 °F)

press. P0 Psia	press. P2 Psia	Inlet- flow %	Compressor Performance and Power consumption on the Motor Shaft at Inlet conditions :					
			75.00 °F 80 % RH acfm Hp	°F % RH acfm Hp	°F % RH acfm Hp	°F % RH acfm Hp	°F % RH acfm Hp	°F % RH acfm Hp
14.700	22.200	100.0	4529 175.9					
14.700	22.200	80.0	3623 140.8					
14.700	22.200	60.0	2717 109.3					
14.700	22.200	45.0	2038 87.6					

- Inlet pressure drop 0.2 psid
- For ASME PTC-10 HEAT BALANCE TEST
with Pressure Tolerance of $\pm 0. \%$
with Flow Tolerance of $\pm 0. \%$
with Power Tolerance of $\pm 4. \%$

Preliminary**CONFIDENTIAL**

PARTS LIST			
ITEM	QTY	DESCRIPTION	LBS.
1	1	COMPRESSOR, KA5SV-GL210	1532
2	1	MOTOR, 400 HP	2100
3	1	COMPRESSOR BASE/OIL RESERVOIR	1706
4	1	Coupling for Compressor and Motor Shaft	50
5	1	COUPLING GUARD	17
6	6	VIBRATION ISOLATOR	60
7	1	FILTER, OIL	75
8	1	PUMP, OIL	151
9	1	COOLER, OIL-AIR	125
10	1	DISCHARGE EXPANSION JOINT, 6"	17
11	1	CONE, DISCHARGE, 6 X 14 X 4, CS	190
12	1	BLOW-OFF VALVE/ACTUATOR	84
13	1	SILENCER, BLOW-OFF, 4", CS	114
14	1	LOCAL CONTROL PANEL	500
15	1	CONNECTOR, INLET FLEX	7
16	1	INLET FILTER/SILENCER	986



NOTES:

- AIR DISCHARGE FLANGE CAN BE ROTATED IN 15° INCREMENTS.
- COMPRESSOR INLET DIAMETER: 13-11/16"
- COMPRESSOR OUTLET DIAMETER: 6"
- BLOW-OFF DIAMETER: 4"
- DISCHARGE CONE DIAMETER: 14"
- DIMENSION VARIES DEPENDING ON DISCHARGE CONE SIZE AND ORIENTATION.
- DIMENSION VARIES DEPENDING ON ACTUAL MOTOR SIZE.
- OVERALL WIDTH VARIES DEPENDING ON ACTUAL SIZE OF CONTROL PANEL AND MOTOR CONDUIT BOX.
- INLET FILTER/SILENCER IS RATED @ 8,000 SCFM.
- ESTIMATED COMPRESSOR SKID PACKAGE WEIGHT: 7,000 LBS.

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OTHER PURPOSE WITHOUT THE EXPRESS
PERMISSION OF THE COMPANY.

Howden

TITLE:
GENERAL ARRANGEMENT DRAWING
FOR STC-GO KA5SV-GL210 (7-1-KA3LJ)

STANDARD

DRAWN BY: DSH CHECKED BY:
DATE: 10/09/12 APPROVED BY:
SCALE: N.T.S.

PATH: L:\DWG\Standard Sales Dwg\GA\3D GA_STE\KAS\GL210\SV\Ar Coated\005L210B.dwg

REV.

DRAWING NUMBER

005L210B



Project Quotation

Project Name:	Norwalk WPCF 3+1
Project Number:	236223
Date:	03/21/2023

More info on <http://www.next-turbo.com>



1. Scope of Delivery

Project Details

Project:	Norwalk WPCF 3+1
Blower Type:	GTB-T20-XY
Blower Control:	Discharge Diffuser & Inlet Guide vane control
Motor Size:	200 hp, rated at 60 Hz, 460 V
Number of Units:	4
Max. Power at Design Conditions:	169.1 hp
Air Volume Turndown:	40-100%
Discharge Temperature:	172 °F (worst case scenario)
Max Air Speed Discharge:	3,458 ft/min with NPS14
Design Inlet Air Temperature:	90°F at 80%rH
Design Airflow:	4,350 scfm at 14.7 psia, 68°F, 36% rH 4,667 acfm at 14.7 psia, 90°F, 80% rH
Design Differential Pressure:	7.5 psig



Scope Selection base offer

ID	#	Item	Type/size	Included
1.	4 x	Geared Turbocompressor	GTB-T20-XY	✓
2.	4 x	Electrical drive motor - ODP	200 hp – 460v / 3ph / 60 Hz	✓
5.	0 x	Softstarter (MCC)		
6.	4 x	Inlet silencer/filter	36x36	✓
7.	4 x	Flexible Compensator	NPS 6	✓
8.	4 x	Discharge diffuser	NPS 6/14	✓
9.	4 x	Blow-off valve/ silencer	NPS 3	✓
10.	4 x	Check valve	NPS 14	✓
12.	0 x	Isolation valve (electrical)		
13.	4 x	Silencer blocks/ mounts	for GTB-T20	✓
14.	4 x	Local Control panel	AB COMPACT LOGIX (Ethernet)	✓
101.	4 x	Bearing temperature	slow/fast shaft	✓
102.	4 x	Vibration monitoring		✓
103.	4 x	Motor winding temperature		✓
104.	4 x	Motor bearing temperature		✓
105.	4 x	Motor space heater		✓
107.	4 x	Remote monitoring		✓
201.	1 x	Commissioning on Site		✓
208.	1 x	Training of Staff		✓
210.	1 x	Performance test		✓

- ✓ Item included in base offer
 ○ Item offered as an option

BUDGET PRICE (4 UNITS):

\$ 840,000

FREIGHT (Estimate):

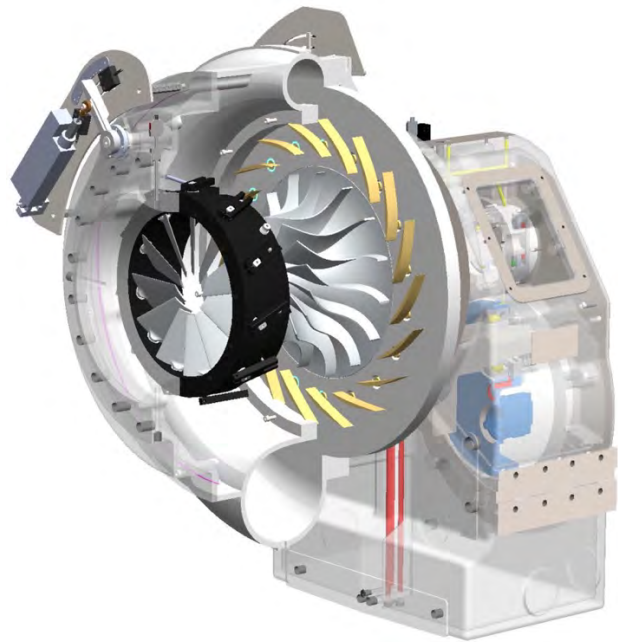
\$ 14,000

Terms and Conditions

Delivery time	7/8 months – from factory order acceptance, Kansas City (MO) USA
Delivery	FOB Kansas City (MO) – Incoterms 2010
Conditions	See attached Terms & Conditions
Payment plan	▪ 25% down payment with contract signature, net 30 days from invoice ▪ 45% with purchasing of major parts such as motor/ gearbox; net 30 days from invoice ▪ 20% at successful mechanical test; net 30 days from invoice ▪ 10% at successful onsite commissioning, however not longer than 3 months after delivery, net 30 days from invoice
Offer Validity	6 months from offer date – non binding for supplier
Warranty	24 months from start up, however not longer than 30 from delivery or supplier readiness notification
Conservation	Before shipping, compressors will be preserved for storage up to 6 months
Packing	
Lubricants	First lube oil filling is included
Manuals	All electronic files in English language are included in 1 CD/DVD.
Documentation	See attached list
Mechanical test	All compressors are mechanically tested before delivery, with issue of a test certificate.
Quality & tests	See attached Inspection & Testing Plan (ITP)

2. Performance Data

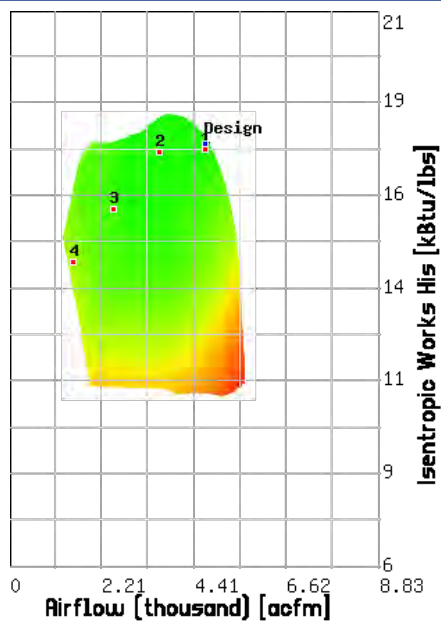
Project:	Norwalk WPCF 3+1
Blower Type:	GTB-T20-XY
Regulation Type:	XY
Number of Units:	4
Motor Size:	200 hp, rated at 60 Hz, 460 V
Recommended Cone:	NPS 14
Max Air Speed Discharge:	3,458 ft/min with NPS 14
Max Discharge Temperature:	172 °F
Impeller Speed:	20,046 rpm
Motor Speed:	3,600 rpm



Designed for:

- Inlet pressure (P0) = 14.7 psi
- Outlet pressure (P2) = 22.2 psi
- Ambient temperature (T0) = 90 °F
- Relative humidity (RH) = 80%
- Airflow (V2)= 4,667 acfm / 4,350 scfm
- Filter loss = 0.2 psig

Efficiency Map



Characteristic	Point1	Point2	Point3	Point4
Temperature [°F]	90	90	45	-0
Rel. Humidity [%]	80	60	40	20
Airflow [acfm]	4,667	3,559	2,484	1,503
Airflow turndown [%]	100	77.01	60	40
Mass flow [lb/s]	5.47	4.19	3.2	2.14
Airflow [scfm]	4,350	3,350	2,610	1,740
Outlet pressure [psi]	22.202	22.202	22.202	22.202
Isentropic Works His [Btu/lbs]	17323	17260	15698	14280
Shaft Power [hp]	169.1	129.8	94.3	63.8

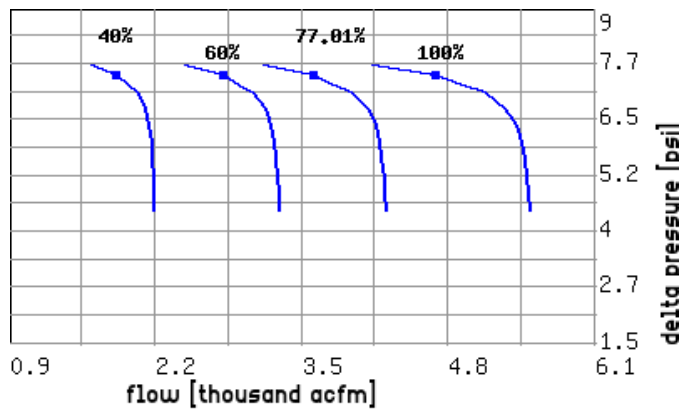
Tolerances on Flow +/-0%, on pressure +/-0%, on power +/-4%

Extended Performance Table

Outlet pressure psi	Airflow turndown	Temperature (T0) 90 °F Relative humidity (rH): 80%		Temperature (T0) 90 °F Relative humidity (rH): 60%		Temperature (T0) 45 °F Relative humidity (rH): 40%		Temperature (T0) -0 °F Relative humidity (rH): 20%	
		V0 [acfm]	P [hp]	V0 [acfm]	P [hp]	V0 [acfm]	P [hp]	V0 [acfm]	P [hp]
22.20	100%	4,667	169.1	4,622	167.3	4,139	153	3,758	141.4
22.20	77.01%	3,594	131	3,559	129.8	3,188	116.8	2,894	109.8
22.20	60%	2,800	103.3	2,773	102.4	2,484	94.3	2,255	87.8
22.20	40%	1,867	75.5	1,849	74.7	1,656	66.9	1,503	63.8

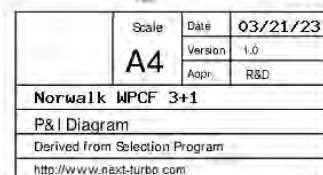
P = shaft power

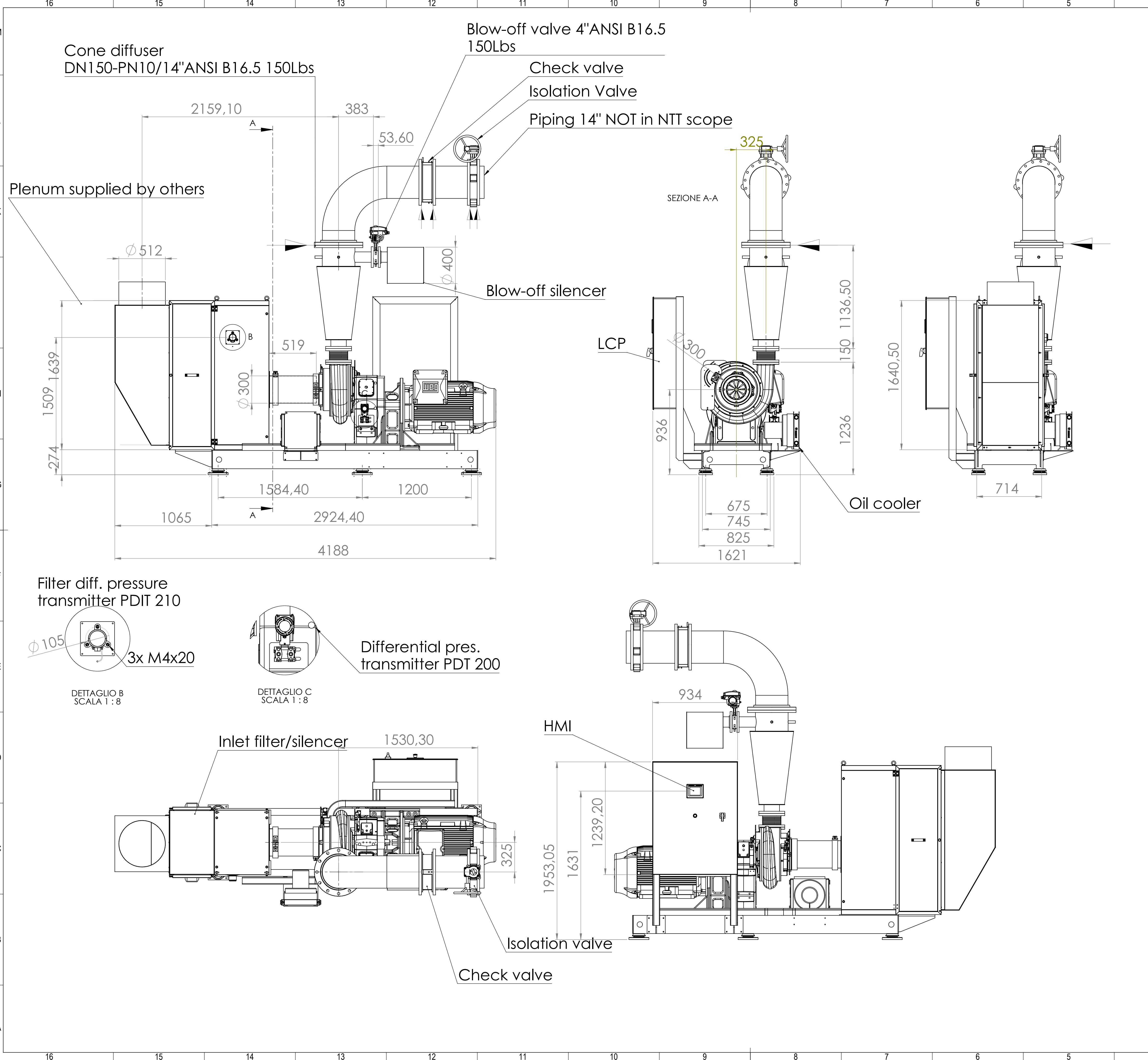
Performance Curve



■ for delta pressure of 7.5 psi and airflow of 4,667 acfm

The diagram to the left shows the compressor curves at the different discharge diffuser positions, covering the defined performance map.



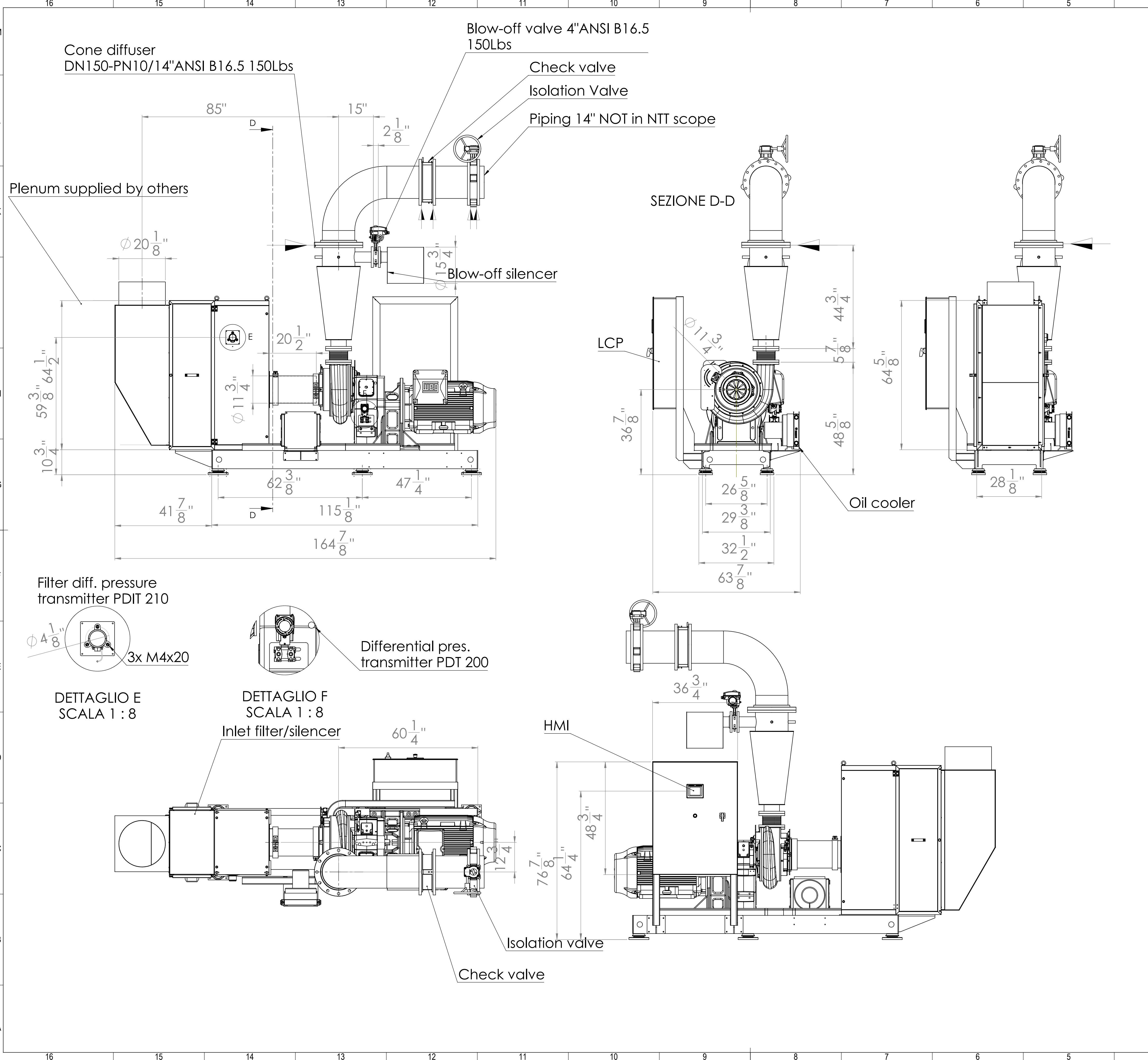


NOTES:

- Discharge cone, Blow off valve & Bov silencer have to be supported by existing discharge pipes at customer care.
- On outlet flange of discharge cone silencer allowable forces has to be limited to keep lower than:
 - max. axial travel - 10mm / + 5 mm &
 - max. transversal travel ± 1.5 mm

02	LCP updated,instruments and cable raceway updated	08/12/2022	S. Schiaffino	S. Schiaffino
01	FIRST ISSUED	30/09/2022	S. Schiaffino	S. Schiaffino
Rev.	Description	Date	Revised by	Approved by
Revisioni				
Dimensioni indicate in mm Dimension in millimeters		Massa (Kg) Mass (Pounds)	Limiti di fornitura Battery limits	
Data Approv. Approval Date		30/09/2022	S. Schiaffino	
Data		28/09/2022	S. Schiaffino	
Scale del foglio Sheet Scale		1:20	22-0989	
Formato Format		A1	GAD TAUNTON	
Foglio Sheet		1/2	Codice / Code	
Tolleranze Tolerances		UNI-EN 22768 m-K	22-0989 - 041	
			02	

Refer to protection notice ISO 18016 / Fare riferimento all'avviso di protezione ISO 18016



NOTES:

- Discharge cone, Blow off valve & Bov silencer have to be supported by existing discharge pipes at customer care.
- On outlet flange of discharge cone silencer allowable forces has to be limited to keep lower than:
 - max. axial travel - 10mm / + 5 mm &
 - max. transversal travel ± 1.5 mm

02	LCP updated,instruments and cable raceway updated	08/12/2022	S. Schiaffino	S. Schiaffino
01	FIRST ISSUED	30/09/2022	S. Schiaffino	S. Schiaffino
Rev.	Description	Date	Revised by	Approved by

Dimensioni indicate in Inches Dimension in inches		Massa (Kg) Mass (Pb)	Limiti di fornitura Battery limits		Altri By Others		Punto di Sollevamento Lifting point	
Data Approv. Approval Date		30/09/2022	Approvato da Approved by		S. Schiaffino		Nota Disegno Drawing Note	
Data Date		28/09/2022	Disegnato da Drawn by		S. Schiaffino		Commessa Job Number	
Scala del foglio Sheet Scale			Stato / Document Status		22-0989		Descrizione / Description	
Formato Format		1:20	S. Schiaffino		GAD TAUNTON		Codice / Code	
Foglio Sheet		A1	UNDER REVISION		22-0989 - 041		Rev.	
Tolleranze Tolerances		2/2	UNI-EN 22768 m-K		02			

Refer to protection notice ISO 16016 / Fare riferimento all'avviso di protezione ISO 16016

MULTI-STAGE BLOWERS



Howden Budget Proposal for: Norwalk, CT WWTP

Howden Roots LLC

To: Udayarka Karra - Arcadis

Location: Norwalk, CT

Project: Norwalk, CT

Our reference Howden: STC2300239

Your ref:

Date: April 4, 2023

Contact: David Roskowic
Tel: 1 417 429 3481
E-Mail: David.roskowic@howden.com
Web: www.howden.com

Revolving Around You™

Spencer Budget Proposal – STC2300239



PROJECT: Norwalk, CT

PROPOSAL DATE: April 4, 2023

PROPOSAL NO.: STC2300239

ENGINEER: Arcadis

SPECIFICATION: None – Emailed Requirements

Dear Udayarka Karra,

Thank you very much for your inquiry and the interest you have shown in our products.

We would recommend for Option 2+1 a 6000 Series PowerMizer with 5 stages model C654T2; for option 3+1 a 5000 Series PowerMizer with 8 stages model C54644.

We are pleased to give you our proposal based on Howden standard technical specifications and the above specifications applied for reference only.

Sincerely,

David G. Roskowic

Environmental Sales Manager, Environmental Applications

Howden, A Chart Industries Company

900 West Mount Street, Connersville, IN 47331 USA

t: +1 417 864 5599

d: +1 417 380 5722

m: +1 417 429.3481

e: david.roskowic@Howden.com

w: www.Howden.com

Spencer Budget Proposal – STC2300239



SPENCER BUDGET PROPOSAL

The Spencer Turbine Company is pleased to submit its proposal for the supply of equipment as listed below. Our Proposal consists of our Spencer Scope of Supply, our Comments/Clarifications and Exclusions and our Commercial Terms and Conditions.

SPENCER'S SCOPE OF SUPPLY

Option 1 (2+1) Spencer Series 6000 Power Mizer, Cat. No. C654T2

Features:

- 20" Inlet 125/150# flanged connection, position
- 18" Outlet 125/150# flanged connection, position
- Cast Iron Construction, Cast Aluminum Impellers
- Shaft Seals: Labyrinth
- Bearing Lubrication: OIL
- Motor: 300 HP, ODP, 400v/60hz
- Base, (common base for blower and motor)
- Flexible coupling & coupling guard included
- Spencer standard paint
- Vibration isolator pads included
- Standard Factory Performance Test

Rated Performance:

- Flow: 6,600 scfm
- Differential Pressure: 7.5 psi(g)
- Inlet Pressure: 14.7, (elevation 0' ASL)
- Inlet Temperature: 75°F
- Relative Humidity: 80%
- Gas: Air

TOTAL Option 1.....\$467,000 - Freight not included.

Option 2 (3+1) Spencer Series 5000 Power Mizer, Cat. No. C54644

Features:

- 15" Inlet 125/150# flanged connection, position
- 14" Outlet 125/150# flanged connection, position
- Cast Iron Construction, Cast Aluminum Impellers
- Shaft Seals: Labyrinth
- Bearing Lubrication: OIL
- Motor: 250 HP, ODP, 400v/60hz
- Base, (common base for blower and motor)
- Flexible coupling & coupling guard included

Spencer Budget Proposal – STC2300239



- Spencer standard paint
- Vibration isolator pads included
- Standard Factory Performance Test

Rated Performance:

- Flow: 4,400 scfm
- Differential Pressure: 7.5 psi(g)
- Inlet Pressure: 14.7, (elevation 0' ASL)
- Inlet Temperature: 75°F
- Relative Humidity: 80%
- Gas: Air

TOTAL Option 2.....\$422,000 - Freight not included.

Adder-Inlet Filter/Silencer, Inlet Expansion Joint, Inlet Butterfly Valve, Discharge Butterfly Valve, Discharge Expansion Joint and Discharge Check Valve.....\$.Please contact Howden

Price quoted is exclusive of any local, state or federal sales or manufacturer's taxes of any sort and such taxes and/or charges pertaining thereto are to be borne by the Purchaser.

Spencer Budget Proposal – STC2300239



COMMENTS/CLARIFICATIONS/EXCEPTIONS

1. Non-Witnessed factory testing in accordance with Spencer's standard factory performance & vibration tests are included.
2. The blower is designed to rest on the vibration isolation pads supplied by Spencer.
3. Blower noise level 97 dB(A), sound levels are free-field (1 meter) estimates only and are not guaranteed as numerous variables that affect sound level are out of Howden scope of supply. Tests per ASME PTC 36-1985 with a tolerance of + 3 dB(A).
4. Special Tools - none required.
5. Spencer's standard surface preparation of epoxy primer and urethane topcoat finish shall be furnished on items manufactured by Spencer.
6. Pricing does not include controls, blower surge protection or startup services. Pricing available upon request.

TERMS & CONDITIONS

Engineering Submittals: Spencer will submit its standard package of submittal drawings for approval within approximately 4-6 weeks after receipt of a purchase order. This submittal includes, if applicable, mechanical and electrical equipment details, mechanical installation drawing recommendation and electrical drawings consisting of control panel layouts and schematics.

Shipment: Shipment will be made approximately 20-22 weeks after receipt by Spencer Turbine Company of approved engineering submittal. Shipment is subject to any restrictions or regulations imposed by state, federal or foreign governments.

Mechanical Warranty: Spencer's Standard 12-month Warranty is offered. The warranty period will begin at the completion of successful start-up or at the time the blower is ready for beneficial use. The warranty period will not exceed 18 months after shipment date. Parts found to be defective in material or workmanship under normal use and service during the warranty period will be repaired or replaced without charge F.O.B. original point of shipment, the responsibility of The Spencer Turbine Company being limited to the cost of the defective parts. Decomposition by chemical action or corrosion from the presence of H₂S or wear caused by the presence of abrasive materials shall not constitute defects. See also Spencer Turbine Company "Terms and Conditions" attached hereto.

Spencer Budget Proposal – STC2300239



Validity of Quotation: 30 days

Thank you for the opportunity to submit this proposal. If you have any questions regarding this quotation, please do not hesitate to contact me.

Sincerely,

Howden Sales Team

Howden Standard Terms and Conditions Apply

Compressor Performance Datasheet

Customer	: UNKNOWN	Model Number	: C654T2
Customer reference	:	Stages	: 5
Quote number	: STC2300239	Casing diameter	: 49.80 in
Item number	: 001	Inlet size	: 20.00 in
Service	:	Outlet size	: 18.00 in
Quantity	: 1	Date last saved	: 04 Apr 2023 12:06 PM
		Impeller	: 10.00

Operating Conditions

Condition		1	2	3	4	5	6
System inlet volume flow	CFM	6,726.1	6,545.7	6,411.9	3,159.2	3,074.5	3,011.7
Actual compressor inlet volume	CFM	6,726.1	6,545.7	6,411.9	3,159.2	3,074.5	3,011.7
Flow at standard conditions	SCFM	6,600.0	6,600.0	6,600.0	3,100.0	3,100.0	3,100.0
Mass flow	lbm/s	8.25	8.25	8.25	3.87	3.87	3.87
Mass flow, dry	lbm/s	8.12	8.19	8.20	3.82	3.84	3.85
System inlet temperature	deg F	75.00	63.00	53.00	75.00	63.00	53.00
System inlet pressure	psi.a	14.700	14.700	14.700	14.700	14.700	14.700
Inlet pressure loss	psi						
Compressor inlet pressure	psi.a	14.171	13.956	13.792	13.052	12.874	12.738
Compressor discharge pressure	psi.a	22.20	22.20	22.20	22.20	22.20	22.20
Discharge pressure loss	psi						
System discharge pressure [p2]	psi.a	22.20	22.20	22.20	22.20	22.20	22.20
Compressor differential pressure	psi	8.03	8.24	8.41	9.15	9.33	9.46
System differential pressure [dp]	psi	7.50	7.50	7.50	7.50	7.50	7.50
Actual system discharge volume	CFM	5,103.3	4,919.9	4,784.0	2,297.3	2,220.0	2,162.6
Atmospheric pressure	psi.a	14.700	14.700	14.700	14.700	14.700	14.700
Elevation above sea level	ft	-7.63	-7.63	-7.63	-7.63	-7.63	-7.63
Site Supply Frequency	Hz	60	60	60	60	60	60
Type of gas	Air	Air	Air	Air	Air	Air	Air
Relative humidity	%	80.00	60.00	60.00	80.00	60.00	60.00
Molecular weight (MW)		28.71	28.84	28.88	28.71	28.84	28.88
Specific gravity		0.991	0.996	0.997	0.991	0.996	0.997
Specific heat (Cp)	Btu/(lb.deg F)	0.2436	0.2418	0.2412	0.2436	0.2418	0.2412
Ratio of specific heat (k)		1.40	1.40	1.40	1.40	1.40	1.40

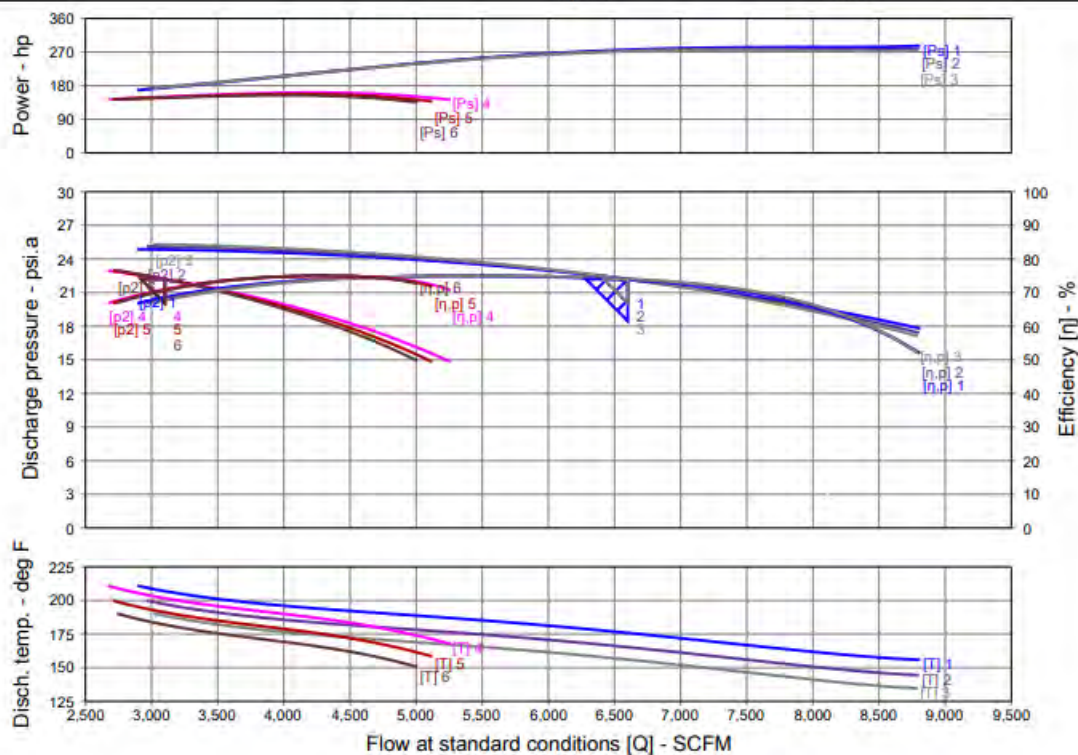
Performance

Quantity of Units Operating in Parallel		1	1	1	1	1	1
Speed	rpm	3550	3550	3550	3550	3550	3550
System discharge pressure (actual) [p2]	psi.a	22.20	22.20	22.20	22.20	22.20	22.20
Inlet throttling applied	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Power, shaft [Ps]	hp	276	274	272	150	149	148
Temperature rise	deg F	100.8	102.3	103.0	126.6	128.1	128.9
Discharge Temperature at Rated Flow	deg F	175.8	165.3	156.0	201.6	191.1	181.9
Rise to surge	psi	2.67	2.93	3.12	0.76	0.78	0.78
Turndown	%	56.18	55.12	54.31	13.87	12.62	11.70
Surge pressure	psi.a	24.87	25.13	25.32	22.96	22.98	22.98
Surge flow	SCFM	2,892.3	2,962.1	3,015.6	2,670.2	2,708.8	2,737.2
Sound level	dB	97.0	97.0	97.0	97.0	97.0	97.0
Inlet size	in	20.00	20.00	20.00	20.00	20.00	20.00
Outlet size	in	18.00	18.00	18.00	18.00	18.00	18.00

Standard conditions : (14.700 psi.a , 68.00 deg F , 36.00 %)

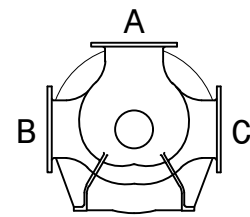
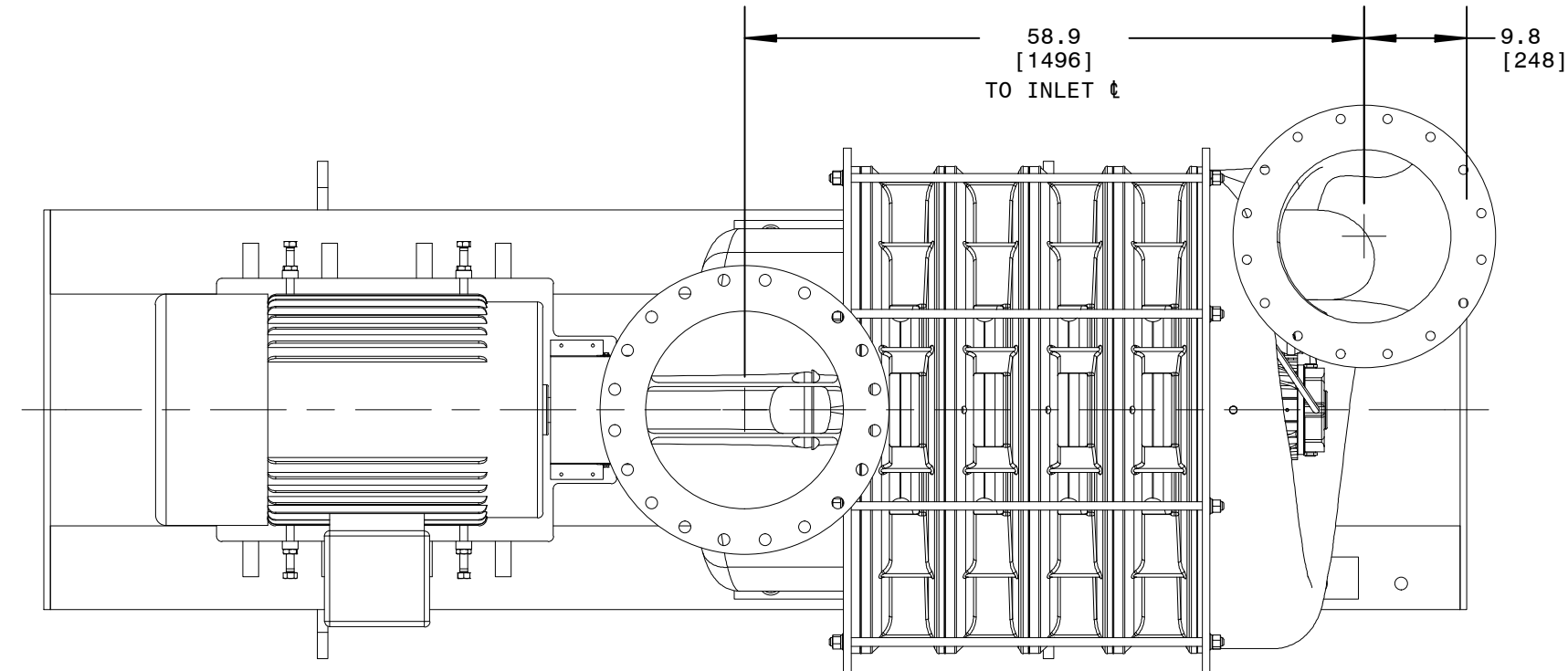
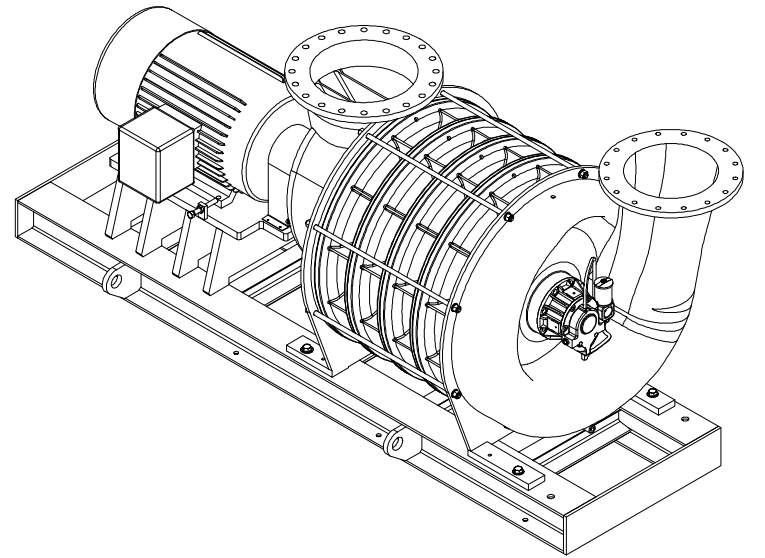
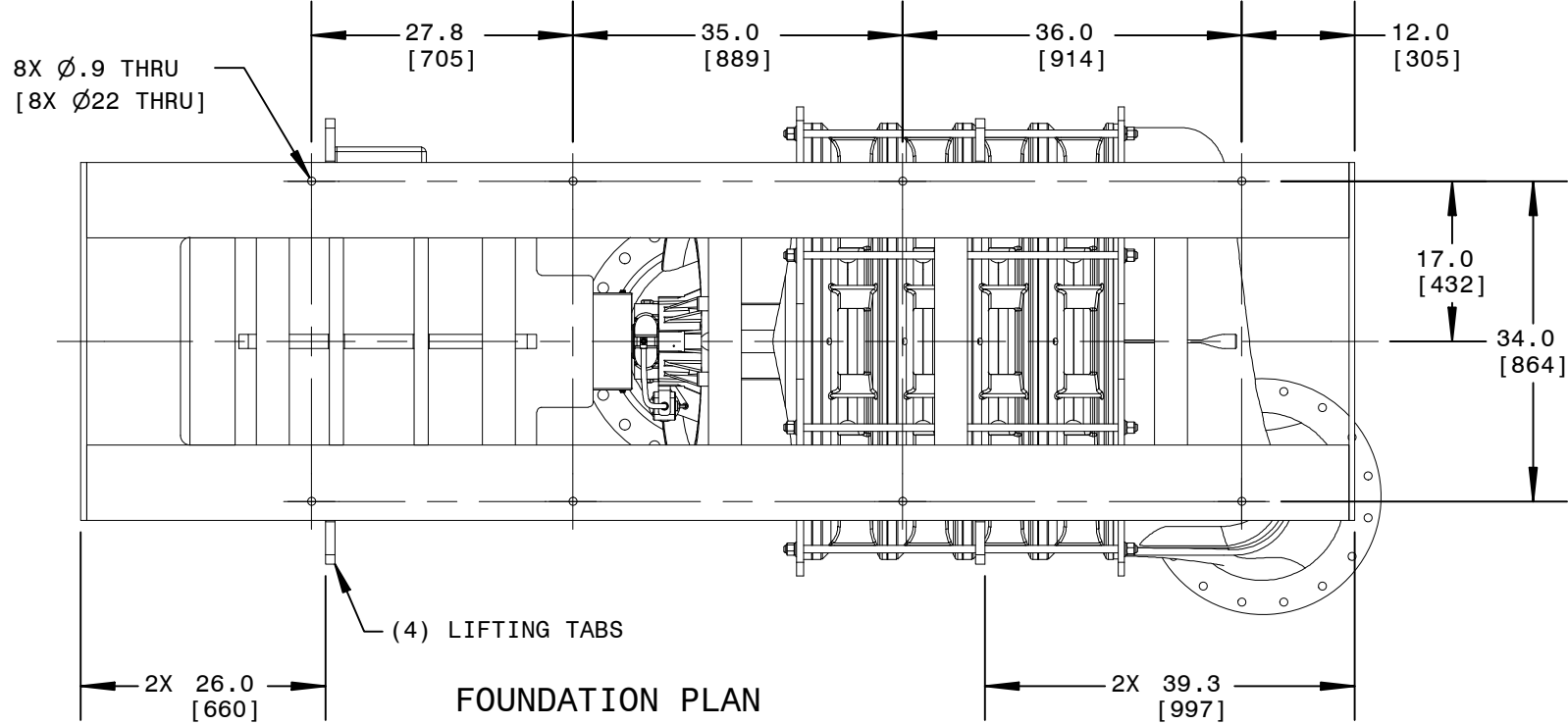
Compressor Performance Datasheet

Customer	: UNKNOWN	Model Number	: C654T2
Customer reference	:	Stages	: 5
Quote number	: STC2300239	Casing diameter	: 49.80 in
Item number	: 001	Inlet size	: 20.00 in
Service	:	Outlet size	: 18.00 in
Quantity	: 1	Date last saved	: 04 Apr 2023 12:06 PM
		Impeller	: 10.00



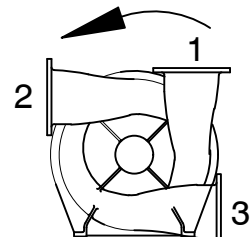
NOTES:
1. ALL DIMENSIONS ARE IN INCHES [MM]
2. DO NOT TRANSMIT EXTERNAL WEIGHT OR STRESS TO THE CASING
FLEXIBLE CONNECTIONS ARE REQUIRED
3. THIS EQUIPMENT IS DESIGNED TO SET FREE ON 1"THK CORK PADS PROVIDED
PAD No. REQUIRED: PAD90008
4. DRAINS ARE 1/2"NPT WITH PLUGS
5. INLET CONNECTION: Ø20 F.F. FLANGE #150 DRILLING, (20) 1-1/8 - 7
UNC-2B HOLES STRADDLING THEIR NATURAL CENTERLINE
6. OUTLET CONNECTION: Ø18 F.F. FLANGE #150 DRILLING, (16) 1-1/8 - 7
UNC-2B HOLES STRADDLING THEIR NATURAL CENTERLINE
7. APPROXIMATE WEIGHT: 9720 LBS
8. ORDER PROCESS: CTOX

MATERIALS OF CONSTRUCTION
1. BASE: ASTM A36 STRUCTURAL STEEL
2. IMPELLER: A356 CAST ALUMINUM
3. BLOWER: ASTM A48 CL30 CAST IRON
4. SHAFT: AISI 1144 CARBON STEEL
5. PAINT: SPENCER TURBINE STANDARD



INLET HEAD
END VIEW

ROTATION



OUTLET HEAD
END VIEW

COUPLING DATA

MAKE KOP-FLEX
TYPE FLEXIBLE DISC
MODEL/SIZE KD1/203
MOTOR BORE 2.375 BLOWER 2.5

MOTOR DATA

MAKE
POWER 300 Hp FRAME SIZE 445TS
RPM VOLTAGE
PHASE HERTZ
ENCLOSURE TYPE ODP

PERFORMANCE DATA

RATED 6600 SCFM
INLET TEMP. 75 ° F
INLET PRESSURE 14.7 PSIA
DIFFERENTIAL PRESSURE 7.5 PSIG
DISCHARGE PRESSURE PSIA
SPECIFIC GRAVITY
ALTITUDE FT. ABOVE S.L.

DIMENSIONS FOR:

INSTALLATION
CUSTOMER Norwalk WWTP - Option I
CUSTOMER ORDER No.
QUOTE No.
SALES ORDER No.
SERIAL No.
MODEL No. C654T2
INLET: POS. A SIZE 20 (T/F): FLANGED
OUTLET: POS. 1 SIZE 18 (T/F): FLANGED

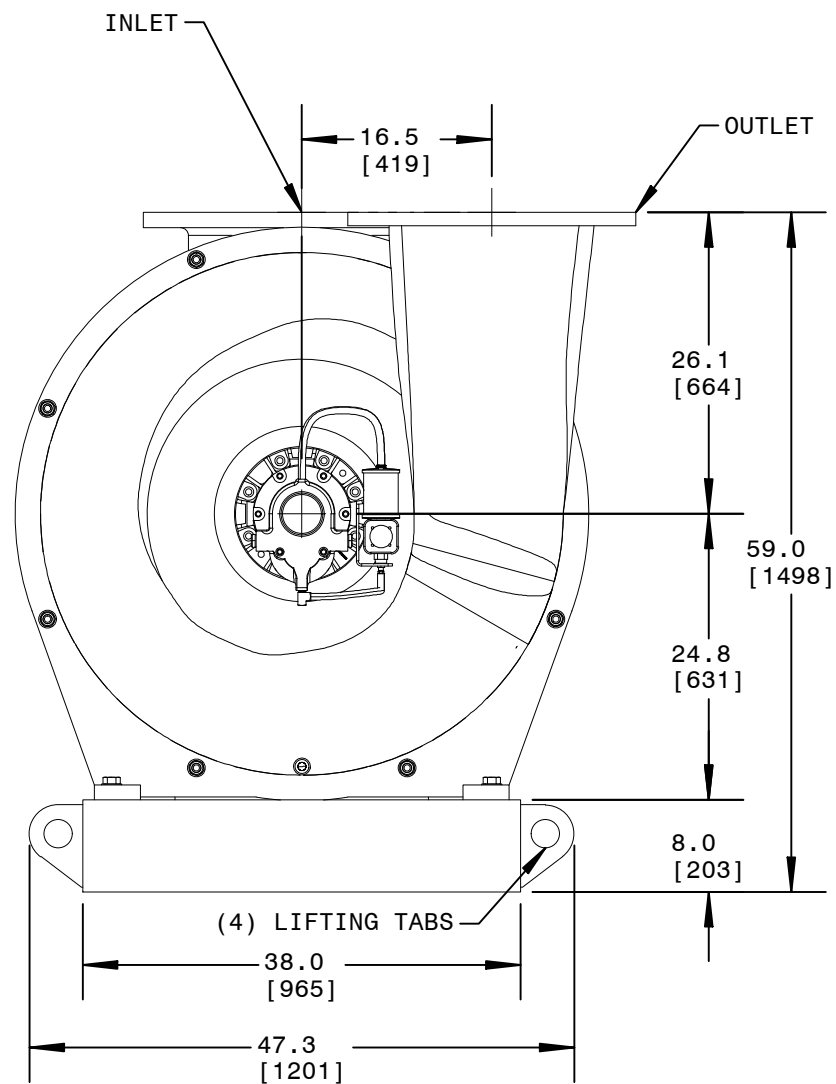
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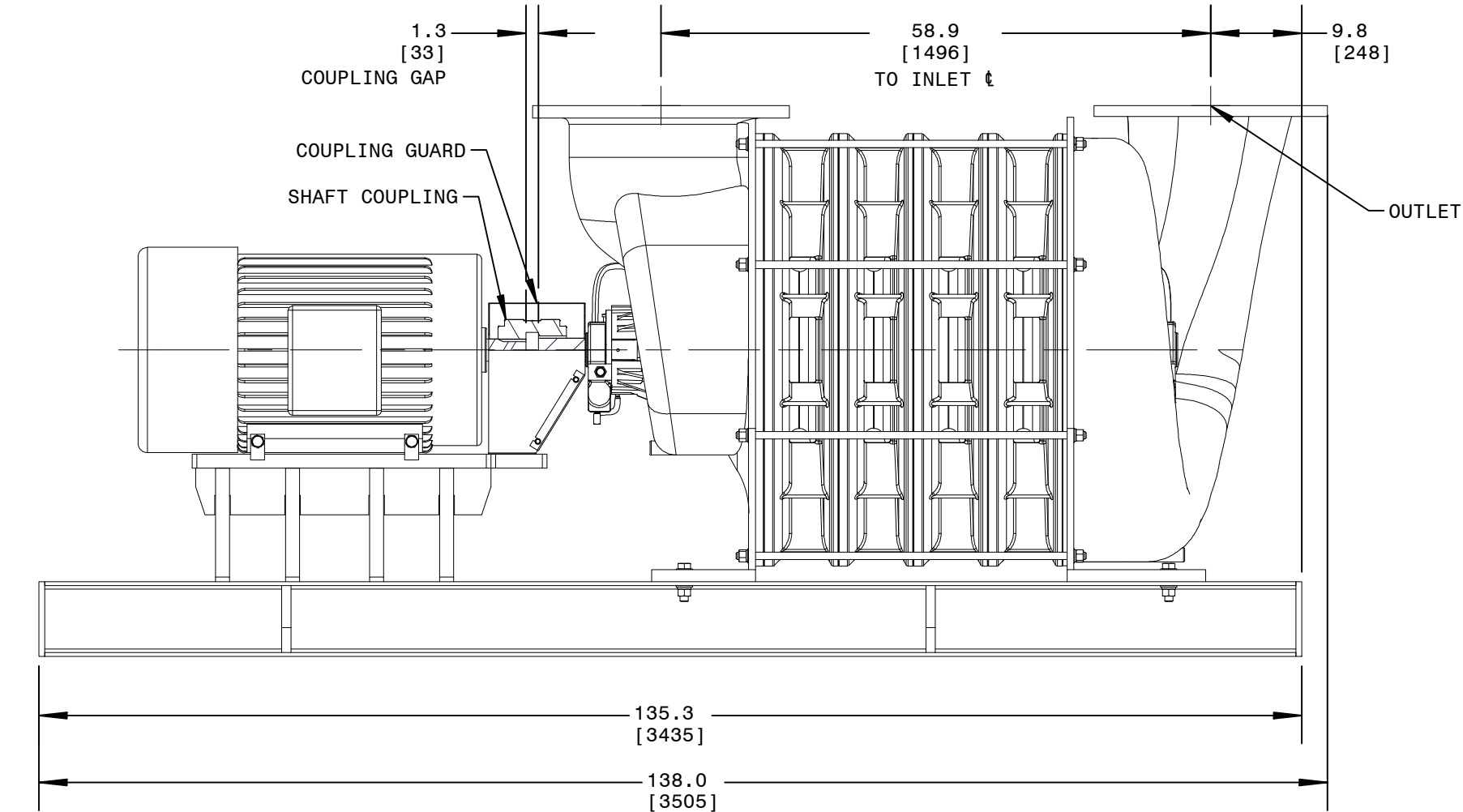
WINDSOR, CT. 06095

TITLE: 6000 SERIES POWERMIZER
C654T2 IN:A / DCH#1

SIZE C		DWG. NO.			REV. 0		
DR. BY		CK'D BY		ENG.		ECN	
DATE 03/08/2017		DATE		DATE			
SCALE: TO FIT				SHEET 1		OF 1	



INFORMATION ONLY



NO.	DESCRIPTION	DATE	BY.
REVISIONS			



Power Mizer® Series 6000

Cast Multistage Centrifugal Blowers and Exhausters

TECHNICAL DATA SHEET



Rugged, energy efficient multistage blowers and exhausters

The Power Mizer® Series 6000 employs proven Spencer technology to meet heavy-duty air and gas handling requirements at peak energy efficiency.

Spencer's multistage centrifugal blowers and exhausters have a long track record of performance. The product line can be paired with Spencer's variable frequency drives (VFD), operator interface, a variety of control system options, and blower protection devices for optimum energy efficiency. It is ideal for maximum uptime in demanding environments.

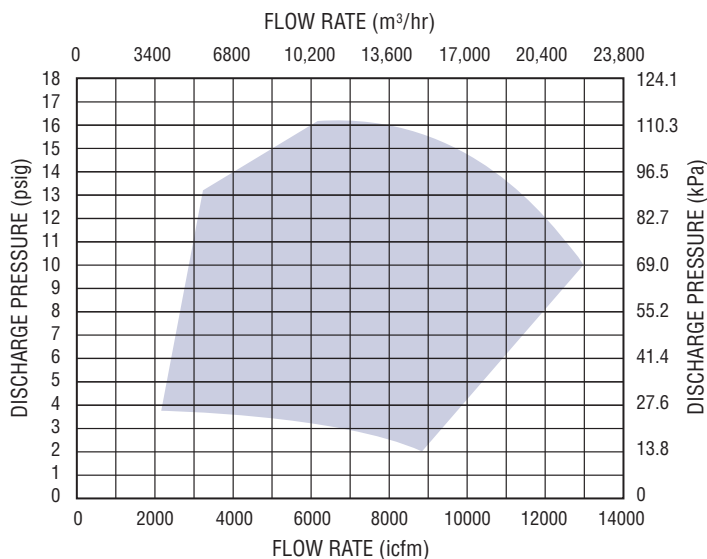
Applications include petrochemical refineries/sulfur recovery; mining/flotation; chemical/combustion air or process air; and municipal and industrial wastewater treatment/aeration.

Spencer's specially engineered aerodynamic components mean smoother, more efficient airflow from blower inlet to discharge. The Power Mizer Series 6000 is a cost-effective solution providing long-term power savings.

Performance Range

Performance at Standard Density

(Air at 68°F, Relative Humidity of 36%, Inlet Pressure 14.7 psia) 3550 rpm



Product Features

Technical Data

Number of stages: 2-6
Operating speed: 3550 rpm
Casing design pressure: 25 psig
Inlet connection: 20" (508mm) flange 125lb/150lb ANSI drilled and tapped
Outlet connection: 18" (457mm) flange 125lb/150lb ANSI drilled and tapped
Seals: labyrinth (single and double carbon ring available)
Bearings: 7314-/6314 ball, minimum L10 bearing life of ten years per AFBMA
Lubrication: oil
Drains: 3/8 and 1/2 NPT with plugs
Impeller diameter: 27.5" (699mm)
Impeller tip speed: 426 ft/sec (130 m/sec)
First critical speed: 4350 rpm for maximum stages
Vibration: 0.23 in/sec

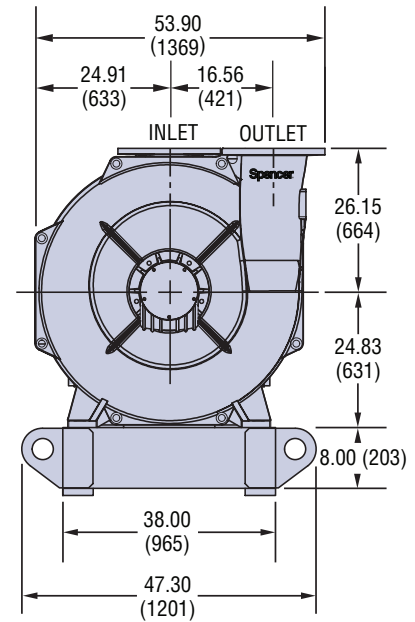
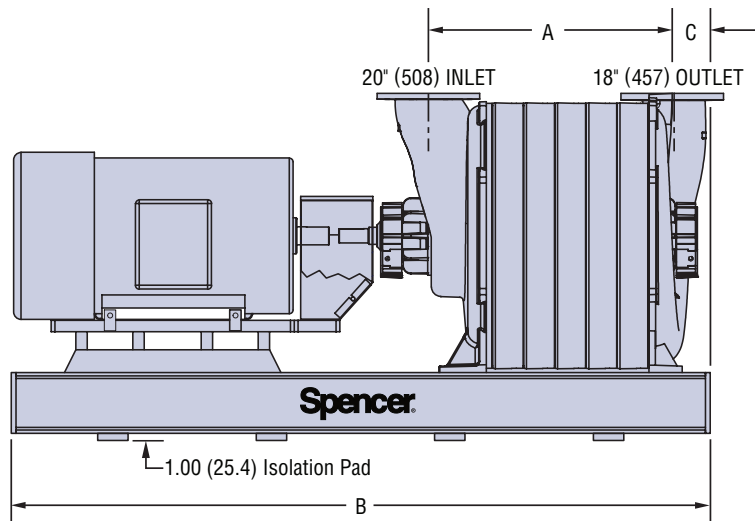
Accessories

Full line of standard and custom electrical control panels for packaged systems – UL and CUL Listed available
Dissolved oxygen control system
Flexible sleeve connectors and expansion joints
Filters and silencers
Butterfly valves and check valves

► Note: Specifications may vary and change without notice.

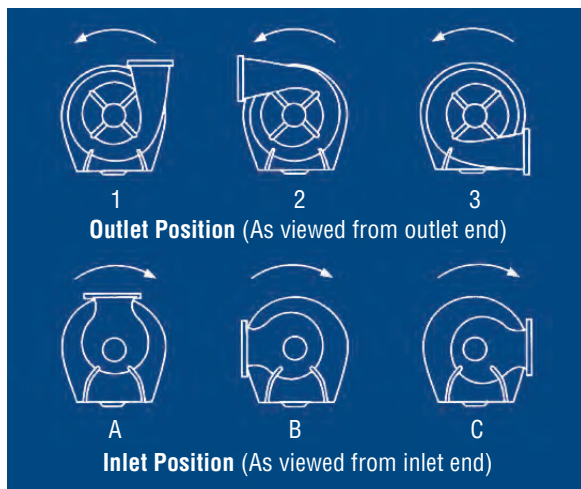
Materials of Construction

- Casing and heads: cast iron Class 30
- Tie rods: AISI 1035 carbon steel
- Interstage sealing: silicone rubber
- Shaft: AISI 1144 carbon steel
- Impellers: ASTM A356.0 cast aluminum
- Base: A36 structural steel
- Finish: epoxy primer with urethane topcoat
- Isolation pads: synthetic rubber and cork



Model Number	No. of Stages	Dimensions						Average Weight	
		A		B		C		Blower and Base (without motor)	
		inches	mm	inches	mm	inches	mm	lb	kg
C62	2	34.88	886	96.25	2445	1.75	45	4914	2231
C63	3	42.88	1089	111.25	2826	1.75	45	6064	2753
C64	4	50.88	1292	119.25	3029	1.75	45	6989	3173
C65	5	58.88	1496	135.25	3435	9.75	248	8049	3654
C66	6	66.88	1699	135.25	3435	1.75	45	8926	4052

Direction of Rotation



► Spencer may make improvements and dimensional changes to equipment designs based on market trends and requirements.

For product selection assistance, please email marketing@spencer-air.com or visit our website at www.spencerturbine.com to locate the Spencer representative in your area.

Power Mizer® is a registered trademark of The Spencer Turbine Company.

Compressor Performance Datasheet

Customer	: UNKNOWN	Model Number	: C54644
Customer reference	:	Stages	: 8
Quote number	: STC2300239	Casing diameter	: 45.80 in
Item number	: 001	Inlet size	: 16.00 in
Service	:	Outlet size	: 14.00 in
Quantity	: 1	Date last saved	: 04 Apr 2023 12:06 PM
		Impeller	: 10.00

Operating Conditions

Condition		1	2	3	4	5	6
System inlet volume flow	CFM	4,484.0	4,363.8	4,274.6	3,159.2	3,074.5	3,011.7
Actual compressor inlet volume	CFM	4,484.0	4,363.8	4,274.6	3,159.2	3,074.5	3,011.7
Flow at standard conditions	SCFM	4,400.0	4,400.0	4,400.0	3,100.0	3,100.0	3,100.0
Mass flow	lbm/s	5.50	5.50	5.50	3.87	3.87	3.87
Mass flow, dry	lbm/s	5.42	5.46	5.47	3.82	3.84	3.85
System inlet temperature	deg F	75.00	63.00	53.00	75.00	63.00	53.00
System inlet pressure	psi.a	14.700	14.700	14.700	14.700	14.700	14.700
Inlet pressure loss	psi						
Compressor inlet pressure	psi.a	12.143	11.910	11.733	11.091	10.885	10.728
Compressor discharge pressure	psi.a	22.20	22.20	22.20	22.20	22.20	22.20
Discharge pressure loss	psi						
System discharge pressure [p2]	psi.a	22.20	22.20	22.20	22.20	22.20	22.20
Compressor differential pressure	psi	10.06	10.29	10.47	11.11	11.32	11.47
System differential pressure [dp]	psi	7.50	7.50	7.50	7.50	7.50	7.50
Actual system discharge volume	CFM	3,085.3	2,966.1	2,877.9	2,038.6	1,961.7	1,904.5
Atmospheric pressure	psi.a	14.700	14.700	14.700	14.700	14.700	14.700
Elevation above sea level	ft	-7.63	-7.63	-7.63	-7.63	-7.63	-7.63
Site Supply Frequency	Hz	60	60	60	60	60	60
Type of gas	Air	Air	Air	Air	Air	Air	Air
Relative humidity	%	80.00	60.00	60.00	80.00	60.00	60.00
Molecular weight (MW)		28.71	28.84	28.88	28.71	28.84	28.88
Specific gravity		0.991	0.996	0.997	0.991	0.996	0.997
Specific heat (Cp)	Btu/(lb.deg F)	0.2436	0.2418	0.2412	0.2436	0.2418	0.2412
Ratio of specific heat (k)		1.40	1.40	1.40	1.40	1.40	1.40

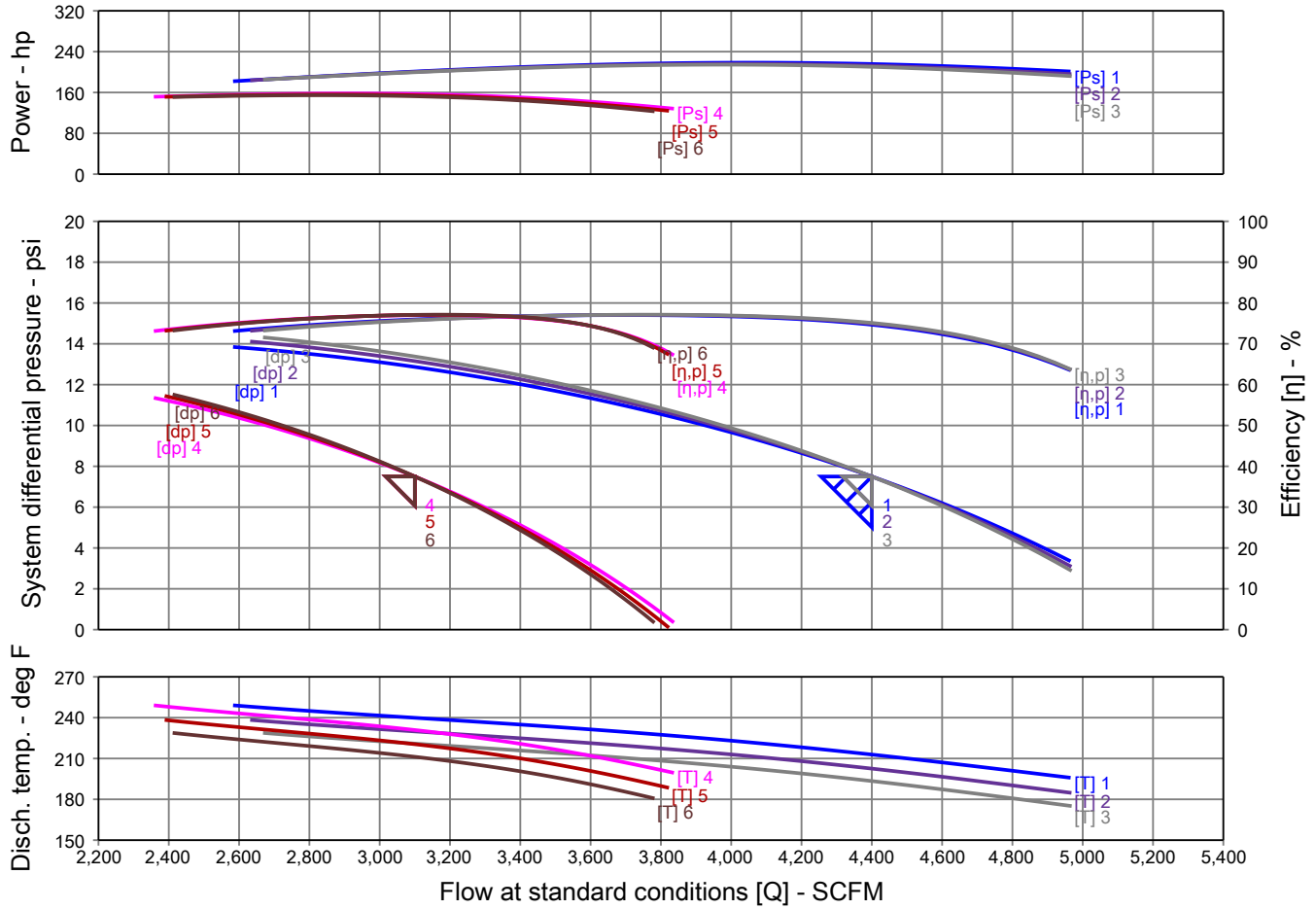
Performance

Quantity of Units Operating in Parallel		1	1	1	1	1	1
Speed	rpm	3550	3550	3550	3550	3550	3550
System discharge pressure (actual) [p2]	psi.a	22.20	22.20	22.20	22.20	22.20	22.20
Inlet throttling applied	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Power, shaft [Ps]	hp	216	213	210	157	155	153
Temperature rise	deg F	137.9	139.6	140.4	155.9	157.5	158.2
Discharge Temperature at Rated Flow	deg F	212.9	202.6	193.4	230.9	220.5	211.2
Rise to surge	psi	6.35	6.61	6.82	3.86	3.95	4.02
Turndown	%	41.30	40.19	39.36	23.95	22.96	22.23
Surge pressure	psi	13.85	14.11	14.32	11.36	11.45	11.52
Surge flow	SCFM	2,582.9	2,631.5	2,668.2	2,357.5	2,388.3	2,411.0
Sound level	dB	97.0	97.0	97.0	97.0	97.0	97.0
Inlet size	in	16.00	16.00	16.00	16.00	16.00	16.00
Outlet size	in	14.00	14.00	14.00	14.00	14.00	14.00

Standard conditions : (14.700 psi.a , 68.00 deg F , 36.00 %)

Compressor Performance Datasheet

Customer	: UNKNOWN	Model Number	: C54644
Customer reference	:	Stages	: 8
Quote number	: STC2300239	Casing diameter	: 45.80 in
Item number	: 001	Inlet size	: 16.00 in
Service	:	Outlet size	: 14.00 in
Quantity	: 1	Date last saved	: 04 Apr 2023 12:06 PM
		Impeller	: 10.00

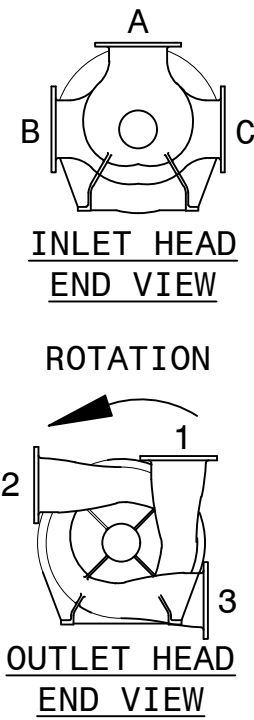
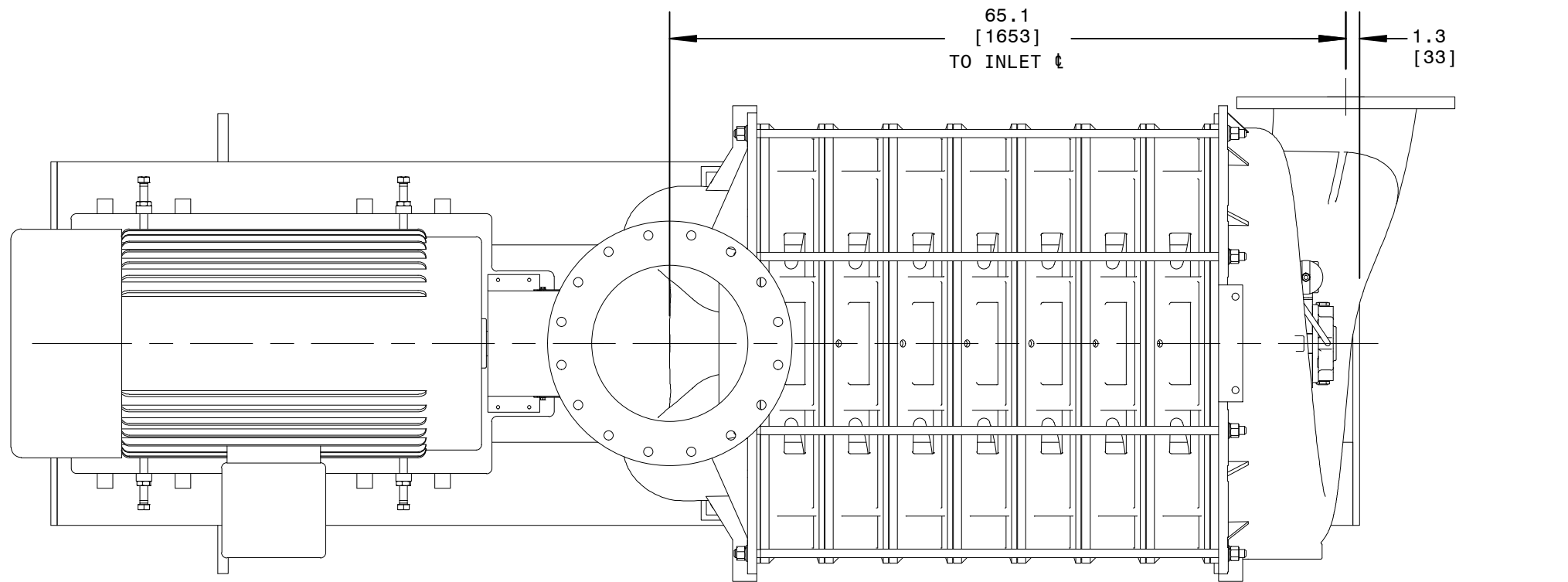
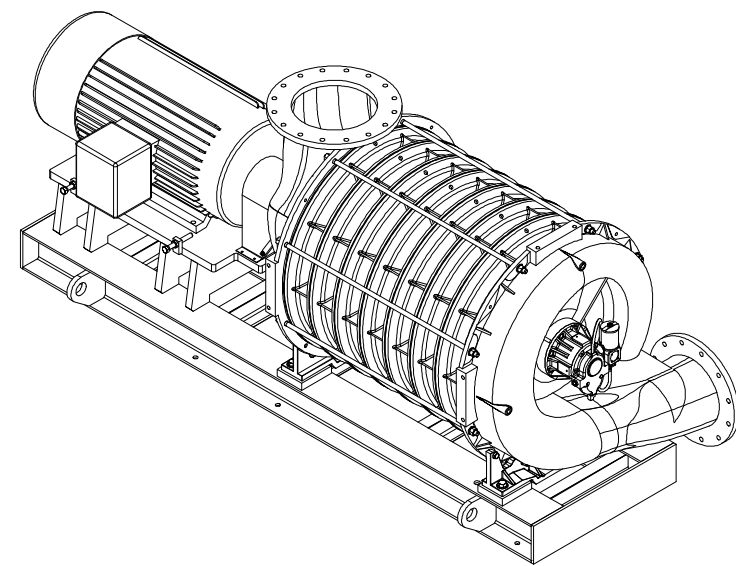
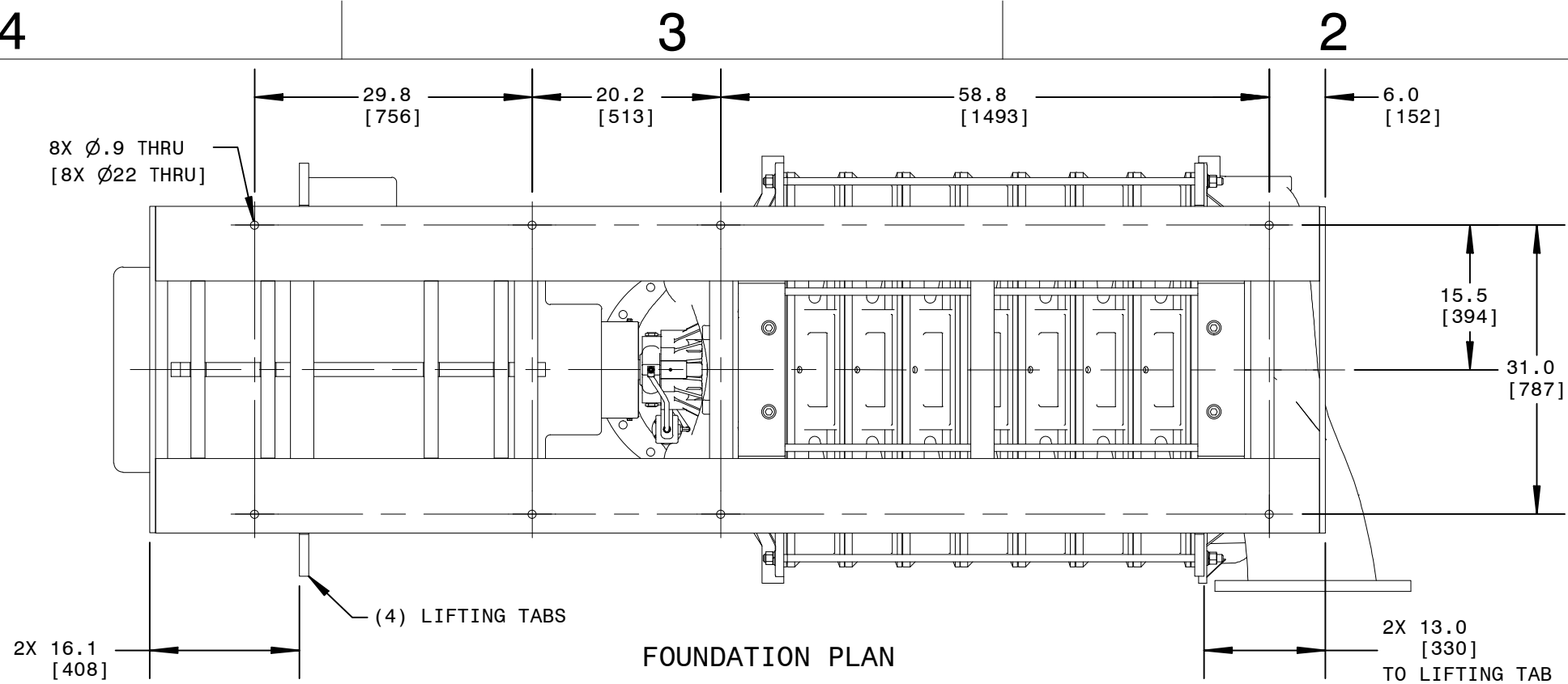


NOTES:

1. ALL DIMENSIONS ARE IN INCHES [MM]
2. DO NOT TRANSMIT EXTERNAL WEIGHT OR STRESS TO THE CASING
FLEXIBLE CONNECTIONS ARE REQUIRED
3. THIS EQUIPMENT IS DESIGNED TO SET FREE ON 1"THK CORK PADS PROVIDED
PAD No. REQUIRED: PAD90012
4. DRAINS ARE 1/2"NPT WITH PLUGS
5. INLET CONNECTION: Ø16 F.F. FLANGE #150 DRILLING, (16) 1.0-8 UNC-2B HOLES STRADDLING THEIR NATURAL CENTERLINE
6. OUTLET CONNECTION: Ø14 F.F. FLANGE #150 DRILLING, (16) 1.0-8 UNC-2B HOLES STRADDLING THEIR NATURAL CENTERLINE
7. APPROXIMATE WEIGHT: 11120 LBS
8. ORDER PROCESS: CTOX

MATERIALS OF CONSTRUCTION

1. BASE: ASTM A36 STRUCTURAL STEEL
2. IMPELLER: A356 CAST ALUMINUM
3. BLOWER: ASTM A48 CL30 CAST IRON
4. SHAFT: AISI 4130 CARBON STEEL
5. PAINT: SPENCER TURBINE STANDARD



COUPLING DATA

MAKE KOP-FLEX
TYPE FLEXIBLE DISC
MODEL/SIZE KD1/203
MOTOR BORE 2.375 BLOWER 2.125

MOTOR DATA

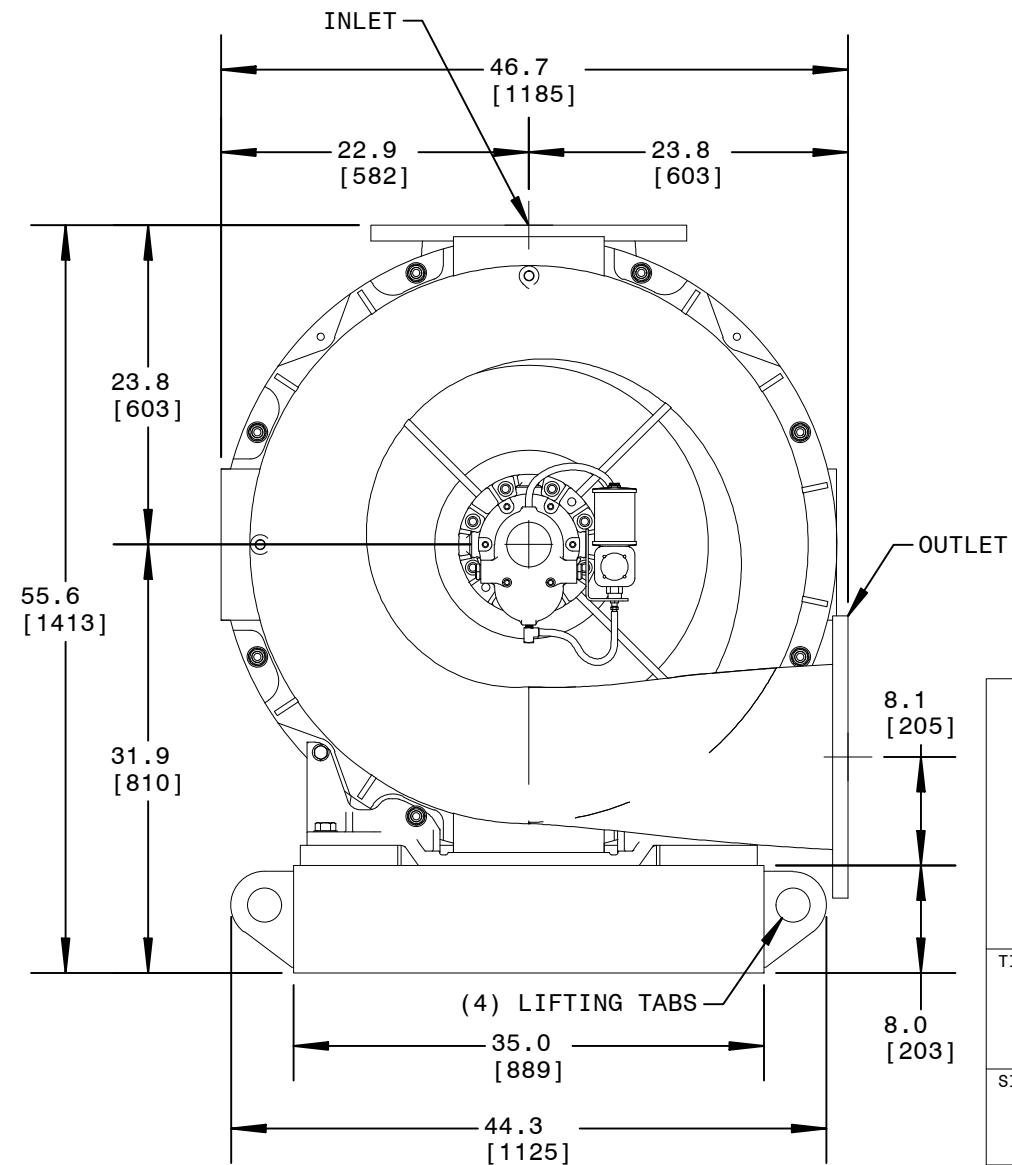
MAKE
HORSEPOWER 250 FRAME SIZE 449TS
RPM VOLTAGE
PHASE HERTZ
ENCLOSURE TYPE TEFC

PERFORMANCE DATA

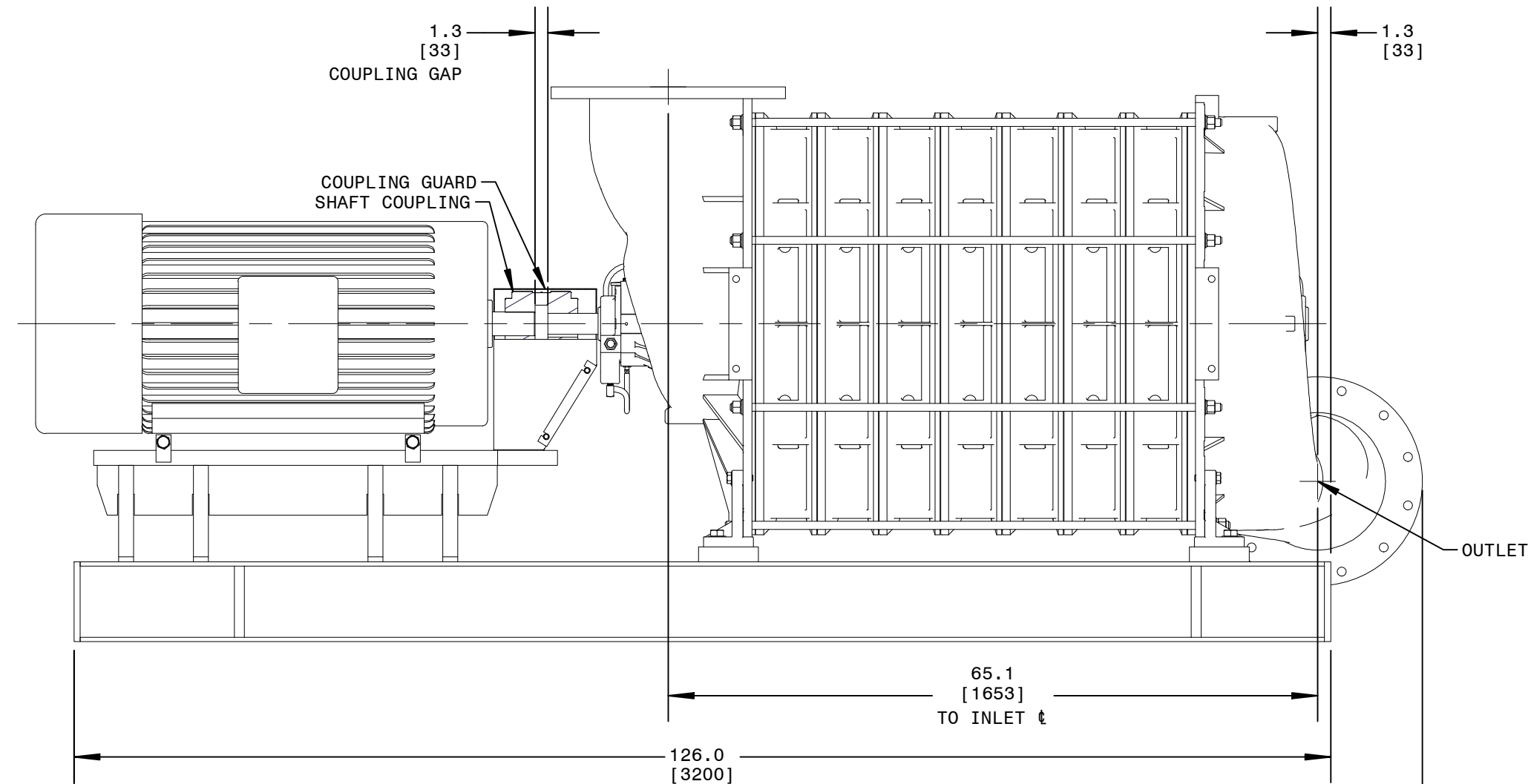
RATED 4400 SCFM
INLET TEMP. 75 ° F
INLET PRESSURE 14.7 PSIA
DIFFERENTIAL PRESSURE 7.5 PSIG
DISCHARGE PRESSURE PSIA
SPECIFIC GRAVITY
ALTITUDE FT. ABOVE S.L.

DIMENSIONS FOR:

INSTALLATION
CUSTOMER Norwalk WWTP - Option II
CUSTOMER ORDER No.
QUOTE No.
SALES ORDER No.
SERIAL No.
MODEL No. C54644
INLET: POS. A SIZE 16 (T/F): FLANGED
OUTLET: POS. 3 SIZE 14 (T/F): FLANGED



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THE SPENCER TURBINE COMPANY

WINDSOR, CT. 06095

TITLE: 5000 SERIES POWERMIZER
C54644 IN:A / DCH#3

SIZE	DWG. NO.	REV.
C		0
DR. BY	CK'D BY	ENG.
DATE	DATE	DATE
SCALE:	TO FIT	SHEET 1 OF 1



Power Mizer® Series 5000

Cast Multistage Centrifugal Blowers and Exhausters

TECHNICAL DATA SHEET



Rugged, energy efficient multistage blowers and exhausters

The Power Mizer® Series 5000 employs proven Spencer technology to meet heavy-duty air and gas handling requirements at peak energy efficiency.

Spencer's multistage centrifugal blowers and exhausters have a long track record of performance. The product line can be paired with Spencer's variable frequency drives (VFD), operator interface, a variety of control system options, and blower protection devices for optimum energy efficiency. It is ideal for maximum uptime in demanding environments.

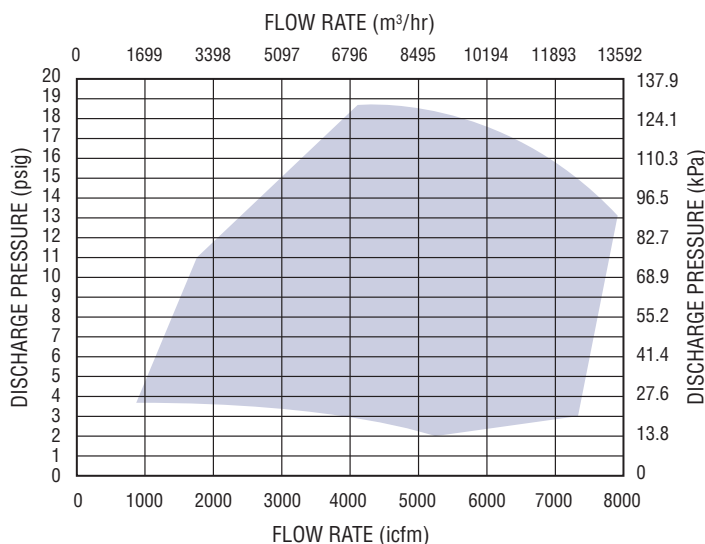
Applications include petrochemical refineries/sulfur recovery; mining/flotation; chemical/combustion air or process air; and municipal and industrial wastewater treatment/aeration.

Spencer's specially engineered aerodynamic components mean smoother, more efficient airflow from blower inlet to discharge. The Power Mizer Series 5000 is a cost-effective solution providing long-term power savings.

Performance Range

Performance at Standard Density

(Air at 68°F, Relative Humidity of 36%, Inlet Pressure 14.7 psia) 3550 rpm



Product Features

Technical Data

Number of stages: 2-8
Operating speed: 3550 rpm
Casing design pressure: 25 psig
Inlet connection: 16" (406mm) flange 125lb/150lb ANSI drilled and tapped
Outlet connection: 14" (356mm) flange 125lb/150lb ANSI drilled and tapped
Seals: labyrinth (single and double carbon ring available)
Bearings: 7312/6312 ball, minimum L10 bearing life of ten years per AFBMA
Lubrication: oil
Drains: 3/8 NPT with plugs
Impeller diameter: 25.5" (648mm)
Impeller tip speed: 395 ft/sec (120 m/sec)
First critical speed: 4286 rpm for maximum stages
Vibration: 0.23 in/sec

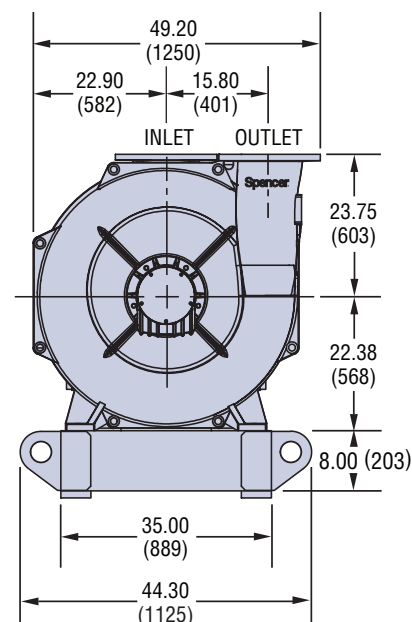
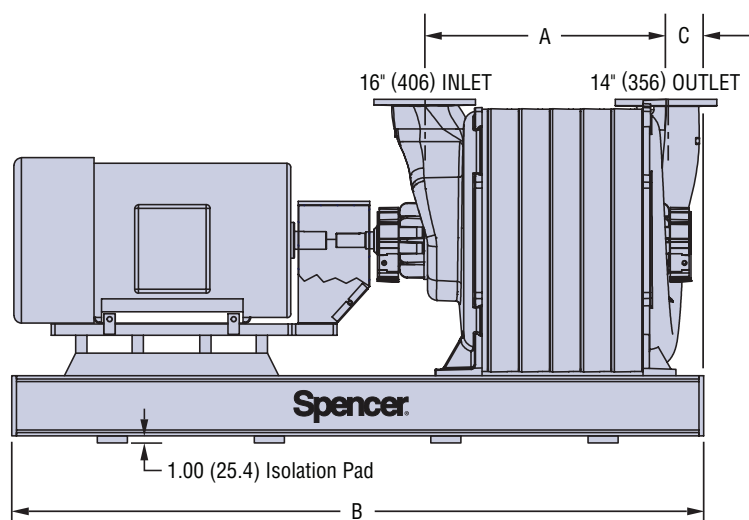
Accessories

Full line of standard and custom electrical control panels for packaged systems – UL and CUL Listed available
Dissolved oxygen control system
Flexible sleeve connectors and expansion joints
Filters and silencers
Butterfly valves and check valves

► Note: Specifications may vary and change without notice.

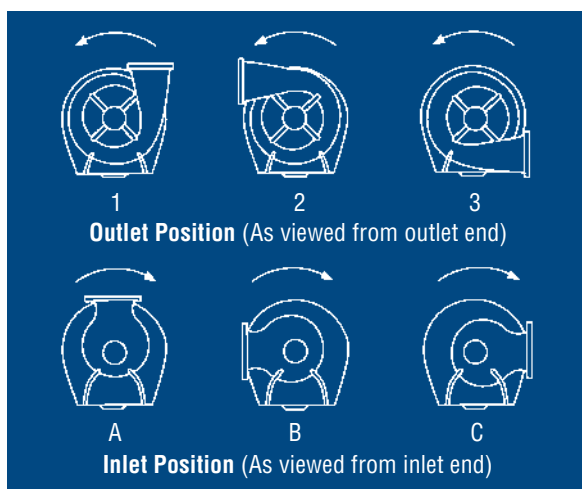
Materials of Construction

- Casing and heads: cast iron Class 30
- Tie rods: AISI 1035 carbon steel
- Interstage sealing: silicone rubber
- Shaft: AISI 1144 carbon steel
- Impellers: ASTM A356.0 cast aluminum
- Base: A36 structural steel
- Finish: epoxy primer with urethane topcoat
- Isolation pads: synthetic rubber and cork



Model Number	No. of Stages	Dimensions						Average Weight	
		A		B		C		Blower and Base (without motor)	
		inches	mm	inches	mm	inches	mm	lb	kg
C52	2	27.97	710	94.25	2394	7.32	186	3852	1747
C53	3	34.16	868	94.25	2394	1.14	29	4518	2049
C54	4	40.34	1025	114	2896	13.5	343	5344	2424
C55	5	46.53	1182	114	2896	7.3	185	6010	2726
C56	6	52.71	1339	114	2896	1.14	29	6676	3028
C57	7	58.89	1496	126	3200	7.3	185	7542	3421
C58	8	65.07	1653	126	3200	1.14	29	8208	3723

Direction of Rotation



► Spencer may make improvements and dimensional changes to equipment designs based on market trends and requirements.

For product selection assistance, please email marketing@spencer-air.com or visit our website at www.spencerturbine.com to locate the Spencer representative in your area.

Date: 1/31/2023

Project Name: Norwalk, CT

Customer: Arcadis

Sales Order Number:

Application Engineer: KEC

Comment: Option 1-B

AMBIENT GAS PARAMETERS	ENGLISH UNITS	METRIC UNITS
Molecular Weight	28.607 lbm/lbmol	28.607 kg/kgmol
R Value	54.009 ft.lbf/lbm.R	0.291 kJ/kg.K
Density	0.072 lbm/ft^3	1.146 kg/m^3
Sp. Heat @ Const. P	0.244 BTU/lbm.R	1.022 kJ/kg.K
Ratio of Sp. Heats	1.397	1.397
Partial Pres. of Vapor	0.472	0.472

GAS MIX:	VOL
Air	100

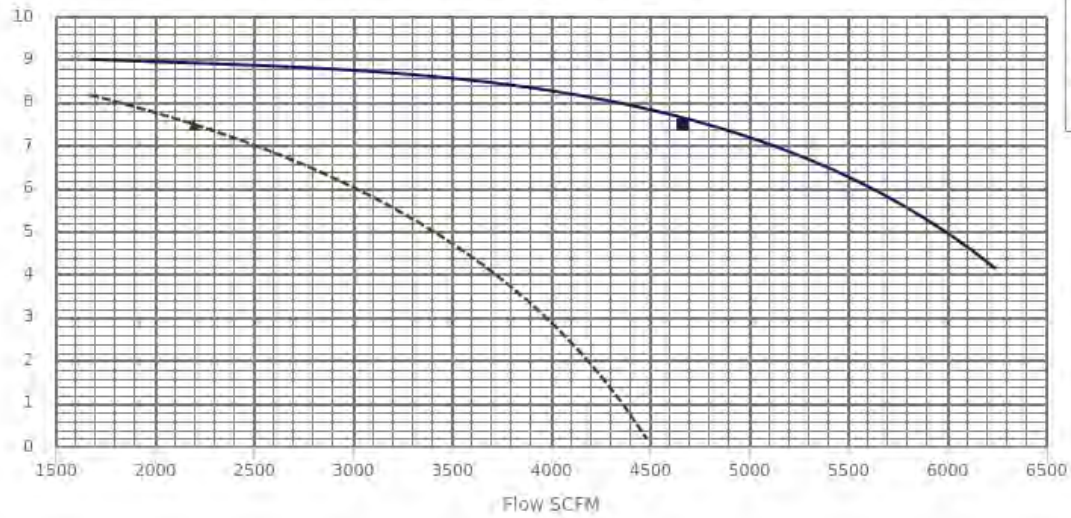
Inlet Set 1

CORRECTED VALUES	ORIGINAL UNITS	ENGLISH UNITS	METRIC UNITS
Ambient Pressure	14.62 PSIA	14.62 PSIA	1.01 bar a
Relative Humidity	78%	78%	78%
Ambient Temperature	85 F	85.00 F	29.44 C
Inlet Pressure	14.4 PSIA	14.40 PSIA	-15.17 mbar g
Inlet Flow	4667 SCFM	5038 ICFM	8560 m3/h
Discharge Pressure	7.5 PSIG	7.50 PSIG	0.52 bar g
MEASURED VALUES	ORIGINAL UNITS	ENGLISH UNITS	METRIC UNITS
Surge Flow Rate	1669 SCFM	1802 ICFM	3061 m3/h
Surge Pressure	9.02 PSIG	9.02 PSIG	0.62 bar g
Pressure Rise to Surge	1.52 PSIG	1.52 PSIG	0.10 bar g
Max. Vol. Turndown	64.24%	64.24%	64.24%
Pressure @ Design	7.50 PSIG	7.50 PSIG	0.52 bar g
Power @ Design	224.86 HP	224.86 HP	167.68 KW
Efficiency @ Design	65.31%	65.31%	65.31%
Temperature @ Design	194.99 F	194.99 F	90.55 C

Inlet Set 2

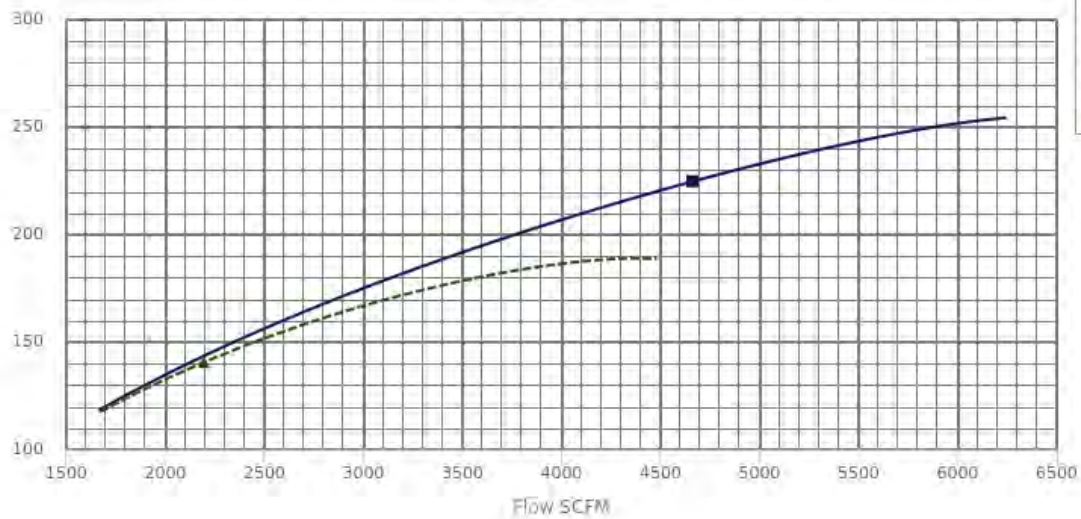
CORRECTED VALUES	ORIGINAL UNITS	ENGLISH UNITS	METRIC UNITS
Ambient Pressure	14.62 PSIA	14.62 PSIA	1.01 bar a
Relative Humidity	78%	78%	78%
Ambient Temperature	85 F	85.00 F	29.44 C
Inlet Pressure	14.4 PSIA	14.40 PSIA	-15.17 mbar g
Inlet Flow	2200 SCFM	2375 ICFM	4035 m3/h
Discharge Pressure	7.5 PSIG	7.50 PSIG	0.52 bar g
MEASURED VALUES	ORIGINAL UNITS	ENGLISH UNITS	METRIC UNITS
Surge Flow Rate	1669 SCFM	1802 ICFM	3061 m3/h
Surge Pressure	9.02 PSIG	9.02 PSIG	0.62 bar g
Pressure Rise to Surge	1.52 PSIG	1.52 PSIG	0.10 bar g
Max. Vol. Turndown	24.13%	24.13%	24.13%
Pressure @ Design	7.50 PSIG	7.50 PSIG	0.52 bar g
Power @ Design	140.81 HP	140.81 HP	105.00 KW
Efficiency @ Design	54.72%	54.72%	54.72%
Temperature @ Design	234.24 F	234.24 F	112.36 C

Static Discharge Pressure PSIG

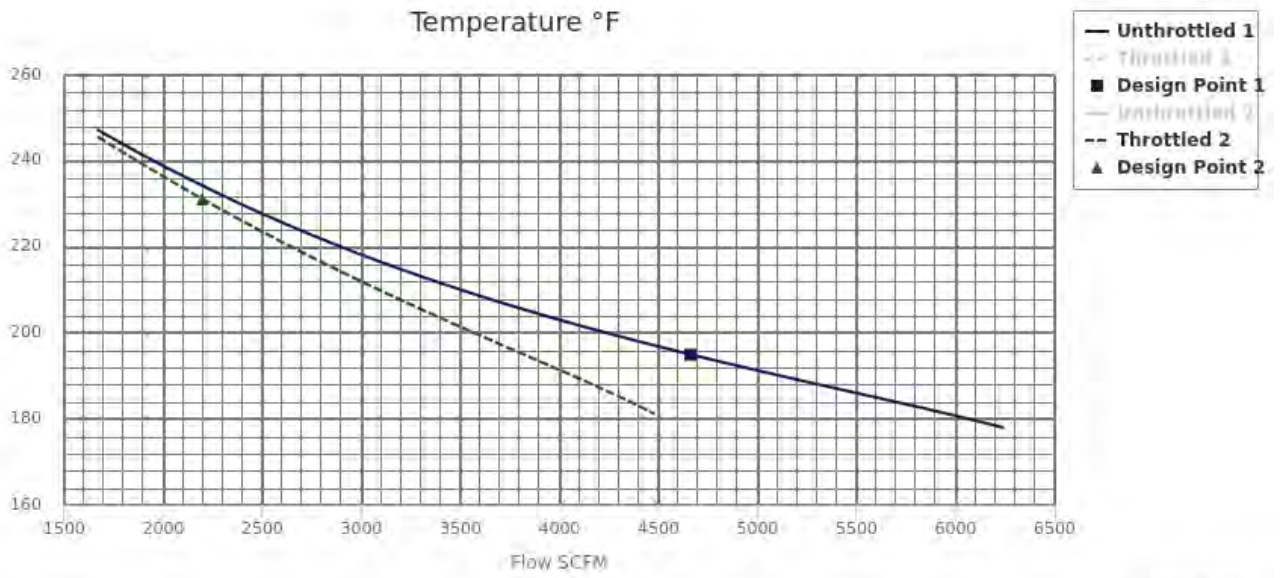


HighCircuitry.com

Shaft Power HP



HighCircuitry.com

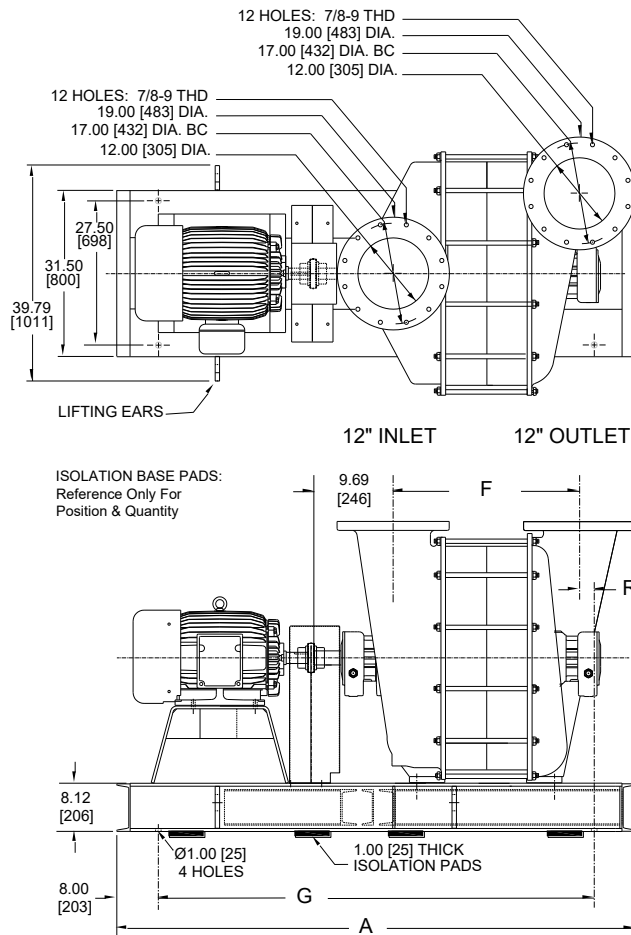


HighChemSystems.com

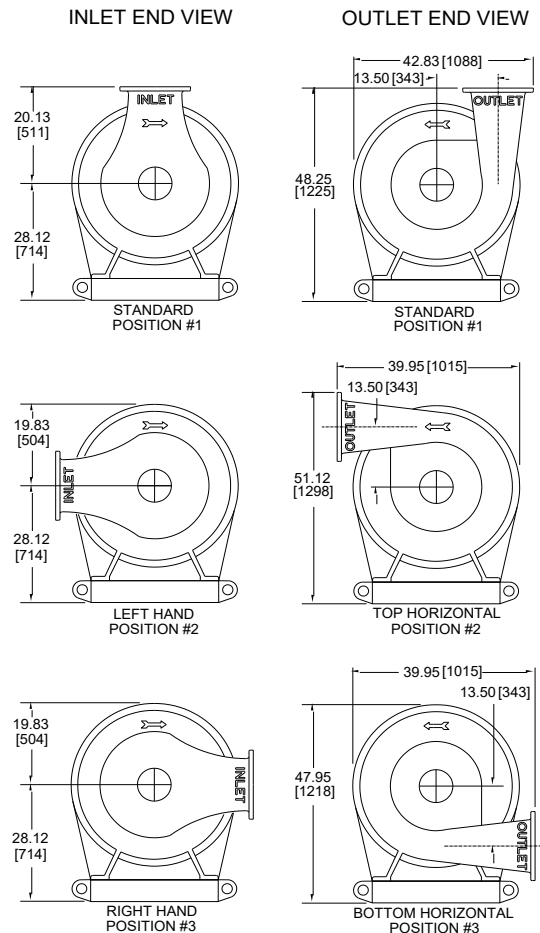


HighChemSystems.com

GENERAL ARRANGEMENT



FLANGE ORIENTATIONS



DIMENSIONAL DATA – inches [millimeters]

FRAME	A	F	G	R
1261	72.00 [1829]	19.94 [506]	56.00 [1422]	2.00 [51]
1262	80.00 [2032]	25.75 [654]	64.00 [1626]	2.00 [51]
1263	93.00 [2362]	31.56 [802]	77.00 [1956]	2.00 [51]
1264	101.00 [2565]	37.38 [949]	85.00 [2159]	2.00 [51]
1265	117.00 [2972]	43.19 [1097]	101.00 [2565]	2.00 [51]
1266	117.00 [2972]	49.00 [1245]	101.00 [2565]	2.00 [51]
1267	123.00 [3124]	54.81 [1392]	107.00 [2718]	2.00 [51]
1268	132.00 [3353]	60.63 [1540]	116.00 [2946]	2.00 [51]

WEIGHTS – lb (kg) & INERTIA – lb-ft² [kg-m²]

FRAME	PKG. LESS MOTOR	BARE UNIT	WK ²
1261	2620 [1188]	1420 [644]	17 [.70]
1262	3040 [1379]	1840 [835]	32 [1.33]
1263	3560 [1615]	2260 [1025]	47 [1.96]
1264	3980 [1805]	2680 [1216]	62 [2.59]
1265	4500 [2041]	3100 [1406]	77 [3.24]
1266	4920 [2232]	3520 [1597]	92 [3.88]
1267	5440 [2468]	3940 [1787]	108 [4.52]
1268	5860 [2658]	4360 [1978]	133 [5.57]

PRODUCT NOTES

- Information is approximate, subject to change without notice, and not for construction use unless certified
- Position #1 is standard inlet & outlet orientation

Gardner Denver Nash

PO Box 130, Bentleyville, PA 15314
 Phone: +1 800-982-3009 / +1 724-239-1500
 Fax: +1 724-239-1502
 E-mail: info.HoffmanLamson@gardnerdenver.com
 Web: www.HoffmanandLamson.com

All Nash facilities are ISO 9001 certified.

Appendix AS-B

Other Aeration System Selections

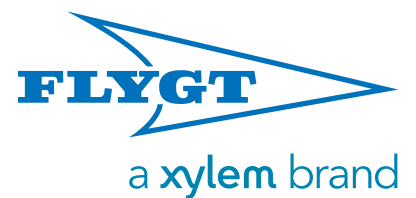
1. **Mixers**
2. **IMLR Pumps**
3. **Diffusers**
4. **Control Valves**

MIXERS

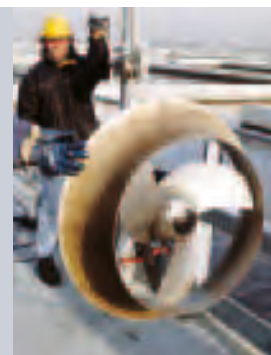


Flygt compact mixers

RELIABLE VERSATILITY, HIGH EFFICIENCY

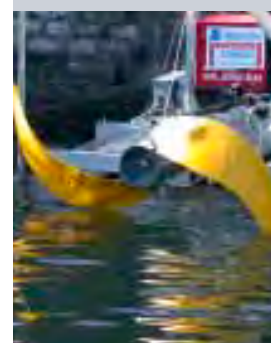


Compact mixing for any requirement



Advantages of Flygt compact mixers

- High efficiency and reliability
- Space-saving installation
- Easy handling of highly fibrous materials
- Few, easy-to-service components
- Durable design
- Low total cost of ownership



Our comprehensive mixing portfolio

Flygt's wide array of reliable, trouble-free mixing equipment includes:

- Flygt low-speed mixers
- Flygt compact mixers
- Flygt top-entry agitators
- Flygt jet mixers
- Flygt hydroejectors

Rising to the mixing challenge

All mixing applications require varying degrees of both small-scale turbulence and bulk flow. With a good bulk flow, the contents of the entire tank are set into motion involving in the mixing process. The strength of the bulk flow is, in turn, dependent on the total amount of installed thrust and layout.

Unparalleled expertise, broad mixing solutions

Flygt pioneered the use of thrust as the main performance parameter for mixing. And every day, we put more than 50 years of R&D expertise and practical experience to work to determine the right technology, mixer size and layout for your requirements.

Our comprehensive portfolio of mixers and agitators cover virtually every requirement. Hundreds of thousands of Flygt mixers and agitators are in service worldwide, delivering efficient mixing performance.

Flygt compact mixers

Engineered for flexibility, versatility and lean installation, these space-saving mixers offer highly efficient solutions for any tank shape and size.

Our compact mixers easily blend highly contaminated fluids high-density or high-viscosity liquids, and liquids with fibrous material. Few components, low capital investment and straightforward service routines make Flygt compact mixers the economical choice for a broad range of mixing applications, like:

- Activated sludge treatment such as conventional ASP or sequencing batch reactor
- Sludge holding tanks
- Equalization tanks
- Pump station mixing
- Grit chamber mixing
- Chlorination basins
- Paper pulp chests
- Quenching tanks

Designed for high reliability

For decades, we have been at the cutting edge of mixer research and development. Flygt compact mixer components contribute to reliable operation, reduced energy costs and efficient mixing.

Compact, robust direct-drive motor

Our squirrel-cage induction motor is manufactured at our premises for durability and dependability. Stator windings are trickle impregnated in resin and rated at Class H 180°C (355°F) for excellent resistance to overheating and long service life.



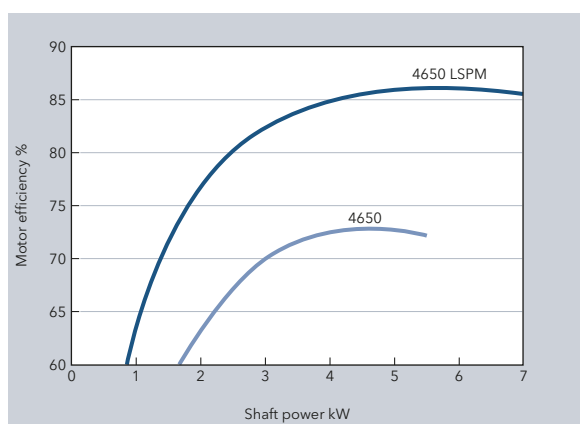
Class H stator motor for long service life.

Line-start permanent magnet motor

The optional line-start permanent magnet (LSPM) motor for the Flygt 4650 compact mixer combines the efficiency of a synchronous permanent magnet motor with the direct on-line starting of an induction motor. This saves on current-related costs, such as for cables and power supplies, additional energy savings.



Optional LSPM motor for additional energy savings.



and up to 20% on energy compared to conventional induction motors.

Oil housing

The large oil volume ensures smooth operation and long service intervals between refills. To make service easy, the oil plugs allow refill without removing the propeller.

Active Seal™ for zero leakage

The Flygt Plug-in seal features the Active Seal™ system for zero leakage into the stator housing. Laser-cut grooves on the inner seal faces, act as a micro-pump to force any liquid present on the drive-unit back to the buffer fluid side. The seal housing with barrier fluid helps lubricate and cool the seal, ensuring efficient heat transfer even when running dry.



Active Seal™ for zero leakage.

Non-clogging, fiber-handling hydraulics

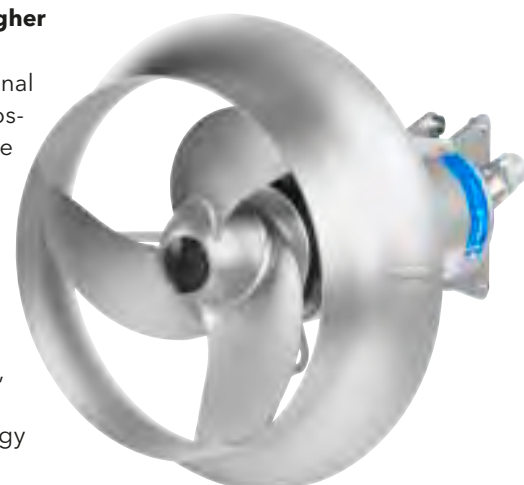
Flygt compact mixers feature an efficient hydraulic design with few, easy-to-service components, which contributes to reliable, trouble-free operation. Engineered to generate maximum thrust with minimal use of energy, the propeller blades with their backswept design allow highly fibrous material to pass through. Wide-hub design deflects fibrous material.



Non-clogging hydraulics

Jet ring for higher efficiency

With the optional jet ring, it is possible to achieve an increase in mixer efficiency by up to 15% in water – and even higher in viscous media, while further reducing energy consumption.



Optional jet ring for increased mixing efficiency.

Dependability starts with attention to detail

1 Cable entry

Compressible bushing and strain relief on the cable prevent leakage into the motor, providing a reliable installation.

5 Motor

High-performance, squirrel-cage induction Class H motor provides thermal overload protection and extra long service life.

2 Oil housing

Large barrier fluid volume lubricates and cools the seal and thereby prolongs service life.

6 Propeller

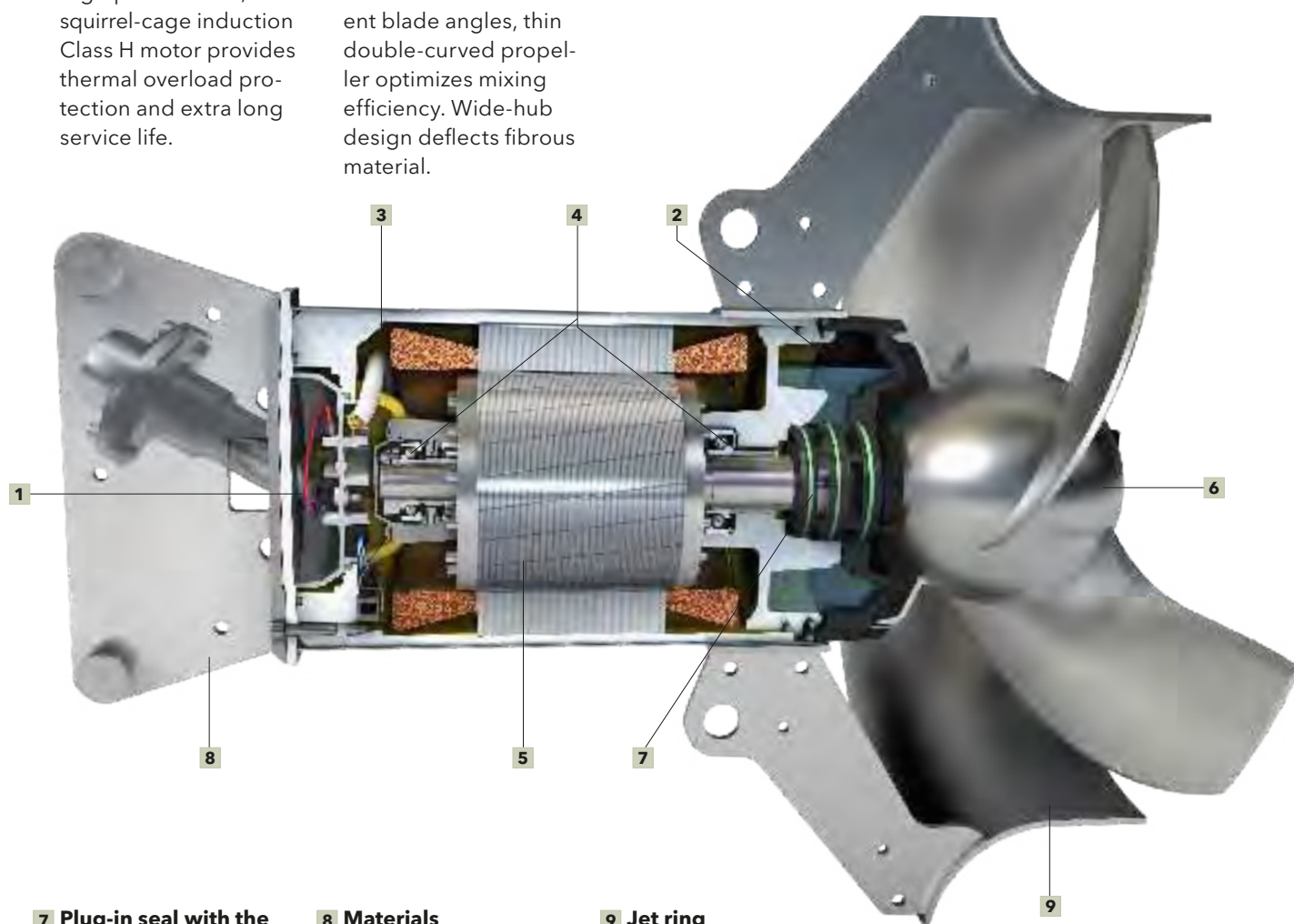
Available with different blade angles, thin double-curved propeller optimizes mixing efficiency. Wide-hub design deflects fibrous material.

3 Monitoring

Thermal sensors embedded in the stator windings prevent overheating. Leakage sensors are available as options.

4 Bearings

Securely supports the shaft by means of one main bearing at the propeller end and a double bearing at the rear end.



7 Plug-in seal with the Active Seal™ system

Offers increased sealing reliability and zero leakage into the motor, thereby reducing the risk of bearing and stator failure.

8 Materials

All external parts manufactured for excellent corrosion-resistance. Major parts in stainless steel.

9 Jet ring

Optional jet ring increases hydraulic efficiency thereby reducing power consumption.

Low-cost installation

Flygt installation equipment is rigid enough to withstand the weight and reaction forces exerted by the mixer throughout its operating life. It is also robust and easy to work with.

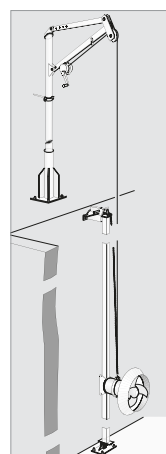
Guide bar systems for any tank

To help withstand fatigue from strongly fluctuating forces within the tank, Flygt compact mixers are usually installed along rigid guide bars at appropriate depths for optimal mixing efficiency. Used together with our lifting equipment, guide bar systems enable easy access for inspection and service.

Safe, convenient lifting equipment

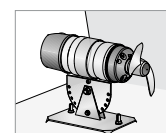
Raising and lowering Flygt compact mixers with our lifting equipment is as easy and convenient as it is safe. The CE-approved lifting davit is mounted in a holder at its lower end, which enables easy turning of the davit. To reduce investment cost, one davit can be used for several mixers.

Methods of installation



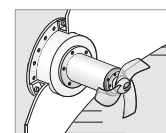
Guide bar mounting

The mixer is lowered or raised along a guide bar located on the tank wall.



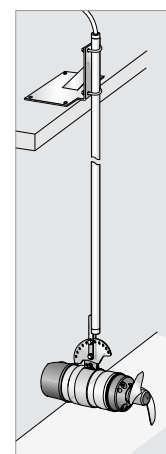
Floor mounting

Affixes to a stand on the bottom; often used in shallow tanks and ponds.



Flange mounting

Securely affixes to an adapter flange, which is mounted in the tank inspection hole.

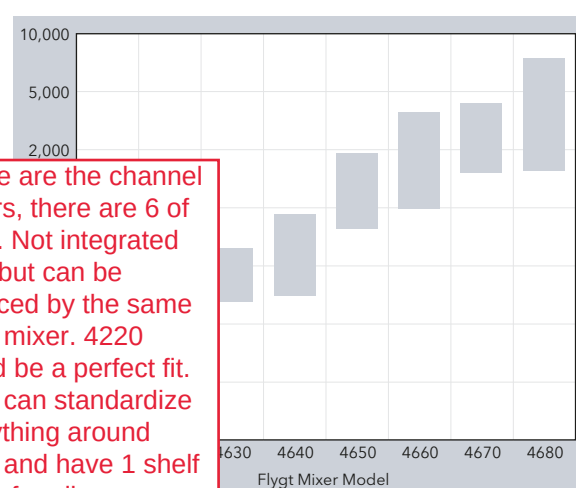


Cantilever mounting

Mounts on a cantilever bar, which is fixed to the tank edge.

A broad range of compact mixers

Our compact mixer portfolio includes eight different sizes of direct drive mixers. Using standardized materials and components, the modular design, which includes a series of blade angles for each model, provides a comprehensive range of mixer performance.



Facts and figures

Model	4610	4620	4630	4640	4650	4660	4670	4680	4650 LSPM				
Power, kW													
· 50 Hz	0.9	1.5	1.5	2.5	3.7	5.5	7.5	10	13	18.5	25	5.0	7.0
· 60 Hz (hp)	0.9 (1.2)	1.7 (2.3)	1.9 (2.5)	3.0 (4.0)	4.5 (6.0)	6.2 (8.3)	8.2 (11.0)	11.2 (15.0)	14.9 (20.0)	22.4 (30.0)	30.0 (40.0)	6.0 (8.0)	8.2 (11.0)
Thrust range:													
· 50 Hz, N	100-200	100-300	200-500	200-800	800-1300	800-1900	800-2200	800-2800	1400-3800	1400-5300	1400-6400	900-1400	900-2000
· 60 Hz, N	100	100-300	300-500	300-800	1200	1200-1500	1200-2300	1200-3100	2000-3800	2000-5500	2000-7000	1200-1600	1200-2400
Propeller diam, m (in)	0.210 (8.3)	0.210 (8.3)	0.368 (14.5)	0.368 (14.5)	0.580 (22.8)	0.580 (22.8)	0.580 (22.8)	0.580 (22.8)	0.766 (31.6)	0.766 (31.6)	0.766 (31.6)	0.580 (22.8)	0.580 (22.8)

Options

SUBCAB®

Heavy-duty submersible rubber cable.

SUBCAB® Screened

Heavy-duty submersible rubber cable for use with VFD and to limit electromagnetic interference.

Special cables

Withstand high temperatures, high voltage and chemical agitation.

Leakage sensors

Automatically detect, together with external monitoring equipment, any leakage in stator and oil housings.

Extended jet ring

For improved motor cooling in viscous liquids.

Flygt MiniCAS supervision

Provides quick and easy equipment protection by monitoring thermal overload switches and leakage detectors.

Explosion-proof versions

For use in potentially explosive or flammable environments.

High chromium cast iron propeller

Withstands severe abrasion resulting from mixing hard mineral slurries.

Silicone carbide (RSiC) seal

Provides excellent abrasion resistance and superior resistance against acid and chloride liquids.

Vortex protection shield

Prevents air vortices from being drawn from the surface into the mixer propeller to maintain optimal performance. For use in applications where the liquid depth is very shallow or when the mixer must be placed close to the surface.

Warm liquid versions

For use in high temperature applications (up to 90°C).

Zinc anode kits

Provides extra corrosion-resistance for seawater applications.



Stator leakage sensor



Flygt MiniCAS supervision unit



Vortex protection shield



Cast iron propeller



Extended jet ring

A perfect blend of support and service



Boost efficiency with monitoring and control

We supply everything from controllers, sensors and start equipment to SCADA software for complete fluid handling supervision.



A deep understanding of fluid handling and vast experience in mixing technologies makes Flygt a trustworthy and reliable partner for all your process requirements.

Systems engineering expertise

Dimensioning and layout are critical factors in maximizing performance. Using our expertise and intelligent tools, we analyze your requirements to identify the right mixer or agitation system to optimize your processes.

Support along the way

Our recommendations result from the use of specially developed and validated Computational Fluid Dynamics software programs, based on carefully selected, relevant models. Our own testing facilities as well as field testing and measurement of actual performance onsite provide Flygt engineers with keen insight into what works. Using this knowledge and expertise we help you maintain your installation in top operating condition.

Global service network

Should any problem occur with your Flygt mixers and agitators, professional assistance and original spare parts are always within easy reach through our extensive service network in 140 countries.



Enjoy the benefits of a premium brand

Genuine spare parts are vital to ensure long and trouble-free operation. We guarantee the availability of spare parts for 10 years after we stop production of a model.

Xylem ['zīləm]

- 1) The tissue in plants that brings water upward from the roots
- 2) A leading global water technology company

We're 12,000 people unified in a common purpose: creating innovative solutions to meet our world's water needs. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. We move, treat, analyze, and return water to the environment, and we help people use water efficiently, in their homes, buildings, factories and farms. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise, backed by a legacy of innovation.

For more information on how Xylem can help you, go to xyleminc.com.



Flygt is a brand of Xylem. For the latest version of this document and more information about Flygt products visit www.flygt.com

MIXING SELECTION REPORT

Quote Number: 3556_3-230323-001 (Rev. 0)
 Project: Norwalk WWTP - Mixer Selections
 Position: Anoxic

Attention! Consult with Application Engineer if CFD should be used to secure and optimize system functionality. Please ask your Sales Representative to raise a CFD request in Sales Force.

INPUT DATA

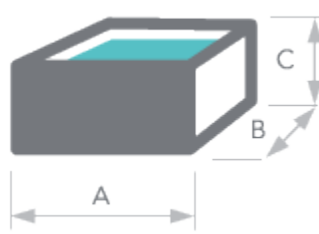
Wastewater Treatment > Biological Treatment Mixing	
Biological Treatment	Anox or Anaerobe or Deox - No Aeration
Type of pre-treatment	Screen <= ½ inch, primary sedimentation
Outlet location in tank	Top
Recommended average velocity	0.82 ft/s
Accept recommended avg. velocity	Yes

PRODUCT DATA

Mixer type	4220 without Jetring
Number of mixers	1
Thrust produced/mixer	342 N
Total thrust produced	342 N
Total thrust required	332 N
Power uptake / mixer	0.62 kW (67 % margin to input power)
Total power uptake	0.62 kW
Propeller diameter	22.83 in
Propeller speed	180 RPM
Number of blades	3
Rec. min Submergence	1.31ft
Hub design	Shielded
Propeller material	Stainless steel
Propeller code	V243058

TANK DIMENSIONS

Rectangular	
[A] Length	31 ft
[B] Width	18.5 ft
[C] Depth	15.2 ft



MOTOR DATA

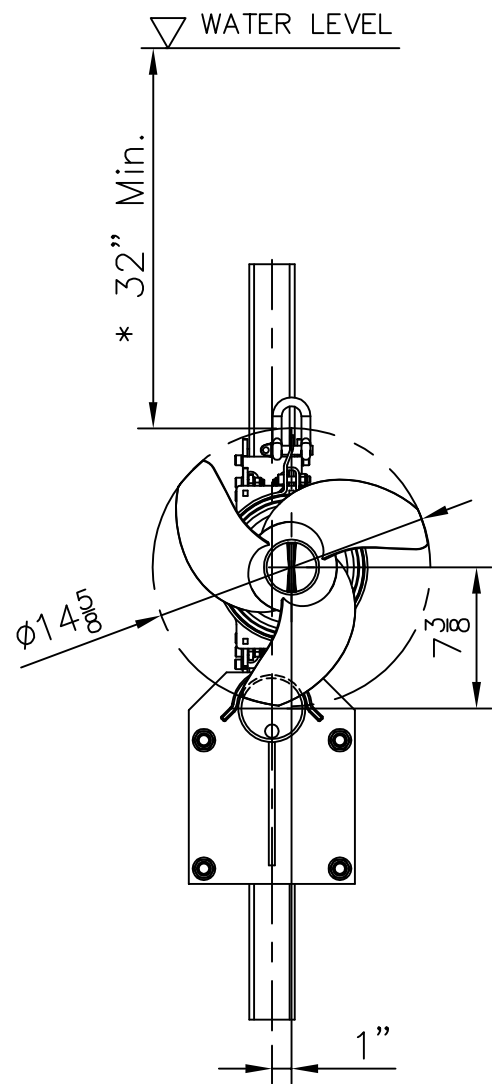
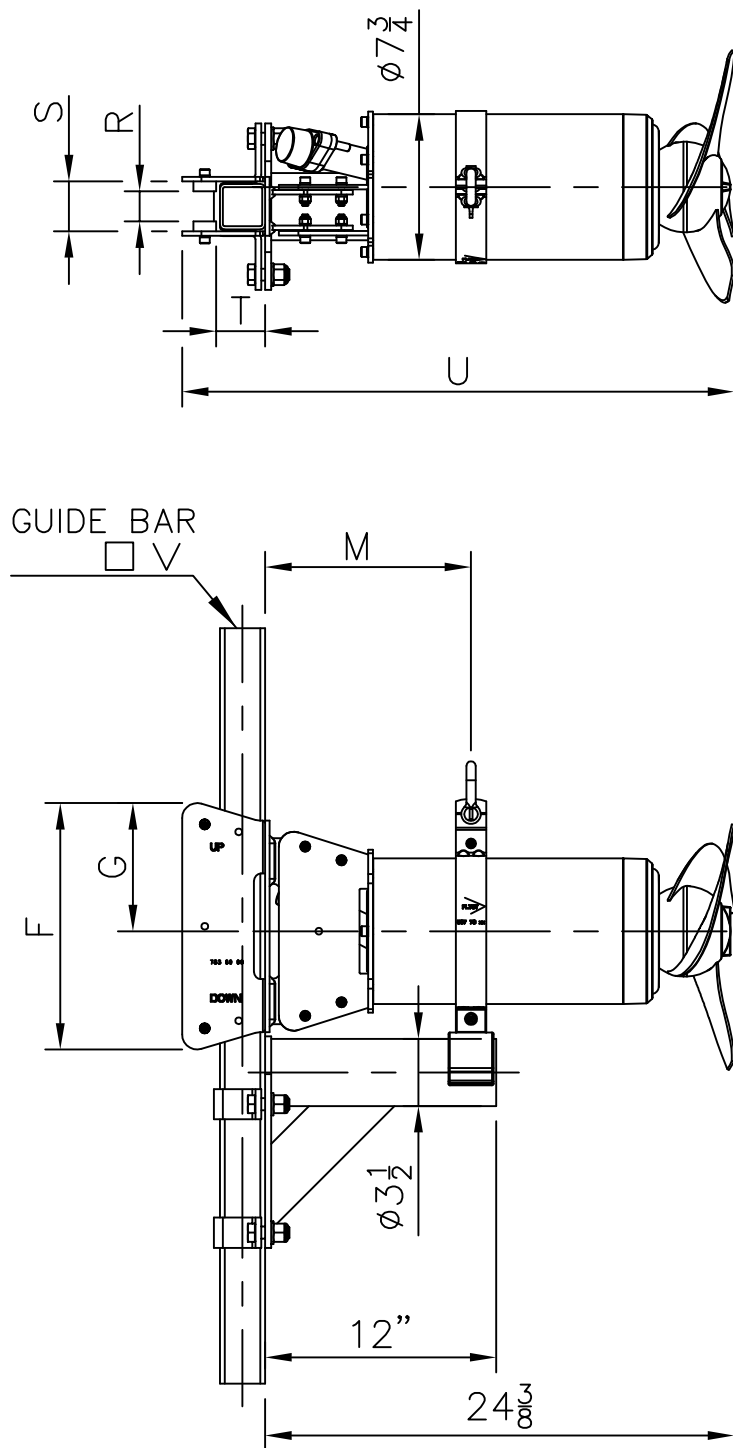
Rated Shaft Power	2 Hp
Mains frequency	50/60 Hz
Number Of Phases	3
Rated voltage	380 - 480 V
Number Of Poles	10
Max Input Power	1.886017373 0879342 kW
Approval	STD
Rated Temperature	40 °C / 104 °F

ISO 21630 VALUES

Nominal thrust	341 N
ISO Input Power	0.61 kW
Efficiency	559 N/kW

Mixer performance data are based on the configuration 400 V Y for 50 Hz and 460 V Y for 60 Hz, for other configurations the data may be different. For mixer performance tolerances, refer to the mixer data chart. Xylem guarantees that the proposed mixer selection will perform the specified duty when all mixers are operating positioned according to Xylem's recommendation. The selection is a function of the input data and the supplier of the data is fully responsible for its correctness.





* Guideline value, recommended minimum submergence can be lower. Contact Xylem Water Solutions for more information.

V	G	F	M	U	S	T	R
2 3/8 x 2 3/8	6 3/4	12 7/8	10 11/16	28 3/4	2 5/8	2 9/16	1 9/16
3 1/4 x 3 1/4	7 3/4	14 5/8	10 5/16	29 5/8	3 3/8	3 3/8	1 7/8
4" x 4"	7 3/4	14 5/8	10 5/16	30 3/8	4 3/16	4 3/16	2 11/16

TOLERANCE: UNLESS OTHERWISE SPEC. $\pm \frac{3}{16}$

Weight (lbs)			
Mixer			
170			
Scale	Date	Drawing number	Revision
1:10	200715	8036600	2

	SR	4640
	Single g bar, Adapt Without Jetring	

MIXING SELECTION REPORT

Quote Number: 3556_3-230323-001 (Rev. 0)
 Project: Norwalk WWTP - Mixer Selections
 Position: Anoxic

Attention! Consult with Application Engineer if CFD should be used to secure and optimize system functionality. Please ask your Sales Representative to raise a CFD request in Sales Force.

INPUT DATA

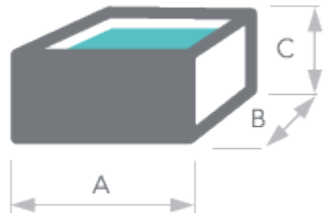
Wastewater Treatment > Biological Treatment Mixing	
Biological Treatment	Anox or Anaerobe or Deox - No Aeration
Type of pre-treatment	Screen <= ½ inch, primary sedimentation
Outlet location in tank	Top
Recommended average velocity	0.82 ft/s
Accept recommended avg. velocity	Yes

PRODUCT DATA

Mixer type	4320 without Jetring
Number of mixers	1
Thrust produced/mixer	568 N
Total thrust produced	568 N
Total thrust required	545 N
Power uptake / mixer	0.87 kW (28 % margin to input power)
Total power uptake	0.87 kW
Propeller diameter	55.12 in
Propeller speed	27 RPM
Number of blades	3
Rec. min Submergence	1.31ft
Hub design	Shielded
Propeller material	Polyurethane
Propeller code	V2701314

TANK DIMENSIONS

Rectangular	
[A] Length	40.5 ft
[B] Width	31 ft
[C] Depth	15.2 ft



MOTOR DATA

Rated Shaft Power	1.5 Hp
Mains frequency	50/60 Hz
Number Of Phases	3
Rated voltage	380 - 480 V
Number Of Poles	10
Max Input Power	1.215906231 5993345 kW
Approval	STD
Rated Temperature	40 °C / 104 °F

ISO 21630 VALUES

Nominal thrust	566 N
ISO Input Power	0.87 kW
Efficiency	651 N/kW

Mixer performance data are based on the configuration 400 V Y for 50 Hz and 460 V Y for 60 Hz, for other configurations the data may be different. For mixer performance tolerances, refer to the mixer data chart. Xylem guarantees that the proposed mixer selection will perform the specified duty when all mixers are operating positioned according to Xylem's recommendation. The selection is a function of the input data and the supplier of the data is fully responsible for its correctness.





Flygt Adaptive Mixers

DESIGNED TO DO MORE



a xylem brand



You can't predict everything, but you can be ready for it.

The only constant in wastewater treatment is change. Whether because of daily variation or long term population growth, the process demands of wastewater treatment shift constantly. With a traditional single speed mixer, you have to operate at 100% capacity, regardless of how much thrust you actually need. But without the ability to control your mixing, you're wasting energy, time, and an opportunity to adapt to what happens next.

Because treatment processes are variable, your mixer should be too. With an integrated drive and remote operation, Flygt Adaptive Mixers put you in complete control, while the next-generation design ensures a lifetime of reliable, streamlined operation.



IMPROVE PROCESS RESILIENCY

Sediment on your tank floor? Seasonal fluctuations?

Process upgrades? Flygt Adaptive Mixers let you adjust output to achieve the required mixing process result – no matter what.



SPEND LESS ON ENERGY

Flygt Adaptive Mixers can be controlled to deliver only the thrust required – and nothing more – which results in remarkable energy cost savings.



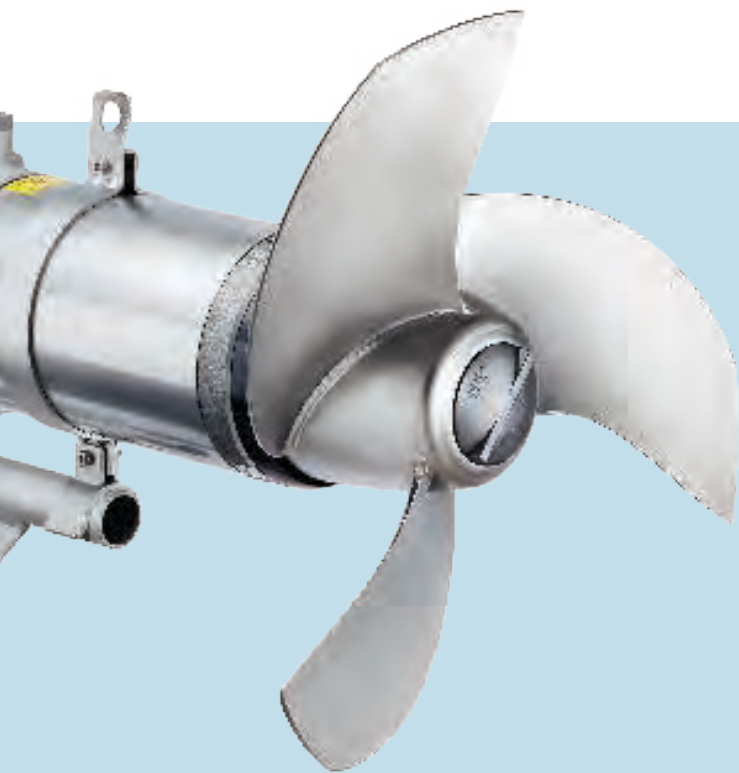
REDUCE MIXER INVENTORY

When you factor in a smaller inventory of parts and spare mixers, plus the ability for mixers to be redeployed across different applications, your mixer investment goes a lot further.



INCREASE MIXER UPTIME

With comprehensive monitoring, auto-correction functions, and a sealed, protected environment for the drive, Flygt Adaptive Mixers introduce a new level in mixing reliability.



+ Super premium efficiency IE4 equivalent motor

Synchronous permanent magnet motors are super premium according to IEC/TS 60034-30-2 Ed.1. When compared to lower classification such as IE3 – often based on conventional asynchronous technology – motors with IE4 efficiency use less energy.

+ Cost-efficient drive system

With their perfect match between motor and integrated power electronics, Flygt Adaptive Mixers require less time during the design phase for selection, purchasing, and programming. Installation costs are further reduced thanks to the elimination of several external components: motor protection devices, power and current measurement devices, etc.

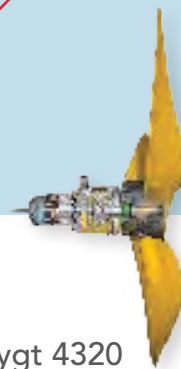
4220 mixer for smaller anoxic zones or maybe they are anaerobic, not sure, integrated VFD, super high efficiency, quoted the same mixer as a pump for IMLR pumps. The controls can be located anywhere in the plant.

4320 mixers for larger anoxic zones, integrated VFD, super high efficiency

ADAPTIVE MIXERS

Technical Innovations

Dirigo™ is the intelligent, flexible and submersible Flygt drive unit, which consists of a synchronous permanent magnet motor and an integrated motor control system. It enables advanced functionality, a more reliable system and extended lifetime.



	Flygt 4220		Flygt 4320		
Rated power, 50/60 Hz	1.1–3.0 kW (1.5–4.0 hp)		2.0–8.0 kW (2.7–10.7 hp)		
Propeller diameter	370 mm (15 in.)	580 mm (23 in.)	1,400 mm (55 in.)	2,000 mm (79 in.)	2,500 mm (98 in.)
Maximum thrust*, N	830	940	3,240	4,540	5,900
Maximum efficiency*, N/kW	470	590	680	1,090	1,580

*According to ISO 21630:2007

+ Quick set-up of the control interface

A set-up wizard guides even untrained users through installation and commissioning with a set of predefined questions. Afterwards, the mixer is ready to operate and communicate.

+ Energy-saving, non-clogging propeller

Designed using the principles of advanced fluid mechanics, our large-diameter propellers with backswept self-cleaning design offer uninterrupted non-clogging performance without compromising efficiency.



Improve Process Resiliency

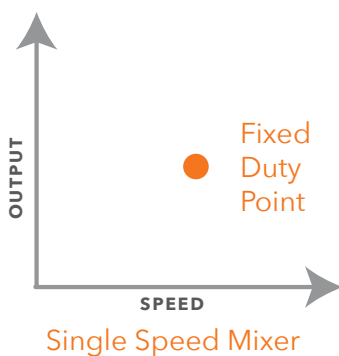
Flygt Adaptive Mixers let you handle both the expected and the unknown.

+ Instant adjustment at your fingertips

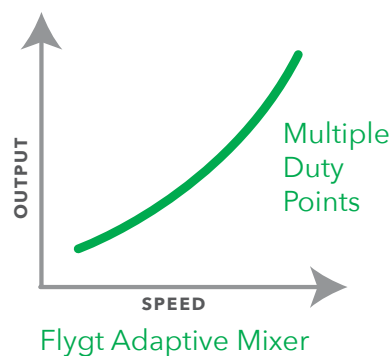
For infrequent events like seasonal fluctuations, tank cleanings, or plant upgrades, the user-friendly operator panel puts you in complete control of your mixer's output so you can react quickly and efficiently.

+ Minute-by-minute process flexibility

With easy integration into a plant-wide SCADA system, the mixer output can be constantly regulated to achieve the desired mixing results. And in multi-mixer tanks, you can keep the process up and running by turning up the output of remaining mixers when one mixer is removed for service.



A single-speed mixer has a fixed output that does not allow for a change, even if the process demand were to increase or decrease.



A Flygt Adaptive Mixer has an output range for the utmost in flexibility in response to process changes.

Know exactly what is going on without having to touch the mixer, or even leave the control room. From a single control panel, you can monitor power consumption, energy usage, run times, temperature, phase loss alarms, and overload.



Spend Less On Energy

Designed to deliver the
exact output you need.

+ Match output to demand

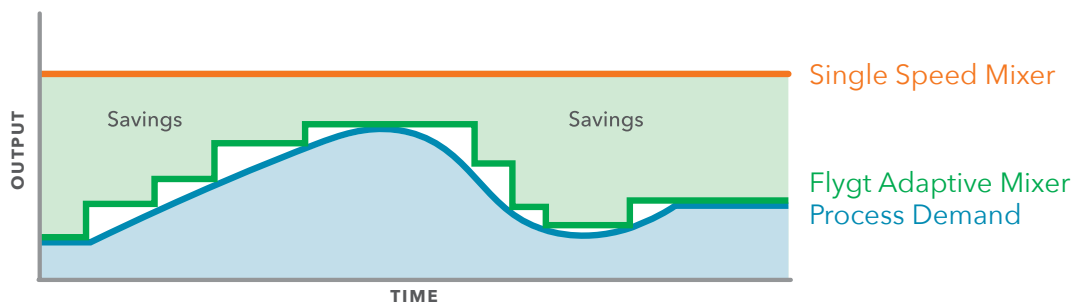
Unlike single speed mixers, which operate at a fixed duty point and use the same amount of energy regardless of process demands, Flygt Adaptive Mixers only use the energy you need based on an exact set of process demands.

+ Avoid overdimensioning

Thanks to their variable speed, Flygt Adaptive Mixers can be easily adjusted during commissioning, overcoming uncertainties from the design phase that often lead to over-dimensioning. Plants operating below their long-term design capacity benefit from this flexibility as well.

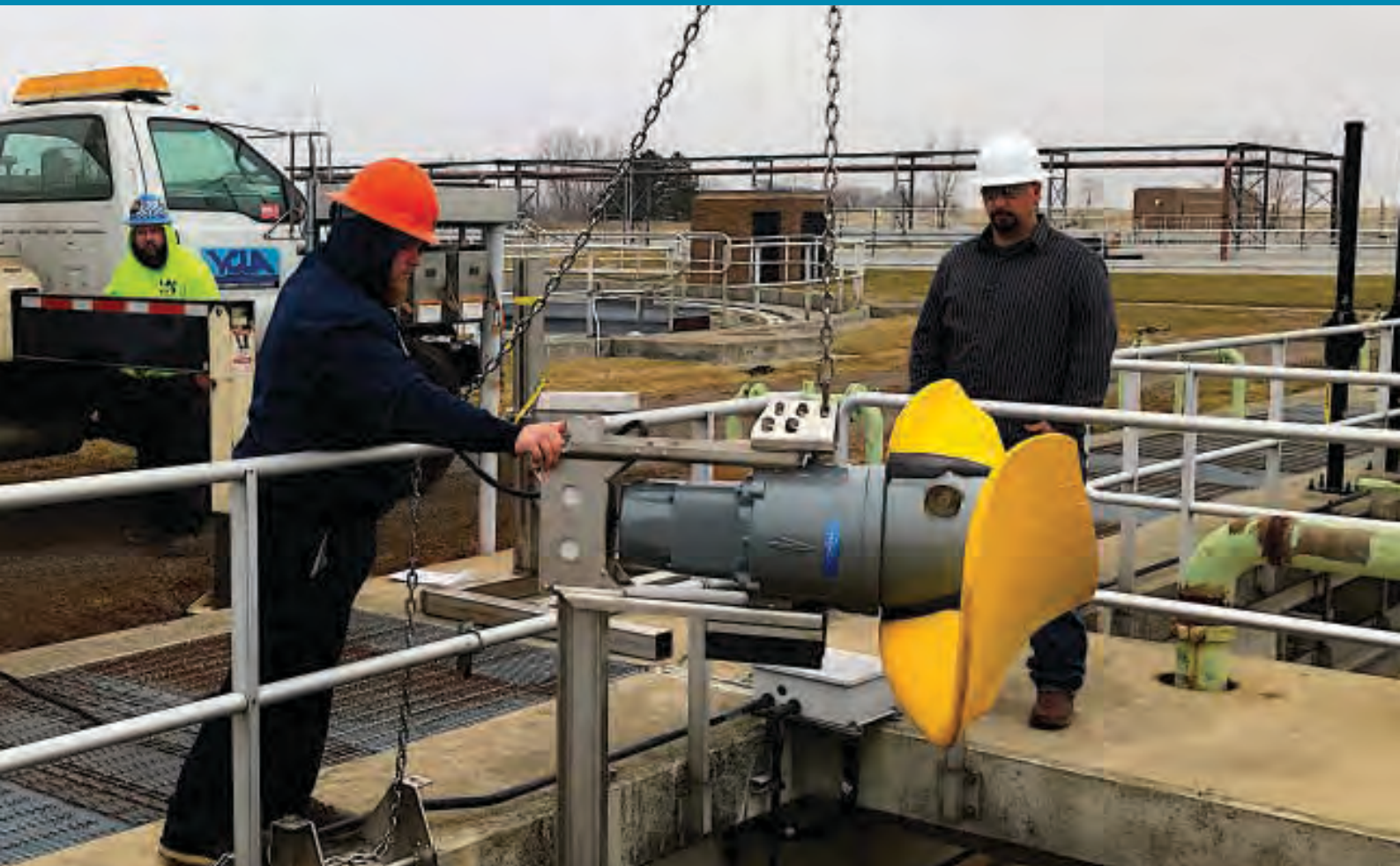
+ Market-leading ISO 21630 efficiency

With efficiencies of up to 1,500 newtons of thrust per kilowatt of input electrical power, Flygt Adaptive Mixers can improve efficiency by up to 50%, resulting in significant cost savings compared to a conventional single speed mixer.



Proven Savings In The Field

YPSILANTI, MICHIGAN, USA



Flygt 4320

APPLICATION:

Aeration tanks of an anoxic nutrient removal process

COSTS SAVINGS:

A 92% decrease in energy consumption over 10 years of implementation

Energy Comparison

Variable speed vs single speed mixers

FLYGT 4320 ADAPTIVE MIXER 5,343 KWH/YR	41,837	COMPETITOR 1
	54,715	COMPETITOR 2
	60,619	COMPETITOR 3

Reduce Mixer Inventory

[Fewer spares. More options.]

+ Smaller inventory of mixers and parts

Because Flygt Adaptive Mixers cover a range of duty points, plants can deploy them across different tanks and applications, which requires a smaller capital investment in spare parts and backup mixers.

+ Lower investment upon reuse

With their easy adjustment, Flygt Adaptive Mixers can be reused in other tanks and applications. During a process redesign or upgrade, Flygt Adaptive Mixers can even be exchanged among different plants – avoiding the need to rebuild or replace an existing mixer.



Increase Mixer Uptime

Proven non-stop performance makes your job easier.

+ Integrated monitoring

With a Flygt Adaptive Mixer, you know exactly what is going on without having to touch the mixer – or even leave your control room. Integrated monitoring functions include power consumption, energy meter, running time, drive temperature, phase loss alarm, and overload.

+ Low maintenance costs

From the reduced wear of the mixers themselves – thanks to their variable output – to their advanced motors, ActiveSeal™ technology, and durable hydraulics, Flygt Adaptive Mixers were designed to handle the harsh demands of wastewater treatment with long maintenance intervals.

+ Enhanced drive system reliability

Placing the control electronics inside a dust-free, non-oxidizing environment reduces the risk for drive failure. In addition, these integrated components are submerged in a cooling media, which eliminates the need for a fan – the most fail-prone component of a traditional VFD (variable frequency drive). This integrated design also eliminates potential errors from sizing, setup, and wiring.

+ Adjusts for overload conditions

When overload conditions are imminent, a Flygt Adaptive Mixer automatically senses the danger, adjusts output accordingly, and triggers an alarm.

◀ Easy replacement of existing mixers

Flygt Adaptive Mixers can often be installed without changing the existing installation system because they fit most common guide bar dimensions.

Xylem |'zīlem|

- 1) The tissue in plants that brings water upward from the roots
- 2) a leading global water technology company.

We're a global team unified in a common purpose: creating advanced technology solutions to the world's water challenges. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. Our products and services move, treat, analyze, monitor and return water to the environment, in public utility, industrial, residential and commercial building services settings. Xylem also provides a leading portfolio of smart metering, network technologies and advanced analytics solutions for water, electric and gas utilities. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise with a strong focus on developing comprehensive, sustainable solutions.

For more information about Flygt Adaptive Mixers, go to www.xylem.com/adaptivemixers



a **xylem** brand

Flygt is a brand of Xylem. For the latest version of this document and more information about Flygt products visit www.xylem.com

IMLR PUMPS



MEMORANDUM

TO: WPCA File

FROM: Ralph Kolb

CC:

DATE: November 2008

REASON: Modification to Internal Recycle Pumps and Channel Mixers

In April 2008, the City of Norwalk requested Department of Environmental Protection (DEP) approval to replace/upgrade the propellers on the internal mixed liquor recycle pumps and channel mixers at the Norwalk Wastewater Treatment Plant.

The new propellers have an 11 degree pitch verse the existing propellers which have a 5 degree pitch. The rationale behind upgrading the propellers on the recycle pumps is to increase the internal recycle flow rate back to the anoxic zone. Ultimately, a higher internal recycle rate would assist in increased nitrogen removal from the wastewater. The mixers in the channel from the primary clarifiers to the aeration tanks would also be upgraded for redundancy purposes.

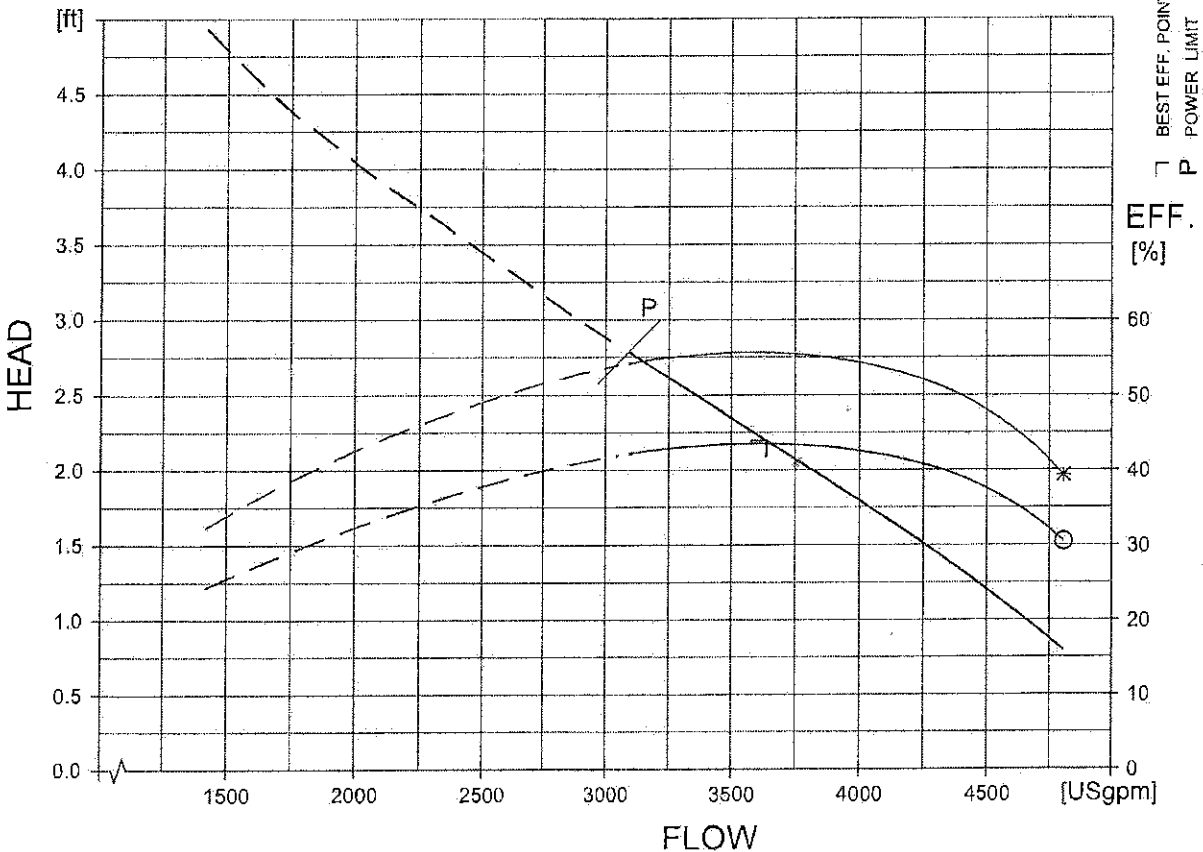
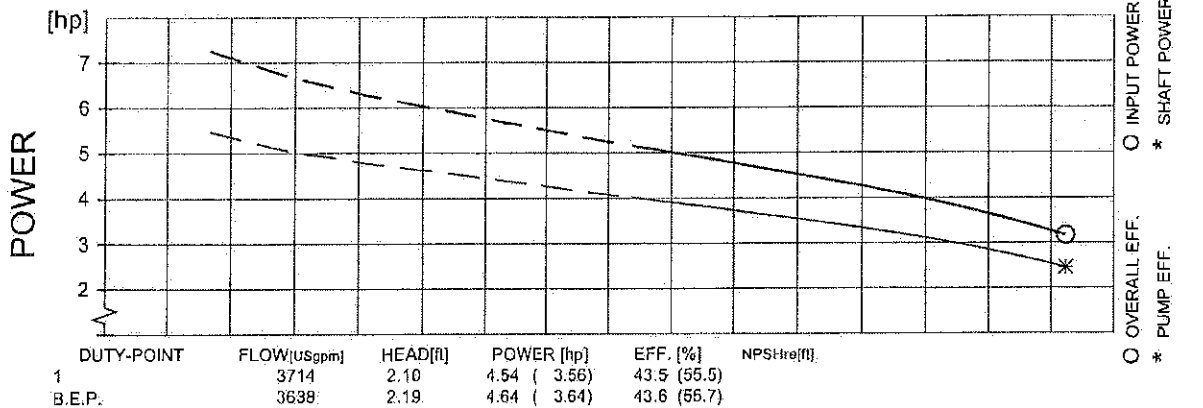
Performance curves for new and old propellers are attached.

On June 10, 2008, DEP approved modifications.

In early November 2008, the new IMLR propellers were installed/online and shortly after improved nitrogen performance was observed with Total Nitrogen concentration (mg/l) discharge numbers in the low 3's.

New - Installed November 2008

FLYGT		PERFORMANCE CURVE		PRODUCT PP4640.410	TYPE
DATE 2007-07-27	PROJECT			CURVE NO 63-837	ISSUE 7
POWER FACTOR 0.73	1/1-LOAD 0.73	3/4-LOAD 0.66	1/2-LOAD 0.54	RATED POWER 4 hp	BLADE ANGLE 11 deg
EFFICIENCY 77.0 %	---	77.5 %	75.0 %	STARTING CURRENT ... 23 A	MOTOR # 18-12-8AA
MOTOR DATA	---	---	---	RATED CURRENT ... 6.7 A	STATOR 31Y
COMMENTS	INLET/OUTLET - /375 mm			RATED SPEED 855 rpm	REV 12
	IMP. THROUGHLET ---			TOT. MOM. OF INERTIA ... ---	FREQ. 60 Hz
				NO. OF BLADES 3	PHASES 3
					VOLTAGE 460 V
					POLES 8
					GEARTYPE ---
					RATIO ---



FLYPS2.19 (20021016)

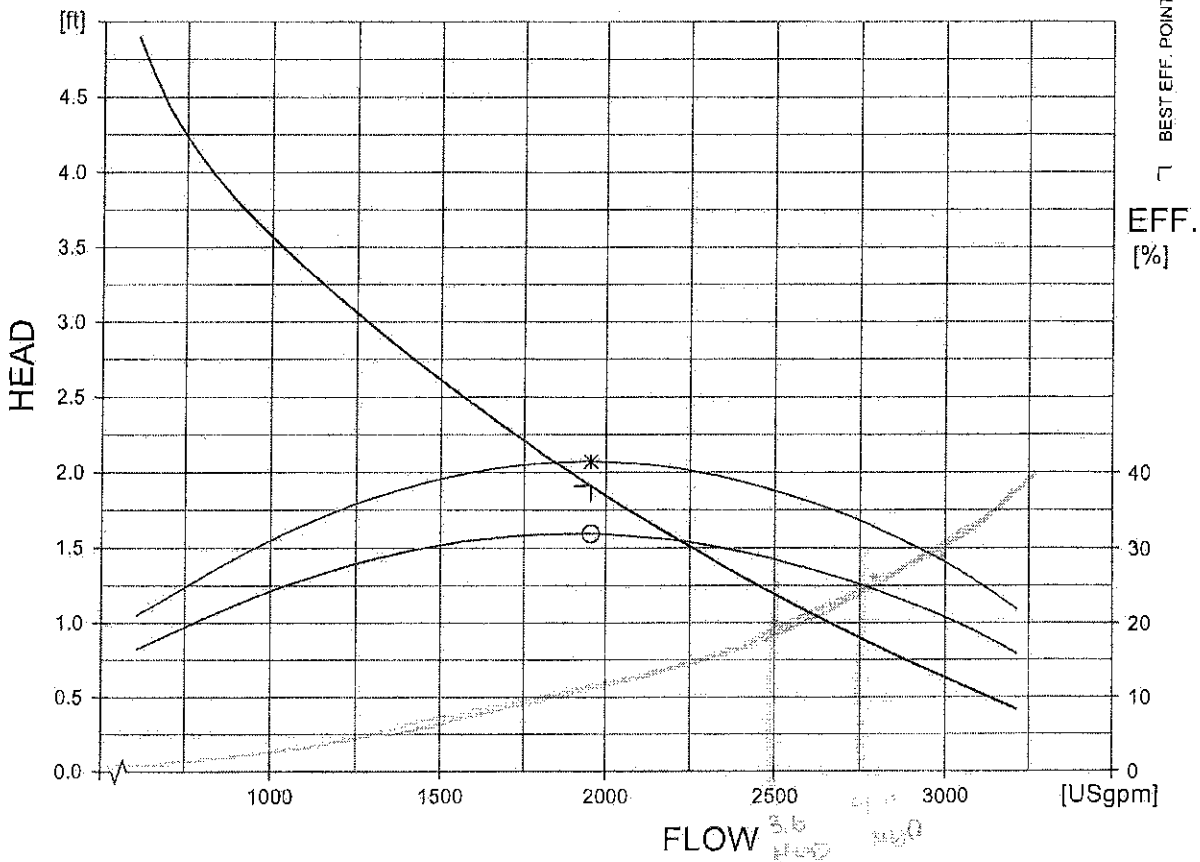
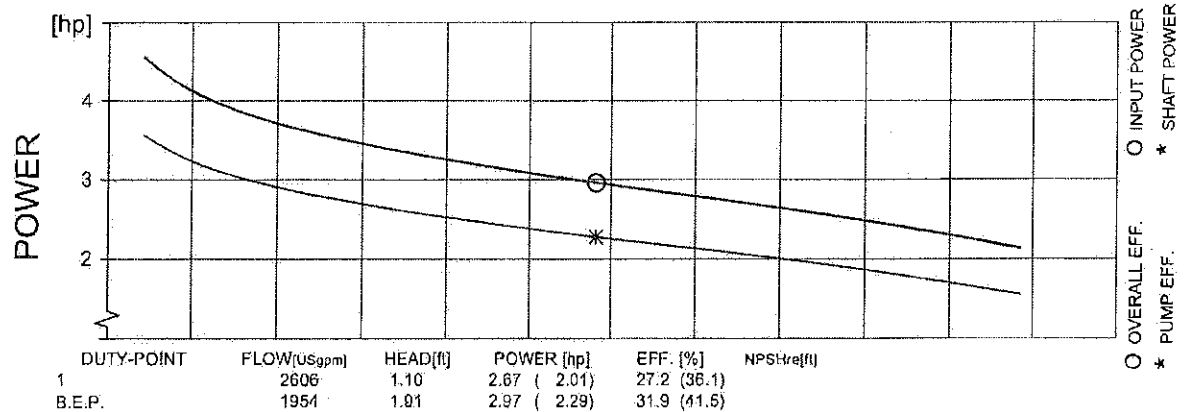
Performance with clear water and ambient temp 40 °C



CURVE

O18 - No Longer in Service (Nov. 2008)

FLYGT		PERFORMANCE CURVE		PRODUCT PP4640.410		TYPE	
DATE 2007-07-27		PROJECT		CURVE NO 63-837		ISSUE 7	
1/1-LOAD		3/4-LOAD		1/2-LOAD		BLADE ANGLE 5 deg	
POWER FACTOR	0.73	0.66	0.54	RATED POWER	4	hp	
EFFICIENCY	77.0 %	77.5 %	75.0 %	STARTING CURRENT	23	A	
MOTOR DATA	---			RATED CURRENT	6.7	A	
COMMENTS			INLET/OUTLET	RATED SPEED	855	rpm	
			- /375 mm	TOT.MOM.OF INERTIA	---		
			IMP. THROUGHLET	NO. OF BLADES	3		
				MOTOR #	18-12-8AA	STATOR	31Y
				FREQ.	60 Hz	PHASES	3
				VOLTAGE	460 V	POLES	8
				GEARTYPE	RATIO		



FLYPS2.19 (20021016)

Performance with clear water and ambient temp 40 °C

FLYGT

CURVE

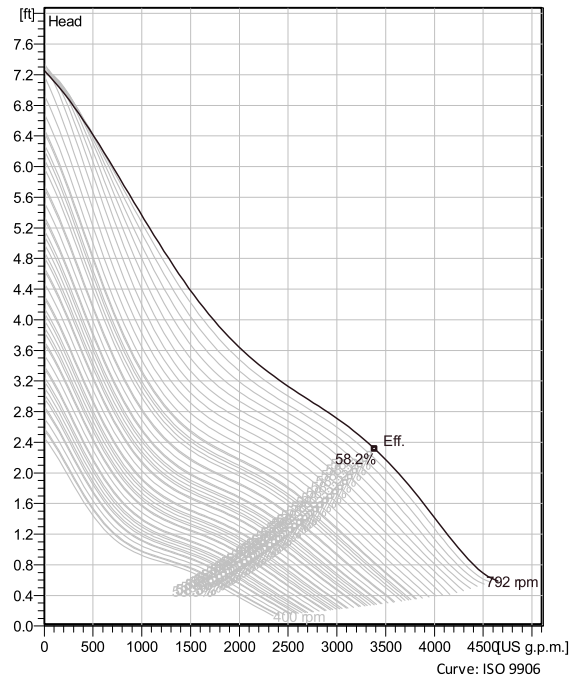
PP4220 5.5 hp 792 rpm

Submersible ultra-low-head propellers pump with adjustable speed and integrated motor control. Intended for wastewater and similar applications containing fibers and solids.



Technical specification

Curves according to: Water, pure [100%], 39.2 °F, 62.42 lb/ft³, 1.6891E-5 ft²/s



Configuration

Motor number	Installation type
P4220.611 18-16-1AZ-W	P - Semi permanent, Wet
5.5hp	
Propeller diameter	
370 mm	

Pump information

Propeller diameter
370 mm
Number of vanes
3

Materials

Propeller
POLYMETHYLENE (POM)

Project	Xylect-20334953	Created by	
Block		Created on	3/23/2023
		Last update	3/23/2023

PP4220 5.5 hp 792 rpm

Technical specification



Motor - General

Motor number P4220.611 18-16-1AZ-W 5.5hp	Phases 3~	Rated current 6.46 A	Rated power 5.5 hp
ATEX approved No	Rated voltage 460 V	Insulation class H	Type of Duty S1
Frequency 50/60 Hz			

Motor - Technical

Power factor - 1/1 Load 0.90	Motor efficiency - 1/1 Load 80.0 %	Nominal speed - 1/1 Load 600
Power factor - 3/4 Load 0.86	Motor efficiency - 3/4 Load 83.0 %	Nominal speed - 3/4 Load 540
Power factor - 1/2 Load 0.78	Motor efficiency - 1/2 Load 84.0 %	Nominal speed - 1/2 Load 480
Starting current 6.46 A		

Project Xylect-20334953
Block

Created by
Created on 3/23/2023 **Last update** 3/23/2023

PP4220 5.5 hp 792 rpm

Performance curve

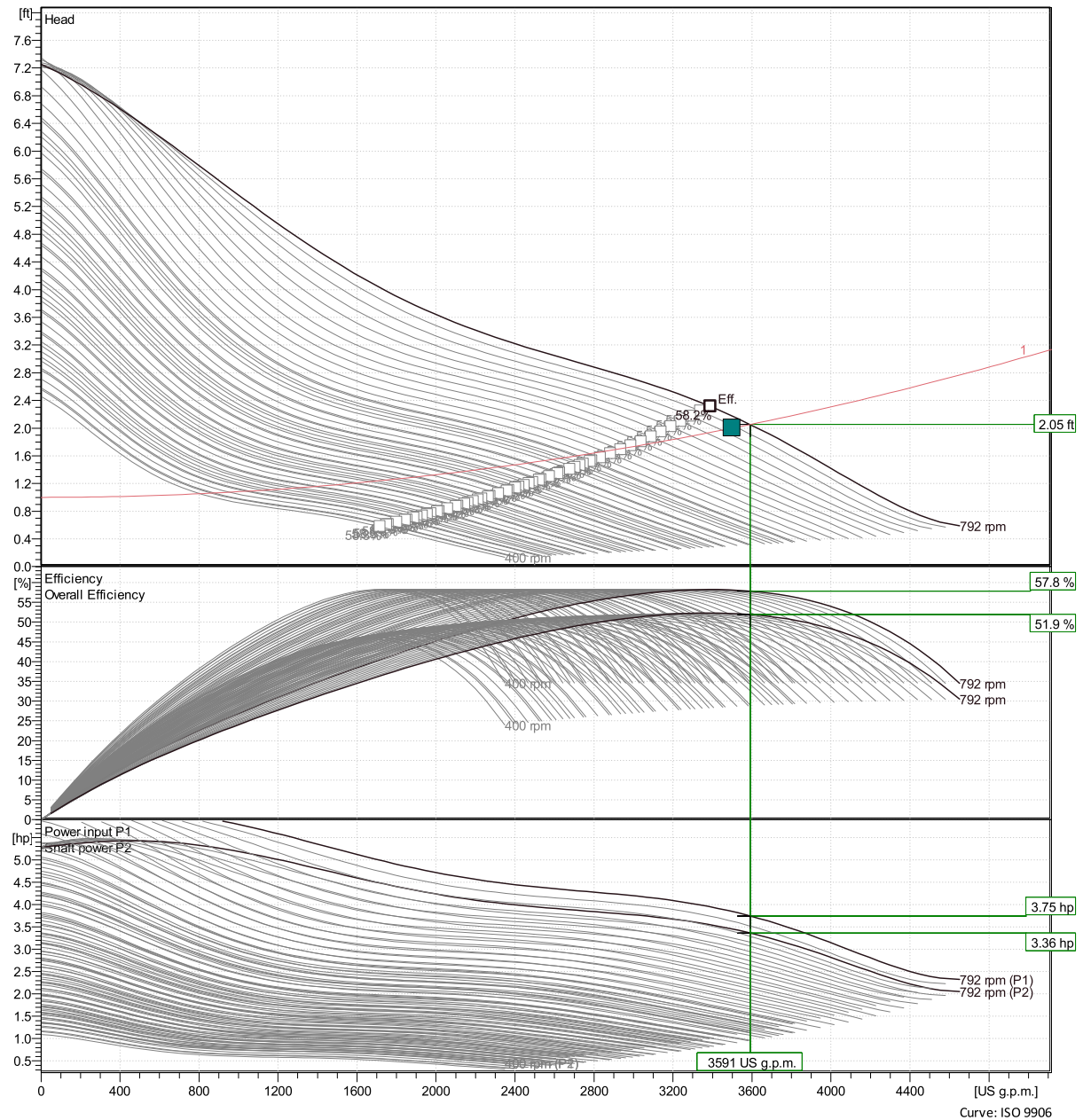


Duty point

Flow
3590 US g.p.m.

Head
2.05 ft

Curves according to: Water, pure [100%], 39.2 °F, 62.42 lb/ft³, 1.6891E-5 ft²/s



Project Xylect-20334953
Block

Created by
Created on 3/23/2023

Last update 3/23/2023

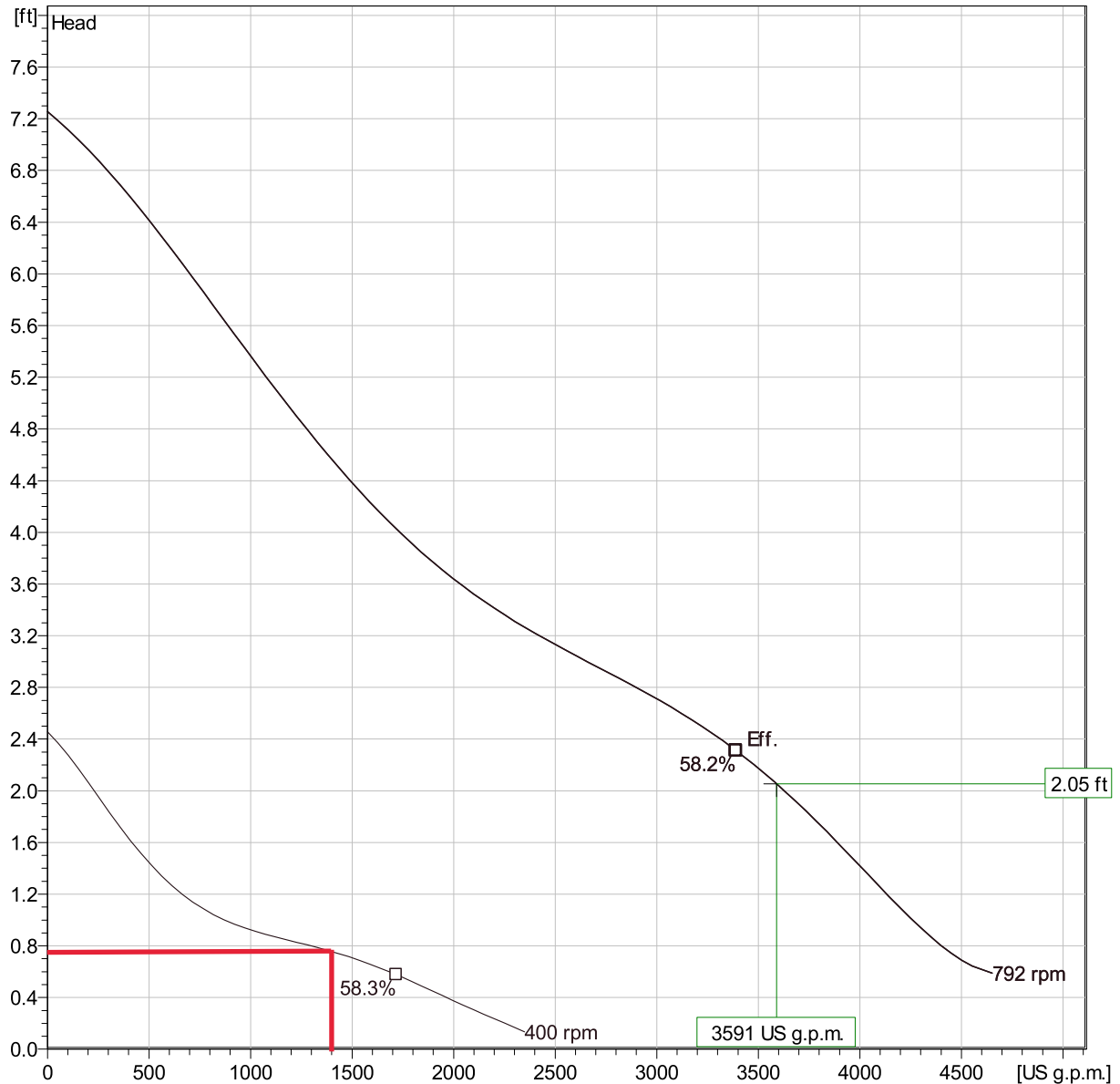
Curve: ISO 9906

PP4220 5.5 hp 792 rpm

Duty Analysis



Curves according to: Water, pure [100%]; 39.2°F; 62.42lb/ft³; 1.6891E-5ft²/s



Operating characteristics

Pumps / Systems	Flow	Head	Shaft power	Flow	Head	Shaft power	Hydr.eff.	Specific Energy	NPSH _{re}
1	3590 US g.p.m.	2.05 ft	3.36 hp	3590 US g.p.m.	2.05 ft	3.36 hp	57.8 %	13 kWh/US MG	

Project

Block Xylect-20334953

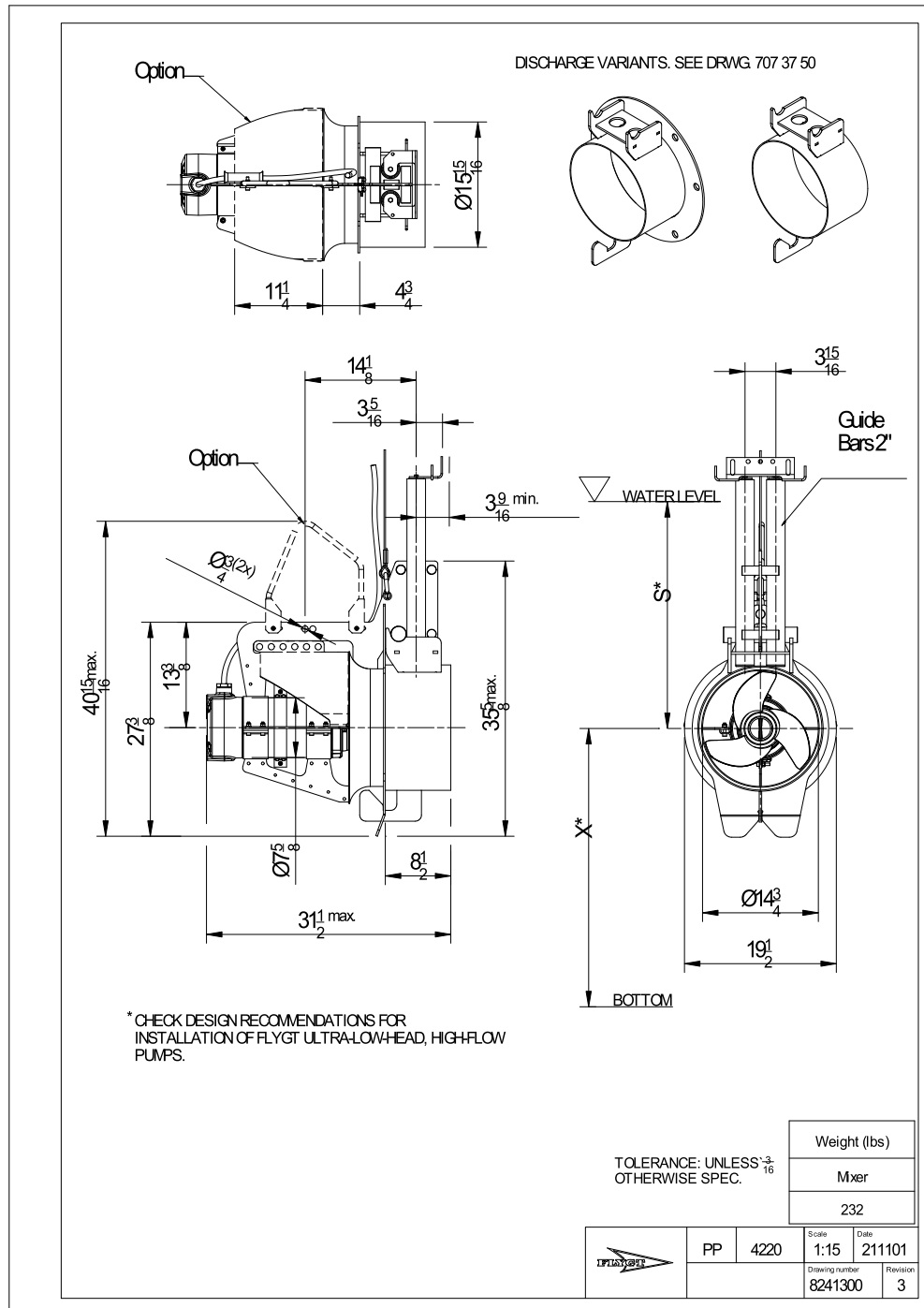
Created by

Created on 3/23/2023

Last update 3/23/2023

PP4220 5.5 hp 792 rpm

Dimensional drawing



Project Xylect-20334953
Block

Created by
Created on 3/23/2023 Last update 3/23/2023

DIFFUSERS



Diffused Aeration Equipment

for
Norwalk, CT WPCF
aeration

Sanitaire #s31959-23
March 21, 2023

jo K:\S31959-23\TECHNICAL DESIGN\2023.02.28_Input_aeration_Norwalk, CT WPCF_s31959-23.aer

Sanitaire Aeration Design Inputs for: Norwalk, CT WPCF, Sanitaire #s31959-23

Tank Geometry

5 Trains each Consisting of: 3

Parameter	Units	Pass 1
Parallel Reactors		1
Pass Process		Aerobic
SWD	ft	14.8
Submergence	ft	13.8
Volume	ft ³	77,986.6
Reactor Geometry:		Rect
Length	ft	173.0
Width	ft	30.5

Oxygen/Air Distribution

	Zone	1	2	3
	Pass	1	1	1
Default		40.0%	35.0%	25.0%

Oxygenation

Parameter	Units	Min. Day CC Aerate	Max Mon. CC SOR	Max Mon. FC SOR	Max Mon. FC Aerate	Max Mon. PC SOR	Max Mon. PC Aerate
No. Trains Operating		1	1	1	1	1	1
Air Rate	scfm	3,000.0			9,000.0		13,500.0
Oxygen Requirement	lb/day		22,400.0-S	23,500.0-S		33,000.0-S	

Standard Oxygen Correction Factor Parameters

Parameter	Units	Min. Day CC Aerate	Max Mon. CC SOR	Max Mon. FC SOR	Max Mon. FC Aerate	Max Mon. PC SOR	Max Mon. PC Aerate
Site Elevation	FASL	43	43	43	43	43	43
Ambient Pressure	PSIA	14.68	14.68	14.68	14.68	14.68	14.68
Water Temperature	°C	20	20	20	20	20	20

Notes:

Bold, Italicized text indicate assumptions made by Sanitaire

A - Indicates Actual (AOR) Requirement.

S - Indicates Standard Condition (SOR) Oxygen requirement.

If the AOR/SOR parameter is not given, then its value will be evaluated later if suitable alpha, beta, D.O., theta, pressure, and temperature data is supplied.

Round tanks are evaluated as rectangular tanks diameter equal to length and equal surface area.

Annular tanks are evaluated as rectangular tanks of width equal to the annular width and equal surface area.

Sanitaire Project Name: Norwalk, CT WPCF
Sanitaire Project #s31959-23
Design Summary

	Units	Operating Point & O2 Distribution					
		Min. Day CC	Max Mon.	Max Mon.	Max Mon.	Max Mon.	Max Mon.
		Aerate Default	CC SOR Default	FC SOR Default	FC Aerate Default	PC SOR Default	PC Aerate Default
No. Trains in Operation		1	1	1	1	1	1
No. Grids in Operation		3	3	3	3	3	3
No. Operating Diffusers		2,756	2,756	2,756	2,756	2,756	2,756
SOR	lb/day	23,461	22,400	23,500	61,515	33,000	86,188
SOTE	%	31.2	31.4	31.2	27.3	29.9	25.5
Total Air Rate	scfm	3,000	2,848	3,006	9,000	4,409	13,500
Min. Diffuser Air Rate	scfm/diff.	1.01	0.95	1.0	3.03	1.46	4.54
Max. Diffuser Air Rate	scfm/diff.	1.15	1.1	1.16	3.46	1.7	5.19
Static Pressure	psig	5.98	5.98	5.98	5.98	5.98	5.98
Diffuser DWP @ Min Air	psig	0.25	0.25	0.25	0.29	0.26	0.35
Diffuser DWP @ Max Air	psig	0.25	0.25	0.25	0.31	0.26	0.38
Pressure @ Top of Dropleg	psig	6.31	6.3	6.31	6.98	6.41	7.88
Est. Blower Efficiency		70%	70%	70%	70%	70%	70%
Est. Motor Efficiency		90%	90%	90%	90%	90%	90%
Shaft Power	Bhp	107.4	101.8	107.6	350.7	160.0	581.8
Est. Motor Electrical Load	kW	89.02	84.42	89.21	290.7	132.6	482.3
Est. Standard Aeration Efficiency	#SOR/BHP-hr	9.10	9.16	9.10	7.31	8.60	6.17

Notes:

- (1) Design air is the maximum of process air or mixing air
- (2) Delivered oxygen based on design air
- (3) Brake Horsepower based on adiabatic compression, 70% mechanical efficiency and 0.30 psi line loss
- (4) Performance based on diffuser density (At/Ad), submergence, and diffuser unit air flow.
- (5) Diffuser Air Flow based on Active Valve Modulation
- (6) Blower Pressure Capability also requires consideration of:
and the aeration assembly dropleg connections.
Design Manual (EPA/625/1-89/023), WEF Manual of Practice FD-13, and other
Pore systems regardless of supplier or type of diffuser element.
C. Increased diffuser submergence during Peak Flow conditions.
- (7) Air Flow defined at 20°C
- (8) Fine Mixing air based on 0.10 scfm/ft²

Sanitaire Project Name: Norwalk, CT WPCF**Sanitaire Project #s31959-23**

Consulting Engineer:

Operating Condition: Min. Day CC Aerate

Oxygen Distribution: Default

Aeration System Design

Parameter	Units	Zone 1	Zone 2	Zone 3	Totals/Overall
Pass		1	1	1	
SWD	ft	14.78	14.78	14.78	
Subm	ft	13.81	13.81	13.81	
Volume	ft ³	25,995.5	25,995.5	25,995.5	77,986.6
No. Parallel Tanks		1	1	1	
No. Trains in Operation		1	1	1	
Grid Count		1	1	1	3
Dropleg Diameter	inches	10	10	8	
At/Ad		4.124839719	4.124839719	6.345907259	
Diffuser Density	% Floor	24.24%	24.24%	15.76%	
Diffusers/Grid		1,040	1,040	676	2,756

Oxygen Transfer

Diffuser Type		SSLP	SSLP	SSLP	
Alpha					
Beta					
Theta					
D.O.	mg/l				
Water Temp	°C	20	20	20	
AOR/SOR					
Oxygen Distribution	%/Zone	40.0%	35.0%	25.0%	100.0%
AOR	lb/day				
SOR	lb/day				
Air Rate (7)	scfm	1,200.0	1,050.0	750.0	3,000.0

Performance

Mixing Criteria	scfm/ft ²	0.10	0.10	0.10	
Safety Factor	%				
Mixing Air (8)	scfm	175.9	175.9	175.9	
Process Air (for SOR)	scfm	1,200.0	1,050.0	750.0	
Design Air (1,7)	scfm	1,200.0	1,050.0	750.0	3,000.0
Diffuser Air Rate	scfm/Diff.	1.15	1.01	1.11	1.09
Delivered SOR	lb/day	9,349.6	8,303.6	5,807.4	23,460.6
Delivered SOTE	%	31.1%	31.6%	30.9%	31.2%
Pressure @ Top of Dropleg	psig	6.31	6.29	6.30	6.31
Shaft Power	Bhp	43.0	37.5	26.8	107.4

Notes:

(1) Design air is the maximum of process air or mixing air

(2) Delivered oxygen based on design air

(3) Brake Horsepower based on adiabatic compression, 70% mechanical efficiency and 0.30 psi line loss

(4) Performance based on diffuser density (At/Ad), submergence, and diffuser unit air flow.

(5) Diffuser Air Flow based on Active Valve Modulation

(6) Blower Pressure Capability also requires consideration of:

A. The Air Main headloss (piping, fittings, valves, instrumentation, etc.)

between the blower and the aeration assembly dropleg connections.

B. Potential for increased headloss resulting from diffuser fouling and/or aging.

Please refer to the US EPA Fine Pore Design Manual (EPA/625/1-89/023), WEF Manual of Practice FD-13,

and other technical publications for a detailed discussion on this subject. Note that this headloss

consideration relates to all Fine Pore systems regardless of supplier or type of diffuser element.

C. Increased diffuser submergence during Peak Flow conditions.

(7) Air Flow defined at 20°C

(8) Fine Mixing air based on 0.10 scfm/ft²

Sanitaire Project Name: Norwalk, CT WPCF**Sanitaire Project #s31959-23**

Consulting Engineer:

Operating Condition: Max Mon. CC SOR

Oxygen Distribution: Default

Aeration System Design

Parameter	Units	Zone 1	Zone 2	Zone 3	Totals/Overall
Pass		1	1	1	
SWD	ft	14.78	14.78	14.78	
Subm	ft	13.81	13.81	13.81	
Volume	ft ³	25,995.5	25,995.5	25,995.5	77,986.6
No. Parallel Tanks		1	1	1	
No. Trains in Operation		1	1	1	
Grid Count		1	1	1	3
Dropleg Diameter	inches	10	10	8	
At/Ad		4.124839719	4.124839719	6.345907259	
Diffuser Density	% Floor	24.24%	24.24%	15.76%	
Diffusers/Grid		1,040	1,040	676	2,756

Oxygen Transfer

Diffuser Type		SSLP	SSLP	SSLP	
Alpha					
Beta					
Theta					
D.O.	mg/l				
Water Temp	°C	20	20	20	
AOR/SOR					
Oxygen Distribution	%/Zone	40.0%	35.0%	25.0%	100.0%
AOR	lb/day				
SOR	lb/day	8,960.0	7,840.0	5,600.0	22,400.0
Air Rate (7)	scfm				

Performance

Mixing Criteria	scfm/ft ²	0.10	0.10	0.10	
Safety Factor	%				
Mixing Air (8)	scfm	175.9	175.9	175.9	
Process Air (for SOR)	scfm	1,143.9	984.3	719.9	
Design Air (1,7)	scfm	1,143.9	984.3	719.9	2,848.0
Diffuser Air Rate	scfm/Diff.	1.10	0.95	1.06	1.03
Delivered SOR	lb/day	8,960.0	7,840.0	5,600.0	22,400.0
Delivered SOTE	%	31.3%	31.8%	31.0%	31.4%
Pressure @ Top of Dropleg	psig	6.30	6.28	6.29	6.30
Shaft Power	Bhp	40.9	35.1	25.7	101.8

Notes:

(1) Design air is the maximum of process air or mixing air

(2) Delivered oxygen based on design air

(3) Brake Horsepower based on adiabatic compression, 70% mechanical efficiency and 0.30 psi line loss

(4) Performance based on diffuser density (At/Ad), submergence, and diffuser unit air flow.

(5) Diffuser Air Flow based on Active Valve Modulation

(6) Blower Pressure Capability also requires consideration of:

A. The Air Main headloss (piping, fittings, valves, instrumentation, etc.)

between the blower and the aeration assembly dropleg connections.

B. Potential for increased headloss resulting from diffuser fouling and/or aging.

Please refer to the US EPA Fine Pore Design Manual (EPA/625/1-89/023), WEF Manual of Practice FD-13,

and other technical publications for a detailed discussion on this subject. Note that this headloss

consideration relates to all Fine Pore systems regardless of supplier or type of diffuser element.

C. Increased diffuser submergence during Peak Flow conditions.

(7) Air Flow defined at 20°C

(8) Fine Mixing air based on 0.10 scfm/ft²

Sanitaire Project Name: Norwalk, CT WPCF**Sanitaire Project #s31959-23**

Consulting Engineer:

Operating Condition: Max Mon. FC SOR

Oxygen Distribution: Default

Aeration System Design

Parameter	Units	Zone 1	Zone 2	Zone 3	Totals/Overall
Pass		1	1	1	
SWD	ft	14.78	14.78	14.78	
Subm	ft	13.81	13.81	13.81	
Volume	ft ³	25,995.5	25,995.5	25,995.5	77,986.6
No. Parallel Tanks		1	1	1	
No. Trains in Operation		1	1	1	
Grid Count		1	1	1	3
Dropleg Diameter	inches	10	10	8	
At/Ad		4.124839719	4.124839719	6.345907259	
Diffuser Density	% Floor	24.24%	24.24%	15.76%	
Diffusers/Grid		1,040	1,040	676	2,756

Oxygen Transfer

Diffuser Type		SSLP	SSLP	SSLP	
Alpha					
Beta					
Theta					
D.O.	mg/l				
Water Temp	°C	20	20	20	
AOR/SOR					
Oxygen Distribution	%/Zone	40.0%	35.0%	25.0%	100.0%
AOR	lb/day				
SOR	lb/day	9,400.0	8,225.0	5,875.0	23,500.0
Air Rate (7)	scfm				

Performance

Mixing Criteria	scfm/ft ²	0.10	0.10	0.10	
Safety Factor	%				
Mixing Air (8)	scfm	175.9	175.9	175.9	
Process Air (for SOR)	scfm	1,207.3	1,038.8	759.8	
Design Air (1,7)	scfm	1,207.3	1,038.8	759.8	3,006.0
Diffuser Air Rate	scfm/Diff.	1.16	1.00	1.12	1.09
Delivered SOR	lb/day	9,400.0	8,225.0	5,875.0	23,500.0
Delivered SOTE	%	31.1%	31.6%	30.9%	31.2%
Pressure @ Top of Dropleg	psig	6.31	6.28	6.30	6.31
Shaft Power	Bhp	43.2	37.1	27.2	107.6

Notes:

(1) Design air is the maximum of process air or mixing air

(2) Delivered oxygen based on design air

(3) Brake Horsepower based on adiabatic compression, 70% mechanical efficiency and 0.30 psi line loss

(4) Performance based on diffuser density (At/Ad), submergence, and diffuser unit air flow.

(5) Diffuser Air Flow based on Active Valve Modulation

(6) Blower Pressure Capability also requires consideration of:

A. The Air Main headloss (piping, fittings, valves, instrumentation, etc.)

between the blower and the aeration assembly dropleg connections.

B. Potential for increased headloss resulting from diffuser fouling and/or aging.

Please refer to the US EPA Fine Pore Design Manual (EPA/625/1-89/023), WEF Manual of Practice FD-13,

and other technical publications for a detailed discussion on this subject. Note that this headloss

consideration relates to all Fine Pore systems regardless of supplier or type of diffuser element.

C. Increased diffuser submergence during Peak Flow conditions.

(7) Air Flow defined at 20°C

(8) Fine Mixing air based on 0.10 scfm/ft²

Sanitaire Project Name: Norwalk, CT WPCF**Sanitaire Project #s31959-23**

Consulting Engineer:

Operating Condition: Max Mon. FC Aerate

Oxygen Distribution: Default

Aeration System Design

Parameter	Units	Zone 1	Zone 2	Zone 3	Totals/Overall
Pass		1	1	1	
SWD	ft	14.78	14.78	14.78	
Subm	ft	13.81	13.81	13.81	
Volume	ft ³	25,995.5	25,995.5	25,995.5	77,986.6
No. Parallel Tanks		1	1	1	
No. Trains in Operation		1	1	1	
Grid Count		1	1	1	3
Dropleg Diameter	inches	10	10	8	
At/Ad		4.124839719	4.124839719	6.345907259	
Diffuser Density	% Floor	24.24%	24.24%	15.76%	
Diffusers/Grid		1,040	1,040	676	2,756

Oxygen Transfer

Diffuser Type		SSLP	SSLP	SSLP	
Alpha					
Beta					
Theta					
D.O.	mg/l				
Water Temp	°C	20	20	20	
AOR/SOR					
Oxygen Distribution	%/Zone	40.0%	35.0%	25.0%	100.0%
AOR	lb/day				
SOR	lb/day				
Air Rate (7)	scfm	3,600.0	3,150.0	2,250.0	9,000.0

Performance

Mixing Criteria	scfm/ft ²	0.10	0.10	0.10	
Safety Factor	%				
Mixing Air (8)	scfm	175.9	175.9	175.9	
Process Air (for SOR)	scfm	3,600.0	3,150.0	2,250.0	
Design Air (1,7)	scfm	3,600.0	3,150.0	2,250.0	9,000.0
Diffuser Air Rate	scfm/Diff.	3.46	3.03	3.33	3.27
Delivered SOR	lb/day	24,476.3	21,833.8	15,204.6	61,514.6
Delivered SOTE	%	27.1%	27.7%	27.0%	27.3%
Pressure @ Top of Dropleg	psig	6.98	6.80	6.93	6.98
Shaft Power	Bhp	140.3	120.2	87.1	350.7

Notes:

(1) Design air is the maximum of process air or mixing air

(2) Delivered oxygen based on design air

(3) Brake Horsepower based on adiabatic compression, 70% mechanical efficiency and 0.30 psi line loss

(4) Performance based on diffuser density (At/Ad), submergence, and diffuser unit air flow.

(5) Diffuser Air Flow based on Active Valve Modulation

(6) Blower Pressure Capability also requires consideration of:

A. The Air Main headloss (piping, fittings, valves, instrumentation, etc.)

between the blower and the aeration assembly dropleg connections.

B. Potential for increased headloss resulting from diffuser fouling and/or aging.

Please refer to the US EPA Fine Pore Design Manual (EPA/625/1-89/023), WEF Manual of Practice FD-13,

and other technical publications for a detailed discussion on this subject. Note that this headloss

consideration relates to all Fine Pore systems regardless of supplier or type of diffuser element.

C. Increased diffuser submergence during Peak Flow conditions.

(7) Air Flow defined at 20°C

(8) Fine Mixing air based on 0.10 scfm/ft²

Sanitaire Project Name: Norwalk, CT WPCF**Sanitaire Project #s31959-23**

Consulting Engineer:

Operating Condition: Max Mon. PC SOR

Oxygen Distribution: Default

Aeration System Design

Parameter	Units	Zone 1	Zone 2	Zone 3	Totals/Overall
Pass		1	1	1	
SWD	ft	14.78	14.78	14.78	
Subm	ft	13.81	13.81	13.81	
Volume	ft ³	25,995.5	25,995.5	25,995.5	77,986.6
No. Parallel Tanks		1	1	1	
No. Trains in Operation		1	1	1	
Grid Count		1	1	1	3
Dropleg Diameter	inches	10	10	8	
At/Ad		4.124839719	4.124839719	6.345907259	
Diffuser Density	% Floor	24.24%	24.24%	15.76%	
Diffusers/Grid		1,040	1,040	676	2,756

Oxygen Transfer

Diffuser Type		SSLP	SSLP	SSLP	
Alpha					
Beta					
Theta					
D.O.	mg/l				
Water Temp	°C	20	20	20	
AOR/SOR					
Oxygen Distribution	%/Zone	40.0%	35.0%	25.0%	100.0%
AOR	lb/day				
SOR	lb/day	13,200.0	11,550.0	8,250.0	33,000.0
Air Rate (7)	scfm				

Performance

Mixing Criteria	scfm/ft ²	0.10	0.10	0.10	
Safety Factor	%				
Mixing Air (8)	scfm	175.9	175.9	175.9	
Process Air (for SOR)	scfm	1,771.2	1,522.9	1,115.1	
Design Air (1,7)	scfm	1,771.2	1,522.9	1,115.1	4,409.3
Diffuser Air Rate	scfm/Diff.	1.70	1.46	1.65	1.60
Delivered SOR	lb/day	13,200.0	11,550.0	8,250.0	33,000.0
Delivered SOTE	%	29.7%	30.3%	29.5%	29.9%
Pressure @ Top of Dropleg	psig	6.41	6.36	6.40	6.41
Shaft Power	Bhp	64.3	54.9	40.4	160.0

Notes:

(1) Design air is the maximum of process air or mixing air

(2) Delivered oxygen based on design air

(3) Brake Horsepower based on adiabatic compression, 70% mechanical efficiency and 0.30 psi line loss

(4) Performance based on diffuser density (At/Ad), submergence, and diffuser unit air flow.

(5) Diffuser Air Flow based on Active Valve Modulation

(6) Blower Pressure Capability also requires consideration of:

A. The Air Main headloss (piping, fittings, valves, instrumentation, etc.)

between the blower and the aeration assembly dropleg connections.

B. Potential for increased headloss resulting from diffuser fouling and/or aging.

Please refer to the US EPA Fine Pore Design Manual (EPA/625/1-89/023), WEF Manual of Practice FD-13,

and other technical publications for a detailed discussion on this subject. Note that this headloss

consideration relates to all Fine Pore systems regardless of supplier or type of diffuser element.

C. Increased diffuser submergence during Peak Flow conditions.

(7) Air Flow defined at 20°C

(8) Fine Mixing air based on 0.10 scfm/ft²

Sanitaire Project Name: Norwalk, CT WPCF**Sanitaire Project #s31959-23**

Consulting Engineer:

Operating Condition: Max Mon. PC Aerate

Oxygen Distribution: Default

Aeration System Design

Parameter	Units	Zone 1	Zone 2	Zone 3	Totals/Overall
Pass		1	1	1	
SWD	ft	14.78	14.78	14.78	
Subm	ft	13.81	13.81	13.81	
Volume	ft ³	25,995.5	25,995.5	25,995.5	77,986.6
No. Parallel Tanks		1	1	1	
No. Trains in Operation		1	1	1	
Grid Count		1	1	1	3
Dropleg Diameter	inches	10	10	8	
At/Ad		4.124839719	4.124839719	6.345907259	
Diffuser Density	% Floor	24.24%	24.24%	15.76%	
Diffusers/Grid		1,040	1,040	676	2,756

Oxygen Transfer

Diffuser Type		SSLP	SSLP	SSLP	
Alpha					
Beta					
Theta					
D.O.	mg/l				
Water Temp	°C	20	20	20	
AOR/SOR					
Oxygen Distribution	%/Zone	40.0%	35.0%	25.0%	100.0%
AOR	lb/day				
SOR	lb/day				
Air Rate (7)	scfm	5,400.0	4,725.0	3,375.0	13,500.0

Performance

Mixing Criteria	scfm/ft ²	0.10	0.10	0.10	
Safety Factor	%				
Mixing Air (8)	scfm	175.9	175.9	175.9	
Process Air (for SOR)	scfm	5,400.0	4,725.0	3,375.0	
Design Air (1,7)	scfm	5,400.0	4,725.0	3,375.0	13,500.0
Diffuser Air Rate	scfm/Diff.	5.19	4.54	4.99	4.90
Delivered SOR	lb/day	34,195.2	30,714.0	21,279.0	86,188.2
Delivered SOTE	%	25.3%	25.9%	25.2%	25.5%
Pressure @ Top of Dropleg	psig	7.88	7.50	7.77	7.88
Shaft Power	Bhp	232.7	195.6	143.8	581.8

Notes:

(1) Design air is the maximum of process air or mixing air

(2) Delivered oxygen based on design air

(3) Brake Horsepower based on adiabatic compression, 70% mechanical efficiency and 0.30 psi line loss

(4) Performance based on diffuser density (At/Ad), submergence, and diffuser unit air flow.

(5) Diffuser Air Flow based on Active Valve Modulation

(6) Blower Pressure Capability also requires consideration of:

A. The Air Main headloss (piping, fittings, valves, instrumentation, etc.)

between the blower and the aeration assembly dropleg connections.

B. Potential for increased headloss resulting from diffuser fouling and/or aging.

Please refer to the US EPA Fine Pore Design Manual (EPA/625/1-89/023), WEF Manual of Practice FD-13,

and other technical publications for a detailed discussion on this subject. Note that this headloss

consideration relates to all Fine Pore systems regardless of supplier or type of diffuser element.

C. Increased diffuser submergence during Peak Flow conditions.

(7) Air Flow defined at 20°C

(8) Fine Mixing air based on 0.10 scfm/ft²

Sanitaire Project Name: Norwalk, CT WPCF

Sanitaire Project #s31959-23

Headloss Summary by System Operating Point

Consulting Engineer:

Operating Condition:

Min. Day CC Aerate

Oxygen Distribution:

Default

Grid Design

	Units	Grid 1	Grid 2	Grid 3
Diffuser Count		1,040	1,040	676
Dropleg Diameter	inches	10	10	8
Line Count		20	20	13
Line Spacing	ft	1.42	1.42	2.25
Manifold Diameter	inches	10	10	8
Manifold Length	ft	26.92	26.92	27.00
Header Length	ft	54.25	54.25	54.25
Manifold Location		End	End	End
Manifold Elevation		Inline	Inline	Inline
Dropleg Location		End	End	End
Header Orientation		Length	Length	Length

Grid Pressure

Grid Air Flow	scfm	1,200.0	1,050.0	750.0
Diffuser Air Flow	scfm	1.15	1.01	1.11
Submergence	ft	13.81	13.81	13.81
Orifice Diameter	inches	13/64	13/64	13/64
Static Header Pressure Differential in Assembly	psig	8.11E-03	6.21E-03	7.51E-03
Average Header Pressure in Assembly	PSI	6.29	6.27	6.28
A: Average Headloss from Top of Dropleg To Headers	PSI	1.60E-02	1.23E-02	1.53E-02
B: Diffuser Orifice Headloss	psi	5.92E-02	4.51E-02	5.46E-02
C: Diffuser Dynamic Wet Pressure	psi	2.50E-01	2.48E-01	2.50E-01
D: Static Pressure	psig	5.98	5.98	5.98
Total Pressure Required at Top of Dropleg (A+B+C+D)	psig	6.31	6.29	6.30
Friction Headloss (A+B)	PSI	7.52E-02	5.73E-02	7.00E-02

Sanitaire Project Name: Norwalk, CT WPCF
Sanitaire Project #s31959-23
Headloss Summary by System Operating Point

Consulting Engineer:

Operating Condition: Max Mon. CC SOR

Oxygen Distribution: Default

Grid Design

	Units	Grid 1	Grid 2	Grid 3
Diffuser Count		1,040	1,040	676
Dropleg Diameter	inches	10	10	8
Line Count		20	20	13
Line Spacing	ft	1.42	1.42	2.25
Manifold Diameter	inches	10	10	8
Manifold Length	ft	26.92	26.92	27.00
Header Length	ft	54.25	54.25	54.25
Manifold Location		End	End	End
Manifold Elevation		Inline	Inline	Inline
Dropleg Location		End	End	End
Header Orientation		Length	Length	Length

Grid Pressure

Grid Air Flow	scfm	1,143.9	984.3	719.9
Diffuser Air Flow	scfm	1.10	0.95	1.06
Submergence	ft	13.81	13.81	13.81
Orifice Diameter	inches	13/64	13/64	13/64
Static Header Pressure Differential in Assembly	psig	7.37E-03	5.46E-03	6.92E-03
Average Header Pressure in Assembly	PSI	6.28	6.27	6.28
A: Average Headloss from Top of Dropleg To Headers	PSI	1.45E-02	1.08E-02	1.41E-02
B: Diffuser Orifice Headloss	psi	5.37E-02	3.95E-02	5.03E-02
C: Diffuser Dynamic Wet Pressure	psi	2.49E-01	2.47E-01	2.49E-01
D: Static Pressure	psig	5.98	5.98	5.98
Total Pressure Required at Top of Dropleg (A+B+C+D)	psig	6.30	6.28	6.29
Friction Headloss (A+B)	PSI	6.82E-02	5.03E-02	6.44E-02

Sanitaire Project Name: Norwalk, CT WPCF

Sanitaire Project #s31959-23

Headloss Summary by System Operating Point

Consulting Engineer:

Operating Condition: Max Mon. FC SOR

Oxygen Distribution: Default

Grid Design

	Units	Grid 1	Grid 2	Grid 3
Diffuser Count		1,040	1,040	676
Dropleg Diameter	inches	10	10	8
Line Count		20	20	13
Line Spacing	ft	1.42	1.42	2.25
Manifold Diameter	inches	10	10	8
Manifold Length	ft	26.92	26.92	27.00
Header Length	ft	54.25	54.25	54.25
Manifold Location		End	End	End
Manifold Elevation		Inline	Inline	Inline
Dropleg Location		End	End	End
Header Orientation		Length	Length	Length

Grid Pressure

Grid Air Flow	scfm	1,207.3	1,038.8	759.8
Diffuser Air Flow	scfm	1.16	1.00	1.12
Submergence	ft	13.81	13.81	13.81
Orifice Diameter	inches	13/64	13/64	13/64
Static Header Pressure Differential in Assembly	psig	8.21E-03	6.08E-03	7.71E-03
Average Header Pressure in Assembly	PSI	6.29	6.27	6.29
A: Average Headloss from Top of Dropleg To Headers	PSI	1.62E-02	1.20E-02	1.57E-02
B: Diffuser Orifice Headloss	psi	5.99E-02	4.41E-02	5.61E-02
C: Diffuser Dynamic Wet Pressure	psi	2.50E-01	2.48E-01	2.50E-01
D: Static Pressure	psig	5.98	5.98	5.98
Total Pressure Required at Top of Dropleg (A+B+C+D)	psig	6.31	6.28	6.30
Friction Headloss (A+B)	PSI	7.61E-02	5.61E-02	7.18E-02

Sanitaire Project Name: Norwalk, CT WPCF
Sanitaire Project #s31959-23
Headloss Summary by System Operating Point

Consulting Engineer:

Operating Condition: Max Mon. FC Aerate

Oxygen Distribution: Default

Grid Design

	Units	Grid 1	Grid 2	Grid 3
Diffuser Count		1,040	1,040	676
Dropleg Diameter	inches	10	10	8
Line Count		20	20	13
Line Spacing	ft	1.42	1.42	2.25
Manifold Diameter	inches	10	10	8
Manifold Length	ft	26.92	26.92	27.00
Header Length	ft	54.25	54.25	54.25
Manifold Location		End	End	End
Manifold Elevation		Inline	Inline	Inline
Dropleg Location		End	End	End
Header Orientation		Length	Length	Length

Grid Pressure

Grid Air Flow	scfm	3,600.0	3,150.0	2,250.0
Diffuser Air Flow	scfm	3.46	3.03	3.33
Submergence	ft	13.81	13.81	13.81
Orifice Diameter	inches	13/64	13/64	13/64
Static Header Pressure Differential in Assembly	psig	7.11E-02	5.48E-02	6.60E-02
Average Header Pressure in Assembly	PSI	6.84	6.69	6.79
A: Average Headloss from Top of Dropleg To Headers	PSI	1.40E-01	1.08E-01	1.34E-01
B: Diffuser Orifice Headloss	psi	5.48E-01	4.20E-01	5.07E-01
C: Diffuser Dynamic Wet Pressure	psi	3.09E-01	2.95E-01	3.04E-01
D: Static Pressure	psig	5.98	5.98	5.98
Total Pressure Required at Top of Dropleg (A+B+C+D)	psig	6.98	6.80	6.93
Friction Headloss (A+B)	PSI	6.88E-01	5.28E-01	6.41E-01

Sanitaire Project Name: Norwalk, CT WPCF

Sanitaire Project #s31959-23

Headloss Summary by System Operating Point

Consulting Engineer:

Operating Condition: Max Mon. PC SOR

Oxygen Distribution: Default

Grid Design

	Units	Grid 1	Grid 2	Grid 3
Diffuser Count		1,040	1,040	676
Dropleg Diameter	inches	10	10	8
Line Count		20	20	13
Line Spacing	ft	1.42	1.42	2.25
Manifold Diameter	inches	10	10	8
Manifold Length	ft	26.92	26.92	27.00
Header Length	ft	54.25	54.25	54.25
Manifold Location		End	End	End
Manifold Elevation		Inline	Inline	Inline
Dropleg Location		End	End	End
Header Orientation		Length	Length	Length

Grid Pressure

Grid Air Flow	scfm	1,771.2	1,522.9	1,115.1
Diffuser Air Flow	scfm	1.70	1.46	1.65
Submergence	ft	13.81	13.81	13.81
Orifice Diameter	inches	13/64	13/64	13/64
Static Header Pressure Differential in Assembly	psig	1.76E-02	1.30E-02	1.65E-02
Average Header Pressure in Assembly	PSI	6.37	6.33	6.36
A: Average Headloss from Top of Dropleg To Headers	PSI	3.47E-02	2.57E-02	3.37E-02
B: Diffuser Orifice Headloss	psi	1.31E-01	9.63E-02	1.23E-01
C: Diffuser Dynamic Wet Pressure	psi	2.61E-01	2.56E-01	2.60E-01
D: Static Pressure	psig	5.98	5.98	5.98
Total Pressure Required at Top of Dropleg (A+B+C+D)	psig	6.41	6.36	6.40
Friction Headloss (A+B)	PSI	1.66E-01	1.22E-01	1.56E-01

Sanitaire Project Name: Norwalk, CT WPCF

Sanitaire Project #s31959-23

Headloss Summary by System Operating Point

Consulting Engineer:

Operating Condition: Max Mon. PC Aerate

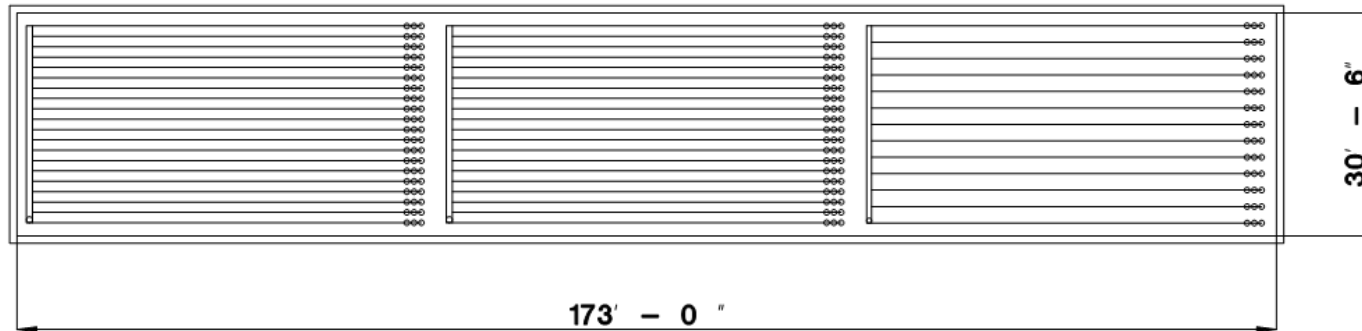
Oxygen Distribution: Default

Grid Design

	Units	Grid 1	Grid 2	Grid 3
Diffuser Count		1,040	1,040	676
Dropleg Diameter	inches	10	10	8
Line Count		20	20	13
Line Spacing	ft	1.42	1.42	2.25
Manifold Diameter	inches	10	10	8
Manifold Length	ft	26.92	26.92	27.00
Header Length	ft	54.25	54.25	54.25
Manifold Location		End	End	End
Manifold Elevation		Inline	Inline	Inline
Dropleg Location		End	End	End
Header Orientation		Length	Length	Length

Grid Pressure

Grid Air Flow	scfm	5,400.0	4,725.0	3,375.0
Diffuser Air Flow	scfm	5.19	4.54	4.99
Submergence	ft	13.81	13.81	13.81
Orifice Diameter	inches	13/64	13/64	13/64
Static Header Pressure Differential in Assembly	psig	1.55E-01	1.20E-01	1.44E-01
Average Header Pressure in Assembly	PSI	7.57	7.27	7.47
A: Average Headloss from Top of Dropleg To Headers	PSI	3.04E-01	2.36E-01	2.93E-01
B: Diffuser Orifice Headloss	psi	1.22E+00	9.38E-01	1.13E+00
C: Diffuser Dynamic Wet Pressure	psi	3.77E-01	3.49E-01	3.68E-01
D: Static Pressure	psig	5.98	5.98	5.98
Total Pressure Required at Top of Dropleg (A+B+C+D)	psig	7.88	7.50	7.77
Friction Headloss (A+B)	PSI	1.52E+00	1.17E+00	1.42E+00



Single Train Information

Grid No	Grid Count	Drop Leg ϕ "	Header Count	Header Spc,ft.	Header Len,ft.	Discs/ Grid	At/ Ad	Discs/ Train
1	1	10	20	1.42	54.25	1040	4.12	1040
2	1	10	20	1.42	54.25	1040	4.12	1040
3	1	8	13	2.25	54.25	676	6.35	676

Total Discs/Train 2756

Note: Some headers may be omitted for clarity

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	DWG NO.			CHKD BY	DATE		SHEET
				APPVD BY	DATE		

9" SANITAIRE® MEMBRANE DISC DIFFUSER SPECIFICATIONS
"SILVER SERIES II - LP"

MATERIAL PROPERTIES	VALUE/UNITS	TEST PROCEDURE
Base Compound	EPDM With Carbon Black for UV Protection	--
Tensile Strength (Unperforated)	1,200 PSI/Min.	ASTM D412
Elongation at Break	350% Min.	ASTM D412
Hardness (Durometer)	58 ± 5, Shore A	ASTM 2240
Accelerated Aging Compression Set (Under Constant Deflection) 22 Hrs. @ 70°C	40% Max.	ASTM D395 Test Method B
Accelerated Aging (Elongation (% Retained) 70 Hrs. @ 100°C	75% Max.	ASTM D573
Ozone Resistance 72 Hrs.; 40°C, 50 pphm	No cracks @ 2X magnification	ASTM D1171 Method A
Modulus @ 300%	500 PSI/Min.	ASTM D412
Dynamic Wet Pressure	6.0" – 8.0" w.c.	@ 1.5 SCFM
PHYSICAL PROPERTIES		
Nominal Diameter	9"	
Active Surface Area	0.41 Ft. ²	
Material Thickness	0.080"	
Check Valve Leakage Rate	0 ml H ₂ O after 48 hours unpressurized	

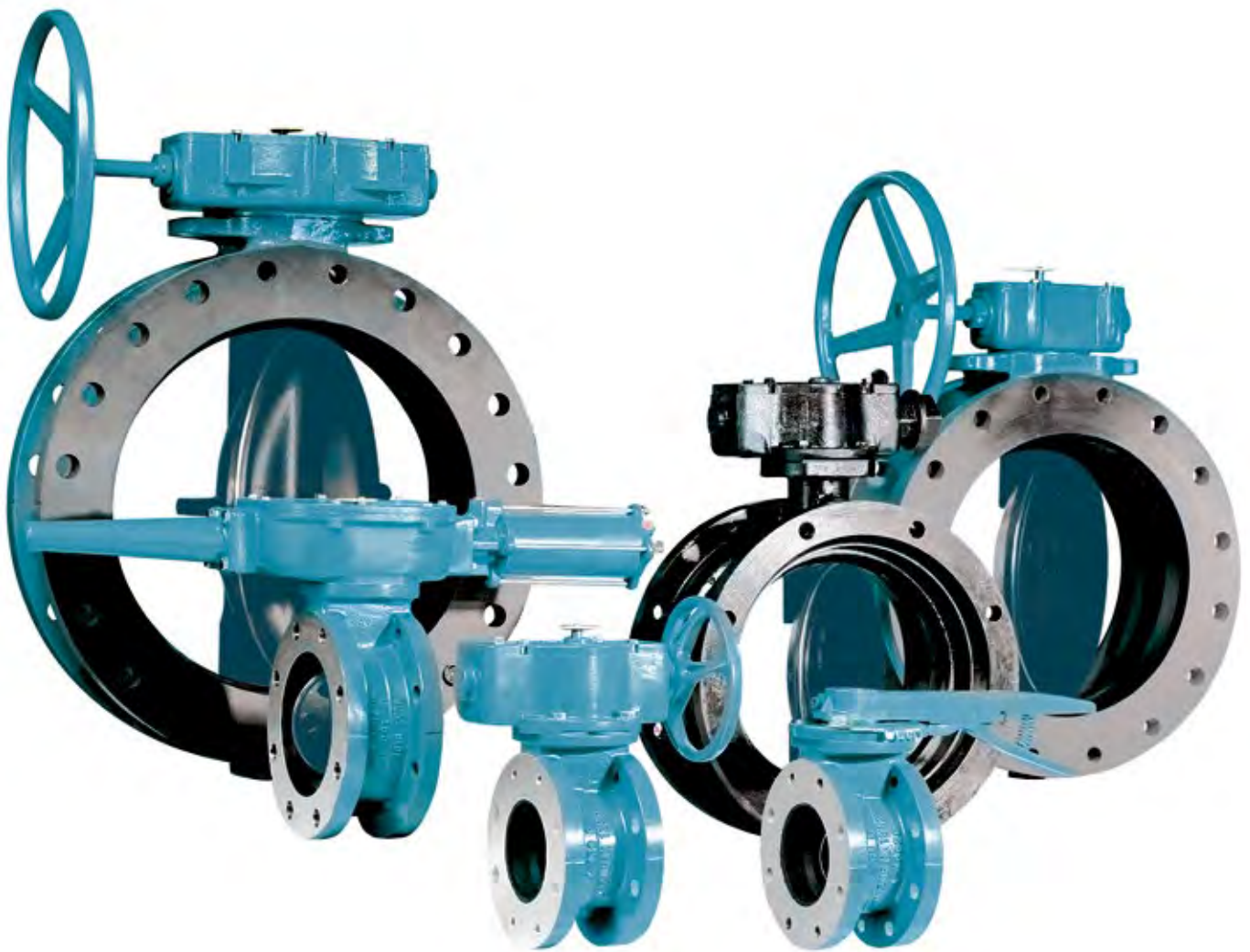
**9" SANITAIRE® MEMBRANE DISC DIFFUSER SPECIFICATIONS
"SILVER SERIES II"**

MATERIAL PROPERTIES	VALUE/UNITS	TEST PROCEDURE
Base Compound	EPDM With Carbon Black for UV Protection	--
Tensile Strength (Unperforated)	1,200 PSI/Min.	ASTM D412
Elongation at Break	350% Min.	ASTM D412
Hardness (Durometer)	58 $\pm$ 5, Shore A	ASTM 2240
Accelerated Aging Compression Set (Under Constant Deflection) 22 Hrs. @ 70°C	40% Max.	ASTM D395 Test Method B
Accelerated Aging (Elongation (% Retained) 70 Hrs. @ 100°C	75% Max.	ASTM D573
Ozone Resistance 72 Hrs.; 40°C, 50 pphm	No cracks @ 2X magnification	ASTM D1171 Method A
Modulus @ 300%	500 PSI/Min.	ASTM D412
Dynamic Wet Pressure	9.6" – 14.4" w.c.	@ 1.0 SCFM @ 2" w.c.
PHYSICAL PROPERTIES		
Nominal Diameter	9"	
Active Surface Area	0.41 Ft. ²	
Material Thickness	0.080"	
Check Valve Leakage Rate	0 ml H ₂ O after 48 hours unpressurized	

I/QC/Silver Series II MD Properties (5-12)

CONTROL VALVES

DeZURIK BAW AWWA BUTTERFLY VALVES



Defining the DeZURIK Difference



DeZURIK History

DeZURIK is an innovative global leader for the water and wastewater treatment industries, recognized worldwide for high quality and superior performance.

While DeZURIK provides innovative valves and related equipment for water and wastewater, DeZURIK eagerly responds as new industries develop and existing industries progress. Our knowledgeable engineers are quick to respond with groundbreaking technological advances. They continue to develop a wide range of products focusing on water and wastewater treatment, pulp and paper, chemical and petrochemical, power, mining and other process industries. Some of our products increase accuracy. Others assure durability or reliability. All of our products work to enhance our customer's profitability.

Certification

For our latest certifications, please visit our web site www.dezurik.com.

Leading Edge Design Software

Computer Aided Design systems are used by research and development engineers throughout the product development cycle. DeZURIK utilizes leading edge solid modeling software which allows product designers to view valve parts and assemblies three dimensionally. The 3D models are electronically transferred to Finite Element Analysis software where stress and deflection calculations are performed. This software allows designers to visualize deflection of critical parts under extreme loads. Proper relief and safety factors are included in every valve design to ensure long performance life.

Advanced Machining Capabilities

DeZURIK's solid modeling CAD software allows parts to be directly transferred to CAM modules for machine fixture design and NC programming. AWWA Butterfly Valves are manufactured with the most sophisticated machining centers available. Milling, drilling, boring, and tapping operations are performed on fully automated machine centers that perform sequential, error-free operations. DeZURIK's investment in state-of-the-art machining centers ensures products of consistently high quality.

Rubber & Elastomer Compounding

DeZURIK formulates and handcrafts rubber to control quality on critical components. Over 50 years of pressure/temperature rubber-molding experience assures the AWWA seat design provides long, maintenance-free service. DeZURIK compounds its own resilient seat materials to assure low operating torque and protection from pipeline corrosion and abrasion from sedimentation deposits.

Prototype Design Testing

Valve prototypes of sizes up to 36" (900mm) are tested in DeZURIK's flow laboratory. Flow ranges from a few cubic centimeters per minute to 72,000 gallons per minute can be tested. Computer controlled testing automatically sets flow, monitors temperatures, takes sample readings, and analyzes information. Before release, beta test sites are used to gain actual field experience. Valves are tested up to 10,000 cycles per AWWA C504 specifications. Proof of design testing certification is available.

Applications

DeZURIK AWWA Butterfly Valves are designed for applications throughout water and wastewater treatment plants, water distribution systems, power plants, and industrial plants. AWWA Butterfly Valves can be applied in applications demanding high-quality and thoroughly tested valves which offer many years of trouble-free service.



Pump Check Control Systems

Pump check control systems, utilizing AWWA Butterfly Valves, are available in many different models.



Production Testing

Each valve is given a hydrostatic, seat leakage and performance test per AWWA C504 before it is shipped.

3-20" (80-500mm) Design

Features for Years of Trouble-Free Service

Body Styles

Flanged, ASME B16.1 Class 125,
3-20" (80-500mm), Valve Class 150B

Flanged, ASME B16.1 Class 125,
3-20" (80-500mm), Valve Class 250B

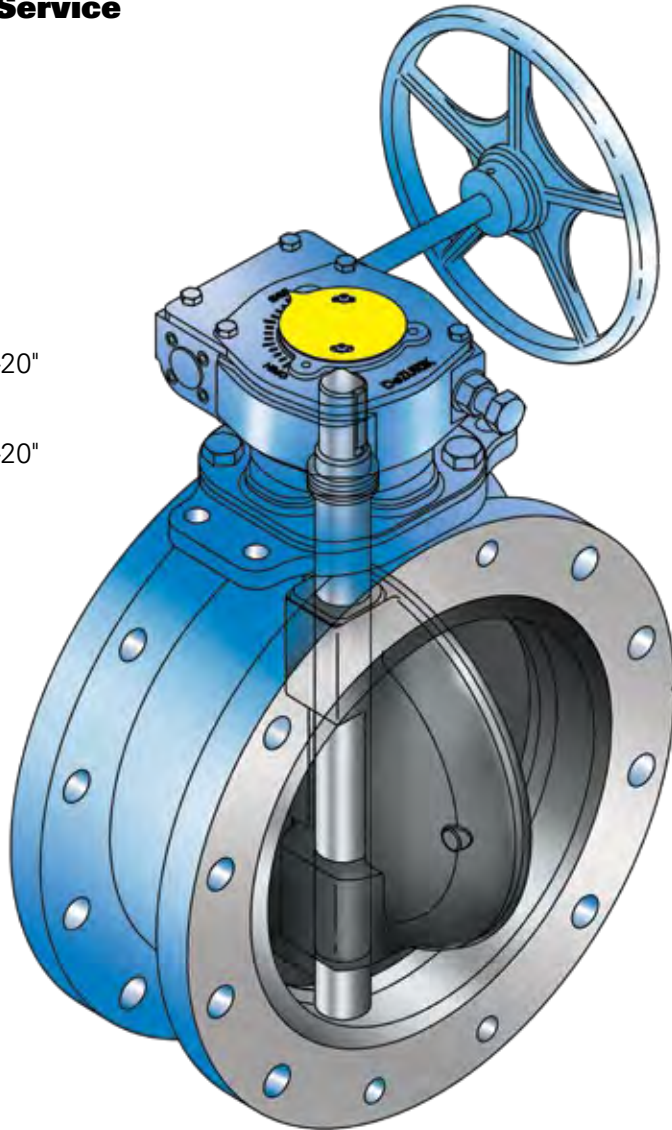
Flanged, ASME B16.1 Class 250,
3-18" (80mm-450mm), Valve Class 250B

Mechanical Joint, ANSI/AWWA C111/A21.11, 4-20"
(100-500mm), Valve Class 150B

Mechanical Joint, ANSI/AWWA C111/A21.11, 4-20"
(100-500mm), Valve Class 250B

Corrosion Resistant Shaft

Stainless steel shafts provide corrosion resistance in bearing and packing journal areas to ensure long bearing and packing life. Standard shaft materials include 304, 316, and 17-4 PH stainless steel.



Self-Compensating Shaft Seals

Shaft seals are self-compensating, V-type packing. DeZURIK uses a minimum of four sealing rings. This proven multi-ring sealing technology offers reliability and continuous self-adjustment.

Long Life, Low Friction Bearings

Upper and lower journal shaft bearings are designed to provide high compressive strength, low friction and require no lubrication.

3-20" (80-500mm) Design

Fully Rubber Lined Body

A fully rubber lined body is standard, eliminating the need for inner body coating, and protecting the body against corrosion buildup.

Integrity of the Proven Molding Process

The rubber bonding process used on DeZURIK AWWA Butterfly Valves is proven by more than 50 years of field experience. AWWA C504 requires testing of the bonding process per ASTM D429, method B. The test requires a 1" (25mm) wide strip of rubber to withstand a minimum 75 lbs. pull force (at a 90° angle) before tearing away from the valve body. During destructive testing, the rubber must tear before the bond between the rubber seat and metal valve body gives way, demonstrating that the bond is stronger than the rubber. Based on extensive experience and proof of design testing, DeZURIK can assure that a molded-in body seat remains maintenance-free for the life of the valve.

Choice of Seat Materials

Standard seat materials include Acrylonitrile-Butadiene (NBR) for water service and EPDM for high-temperature applications such as air blower lines.

4° Sealing Surface

The spherical sealing surface, molded into the valve seat, provides constant interference between the sealing surface and the disc edge for a full 4° sealing range. This allows the actuator to be adjusted within the correct sealing range while the valve is under pressure and flow.

Molded-In Body Seat

The pressure/temperature molding process used on AWWA Butterfly Valves provides a long-lasting, maintenance-free seat. DeZURIK's molded-in body seat lasts far beyond the 10,000 cycles required by AWWA C504. The molded seat-in-body design provides:

- Uniform rubber thickness.
- Consistent interference between the rubber seating surfaces and the stainless steel disc edge.
- Tight tolerance control on critical seat dimensions.



3-20" (80-500mm) Design



Disc Locators

An innovative, molded-in, disc-centering device aligns the disc in the seat, providing a positive seal and longer seat life. Disc hubs, supported by the locators, ensure disc location accuracy. The offset style disc design means disc-alignment locators are separate from the sealing surface, extending valve seat life.

Proven Disc-To-Shaft Pinning

All DeZURIK disc-to-shaft pinning connections conform to AWWA C504. Disc-to-shaft pinning is provided by a stainless steel torque screw on sizes 3-12" (80-300mm). Sizes 14-20" (350-500mm) utilize a tangential pin which is locked in place with a stainless steel set screw.



High Temperature Applications

For operating temperatures to 290° F (143°C), EPDM seat material and packing, high temperature bearings and high temperature paint on the disc are available as standard options. Other seat materials for higher temperatures available on application.

3-20" (80-500mm) Design

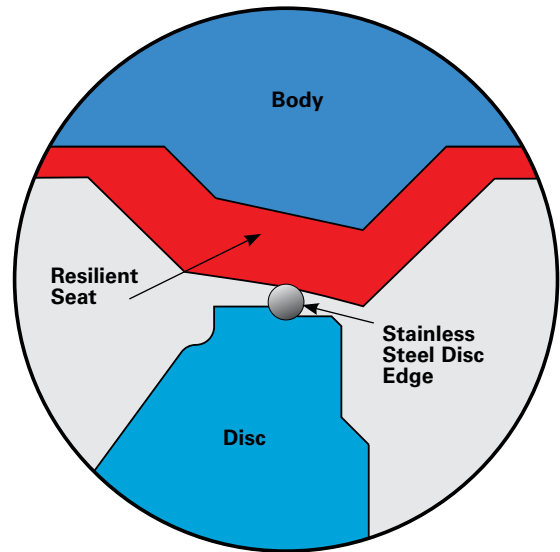
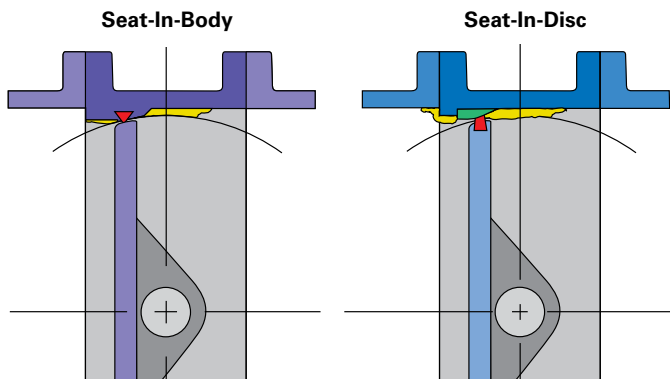
Integral Shaft Bearing Seals

To ensure all components of the valve remain maintenance-free, the molded-in body seat and body liner contain integral shaft bearing seals in the upper and lower journals. These seals protect bearing journal areas against sedimentation, mineral deposits, and corrosion particles — all of which can damage bearings and shorten valve life.

Seat-In-Body vs. Seat-On-Disc

DeZURIK's AWWA Butterfly began its evolution over 40 years ago. For over 25 years, a stationary rubber seat located in the valve body has been the standard. This feature is fundamental to the long-term performance of the valve.

After years of service, water distribution valves and pipelines (regardless of material) suffer the effects of abrasive corrosion and tuberculation buildup. When the rubber seat of a butterfly valve is located on the moving disc edge, it will erode or tear away as it plows its way through line buildup, causing the valve to leak. With a rubber seat-in-body design, the stainless steel disc provides the resistance necessary to plow through line buildup without seat-on-disc edge damage.



Offset Disc Design

The offset disc provides an uninterrupted 360° sealing surface. The sealing surface is not interrupted by the valve shaft and does not have any continuous contact points between the rubber seat and the disc edge. This results in a longer seat life.

Stainless Steel Disc Edge

Solid 316 stainless steel disc edge provides the corrosion and abrasion resistance essential for long-lasting, maintenance-free service. The stainless steel disc edge is on all disc materials including iron, carbon steel and aluminum bronze discs.



24" (600mm) and Larger Design

Quality Features for Superior Performance

Body Styles

Flanged, ASME B16.1 Class 125,
24–120" (600–3000mm), Valve Class 150B

Flanged, ASME B16.1 Class 125,
30–72" (750–1800mm), Valve Class 75B

Flanged, ASME B16.1 Class 125,
30–48" (750–1200mm), Valve Class 25A

Flanged, ASME B16.1 Class 125,
20–54" (600–1400mm), Valve Class 250B

Flanged, ASME B16.1 Class 250,
24–48" (600–1200mm), Valve Class 250B

Mechanical Joint, ANSI/AWWA C111/A21.11,
24–48" (600–1200mm), Valve Class 150B

Mechanical Joint, ANSI/AWWA C111/A21.11,
24–48" (600–1200mm), Valve Class 250B

Corrosion Resistant Shaft Material

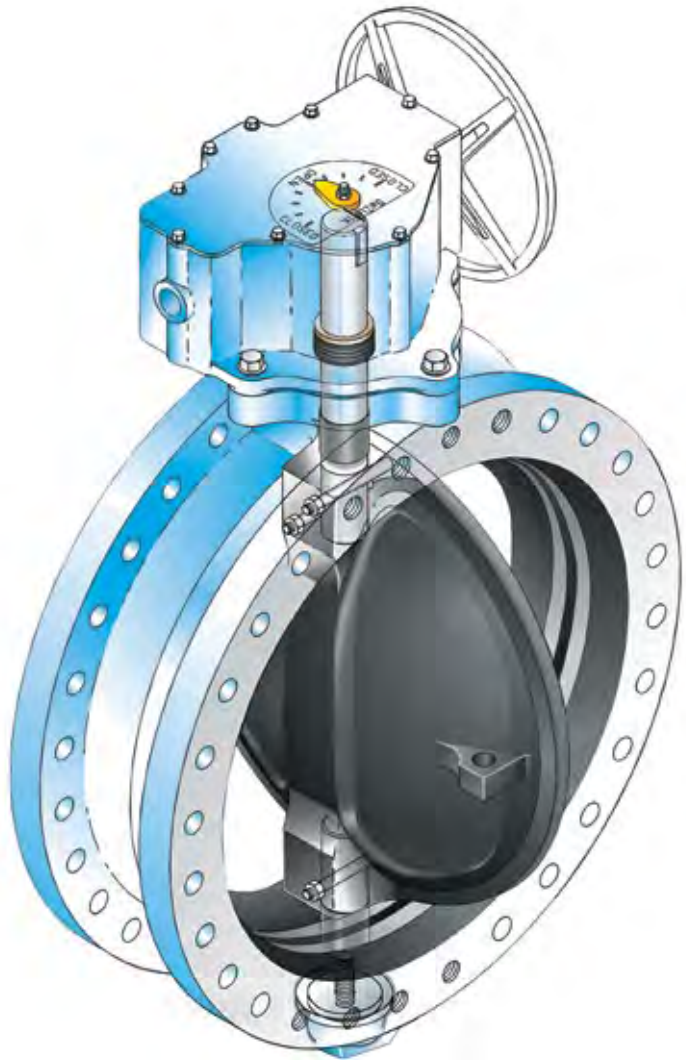
Standard shaft materials include 304, 316, and 17-4 PH stainless steel, providing the corrosion resistance in the bearing and packing journal areas necessary to ensure long bearing and packing life.

Stainless Steel Disc Edge

Solid 316 stainless steel disc edges provide a corrosion and abrasion resistant seating area essential for long-lasting, maintenance-free service.

Choice of Seat Materials

Standard seat materials include Acrylonitrile Butadiene (NBR) for water service and EPDM for high temperature applications such as air blower lines.



High Temperature Applications

For operating temperatures to 290°F (143°C), EPDM seat material and packing, high temperature bearings and high temperature paint on the body and disc are standard. Other seat materials for higher temperatures available on application.

Positive Disc Locators

Incorporated into the lower shaft is an adjustable thrust bearing assembly which holds the disc position in all possible installation orientations. This thrust bearing absorbs forces from the disc weight, internal hydraulics and axial shaft loads.

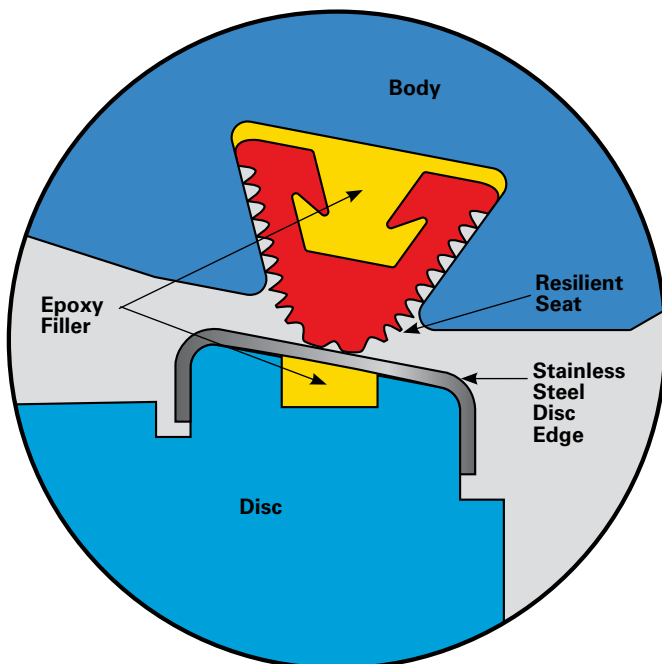
24" (600mm) and Larger Design

Rugged Disc Structure

DeZURIK utilizes state-of-the-art design and analysis computer software and test equipment to develop the optimum disc structure. Larger valves have an open disc structure, allowing water to flow through the center ports of the disc. On smaller sizes, DeZURIK utilizes a dome disc structure. On all valve sizes the disc structure is non-hollow, allowing inspection of each surface and wall thickness against shrinkage and core shift during the casting process.

Seat Design

DeZURIK's large valve seat design is industry proven and offers reliability, low operating torque and long life. The rubber seat is retained within a dovetail groove in the valve body and locked in place by an epoxy wedge. This design eliminates the need for fasteners, retaining rings or retaining segments to lock the seat in place. After the valve is fully assembled, with the disc in the closed position, an epoxy compound is injected behind the rubber seat and cured at a predetermined pressure based on the valve's pressure class. The injection pressure controls the interference between the rubber and stainless steel disc edge, providing a level of seating performance virtually impossible to achieve with other seat designs.



Adjustable, Replaceable Seat

As required by AWWA C504 for valves 24" (600mm) and larger, this seat design offers field adjustment and replacement capabilities. Proper field adjustment can be performed from either the upstream or downstream side of a pressurized valve.

Proven Disc-To-Shaft Pinning

Disc-to-shaft pinning is provided by a stainless steel tapered pin on sizes 24" (600mm) and larger. This proven design provides a reliable, high strength connection that conforms to AWWA C504.

Long Life, Low Friction Bearings

The upper and lower journal shaft bearings are designed to provide high compressive strength, low friction and require no lubrication.

Self-Compensating Shaft Seals

Shaft seals are self-compensating, V-type packing. DeZURIK uses a minimum of four sealing rings. This proven multi-ring sealing technology offers reliability and continuous self-adjustment. Standard packing materials include Acrylonitrile-Butadiene (NBR) or EPDM to meet all application requirements.

Offset Disc Design

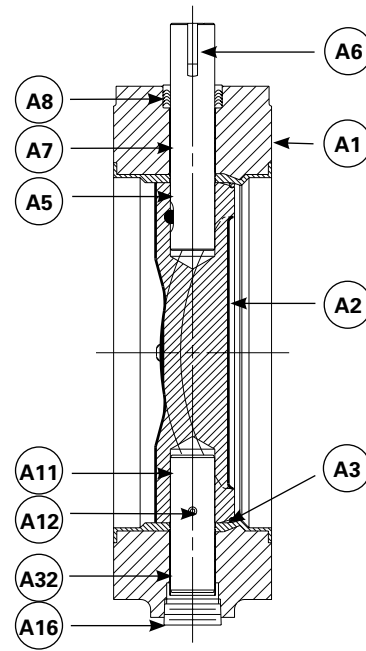
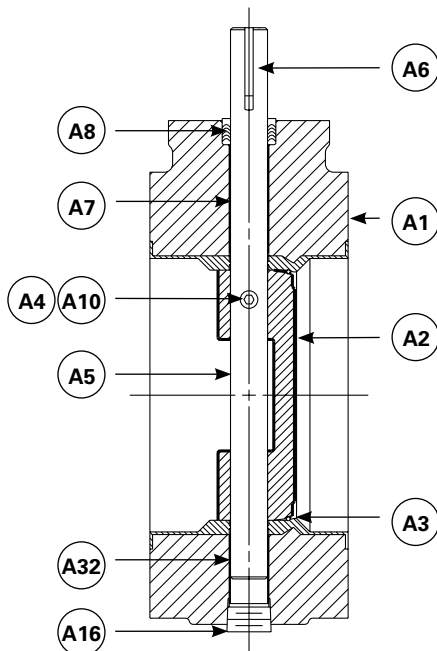
The offset disc provides an uninterrupted 360° sealing surface. The sealing surface is not interrupted by the valve shaft and does not have any continuous contact points between the rubber seat and the disc edge. This results in a longer seat life.



Materials of Construction

3-16" (80-400mm)

18 & 20" (450 & 500mm)



3-20" (80-500mm) Valve Sizes

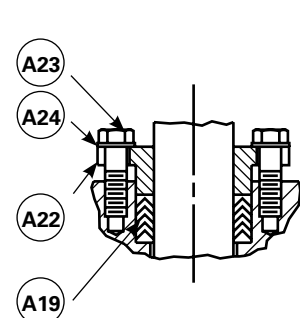
Item	Description	Material
A1	Body NBR or EPDM seat is permanently bonded to the body	Cast Iron ASTM A126 Class B Ductile Iron ASTM A536 Grade 65-45-12
A2	Disc	Ductile Iron ASTM A536 Grade 65-45-12 316 Stainless Steel, ASTM A743, Type CF8M Aluminum Bronze, C95500, ASTM B763/B271/B505
A3	Disc Seating Edge	316 Stainless Steel, ASTM A276, Type 316 316 Stainless Steel, ASTM A743, Type CF8M
A4	Tangential Pin 14-20" (350-500mm)	316 Stainless Steel, ASTM A276, Type 316 (250B) 17-4 PH Stainless Steel, H1100
A5	Shaft 3-16" (80-400mm) Upper Shaft 18-20" (450-600mm)	316 Stainless Steel, ASTM A276, Type 316 17-4 PH Stainless Steel, ASTM A564, Type 630 Condition 1150
A6	Key	Steel AISI 1018
A7	Upper Journal Bearing	Nylon and Molybdenum Disulphide Composition (NBR Seat) PTFE (EPDM Seat) (250B) PTFE Fabric Liner, Fiberglass back-up shell
A8	Packing	Acrylonitrile Butadiene (NBR Seat) Ethylene Propylene Diene Terpolymer (EPDM Seat)
A10	Torque Screw 3-12" (80-300mm)	316 Stainless Steel, ASTM A276, Type 316 (250B) 17-4 PH Stainless Steel, Condition 1100
A10	Set Screw 14-20" (350-500mm)	18-8 Stainless Steel
A11	Lower Shaft 18-20" (450-600mm)	316 Stainless Steel, ASTM A276, Type 316 17-4 PH Stainless Steel, ASTM A564, Type 630 Condition 1150
A12	Set Screw 18-20" (450-500mm)	18-8 Stainless Steel
A16	Plug 3-20" (80-500mm)	3-8" (80-200mm) Carbon Steel, SAE J403, Grade 1008/1010 10-20" (250-500mm) Malleable Iron, ASTM A47-52 Grade 35018 (250B, 3-6" (80-150mm)) Carbon Steel, SAE J403, Grade 1008/1010 (250B, 8-20" (200-500mm)) Malleable Iron, ASTM A47-52 Grade 35018
A32	Lower Journal Bearing	Nylon and Molybdenum Disulphide Composition (NBR Seat) PTFE (EPDM Seat) (250B) PTFE Fabric Liner, Fiberglass back-up shell

Materials of Construction

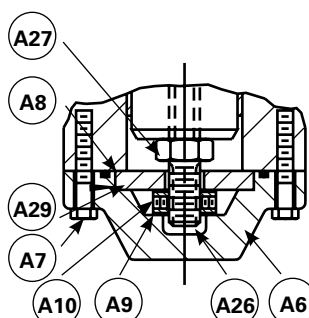
24-72" (600-1800mm) Valve Sizes

Item	Description	Material
A1	Body	Cast Iron, ASTM A126 Class B Ductile Iron, ASTM A536 Grade 65-45-12
A2	Seat	Acrylonitrile-Butadiene (NBR) Terpolymer of Ethylene, Propylene and a Diene (EPDM)
A6	Thrust Bearing Cover	Cast Iron, ASTM A126 Class B Ductile Iron, A536 Grade 65-45-12
A7	Screw	18-8 Stainless Steel
A8	O-Ring	Acrylonitrile-Butadiene (NBR) Terpolymer of Ethylene Propylene and a Diene (EPDM)
A9	Thrust Collar	Steel, ASTM 108
A10	Set Screw	18-8 Stainless Steel
A11	Disc	Ductile Iron ATM A536 Grade 65-45-12
A12	Disc Edge	316 Stainless Steel, ASTM A240, Type 316
A13	Disc Pin	304 Stainless Steel, ASTM A276, Type 304 303 Stainless Steel, ASTM 582, Type 303
A14	Nut	18-8 Stainless Steel
A15	Upper Shaft	304 Stainless Steel, ASTM A276, Type 304 316 Stainless Steel, ASTM A276, Type 316 17-4 PH Stainless Steel, ASTM 564, Type 630 Condition 1150
A16	Key	Steel AISI 1018
A17	Bearing	PTFE Fabric Liner, Fiberglass back-up shell
A19	Packing	NBR Acrylonitrile-Butadiene (NBR Seat) EPDM Ethylene Propylene and a Diene (EPDM Seat)
A20	Spacer 30-48" (750-1200mm)	316 Stainless Steel, ASTM A276, Type 316
A22	Gland 60-72" (1500-1800mm)	Bronze ASTM B-62
A23	Screw (Used with A22)	18-8 Stainless Steel
A24	Washer (Used with A22)	18-8 Stainless Steel
A25	Lower Shaft	304 Stainless Steel, ASTM A276, Type 304 316 Stainless Steel, ASTM A276, Type 316 17-4 PH Stainless Steel, ASTM 564, Type 630 Condition 1150
A26	Adjusting Screw	303 Stainless Steel, ASTM A582, Type 303
A27	Jam Nut	18-8 Stainless Steel
A29	Thrust Plate	Carbon Steel AISI A108
A30	Screw 24-48" (600-1200mm)	18-8 Stainless Steel
A31	Lockwasher 24-48" (600-1200mm)	18-8 Stainless Steel
A32	Epoxy	Epoxy
A33	O-Ring	Acrylonitrile-Butadiene (NBR) Terpolymer of Ethylene Propylene and a Diene (EPDM)

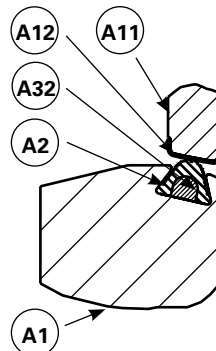
Contact DeZURIK for materials of construction on valve sizes 78-120" (2000-3000mm).



Detail E
Adjustable Packing
Optional on 24-48" (600-1200mm)
Standard on 54-72" (1400-1800mm)

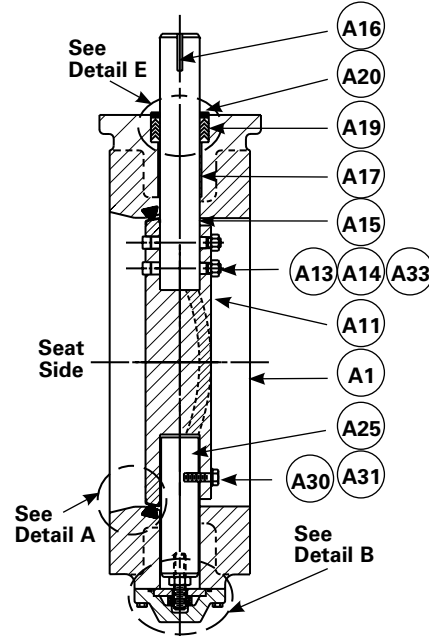


Detail B

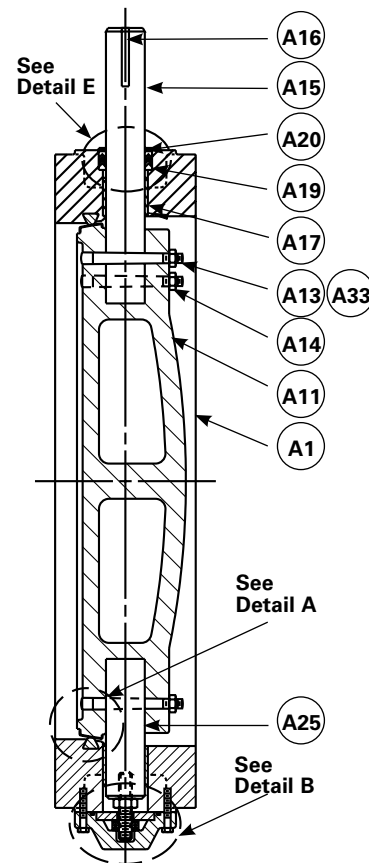


Detail A

24-42" (600-1100mm) Valve Sizes



48-72" (1200-1800mm) Valve Sizes



Valve Selection

Cv/Kv Values*

Class 150B

Valve Size	100% Cv/Kv	
	Flat Cv/Kv	Dome Cv/Kv
3" 80mm	362 313	356 308
4" 100mm	658 569	646 559
6" 150mm	1,380 1,194	1,360 1,176
8" 200mm	2,440 2,111	2,390 2,067
10" 250mm	3,910 3,382	3,840 3,322
12" 300mm	5,730 4,960	5,630 4,870
14" 350mm	7,840 6,782	7,700 6,661
16" 400mm	10,200 8,823	9,980 8,633
18" 450mm	12,600 10,899	12,400 10,726
20" 500mm	15,800 13,667	15,500 13,408
24" 600mm	22,900 19,809	22,500 19,463

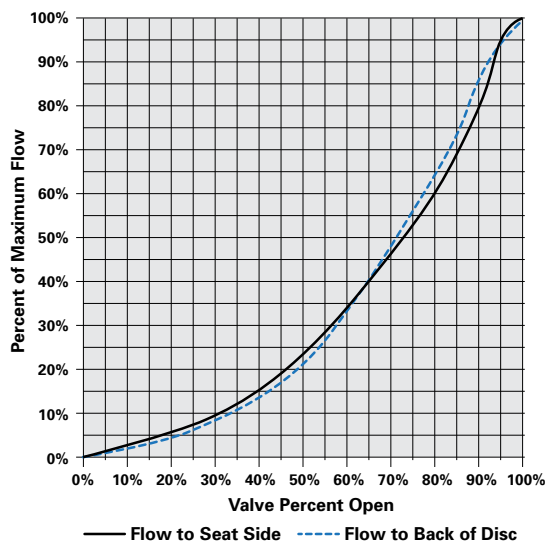
Class 25A, 75B, 150B

Valve Size	100% Cv/Kv	
	Flat Cv/Kv	Dome Cv/Kv
30" 750mm	36,500 31,573	35,900 31,054
36" 900mm	53,200 40,018	52,300 45,240
42" 1100mm	73,100 63,232	71,800 62,107
48" 1200mm	109,000 94,285	103,000 89,095
54" 1400mm	140,000 121,100	131,000 113,315
60" 1500mm	173,000 149,645	163,000 140,995
66" 1700mm	210,000 181,650	198,000 171,270
72" 1800mm	250,000 216,250	236,000 204,140

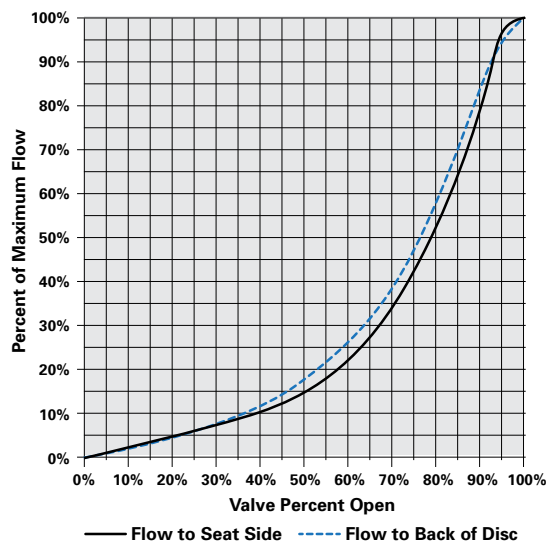
Contact DeZURIK for Cv/Kv Values on 78-120" (2000-3000mm) valves and for Class 250B.

* Cv = Flow in GPM of water at 1 psi pressure drop.
Kv = Flow in m³/hr. of water at 100 kPa pressure drop.

Flow characteristic 3-42" (80-1100mm)



Flow Characteristic 48-72" (1200-1800mm)



Applicable Standards

DeZURIK BAW AWWA Butterfly Valves are designed and/or tested to meet the following standards:

ANSI/AWWA C111/A21.11	Mechanical Joint Bell dimensions conform to ANSI/AWWA C111/A21.11, Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe Fittings.
ANSI/AWWA C-504	Valves conform to AWWA Standard ANSI/AWWA C-504 for sizes 3-72" (80-1800mm) Rubber Seated Butterfly Valves. Standard interior and exterior coatings meet the requirements of this standard.
ANSI/AWWA C-516	Valves conform to AWWA Standard ANSI/AWWA C-516 for sizes 78" (2000mm) & larger Rubber Seated Butterfly Valves. Standard interior and exterior coatings meet the requirements of this standard.
ASME B16.1	Dimensions and drilling of flanged end connections on valves up to 96" (2400mm) conform to Class 125 sections of ASME B16.1 Cast Iron Pipe Flanges and Flange Fittings.
ASTM D429	Bonding of 3-20" (80-600mm) seats conforms to ASTM D429, Standard Test Methods for Rubber Property - Adhesion to Rigid Substrates.
ASTM D471	Seat material volume increase is less than 2% after immersion in distilled water for 70 hours, when tested in accordance with ASTM D471, Standard Test Method for Rubber Property - Effect of Liquids.
ASTM D1149	Ozone resistance of seat material conforms to ASTM D1149, Standard Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber.
AWWA C110	Ductile-Iron and Gray-Iron Fittings, Mechanical Joint Accessories 30-48" (750-1200mm) meet this standard.
AWWA C153	Ductile-Iron Compact Fittings, Mechanical Joint Accessories 4-24" (100-600mm) meet this standard.
AWWA C207	For sizes 102" (2600mm) and larger, flange bolt patterns comply with AWWA C207 and flange thickness complies with AWWA C516.

Basic Valve Weights*

Valve Size	Flanged F1	Flanged F2	Mechanical Joint
	All Classes	Class 250B	Class 150B (Use for Class 250B)
3" 80mm	33 15	45 21	—
4" 100mm	45 21	62 29	50 23
6" 150mm	65 30	90 41	76 35
8" 200mm	100 46	144 66	112 51
10" 250mm	156 71	207 94	123 56
12" 300mm	250 114	312 142	213 97
14" 350mm	325 148	454 206	238 108
16" 400mm	383 174	538 245	398 181
18" 450mm	428 195	596 271	444 202
20" 500mm	547 249	773 351	570 259
24" 600mm	1025 466	1435 652	1025 466
28" 700mm	1360 618	—	—
30" 750mm	1850 840	2405 1092	1850 840
36" 900mm	2800 1271	3640 1652	2800 1271
42" 1050mm	4050 1838	5265 2389	4050 1838
48" 1200mm	5750 2609	7475 3392	5750 2609
54" 1400mm	7500 3403	—	—
60" 1500mm	9825 4458	—	—
66" 1700mm	12100 5491	—	—
72" 1800mm	15150 6874	—	—
Contact DeZURIK for weights on valve sizes 78" (2000mm) and larger.			

lbs

kilograms

* Weights are approximate and do not include crating or actuators.

Ordering

Valve Style

Give valve style code as follows:

BAW = AWWA Butterfly Valve

Valve Size

Give valve size code as follows:

3"	(80mm)	42"	(1100mm)
4"	(100mm)	48"	(1200mm)
6"	(150mm)	54"	(1400mm)
8"	(200mm)	60"	(1500mm)
10"	(250mm)	66"	(1700mm)
12"	(300mm)	72"	(1800mm)
14"	(350mm)	78"	(2000mm)
16"	(400mm)	84"	(2100mm)
18"	(450mm)	90"	(2300mm)
20"	(500mm)	96"	(2400mm)
24"	(600mm)	102"	(2600mm)
28"	(700mm)	108"	(2700mm)
30"	(750mm)	114"	(2900mm)
36"	(900mm)	120"	(3000mm)
		144"	(3600mm)

Note: All orders for 28" (700mm) and larger must include valve pipeline mounting position and shaft orientation as second line information.

End Connection

Give end connection code as follows:

F1 = ASME 125 Flanged 3-96" (80-2400mm)
AWWA C207 Class B & C Flanged 102-144" (2600-3600mm)
F2 = ASME 250 Flanged 3-48" (80-1200mm)
MJ = Mechanical Joint 4-48" (100-1200mm)
With Mechanical Joint ends, buriable actuators are recommended.

Body Material

Give body material code as follows:

CI = Cast Iron - F1 or MJ
CS = Carbon Steel - F1, 24" & larger (600mm & larger)
DI = Ductile Iron - F1, F2, or MJ
S2 = 316 Stainless Steel - F1, 24" & larger (600mm & larger)

Packing/Seat Combination

Give packing/seat material codes as follows:

Packing Material

NBRN = Acrylonitrile-Butadiene Self-Adjusting 3-144" (80-3600mm)
-20 to 180°F (-29 to 82°C)
NBRA = Acrylonitrile-Butadiene Adjustable 3-144" (80-3600mm)
-20 to 180°F (-29 to 82°C)
Do not use with buried service
EPDN = EPDM Self-Adjusting -20 to 290°F (-29 to 143°C)
3-48" (80-1200mm)
EPDA = EPDM Adjustable -20 to 290°F (-29 to 143°C)
3-48" (80-1200mm)
Do not use with buried service.
TCN = PTFE Self-Adjusting -20 to 450°F (-29 to 232°C)
3-144" (80-3600mm)
TCA = PTFE Adjustable -20 to 450°F (-29 to 232°C)
28-144" (700-3600mm)
Do not use with buried service.

Seat Material

NBR = Acrylonitrile-Butadiene -20 to 180°F (-29 to 82°C)
Must use NBRN or NBRA packing.
EPDM = Terpolymer of Ethylene Propylene & a Diene
-20 to 290°F (-29 to 143°C)
Must use EPDA or EPDN, TCN or TCA packing.

Class AWWA C-504

Give AWWA Class code as follows:

25A = 28-48" (700-1200mm) Flanged
75B = 28-144" (700-3600mm) Flanged
150B = 3-144" (80-3600mm) Flanged
4-48" (100-1200mm) Mechanical Joint
250B = 3-144" (80-3600mm) Flanged
4-48" (100-1200mm) Mechanical Joint

Note: Pressure ratings above 150 not available with EPDM Seat on valves 24" & larger (600mm & larger).

Disc/Shaft Combination

Give disc/shaft code as follows:

Disc Material

DI = Ductile Iron disc with 316 stainless steel edge
S2 = 316 Stainless Steel
ALB = Aluminum Bronze (3-18" only)
CS = Carbon Steel, 24" & larger (600mm & larger)

Shaft & Pin Material

Give shaft & pin material code as follows:

S2 = 316 Stainless Steel shaft & pin, Standard on 3-20" (80-500mm), optional on 24" (600mm) and larger
S1 = 304 Stainless Steel shaft
Pin is 316 Stainless Steel on 24-36" (600-900mm) and 304 Stainless Steel on 42-144" (1100-3600mm)
S5 = 17-4 pH Stainless Steel shaft & pin (must be used with 250B)

Options

Give options code as follows:

AIS = Valves conform to H.R. 3547 Consolidated Appropriations Act, 2014 Section 436
DTR = DeZURIK Standard Certified Production Hydrostatic Shell and Seat Test Report
BAA = Buy American Act
CMC = Certificate of Material Conformance
TB = DeZURIK Standard Certified Hydrostatic Shell Test and Seat Leak Test, both directions

Ordering Example:

BAW,24,F1,CI,NBRN-NBR,150B,DI-S1*Actuator

Mechanical Joint Accessories

Accessories include bolts, nuts, packing and glands for both ends. Sizes 4-24" (100-600mm) meet AWWA C153. Sizes 30-48" (750-1200mm) meet AWWA C110. Order as a separate item by giving code ACC*MJ-valve size.

Manual Actuators

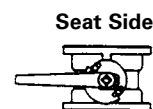
Lever Actuators



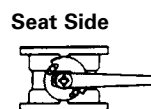
A 10-position dial provides positive latching in open, closed and eight intermediate positions. A pointer indicates position of disc plus a notch in the handle allows use of a padlock to prevent unauthorized valve operation.

Mounting

Lever actuators can be mounted at standard or 180°. Levers are available on 3–8" (80–200mm) valve sizes.



Standard Position



180° Position

Rotary Manual Actuators

DeZURIK offers a variety of rotary manual actuator options which are in complete compliance with AWWA C504. Manual actuators are available with handwheel, chainwheel or 2" (80mm) square nut options.

Easily Adjustable Stops

Open and closed position stops can be easily adjusted without drilling, shimming or pinning. The stops ride the input shaft and can be repositioned with a simple adjustment of the stop nut.

Rugged Designs

Manual actuators are sized to operate with a maximum input of 150 foot pounds on 2" (80mm) square operating nuts, and can be sized for 40 or 80 pound rim pull on handwheels and chainwheels. The actuators are self-locking, maintaining valve position under varying flow conditions.

Buriable and Weatherproof Construction

DeZURIK actuators feature a cast iron housing in buriable or weatherproof construction. The mechanism is totally enclosed and does not require lubrication for routine maintenance. Buried service actuators are grease filled per AWWA C504.

Valve Position Indicator

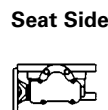
The pointer on weatherproof actuators clearly indicates the valve position marked on top of the housing. The indicator shaft is sealed to keep moisture from entering the actuator housing.

Easily Rotatable

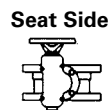
The four keyways in the yoke make DeZURIK nut and handwheel manual actuators easy to rotate to any of four mounting positions. Chainwheel actuators can be mounted at standard and 180°.

Mounting

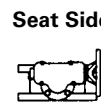
Nut & Handwheel



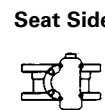
Standard Position



90° Position

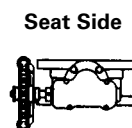


180° Position

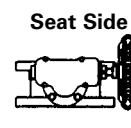


270° Position

Chainwheel



Standard Position



180° Position

Manual Actuators

G-Series Design

The G-Series design is available on 3–30" (80–750mm) valve sizes with a handwheel, chainwheel or 2" square nut input. The worm gear mechanism allows the G-Series actuators to provide high output torque with a torque curve matching the torque required by the valve. G-Series actuators feature a steel worm and ductile iron gear.

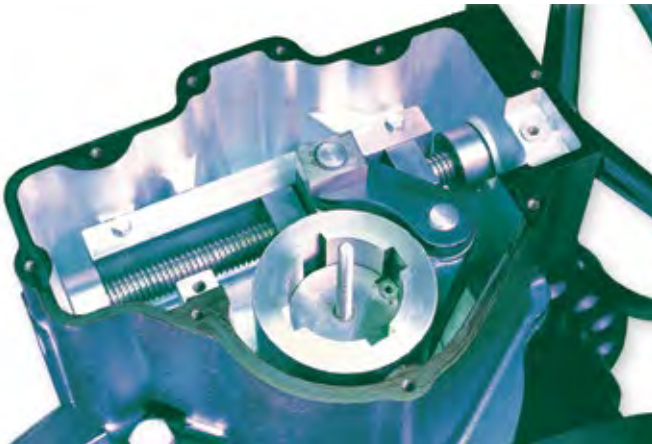
300 & 450 Foot Pound Input Torque

As required by AWWA C504, an input torque of 300 foot pounds against the fully adjustable open and closed position stops is standard. A 450 foot pound input capability against the stops is an option.



LA-Series Design

The LA-Series design is available on 30–72" (750–1800mm) valve sizes. The link-arm mechanism allows the LA-Series actuator to provide characterized closure which slows valve travel as the disc comes into the seat. The actuators feature high compressive strength yoke nut bearings which ensure reliable operation and increase cycle life.



High Output Torque

The LA-Series actuators feature an input torque capability of 450 foot pounds against the open and closed position stops as standard. An optional spur gear provides a 2:1 mechanical advantage while maintaining an input torque capability of 300 foot pounds against the stops. The spur gear slows closing of the valve, minimizing the possibility of water hammer.

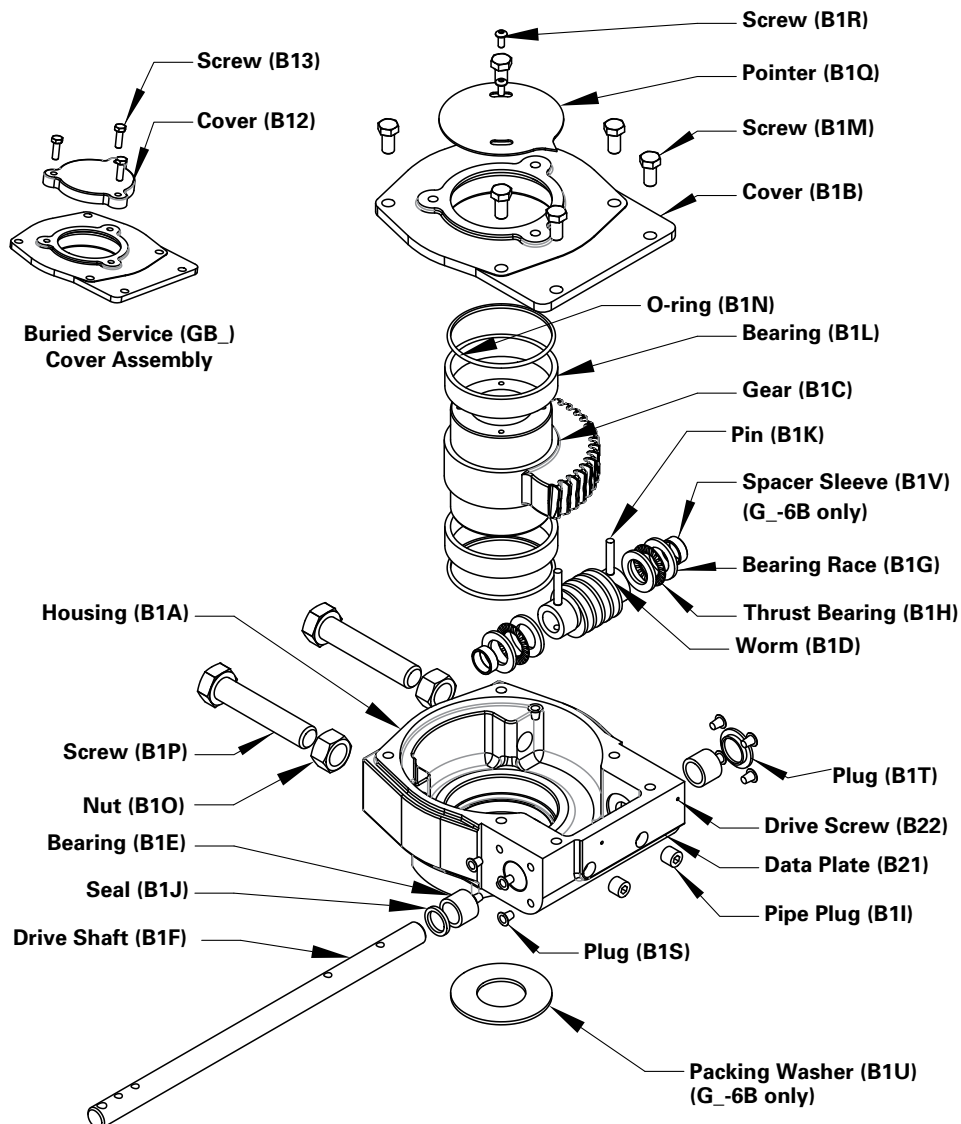
450 Ft-Lb Input Stops

LA-Series actuators have 450 Ft-Lb input stops as standard.

Rotary Manual Actuators

GS/GB-6B Materials of Construction

Item	Description	Material
B1A	Housing	Cast Iron, ASTM A126, Class B
B1B	Cover	Cast Iron, ASTM A126, Class B
B1C	Gear	Ductile Iron, ASTM A536, Grade 80-55-06
B1D	Worm	Steel, EN19 or ASTM A322, Grade 1440, UNS G14400
B1L	Bearing	Bronze, Oil Impregnated
B1F	Drive Shaft	Stainless Steel, Type 431 ASTM 276
B1G	Bearing Race	Steel
B1H	Thrust Bearing	Steel
B1I	Pipe Plug	18-8 Stainless Steel, ANSI B16.14
B1J	Shaft Seal	Acrylonitrile-Butadiene (NBR) and carbon steel case
B1K	Pin	Type H Steel EN8 Rockwell C20-25, ANSI B18.8.2
B1E	Bearing	Bronze, Oil Impregnated, ASTM B438, Grade 1, Type 2
B1M	Screws	A2-70, DIN933 (comparable to Stainless Steel 18-8)
B1N	O-ring	Acrylonitrile-Butadiene (NBR)
B1O	Nut	A2, DIN439B, (comparable to Stainless Steel 18-8)
B1P	Screw	A2-80, DIN933 (comparable to Stainless Steel 18-8)
B1Q	Pointer	Steel Zinc Plated, ASTM 569
B1R	Screw	A2 (comparable to Stainless Steel 18-8) ANSI B18.3.4M
B1S	Plug, Tapered	Plastic 238-D
B1T	Plug	Steel, ASTM A108, UNS G1018
B1U	Packing Washer	316 Stainless Steel, ASTM A276, UNS S31600
B1V	Spacer Sleeve	Steel EN 19 or ASTM A322, Grade 4140 UNS G41400



Rotary Manual Actuators

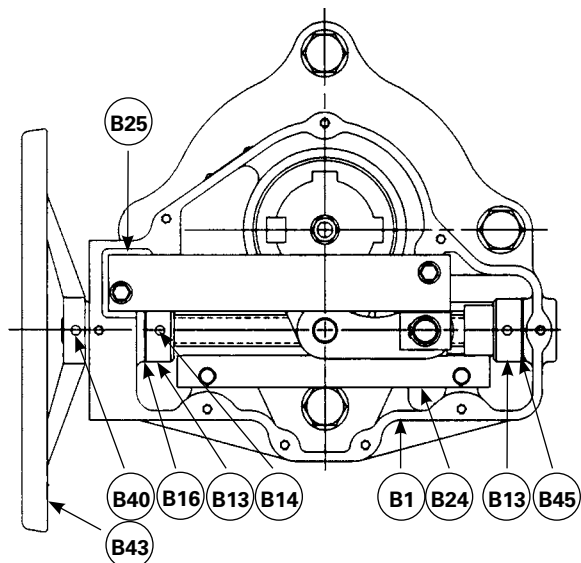
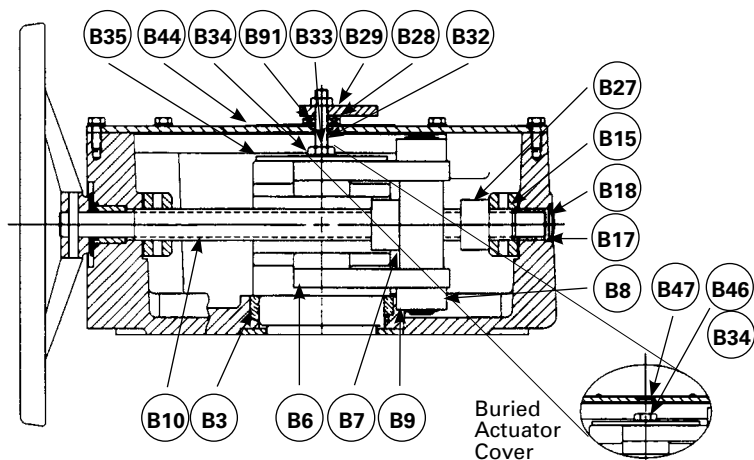
LA-Series Actuator Materials of Construction

Item	Description	Material
B1	Housing	Cast Iron, ASTM A126 Class B
B2	Bearing	Bronze Oil Impregnated
B3	Yoke	Ductile Iron, ASTM A536 80-55-06
B4	Cover	Steel Plate, A36 HR
B5	Packing Retainer	Steel Plate, A36 HR
B6	Link	Steel
B7	Yoke Nut	Ductile Iron, ASTM A536 80-55-06
B8	Guide Nut (LA-4 & LA-6)	Powder Metal 8020 23B
B9	Retaining Ring	Carbon Steel, SAE 1060-1090
B10	Input Shaft	Steel, AISI 1141
B11	O-Ring	Acrylonitrile-Butadiene
B12	O-Ring	Acrylonitrile-Butadiene
B13	Collar	Steel, AISI 1215
B14	Pin	Steel
B15	Thrust Washer	Teflon/Glass Fabric, Stainless Steel Backing
B16	Thrust Washer	Teflon/Glass Fabric, Stainless Steel Backing
B17	Bearing	Bronze Oil Impregnated
B18	Expansion Plug	Steel Zinc Plated
B23	Retaining Washer	Stainless Steel, Type 18-8
B24	Outer Guide Bar	Steel, AISI 1018
B25	Inner Guide Bar	Steel, AISI 1018
B26	Square Nut	Steel, AISI 1018
B27	Stop Nut	Steel, AISI 1018
B28	Seal	Steel with Nitrile
B29	Pointer	Steel, ASTM A36
B32	Stud	Steel Zinc Plated
B33	Nut	Steel Zinc Plated
B34	Thread Seal	Steel with Nitrile
B35	Yoke Cover	Steel, ASTM A569
B40	Pin	Steel Zinc Plated
B43	Handwheel	Cast Iron, ASTM A126 Class B
B44	Position Plate	Vinyl
B45	Shim	Steel
B47	Expansion Plug	Steel Zinc Plated

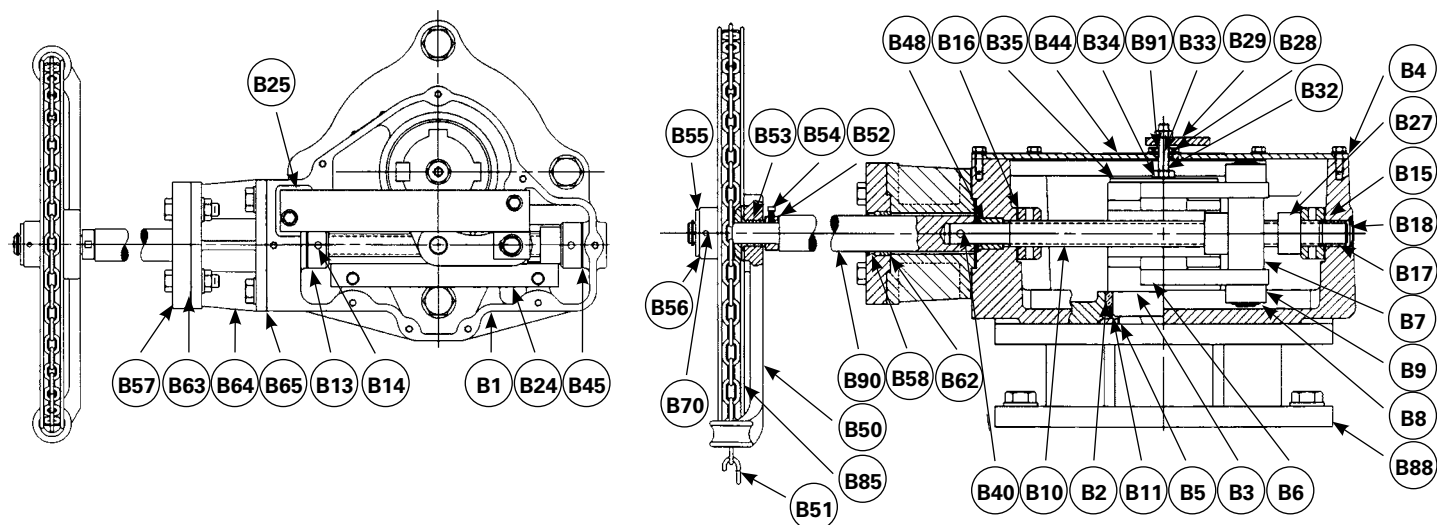
Item	Description	Material
B48	Bushing	Bronze Oil Impregnated
B50	Chain Guide	Cast Iron, ASTM A126
B51	Closing Link	Steel
B52	Collar	Steel, ASTM A36
B53	Bearing	Bronze
B54	Screw	Steel Zinc Plated
B55	Washer	Steel Zinc Plated
B56	Retaining Ring	Carbon Steel
B57	Adaptor Plate	Steel, ASTM A36
B58	Seal	Garlock
B62	Bearing	Bronze
B63	Gasket	Non-Asbestos
B64	Adaptor	Cast Iron, ASTM A126 Class B
B65	Gasket	Non-Asbestos
B69	Housing (Spur Gear)	Cast Iron, ASTM A126
B70	Pin (Chainwheel)	Steel Zinc Plated
B71	Gasket	Fiber Non-Asbestos
B72	Screw	Steel Zinc Plated
B73	Screw	Steel Zinc Plated
B74	Seal	Steel Zinc Plated
B75	Pin	Steel Zinc Plated
B76	Pin	Steel Zinc Plated
B77	Retainer Ring	Steel Zinc Plated
B78	Cover	Steel Plate, ASTM A36
B81	Gear	Carbon Steel
B82	Gear	Carbon Steel
B83	Input Shaft (Spur Gear)	Steel, ASTM A29
B84	O-Ring	Nitrile
B85	Chainwheel	Cast Iron, ASTM A126 Class B
B88	Adaptor (Adj. Packing)	Steel, ASTM A36
B89	Bearing	Bronze
B90	Shaft Extension	Steel, AISI 1215
B91	Washer	Steel Zinc Plated
B92	Expansion Plug	Zinc Plated Steel
B93	Lockwasher	Zinc Plated Steel

Note: All fasteners are zinc plated steel unless stainless steel bolting is specified.

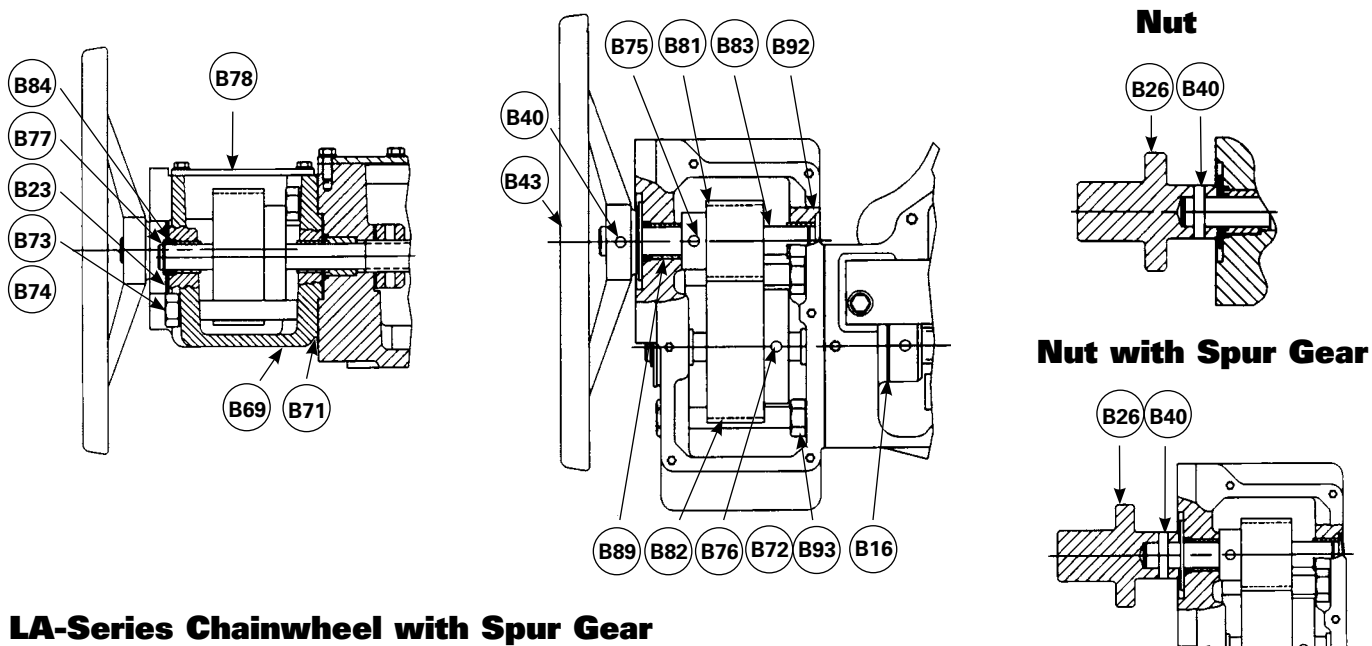
LA-Series Handwheel



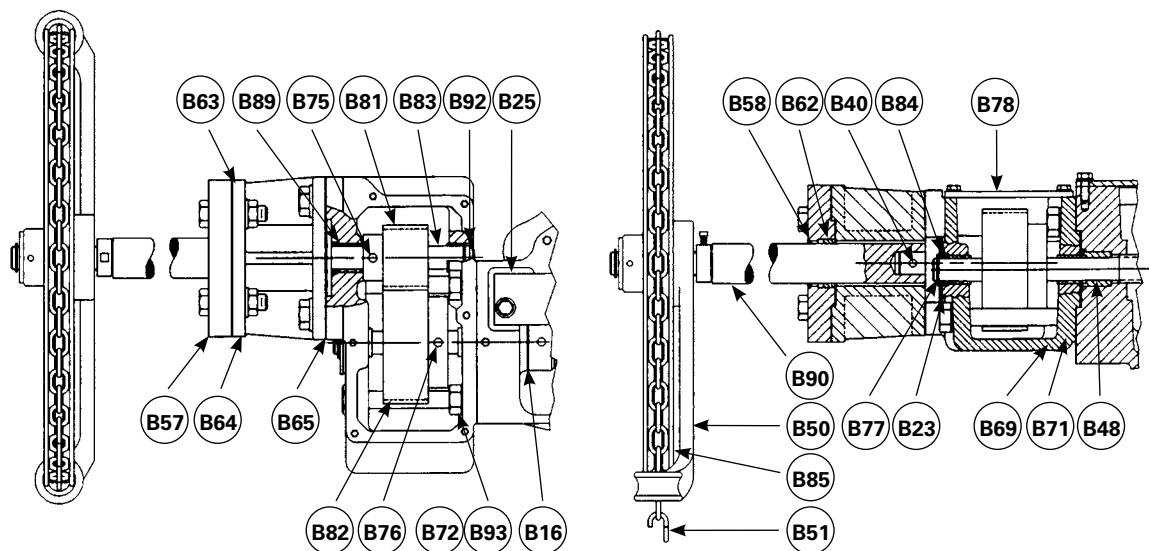
LA-Series Chainwheel



LA-Series Handwheel with Spur Gear



LA-Series Chainwheel with Spur Gear



Manual Actuator Accessories

Tee Wrench

For use in actuating 2" (50mm) nut actuators. Available in 4, 5, 6, 7 or 8 foot lengths. Other lengths available on special order.

Chain — For Chainwheel Actuators

Chain for chainwheel actuators are available in zinc plated, galvanized or 304 stainless steel.

Stainless Steel Bolting

Includes stainless steel fasteners on valve and actuator.

Clockwise Rotation

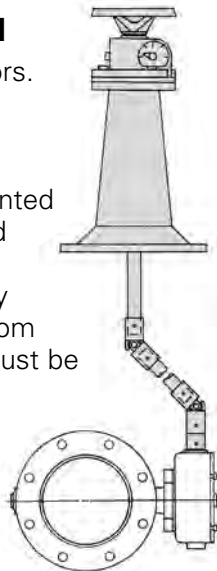
Clockwise rotation to open (open right). Available with GS/GB-6B-Series and LA Series Manual Actuators.

Galvanized Chainwheel and Guide

Same as chainwheel actuator except chainwheel and guide are galvanized.

Dial Indicating Floorstand

For valves with handwheel actuators. Actuator is mounted on the valve and the input shaft is extended to the floorstand. Included with the floorstand are the handwheel mounted on the floorstand, dial indicator and couplings. Extension rod must be ordered separately. Floorstand may be directly above valve or offset from valve location. A buried actuator must be specified when ordering an FSDI.



Extension Rod

Extension rod is required for use with FSDI floorstand.

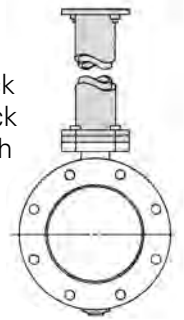
Actuator Mounted on Floorstand

Included with floorstand are the couplings, extension pipe and mounting of actuator on floorstand.



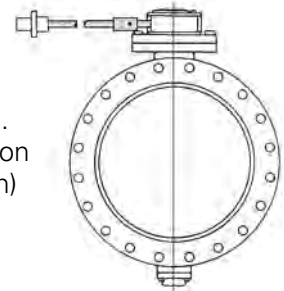
Neck Extensions

Included is an extended valve neck and shaft. Valves for use with neck extensions must be furnished with non-adjustable packing and a non-buried actuator. Extensions are not recommended for use with positioners.



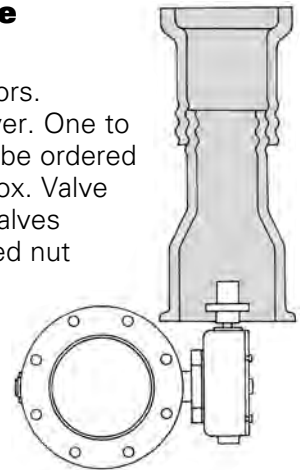
Extended Nut for Manual Actuators

For actuators used with floorboxes and valve boxes. Includes couplings, extension rod and extended 2" (50mm) square nut.



Valve Box and Valve Box Extensions

For use with buried actuators. Includes valve box and cover. One to five extension pieces may be ordered to extend depth of valve box. Valve boxes may be used with valves having standard or extended nut actuators. Top of nut must be 6" (150mm) below grade. Valve boxes are tee wrench actuated. Tee wrenches must be ordered separately.



Cylinder Actuators

DeZURIK cylinder actuators are available as double-acting pneumatic or water hydraulic cylinders for either on-off or positioning services.

All cylinder actuators are double-acting, stationary mounted with all working parts totally protected within weatherproof enclosures.

C540 Cylinder Actuators

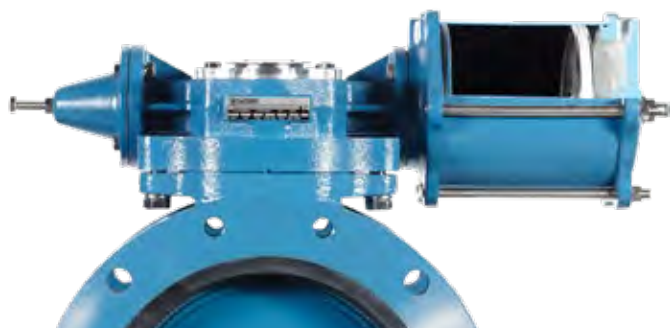
DeZURIK C540 pneumatic and hydraulic cylinder construction is in strict accordance with AWWA C540. The cylinder head and end cap are ductile iron. On pneumatic cylinders, interior surfaces are epoxy coated; on hydraulic cylinders, interior surfaces are nickel plated.

On pneumatic cylinders, the piston is epoxy coated cast iron and the piston rod is chrome plated carbon steel.

On hydraulic cylinders, the piston is nickel plated cast iron and the piston rod is chrome plated stainless steel.

Manual and Throttling Manual Override

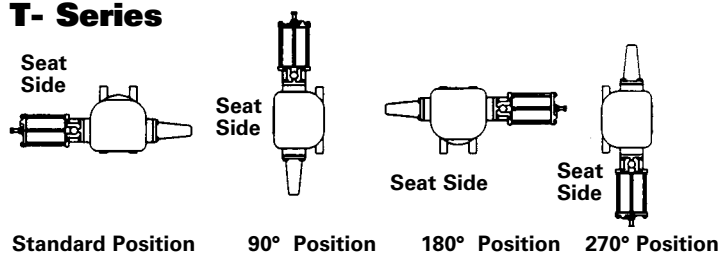
Contact Application Engineering for assistance.



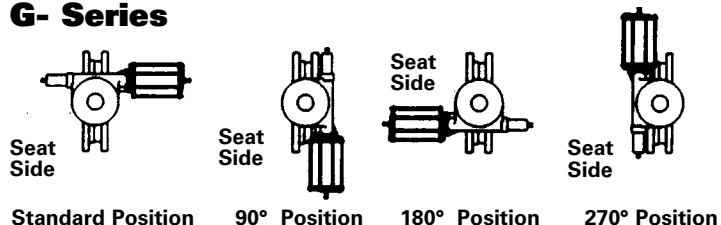
Mounting

Cylinder actuators can be mounted at 90° increments from standard.

T- Series



G- Series



Electric Motors

Electric motors offer reliable and economical valve operation. The electric actuator and associated gearing meet AWWA C540. DeZURIK AWWA Butterfly Valves can be furnished with electric motor actuators produced by leading manufacturers.

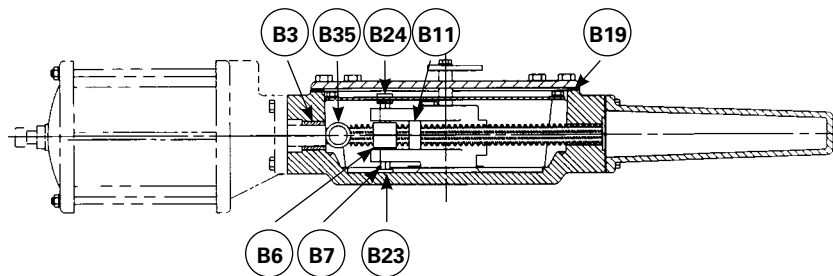
When ordering electric motor actuators, please provide information listed on "Data Input Checklist" at end of bulletin.

Cylinder Actuators

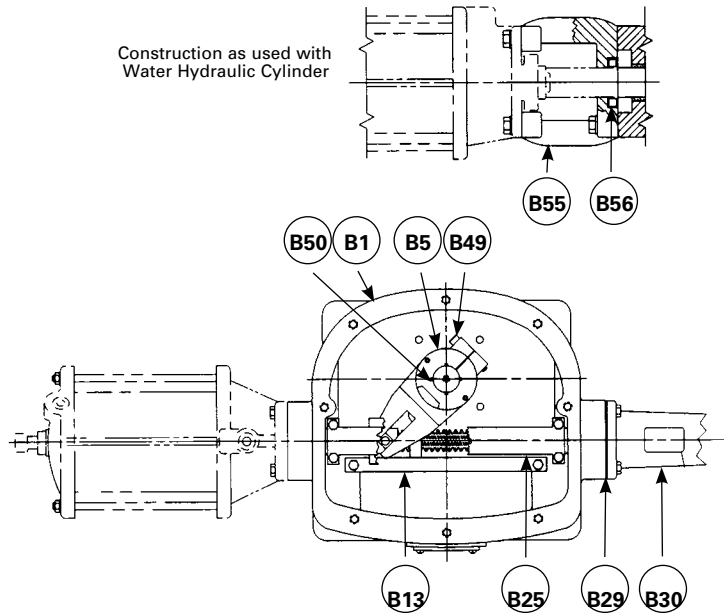
T-Series Cylinder Actuator Materials of Construction

Item	Description	Material
B1	Housing	Cast Iron, ASTM A126 Class B
B3	Bearing	Bronze
B5	Yoke	Cast Ductile Iron, A536
B6	Yoke Nut	Cold Rolled Steel
B7	Bearing	Sintered Stainless Steel
B11	Stop Nut	Cold Rolled Steel
B13	Guide Rail	Cold Rolled Steel
B19	Gasket	Neoprene
B23	Lower Yoke Guide (TW-7 only)	Steel, AISI 1215
B24	Upper Yoke Guide (TW-7 only)	Steel, ASTM A366
B25	Guide Rail (TW-7 only)	Steel, ASTM A36
B29	Gasket	Neoprene
B30	Cap	Fiberglass
B35	Stay Pin	Steel
B49	Screw	Alloy Steel
B50	Key	Steel, AISI 1018
B55	Adaptor (Hydraulic only)	Cast Iron, ASTM A126 Class B
B56	Wiper (Hydraulic only)	Carbon Steel

Note: All fasteners are zinc plated steel unless stainless steel bolting is specified.

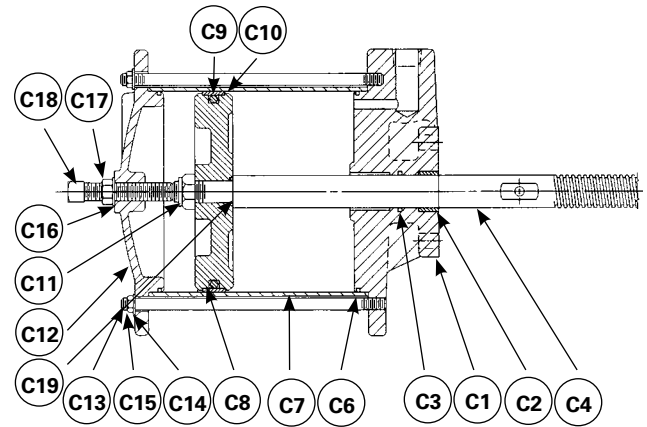


Construction as used with
Water Hydraulic Cylinder



Pneumatic/Low Pressure Oil Hydraulic Cylinder Materials of Construction

Item	Description	Standard Construction	C-540 Construction
C1	Cylinder Head	Cast Iron, ASTM A126 Class B	Ductile Iron, ASTM A536 65-45-12
C2	Bearing	Bronze Oil Impregnated	Bronze Oil Impregnated
C3	Rod Seal	Teflon with NBR	Teflon with NBR
C4	Piston Rod	Steel, AISI 1215 Chrome Plated	Steel, AISI 1215 Chrome Plated
C6	O-Ring	Acrylonitrile-Butadiene	Acrylonitrile-Butadiene
C7	Cylinder Tube	Fiberglass	Fiberglass
C8	Piston	Cast Iron, ASTM A126 Class B	Cast Iron, ASTM A126 Class B
C9	O-Ring	Acrylonitrile-Butadiene	Acrylonitrile-Butadiene
C10	Piston Seal	Virgin Teflon	Virgin Teflon
C11	Nut	Zinc Plated Steel	Zinc Plated Steel
C12	Cylinder Cap	Ductile Iron, ASTM A536 65-45-12	Ductile Iron, ASTM A536 65-45-12
C13	Tie Rod	Zinc Plated Steel	Steel, AISI C1018 Zinc Plated
C14	Washer	Zinc Plated Steel	Zinc Plated Steel
C15	Nut	Zinc Plated Steel	Zinc Plated Steel
C16	Seal Thread	Steel with Nitrile	Steel with Nitrile
C17	Jam Nut	Zinc Plated Steel	Zinc Plated Steel
C18	Set Screw	Zinc Plated Steel	Zinc Plated Steel
C19	O-Ring	Acrylonitrile-Butadiene	Acrylonitrile-Butadiene

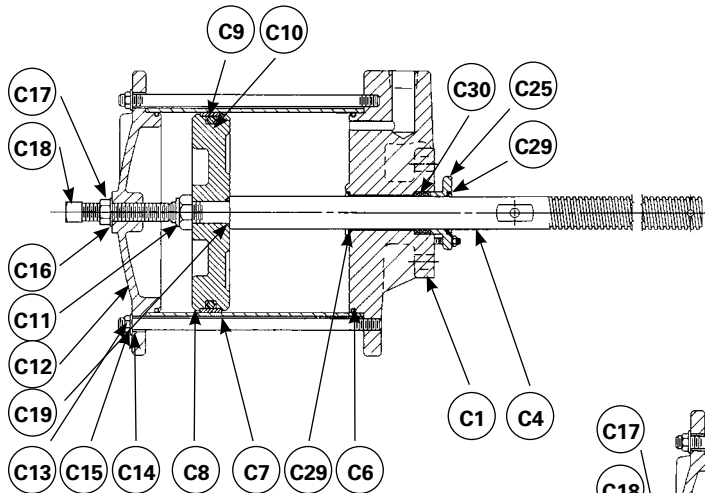


Cylinder Actuators

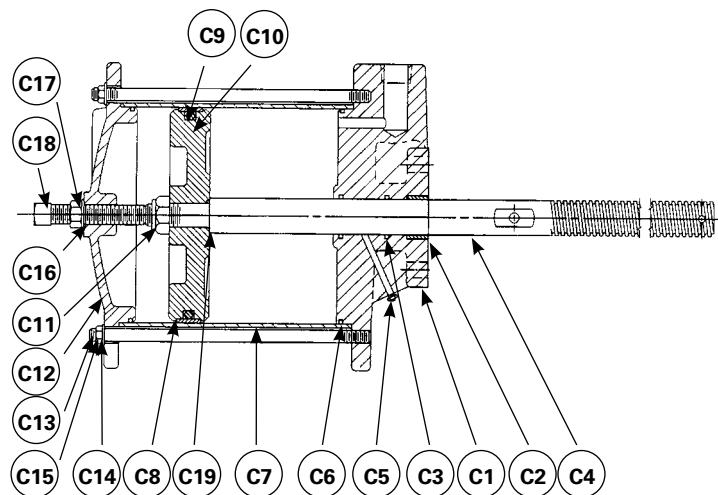
Water Hydraulic Cylinder Materials of Construction

Item	Description	Standard Construction	C-540 Construction
C1	Cylinder Head	Cast Iron, ASTM A126	Ductile Iron, ASTM A536 65-45-12 Nickel Plated
C2	Bearing	–	Bronze Oil Impregnated
C3	Rod Seal	–	Teflon with NBR
C4	Piston Rod	Stainless Steel, ASTM A564, Type 17-4	Stainless Steel, Type 304 Chrome Plated
C5	Vent Plug	–	Alemite 47200
C6	O-Ring	Acrylonitrile-Butadiene	Acrylonitrile-Butadiene
C7	Cylinder Tube	Fiberglass	Fiberglass
C8	Piston	Cast Iron, ASTM A126	Cast Iron, ASTM A126 Class B Nickel Plated
C9	O-Ring	Acrylonitrile-Butadiene	Acrylonitrile-Butadiene
C10	Piston Seal	Virgin Teflon	Virgin Teflon
C11	Nut	Stainless Steel, Type 18-8	Stainless Steel, Type 18-8
C12	Cylinder Cap	Ductile Iron, ASTM A536	Ductile Iron, ASTM A536 65-45-12 Nickel Plated
C13	Tie Rod	Zinc Plated Steel	Steel, AISI C1018 Zinc Plated
C14	Washer	Zinc Plated Steel	Zinc Plated Steel
C15	Nut	Zinc Plated Steel	Zinc Plated Steel
C16	Seal Thread	Steel with Nitrile	Steel with Nitrile
C17	Jam Nut	Zinc Plated Steel	Zinc Plated Steel
C18	Set Screw	Stainless Steel, Type 18-8	Stainless Steel, Type 18-8
C19	O-Ring	Acrylonitrile-Butadiene	Acrylonitrile-Butadiene
C25	Gland	Cast Iron, ASTM A126	–
C29	Scraper	Carbon Steel	–
C30	Packing	Neoprene & Cotton Duck	–

Water Hydraulic — Standard



Water Hydraulic — C-540



Cylinder Actuator Accessories

Positioners

DeZURIK offers both pneumatic and electronic signal valve positioners for use with cylinder actuators.

Gauges

Pneumatic positioners are available with three gauges mounted and piped; electronic positioners are available with two gauges mounted and piped.

4-Way Solenoid Valves

For cylinder actuators, 4-way direct acting, two position solenoid valves feature metal enclosures, .25" (6mm) NPT connections, Cv of .70 and a maximum pressure differential of 125 psi (8.5 Bar). Solenoid coil voltage is both 110/50/1 and 120/60/1 AC power. Contact Sartell Valves, Inc. for DC voltage. Solenoids are available with or without manual overrides. On large valves, furnish valve/actuator size, service conditions, and required operating speed for recommendations. Solenoid action should be specified.

Air Filter Regulator

For use on all pneumatic actuators. Includes a pressure reducing valve with filter and gauge. Maximum supply is 100 psi (7 Bar).

Speed Control Valves

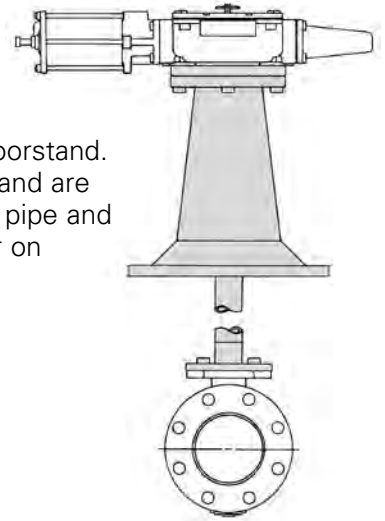
Speed control valves are available for controlling opening and closing speed on cylinder actuators.

Position Indicating Switches

Available in NEMA 4, 4x, 7 or 9 ratings. Switches are available as two SPDT or four SPDT.

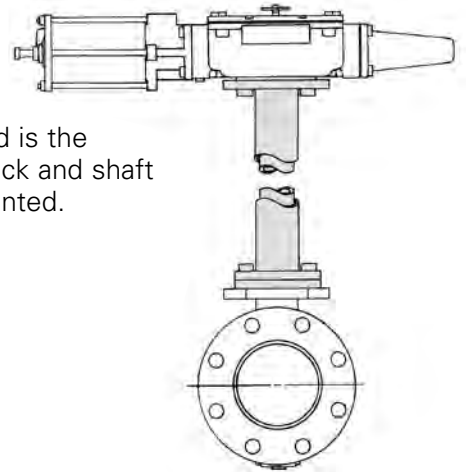
Floorstand

For valves with cylinder actuators mounted on floorstand. Included with the floorstand are couplings, the extension pipe and mounting of the actuator on the floorstand.

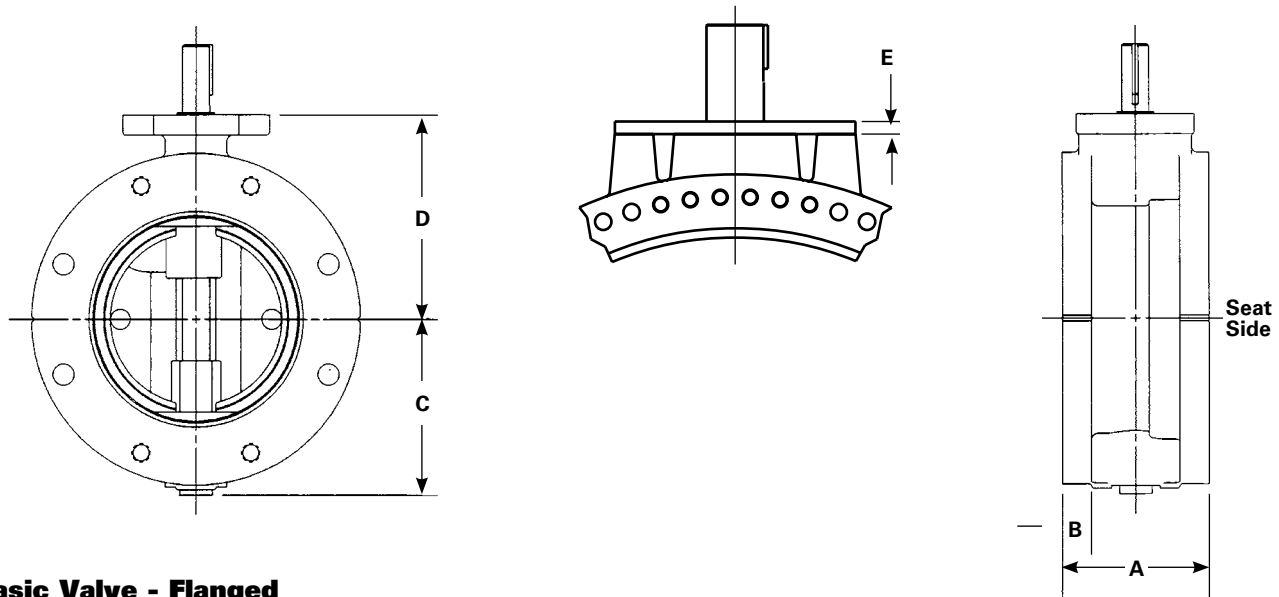


Neck Extension

For 3–20" (80–500mm) valves using T-Series Cylinder actuators. Included is the extended valve neck and shaft with actuator mounted.



Dimensions



Basic Valve - Flanged

Valve Size	A		B		C		D		E
	F1 25A, 75B & 150B	F2 250B	25A, 75B & 150B	250B	25A, 75B & 150B	250B	25A, 75B & 150B	250B	250B Only
3" 80mm	5.00 127	5.00 127	.81 21	1.19 30	4.00 102	4.12 105	4.81 122	4.81 122	—
4" 100mm	5.00 127	5.00 127	1.00 25	1.31 33	4.75 121	5.00 127	5.56 141	5.56 141	—
6" 150mm	5.00 127	5.00 127	1.06 27	1.50 38	6.03 153	6.25 159	7.00 178	7.00 178	—
8" 200mm	6.00 152	6.00 152	1.19 30	1.69 43	7.16 182	7.50 191	8.31 211	8.31 211	—
10" 250mm	8.00 203	8.00 203	1.25 32	1.97 50	8.38 213	8.75 222	9.50 241	9.50 241	—
12" 300mm	8.00 203	8.00 203	1.31 33	2.09 53	9.66 245	10.25 260	11.00 279	11.00 279	—
14" 350mm	8.00 203	8.00 203	1.47 37	2.25 57	10.91 277	11.50 292	11.50 292	11.50 292	—
16" 400mm	8.00 203	8.00 203	1.53 39	2.38 60	12.06 306	12.75 324	12.75 324	12.75 324	—
18" 450mm	8.00 203	8.00 203	1.66 42	2.50 64	14.03 356	14.50 368	13.50 343	14.00 356	—
20" 500mm	8.00 203	8.00 203	1.78 45	2.63 67	15.02 382	17.50 445	15.25 387	15.25 387	—
24" 600mm	8.00 203	12.00 305	1.97 50	2.91 74	19.00 483	20.19 513	18.41 468	19.50 495	—
30" 750mm	12.00 305	12.00 305	2.25 57	3.13 80	23.00 584	23.75 603	22.62 575	21.75 552	1.25 32
36" 900mm	12.00 305	15.00 381	2.50 64	3.50 89	27.38 696	27.38 695	25.62 651	25.62 651	1.25 32
42" 1100mm	12.00 305	15.00 381	2.75 70	3.81 97	30.91 785	30.91 785	30.42 773	30.42 773	1.25 32
48" 1200mm	15.00 381	15.00 381	2.88 73	4.13 105	35.38 899	35.38 899	33.00 838	33.00 838	1.25 32

Inches
Millimeter

Contact DeZURIK for dimensions on valve sizes 54" (1400mm) and larger.

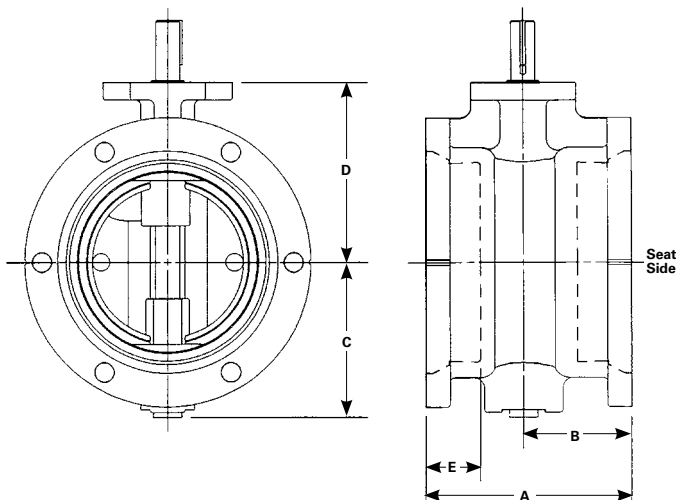
Note: All dimensions are subject to change without notice. Request certified drawings for use in preparing piping layouts.

Dimensions

Basic Valve — Mechanical Joint

Valve Size	A	B	C	D	E
4" 100mm	8.56 217	4.75 121	4.75 121	5.56 141	2.50 64
6" 150mm	8.88 226	4.75 121	6.03 153	7.00 178	2.50 64
8" 200mm	9.50 241	5.00 127	7.16 182	8.31 211	2.50 64
10" 250mm	9.88 251	5.25 133	8.38 213	9.50 241	2.50 64
12" 300mm	10.00 254	5.38 137	9.66 245	11.00 279	2.50 64
14" 350mm	12.38 315	6.62 168	10.91 277	11.50 292	3.50 89
16" 400mm	12.75 324	6.75 171	12.06 306	12.75 324	3.50 89
18" 450mm	13.42 341	7.00 178	14.03 356	13.50 343	3.50 89
20" 500mm	13.38 340	7.12 181	15.02 382	15.25 387	3.50 89
24" 600mm	13.75 349	7.50 191	19.00 483	18.41 468	3.50 89
30" 750mm	17.75 451	9.62 244	23.00 584	22.62 575	4.00 102
36" 900mm	18.00 458	10.00 254	27.38 696	25.62 651	4.00 102
42" 1100mm	18.75 476	10.25 260	30.91 785	30.41 772	4.00 102
48" 1200mm	19.62 498	10.62 270	35.38 898	33.00 838	4.00 102

Inches
Millimeter

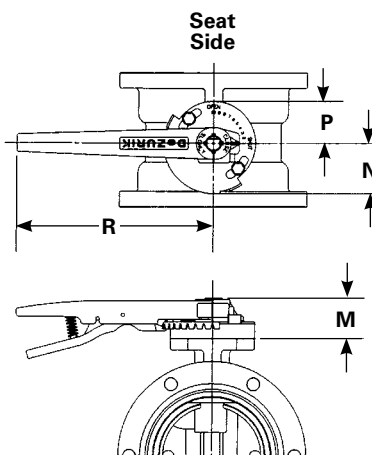


Note: All dimensions are subject to change without notice. Request certified drawings for use in preparing piping layouts.

Lever Actuator

Valve Size	Dimensions			
	M	N	P	R
3-4" 80-100mm	2.56 65	3.56 90	3.00 76	14.00 356
6-8" 150-200mm	2.88 73	3.56 90	3.00 76	14.00 356

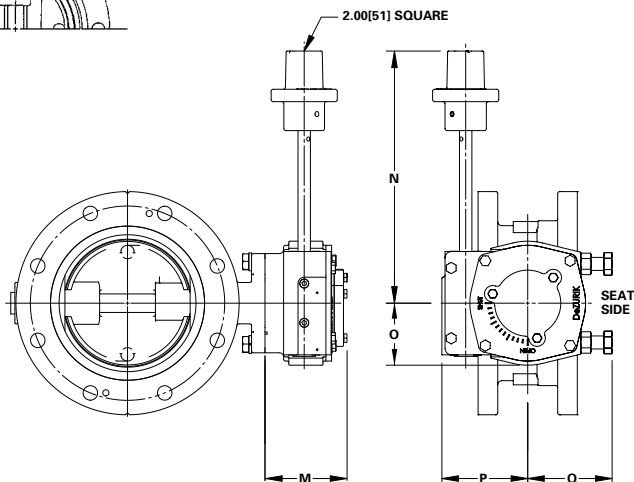
Inches
Millimeter



GS/GB Nut

Valve Size	Actuator Size	Dimensions				
		M	N	O	P	Q
3-12" 50-300mm	6B	4.96 126	15.25 387	3.75 95	5.19 132	5.10 130
14-20" 350-500mm	6B	5.96 151	15.25 387	3.75 95	5.19 132	5.10 130
20-30" 500-750mm	12A	6.27 159	17.85 453	7.47 190	8.90 226	7.60 193

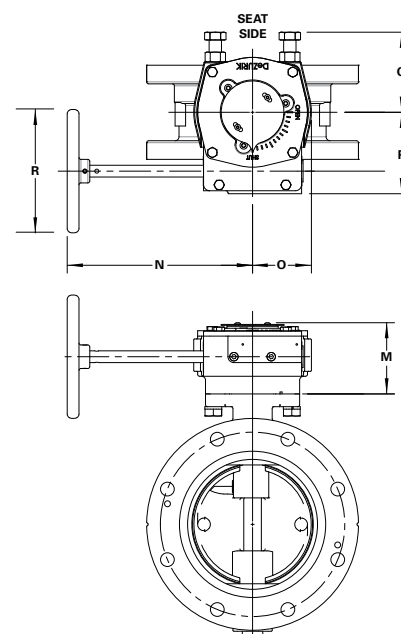
Inches
Millimeter



Dimensions (continued)

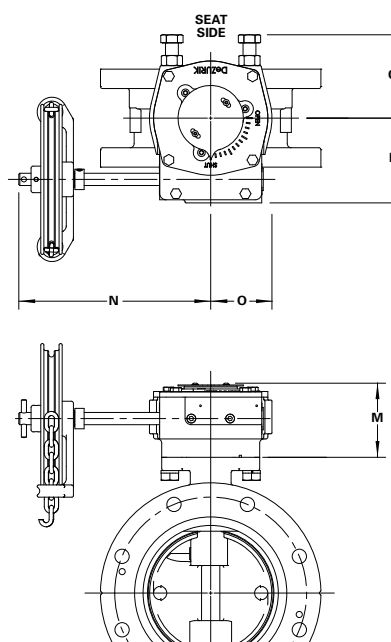
GS/GB Handwheel

Valve Size	Actuator Size	Dimensions					
		M	N	O	P	Q	R
3-12" 50-300mm	6B-HD8	4.54 115	11.81 300	3.75 95	5.19 132	5.10 130	8.00 203
	6B-HD12	4.54 115	11.81 300	3.75 95	5.19 132	5.10 130	12.00 305
	6B-HD16	4.54 115	12.25 311	3.75 95	5.19 132	5.10 130	16.00 406
14-20" 350-500mm	6B-HD12	5.54 141	11.81 300	3.75 95	5.19 132	5.10 130	12.00 305
	6B-HD16	5.54 141	12.25 311	3.75 95	5.19 132	5.10 130	16.00 406
	6B-HD24	5.54 141	15.94 405	3.75 95	5.19 132	5.10 130	24.00 610
18-20" 450-500mm	12A-HD16	5.66 144	15.48 393	7.47 190	8.90 226	7.60 193	16.00 406
	12A-HD20	5.66 144	15.48 393	7.47 190	8.90 226	7.60 193	20.00 508
24" 500mm	12A-HD12	5.68 144	15.12 384	7.47 190	8.90 226	7.60 193	12.00 305
	12A-HD16	5.68 144	15.48 393	7.47 190	8.90 226	7.60 193	16.00 406
	12A-HD20	5.68 144	15.48 393	7.47 190	8.90 226	7.60 193	20.00 508
	12A-HD24	5.68 144	19.19 487	7.47 190	8.90 226	7.60 193	24.00 610
	12A-HD30	5.68 144	20.69 526	7.47 190	8.90 226	7.60 193	30.00 762
28-30" 700-750mm	12A-HD20	5.68 144	15.48 393	8.25 210	8.90 226	7.60 193	20.00 508
	12A-HD30	5.68 144	20.69 526	8.25 210	8.90 226	7.60 193	30.00 762
	12A-HD36	5.68 144	22.75 578	8.25 210	8.90 226	7.60 193	36.00 914



GS/GB Chainwheel

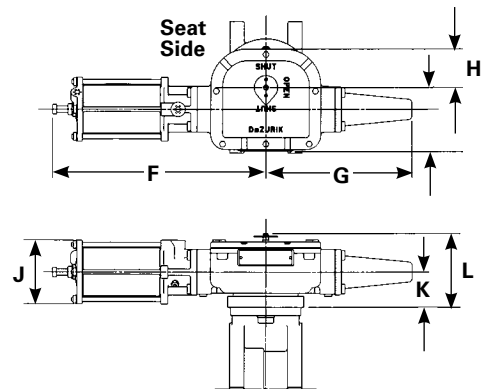
Valve Size	Actuator Size	Dimensions					
		M	N	O	P	Q	R
3-12" 50-300mm	6B-CW8	4.54 115	11.81 300	3.75 95	5.19 132	5.10 130	8.00 203
	6B-CW12	4.54 115	11.81 300	3.75 95	5.19 132	5.10 130	12.00 305
	6B-CW20	4.54 115	18.64 473	3.75 95	5.19 132	5.10 130	20.00 508
14-20" 350-500mm	6B-CW12	5.54 141	11.81 299	3.75 95	5.19 132	5.10 130	12.00 305
	6B-CW20	5.54 141	18.64 473	3.75 95	5.19 132	5.10 130	20.00 508
	6B-CW24	5.54 141	18.64 473	3.75 95	5.19 132	5.10 130	24.00 610



Dimensions (continued)

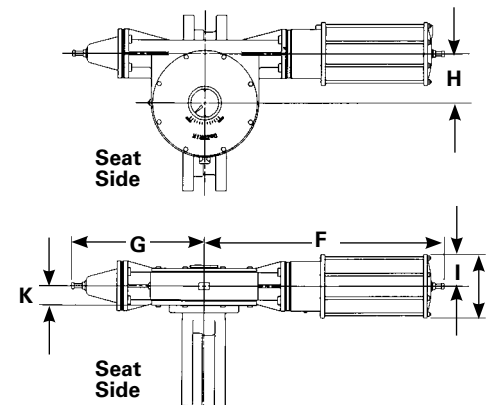
T-Series Cylinder Actuator

Valve Size (Cylinder Size)	F		G	H	I	J	K	L
	Pneumatic	Hydraulic						
3-12" 80-300mm (C4)	<u>18.12</u> 460	<u>21.12</u> 536	<u>16.31</u> 414	<u>3.25</u> 83	<u>5.94</u> 151	<u>5.38</u> 137	<u>1.81</u> 46	<u>4.69</u> 119
12" 300mm (C6)	<u>18.88</u> 480	<u>21.88</u> 556	<u>16.31</u> 414	<u>3.25</u> 83	<u>5.94</u> 151	<u>7.88</u> 200	<u>1.81</u> 46	<u>4.69</u> 119
14-16" 350-400mm (C6)	<u>23.44</u> 595	<u>26.44</u> 672	<u>17.88</u> 454	<u>4.44</u> 113	<u>8.12</u> 206	<u>7.88</u> 200	<u>3.12</u> 79	<u>5.84</u> 148
18-20" 450-500mm (C6)	<u>23.44</u> 595	<u>26.44</u> 672	<u>17.88</u> 454	<u>4.44</u> 113	<u>8.12</u> 206	<u>7.88</u> 200	<u>3.12</u> 79	<u>6.03</u> 153
18-20" 450-500mm (C8)	<u>24.06</u> 611	<u>27.06</u> 687	<u>17.88</u> 454	<u>4.44</u> 113	<u>8.12</u> 206	<u>10.25</u> 260	<u>3.12</u> 79	<u>6.03</u> 153



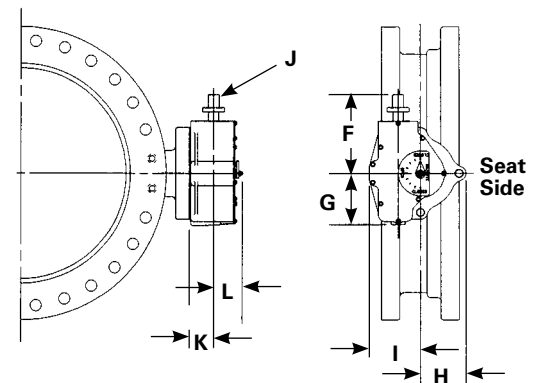
G-Series Cylinder Actuator

Valve Size (Cylinder Size)	F		G	H	I	J	K
	Pneumatic	Hydraulic					
24" 600mm (GS-12-PC8)	<u>31.50</u> 800	<u>32.75</u> 832	<u>17.50</u> 445	<u>6.88</u> 175	<u>4.25</u> 108	<u>8.50</u> 216	<u>3.25</u> 83
24" 600mm (GS-12-PC10)	<u>31.62</u> 803	<u>33.88</u> 861	<u>17.50</u> 445	<u>6.88</u> 175	<u>5.25</u> 133	<u>10.50</u> 267	<u>3.25</u> 83
24" 600mm (GS-16-PC10)	<u>43.88</u> 1115	<u>41.78</u> 1061	<u>24.25</u> 616	<u>9.00</u> 229	<u>5.88</u> 149	<u>11.75</u> 298	<u>3.50</u> 89
30" 750mm (GS-12-PC8)	<u>31.50</u> 800	<u>32.75</u> 832	<u>17.50</u> 445	<u>6.88</u> 175	<u>4.25</u> 108	<u>8.50</u> 216	<u>3.50</u> 89
30-36" 750-900mm (GS-12-PC10)	<u>31.62</u> 803	<u>33.88</u> 861	<u>17.50</u> 445	<u>6.88</u> 175	<u>5.25</u> 133	<u>10.50</u> 267	<u>3.50</u> 89
30-42" 750-1100mm (GS-16-PC10)	<u>43.25</u> 1099	<u>41.78</u> 1061	<u>24.25</u> 616	<u>9.00</u> 229	<u>5.88</u> 149	<u>11.75</u> 298	<u>3.75</u> 95
36-42" 900-1100mm (GS-16-PC12)	<u>44.62</u> 1133	<u>43.50</u> 1105	<u>24.25</u> 616	<u>9.00</u> 229	<u>7.00</u> 178	<u>14.00</u> 356	<u>3.75</u> 95



LA-Series Nut

Valve Size (Actuator Size)	F	F with Spur Gear	G	H	I	J	K	L
30-42" 750-1100mm (LA-4)	<u>14.19</u> 360	<u>20.81</u> 529	<u>9.38</u> 238	<u>8.25</u> 210	<u>9.44</u> 240	<u>2.00</u> 51	<u>4.41</u> 112	<u>6.25</u> 159
36-54" 900-1400mm (LA-6)	<u>16.19</u> 411	<u>22.81</u> 579	<u>12.12</u> 308	<u>8.25</u> 210	<u>11.12</u> 282	<u>2.00</u> 51	<u>4.41</u> 112	<u>6.25</u> 159
42-54" 1100-1400mm (LA-10)	<u>20.19</u> 513	<u>26.81</u> 681	<u>16.81</u> 427	<u>8.25</u> 210	<u>16.12</u> 409	<u>2.00</u> 51	<u>4.81</u> 122	<u>5.84</u> 148

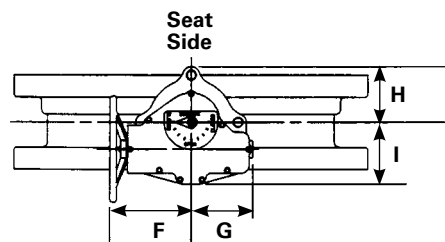


Inches
Millimeter

Dimensions (continued)

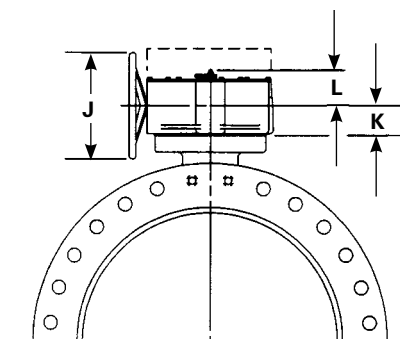
LA-Series Handwheel 30-48" (750-1200mm)

Actuator Size	F	F with Spur Gear	G	H	I	J	K	L
LA-4-HD12	11.62 295	18.25 464	9.38 238	8.25 210	9.44 240	12.00 305	4.41 112	6.25 159
LA-4-HD16	12.25 311	18.88 480	9.38 238	8.25 210	9.44 240	16.00 406	4.41 112	6.25 159
LA-4-HD24	20.25 514	26.88 683	9.38 238	8.25 210	9.44 240	24.00 610	4.41 112	6.25 159
LA-4-HD30	22.88 581	29.50 749	9.38 238	8.25 210	9.44 240	30.00 762	4.41 112	6.25 159
LA-4-HD36	25.50 648	32.12 816	9.38 238	8.25 210	9.44 240	36.00 914	4.41 112	6.25 159



LA-Series Handwheel 36-54" (900-1400mm)

Actuator Size	F	F with Spur Gear	G	H	I	J	K	L
LA-6-HD12	13.62 346	20.25 514	12.12 308	8.25 210	11.12 282	12.00 305	4.41 112	6.25 159
LA-6-HD16	14.25 362	20.88 530	12.12 308	8.25 210	11.12 282	16.00 406	4.41 112	6.25 159
LA-6-HD24	22.25 565	28.88 734	12.12 308	8.25 210	11.12 282	24.00 610	4.41 112	6.25 159
LA-6-HD30	24.88 632	31.50 800	12.12 308	8.25 210	11.12 282	30.00 762	4.41 112	6.25 159
LA-6-HD36	27.50 699	34.12 867	12.12 308	8.25 210	11.12 282	36.00 914	4.41 112	6.25 159



LA-Series Handwheel 42-54" (1100-1400mm)

Actuator Size	F	F with Spur Gear	G	H	I	J	K	L
LA-10-HD12	17.62 448	24.25 616	16.81 427	8.25 210	16.12 409	12.00 305	4.81 122	5.84 148
LA-10-HD16	18.25 464	24.88 632	16.81 427	8.25 210	16.12 409	16.00 406	4.81 122	5.84 148
LA-10-HD24	26.25 667	32.88 835	16.81 427	8.25 210	16.12 409	24.00 610	4.81 122	5.84 148
LA-10-HD30	28.88 734	35.50 902	16.81 427	8.25 210	16.12 409	30.00 762	4.81 122	5.84 148
LA-10-HD36	31.50 800	38.12 968	16.81 427	8.25 210	16.12 409	36.00 914	4.81 122	5.84 148

Inches
Millimeter

Note: All dimensions are subject to change without notice.

Request certified drawings for use in preparing piping layouts.

Dimensions (continued)

LA-Series Chainwheel 30-48" (750-1200mm)

Actuator Size	F	F with Spur Gear	G	H	I	J	K	L
LA-4-CW12	35.00 889	41.62 1057	9.38 238	8.25 210	9.44 240	12.75 324	4.41 112	6.25 159
LA-4-CW20	35.00 889	41.62 1057	9.38 238	8.25 210	9.44 240	20.06 510	4.41 112	6.25 159
LA-4-CW30	35.00 889	41.62 1057	9.38 238	8.25 210	9.44 240	29.75 756	4.41 112	6.25 159

LA-Series Chainwheel 36-54" (900-1400mm)

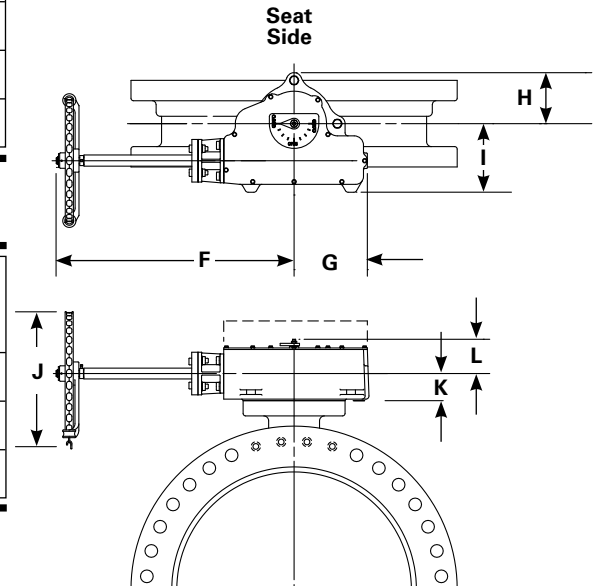
Actuator Size	F	F with Spur Gear	G	H	I	J	K	L
LA-6-CW12	37.00 940	43.62 1108	12.12 308	8.25 210	11.12 282	12.75 324	4.41 112	6.25 159
LA-6-CW20	37.00 940	43.62 1108	12.12 308	8.25 210	11.12 282	20.06 510	4.41 112	6.25 159
LA-6-CW30	37.00 940	43.62 1108	12.12 308	8.25 210	11.12 282	29.75 756	4.41 112	6.25 159

LA-Series Chainwheel 42-54" (1100-1400mm)

Actuator Size	F	F with Spur Gear	G	H	I	J	K	L
LA-10-CW12	41.00 1041	47.62 1210	16.81 427	8.25 210	16.12 409	12.75 324	4.81 122	5.84 148
LA-10-CW20	41.00 1041	47.62 1210	16.81 427	8.25 210	16.12 409	20.06 510	4.81 122	5.84 148
LA-10-CW30	41.00 1041	47.62 1210	16.81 427	8.25 210	16.12 409	29.75 756	4.81 122	5.84 148

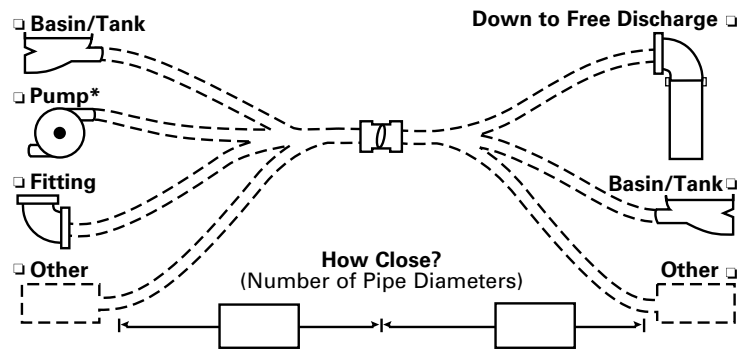
Inches
Millimeter

Note: All dimensions are subject to change without notice.
Request certified drawings for use in preparing piping layouts.



DeZURIK Butterfly Valve Applications Data Input Checklist

Part A: Check boxes and complete lines to show upstream/downstream configuration, enter distances in pipe diameters.



Part B: Check off or enter operating conditions.

- Valve Function? ☐ Open/Shut ☐ Throttling ☐ Modulating Control
- Where Installed? ☐ Buried ☐ Submerged ☐ Above Ground, In Plant
- Line Fluid? ☐ Fresh Water ☐ Sewage ☐ Air ☐ Other? _____
- Maximum Fluid Temperature? _____°C _____°F
- Line Size? _____ inches _____ (mm) (nominal)
- Normal Working Pressure? _____ psi _____ kPa
Maximum (Shutoff) Pressure Differential? _____ psi _____ kPa
- Normal Wide Open Valve Flow? _____ flow rate or _____ flow units
- Emergency Maximum (Line Break, Etc.) Flow? _____ flow rate _____ flow units
- (If Throttling or Modulating Control) Flow Range Desired?
Maximum Flow? _____ flow rate _____ flow units
Minimum Flow? _____ flow rate _____ flow units
- Pipe Connection? _____ Flanged _____ Mechanical Joint _____ Other

Part C: Check off or enter operator requirements.

- Operator Type? Manual: ☐ Lever ☐ Lead Screw ☐ Gear ☐ Other?
Power: ☐ Cylinder ☐ Electric ☐ Other?
- Direction of Rotation To Open: ☐ Clockwise—(OR) ☐ Counter clockwise—(OL)
- Cylinder Specifications:
 - Supply Type and Pressure? ☐ Water _____ psi _____ kPa ☐ Oil _____ psi _____ kPa
☐ Air _____ psi _____ kPa ☐ Other _____ psi _____ kPa
 - Fail Safe? ☐ Yes ☐ No; If yes which way if valve fails? ☐ Open ☐ Close
 - Operating Times? _____ sec Open to Close; _____ sec Close to Open
 - Accessories?

☐ Speed Control	☐ Limit Switches (ES) (Qty: _____ O, _____ C, _____ I)
☐ Solenoid W/Manual Override	☐ Positioner
☐ Manual Override (On loss of supply press.)	☐ Solenoid W/O Manual Override
☐ Other? _____	
- Electric Specifications:
 - Supply? _____ Volts _____ Phase _____ Hz
 - Duty Cycle? ☐ Intermittent ☐ Continuous
 - Starter/Control Needs? _____
 - Operating Times? _____ sec (Note: 60 sec per AWWA unless specified)
 - Accessories?

☐ AUX Switches	☐ Potentiometer	☐ Slidewire Receiver	☐ Reversing Starter
☐ Heaters	☐ Control Station	☐ Control Transformer	☐ Other? _____

Sales and Service

For information about our worldwide locations, approvals, certifications and local representative:

Web Site: www.dezurik.com E-Mail: info@dezurik.com



250 Riverside Ave. N. Sartell, Minnesota 56377 • Phone: 320-259-2000 • Fax: 320-259-2227

DeZURIK, Inc. reserves the right to incorporate our latest design and material changes without notice or obligation. Design features, materials of construction and dimensional data, as described in this bulletin, are provided for your information only and should not be relied upon unless confirmed in writing by DeZURIK, Inc. Certified drawings are available upon request.

DeZURIK BHP HIGH PERFORMANCE BUTTERFLY VALVES



Time-Tested, Exceptional Performance

DeZURIK BHP High Performance Butterfly Valves are specially designed for applications in the chemical, hydrocarbon processing, pulp & paper, water & wastewater and HVAC industries worldwide. The valve was designed with an understanding that process industries need products that provide exceptional performance while reducing the total cost of ownership.

BHP butterfly valves have been rigorously tested to meet industry performance requirements. A fully supported one-piece shaft and heavy-duty bearings ensure perfect alignment of seat and disc leading to long life and trouble-free performance.

DeZURIK offers a wide variety of seat options including PTFE seat, reinforced PTFE seat, flexible metal seat and a dual seat.

DeZURIK BHP Butterfly Valves combine extreme service capabilities with features which have been time-tested for over 30 years.

Wafer or Lugged Body Styles

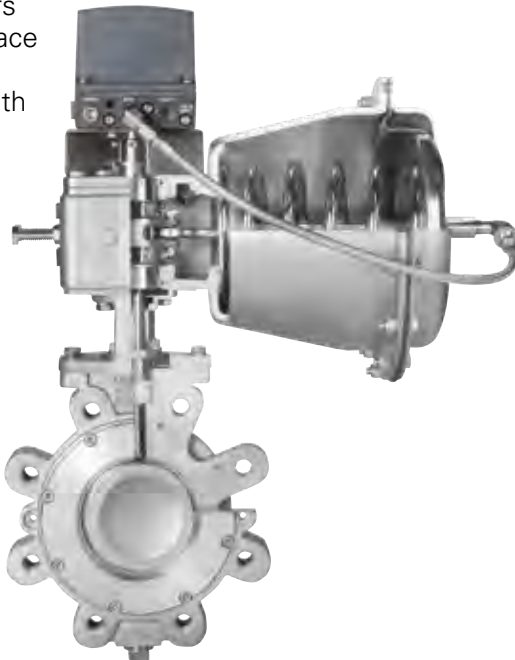
BHP butterfly valves are available in both lugged and wafer bodies in sizes 2–60" (50–1500mm). Body materials include Carbon Steel, 316 stainless steel, 317 stainless steel and higher alloys. In addition, DeZURIK regularly supplies valves in materials such as Hastelloy C, Monel, Alloy 20, and Titanium.

Material Certification

Materials chosen for the construction of the BHP butterfly valve are certified per ASME B16.34.

Face-To-Face Options

DeZURIK offers valve face-to-face dimensions in compliance with API 609, MSS SP-68 and ASME B16.1.



Flange Drilling Options

Flange drilling conformance to ASME 150, PN10/16 (ISO, DIN, BS, JIS) and ASME 300, PN25/40 (ISO, DIN, BS, JIS).

Full Bi-Directional Seating

Dual Seat, PTFE, and reinforced PTFE seats provide full bi-directional seating.

Dead-End Service

BHP lugged body style allows installation in dead-end service to the full pressure rating of the valve.

Flange Gasket Compatibility

Standard construction provides effective sealing with ASME B16.20 gaskets (formerly API 601). The standard seat retainer is drilled to meet the requirements of API 609 standard. As an option, an undrilled seat retainer is available to provide full gasket seal area contact. The seat retaining ring is nested in the valve body, providing support and protection for the seat and a captured blow-out resistant body-to-retainer seal.

Recommended for Critical Applications

BHP butterfly valves are designed to handle everything from general applications to viscous and corrosive liquids; corrosive gases; and steam. They have been successfully applied in extreme services, including:

- high temperature services
- cryogenic applications
- throttling steam control
- polymerizing media
- liquor service with entrained solids
- high cycle industrial gas
- process gas-off applications
- paper stock isolation
- vacuum pump isolation
- corrosive chemical service (titanium construction)
- fire-safe refinery & chemical service
- heat transfer service
- throttling hydrocarbon service

Proven Performance & Reliability

To ensure accurate and reliable performance, BHP butterfly valves have been tested to the most demanding industry specifications:

- Performance tested in up to 5% consistency pulp stock isolation.
- Tested for over 1 million cycles in oxygen manufacturing service with zero leakage.
- Fire tested to API 607, 6th edition.
- Tested in hydrogen peroxide service for over 75,000 cycles with zero leakage.
- Accuracy to repeat signal changes as small as 0.5% of total signal.



Offset Disc Design

The offset disc design provides uninterrupted 360° sealing surface. The offset disc also minimizes the amount of seat-to-disc interference, lowering operating torque, increasing cycle life, and reducing the size of actuators required. Smaller actuators reduce initial purchase price and use less energy over time.

One-Piece Stainless Steel Shaft

The solid one-piece stainless steel shaft provides superior strength and disc support. The extra support provided by the one-piece shaft enhances alignment, ensuring a proper seal.



Solid Disc-To-Shaft Pinning

DeZURIK uses a reliable method for disc-to-shaft pinning. The 2–12" (50–300mm) valves utilize a wedge-shaped, tangential pin with a locking taper to ensure a tight connection between disc and shaft. On 14" (350mm) and larger, two pins mounted in compression offer a non-shear method of locking. Both connections place the pin, shaft and disc in compression load providing a much stronger connection. This solid pinning ensures no lost motion between shaft and disc, an essential feature for a control valve. Set screws and pins are securely locked in place, but can be removed if repairs are necessary.

Disc Centered In Body/Seat

Close-tolerance machined surfaces between the body and disc hubs ensure proper alignment and seating.

Multiple Shaft Bearings

The valve shaft is fully supported with bearings for high cycle capability. Bearing options include PTFE backed with 317 stainless steel or Hastelloy C and solid metal (nickel stainless steel, 316 stainless steel). The bearings also provide a large area of radial support, greatly reducing any possibility of shaft fatigue and breakage. The bearing has a low coefficient of friction, minimizing operating torque.

NACE Trim

BHP butterfly valves meet the requirements of ASME/NACE MR0175/ISO 15156. NACE trim (NT) is optional when "NS" bearing material is ordered and standard on all other combinations. When ordered with the "NT" option, the bearing material is 316 stainless steel nickel-plated and heat-treated.

Ease of Maintenance

DeZURIK BHP valves are easily repairable. In the unlikely event that a seat, disc or bearing needs to be replaced, the valve can be easily disassembled. Internal valve components can be replaced or repaired in minutes, not hours. There are no welds to remove or pins to drill out, and all fasteners are common sizes. All that is required is to remove the screws fastening the retainer to the body and the screw that locks the disc-to-shaft pin.



Features For Extended Service Life

Extended service life is an important attribute when considering a valve for a given application. DeZURIK realizes installation and replacement costs, combined with the costs of a process shutdown, are expensive. That's why DeZURIK has always been dedicated to designing and manufacturing valves that last longer and perform better.

Metal Seated Valves Incorporate an Independent Static Seal

DeZURIK's Class IV and Class V metal seated valves have a gasket between the valve body, seat and seat retainer which provides an independent static seal. Without this seal, corrosion or pitting on the body or seat retainer could cause leakage around the seat. This is of particular concern in valves of carbon steel construction, or in applications where stainless steel is prone to pitting due to corrosive precipitation.



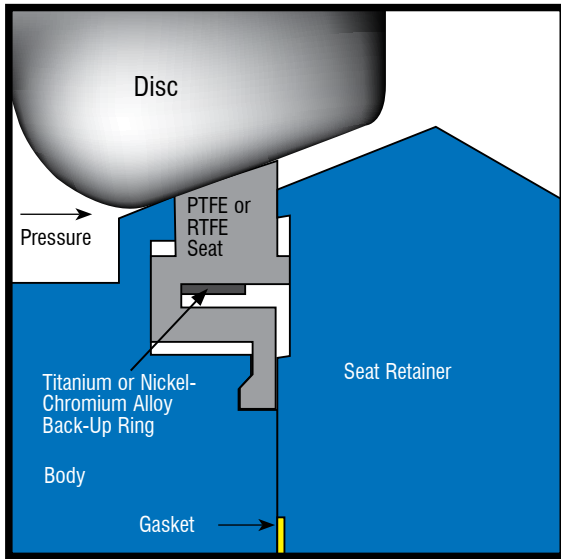
Compatible with Standard Actuators

High Performance Butterfly Valves are compatible with all DeZURIK standard actuators including levers, handwheels, chainwheels, PowerRac® cylinder, spring diaphragm, and Compak actuators.

Full Line of Accessories

Also available is a full line of accessories integrated with the actuator system including positioners, solenoids, switches, and speed controls.

Seat Designs



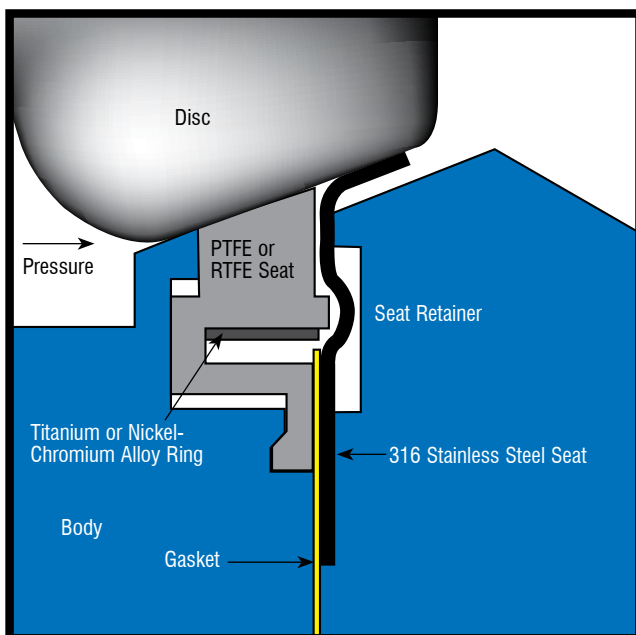
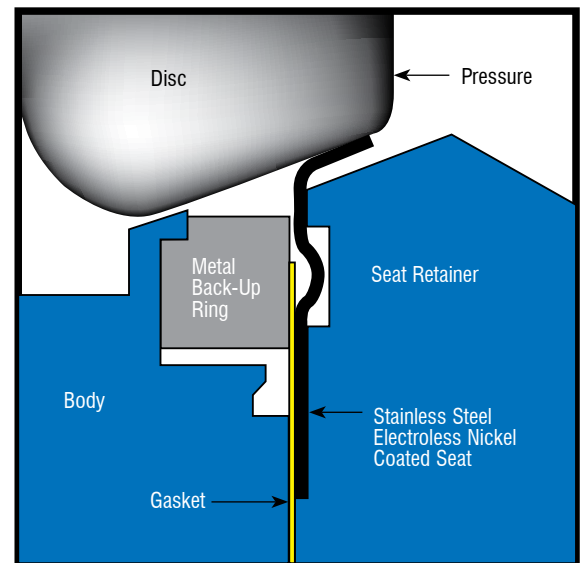
Spring & Pressure Assisted Soft Seats

Pressure assisted soft seats, in either PTFE and reinforced PTFE, offer bi-directional bubble tight shutoff. Soft seat options include either a titanium or nickel-chromium alloy back-up ring which utilizes hoop stress to provide memory for the seat.

The unique PTFE / RTFE design seals as well at low pressures as it does at high pressures. The soft seats also provide tight shutoff in vacuum service applications.

High-Temperature & Low-Temperature Metal Seats

For high-temperature applications to 700°F (370°C) as standard and to over 1000°F (538°C), a metal seat of 316 stainless steel provides ANSI/FCI 70-2 Class IV or V shutoff even at elevated temperatures. For increased economy in applications to 450°F (232°C), the metal seat can be specified with lower temperature bearings, packing and paint. The metal seat is electroless nickel coated and heat treated for superior service without the use of costly, exotic seating materials.



Dual Seat Design

The dual seat design is ideal for applications in which scaling media can solidify on the disc edge. The secondary metal seat wipes the disc edge, protecting the PTFE or RTFE seat. For services requiring a fire-tested valve, the Fyre-Block® option with dual seat combines a primary PTFE soft seat with a secondary 316 stainless steel metal seat. This dual, bi-directional seat design provides positive sealing even when the resilient seat has been destroyed by fire. The Fyre-Block® option with dual seat design meets the API 607 standard, 6th Edition.

Special Construction Options

Fugitive Emissions Packing Systems

To enable manufacturers to meet clean air regulations, DeZURIK offers options for fugitive emissions control including live loaded and dual packing sets. Dual packing options feature a primary and secondary packing set, lantern ring and emissions sniffing port. When required, the packing gland can be live loaded with spring washers to maintain compression, even through extreme thermal cycling. Live loaded and dual packing options have been cycle tested per EPA method 21 and have been proven to provide long service life with emissions control well below Clean Air Act regulations of 500 parts per million. Live loaded packing and dual packing sets are available in the BHP butterfly valve with a bolt-on packing chamber.



NSF/ANSI 61, 372 Certified for Drinking Water

DeZURIK BHP High Performance Butterfly Valves are specially designed for critical applications in the water industry, where high pressures, high velocity flows and stainless steel construction are required. When specified, DeZURIK BHP Valves are certified to meet the NSF/ANSI-61, 372 standard *Drinking Water Systems Components – Lead Content* which provides recognized safety in municipal water service.

Typical Water Applications

High Service Pumps:

- Transmission lines requiring NSF 61, 372 approval
- Pressures over 250 psi (1720 kPa)
- Pump isolation at pressures in excess of 250 psi (1720 kPa)
- Control Check service at pressures in excess of 300 psi (2070 kPa)

Typical Wastewater Applications

- Aeration lines in filter systems
- Oxygen and Ozone service



Fire-Tested Per API 607 Standard

The High Performance Butterfly Valve with Fyre-Block® FB construction and manual actuators are certified to API 607, 6th edition fire tests. Fyre-Block® valves offer a seat and seal design that provides positive sealing, even when the resilient material has been burned away. It is also certified to ISO 10497:2010.



Critical Service Valve Cleaning & Packaging

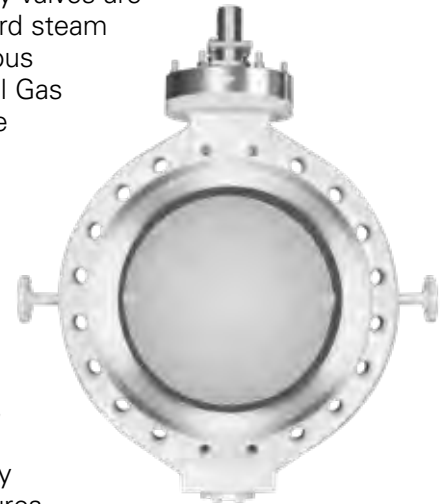
Meeting the highest standards for special valve cleaning and packaging services is of paramount importance for DeZURIK. In order to ensure proper cleaning procedures are performed on BHP High Performance Butterfly valves intended for oxygen, ozone, chlorine, hydrogen peroxide, isocyanate and other applications, DeZURIK has constructed a dedicated clean room within its Sartell manufacturing plant. Our professional, skilled and trained cleaning technicians maintain a safe environment for a wide variety of cleaning services.



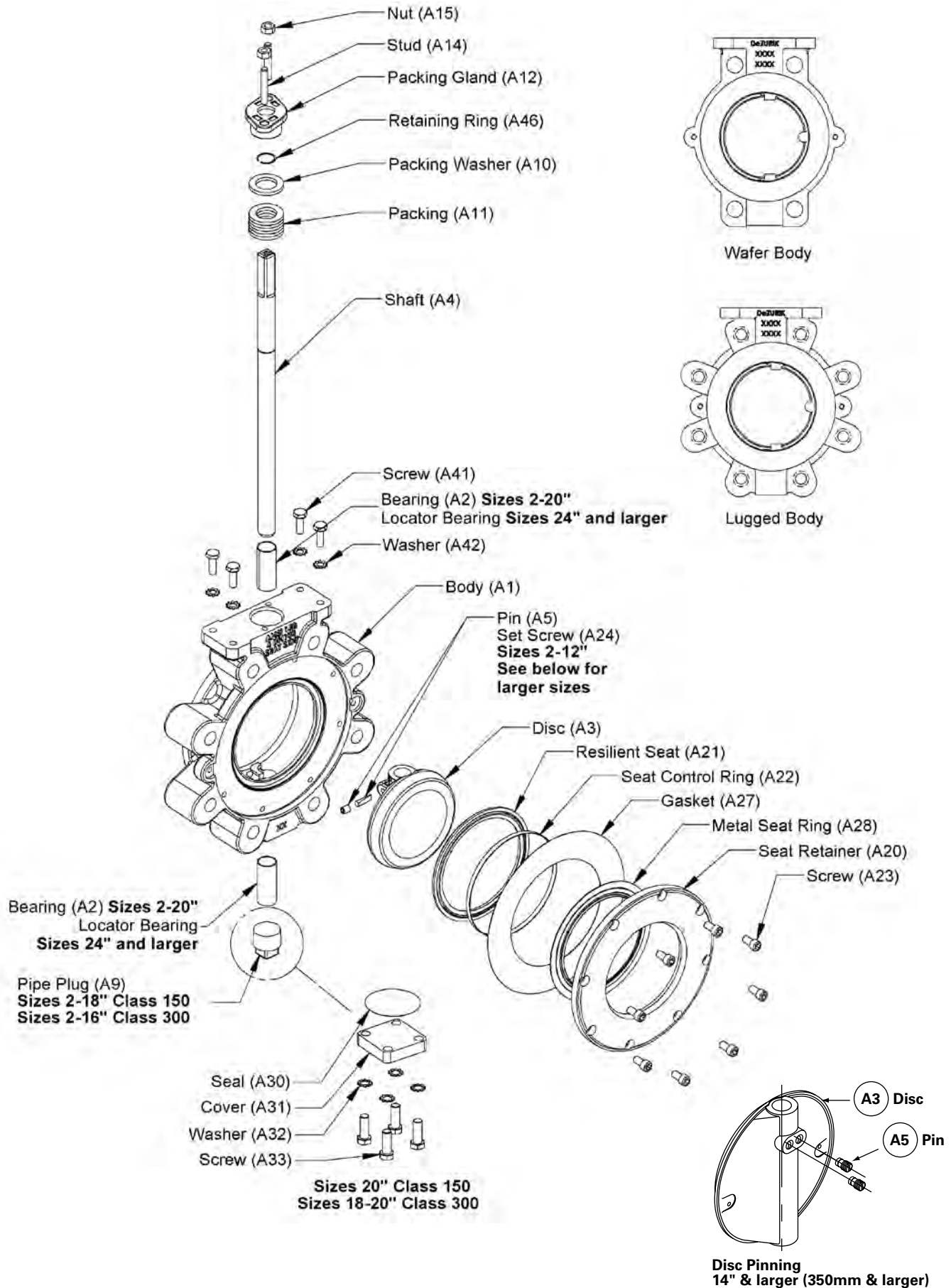
BTG Tail Gas Butterfly Valves

DeZURIK has specially designed the Tail Gas High Performance Butterfly Valve to meet the rigorous requirements of services where polymerization or solidification of media can prevent valve operation, including: Tail gas service in refinery sulfur recovery units, polymer processing or adhesive manufacturing.

DeZURIK standard High Performance Butterfly Valves are available with standard steam jackets for less rigorous requirements, but Tail Gas Valves include unique features which keep the valve at process temperature and protect critical bearing and seat areas. In addition to steam jacketing the body, internal steam passage ports are located near the upper and lower body bearings. These features prevent hydrogen sulfide and other media from solidifying, freezing the bearings, damaging the seat and preventing tight shutoff. NACE trim is standard (NACE MR0175) with 316 stainless steel bearing.



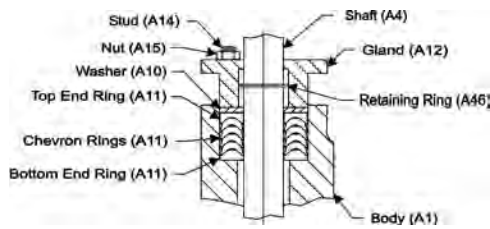
Materials of Construction



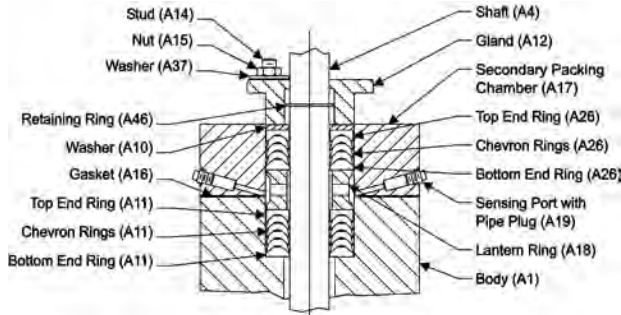
Packing Options

Standard

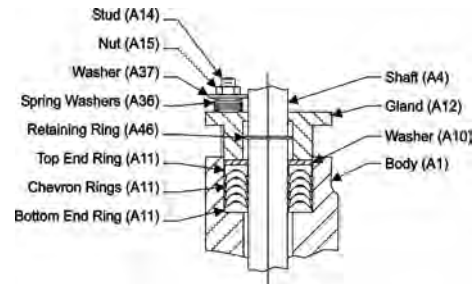
PTFE V-Flex Packing (TC)



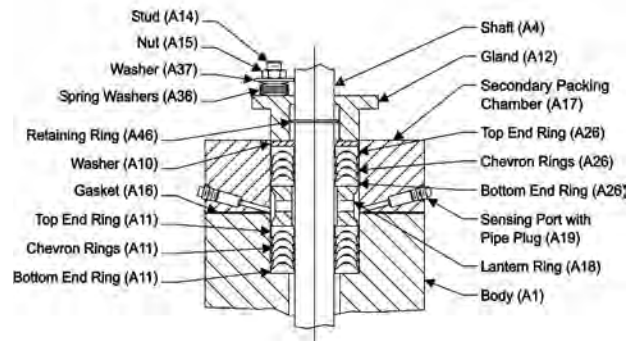
PTFE V-Flex, Dual Seal, Low Cycle Packing (TCD)



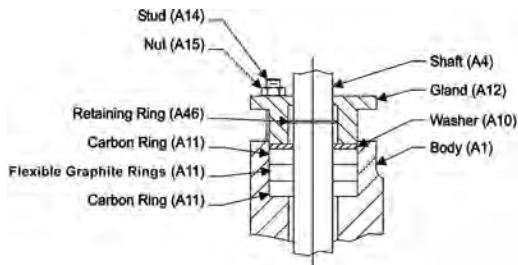
PTFE V-Flex Packing, Live Loaded, Low Cycle (TCL)



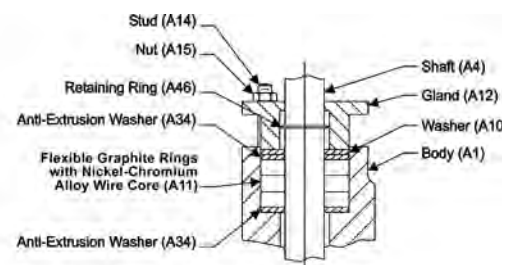
PTFE V-Flex, Dual Seal, Live Loaded, Low Cycle Packing (TCDL)



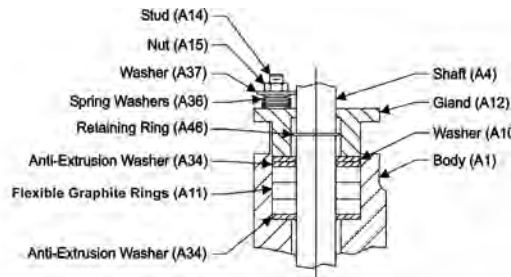
Standard Carbon Graphite (G1)



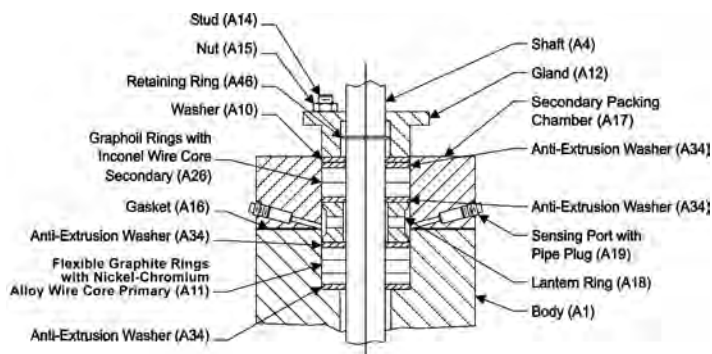
Flexible Carbon Graphite (G2)



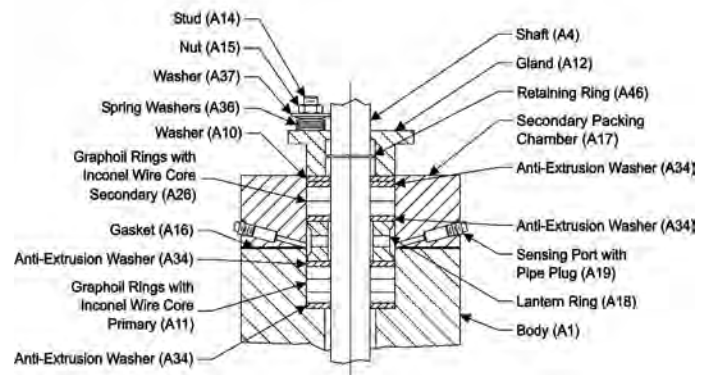
Flexible Carbon Graphite, High Cycle Live Loaded (G2L)



Flexible Carbon Graphite, Dual Seal, High Cycle Packing (G2D)



Flexible Carbon Graphite, Dual Seal, Live Loaded, High Cycle Packing (G2DL)



Materials of Construction

Item	Description	Material
A1	Body	Carbon Steel, ASTM A216, Grade WCB
		316 Stainless Steel, ASTM A351, Grade CF8M
		317 Stainless Steel, ASTM A351, Grade CG-3M except with .03% max carbon
A2	Bearing	PTFE Fabric with 317 Stainless Steel Backing, to 500°F (260°C)
		316 Stainless Steel, Diffusion Hardened, to 700°F (371°C)
		Nickel Stainless Steel ASTM A494, Grade CY5SnBiM, to 700°F (371°C)
		316 Stainless Steel Nickel Coated, Heat Treated, to 700°F (371°C)
		316 Stainless Steel, Diffusion Hardened, to 700°F (371°C)
		PTFE Fabric with Hastelloy C Backing, to 500°F (260°C)
A3	Disc	316 Stainless Steel, ASTM A351, Grade CF8M
		316 Stainless Steel, ASTM A351, Grade CF8M, Nickel Overlay, Heated Treated to RC70
		317 Stainless Steel, ASTM A351, Grade CG-3M except with .03% max carbon
A4	Shaft	2205 Duplex Stainless Steel, ASTM A276 Type 2205
		17-4 PH Stainless Steel, ASTM A 564, Type 630, Cond H1150 per NACE MR-01-75
		316 Stainless Steel, ASTM A479, Type 316
A5	Pin	Nitrogen-Strengthened Austenitic Alloy ASTM A479, Type XM-19, Condition A, to NACE MR0175/ISO 15156
		316 Stainless Steel, ASTM A276, Type 316, Flash Chrome Plate
A9	Pipe Plug	Carbon Steel, ASTM A216, Grade WCB, Galvanized
		316 Stainless Steel, ASTM A351, Grade CF8M
		317 Stainless Steel, ASTM A240, Type 317
A10	Packing Washer	316 Stainless Steel, ASTM A240, Type 316
		316 Stainless Steel, ASTM A276, Type 316, Condition A
		316 Stainless Steel, ASTM A511, Type 316
		317 Stainless Steel, A167, Type 317
A11	Packing	PTFE, V-Flex
		Carbon Graphite
A12	Packing Gland	317 Stainless Steel, ASTM A351, Type 317
		316 Stainless Steel, ASTM A511, Grade MT316
A14	Stud	316 Stainless Steel
A15	Gland Nut	316 Stainless Steel
A16	Gasket	Carbon Graphite/Stainless Steel
A19	Pipe Plug	316 Stainless Steel
A20	Seat Retainer	Carbon Steel, ASTM A516, Grade 70 or ASTM A216, Grade WCB
		316 Stainless Steel, ASTM A240, Type 316 or ASTM A351, Grade CF8M
		317 Stainless Steel, ASTM A240, Type 317
A21	Resilient Seat	PTFE, White Virgin
		RTFE, 10% Carbon Graphite Filled PTFE
A22	Seat Control Ring	Titanium, ASTM B265, Grade 3
		Nickel-Chromium Alloy
A23	Screw	316 Stainless Steel
		317 Stainless Steel
A24	Set Screw	316 Stainless Steel
A27	Gasket	317 Stainless Steel, ASTM A167, Type 317
A28	Metal Seat Ring	Carbon Graphite, Commercial Grade GTB
A30	Seal	316 Stainless Steel, ASTM A240, Type 316, Condition A
		PTFE
A31	Cover	Carbon Graphite, Commercial Grade GTB
		Carbon Steel, ASTM A516, Grade 70
A32	Lock Washer	316 Stainless Steel, ASTM A240, Type 316, Condition A
		410 Stainless Steel
		316 Stainless Steel
A33	Screw	Stainless Steel, ASTM A193, Grade B8M, Class 1 or 2
A34	Anti-Extrusion Washer	PTFE/317 Stainless Steel (See page 7)
A37	Washer	Steel, Zinc Plated (See page 7)
A42	Lock Washer	410 Stainless Steel
		316 Stainless Steel
A46	Retaining Ring	303 Series Stainless Steel

Valve Selection

Applicable Standards

DeZURIK BHP High Performance Butterfly Valves are designed and/or tested to meet the following standards:	
ASME B16.1	Cast Iron Pipe Flanges and Flanged Fittings. Class 150 valves mate with pipeline flanges conforming to the Class 125 requirements and Class 300 valves are designed to mate with Class 250 pipe flanges.
ASME B16.20	Metallic Gaskets for Pipe Flanges Ring-Joint, Spiral-Wound, and Jacketed. End connections compatible (within the limits of API 609) with spiral-wound gaskets in accordance with API 601 gaskets. Optional undrilled seat retainer (UR) construction available to provide full seal area contact with API 601 gaskets.
ASME B16.34	Valves-Threaded and Welded End. All BHP Butterfly Valves comply with requirements of this standard.
ASME B16.47	Pipe Flanges and Flanged Fittings. Class 150, Series A, Table I-29; Class 300, Series A, Table I-30. Sizes 28" (700mm) and larger are designed to mate with pipeline flanges conforming to the Series A requirements, Large Diameter Steel Flanges.
ASME B16.5	Pipe Flanges and Flanged Fittings. 2-24" (80-300mm) valves are designed to mate with Class 150 or 300 flanges.
ANSI/FCI 70-2	Control Valve Seat Leakage. Metal-seated valves conform to the Class IV leak rate requirements. All valves are tested to Class IV. If Class V is required, it must be specified as an option to allow for test differences. PTFE and RTFE seat options meet or exceed Class VI requirements.
API 598	Seat/Shell Test. Resilient and Dual Seated Valves meet the leak rate requirements of this standard.
API 607	Fire Test for Soft Seated, Quarter-Turn Valves, 6th Edition. Valves with Fyre-Block (FB) option conform to this requirement.
API 609	Face-to-face dimensions for 3-24" valves conform to Category B Class 150 and Class 300 requirements (Sizes 2", 2.5" and 5" are not named in this standard). Class 150 sizes 28" and larger conform to the requirements of Category A.
AWWA C207	Class 150, Class D (175-150 psi), Table 3 and Class E (275 psi) Table 4.
BS 4504	Conforms to flange bolt guide and pressure ratings.
BS 5146	Inspection and Test of Steel Valves for the Petroleum, Petrochemical and Allied Industries. Dual Seated valves with Fyre-Block (FB) option meet with fire portion of standard.
DIN 2632	Conforms to flange bolt guides and pressure 2635 ratings.
DIN 3230	Leak Rate 1 Requirement. Resilient and Dual Seated Valves meet the leak rate requirements of this standard.
EN 29001	DeZURIK manufacturing processes comply with this quality standard.
ISA D79.01	Level 2 Leak Rates Cryogenic Tests ISA A75.02 Standard Control Valve Capacity Test Procedure.
ISO 5208	Conforms to pressure testing requirements of this standard.
ISO 5211	Conforms to flange bolt guide and pressure ratings.
ISO 5752	All valves designed to comply with face-to-face dimensions.
ISO 7005	Conforms to flange bolt guide and pressure ratings.
ISO 9001	DeZURIK manufacturing processes certified to this quality standard.
JIS B2212	Conforms to flange bolt guide and pressure ratings.
MSS SP-25	Standard Marking System for Valves, Fittings, Flanges, and Unions. All valves comply with requirements of this standard.
MSS SP-44	Steel Pipeline Flanges, Class 150, Annex C, Table C3; Class 300, 740 psi, Annex C, Table C4.
MSS SP-61	Pressure Testing of Steel Valves.
MSS SP-68	High Pressure Offset Seat Butterfly Valves. All valves comply with the requirements of this standard.
NACE MR0175	Sulfide Stress Cracking Resistant Metallic Material for Oil Field Equipment. NACE trim is standard on all valves except metal seated. This construction available as an option with metal seated valves.
NSF/ANSI-61	Certified to NSF/ANSI-61 Drinking Water System Components.
NSF/ANSI-372	Certified to NSF/ANSI-372 with requirements for Lead-free as defined by CA, VT, MD, LA state laws and the US Safe Drinking Water Act.
PED Pressure Equipment Directive	Quality System for the design, manufacture, final inspection and testing meet provisions of the directive.

Shut-Off Capabilities

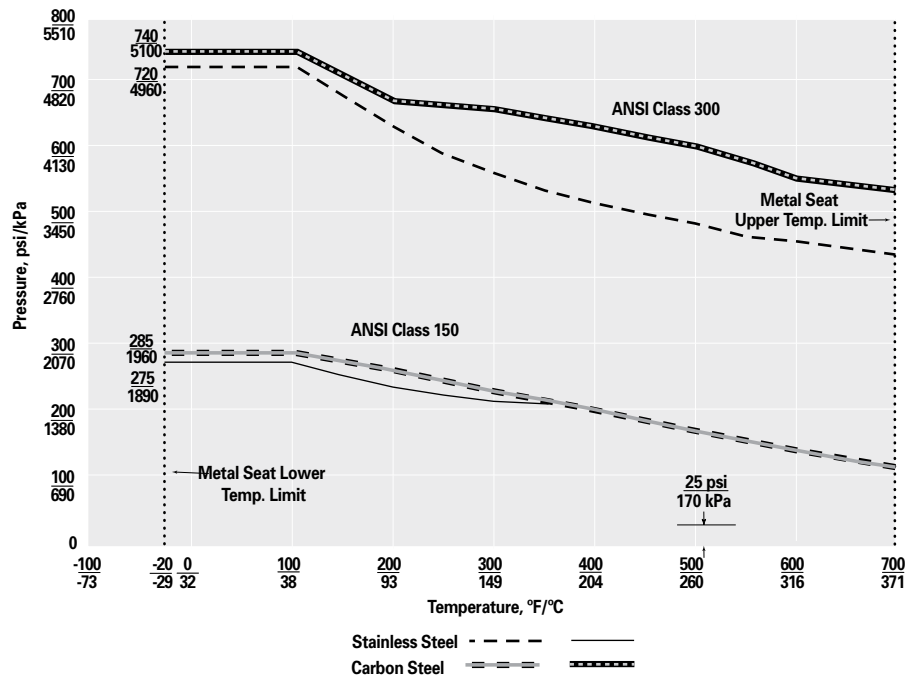
Seat Type	Shutoff Capability
PTFE & RTFE Seated	Bubble-Tight Shutoff with pressure on either side of the disc
Dual Seated	Class VI - DIN 1 Bubble-Tight Shutoff
Metal Seated	Standard, Class IV unidirectional on seat side. With optional C5, Class V unidirectional on seat side.

Pressure Ratings (Ambient Temperature)

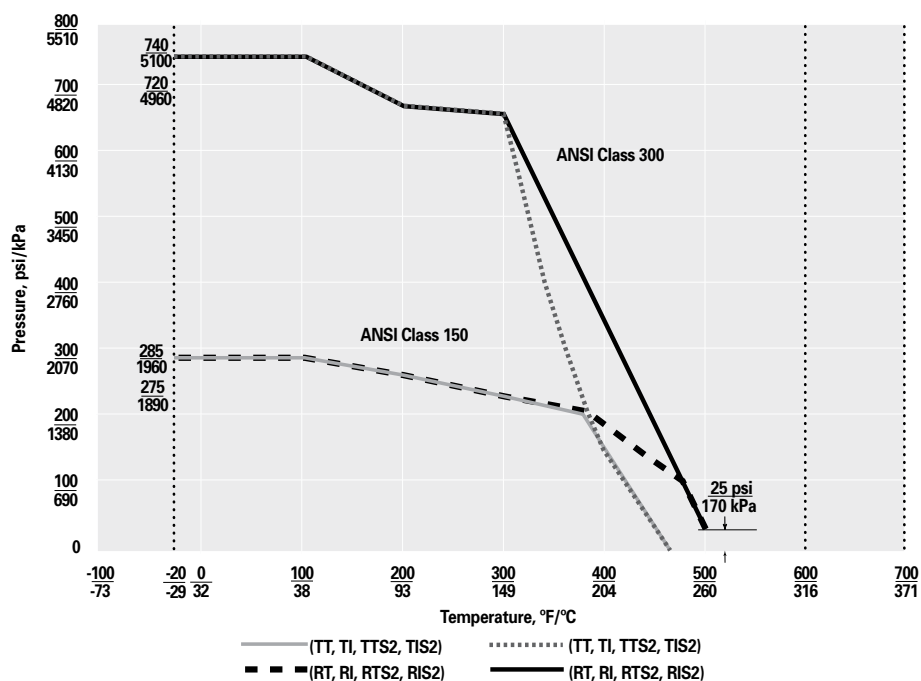
Body Material/Class	Pressure Rating
Carbon Steel, Class 150	285 psi (1960 kPa)
Carbon Steel, Class 300	740 psi (5100 kPa)
Stainless Steel, Class 150	275 psi (1890 kPa)
Stainless Steel, Class 300	720 psi (4960 kPa)

Pressure/Temperature Curves

Metal Seat



Resilient and Dual Seats



Valve Selection

Flow Parameters

Valve Size	Class 150		Class 300	
	Cv*/Kv* 100% Open	K Factor**	Cv*/Kv* 100% Open	K Factor**
2" 50mm	85 74	2.25	85 74	1.74
2.5" 65mm	180 156	1.02	160 138	1.01
3" 80mm	275 238	1.04	260 225	0.93
4" 100mm	520 450	0.87	475 411	0.85
5" 125mm	860 744	0.78	770 666	0.81
6" 150mm	1360 1176	0.65	1130 977	0.77
8" 200mm	2260 1955	0.71	2110 1825	0.68
10" 250mm	3550 3071	0.71	3350 2898	0.66
12" 300mm	5000 4325	0.72	4800 4152	0.65
14" 350mm	6800 5882	0.57	6390 5527	0.53
16" 400mm	9000 7785	0.56	8460 7318	0.52
18" 450mm	11800 10207	0.52	11100 13500	0.49
20" 500mm	14400 12456	0.54	13500 11678	0.51
24" 600mm	20000 17300	0.58	17700 15311	0.61
28" 700mm	27000 23355	0.67	Contact DeZURIK	
30" 750mm	33300 28805	0.53	26300 22750	0.74
36" 900mm	56500 48873	0.40	47000 40655	0.51
42" 1050mm	67000 57955	0.53	Contact DeZURIK	
48" 1200mm	103000 89095	0.39		
54-60" 1400-1500mm	Contact DeZURIK			

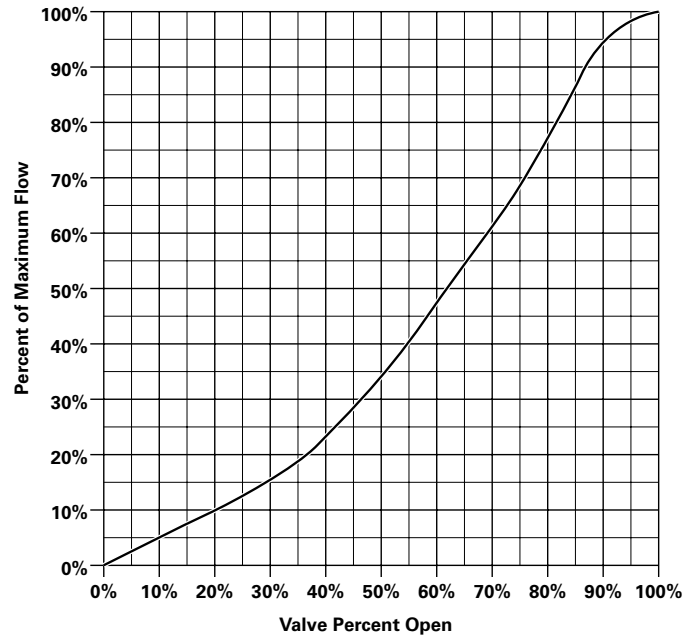
*Cv = Flow in GPM of water at 1 psi pressure drop.

Kv = Flow in m³/hr. of water at 100 kPa pressure drop.

** K = The resistance coefficient of the valve. The constant (K) can be used to determine the equivalent length of pipe.

$L = \frac{K \times D}{f}$ Where
 L = Equivalent length of pipe in feet
 K = Resistance coefficient
 D = Pipe diameter in feet
 f = Friction factor, related to type of pipe

Flow Characteristics



Weights

Basic Valve, Class 150

Valve Size	Wafer Body	Lugged Body
2" 50mm	3 2	7 4
2.5" 65mm	4 2	9 5
3" 80mm	10 5	11 5
4" 100mm	11 5	19 9
5" 125mm	18 9	26 12
6" 150mm	22 10	45 21
8" 200mm	36 17	46 21
10" 250mm	61 28	67 31
12" 300mm	100 46	145 66
14" 350mm	142 65	188 86
16" 400mm	192 88	243 111
18" 450mm	314 143	363 165
20" 500mm	411 187	335 152
24" 600mm	665 302	800 363
28" 700mm	Contact DeZURIK	
30" 750mm	975 443	1175 534
36" 900mm	1560 708	1900 863
42" 1050mm	Contact DeZURIK	4507 2045
48" 1200mm	4015 1822	4545 2063
54-60" 1400-1500mm	Contact DeZURIK	

Basic Valve, Class 300

Valve Size	Wafer Body	Lugged Body
2" 50mm	4 2	11 5
2.5" 65mm	6 3	18 9
3" 80mm	8 4	21 10
4" 100mm	14 7	35 16
5" 125mm	25 12	49 23
6" 150mm	28 13	64 30
8" 200mm	49 23	110 50
10" 250mm	79 36	175 80
12" 300mm	124 57	230 105
14" 350mm	182 83	232 106
16" 400mm	246 112	312 142
18" 450mm	402 183	465 211
20" 500mm	525 239	613 279
24" 600mm	736 334	1025 466
30" 750mm	Contact DeZURIK	3000 1362
36" 900mm		4350 1974

Pounds
Kilograms

Note: Weights are approximate and do not include crating.

Ordering

To order, simply complete the valve order code from information shown.
An ordering example is shown for your reference.

Valve Style

Give valve style code as follows:

BHP = High Performance Butterfly Valve

Valve Size

Give valve size code as follows:

2	=	2"	(50mm)	18	=	18"	(450mm)
2.5	=	2.5"	(65mm)	20	=	20"	(500mm)
3	=	3"	(80mm)	24	=	24"	(600mm)
4	=	4"	(100mm)	28	=	28"	(700mm)
5	=	5"	(125mm)	30	=	30"	(750mm)
6	=	6"	(150mm)	36	=	36"	(900mm)
8	=	8"	(200mm)	42	=	42"	(1050mm)
10	=	10"	(250mm)	48	=	48"	(1200mm)
12	=	12"	(300mm)	54	=	54"	(1400mm)
14	=	14"	(350mm)	60	=	60"	(1500mm)
16	=	16"	(400mm)				

End Connection

Give end connection code as follows:

Class 150 Wafer

W1 = ASME
W110 = DIN 10 or BS4504/10 Drilling
W116 = DIN 16 or BS4504/16 Drilling
W1D = B.S. Table D Drilling
W1E = B.S. Table E Drilling
W1J1 = JIS 10 Drilling

Class 150 Lugged

L1 = ASME
L110 = DIN 10 or BS4504/10 Drilling
L116 = DIN 16 or BS4504/16 Drilling
L1D = B.S. Table D Drilling
L1E = B.S. Table E Drilling
L1J1 = JIS 10 Drilling

Class 300 Wafer

W2 = ASME
W225 = DIN 25 or BS4504/25 Drilling
W240 = DIN 40 or BS4504/40 Drilling
W2F = B.S. Table F Drilling
W2H = B.S. Table H Drilling
W2J = B.S. Table J Drilling
W2J2 = JIS 20 Drilling

Class 300 Lugged

L2 = ASME
L225 = DIN 25 or BS4504/25 Drilling
L240 = DIN 40 or BS4504/40 Drilling
L2F = B.S. Table F Drilling
L2H = B.S. Table H Drilling
L2J = B.S. Table J Drilling
L2J2 = JIS 20 Drilling

Body Material

Give body material code as follows:

CS = Carbon Steel
S2 = 316 Stainless Steel
S3 = 317 Stainless Steel (3-12" except 5" Class 150 Lugged only)

On Application

AA = Alloy 20
HC = Hastelloy C
ML = Monel
T3 = Titanium Grade 3

Packing Material

Give packing material code as follows:

TC = PTFE V-Flex, to 500°F (260°C)
G1 = Carbon Graphite to 700°F (371°C)

Special Packing

G2 = Flexible Graphite to 1000°F (538°C)
TCD = PTFE V-Flex, Dual Seal, Low Cycle to 500°F (260°C)
TCDL = PTFE V-Flex, Dual Seal, Live Loaded, Low Cycle to 500°F (260°C)
TCL = PTFE V-Flex, Live Loaded, Low Cycle to 500°F (260°C)
G2D = Flexible Graphite, Dual Seal, High Cycle to 1000°F (538°C)
G2L = Flexible Graphite, Live Loaded, High Cycle to 1000°F (538°C)
G2DL = Flexible Graphite, Dual Seal, Live Loaded, High Cycle to 1000°F (538°C)

Trim Combination

Disc Material

Give disc material code as follows:

S2 = 316 Stainless Steel
S2NH = 316 Stainless Steel Nickel Plated Heat Treated
(must use 17-4 PH Shaft material)
S3 = 317 Stainless Steel
(used with S10 Shaft, FT bearings and TT, TI, RT or RI seat)

On Application

AA = Alloy 20
CSN = Carbon Steel Nickel Coated (24" and larger only)
CSNH = Carbon Steel Nickel Coated Heat Treated (24" and larger only)
(must use 17-4 PH Shaft material)
HC = Hastelloy C
ML = Monel
TN3 = Titanium Grade 3 (anodized)

Shaft Material (2-20")

Give shaft material code as follows:

S10 = 2205 Duplex
S10B = 2205 Duplex (used only with L1 or W1 end connection, CS or S2 body material & TT, TI, RT or RI seat)
S5A = 17-4 PH Stainless Steel
S5B = 17-4 PH Stainless Steel (used only with L1 or W1 End Connection CS or S2 Body Material & TT/TI/RT/TI Seats)

Shaft Material (24-60")

S2 = 316 Stainless Steel
S5 = 17-4 PH Stainless Steel

On Application (all sizes)

AA = Alloy 20
HC = Hastelloy C
ML = Monel
T5C = Titanium Grade 5 (ceramic coated)

Bearing Material

Give bearing material code as follows:

FT = PTFE Fabric with 317 Stainless Steel Backing, to 500°F (260°C)
NS = 316 Stainless Steel, Diffusion Hardened, to 700°F (371°C) Sizes 2-20"
NS = Nickel Stainless Steel ASTM A494, Grade CYSnBiM, to 700°F (371°C) Sizes 24" and Larger
NS = 316 Stainless Steel Nickel Coated, Heat Treated, to 700°F (371°C) Used with NT option
S2 = 316 Stainless Steel, Diffusion Hardened, to 700°F (371°C) 24" and Larger with NSF option

On Application

FH = PTFE Fabric with Hastelloy C Backing, to 500°F (260°C)

Seat Seal/Seat Control Ring Material

Give seat material code as follows:

Standard Seats

TT = PTFE/Titanium to 450°F (232°C)
TTS2 = PTFE/Titanium and 316 Stainless Steel to 450°F (232°C)
S2 = 316 Stainless Steel, to 700°F (371°C), must use Graphite packing and NS bearings or to 450°F (232°C), recommended with TC packing and FT bearing. Not available on 5" valve.

Special Seats

TI = PTFE/Nickel-Chromium Alloy, to 450°F (232°C). For oxygen service.
TIS2 = PTFE/Nickel-Chromium Alloy and 316 Stainless Steel, to 450°F (230°C). For oxygen service.
RT = Reinforced PTFE/Titanium, to 500°F (260°C)
RTS2 = Reinforced PTFE/Titanium and 316 Stainless Steel, to 500°F (260°C)
RI = Reinforced PTFE/Nickel-Chromium Alloy, to 500°F (260°C)
RIS2 = Reinforced PTFE/Nickel-Chromium Alloy and 316 Stainless Steel, to 500°F (260°C)

Note: Any seat seal/seat control ring combination with S2 seat is not available in 5" (125mm) or 54" (1400mm) sizes.

Ordering (Continued)

Options

Give options code as follows:

- NSF = Certified to NSF/ASME Standard 61 Drinking Water System Components
- FB = Conforms to ASME/API 607 Sixth Edition Fire Test for Soft-Seated Quarter Turn Valves. API 607 Sixth Edition does not cover the testing requirements for valve actuators other than manually operated gear boxes or levers.
- BAA = Buy American Act
- CRT = Certified Material Physical & Chemical Test Report
- CMC = Certificate of Material Conformance
- DTR = DeZURIK Standard Certified Production Hydrostatic Shell and Seat Test Report
- UR = Undrilled Seat Retainer - Available on 2-10" lugged valves only. Not rated for dead end service.
- C5 = Class 5 Seat Test for (S2) metal seated valves per ASME B16.104/FCI70.2
- 15 = 150 psi Disc - 36" & Larger (Not available with Dual Seat, Fyre Block or Metal Seats)
- NT = ANSI/NACE MR0175/ISO 15156, Petroleum and natural gas industries, Materials for use in H2S-containing environments in oil and gas production. Specify (NT) NACE Trim when NS bearings are ordered. All other combinations are NACE Certified as standard.
- API = Conforms to API-609 Butterfly Valves: Double Flanged, Lug- and Wafer-Type and API-598 Valve Inspection and Testing. Conformance to these API standards do not apply to valves with the (S2) metal seat because of allowable seat leak rate or valve sizes 2", 2.5" or 5".

On Application

- = Pressure Equipment Directive (CE Mark)

Ordering Example

BHP,6,W1,CS,TC,S2-S10-FT-TT*Actuator

NOTE: For High Temperature Service, the limiting factor in valve selection is the lowest temperature rating of the packing, bearing or seat seal material.

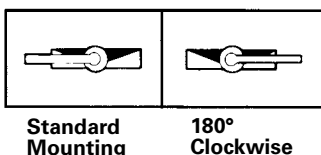
Manual Actuators

10-Position Levers

A 10-position dial provides positive latching in open, closed and eight intermediate positions. A pointer indicates position of disc plus a notch in the handle allows use of a padlock to prevent unauthorized valve operation.

Mounting

Lever actuators can be mounted at standard and 180° clockwise from standard. Specify mounting positions other than standard below the valve and actuator identification.



Ordering

To order, add lever code LT to basic valve identification. Lever actuators available on 2–8" (50–200mm) Class 150 and Class 300 valve sizes only. Handwheel actuators are recommended for valve sizes over 6" (150mm) and where water hammer may occur due to a sudden valve closure. Maximum pipeline velocity for lever operated valve is 20 feet (6 meters) per second.

Lever Actuator Sizing

Class 150

Valve Size	Order Code	Maximum Shutoff Pressure Differential psi/kPa		
		TT/TI RT/RI	TTS2/TIS2 RTS2/RIS2	S2/TTS2 & FB RTS2 & FB
2-6" 50-150mm	LT	285 1960	285 1960	285 1960
8" 200mm	LT	285 1960	285 1960	50 340

Note: Stainless Steel valves are rated to 275 psi (1890 kPa).

Class 300

Valve Size	Order Code	Maximum Shutoff Pressure Differential psi/kPa		
		TT/TI RT/RI	TTS2/TIS2 RTS2/RIS2	S2/TTS2 & FB RTS2 & FB
2 & 4" 50 & 100mm	LT	740 5100	740 5100	740 5100
6" 150mm	LT	740 5100	650 4480	300 2070
8" 200mm	LT	740 5100	450 3100	50 340

Note: Stainless Steel valves are rated to 720 psi (4960 kPa).

Ordering Example:

BHP,3,L1,S2,TC,S2-S10B-FT-TT*LT

Memory Stop

An adjustable memory stop is available which allows return of the valve to preset open position after shutoff. Order the memory stop as part of a complete valve, by adding "ST" after the actuator code.

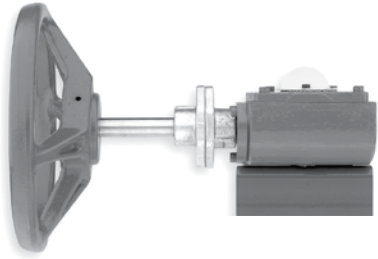
Ordering Example:

BHP,3,L1,S2,TC,S2-S10B-FT-TT*LT,ST

Actuators

MG Manual Gear Actuators

Manual gear actuator housings are constructed of high strength metal and feature sintered bronze bearings on each end of the input shaft for durability and performance. The high strength gear provides strength for robust applications and a long service life without maintenance. All manual gear actuators feature external position indication and are available with safety lockout devices. Actuators for buried service are available as an option.



G-Series Manual and Cylinder Actuators

Rotary manual actuators feature a cast iron housing with bearings on each end of the input shaft for durability and performance. The ductile iron gear provides strength for robust applications and a long service life without maintenance. Rotary manual actuators are available with handwheel, chainwheel, or a 2" (50mm) square nut input option. Actuators feature external position indication and are available with safety lockout devices.



Compak Cylinder Actuators

Compak actuators are a versatile rack-and-pinion design and are available as double-acting or spring-return units. The compact, modular design allows the actuator to be mounted for a low profile assembly. Compak actuators are matched to each valve's torque requirements to ensure that the most economical valve and actuator package is specified.



PowerRac® Cylinder Actuators

PowerRac double-acting and spring-return actuators feature a proven rack-and-pinion design. PowerRac® provides high torque output throughout the full stroke for accurate control.



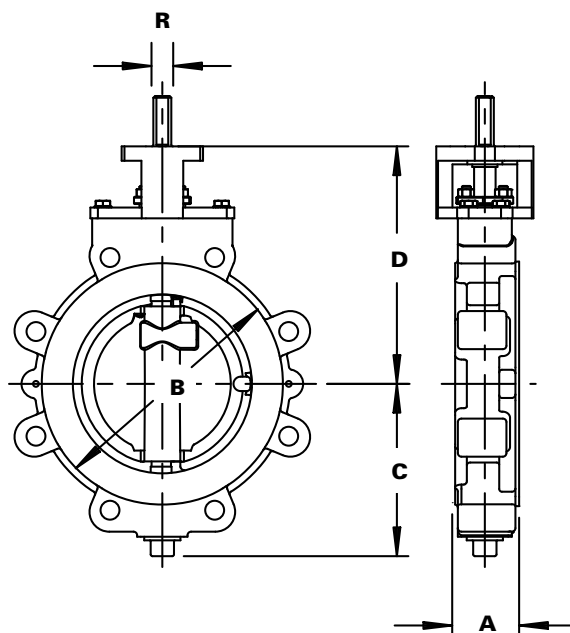
Spring-Diaphragm Actuators

DeZURIK spring-diaphragm actuators feature all steel, cast iron and stainless steel construction with no aluminum parts to corrode in caustic environments. The output shaft is supported at the top and bottom with bronze bearings that absorb side thrust and ensure smooth, efficient throttling control. Diaphragm actuators provide on-off or modulating control with either spring-to-spring or spring-to-close operation. All diaphragm actuators feature external position indication and are available with safety lockout devices.



Dimensions

Basic Valve



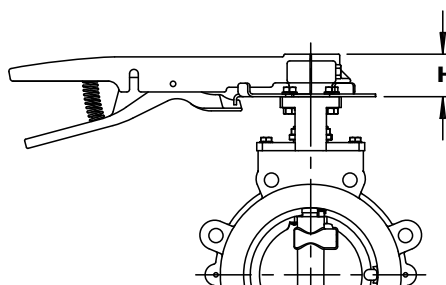
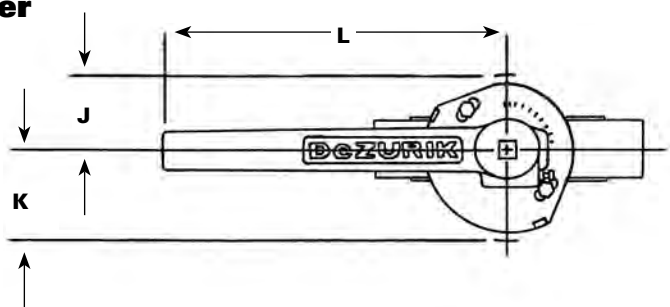
Valve Size	Dimensions											
	A		B				C		D		R (Dia.)	
			Class 150		Class 300		Class 150	Class 300	Class 150	Class 300	Class 150	Class 300
	Class 150	Class 300	Wafer	Lugged	Wafer	Lugged						
2" 50mm	1.75 44	1.75 44	4.31 110	6.06 154	4.31 110	6.44 164	3.31 84	3.50 89	5.50 140	5.50 140	0.371 9	0.371 9
2.5" 65mm	1.88 48	1.88 48	5.00 127	7.00 178	5.00 127	7.44 189	3.44 87	4.00 102	5.75 146	6.00 152	0.371 9	0.434 11
3" 80mm	1.88 48	1.88 48	5.66 144	7.62 194	5.66 144	8.19 208	3.97 101	4.38 102	6.00 152	6.38 162	0.434 11	0.496 13
4" 100mm	2.12 54	2.12 54	6.78 172	9.00 229	6.78 172	9.75 248	4.75 121	5.06 129	6.75 171	7.75 197	0.496 13	0.621 16
5" 125mm	2.31 59	2.31 59	7.69 195	10.00 254	7.75 197	10.94 278	5.50 140	5.94 151	7.75 197	8.25 210	0.621 16	0.746 19
6" 150mm	2.31 59	2.44 62	8.88 226	11.00 279	9.00 229	12.44 316	6.50 165	7.16 182	8.25 210	9.00 229	0.746 19	0.995 25
8" 200mm	2.50 64	2.88 73	11.00 279	13.50 343	11.12 282	14.88 378	7.59 193	8.47 215	9.50 241	10.75 273	0.995 25	1.245 32
10" 250mm	2.93 74	3.36 85	13.75 349	16.12 409	13.25 337	17.50 445	8.78 223	10.06 256	11.19 284	12.62 321	1.245 32	1.495 38
12" 300mm	3.28 83	3.72 95	15.50 394	19.12 486	15.50 394	20.38 518	10.19 259	11.38 289	12.75 324	13.75 349	1.495 38	1.745 44
14" 350mm	3.61 92	4.64 118	16.50 419	21.00 533	16.62 422	22.25 565	11.81 300	12.84 326	14.00 356	16.88 429	1.495 38	1.870 48
16" 400mm	3.99 101	5.26 134	18.75 476	23.50 597	18.69 475	24.50 622	12.94 329	13.81 351	15.75 400	14.25 362	1.620 41	1.995 51
18" 450mm	4.43 113	5.89 150	21.25 540	25.00 635	21.38 543	27.00 686	14.31 329	16.00 406	18.62 473	15.50 394	1.870 48	2.245 57
20" 500mm	4.92 125	6.26 159	23.25 591	27.75 705	23.50 597	29.25 743	15.81 402	16.81 427	20.56 522	16.75 425	2.245 57	2.449 63
24" 600mm	6.12 155	7.22 183	27.25 692	32.00 813	27.50 699	34.50 876	17.31 440	20.06 510	17.75 451	19.69 500	2.499 63	3.624 92
28" 700mm	6.50 165	—	—	36.50 927	—	—	19.88 505	—	20.00 508	—	2.998 76	—
30" 750mm	6.50 165	9.88 251	33.75 857	38.75 984	34.12 867	43.00 1092	21.06 535	25.84 656	21.12 536	25.00 635	2.999 76	4.499 114
36" 900mm	7.88 83	10.88 276	40.25 1022	46.00 1168	40.88 1038	50.00 1270	25.38 645	28.75 730	25.00 635	28.50 724	3.624 92	5.000 127
42" 1050mm	9.88 251	—	53.00 1346	47.25 1200	—	—	28.94 735	—	30.00 762	—	4.499 114	—
48" 1200mm	10.88 276	—	59.50 1511	53.81 1367	—	—	32.50 826	—	31.68 805	—	5.000 127	—
54-60" 1400-1500mm	Contact DeZURIK											

Inches
Millimeters

NOTE: All dimensions are subject to change without notice. For piping layouts, request certified drawings.

Dimensions

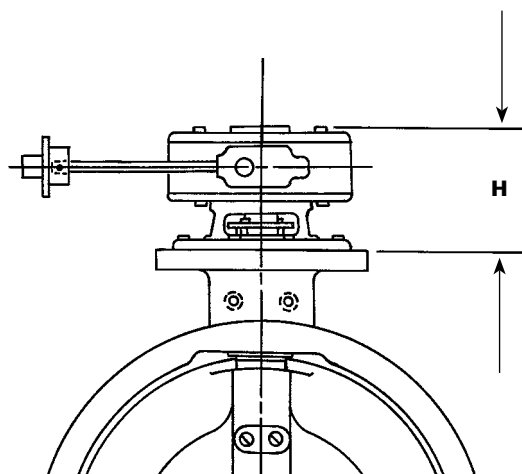
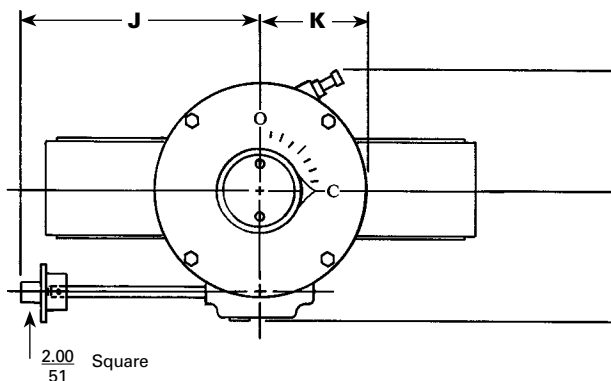
Lever



Valve Size	Dimensions										
	H	J		K		L					
		Class 150	Class 300	Class 150	Class 300	Resilient Seats (RT, RI, TT & TI)		Dual Seat (TTS2, TIS2, RTS2 & RIS2)		Metal Seat (S2)	
						Class 150	Class 300	Class 150	Class 300	Class 150	Class 300
2" 50mm	2.00 51	2.00 51	2.00 51	2.44 62	2.44 62	10.00 254	10.00 254	10.00 254	10.00 254	10.00 254	10.00 254
2.5" 65mm	2.00 51	2.00 51	2.00 51	2.44 62	2.44 62	10.00 254	10.00 254	10.00 254	10.00 254	10.00 254	10.00 254
3" 80mm	2.00 51	2.00 51	2.00 51	2.44 62	2.44 62	10.00 254	10.00 254	10.00 254	10.00 254	10.00 254	10.00 254
4" 100mm	2.00 51	2.00 51	3.00 72	2.44 62	3.56 90	10.00 254	10.00 254	10.00 254	10.00 254	10.00 254	10.00 254
5" 125mm	2.00 51	2.00 51	3.00 72	2.44 62	3.56 90	10.00 254	14.00 356	—	—	—	—
6" 150mm	2.25 57	3.00 72	3.00 72	3.56 90	3.56 90	14.00 356	22.00 559	14.00 356	22.00 559	22.00 559	22.00 559
8" 200mm	2.25 57	3.00 72	3.00 72	3.56 90	3.56 90	22.00 559	22.00 559	22.00 559	22.00 559	22.00 559	22.00 559

Inches
Millimeters

2" (50mm) Square Nut, G-Series Actuator



Actuator Code	Dimensions				
	H	J	K	L	M
GS-12-N	10.37 263	16.38 416	7.88 200	9.25 235	9.50 241

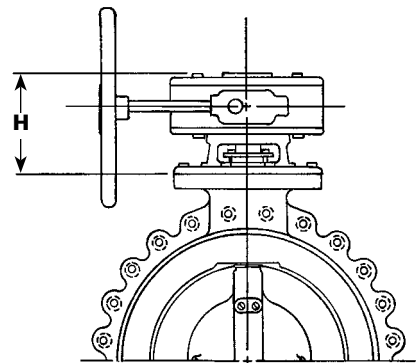
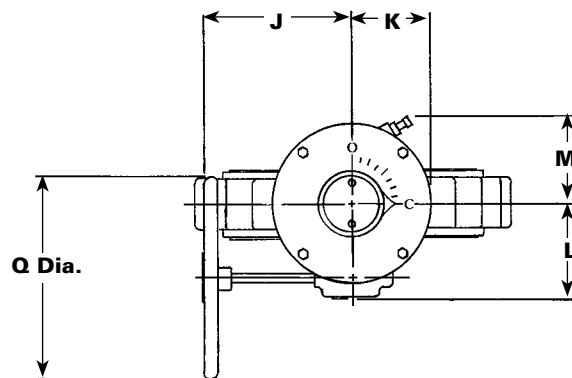
Note: H dimension on 14" (350mm) valve with GS-12-N is 11.25
286

Inches
Millimeters

Note: All dimensions are subject to change without notice. For piping layouts, request certified drawings.

Dimensions

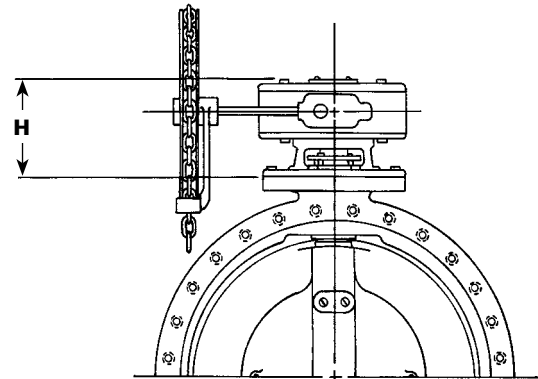
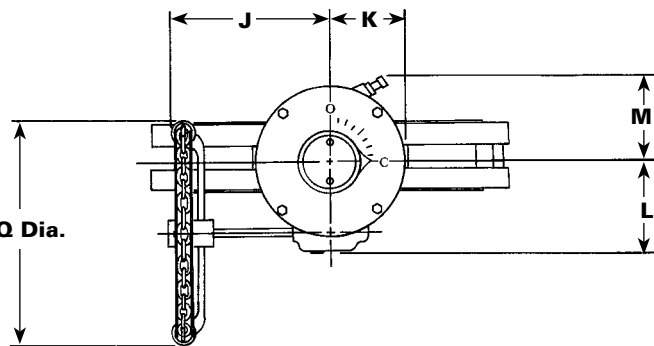
Handwheel, G-Series Actuator



Actuator Code	Dimensions					
	H	J	K	L	M	Q
GS-12-HD16	10.37 263	13.50 343	7.88 200	9.25 235	9.50 241	16.00 406
GS-12-HD24	10.37 263	17.50 445	7.88 200	9.25 235	9.50 241	24.00 610
GS-12-HD30	10.37 263	17.50 445	7.88 200	9.25 235	9.50 241	30.00 762

Note: H dimension on 14" (350mm) valve with GS-12-HD24 is $\frac{11.25}{286}$

Chainwheel, G-Series Actuator



Actuator Code	Dimensions					
	H	J	K	L	M	Q
GS-12-CW20	10.37 263	13.50 343	7.88 200	9.25 235	9.50 241	16.00 406
GS-12-CW30	10.37 263	17.50 445	7.88 200	9.25 235	9.50 241	24.00 610

Note: H dimension on 14" (350mm) valve with GS-12-CW20 is $\frac{11.25}{286}$

Inches
Millimeters

Sales and Service

For information about our worldwide locations, approvals, certifications and local representative:

Web Site: www.dezurik.com E-Mail: info@dezurik.com

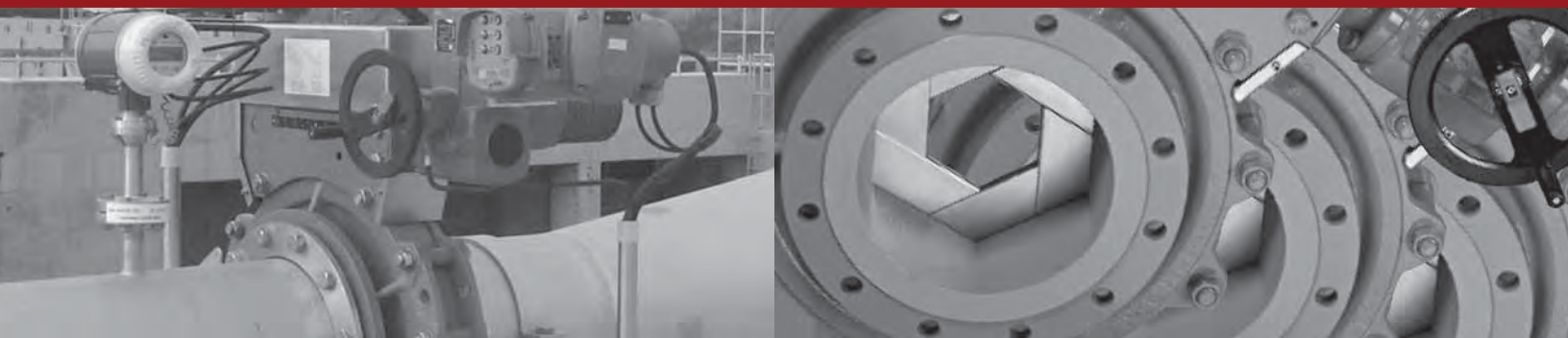


250 Riverside Ave. N. Sartell, Minnesota 56377 • Phone: 320-259-2000 • Fax: 320-259-2227

DeZURIK, Inc. reserves the right to incorporate our latest design and material changes without notice or obligation. Design features, materials of construction and dimensional data, as described in this bulletin, are provided for your information only and should not be relied upon unless confirmed in writing by DeZURIK, Inc. Certified drawings are available upon request.



Diaphragm control valve
With integrated sensyflow®



Design benefits

For precise and economic control
of fluids with or without solids or gases.

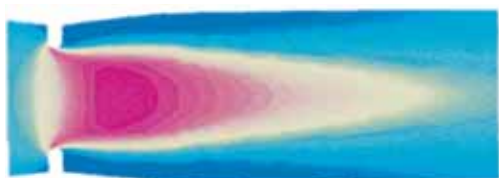
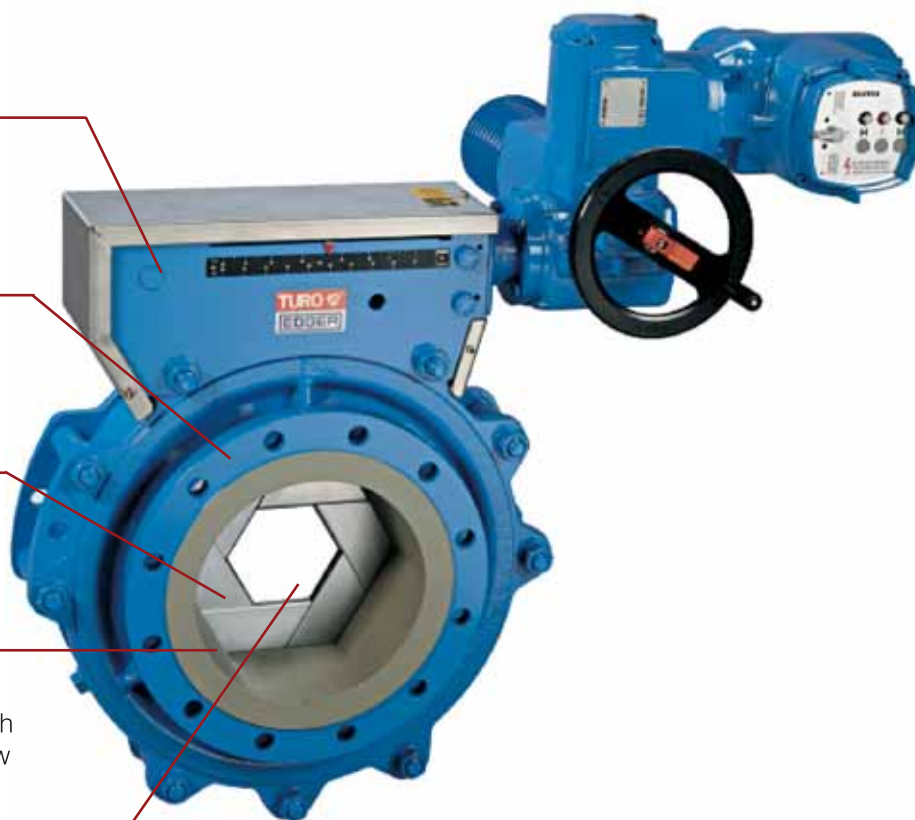
Optimised energy control characteristic
according to DIN EN 60534

Robust construction designed for high
switching frequencies, specialized for
regulation applications

Fully retractable control diaphragm
Large free aperture.
High flow capacity K_{vs}

Large adjustment field and control
range. High position repeatability

Optimum speed profile obtained through
central axial flow as well as rounded flow
optimised edges.



Energy cost savings and low noise emission due to flow-optimised design. Because the flow is almost completely unobstructed and eddy formation is low in our valves, losses are reduced to a minimum.

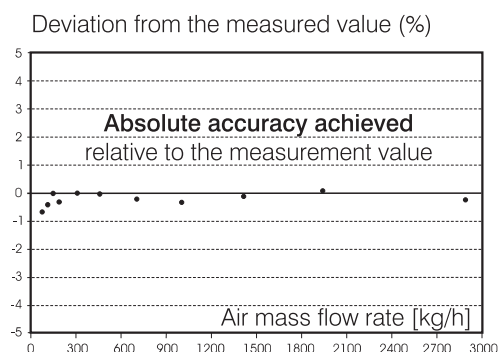
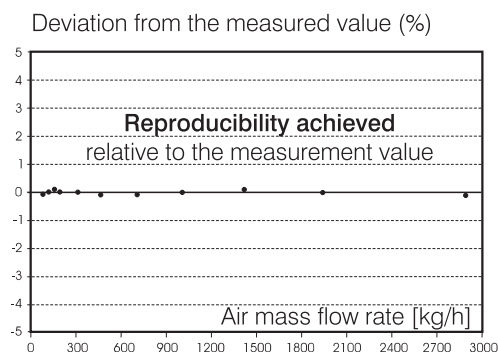
Our valve characteristics allow for proper regulation at wide aperture which means energy efficient operation. Fixed throttling apertures and imprecise regulation methods cause unnecessary pressure losses and energy costs.

- Sensyflow® integrated mass flow rate measurement
- Accurately measured air flow rates
- Precisely controlled air flow rates

The high precision thermal Sensyflow® gas mass flow rate measurement system from ABB Automation Products Ltd. is integrated directly in the, **central flow axis** of the IRIS® diaphragm control valve.

Long flow stabilising pipes on the inlet and outlet are not needed with our optional Sensyflow calibration on a DKD certified test bench.

Sensyflow® IG compact measurement unit



Options:
Profibus DP / V1
remote version with
separate wall housing

Weld-on adaptor

Pipeline

Advantages in a glance:

- Independent of the control valve
- Independent of the control valve stroke
- Independent of the pressure and temperature
- High precision measurement ($\pm 2-5\%$ measurement value)
- High reproducibility ($\pm 0.5\%$)
- Rapid response time (0.5 Seconds)
- Robust and compact unit
- Can be mounted in any position

Design information

Information on designing plants with control valves

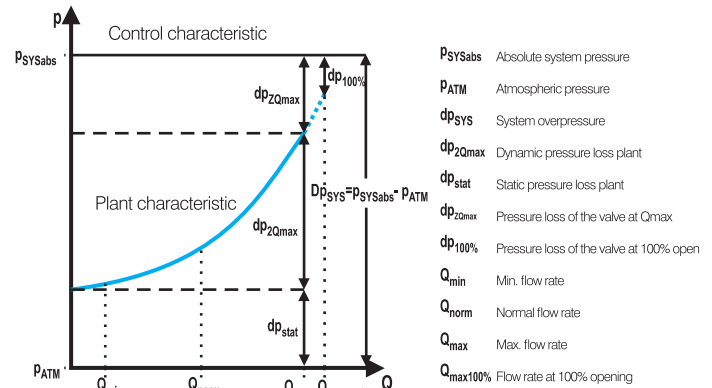
The controllability of a plant is a physical function of the **fluid properties, environmental conditions, plant characteristics**, delivery pressure characteristics and **the control characteristics of the valve**.

The data mentioned above is therefore needed to select a proper control valve. To illustrate the plant characteristics the following has been put into a chart: the dependencies of the plant characteristic (dynamic pressure losses of the installation without control valves relative to the flow rate), necessary control pressure allowance, and static pressure component in the plant and system pressure in the plant.

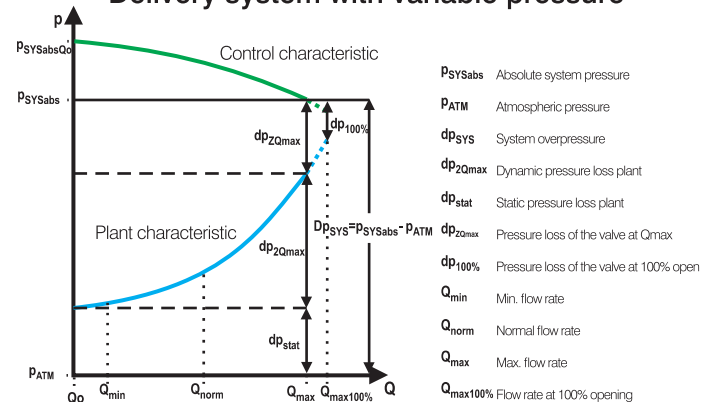
To simplify, there are generally two different pressure systems. The required system pressure is held constant (constant pressure regulation) or the delivery pressure is variable and must be taken into account.

Regulation of **constant pressure** systems is usually used for the delivery and control of multiple gas flow paths in parallel, such as air entrainment systems in biological applications and wastewater purifications plants. **Variable pressure** systems are generally used for the delivery and control of liquids.

Delivery system with constant pressure



Delivery system with variable pressure



Required data for the design:

- Static pressure loss of the plant
- Dynamic pressure loss of the plant
- Permitted pressure loss of the valve at Q_{max}
- Physical data of the delivery medium
- Temperature of the delivery medium
- Delivery characteristic of the pump/compressor
- Flow rates $Q_{max} / Q_{norm} / Q_{min}$
- Nominal diameter of the pipeline upstream/downstream of the valve



Control characteristic of control valves

To demonstrate the control characteristics of a control valve, it is necessary to know the flow and **valve characteristic (AKL)**. These are determined on a certified test bench according to DIN EN 60534. On the test bench, flow factors (kv) are measured at constant pressure (1 bar) with many different degrees of opening of the valve as defined in DIN EN 60534. Other testing methods used to determine kv cannot be used for comparison between different valve types. Only valves tested under the same standard can be compared, all other comparisons are irrelevant.

When installed, the control valve becomes a part of the pipeline system. In other words, the control characteristics are not only determined by the valve characteristic but also by the dynamic losses, static pressure of the pipeline system, total static head, ratio between dynamic pressure loss of the control valve

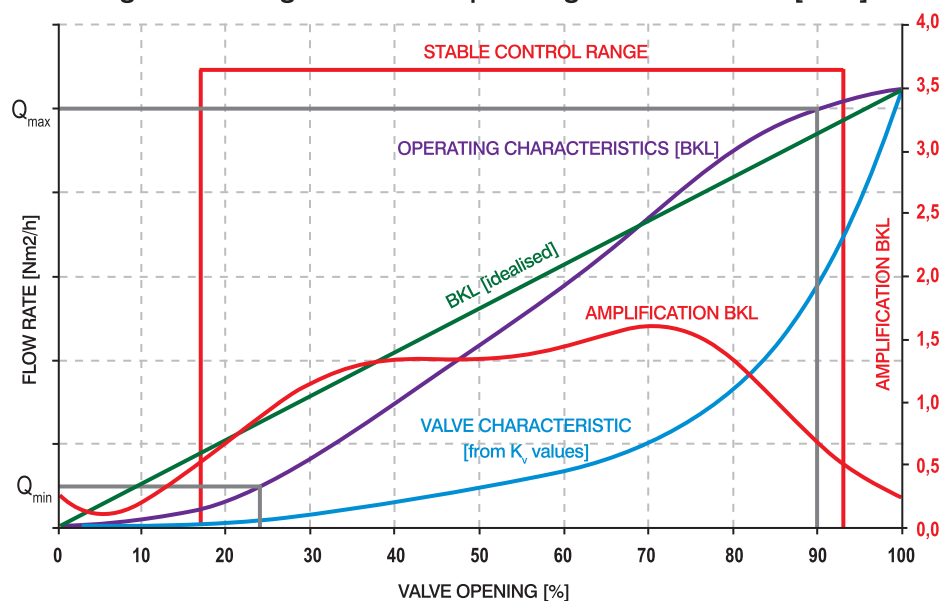
and dynamic pressure loss of the entire system, permitted pressure loss at the control valve at QMAX. The combination of all these factors produces the **operating characteristic (BKL)** of the complete system, including the valve.

The deviation from an ideal linear operating characteristic (linear change in flow rate to change in degree of opening) is expressed as the **Gain**.

A forgiving and stable control characteristic for the system is obtained with a gain factor between 0.5 and 2.0. Within these limits, the system is said to be within a **stable control range**. The basic requirement for an uninterrupted, wide (over almost the entire adjustment range of the control valve) and stable control range is a steadily increasing kv value.

Control circuits which are cost effective and stable can only be built using control valves that function within the stable control range limits such as the **IRIS® diaphragm control valve**.

Design according to the flow operating characteristics [BKL]



Inquiry Form

... Diaphragm control valve(s)

Control valve with measured control characteristic according to DIN EN 60534.

Diaphragm control valve with central hexagonal aperture as the control diaphragm for the precise, process-stable control of liquid and gaseous media.

Diaphragm can be retracted completely from the valve body to allow passage of the entire nominal cross section.

Minimum pressure losses due to flow-optimised valve segments

Hysteresis-free valve behaviour even with high frequency regulation to identical positions

Valve opening values are indicated directly on the valve

Compact, robust design

Automatic spindle lubrication

□ Dimensioning specifications

Medium:.....

Flow rate: Q_{MIN} m3/h, gpm
 Q_{NORM} m3/h, gpm
 Q_{MAX} m3/h, gpm

Temperature of medium: °C, °F

Nominal pipe diameter up-/downstream of valve
/..... mm, inch

Permitted pressure loss due to valve at Q_{MAX} :
 bar, psi

Static pressure loss of plant: bar, psi

Dynamic pressure loss of plant: bar, psi

System pressure compressor/pump: bar, psi

□ Option K_v value measurement

Valve performance test with protocol. Test includes measurement of K_v values according to DIN EN 60534-2-3 on a certified valve control test bench.

□ Materials for fluids (solids)

Body made from GG 20 and GGG 40, all screws and nuts made from stainless steel, segments made from bronze GC-CuSn12 hard-chrome plated, NBR elastomers, two coats of paint consisting of a two-component epoxy resin (80 μ m) and a two component PUR (60 μ m).

□ Materials for corrosive fluids (solids)

Body made from stainless steel (1.4408), all screws and nuts made from stainless steel, segments made from stainless steel, FPM elastomers, two coats of paint consisting of a two-component epoxy resin (80 μ m) and a two component PUR (60 μ m).

□ Manufacturer's specifications

Make, Type: EGGER BS DN
 Nominal connection diameter DN
 Installed length: mm, inch
 Nominal pressure: bar, psi
 Max. operating temperature: °C, °F
 Valve pressure loss at Q_{MAX} : bar, psi
 Stable control range from: to m3/h, gpm
 (flow data for gases in Nm3/h, gpm)

□ Electric actuation

Actuator with integrated motor controller (thyristor rotating unit) and local control point, suitable for intermittent operation S4 - 25 % ED, electronic position encoder (4 - 20 mA), torque and end-position switching for opening and closing, handwheel for manual operation, switchgear chamber heater, IP 67 enclosure, corrosion protection for outdoor installation. Other options available on request.

Make, Type: AUMASAR

□ Integrated gas mass flow rate measurement system

Integrated in the central flow axis is a robust direct gas mass flow rate measuring device.

Make, Type: EGGER /ABB, Sensyflow®

Accuracy of measurement independent of the valve, pressure, temperature and inlet-outlet lines.

Measurement accuracy $\pm 2-5\%$, reproducibility $\pm 0.5\%$, measurement range 1:100, rapid response time (0.5 seconds) to achieve stable positioning.

Calibration of the Sensyflow with piping and valve on certified test bench monitored by the German Calibration Service.

Measurement sensor: ceramic sensor unit with protective cage.

Welded-on adaptor made of stainless steel with centring pin for reproducible installation position, set up as a four-conductor compact measurement unit, without display, type of enclosure IP 65, voltage supply 24 V external, output signal 4 - 20 mA.

Optional: Integrated Profibus connection DP/V1, graphics display to show flow rate and temperature, voltage supply 220 V / 24 V.

Dimensioning specifications: Dimensions to specify for calibration.

Materials, dimensions, actuator types

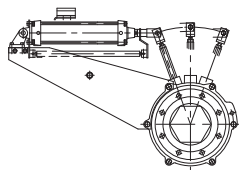
Materials and versions

OVERALL DIMENSIONS:	DN 25 - DN 600, 1"-24"	MATERIALS:	BODY:	CAST IRON, STAINLESS STEEL, BRONZE (ZINC-FREE)
FLANGE CONNECTIONS:	PN 10 ACCORDING TO DIN 2501		SEGMENTS:	BRONZE, HARD CHROME PLATED (ZINC-FREE)
OPERATING PRESSURE:	MAX. 6 BAR, 87psi			STAINLESS STEEL (OPTIONAL HARDENED)
TEMPERATURE:	MAX. 140 °C, 280°F	TYPES OF ACTUATOR:	HAND LEVER, HANDWHEEL, ELECTRIC ACTUATOR, PNEUMATIC ACTUATOR	
ON REQUEST:			ANSI CONNECTION RF 150, TEMPERATURES > 140°C SPECIAL MATERIALS	

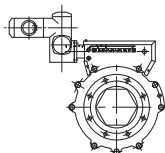
Dimensions for design E and EM

DN	80	100	125	150	200	250	300	400
TYP	BS DN80	BS DN100	BS DN125	BS DN150	BS DN200	BS DN250	BS DN300	BS DN400
A	297	287	368	362	450	575	662	875
L	182	182	194	194	194	211	213	310
1.) L1	583	583	618	618	618	675	693	801
2.) L1	413	413	448	448	448	505	523	631
L2	148,5	148,5	188	188	225	287,5	251	346
L3	337	337	442	442	423	488	513	653
L4	243	243	278	278	278	335	353	461
H	530	530	658	658	724	871	951	1212
H1	127	127	158	158	225	288	326	438
H2	166	166	263	263	262	336	378	527
H3	432	432	560	560	586	708	781	1042
H4	237	237	237	237	237	247	247	247
M	249	249	249	249	249	254	254	254
N	265	265	265	265	265	282	282	282
P	40	40	40	40	40	50	50	50
D	200	220	250	285	340	395	483	565
d4	135	155	185	210	265	315	370	480
b	20	20	21	21	23	25	24	29
K	160	180	210	240	295	350	400	515
Nr	8	8	8	8	8	12	12	16
S	18	18	18	22	22	22	22	27

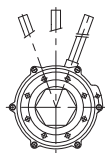
1.) L1 - Version E with AUMA STANDARD actuator 2.) L1 - Version EM with AUMA MATIC actuator



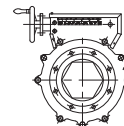
Design P
Pneumatic control actuator



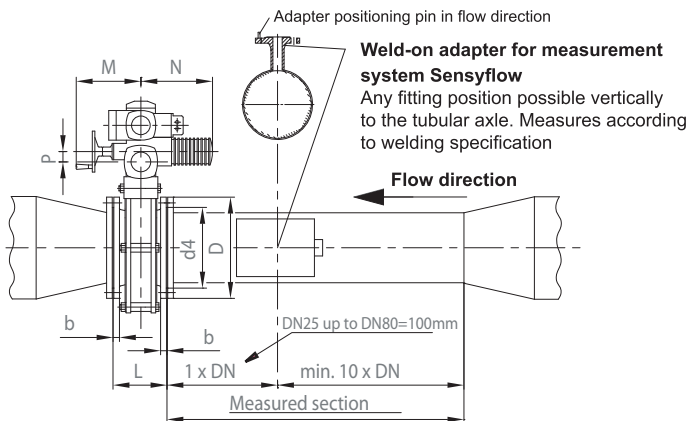
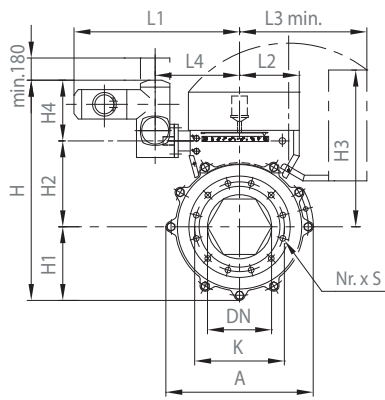
Design E and EM
Electric control actuator



Design H
Hand-lever actuator for DN25-DN150, 1"-6"



Design S
Precision handwheel actuator





Emile EGGER & Cie SA
Route de Neuchâtel 36
CH - 2088 Cressier
Switzerland

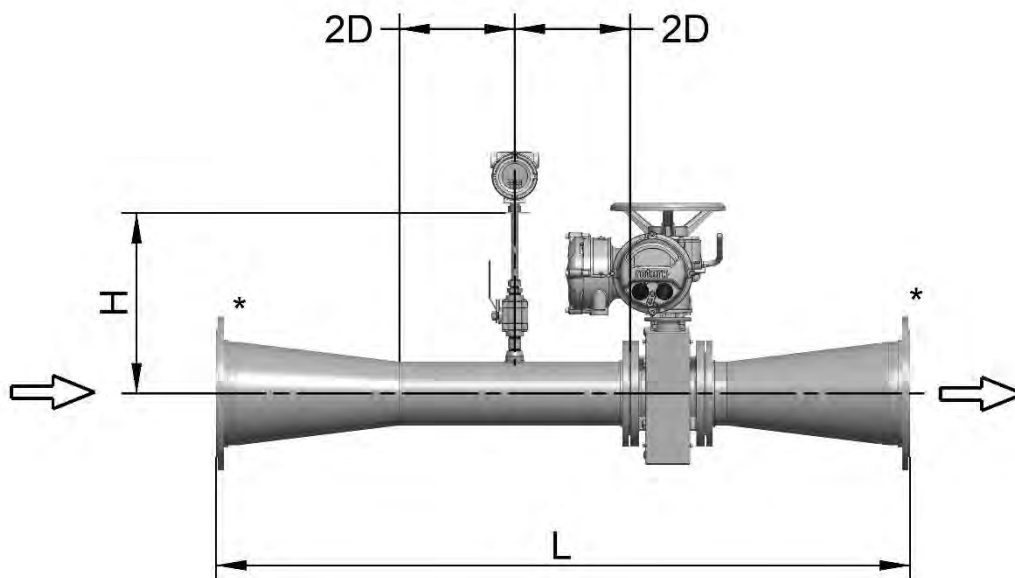
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Iris Diaphragm Control Valve

Standard Spool Kit Dimensions



*Upstream and downstream Van Stone flanges, with bolt hole drilling pattern to ASME B16.5 Class 150

DIMENSIONS : Iris Process Control Valve Spool Assembly

Upstream Flange Size [inches]	Valve Size [inches]	SCH10 St. Steel Pipe O.D. [inches]	Reducer Expander Angle [degrees]	Distance Reducer - Flow Meter (2 dia.) [inches]	Distance Flow Meter - Valve (2 dia.) [inches]	Valve Length [inches]	Overall Length (L) [inches]	Flow Meter Height (H) [inches]	Downstream Flange Size [inches]
4	2	2.375	7	4	4	6.693	38.756	18	4
5	2.5	2.875	7	5	5	7.165	45.853	18	5
6	3	3.500	7	6	6	7.165	51.478	18	6
8	4	4.500	7	8	8	7.165	63.603	18	8
8	5	5.563	7	10	10	7.638	59.451	18	8
10	6	6.623	7	12	12	7.638	72.076	18	10
12	8	8.625	7	16	16	7.638	63.701	18	12
14	10	10.750	7	20	20	8.307	80.745	18	14
16	12	12.750	7	24	24	8.386	78.699	18	16

Appendix AS-C

Opinion of Probable Construction Cost

Estimate Totals

NORWALK WATER POLLUTION CONTROL AUTHORITY NORWALK WPCF UPGRADES FACILITY PLAN ESTIMATE

Description		Rate	Amount	Rate	Amount	Cost Basis
<u>AERATION LUMP SUM WORK</u>			Prime Contractor Work		Sub-Contractor Work	
	Labor		1,881,720		1,863,549	
	Material		4,922,375		2,932,599	
	Equipment		728,025		120,410	
	Other		1,281,000		3,450,400	
	Subtotal		8,813,120		8,366,958	
	General Conditions	15.00%	1,321,968	15.00%	1,255,044	
	Subtotal		10,135,088		9,622,002	
Incidental Overtime Allowance (Calculated On Labor)		5.00%	94,086	5.00%	93,177	Category
Small Tools (Calculated On Labor)		5.00%	94,086	5.00%	93,177	Category
Equipment Sales Tax (Calculated On Equipment)		6.35%	46,230	6.35%	7,646	Category
	Subtotal		10,369,490		9,816,003	
	Escalation	17.08%	1,770,938	17.08%	1,676,412	Total
	Subtotal		12,140,428		11,492,414	
	Contractor Overhead	10.00%	1,214,043	10.00%	1,149,241	Total
	Subtotal		13,354,470		12,641,656	
	Contractor Profit	10.00%	1,335,447	10.00%	1,264,166	Total
	Subtotal		14,689,917		13,905,821	
	Prime Contractor OH & P (On Subs)	5.00%	695,291	0.00%		Total
	Subtotal		15,385,208		13,905,821	
	Design Contingency	30.00%	4,615,563	30.00%	4,171,746	Total
	Subtotal		20,000,771		18,077,568	
	Contractor Bonds & Insurance	3.00%	600,023	3.00%	542,327	Total
	Subtotal		20,600,794		18,619,895	
<u>AERATION LUMP SUM WORK, TOTAL</u>					\$39,220,689	
<u>(ALLOW 2% OF LUMP SUM)</u>					\$784,414	
<u>TOTAL, FINAL SETTLING TANKS</u>					\$40,005,102	
AACE CLASS 4 ACCURACY RANGE						
	-30%				\$28,003,572	
	To + 50%				\$60,007,654	

Spreadsheet Level	Labor Hours	Labor Amount	Material Amount	Equip Amount	Other Amount	Total Amount
20 AERATION						
30 SECONDARY CONTROL BUILDING						
20 ARCHITECTURAL & STRUCTURAL WORK	4,712.499	366,775	299,257	42,100	992,400	1,700,531
30 PROCESS MECHANICAL WORK	4,419.994	372,593	1,301,596	136,950	325,000	2,136,139
40 BUILDING MECHANICAL WORK					1,720,000	1,720,000
50 ELECTRICAL WORK	9,633.259	798,463	1,200,352	61,763	1,274,000	3,334,578
60 I&C WORK	2,560.000	460,800	135,000		25,000	620,800
30 SECONDARY CONTROL BUILDING	21,325.752	1,998,631	2,936,205	240,812	4,336,400	9,512,049
31 AERATION TANKS						
20 ARCHITECTURAL & STRUCTURAL WORK	5,832.271	502,724	2,041,989	65,983	250,000	2,860,696
30 PROCESS MECHANICAL WORK	15,116.874	1,216,918	2,724,280	541,640	145,000	4,627,838
60 I&C WORK	300.000	26,996	152,500			179,496
31 AERATION TANKS	21,249.145	1,746,638	4,918,769	607,623	395,000	7,668,030
20 AERATION	42,574.897	3,745,269	7,854,974	848,436	4,731,400	17,180,079

Project name	23-0068, Norwalk WPCF
Labor rate table	CT PW Fairfield 23
Equipment rate table	FACL2023
Report format	Sorted by 'Area/Process/System/Division/Work Pack./Assembly' 'Detail' summary Print sort level notes Paginate
Alternates	Prime, Prime, Alt. 3, Sub

Spreadsheet Level	Takeoff Quantity	Prime/Sub	Labor Hours	Labor Cost/Unit	Labor Amount	Material Cost/Unit	Material Amount	Equip Cost/Unit	Equip Amount	Other Cost/Unit	Other Amount	Total Cost/Unit	Total Amount	Notes
031051 Blower Equipment Pads (Allow 4 Each at 8' x 4')														
C.I.P. concrete forms, equipment pad, 6" to 12" high, includes erecting, bracing, stripping and cleaning	48.00 sf	Prime	9.216	13.61 /sf	653	2.09 /sf	100	-	-	-	-	15.70 /sf	754	
Reinforcing steel, in place, equipment pad	614.00 lb	Prime	7.368	1.06 /lb	651	0.80 /lb	491	-	-	-	-	1.86 /lb	1,142	
Reinforcing steel, unload and sort, add to base	0.31 ton	Prime	0.174	48.13 /ton	15	-	-	22.74 /ton	7	-	-	70.87 /ton	22	
Reinforcing steel, crane cost for handling	0.31 ton	Prime	0.189	52.32 /ton	16	-	-	24.70 /ton	8	-	-	77.03 /ton	24	
Structural concrete, ready mix, heavyweight, 4500 psi, includes local aggregate, sand, portland cement and water, delivered	2.50 cy	Prime		-	-	175.00 /cy	438	-	-	-	-	175.00 /cy	438	
Structural concrete, placing, slab on grade, pumped, up to 6" thick, includes leveling (strike off) & consolidation, excludes material	2.50 cy	Prime	1.845	51.25 /cy	128	-	-	10.85 /cy	27	-	-	62.10 /cy	155	
Concrete finishing, fresh concrete flatwork, floors, basic finishing for unspecified flatwork	128.00 sf	Prime	5.464	3.28 /sf	420	-	-	-	-	-	-	3.28 /sf	420	
Chemical anchor, in concrete, incl layout, drilling, dowel & epoxy cartridge	96.00 ea	Prime	56.889	19.11 /ea	1,835	9.55 /ea	917	4.38 /ea	420	-	-	33.04 /ea	3,172	
031051 Blower Equipment Pads (Allow 4 Each at 8' x 4')	128.00 SF		81.144	29.05 /SF	3,718	15.20 /SF	1,946	3.61 /SF	462	/SF		47.86 /SF	6,126	
0310 CIP Concrete			81.144		3,718		1,946		462				6,126	
03 CONCRETE			81.144		3,718		1,946		462		25,000		31,126	
04 MASONRY														
0410 Unit Masonry														
041015 CMU Wall Door Infill, 8" Thk. (Area Classification Separation)														
Grout, concrete masonry unit (CMU) cores, 8" thick, 0.258 C.F./S.F., pumped	288.00 sf	Prime	20.329	5.73 /sf	1,651	1.52 /sf	438	0.35 /sf	101	-	-	7.60 /sf	2,189	
Masonry reinforcing bars, #5 and #6 reinforcing steel bars	432.00 lb	Prime	7.975	1.53 /lb	662	0.71 /lb	307	-	-	-	-	2.24 /lb	969	
Concrete block partitions, 8" x 8" x 16", tooled joints both sides, includes mortar and horizontal joint reinforcing every other course	288.00 sf	Prime	62.208	18.17 /sf	5,232	2.94 /sf	847	-	-	-	-	21.11 /sf	6,078	
Chemical anchor, in masonry, incl layout, drilling, dowel & epoxy cartridge	168.00 ea	Prime	99.556	19.11 /ea	3,211	9.55 /ea	1,604	4.38 /ea	735	-	-	33.04 /ea	5,550	
041015 CMU Wall Door Infill, 8" Thk. (Area Classification Separation)	288.00 SF		190.068	37.35 /SF	10,756	11.10 /SF	3,196	2.90 /SF	836	/SF		51.34 /SF	14,787	
0410 Unit Masonry			190.068		10,756		3,196		836				14,787	
04 MASONRY			190.068		10,756		3,196		836				14,787	
05 METALS														
0510 Structural Steel														
051010 Strengthen Mezzanine Floor														
Strengthen mezzanine floor, allow 15 LBS/SF	16,500.00 lb	Sub	825.000	4.59 /lb	75,709	1.75 /lb	28,875	0.31 /lb	5,036	-	-	6.64 /lb	109,620	
051010 Strengthen Mezzanine Floor	1,100.00 SF		825.000	68.83 /SF	75,709	26.25 /SF	28,875	4.58 /SF	5,036	/SF		99.65 /SF	109,620	
051011 Structural Steel Support for Roof Modifications														
Structural Steel Support for Roof Modifications, allow 100 LBS/LF	170.00 lf	Sub	221.000	114.11 /lf	19,399	200.00 /lf	34,000	62.20 /lf	10,573	-	-	376.30 /lf	63,972	
051011 Structural Steel Support for Roof Modifications	170.00 LF		221.000	114.11 /LF	19,399	200.00 /LF	34,000	62.20 /LF	10,573	/LF		376.30 /LF	63,972	
0510 Structural Steel			1,046.000		95,108		62,875		15,609				173,592	
0520 Metal Fabrications														
052021 Ground Floor Access Stairs														
Platform framing, allow 6 LBS/SF	384.00 lb	Sub	19.200	4.59 /lb	1,762	2.25 /lb	864	0.31 /lb	117	-	-	7.14 /lb	2,743	
Stair, shop fabricated, steel, 3'-0" W, incl pipe railing, stringers, grating treads w/ safety nosing, per riser	12.00 risr	Sub	10.971	83.42 /risr	1,001	400.00 /risr	4,800	4.20 /risr	50	-	-	487.62 /risr	5,851	
Railing, pipe, steel, galvanized, 2 rails, 3'-6" high	44.00 lf	Sub	13.200	27.37 /lf	1,204	62.50 /lf	2,750	1.38 /lf	61	-	-	91.25 /lf	4,015	

Spreadsheet Level	Takeoff Quantity	Prime/Sub	Labor Hours	Labor Cost/Unit	Labor Amount	Material Cost/Unit	Material Amount	Equip Cost/Unit	Equip Amount	Other Cost/Unit	Other Amount	Total Cost/Unit	Total Amount	Notes
052021 Ground Floor Access Stairs														
Railing, welded, galvanized steel, for 4" x 1/4" kick plate, add	44.00 lf	Sub		-	-	10.00 /lf	440	-	-	-	-	10.00 /lf	440	
Floor grating, steel, 1-1/2"	64.00 sf	Sub	8.960	12.29 /sf	786	22.50 /sf	1,440	6.72 /sf	430	-	-	41.51 /sf	2,657	
052021 Ground Floor Access Stairs	4.00 EA		52.331	1,188.44 /EA	4,754	2,573.50 /EA	10,294	164.66 /EA	659	/EA		3,926.59 /EA	15,706	
052022 Mezzanine Level Access Stairs														
Platform framing, allow 6 LBS/SF	384.00 lb	Sub	19.200	4.59 /lb	1,762	2.25 /lb	864	0.31 /lb	117	-	-	7.14 /lb	2,743	
Stair, shop fabricated, steel, 3'-0" W, incl pipe railing, stringers, grating treads w/ safety nosing, per riser	40.00 risr	Sub	36.571	83.42 /risr	3,337	400.00 /risr	16,000	4.20 /risr	168	-	-	487.62 /risr	19,505	
Railing, pipe, steel, galvanized, 2 rails, 3'-6" high	44.00 lf	Sub	13.200	27.37 /lf	1,204	62.50 /lf	2,750	1.38 /lf	61	-	-	91.25 /lf	4,015	
Railing, welded, galvanized steel, for 4" x 1/4" kick plate, add	44.00 lf	Sub		-	-	10.00 /lf	440	-	-	-	-	10.00 /lf	440	
Floor grating, steel, 1-1/2"	64.00 sf	Sub	8.960	12.29 /sf	786	22.50 /sf	1,440	6.72 /sf	430	-	-	41.51 /sf	2,657	
052022 Mezzanine Level Access Stairs	2.00 EA		77.931	3,544.69 /EA	7,089	10,747.00 /EA	21,494	388.15 /EA	776	/EA		14,679.84 /EA	29,360	
0520 Metal Fabrications			130.263		11,843		31,788		1,435				45,066	
05 METALS			1,176.263		106,951		94,663		17,044				218,658	
07 THERMAL MOISTURE PROTECTION														
0720 Roofing														
072010 Membrane Roofing System Replacement														
Selective demolition, rubbish handling, dumpster	8.00 ton	Sub		-	-	88.00 /ton	704	-	-	-	-	88.00 /ton	704	
Selective demolition, rubbish handling	123.00 lcy	Sub	119.273	62.55 /lcy	7,693	-	-	-	-	-	-	62.55 /lcy	7,693	
Selective demolition, thermal and moisture protection, membrane roofing system	8,060.00 sf	Sub	604.500	4.93 /sf	39,749	-	-	-	-	-	-	4.93 /sf	39,749	
Membrane roofing system, complete with insulation & flashings	8,060.00 sf	Sub	1,410.500	14.47 /sf	116,607	8.00 /sf	64,480	2.17 /sf	17,451	-	-	24.63 /sf	198,539	
072010 Membrane Roofing System Replacement	8,060.00 SF		2,134.273	20.35 /SF	164,050	8.09 /SF	65,184	2.17 /SF	17,451	/SF		30.61 /SF	246,685	
0720 Roofing			2,134.273		164,050		65,184		17,451				246,685	
07 THERMAL MOISTURE PROTECTION			2,134.273		164,050		65,184		17,451				246,685	
08 OPENINGS														
0810 Doors														
081010 Exterior Door Replacement														
Door demolition, single	5.00 ea	Prime	4.000	51.60 /ea	258	-	-	-	-	-	-	51.60 /ea	258	
Door demolition, door frames, metal, single door	5.00 ea	Prime	5.000	64.50 /ea	323	-	-	-	-	-	-	64.50 /ea	323	
Steel frames, hollow metal, single door	5.00 ea	Prime	8.000	114.16 /ea	571	300.00 /ea	1,500	-	-	-	-	414.16 /ea	2,071	
Doors, for vision lite, add	5.00 ea	Prime		-	-	300.00 /ea	1,500	-	-	-	-	300.00 /ea	1,500	
Doors, steel, single door	5.00 ea	Prime	7.500	107.03 /ea	535	1,300.00 /ea	6,500	-	-	-	-	1,407.03 /ea	7,035	
Exterior door hardware	5.00 lvs	Prime	20.000	285.41 /lvs	1,427	790.00 /lvs	3,950	-	-	-	-	1,075.41 /lvs	5,377	
081010 Exterior Door Replacement	5.00 LVS		44.500	622.71 /LVS	3,114	2,690.00 /LVS	13,450	/LVS		/LVS		3,312.71 /LVS	16,564	
081015 Interior Door Replacement														
Door demolition, single	7.00 ea	Prime	5.600	51.60 /ea	361	-	-	-	-	-	-	51.60 /ea	361	
Door demolition, door frames, metal, single door	5.00 ea	Prime	5.000	64.50 /ea	323	-	-	-	-	-	-	64.50 /ea	323	
Door demolition, door frames, metal, double door	1.00 ea	Prime	1.250	80.63 /ea	81	-	-	-	-	-	-	80.63 /ea	81	
Steel frames, hollow metal, single door	5.00 ea	Prime	8.000	114.16 /ea	571	300.00 /ea	1,500	-	-	-	-	414.16 /ea	2,071	
Steel frames, hollow metal, double door	1.00 ea	Prime	2.000	142.71 /ea	143	490.00 /ea	490	-	-	-	-	632.71 /ea	633	
Doors, steel, single door	7.00 ea	Prime	10.500	107.03 /ea	749	1,300.00 /ea	9,100	-	-	-	-	1,407.03 /ea	9,849	
Interior door hardware	7.00 lvs	Prime	21.000	214.06 /lvs	1,498	640.00 /lvs	4,480	-	-	-	-	854.06 /lvs	5,978	
081015 Interior Door Replacement	7.00 LVS		53.350	532.21 /LVS	3,726	2,224.29 /LVS	15,570	/LVS		/LVS		2,756.50 /LVS	19,296	
081017 Exterior HM Doors														
Steel frames, hollow metal, double door	6.00 ea	Prime	12.000	142.71 /ea	856	490.00 /ea	2,940	-	-	-	-	632.71 /ea	3,796	
Doors, for vision lite, add	12.00 ea	Prime		-	-	300.00 /ea	3,600	-	-	-	-	300.00 /ea	3,600	
Doors, steel, single door	12.00 ea	Prime	18.000	107.03 /ea	1,284	1,300.00 /ea	15,600	-	-	-	-	1,407.03 /ea	16,884	
Exterior door hardware	12.00 lvs	Prime	48.000	285.41 /lvs	3,425	790.00 /lvs	9,480	-	-	-	-	1,075.41 /lvs	12,905	

Spreadsheet Level	Takeoff Quantity	Prime/Sub	Labor Hours	Labor Cost/Unit	Labor Amount	Material Cost/Unit	Material Amount	Equip Cost/Unit	Equip Amount	Other Cost/Unit	Other Amount	Total Cost/Unit	Total Amount	Notes
081017 Exterior HM Doors	12.00 LVS		78.000	463.79 /LVS	5,566	2,635.00 /LVS	31,620	/LVS		/LVS		3,098.79 /LVS	37,186	
081030 Overhead Door Replacement														
Door demolition, special doors, overhead, 14' x 14' high, remove, includes frames	2.00 ea	Prime	16.000	570.83 /ea	1,142	-	-	-	-	-	-	570.83 /ea	1,142	
Door frames, steel channels with anchors and bar stops, 14' x 14' door	2.00 ea	Prime	24.000	1,094.83 /ea	2,190	1,975.00 /ea	3,950	36.77 /ea	74	-	-	3,106.60 /ea	6,213	
Doors, rolling service, 14' x 14' high, incl. hardware	2.00 ea	Prime	80.000	3,585.36 /ea	7,171	5,500.00 /ea	11,000	-	-	-	-	9,085.36 /ea	18,171	
081030 Overhead Door Replacement	2.00 EA		120.000	5,251.02 /EA	10,502	7,475.00 /EA	14,950	36.77 /EA	74	/EA		12,762.79 /EA	25,526	
0810 Doors			295.850		22,907		75,590		74				98,570	
0820 Windows														
082010 Window Replacement														
Remove exterior windows	210.00 sf	Prime	21.000	6.45 /sf	1,355	-	-	-	-	-	-	6.45 /sf	1,355	
Windows, aluminum, incl. frame and glazing	210.00 sf	Prime	42.000	17.93 /sf	3,765	60.00 /sf	12,600	-	-	-	-	77.93 /sf	16,365	
082010 Window Replacement	210.00 SF		63.000	24.38 /SF	5,119	60.00 /SF	12,600	/SF		/SF		84.38 /SF	17,719	
082050 Louver Replacement														
Remove louvers	140.00 sf	Prime	21.000	9.68 /sf	1,355	-	-	-	-	-	-	9.68 /sf	1,355	
Louver, aluminum, extruded, with screen	140.00 sf	Prime	42.000	31.27 /sf	4,378	85.00 /sf	11,900	-	-	-	-	116.27 /sf	16,278	
082050 Louver Replacement	140.00 SF		63.000	40.95 /SF	5,733	85.00 /SF	11,900	/SF		/SF		125.95 /SF	17,633	
0820 Windows			126.000		10,852		24,500						35,352	
08 OPENINGS			421.850		33,759		100,090		74				133,922	
09 FINISHES														
0995 Miscellaneous Finishes														
099590 Miscellaneous Finishes, Painting & Coatings														
Miscellaneous Finishes, Painting & Coatings Allowance	17,200.00 gsf	Sub						-	-	12.00 /gsf	206,400	12.00 /gsf	206,400	
099590 Miscellaneous Finishes, Painting & Coatings	1.00 LS			/LS		/LS		/LS		206,400.00 /LS	206,400	206,400.00 /LS	206,400	
0995 Miscellaneous Finishes											206,400		206,400	
09 FINISHES											206,400		206,400	
20 ARCHITECTURAL & STRUCTURAL WORK			4,712.499		366,775		299,257		42,100		992,400		1,700,531	
30 PROCESS MECHANICAL WORK														
02 EXISTING CONDITIONS														
0240 Process Piping Demolition														
024020 Aeration Piping & Valve Demolition														
Crane crew, 12-ton truck-mounted hydraulic crane	12.00 day	Prime	96.000	690.08 /day	8,281	-	-	2,150.65 /day	25,808	-	-	2,840.73 /day	34,089	
Pipe, metal pipe, 8" to 14" diam., selective demolition	50.00 lf	Prime	20.000	36.00 /lf	1,800	-	-			-	-	36.00 /lf	1,800	
Pipe, metal pipe, 16" thru 20" diameter, selective demolition	290.00 lf	Prime	149.144	46.28 /lf	13,421	-	-			-	-	46.28 /lf	13,421	
Pipe, metal pipe, 30" thru 36" diameter, selective demolition	120.00 lf	Prime	108.000	80.99 /lf	9,719	-	-			-	-	80.99 /lf	9,719	
Valves, strainers and similar, metal, 8" thru 14" diameter, selective demolition	1.00 ea	Prime	4.500	404.94 /ea	405	-	-	-	-	-	-	404.94 /ea	405	
Valves, strainers and similar, metal, 16" thru 20" diameter, selective demolition	14.00 ea	Prime	252.000	1,619.77 /ea	22,677	-	-	-	-	-	-	1,619.77 /ea	22,677	
024020 Aeration Piping & Valve Demolition	1.00 LS		629.644	56,302.01 /LS	56,302	/LS		25,807.78 /LS	25,808	/LS		82,109.79 /LS	82,110	
0240 Process Piping Demolition			629.644		56,302				25,808				82,110	
02 EXISTING CONDITIONS			629.644		56,302				25,808				82,110	
40 PROCESS INTEGRATION														
4010 Process Piping														
401025 Aeration Piping, Stainless Steel														
Pipe supports	1.00 ls	Prime						-	-	50,000.00 /ls	50,000	50,000.00 /ls	50,000	
Insulation, pipe, cellular glass, closed cell foam, all service jacket, includes sealant	449.00 lf	Prime	404.100	80.99 /lf	36,364	140.00 /lf	62,860	-	-	-	-	220.99 /lf	99,224	
Stainless steel pipe, sch 10, type 316 (Material Cost)	24,069.00 lb	Prime				8.00 /lb	192,552			-	-	8.00 /lb	192,552	
Stainless steel fittings, sch 10 type 316 (Material Cost)	6,017.00 lb	Prime				12.00 /lb	72,204			-	-	12.00 /lb	72,204	

Spreadsheet Level	Takeoff Quantity	Prime/Sub	Labor Hours	Labor Cost/Unit	Labor Amount	Material Cost/Unit	Material Amount	Equip Cost/Unit	Equip Amount	Other Cost/Unit	Other Amount	Total Cost/Unit	Total Amount	Notes
260510 Electrical Equipment Demolition														
MV SWGR demolition, vertical sections	4.00 ea	Sub	96.000	1,989.03 /ea	7,956	-	-	-	-	-	-	1,989.03 /ea	7,956	
260510 Electrical Equipment Demolition	1.00 LS		96.000	7,956.10 /LS	7,956	/LS		/LS		/LS		7,956.10 /LS	7,956	
260520 Electrical Circuitry Demolition														
Misc. Circuitry Demolition	1.00 ls	Sub	160.000	13,260.16 /ls	13,260	-	-	-	-	-	-	13,260.16 /ls	13,260	
260520 Electrical Circuitry Demolition	1.00 LS		160.000	13,260.16 /LS	13,260	/LS		/LS		/LS		13,260.16 /LS	13,260	
2605 Electrical Demolition			256.000		21,216								21,216	
2610 Electrical Equipment														
261005 Unit Substation														
Transformers, 4,800 volts to 480/277 volts	1.00 ea	Sub	96.000	7,956.10 /ea	7,956	50,000.00 /ea	50,000			-	-	57,956.10 /ea	57,956	
Switchgear, 480V vertical sections (Allow 5 ea)	1.00 ls	Sub	240.000	19,890.24 /ls	19,890	250,000.00 /ls	250,000	-	-	-	-	269,890.24 /ls	269,890	
261005 Unit Substation	1.00 LS		336.000	27,846.34 /LS	27,846	300,000.00 /LS	300,000	/LS		/LS		327,846.34 /LS	327,846	
261030 Relocate Existing Control Panels														
Relocate existing control panels	2.00 ea	Sub	160.000	6,630.08 /ea	13,260	2,500.00 /ea	5,000	-	-	-	-	9,130.08 /ea	18,260	
261030 Relocate Existing Control Panels	2.00 EA		160.000	6,630.08 /EA	13,260	2,500.00 /EA	5,000	/EA		/EA		9,130.08 /EA	18,260	
261090 Miscellaneous Electrical Equipment Replacement														
Replacement of LV equipment allowance	1.00 ls	Sub						-	-	25,000.00 /ls	25,000	25,000.00 /ls	25,000	ALLOW
261090 Miscellaneous Electrical Equipment Replacement	1.00 LS			/LS		/LS		/LS		25,000.00 /LS	25,000	25,000.00 /LS	25,000	
2610 Electrical Equipment			496.000		41,107		305,000				25,000		371,107	
2620 Power Circuitry														
262010 New Service Feeders, From Substation														
Modify & re-use existing 5 kV circuit	1.00 ls	Sub	32.000	2,652.03 /ls	2,652	2,500.00 /ls	2,500	-	-	-	-	5,152.03 /ls	5,152	
Wire, copper, stranded, 600 volt, 1/0, type XHHW, in wireway, conduit, cable tray, incl terminations	0.66 clf	Sub	2.396	300.83 /clf	199	381.00 /clf	251	-	-	-	-	681.83 /clf	450	
Wire, copper, stranded, 600 volt, 350 kcmil, type XHHW, in wireway, conduit, cable tray, incl terminations	1.98 clf	Sub	13.199	552.45 /clf	1,094	1,130.00 /clf	2,237	-	-	-	-	1,682.45 /clf	3,331	
Conduit hangers, boxes, cores, fittings, etc.	1.00 ls	Sub	6.600	546.98 /ls	547	822.00 /ls	822	-	-	-	-	1,368.98 /ls	1,369	
RGS plastic coated conduit, 40 mil thick, 3" diameter, incl 2 terminations, 2 elbows, 11 beam clamps, and 11 couplings per 100 LF	60.00 lf	Sub	32.760	45.25 /lf	2,715	68.50 /lf	4,110	-	-	-	-	113.75 /lf	6,825	
262010 New Service Feeders, From Substation	1.00 LS		86.954	7,206.43 /LS	7,206	9,920.86 /LS	9,921	/LS		/LS		17,127.29 /LS	17,127	
262026 Blowers														
Wire, copper, stranded, 600 volt, #2, type XHHW, in wireway, conduit, cable tray, incl terminations	8.80 clf	Sub	23.470	221.03 /clf	1,945	275.00 /clf	2,420	-	-	-	-	496.03 /clf	4,365	
Wire, copper, stranded, 600 volt, 4/0, type XHHW, in wireway, conduit, cable tray, incl terminations	26.40 clf	Sub	143.986	452.01 /clf	11,933	740.00 /clf	19,536	-	-	-	-	1,192.01 /clf	31,469	
Conduit hangers, boxes, cores, fittings, etc.	1.00 ls	Sub	77.000	6,381.45 /ls	6,381	9,680.00 /ls	9,680	-	-	-	-	16,061.45 /ls	16,061	
RGS plastic coated conduit, 40 mil thick, 2-1/2" diameter, incl 2 terminations, 2 elbows, 11 beam clamps, and 11 couplings per 100 LF	800.00 lf	Sub	384.000	39.78 /lf	31,824	60.50 /lf	48,400	-	-	-	-	100.28 /lf	80,224	
Motor connections, flexible conduit and fittings, 250 HP motor	4.00 ea	Sub	32.000	653.55 /ea	2,614	385.00 /ea	1,540	-	-	-	-	1,038.55 /ea	4,154	
Disconnect switches, 400 amp, NEMA 4X	4.00 ea	Sub	60.000	1,243.14 /ea	4,973	7,000.00 /ea	28,000	-	-	-	-	8,243.14 /ea	32,973	
262026 Blowers	4.00 EA		720.455	14,917.65 /EA	59,671	27,394.00 /EA	109,576	/EA		/EA		42,311.65 /EA	169,247	
262031 Motorized Valves														
Wire, copper, stranded, 600 volt, #12, type XHHW, in wireway, conduit, cable tray, incl terminations	220.00 clf	Sub	239.999	90.41 /clf	19,890	31.00 /clf	6,820	-	-	-	-	121.41 /clf	26,710	
Conduit hangers, boxes, cores, fittings, etc.	1.00 ls	Sub	17.200	1,425.47 /ls	1,425	1,585.00 /ls	1,585	-	-	-	-	3,010.47 /ls	3,010	

Spreadsheet Level	Takeoff Quantity	Prime/Sub	Labor Hours	Labor Cost/Unit	Labor Amount	Material Cost/Unit	Material Amount	Equip Cost/Unit	Equip Amount	Other Cost/Unit	Other Amount	Total Cost/Unit	Total Amount	Notes
262031 Motorized Valves														
RGS plastic coated conduit, 40 mil thick, 3/4" diameter, incl 2 terminations, 2 elbows, 11 beam clamps, and 11 couplings per 100 LF	500.00 lf	Sub	85.500	14.17 /lf	7,086	15.85 /lf	7,925	-	-	-	-	30.02 /lf	15,011	
RGS plastic coated conduit, 40 mil thick, 3/4" diameter, incl 2 terminations, 2 elbows, 11 beam clamps, and 11 couplings per 100 LF	4,500.00 lf	Sub	769.500	14.17 /lf	63,773	15.85 /lf	71,325	-	-	-	-	30.02 /lf	135,098	Aeration Tanks
Motor connections, flexible conduit and fittings	20.00 ea	Sub	30.000	124.31 /ea	2,486	10.00 /ea	200	-	-	-	-	134.31 /ea	2,686	
Disconnect switches, 30 amp, NEMA 4X	20.00 ea	Sub	80.000	331.50 /ea	6,630	1,200.00 /ea	24,000	-	-	-	-	1,531.50 /ea	30,630	
262031 Motorized Valves	20.00 EA		1,222.199	5,064.55 /EA	101,291	5,592.75 /EA	111,855	/EA		/EA		10,657.30 /EA	213,146	
262032 Mixers														
Wire, copper, stranded, 600 volt, #10, type XHHW, in wireway, conduit, cable tray, incl terminations	198.00 clf	Sub	237.600	99.45 /clf	19,691	45.00 /clf	8,910	-	-	-	-	144.45 /clf	28,601	
Conduit hangers, boxes, cores, fittings, etc.	1.00 ls	Sub	15.400	1,276.29 /ls	1,276	14,265.00 /ls	14,265	-	-	-	-	15,541.29 /ls	15,541	
RGS plastic coated conduit, 40 mil thick, 3/4" diameter, incl 2 terminations, 2 elbows, 11 beam clamps, and 11 couplings per 100 LF	4,500.00 lf	Sub	769.500	14.17 /lf	63,773	15.85 /lf	71,325	-	-	-	-	30.02 /lf	135,098	
Motor connections, flexible conduit and fittings	15.00 ea	Sub	22.500	124.31 /ea	1,865	10.00 /ea	150	-	-	-	-	134.31 /ea	2,015	
Disconnect switches, 30 amp, NEMA 4X	15.00 ea	Sub	60.000	331.50 /ea	4,973	1,200.00 /ea	18,000	-	-	-	-	1,531.50 /ea	22,973	
Install vendor provided local CP	15.00 ea	Sub	240.000	1,326.02 /ea	19,890	100.00 /ea	1,500	-	-	-	-	1,426.02 /ea	21,390	
262032 Mixers	15.00 EA		1,345.000	7,431.21 /EA	111,468	7,610.00 /EA	114,150	/EA		/EA		15,041.21 /EA	225,618	
262033 Recycle Pumps														
Wire, copper, stranded, 600 volt, #10, type XHHW, in wireway, conduit, cable tray, incl terminations	77.00 clf	Sub	92.400	99.45 /clf	7,658	45.00 /clf	3,465	-	-	-	-	144.45 /clf	11,123	
Conduit hangers, boxes, cores, fittings, etc.	1.00 ls	Sub	60.000	4,972.56 /ls	4,973	5,548.00 /ls	5,548	-	-	-	-	10,520.56 /ls	10,521	
RGS plastic coated conduit, 40 mil thick, 3/4" diameter, incl 2 terminations, 2 elbows, 11 beam clamps, and 11 couplings per 100 LF	1,750.00 lf	Sub	299.250	14.17 /lf	24,801	15.85 /lf	27,738	-	-	-	-	30.02 /lf	52,538	
Motor connections, flexible conduit and fittings	10.00 ea	Sub	15.000	124.31 /ea	1,243	10.00 /ea	100	-	-	-	-	134.31 /ea	1,343	
Disconnect switches, 30 amp, NEMA 4X	10.00 ea	Sub	40.000	331.50 /ea	3,315	1,200.00 /ea	12,000	-	-	-	-	1,531.50 /ea	15,315	
Install vendor provided local CP	10.00 ea	Sub	160.000	1,326.02 /ea	13,260	100.00 /ea	1,000	-	-	-	-	1,426.02 /ea	14,260	
262033 Recycle Pumps	10.00 EA		666.650	5,524.93 /EA	55,249	4,985.05 /EA	49,851	/EA		/EA		10,509.98 /EA	105,100	
262069 Miscellaneous Connection To Existing & New Mechanical Equipment														
Miscellaneous Connection To Existing & New Mechanical Equipment Allowance	17,200.00 gsf	Sub						-	-	5.00 /gsf	86,000	5.00 /gsf	86,000	
262069 Miscellaneous Connection To Existing & New Mechanical Equipment											86,000		86,000	
2620 Power Circuitry			4,041.259		334,886		395,352				86,000		816,238	
2630 Control Circuitry														
263090 Control Point Circuitry														
Control point circuitry (hardwired I/O)	500.00 pt	Sub	4,000.000	663.01 /pt	331,504	1,000.00 /pt	500,000	-	-	-	-	1,663.01 /pt	831,504	
263090 Control Point Circuitry	1.00 LS		4,000.000	331,504.00 /LS	331,504	500,000.00 /LS	500,000	/LS		/LS		831,504.00 /LS	831,504	
2630 Control Circuitry			4,000.000		331,504		500,000						831,504	
2650 Lighting														
265090 Lighting & Device Replacement Allowance														
Lighting & Device Allowance	3,500.00 gsf	Sub						-	-	20.00 /gsf	70,000	20.00 /gsf	70,000	
Lighting & Device Allowance (Classified Areas)	13,700.00 gsf	Sub						-	-	30.00 /gsf	411,000	30.00 /gsf	411,000	
265090 Lighting & Device Replacement Allowance	1.00 LS			/LS		/LS		/LS		481,000.00 /LS	481,000	481,000.00 /LS	481,000	

Spreadsheet Level	Takeoff Quantity	Prime/Sub	Labor Hours	Labor Cost/Unit	Labor Amount	Material Cost/Unit	Material Amount	Equip Cost/Unit	Equip Amount	Other Cost/Unit	Other Amount	Total Cost/Unit	Total Amount	Notes
2650 Lighting											481,000		481,000	
2690 Electrical Requirements														
269010 Temporary Power & Phasing Allowance														
Temporary power & phasing, allow 25% of total electrical cost	1.00 ls	Sub		-	-			-	-	650,000.00 /ls	650,000	650,000.00 /ls	650,000	
269010 Temporary Power & Phasing Allowance	1.00 LS			/LS		/LS		/LS		650,000.00 /LS	650,000	650,000.00 /LS	650,000	
269090 Miscellaneous Electrical Requirements														
Crane crew, 12-ton truck-mounted hydraulic crane	5.00 day	Sub	40.000	690.08 /day	3,450	-	-	2,150.65 /day	10,753	-	-	2,840.73 /day	14,204	
Rent aerial lift, scissor type, electric	260.00 day	Sub		-	-	-	-	196.19 /day	51,009	-	-	196.19 /day	51,009	
Start-up, testing & commissioning	1.00 ls	Sub	800.000	66,300.80 /ls	66,301	-	-	-	-	32,000.00 /ls	32,000	98,300.80 /ls	98,301	
269090 Miscellaneous Electrical Requirements	1.00 LS		840.000	69,751.20 /LS	69,751	/LS		61,762.64 /LS	61,763	32,000.00 /LS	32,000	163,513.84 /LS	163,514	
2690 Electrical Requirements			840.000		69,751				61,763		682,000		813,514	
26 ELECTRICAL			9,633.259		798,463		1,200,352		61,763		1,274,000		3,334,578	
50 ELECTRICAL WORK			9,633.259		798,463		1,200,352		61,763		1,274,000		3,334,578	
60 I&C WORK														
40 PROCESS INTEGRATION														
4060 Instrumentation & Control														
406010 Control Panels														
PLC Panel	1.00 ea	Sub	400.000	72,000.00 /ea	72,000	100,000.00 /ea	100,000	-	-	-	-	172,000.00 /ea	172,000	
Network interface panel	1.00 ea	Sub	40.000	7,200.00 /ea	7,200	15,000.00 /ea	15,000	-	-	-	-	22,200.00 /ea	22,200	
SCADA Operator Workstation	1.00 ea	Sub	40.000	7,200.00 /ea	7,200	20,000.00 /ea	20,000	-	-	-	-	27,200.00 /ea	27,200	
406010 Control Panels	1.00 LS		480.000	86,400.00 /LS	86,400	135,000.00 /LS	135,000	/LS		/LS		221,400.00 /LS	221,400	
406020 Field Instruments Allowance														
Field Instruments Allowance	1.00 ls	Prime						-	-	25,000.00 /ls	25,000	25,000.00 /ls	25,000	
406020 Field Instruments Allowance	1.00 LS			/LS		/LS		/LS		25,000.00 /LS	25,000	25,000.00 /LS	25,000	
406030 Control Point Programming & Integration														
Control Point Programming, Integration	1.00 ls	Sub	2,000.000	360,000.00 /ls	360,000			-	-	-	-	360,000.00 /ls	360,000	
Start-up, Testing & Training	1.00 ls	Sub	80.000	14,400.00 /ls	14,400			-	-	-	-	14,400.00 /ls	14,400	
406030 Control Point Programming & Integration	1.00 LS		2,080.000	374,400.00 /LS	374,400	/LS		/LS		/LS		374,400.00 /LS	374,400	
4060 Instrumentation & Control			2,560.000		460,800		135,000				25,000		620,800	
40 PROCESS INTEGRATION			2,560.000		460,800		135,000				25,000		620,800	
60 I&C WORK			2,560.000		460,800		135,000				25,000		620,800	
30 SECONDARY CONTROL BUILDING			21,325.752		1,998,631		2,936,205		240,812		4,336,400		9,512,049	

Spreadsheet Level	Takeoff Quantity	Prime/Sub	Labor Hours	Labor Cost/Unit	Labor Amount	Material Cost/Unit	Material Amount	Equip Cost/Unit	Equip Amount	Other Cost/Unit	Other Amount	Total Cost/Unit	Total Amount	Notes
017012 Aeration Tank Cleaning														
Removal of residuals within the existing tanks including sludge, grit, floatables, screenings	334.00 cy	Prime	286.572	58.52 /cy	19,545	-	-	21.33 /cy	7,125	-	-	79.85 /cy	26,670	Allow 3" thk.
Disposal of tank residuals	450.00 ton	Prime		-	-	-	-	-	-	100.00 /ton	45,000	100.00 /ton	45,000	
Tank cleaning	5.00 ea	Prime	320.000	4,208.32 /ea	21,042	-	-	416.93 /ea	2,085	-	-	4,625.25 /ea	23,126	
017012 Aeration Tank Cleaning	5.00 EA		606.572	8,117.33 /EA	40,587	/EA		1,841.88 /EA	9,209	9,000.00 /EA	45,000	18,959.21 /EA	94,796	
017020 Tank Dewatering														
Tank dewatering, attended 8 hours per day including, suction & discharge hoses	200.00 day	Prime	1,600.000	649.36 /day	129,872	-	-	396.16 /day	79,232	-	-	1,045.52 /day	209,104	Assume incidental water at leaking bulkheads
017020 Tank Dewatering	200.00 DAY		1,600.000	649.36 /DAY	129,872	/DAY		396.16 /DAY	79,232	/DAY		1,045.52 /DAY	209,104	
0170 Cleaning & Waste Management			2,206.572		170,459				88,441		45,000		303,900	
01 GENERAL REQUIREMENTS			2,206.572		170,459				88,441		45,000		303,900	
02 EXISTING CONDITIONS														
0240 Process Piping Demolition														
024020 Aeration Piping & Valve Demoltion														
Crane crew, 12-ton truck-mounted hydraulic crane	4.00 day	Prime	32.000	690.08 /day	2,760	-	-	2,150.65 /day	8,603	-	-	2,840.73 /day	11,363	
Pipe, metal pipe, 8" to 14" diam., selective demolition	350.00 lf	Prime	140.002	36.00 /lf	12,598	-	-			-	-	36.00 /lf	12,598	
Valves, strainers and similar, metal, 4" thru 6" diameter, selective demolition	20.00 ea	Prime	60.000	269.96 /ea	5,399	-	-	-	-	-	-	269.96 /ea	5,399	
Valves, strainers and similar, metal, 8" thru 14" diameter, selective demolition	11.00 ea	Prime	49.500	404.94 /ea	4,454	-	-	-	-	-	-	404.94 /ea	4,454	
024020 Aeration Piping & Valve Demoltion	1.00 LS		281.502	25,212.24 /LS	25,212	/LS		8,602.59 /LS	8,603	/LS		33,814.83 /LS	33,815	
0240 Process Piping Demolition			281.502		25,212				8,603				33,815	
02 EXISTING CONDITIONS			281.502		25,212				8,603				33,815	
40 PROCESS INTEGRATION														
4010 Process Piping														
401025 Aeration Piping, Stainless Steel														
Insulation, pipe, cellular glass, closed cell foam, all service jacket, includes sealant	752.00 lf	Prime	676.800	80.99 /lf	60,903	140.00 /lf	105,280	-	-	-	-	220.99 /lf	166,183	
Stainless steel pipe, sch 10, type 316 (Material Cost)	19,600.00 lb	Prime				8.00 /lb	156,800			-	-	8.00 /lb	156,800	
Stainless steel fittings, sch 10 type 316 (Material Cost)	4,900.00 lb	Prime				12.00 /lb	58,800			-	-	12.00 /lb	58,800	
Install Pipe & fittings, stainless steel, 8" pipe size, schedule 10, type 316	101.00 lf	Prime	101.000	89.06 /lf	8,995			21.94 /lf	2,216	-	-	111.00 /lf	11,211	
Install Pipe & fittings, stainless steel, 10" pipe size, schedule 10, type 316	140.00 lf	Prime	175.000	111.32 /lf	15,585			27.43 /lf	3,840	-	-	138.75 /lf	19,425	
Install Pipe & fittings, stainless steel, 12" pipe size, schedule 10, type 316	180.00 lf	Prime	270.000	133.58 /lf	24,045			32.91 /lf	5,924	-	-	166.50 /lf	29,969	
Install Pipe & fittings, stainless steel, 14" pipe size, schedule 10, type 316	76.00 lf	Prime	171.000	200.37 /lf	15,228			49.37 /lf	3,752	-	-	249.74 /lf	18,981	
Install Pipe & fittings, stainless steel, 16" pipe size, schedule 10, type 316	108.00 lf	Prime	297.000	244.90 /lf	26,449			60.34 /lf	6,517	-	-	305.24 /lf	32,966	
Install Pipe & fittings, stainless steel, 18" pipe size, schedule 10, type 316	102.00 lf	Prime	357.000	311.69 /lf	31,793			76.80 /lf	7,833	-	-	388.49 /lf	39,626	
Install Pipe & fittings, stainless steel, 20" pipe size, schedule 10, type 316	45.00 lf	Prime	180.000	356.22 /lf	16,030			87.77 /lf	3,950	-	-	443.99 /lf	19,980	
401025 Aeration Piping, Stainless Steel	1.00 LS		2,227.800	199,027.53 /LS	199,028	320,880.00 /LS	320,880	34,032.82 /LS	34,033	/LS		553,940.35 /LS	553,940	
401090 Miscellaneous Process Mechanical Piping Allowance														
Miscellaneous Process Mechanical Piping Removal & Replacement Allowance	1.00 ls	Prime								100,000.00 /ls	100,000	100,000.00 /ls	100,000	ALLOW

Spreadsheet Level	Takeoff Quantity	Prime/Sub	Labor Hours	Labor Cost/Unit	Labor Amount	Material Cost/Unit	Material Amount	Equip Cost/Unit	Equip Amount	Other Cost/Unit	Other Amount	Total Cost/Unit	Total Amount	Notes
401090 Miscellaneous Process Mechanical Piping Allowance	1.00 LS			/LS		/LS		/LS		100,000.00 /LS	100,000	100,000.00 /LS	100,000	
4010 Process Piping			2,227.800		199,028		320,880		34,033		100,000		653,940	
4015 Process Valves														
401520 Aeration Valves														
Motorized HP butterfly valves, 4"	5.00 ea	Prime	22.500	404.94 /ea	2,025	13,000.00 /ea	65,000	-	-	-	-	13,404.94 /ea	67,025	Dezurik Quote
Motorized HP butterfly valves, 6"	5.00 ea	Prime	35.000	629.91 /ea	3,150	13,800.00 /ea	69,000	-	-	-	-	14,429.91 /ea	72,150	Dezurik Quote
Motorized HP butterfly valves, 8"	5.00 ea	Prime	40.000	719.90 /ea	3,599	14,800.00 /ea	74,000	-	-	-	-	15,519.90 /ea	77,599	Dezurik Quote
401520 Aeration Valves	15.00 EA		97.500	584.92 /EA	8,774	13,866.67 /EA	208,000	/EA		/EA		14,451.58 /EA	216,774	
4015 Process Valves			97.500		8,774		208,000						216,774	
40 PROCESS INTEGRATION			2,325.300		207,801		528,880		34,033		100,000		870,714	
43 PROCESS GAS & LIQUID HANDLING, PURIFICATION & STORAGE EQUIPMENT														
4320 Aeration Equipment														
432020 Aeration Diffuser Replacement														
Aeration diffuser demolition	15.00 grid	Prime	2,160.000	10,572.19 /grid	158,583	-	-	4,301.30 /grid	64,519	-	-	14,873.49 /grid	223,102	
Diffuser system quote:	1.00 ls	Prime				887,000.00 /ls	887,000			-	-	887,000.00 /ls	887,000	GA Fleet Quote
10" 12ga 304SS Dropleg	10.00 ea	Prime	160.000	1,424.88 /ea	14,249			351.08 /ea	3,511	-	-	1,775.96 /ea	17,760	
8" 12ga 304SS Dropleg	5.00 ea	Prime	70.000	1,246.77 /ea	6,234			307.20 /ea	1,536	-	-	1,553.97 /ea	7,770	
10" SCH40 PVC Manifold	10.00 ea	Prime	120.000	1,079.84 /ea	10,798					-	-	1,079.84 /ea	10,798	
8" SCH40 PVC Manifold	5.00 ea	Prime	50.000	899.87 /ea	4,499					-	-	899.87 /ea	4,499	
4" 33.5 SDR PVC Distributors	265.00 ea	Prime	1,590.000	539.92 /ea	143,079					-	-	539.92 /ea	143,079	
9" SSII Diffusers	13,780.00 ea	Prime	1,033.500	6.75 /ea	93,002					-	-	6.75 /ea	93,002	
432020 Aeration Diffuser Replacement	5.00 TAN K		5,183.500	86,088.84 /TANK	430,444	177,400.00 /TAN K	887,000	13,913.24 /TAN K	69,566	/TAN K		277,402.09 /TANK	1,387,010	
432030 Aeration Tank Influent Channel Mixer Replacement														
Remove mixers	5.00 ea	Prime	320.000	4,807.17 /ea	24,036			4,546.62 /ea	22,733	-	-	9,353.79 /ea	46,769	
Submersible mixer, 4 HP	5.00 ea	Prime	640.000	9,614.34 /ea	48,072	50,000.00 /ea	250,000	9,093.25 /ea	45,466	-	-	68,707.58 /ea	343,538	Material Allowance
Contractor start-up & testing	1.00 ls	Prime	80.000	5,616.08 /ls	5,616					-	-	5,616.08 /ls	5,616	
432030 Aeration Tank Influent Channel Mixer Replacement	5.00 EA		1,040.000	15,544.72 /EA	77,724	50,000.00 /EA	250,000	13,639.87 /EA	68,199	/EA		79,184.59 /EA	395,923	
432031 Aeration Tank Zone Mixer Replacement														
Remove mixers	10.00 ea	Prime	640.000	4,807.17 /ea	48,072			4,546.62 /ea	45,466	-	-	9,353.79 /ea	93,538	
Anoxic zone mixers, simplex control panels, 316SS 4"x4" mast assemblies, cable handling kits, 7.5 HP	5.00 ea	Prime	640.000	9,614.34 /ea	48,072	59,500.00 /ea	297,500	9,093.25 /ea	45,466	-	-	78,207.58 /ea	391,038	GA Fleet Quote
Anaerobic zone mixers, simplex control panels, 316SS 2"x2" mast assemblies, cable handling kits, 7.5 HP	5.00 ea	Prime	640.000	9,614.34 /ea	48,072	42,580.00 /ea	212,900	9,093.25 /ea	45,466	-	-	61,287.58 /ea	306,438	GA Fleet Quote
Contractor start-up & testing	1.00 ls	Prime	160.000	11,232.16 /ls	11,232					-	-	11,232.16 /ls	11,232	
432031 Aeration Tank Zone Mixer Replacement	10.00 EA		2,080.000	15,544.72 /EA	155,447	51,040.00 /EA	510,400	13,639.87 /EA	136,399	/EA		80,224.59 /EA	802,246	
432040 Aeration Tank Submersible Recycle Pump Replacement														
Remove pumps	10.00 ea	Prime	640.000	4,807.17 /ea	48,072			4,546.62 /ea	45,466	-	-	9,353.79 /ea	93,538	
Recycle pump, simplex control panels, installation accessories, cable handling kits	10.00 ea	Prime	1,280.000	9,614.34 /ea	96,143	54,800.00 /ea	548,000	9,093.25 /ea	90,932	-	-	73,507.58 /ea	735,076	GA Fleet Quote
Contractor start-up & testing	1.00 ls	Prime	80.000	5,616.08 /ls	5,616					-	-	5,616.08 /ls	5,616	
432040 Aeration Tank Submersible Recycle Pump Replacement	10.00 EA		2,000.000	14,983.11 /EA	149,831	54,800.00 /EA	548,000	13,639.87 /EA	136,399	/EA		83,422.98 /EA	834,230	
4320 Aeration Equipment			10,303.500		813,446		2,195,400		410,563				3,419,409	
43 PROCESS GAS & LIQUID HANDLING, PURIFICATION & STORAGE EQUIPMENT			10,303.500		813,446		2,195,400		410,563				3,419,409	
30 PROCESS MECHANICAL WORK			15,116.874		1,216,918		2,724,280		541,640		145,000		4,627,838	
60 I&C WORK														
40 PROCESS INTEGRATION														
4060 Instrumentation & Control														
406025 Flow Meters														
Venturi flow, measuring device, 8" diameter	5.00 ea	Prime	40.000	719.90 /ea	3,599	2,500.00 /ea	12,500	-	-	-	-	3,219.90 /ea	16,099	
Venturi flow, measuring device, 10" diameter	5.00 ea	Prime	60.000	1,079.84 /ea	5,399	5,000.00 /ea	25,000	-	-	-	-	6,079.84 /ea	30,399	
Venturi flow, measuring device, 12" diameter	5.00 ea	Prime	80.000	1,439.79 /ea	7,199	8,000.00 /ea	40,000	-	-	-	-	9,439.79 /ea	47,199	

Spreadsheet Level	Takeoff Quantity	Prime/Sub	Labor Hours	Labor Cost/Unit	Labor Amount	Material Cost/Unit	Material Amount	Equip Cost/Unit	Equip Amount	Other Cost/Unit	Other Amount	Total Cost/Unit	Total Amount	Notes
406025 Flow Meters	15.00 EA		180.000	1,079.84 /EA	16,198	5,166.67 /EA	77,500	/EA		/EA		6,246.51 /EA	93,698	
406026 Aeration Tank Instruments														
Remove & replace DO sensors & transmitters	15.00 ea	Prime	120.000	719.90 /ea	10,798	5,000.00 /ea	75,000	-	-	-	-	5,719.90 /ea	85,798	
406026 Aeration Tank Instruments	15.00 EA		120.000	719.90 /EA	10,798	5,000.00 /EA	75,000	/EA		/EA		5,719.90 /EA	85,798	
4060 Instrumentation & Control			300.000		26,996		152,500						179,496	
40 PROCESS INTEGRATION			300.000		26,996		152,500						179,496	
60 I&C WORK			300.000		26,996		152,500						179,496	
31 AERATION TANKS			21,249.145		1,746,638		4,918,769		607,623		395,000		7,668,030	
20 AERATION			42,574.897		3,745,269		7,854,974		848,436		4,731,400		17,180,079	

Partial Totals

Description	Amount	Totals	Hours	Percent of Total	
Labor	3,745,269		42,574.897 hrs	21.80%	
Material	7,854,974			45.72%	
Equipment	848,436		21,759.397 hrs	4.94%	
Other	4,731,400			27.54%	
TOTAL	17,180,079	17,180,079		100.00%	100.00%

Appendix G

Final Settling Tanks Improvements Technical Memorandum (Arcadis)

Privileged and Confidential-Subject to Attorney-Client/Work Product Privilege

SUBJECT

Norwalk Facility Plan Update
Final Settling Tanks Improvements Technical Memorandum

TO

Mr. Ralph Kolb, P.E.
Norwalk WPCA
Senior Environmental Engineer
15 S. Smith Street
Norwalk, CT 06855-1017

DATE

September 29, 2023

ARCADIS PROJECT NUMBER

30051745

PRIMARY AUTHOR

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1.0 Background and Purpose

1.1 Background

The Norwalk Water Pollution Control Facility (WPCF) includes four final settling tanks (FSTs) that are designed to treat 30 million gallons per day (MGD) of peak flow, which is the full rated capacity of the secondary treatment system. The FSTs, installed in 1997, are 110-foot diameter circular concrete settling tanks with a single suction header clarifier mechanism in each tank. The FSTs separate the aerated Mixed Liquor Suspended Solids (MLSS) produced by the activated sludge biological nutrient removal reactors (aeration tanks) from the water. The settled MLSS are removed via the suction header while the water exits the FSTs over a weir for disinfection and dechlorination. Once fully treated, the plant effluent is discharged through Outfall-001-1. Since the initial installation in 1997, repairs and modifications have been made to the FST mechanisms along with routine maintenance to extend the useful life of the FSTs.

1.2 Purpose

Arcadis U.S., Inc. (Arcadis) has prepared this technical memorandum for the Norwalk Water Pollution Control Authority (WPCA), to summarize the findings of the WPCF FST evaluation and present conceptual alternatives for enhancements to this process area. The analysis and recommendations in this Technical Memorandum are not subject to the Consent Order entered into by the City of Norwalk and the Connecticut Department of Energy and Environment Protection (DEEP) in May 2022. An estimate of probable total project cost for the recommended conceptual alternative is included herein to aid the WPCA in budgeting and planning for the potential enhancements. This memorandum includes a summary of existing conditions, viable clarifier technologies, a preliminary alternatives analysis, and recommendations for overall improvements to the FSTs at the WPCF.

The sections included within this technical memorandum are as follows:

- 1.0 Background and Purpose
- 2.0 Existing Facilities and Treatment Description
- 3.0 Design Criteria
- 4.0 Technologies Considered
- 5.0 Alternatives Analysis

- 6.0 Other Considerations for Future Upgrades
- 7.0 Probable Total Project Cost

2.0 Existing Facilities and Treatment Description

The Norwalk WPCF has a design flow of 18 MGD and a peak hydraulic flow of 30 MGD through the primary settling tanks and secondary treatment system. All influent flow up to 95 MGD receives preliminary treatment including screening and grit removal within the preliminary treatment building (PTB). After the PTB, flows up to 30 MGD continue first to the primary settling tanks and then to the aeration tanks. After the aeration tanks, flow is pumped at the secondary lift pump station into the final settling tanks (FSTs). Flows in excess of 30 MGD are directed to the wet weather treatment system in the supplemental treatment building (STB) after passing through the PTB. Areas relevant to the FSTs are identified in an aerial map of the WPCF shown in Figure 1.

Information on the condition of the existing FSTs, including the concrete tanks, clarifier mechanisms, and other

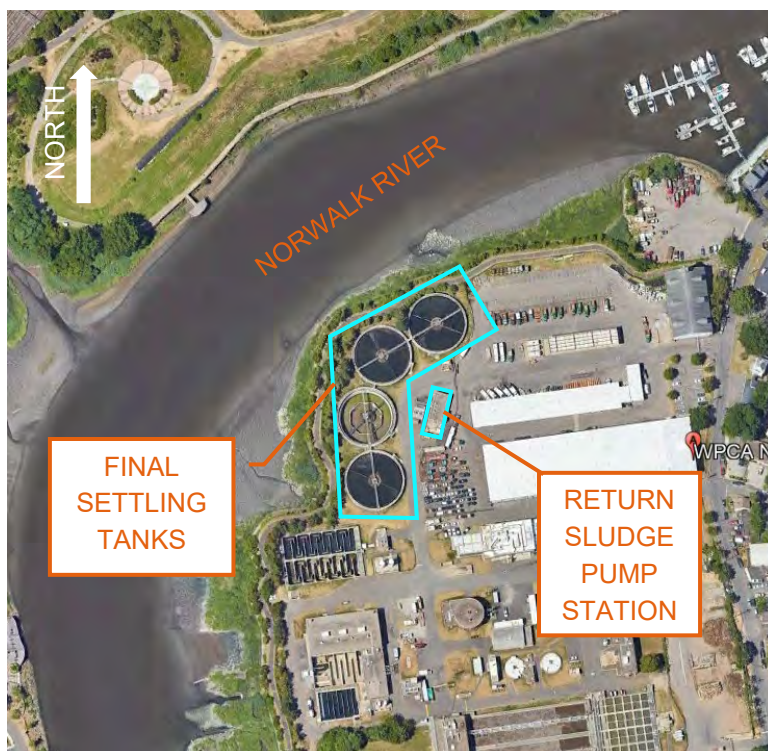


Figure 1. WPCF FST Aerial Map

associated equipment are based on inspections and reports as well as WPCA and Veolia feedback from the FST Workshop held on March 21, 2023. The inspections and reports referenced are as follows:

- 2022 Ovivo Field Service Report
- 2018 Equipment Baseline Evaluation WAS and RAS Pump Inspection Reports
- 2016 Arcadis Final Settling Tank Equipment Inspection and Log-Term Planning Technical Memorandum
- 2016 Ovivo Field Service Report
- 2009 CPE Services Report
- 2009 DRAFT Malcolm Pirnie Comprehensive Solids Evaluation and Wastewater Characterization

- 2009 CDM Wastewater Alternatives and Recommended Improvements
- 2004 Tighe and Bond Operational Evaluation and Recommendations
- 2004 Finals Operating Strategy
- 1996 EIMCO FST Shop Drawings

2.1 Final Settling Tanks Overview

The WPCF's final settling system consists of:

- Four (4) concrete tanks
- Four (4) clarifier mechanisms and associated drive units (one per tank)
- Four (4) 2,170 gallon per minute (gpm) return activated sludge (RAS) pumps
- Two (2) 2,530 gpm RAS pumps
- Two (2) 250 gpm waste activated sludge (WAS) pumps

Each of the existing FST mechanisms were manufactured by EIMCO Process Equipment Company (now Ovivo) and have single arm suction header-type clarifier mechanisms. The existing mechanisms are shown in Figure 2. Each mechanism includes a sludge header, two scum skimmer arms, influent column, feedwell, scum troughs, and Stamford baffle. The 1996 EIMCO FST drawings are located in Appendix FST-A.



Figure 2. Existing FST Mechanism

The existing clarifier mechanisms have been extensively repaired to keep the equipment in good operating condition. Based on available information the FSTs have experienced high sludge blankets, poor sludge settling, uneven flow distribution between the tanks, algae growth in weirs and overflow launders, and excessive scum buildup. The following clarifier components will be evaluated for replacement or incorporation into the design in the following section of this memorandum: clarifier mechanism (or sludge collection system), energy dissipating inlet (EDI), Stamford baffles, cylindrical baffle, effluent launder covers, and drip edge.

In 2018, the RAS pumps were replaced. The current RAS pumping system has four 2,170 gpm and two 2,530 gpm pumps (per existing pump nameplate data). The two larger pumps are typically on standby. The nominal

total combined capacity of the four smaller pumps is approximately 8,700 gpm or 12.5 MGD, however Veolia has reported that the RAS pumps provide a sludge removal rate of only 11.3 to 11.6 MGD at full capacity. A detailed discussion of RAS pumping capacity is included in Section 6 of this memorandum. The total combined capacity of the two WAS pumps is 500 gpm or 0.72 MGD. The WAS pumps were both replaced in 2018. Additionally, four FST drives were purchased in 2018-2019 and were replaced in 2022-2023.

3.0 Design Criteria

The four existing FSTs are each 110 feet in diameter with a 15-foot side water depth. The volume of each tank is approximately 1.0 MG. Design criteria were determined from prior record reports and drawings. The WPCF's National Pollutant Discharge Elimination Systems (NPDES) permit limits the monthly average, weekly, and daily effluent biochemical oxygen demand (BOD) and total suspended solids (TSS) to less than 20 milligrams per liter (mg/L), 30 mg/L, and 40 mg/L, respectively. Total nitrogen (TN) is limited to 1,105 pounds per day (lbs/d) as an annual average. The WPCF is also subject to the CT General Permit for Nitrogen Discharges with a limit of 718 lbs/d total nitrogen for the calendar year. The FSTs are the final BOD and TSS removal stage in the treatment process. Per the March 21, 2023, FST Workshop, the FST sludge blanket goal is less than 1-foot. A summary of the design criteria for the four FST units is included in Table 1.

Table 1. Final Settling Tank Design Criteria

Design Criteria	Value
Number of Tanks:	4
Material Collected and Removed:	Activated Secondary Sludge, Scum
Inside Tank Diameter:	110-feet
Side Water Depth:	15-feet
Freeboard:	3.00-feet
Tank Bottom Slope:	1/16-inch per foot
Average Secondary Treatment Flow	18 MGD
Average Design Flow to Each Tank:	4.5 MGD
Maximum Secondary Treatment Flow	30 MGD
Maximum Flow to Each Tank:	7.5 MGD
Surface Overflow Rate at Design Flow:	470 gallons per day per square foot (gpd/sf)
Surface Overflow Rate at Maximum Flow:	790 gpd/sf
Weir Loading Rate at Design Flow	13,700 gpd/ft

Design Criteria	Value
Dry Solids Loading Rate at Design Flow:	917,500 lbs/day
Underflow Solids Concentration at Design Flow:	7,400 mg/L

The design criteria for the existing FSTs were compared to that of industry design guidelines including the Water Environment Federation (WEF) Manual of Practice No. FD-8, Clarifier Design Second Edition (FD-8) and TR-16 Guides for the Design of Wastewater Treatment Works (TR-16). A summary of the design criteria for the four FST units in service as compared to the industry standards is included in Table 2. All the criteria considered are within the design guidelines except for side water depth (SWD) per TR-16 which is not a concern, as the SWD is within the FD-8 design guidelines.

Table 2. Design Values Based on Four Tanks in Service

Design Criteria	Value at Average Design Flow	Design Guideline	Source	Comparison
Side Water Depth	15-feet	16-feet minimum	TR-16	Unsatisfactory
		8 to 15-feet	FD-8	Satisfactory
Surface Overflow Rate at Design Peak Hourly Flow	790 gpd/sf	930 gpd/sf	TR-16	Satisfactory
		1,000 to 16,000 gpd/sf ¹	FD-8	Satisfactory
Solids Loading Rate at Design Peak Hourly Flow	24 lbs/day/sf	42 lb/day/ft ²	TR-16	Satisfactory
		20 to 30 lb/day/ft ²	FD-8	Satisfactory
Weir Loading Rate at Design Peak Hourly Flow	13,700 gpd/ft	N/A	TR-16	N/A
		15,000 gpd/ft	FD-8	Satisfactory

¹ Average is 1,230 gpd/sf

4.0 Technologies Considered

The technologies evaluated in this section of the memorandum include clarifier sludge collection systems (suction header, draft tubes, and spiral scraper), as well as other clarifier components such as energy dissipating inlets, baffles (Stamford and cylindrical), and algae prevention measures (effluent launder covers and drip edges).

4.1 Clarifier Sludge Collection Systems

The purpose of secondary clarifiers (FSTs) is to separate aerated MLSS produced by the activated sludge process from the water. Settled MLSS are removed via a sludge collection system and returned to the activated sludge process while the clarified water exits the clarifier (FST) for further treatment.

There are many types of FST sludge collection systems, or clarifier mechanisms, available in the industry. Each mechanism has its advantages and disadvantages based on the application, design criteria, and maintenance requirements. Based on the application at the Norwalk WPCF, three types of sludge collection systems were considered to replace the existing system. The three types considered were: suction header; conventional scraper with draft tubes; and spiral scraper. A description of each clarifier mechanism type is provided below.

4.1.1 Suction Header

The existing FST mechanisms are a suction header type. A suction header collection system removes sludge using a rotating suction header tube(s) that removes the concentrated sludge along the bottom of the clarifier via suction provided by a pump or gravity. Suction header clarifiers can have either one or two suction header arms. Unlike other sludge collection types, the suction header does not use scraper blades to direct sludge towards discrete suction ports, but instead provides a linear suction tube with many orifices that spans the entire radius of the clarifier. The header is mounted at an angle to physically and hydraulically trap the sludge. Typically, suction header clarifiers have a flat-bottomed tank as there is no need for a separate drain line, sloping floors, or special hoppers. An example of a single suction header type clarifier is shown below in Figure 3.



Figure 3. Suction Header Type Clarifier from Envirodyne Systems Inc.

The header design and gentle removal action reduces the chance of concentrated settled sludge resuspending into the upper liquid. The header's tapered design with a cross section that decreases from the center of the tank to the outer tip creates a uniform sludge withdrawal velocity. The orifice size on the headers is based on the amount of sludge that each orifice must remove to ensure the hydraulic balance required for proportional sludge withdrawal over the entire tank bottom. Performance of the suction header mechanism depends on the removal of rags, grit and grease before reaching the FSTs. Large amounts of rags and grit can damage or clog the suction header orifices.

4.1.2 Draft Tubes

A conventional scraper with draft tubes removes sludge using rotating sludge rake arms with many straight blades that direct sludge into multiple draft tubes. The draft tubes rotate around the center column with the rake arms and transport sludge from the tank floor to a sludge box near the drive platform. An example of a mechanism with draft tubes is shown in Figure 4.



Figure 4. Conventional Scraper with Draft Tubes

Once transported into the sludge box, the sludge is returned to the biological treatment process via a common pipe at the center of the clarifier. Control valves located in the sludge box allow for operators to vary the flow of sludge from each individual draft tube to better control the sludge removal from various areas of the tank floor. The sludge box discharges to a center sludge pipe located within the center column (pipe within a pipe). This piping configuration is substantially different than the existing FST configuration when comparing the physical tank and sludge piping arrangement.

4.1.3 Spiral Scraper

A spiral scraper collection system removes sludge using rotating sludge rake arms with spiral blades that direct sludge to a rotating sludge collection drum at the center of the tank. Each rake arm has a single blade constructed to a logarithmic spiral curve with a constant 30-degree angle. The sludge drum removes highly concentrated sludge that is brought by the spiral blades to the center of the tank. Sludge is then removed from the FST using a sludge draw off pipe located in the floor of the tank outside of the center column. An example of a spiral clarifier type mechanism is shown in Figure 5.



Figure 5. Spiral Scraper Type Mechanism from Envirodyne Systems Inc.

4.2 Other Clarifier Components and Considerations

4.2.1 Energy Dissipating Inlet

An energy dissipating inlet (EDI) is a clarifier component located between the influent column and the feedwell. An EDI lowers the velocity of the flow entering the clarifier to provide gentle mixing into the feedwell to maximize flocculation. EDIs lower the high velocity clarifier influent flow by directing the flow through ports or gates which deflect and reduce the force of water entering. EDIs have not been shown to cause head loss and negligibly effect plant hydraulics. By decreasing the influent velocity, EDIs improve the formation of a uniform sludge blanket and optimize solids settling.

There are a variety of types of EDIs on the market including a gated EDI, baffled EDI, and LA-EDI. An example of a LA-EDI is shown in Figure 6. Computational fluid dynamics (CFD) modeling of the various types of EDIs during detailed design is a cost-effective way to understand the potential performance of each EDI for the specific application prior to construction. While a retrofit is possible to add an EDI to an existing mechanism, incorporating an EDI should be considered during the clarifier design as a retrofit would be costly and include constructability concerns.



Figure 6. LA EDI

4.2.2 Baffle Considerations

Two baffles were considered for implementation at the WPCF's existing FSTs – a Stamford baffle and a cylindrical baffle.

4.2.2.1 Stamford Baffle

Stamford baffles are already installed on the WPCF's existing FSTs. A Stamford baffle is a downward-angled baffle installed along the interior walls of a clarifier under the effluent discharge weirs. Short-circuiting in clarifiers is often caused by currents of high-density influent which run along the clarifier floor, up the clarifier walls, and over the effluent weirs. Stamford baffles divert density currents rising along the clarifier walls and force them to mix with the rest of the tank volume. Stamford baffles act as the last layer of protection to prevent short-circuiting of solids over the weirs. The baffle is most effective when mounted to the tank below the effluent launder and approximately 2 feet above the sludge blanket. The distance the baffle protrudes into the tank is determined by the clarifier's specific hydraulic characteristics but is typically 2-feet or larger. An example of a Stamford baffle is shown in Figure 7.



Figure 7. Stamford Baffle

4.2.2.2 Cylindrical Baffle

A cylindrical baffle is typically positioned within a tank between $\frac{1}{3}$ and $\frac{2}{3}$ of the radius of the tank and is suspended above the floor but below the water surface. The height of the baffle can vary depending on the application. The baffle reduces density currents within the FST and increases the retention time in the clarifier by forcing water to take a more circuitous path from the feedwell to the clarifier walls. Reducing density currents promote better settling and keeps solids away from the effluent launders. The benefits of a cylindrical baffle are more evident during high flow events when density currents are exacerbated due to increased flow rates into the tank. Therefore, during high flow events, tanks with cylindrical baffles have been shown to retain solids better than those without. To be compatible with a spiral scraper mechanism, a gap between the floor and the baffle will need to be included. An example of a cylindrical baffle is shown in Figure 8.

The optimal baffle dimensions and locations should be analyzed with CFD modeling to minimize costs and avoid disturbing plant operations for in tank testing. If cylindrical baffles are not included in the initial design and installation of a mechanism, they can be added later in a phased approach as necessary to meet clarifier performance targets.



Figure 8. Cylindrical Baffles

4.2.3 Algae Prevention

Algae can grow rapidly on the surface of weirs, baffles, and troughs within a FST and require significant maintenance effort to remove. Algae can restrict flow through v-notches in weirs and impede other equipment. Two alternatives are considered for algae prevention – effluent launder covers and drip edges.

4.2.3.1 Effluent Launder Covers

Covering the effluent launders with an outward sloping cover extending from the outer wall to inboard of the scum baffle restricts sunlight penetration and mitigates algae growth. Aluminum launder covers are resistant to corrosion, normal abrasion, sunlight, atmospheric conditions, and environmental factors. In addition to reducing algae growth, launder covers contain odors and keep wildlife such as waterfowl out of the effluent launders. An example of an aluminum launder cover system is shown in Figure 9 and a proposal from Hallsten is included in Appendix FST-B.

Once the launders are covered, it may only be necessary to open the covers once or twice a year for inspection. When all sections are opened for cleaning, the effluent troughs, weirs, and baffles can be hosed down at the same time. It is important to note that a weir brush cannot be used with launder covers due to the configuration of the covers. However, because the launder covers reduce algae growth, weir brushing is not common.



Figure 9. Hallsten Aluminum Effluent Launder Cover

4.2.3.2 Drip Edges

Drip edges are an alternative to effluent launder covers that reduce the likelihood of algae growth on the inside of the effluent launders. An example detail for a drip edge is shown in Figure 10. The drip edges are made of ultra-high molecular weight polyethylene (UHMW) sheet stocks, which is not conducive to algae growth, and prevents effluent from trickling down the face of the concrete wall of the tank which is often an ideal surface for algae growth due to sunlight exposure.

While drip edges are less costly than effluent launder covers, a drip edge does not eliminate algae growth and does not address odor and waterfowl concerns. However, the drip edge does allow for the use of a weir brush to help aid in cleaning of the weirs during normal operation of the mechanism.

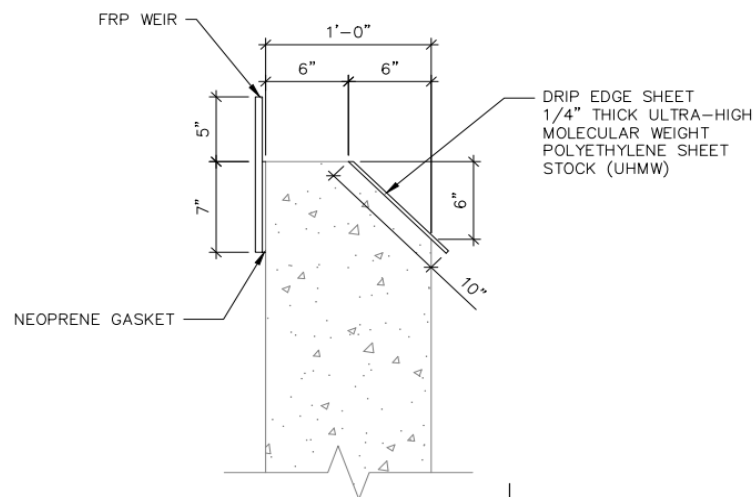


Figure 10. Drip Edge Detail

4.3 Material Type

The clarifier mechanism material will need to be evaluated during detailed design. Common clarifier mechanism material types include hot-dipped galvanized carbon steel, stainless steel, and painted steel. The chemical and physical characteristics of the FSTs help determine what mechanism material is recommended, also noting that the Plant Effluent Water used for flushing and spray is chlorinated.

5.0 Alternatives Analysis

A preliminary alternatives analysis was conducted to compare the viable clarifier mechanisms for upgrading the FSTs at the WPCF. The alternatives analysis assumes the existing concrete tanks and effluent launder remain unaltered. The analysis considers the suitability for the existing FSTs, performance, ability to address the concerns with the existing mechanism, and cost. The alternatives considered include the following:

- Alternative 1 – Suction headers
- Alternative 2 – Draft tubes
- Alternative 3 – Spiral scrapers
- Alternative 4 – Rehabilitate existing mechanism

Six of the leading clarifier equipment manufacturers were contacted and issued a request for information (RFI) for recommended mechanisms to replace the existing equipment. The RFI requested a cost proposal, product literature, and general arrangement drawings for the proposed equipment. A specific mechanism type or alternative was not specified in the RFI, and instead the manufacturers were allowed to propose the mechanism they recommended for the application. After receiving proposals from manufacturers, some of the alternatives were removed from consideration because they were not recommended by any manufacturers. Table 3 presents a summary of the clarifier manufacturer recommendations. The proposals are included in Appendix FST-C.

Table 3. Mechanism Manufacturer Response Summary

Manufacturer Responses	Alternatives			
	1. Suction Header	2. Draft Tubes	3. Spiral Scrapers	4. Rehabilitate Existing
	Envirodyne		Envirodyne	
	Evoqua			
	Kusters Water			
	Ovivo			Not Recommended
	Walker			
	WesTech		WesTech	

The subsections below summarize specific details associated with considerations for each alternative including mechanism specifics, constructability, and performance. Following the details of each alternative, Table 4 summarizes the benefits and considerations associated with each alternative.

5.1 Alternative 1 – Suction Header

The existing FST sludge collection mechanism is a single suction header type. In response to our RFI, six manufacturer proposals included suction header clarifiers. Four of the proposals were dual arm type and two were single arm type. All six proposals recommended including an EDI in the design.

Typically, a single arm suction header is adequate for clarifiers less than 110-feet in diameter, while larger clarifiers require dual arm suction headers. Due to the WPCF's operational needs and the capacity of the FSTs, replacement in kind with the existing single arm suction header mechanism is not recommended. Accordingly, under this Alternative, a dual arm suction header mechanism has been considered to provide improved sludge removal.

5.2 Alternative 2 – Draft Tubes

No mechanism manufacturer recommended draft tube clarifiers to replace the existing mechanisms. This is due to the configuration of the existing FST concrete tank and sludge piping in the tank floor which are not compatible with draft tubes. Therefore, Alternative 2 was removed from consideration.

5.3 Alternative 3 – Spiral Scrapers

In response to our RFI, two manufacturers recommended spiral scraper mechanisms to replace the existing equipment. Both proposals recommended the inclusion of an EDI. All of the manufacturers except for Evoqua make spiral scrapers. Even though only two of the five manufacturers recommended spiral scrapers, the performance concerns with the existing suction header mechanism make spiral scrapers an apt alternative. Both WesTech and Envirodyne indicated that they have successfully converted FSTs with suction header mechanisms to spiral scraper mechanisms. Additionally, both manufacturers confirmed that their spiral scraper mechanisms have been successfully installed in FSTs with flat floors without any significant slope. The slope of the FST floor has no impact on the mechanism design and in the manufacturer's opinion, the slope of the floor only impacts the FSTs' sludge storage capacity.

Spiral scrapers are an increasingly popular technology in the clarifier equipment market and have been implemented at numerous plants. The spiral scraper clarifier removes sludge quickly because only one rotation of the scrapers is required to bring the sludge from the edge of the clarifier to the center for removal. The drum is less susceptible to clogging and requires little maintenance, and the spiral scraper mechanism has fewer moving parts than suction header mechanisms. However, due to the length sludge has to be carried with the spiral scraper, the drive unit experiences higher torque loading when compared to other types of mechanisms.

5.4 Alternative 4 – Rehabilitate Existing Mechanism

Due to the condition of the existing clarifier mechanisms and the concerns with sludge removal with a single suction header arm, rehabilitation of the existing mechanisms was not recommended by the original equipment manufacturer, Ovivo. The average useful life of a clarifier mechanism is estimated to be 30 to 35-years. This means that by the time the WPCF rehabilitated the existing clarifier mechanism, which is currently 26-years-old, its remaining useful life would be less than 20%.

5.5 Alternative Analysis Summary

A summary of the benefits and considerations associated with the four alternatives evaluated are included in Table 4.

Table 4. Comparison of Feasible Alternatives

Alternative	Benefits	Considerations
Alternative 1 – Suction Header	- Increased sludge removal rate with dual arm headers - Operations and maintenance staff familiar with technology - Minimal underwater disturbance - Rapid removal of sludge	- Potential for clogging of intake orifices - Suction headers can be damaged from rags or grit - Neoprene seal for sludge manifold to center column is critical
Alternative 2 – Draft Tubes	Removed from consideration due to lack of manufacturer recommendations and sludge blanket depth concerns	
Alternative 3 – Spiral Scrapers	- Ability to operate with lower sludge blanket - No orifices to clog - One rotation to bring sludge from clarifier edge to center collection drum	- Increased torque on drive unit - Routine maintenance of neoprene seal for sludge collection drum to center column
Alternative 4 – Rehabilitate Existing Mechanism	Removed from consideration due to existing mechanism conditions and previous repairs	

5.6 Recommended Alternative

Based on the operational and maintenance requirements along with the performance benefits, the recommended alternative is Alternative 3 – Spiral scrapers. This alternative addresses the concerns with the existing FSTs while reducing the maintenance frequency, reducing potential of clogging of intake orifices, and lower the operating sludge blanket. Per the March 21, 2023 FST Workshop, the alternative also includes four new drives for the FSTs.

6.0 Other Considerations for Improvements

6.1 Clarifier Components

It is recommended that CFD modeling is used during detailed design to determine which clarifier components will best enhance the effectiveness of the FSTs. Table 5 is a summary of the other clarifier components considered in conjunction with the recommended alternative.

Table 5. Other Clarifier Components

Clarifier Component	Summary
Energy Dissipating Inlet	Include in detailed design and evaluate with CFD modeling for which type of EDI is best suited for the recommended alternative.
Cylindrical Baffle	Evaluate as part of detailed design with CFD modeling to determine if it is beneficial for the recommended alternative while determining the radius, height, depth below water surface, and floor gap.
Stamford Baffle	Include in detailed design.
Effluent Launder Covers	Include in detailed design.
Drip Edge	Not recommended to address the concerns raised with algal growth and water foul.

6.2 Return Sludge Pump Station

6.2.1 RAS Pumping Capacity

As discussed previously, the WPCA reported that the RAS pumps are not reaching the design flow rate of 12.5 MGD when the return sludge pump station (RSPS) is operating at full capacity. The four existing 2,170 gpm RAS pumps are providing a maximum sludge removal rate of 11.6 MGD. When the two larger 2,530 gpm RAS pumps are also used, the sludge removal rate increases to 12.0 MGD. The two larger RAS pumps have the capability to discharge flow into the flow distribution box located between the FSTs and the RSPS. WPCA and Veolia have expressed a desire to increase the RAS system capacity (potentially to 150% of rated WPCF capacity, or 27 MGD) with the goal of improving secondary treatment performance and providing greater operational flexibility.

To better understand existing limitations on RAS flow, hydraulic calculations were performed to develop and plot the RAS system curve against the existing pump curves. The existing system and pump curves are shown in Figure 11. Figure 11 shows that when the four lower capacity RAS pumps are running, the system should theoretically produce 11.8 MGD of flow, and that when all six pumps (low and high capacity) are running, the system should theoretically produce 13.5 MGD of flow. The theoretical operating point with the four RAS pumps running is 0.2 MGD higher than the observed system flows, which is well within the expected error range of +/-10

percent for hydraulic calculations and calibration. However, the deviation in flow between observed and theoretical values when all six pumps are running is 1.5 MGD, outside the expected error range. This may indicate that there was a partially closed valve or some other hydraulic irregularity contributing excess headloss to the system when the high-capacity RAS pump flow data was collected. It is recommended that flow conditions with six pumps operating be further evaluated during detailed design before any improvement alternatives are implemented.

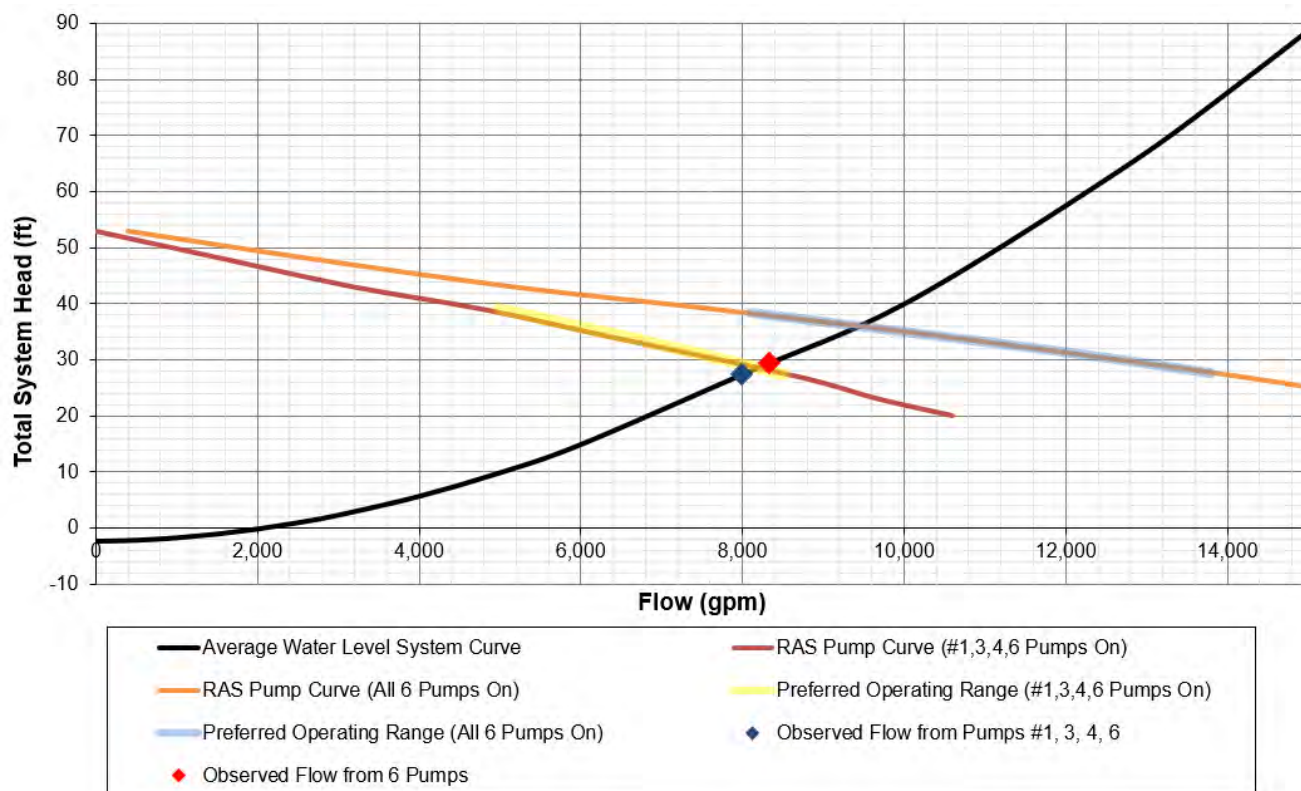


Figure 11. Existing Pump and System Curve

It should be noted that the four low-capacity RAS pumps are theoretically operating on the low end of the pumps' preferred operating range (POR) but within the allowable operating range (AOR). When all six RAS pumps are operating, the theoretical operating point is well within the POR.

Two alternatives were considered on a conceptual level to increase the pumping capacity of the RSPS:

- 1) Upsizing the existing RAS pumps only (no modifications to discharge pipe)
- 2) Upsizing the existing RAS pumps and discharge pipe capacity

Upsizing or altering the configuration of piping within the pump station was not evaluated, as the interior pump station piping contributes a low proportion of the existing total system head loss. Optimizing the piping within the RSPS should be reviewed alongside proposed improvements for this area of the WPCF if significant modifications to the RSPS are considered.

6.2.1.1 Alternative 1 – Upsize Existing RAS Pumps

The first alternative evaluated was upsizing all six pumps to Pentair C5424 30 horsepower (HP) pumps with an 18-inch diameter impeller. The existing larger pumps are Pentair C5424 pumps but have a 17.22-inch diameter impeller. Figure 12 plots the existing system curve against the upsized pump curves. Figure 12 shows that four upsized RAS pumps could produce 13.5 MGD, while all six upsized pumps could produce 14.7 MGD, an increase of 1.7 MGD and 1.2 MGD from existing theoretical operating points, respectively. Upsizing the pumps shifts the system curve further into the POR when the four RAS pumps are running, potentially increasing the efficiency of the RAS system.

The existing RAS pumps and the C524 pumps have similar footprints. Accordingly, the existing RSPS layout and footprint could be maintained, which would minimize construction complexity, cost, and operational impacts to the WPCF. Some localized layout modifications are anticipated to accommodate the new pumps. The impacts of pump dimensions on the layout should be evaluated further during detailed design.

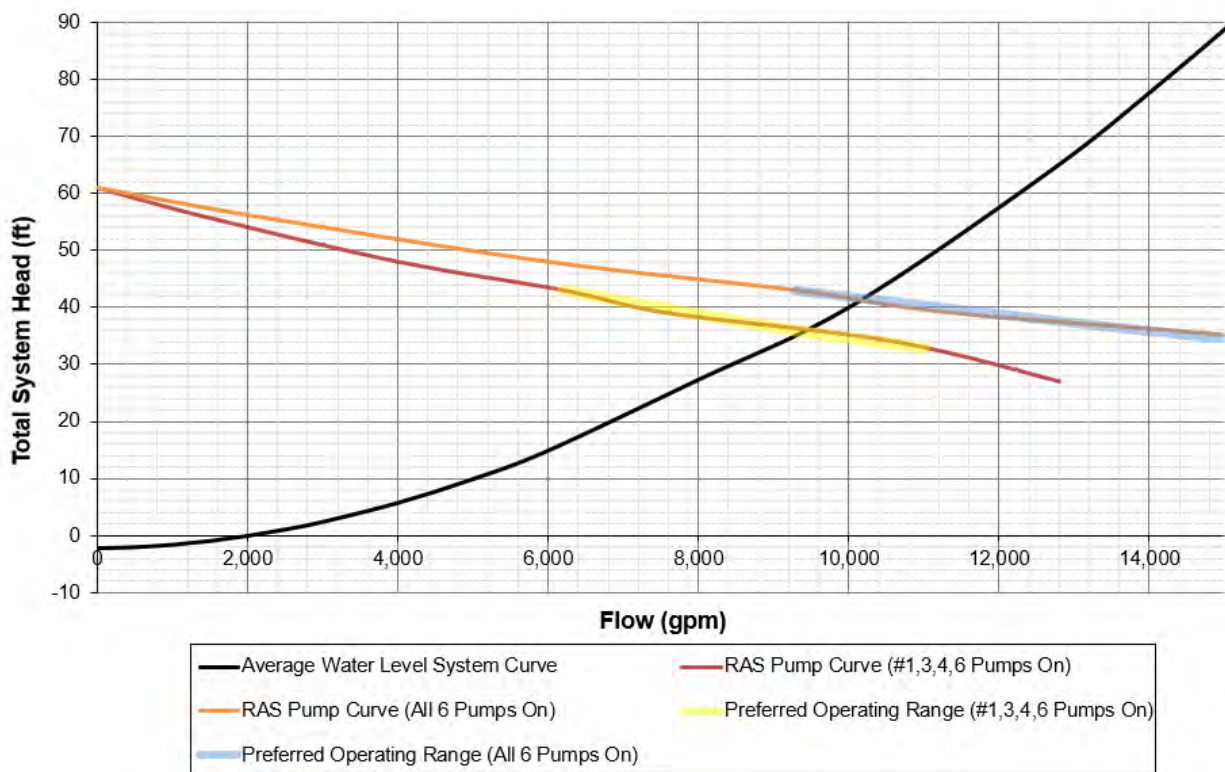


Figure 12. Replace all pumps with Pentair C5424 18" Impeller

6.2.1.2 Alternative 2 – Upsize Existing RAS Pumps and Discharge Pipe Capacity

To further increase RAS system capacity beyond that described in Alternative 1 and achieve the maximum RAS system capacity goal of 27 MGD, the capacity of the RAS discharge piping must be increased. The hydraulic calculations show that the primary limiting factor of the RAS system capacity is the existing 20-inch diameter discharge pipe, as the majority of the system head loss occurs in the discharge pipe. Alternative 2 could be

accomplished by either upsizing the discharge pipeline to a single larger pipeline diameter, or by installing a parallel 20-inch diameter discharge pipeline. If the discharge pipe size was increased or a parallel header is installed, the existing pumps would have to be replaced to maintain efficient pump operation, as the shift in the system curve would result in the existing pumps operating outside of their POR.

Due to the significant difference in both flow and head between the target design flow of 18 MGD and the maximum flow of 27 MGD, variable frequency devices (VFD) would be required to provide the new pumps with the necessary range to operate under both conditions. Six identical pumps could be installed, which together could meet the target maximum flow while running at full speed. Under typical operating conditions, four of the pumps could run at a reduced speed to remain within their POR at lower flow and head conditions. The required pumps would have approximately 100 HP motors, which is significantly larger than the existing 20 HP and 30 HP pump motors. Due to the larger pump size, it is possible that the existing RSPS would have to be substantially altered or expanded to accommodate the larger pump footprint.

The construction required to incorporate a higher capacity RAS discharge pipe and upsized RAS pumps is substantially more complex and costly when compared to Alternative 1. Furthermore, the operational impacts to the WPCF will need to be further assessed and discussed with the WPCA and Veolia.

6.2.1.3 Recommendations

It is recommended that Alternative 1 be implemented as an initial step to improve RAS system capacity. Although upsizing the discharge pipe is necessary to significantly increase RAS system capacity, replacement of the discharge piping or installation of a parallel header would be costly, would require replacement of the RAS pumps, and may require significant alteration or expansion of the RSPS.

Upsizing the existing pumps is less costly, and provides an increase in of 1.2 to 1.7 MGD of RAS capacity depending on the operating conditions. Other recommended improvements to the FSTs, including improvements to the sludge collection system, may alleviate the need for additional RAS capacity. Therefore, it is recommended that the WPCA approach FST and RSPS related improvements in a stepwise manner beginning with completion of the tank-related improvements (sludge collection system upgrade and incorporation of other clarifier components) and Alternative 1 of RSPS improvements. If necessary after post-construction observation, the more robust RSPS improvements could be considered.

6.2.2 Structural Condition Assessment

The existing RSPS building was visually surveyed on March 23, 2023, and the existing structural drawings from the 1996 Plant Upgrade were reviewed. The existing structural conditions are summarized below in Table 6. The referenced structural photos are located in Appendix FST-D.

Table 6. Structural Condition Assessment for RSPS

Area	Structural Assessment
Return Sludge Pump Station Building – Lower Area	Internal surface of concrete walls showed hairline cracks with efflorescence, a crystalline salt deposit. Photos at the locations are attached. See photo #s 1-11. Some minor cracks with efflorescence were also seen in the ceiling. See photo # 8. There were also surface stains due to a leak at pipe penetration. See photo #12.
Return Sludge Pump Station Building – First Floor	On the first floor, cracks in the concrete topping were observed and at one location part of topping was missing. See photo #s 13-14. Precast roof slabs over first floor are in good condition.
External Fuel Tank	Under the stair footing, soil has settled and created a hole, likely due to erosion. Some repair was completed. See photo #s 15-16.

Based on the assessment, the structure is generally in good condition. Signs of wear included wall cracks with efflorescence on the lower level of the building and floor topping damage on the first floor level.

A more detailed structural assessment is recommended during detailed design. The existing structure should be addressed per the following recommendations:

- Detailed concrete surface assessment will need to be performed to prepare repair drawings.
- First floor topping will need to be removed and replaced with new topping.
- Stair foundation for external fuel storage tank will need to be reviewed on site to prepare repair detail.

6.2.3 HVAC Condition Assessment

The RSPS includes a hot water heating system consisting of a boiler and pumps that supply hot water to heating and ventilating equipment in the building. The boiler is fuel oil fired and receives fuel oil from an aboveground steel tank at the south end of the building. The fuel oil pumps are located in the HVAC room along with the boiler and heating and ventilating unit. The heating and ventilating unit provides 100% outdoor air to the building and includes a hot water heating coil for heating. There are two ductless split system air conditioning units serving the electric room. Exhaust fans for removing air from the building are located on the roof. Arcadis completed a detailed condition assessment of the HVAC system in the RSPS in 2016. As part of this condition assessment, Arcadis reported that most ventilation equipment was not operational or operating at limited capacity. Although most equipment has reached the end of its service life, the building interior mounted equipment appeared at that time to be in fair condition and in better condition than most of the equipment observed in other buildings that were replaced during the 1996 Plant Upgrade. Given the age of the equipment, it is recommended that all HVAC components within the RSPS be upgraded alongside other building improvements.

6.2.4 Electrical

The RSPS electrical distribution consists of a motor control center (MCC-RSPS) which distributes power to all of the building loads and the FST drives. The MCC was installed in the 1990's and is in good condition.

The scope of work for this focus area is to replace the FST drives, WAS pumps, RAS pumps, and the entire building's HVAC system.

Per the previous RAS discussion, the RAS pumps, which are variable frequency drive (VFD), may increase in size. The FST drive would likely be changed from a control panel to a starter in the MCC and new starters and controls would be required for the HVAC system. The loads mentioned above would require approximately 75% of the MCC to be modified. Therefore, while MCC-RSPS is in good condition, it is over 25 years old and required retrofitting would be cost prohibitive. It is therefore recommended that the WPCA replace the MCC rather than perform field modifications to the existing. Included with the replacement of the MCC, all conduit and wires originating from the MCC will be demolished and replaced with new.

In addition, an increase in the size of the RAS pumps may result in the associated existing VFD's being undersized and require replacement.

MCC and the VFD replacement will need to be staged to avoid disruptions during construction. The staging will be developed during the detailed design.

Additional existing equipment such as low voltage transformers and panelboard may be demolished and replaced. This determination will occur during the detailed design.

6.2.5 Instrumentation and Controls

A detailed review of the existing 'as built' Norwalk WPCF supervisory control and data acquisition (SCADA) Network diagram, return sludge control panel (RSCP) drawings were performed. These documents were prepared by Aaron Associates of Waterbury, CT, dated 2019/2020.

A marked-up plant SCADA network diagram is located Appendix FST-E for ease of understanding this report.

A site visit was done in March 2023 to assess the existing conditions and to record any changes to the existing programmable logic controllers (PLCs) input/output (I/O) and SCADA network connections in the RSPS.

Currently, the existing RSCP in the RSPS electrical room provides remote monitoring and control capability for the FSTs, RAS pumps, WAS pumps, and secondary scum systems, and is utilized to integrate the respective process equipment into the plant SCADA system. This panel was furnished over 25 years ago and contains many obsolete and non-operational components. It is recommended that a new PLC control panel be installed in the electrical/control room to replace the existing RSCP.

Prior to installing a new RSCP, the existing secondary scum wet well bubbler system will be switched over to a new submersible hydrostatic level detection system. Subsequently, the existing bubbler system will be decommissioned and demolished and the new RSCP will be installed in its location in the existing electrical/control room. All other equipment pertaining to the FSTs, RAS pumps, WAS pumps, and secondary scum systems currently hardwired to the existing RSCP will also be replaced as part of the RSPS upgrades and will be connected to the new RSCP via new field wiring. To minimize impact to the plant's operations, the switchover from existing to new RSCP will be carried out sequentially, with both control panels running in parallel. Once all field equipment and systems are successfully switched over to the new RSCP and verified, the existing PLC control panel will be decommissioned and demolished. The existing PLC and Operator Interface Terminal (OIT) units furnished as part of 2019 SCADA upgrades will be turned over to the City to be utilized as spare parts.

A new return sludge building network interface panel (RSBNIP) will be furnished to house the fiber and copper ethernet communication devices currently residing inside the existing RSCP and will be installed inside the

existing electrical/control room. The new RSCP will be connected to the plant SCADA network via Category 6 (CAT6) Ethernet connection between its local Ethernet switch and the new RSNIP. A new Ethernet switch will be furnished and installed inside RSNIP to support future SCADA network connections in the building.

The new RSCP will be equipped with a door-mounted OIT, which will be configured to provide graphical interface for the field equipment connected to this panel. The existing RSCP PLC program will be modified as required and migrated onto the new PLC hardware to provide remote monitoring/control functionality for connected field equipment. The plant SCADA system human-machine interface (HMI) application will be modified to incorporate graphical interfaces for all systems/field equipment upgraded as part of the RSPS improvements. In addition, the SCADA Historian and reporting systems will be reconfigured to incorporate system parameters for historical data logging and reporting. All changes/additions to existing software applications will adhere to the existing SCADA system programming standards/conventions to maintain consistency in interface and functionality across the plant SCADA system.

6.3 FST Structural Assessment

One of four existing FSTs was visually examined on March 23, 2023 to assess the need for further detailed evaluation for structural rehabilitation. In addition to the visual survey, the existing structural drawings prepared by Malcolm Pirnie, dated March 1996, were reviewed. FST #1 was examined and seemed to be in good condition. Minor cracking at the access stair was observed. As all tanks were operational, existing conditions under the water surface could not be observed. A photolog of the observed cracking is located in Appendix FST-F.

A more detailed structural assessment is recommended during detailed design. Existing FST structures should be addressed per the following recommendations:

- Detailed concrete surface assessment will need to be performed to prepare repair drawings.
- Cracks to be injected with appropriate materials (during construction).

Arcadis subcontracted KS Engineers (KSE) to perform a more detailed visual inspection of the FSTs on May 19, 2023, and the report is included as Appendix FST-G. The purpose of the inspection was to determine the overall conditions of the structures and to identify any major structural deficiencies via a visual inspection. FST #1 was taken offline for closer observation of the interior concrete walls. KSE inspected the inside faces of FST #1 and the outside walls of FSTs #1 through #4. The overall concrete on the outside faces is in good condition, except for some isolated longitudinal and vertical hairline cracks, some with efflorescence. The underside of the top concrete catwalk exhibits a typical pattern of hairline transverse cracks with efflorescence throughout the perimeter of the tanks. KSE noted a shallow spall at the fascia of the catwalk on FST #4. The concrete on the inside faces of FST #1 is in overall good condition. No significant structural concerns were noted on the inside or outside faces of the FSTs, however, isolated repairs are recommended to promote the longevity of the FSTs. The type and extent of repairs will be evaluated during detailed design.

6.4 Wash Water Sources

Plant effluent that is used as the wash water source is chlorinated. Proposed construction materials will be reviewed for compatibility with this source water in detailed design.

6.5 Flow Distribution Box

The WPCA and previous reports suggested that the flow distribution within the FSTs may be uneven which could result in eddies or currents. Due to these concerns, the hydraulics for the flow split of the distribution box should be reviewed in detailed design.

7.0 Probable Total Project Cost

A preliminary total project cost estimate was developed as a part of this evaluation and includes an opinion of probable construction cost (OPCC) and associated project cost for the selected alternative described in Section 5.6 and other recommended upgrades described in Section 6.0. The OPCC includes the recommended sludge collection system identified in Section 5.6 (spiral scraper), other clarifier components outlined in Section 6.1 (EDI, Stamford Baffle and effluent launder covers), Alternative 1 for the RSPS presented in Section 6.2.1.3 (upsized pumps only), and other building improvements summarized in Sections 6.2.2 through 6.2.5.

The costs presented herein are a preliminary estimate for engineering feasibility/planning purposes only. The construction cost estimate is consistent with a Class 4 estimate as defined by the Association for the Advancement of Cost Engineering (AACE) International. The guidelines for Class 4 estimate per AACE indicate the estimate is typically used for feasibility studies and carries an expected range of accuracy of -30% to + 50%, with approximately 1% to 15% project definition. The OPCC for the FST improvements as a point estimate is \$17,000,000. A breakdown of the OPCC can be found in Appendix FST-H.

In addition to the construction cost, an engineering and contingency addition of 15-20% is projected, or a total additional cost of approximately \$3,000,000 for a probable total project cost of \$20,000,000.

Appendix FST-A

1996 EIMCO Final Settling Tank Drawings

Appendix FST-B

Aluminium Launder Cover System Proposal



Wednesday, March 22, 2023

Project: Norwalk CT. – Final Settling Tanks - Weir Covers

BUDGETARY MATERIAL SCOPE
ALUMINUM COVERS
(Limited by this Material Scope as Set Forth Below)

Final Settling Tanks No. 1~4

- Four (4) approx. 110'-0" outside diameter annular aluminum launder cover approx. 3'-7" wide. (111'-0" outside diameter, 103'-6" inside diameter.) Each cover system is mounted to the top surface of the outside wall and contains vertical supports (provided by Hallsten) attached to the concrete weir walls (approximately 36" tall) as required for a complete installation. The cover system also includes Hallsten standard gear hinge hatches (hinged as shown on proposal drawing) for access to the launder/weir area around the perimeter of the clarifier at the locations shown on the drawings, a Santoprene curtain extending downward from the inside face of the cover system as required, handrail sockets, OSHA two rail handrail panels and kick plates located at the interior circumference of the clarifier cover, and zero (0) penetrations for any off gas piping or vents.

Approximate Total Square Footage: 5,056 Sq. Ft.

INSTALLED (EXCLUDING TAX) BUDGETARY QUOTE \$ 828,750.00
Sales Tax (If required, any applicable sales tax will need to be added) \$
OPTION 1: Add a Hallsten penetration kit (11" x 11" I.D.) \$ 550.00

Note: The Contractor accepting this Scope of Work shall be responsible for unloading of Hallsten's material at the project site and shall provide a safe and secure location for its storage.

Including:

- Hallsten's patented double interlocking decking incorporating a permanent integral non-skid surface.
- 6061-T6 corrosion resistant aluminum alloy construction with mill finish.
- 316 stainless steel anchor bolts and fasteners.
- Designed for 150-pound uniform live load with an L/240 deflection limitation.
- Designed for a 500-pound concentrated load on a 12" x 12" square area at any location of any panel.
- Hallsten standard hatches located around the circumference of the clarifier at the locations indicated on the drawings.
- Vertical supports as required for a complete installation.
- OSHA two rail aluminum guardrail with toe plate at the interior circumference of each primary clarifier cover.
- Panel weight limitation of 150 pounds.
- Santoprene gaskets.
- Installation limited to (2) two mobilizations.
- Production of shop drawings.
- Submittal drawings and calculations signed and sealed by a California professional engineer. Final revision signed and sealed by a Connecticut professional engineer.
- Delivery to job site.

- Site survey as required for fabrication of cover system. Note: All areas and equipment must be in place prior to Hallsten deploying for field survey.
- Hallsten Corporation one (1) year warranty.

Excluding:

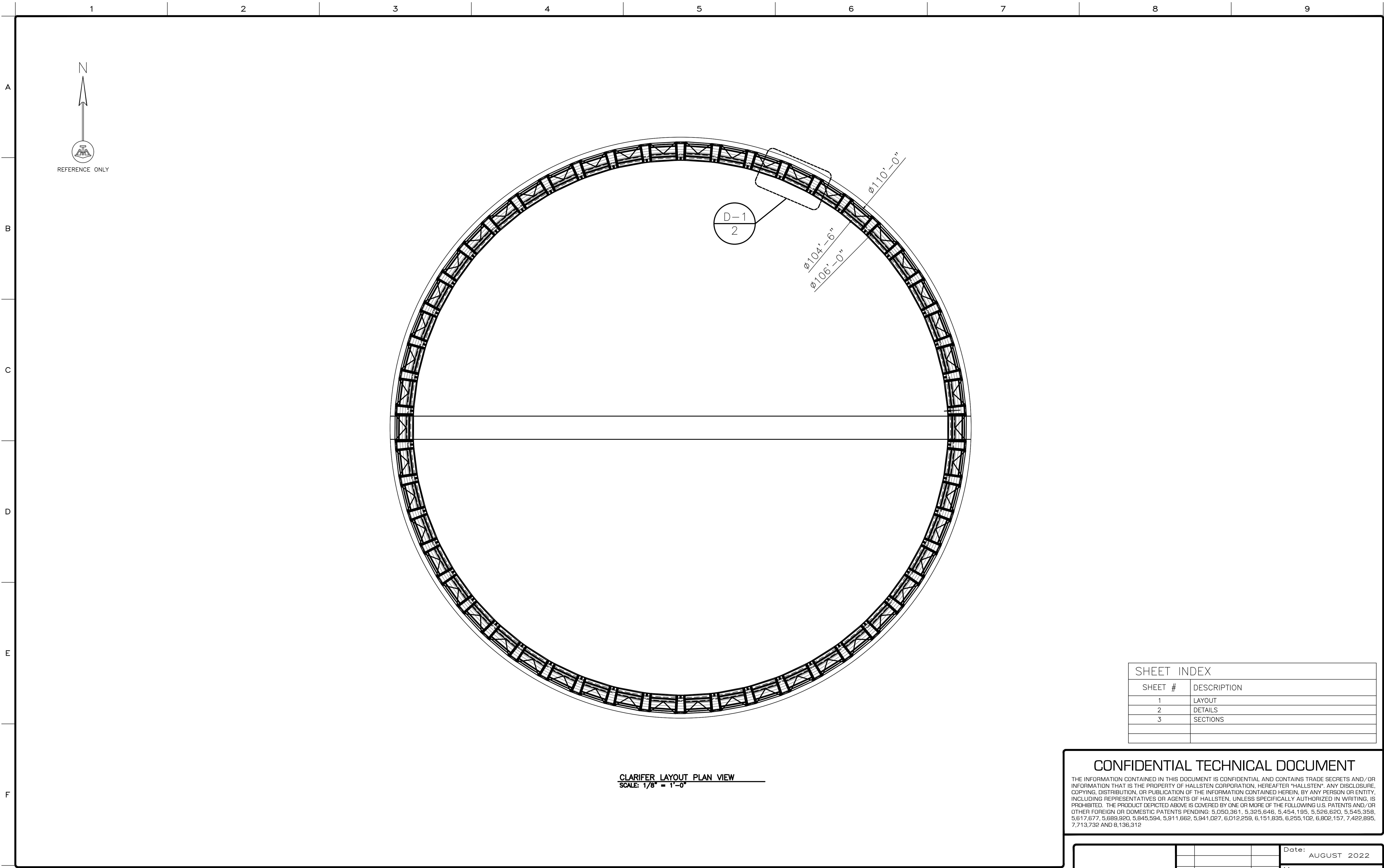
- ✧ Unloading of Hallsten supplied materials.
- ✧ Storage or protection of Hallsten supplied materials.
- ✧ Applicable sales tax.
- ✧ Onsite testing of any kind.
- ✧ Permit, bond and license fees.
- ✧ Tank shutdown or sludge removal costs.
- ✧ Trash receptacle or dumpster.
- ✧ Onsite portable toilet, temporary office or phones.
- ✧ Union agreements.
- ✧ Weir Plates.
- ✧ Piping and ductwork.
- ✧ Pipe Flanges or Curbs.
- ✧ Pipe supports.
- ✧ Vents or dampeners of any kind including vacuum/pressure relief.
- ✧ Electrical work of any kind including relocation of conduit for cover clearance.
- ✧ Loads greater than 50-pounds per square foot imposed on the cover system by pipe supports, ductwork, gates or gate operators, or any other appurtenances.
- ✧ Confined space entry, equipment or certified personnel of any kind.
- ✧ Concrete repairs and coatings.
- ✧ Anodizing.
- ✧ Silicone sealants. (Hallsten uses Sikaflex 1a as an equal to this item.)
- ✧ EDPM gaskets or sealing strips. (Hallsten uses Santoprene as an equal to this item.)
- ✧ Demolition or disposal of any existing equipment.
- ✧ Handrail or relocation of handrail for cover clearance. (other than listed above)
- ✧ Walkways, Stairs, Grating, Drains, or Checker plate.
- ✧ Nameplates or Signage of any kind.

Hallsten Corporation shall hold the budgetary price listed above for 90 days from the date listed at the top of this scope. Estimated time frame for submittals is 10 weeks from receipt of an order. Estimated time frame for fabrication/delivery is 36~40 weeks from receipt of approved submittals and completed site survey.

Sincerely,



Brian Lambert
Project Manager



SHEET INDEX	
SHEET #	DESCRIPTION
1	LAYOUT
2	DETAILS
3	SECTIONS

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PLANT ADDRESS:
6944 34TH STREET, N. HIGHLANDS, CA 95660
MAILING ADDRESS:
P.O. BOX 41036 SACRAMENTO, CA 95841
(800) 473-7440 / (916) 331-7211 / HALLSTEN.COM

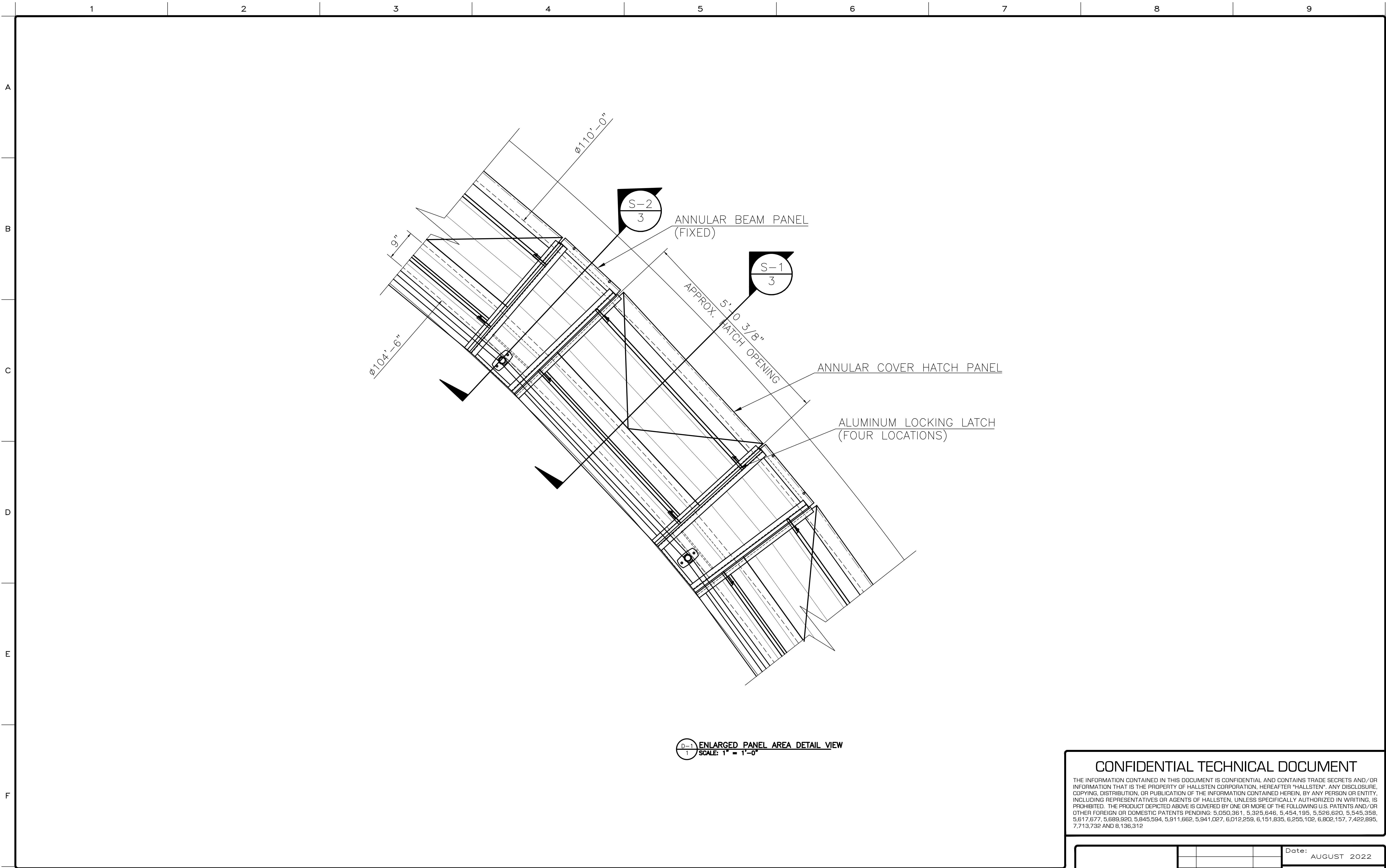
110' CLARIFIER - LAUNDER COVER EXAMPLE

ALUMINUM COVERS
ANYTOWN, USA

TYPICAL LAUNDER COVER

0 1/2 1
DRAWING NOT TO SCALE
IF BAR IS NOT 1"

			Date:	AUGUST 2022
			Manager:	M. ADAMS
			Drawn By:	B. LAMBERT
			Sheet:	1 of 3
			Dwg. No.:	PROPOSAL
			REVISIONS	



D-1
1
ENLARGED PANEL AREA DETAIL VIEW
SCALE: 1" = 1'-0"

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110' CLARIFIER - LAUNDER COVER EXAMPLE

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ENLARGED AREA

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IF BAR IS NOT 1"

			Date:	AUGUST 2022
			Manager:	M. ADAMS
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			Sheet:	2 of 3
			Dwg. No.:	PROPOSAL
			REVISIONS	

SPECIFICATION FOR ENGINEERED SURFACE MOUNTED ALUMINUM ANNULAR/LAUNDER COVERS

I. General

1. This specification is for a fully engineered, substantially airtight, surface mounted aluminum cover structure comprised of panels, and beams as manufactured by Hallsten Corporation, P.O. Box 41036, Sacramento, California 95841, (800) 473-7440. This specification shall be regarded as a minimum standard for design and fabrication. Other cover system types such as formed aluminum, dome, fiberglass, carbon steel, or geomembrane shall not be acceptable and will not be considered for this project.

2. Scope of Work:

Furnish all labor, materials, and equipment to provide a complete, installed system of fixed and removable, custom fit, flat aluminum covers. The Tank Cover system includes cover panels, structural beams, support columns, Santoprene curtain, optional aluminum guardrails, and attachment hardware.

Please list all tanks, channels, etc. where an engineered cover system is required and clearly identify on the contract drawings provided:

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

II. Engineering

A submittal shall be provided to the engineer prior to the beginning of fabrication. The submittal shall include:

- (a) Complete structural calculations showing the governing stresses in all members and connections, and detailed shop drawings. Preliminary drawings shall be stamped by cover manufacturer's PE. Final Drawings and calculations shall bear the stamp of local state PE if required.
- (b) Manufacturer's standard guarantee.
- (c) A letter of certification signed and sealed by a registered Professional Civil Engineer confirming that the aluminum cover is in full compliance with the plans and specifications including any testing provisions included therein.

III. QUALIFICATIONS

1. Manufacturer:

Shall be a company specialized in providing engineered aluminum covers for wastewater treatment tanks/troughs for at least ten (10) years. When requested by the Engineer, submit written evidence to show experience qualifications and adequacy of plant capability and facilities for performance of contract requirements.

2. Erector:

Regularly engaged for at least ten (10) years in the erection of aluminum covers for wastewater treatment tanks.

3. Welders:

Qualified within the past two (2) years in accordance with AWS.

IV. Performance

1. Span:

The clear span length of the cover shall be as noted in the scope of work.

2. Width:

The inside width of the cover shall be as noted in the scope of work.

3. Walking surface elevation:

Installed cover system walking surface elevation to be approximately two inches above top elevation of tank/basin walls.

4. Distributed Design Live Load and Deflection:

All structural components shall be designed to support the dead weight of the structure, plus a live load of 50 pounds per square foot of surface. The maximum deflection of any component under this load shall not exceed $L/240$ of the span of that component. In no event shall the dead load deflection exceed the rise of any component in order to avoid surface ponding.

5. Concentrated Live Load:

The structural components shall be designed to support a 400-pound load on a 6" X 6" area located anywhere on the surface of the structure without permanently deforming the tested area.

6. Design Stresses:

All allowable design stresses in structural aluminum shall be in accordance with the "Specifications for Aluminum Structures" for building-type structures by the Aluminum Association.

7. Skid Resistance:

The cover shall possess an integral non-skid surface and no exposed area of cover system wider than one inch shall be without ribs/non-skid surface. The aluminum-decking surface of the structure shall be Hallsten's Deck Slat, which is ribbed to provide an aggressively non-skid surface. The edges of adjacent deck slats shall double interlock so that the slats shall act together. The decking surface shall be manufactured from 6061-T6 alloy. The Manufacturer of the non-skid surface shall demonstrate in writing satisfactory performance for a minimum period of 10 years in the wastewater industry for the intended purpose. This surface shall not be achieved by the use of paint, adhesive tapes, sand blasting or any other means other than an extruded process.

8. Chemical Resistance:

Panels shall be fabricated entirely of 6061-T6 corrosion resistant aluminum extrusions. Every panel to beam connection shall be chemical resistant and will not weaken or corrode and will interlock. A mechanical and replaceable Santoprene seal shall isolate the cover perimeter from the concrete wall. No foam tape or caulk shall be allowed.

9. Configuration:

The aluminum cover shall be composed of panels and beams. All panels shall interlock with the adjoining beam/beams without the use of threaded fasteners. Uplift of each panel will be resisted with the use of an integral latch system. The weight of an individual panel shall not exceed 150 pounds. Each removable panel shall be easy to remove without disruption of adjacent panels and the lifting force required shall not exceed the dead weight of the panel.

10. Curtain:

A mechanically attached Santoprene curtain shall be installed at the interior inside edge of all panels and beams to provide a U.V. barrier for the weir area. The curtain will also assist in isolating the area under the cover if a negative pressure scrubber is to be utilized.

V. Materials

1. Aluminum:

All aluminum used in the fabrication of the cover shall be alloy 6061-T6. All plate shall be alloy 6061-T6. Material shall be new and of top quality.

2. Welding Electrodes:

Welding shall be with electrodes of an alloy, which shall produce welds with strength and corrosion resistant characteristics compatible to the base metal.

3. Fasteners:

All fasteners between aluminum components shall be stainless steel or structural plastic. Aluminum shall be isolated from dissimilar materials by means of a stainless steel spacer or an elastomeric isolator. Beams and panels shall be fastened to concrete using stainless steel drill in place anchor bolts.

4. Steel Accessories:

No carbon steel components shall be used.

5. Seals:

A mechanical and replaceable Santoprene seal shall isolate the cover perimeter from dissimilar materials such as concrete and steel. No foam tape or caulk shall be allowed for isolation of cover system.

6. Access Hatch Panels:

Access to any location under the cover shall be gained through integral gear hinged access hatches. The Access Hatch Panels shall have the identical properties as the rest of the aluminum cover including loads, deflection and slip resistance specifications. The access-hinged panels shall be the full panel width. The length of the access panel shall be clearly indicated on drawings. Hinged panel components including hinges, decking and lifting handles shall be extruded 6061-T6. While in the closed position the hatches will be completely flush therefore posing no tripping hazard. In the open position the panel shall lie flat on the cover and will not need a hold open device.

7. Handles:

Handles shall be an integral flush mounted aluminum and incorporated into the non-skid deck slat.

VII. Fabrication and Workmanship

1. Workmanship:

The quality of workmanship shall be equal to the best general practice in modern structural fabrication shops. Workmanship, fabrication, and shop connections shall be in accordance with the latest edition of ANSI/AWS D1.2 "Structural Welding Code - Aluminum".

2. Experience:

The manufacturer must furnish adequate evidence of a minimum of ten (10) years of ongoing experience in the manufacture of similar structures.

3. Preparation for Welding:

All components to be welded shall be free of dirt, grease, and other contaminants and shall fit up properly for sound welding. Surfaces to be welded may not be cut with oxygen. Sawing, shearing, or machining may be used.

4. Welding Procedures:

All welding shall be with an inert gas shield arc process. Machine settings shall be developed with test welds of the same material, alloy and geometry as the work pieces and samples will be tested destructively.

VIII. Testing

1. Loads:

After installation the cover structure will be tested for conformance with the deflection limits. A load of 400 pounds will be placed as directed by the Engineer and the maximum deflection created by the load will be measured.

2. Prequalified Shop Testing:

MANUFACTURER shall perform a prequalified shop air tightness test and certification for the cover components proposed. This test shall be performed in accordance with the "Procedural Standards for Testing, Adjusting and Balancing of Environment System" as published by the National Environmental Balancing Bureau (NEBB) on cover components of not less than 80 square feet. Said test shall be conducted and witnessed by a NEBB certified technician. The method of testing, test apparatus and proposed contents of the test report shall be submitted to the ENGINEER for approval. Subsequent to the receipt of ENGINEER'S approval, the MANUFACTURER shall set up testing protocol and schedule the test. The MANUFACTURER will provide the ENGINEER with at least 72 hours notice prior to the scheduled test. A report of the test shall be prepared by the certified technician and shall be sealed with the NEBB seal. The report shall include a description and illustration of the test components, a description and illustration of the test apparatus and a report of the results. The cover shall maintain an air intrusion leakage rate not to exceed 0.2 cfm per square foot at an applied negative pressure of 0.2 inches of water column for a 5-minute duration.

IX. Delivery and installation

1. Delivery:

Delivery of the components of the structure shall be made to a location nearest the site that is accessible to over the road trucks, unless otherwise specified.

2. Storage:

The manufacturer shall be responsible for jobsite storage of the delivered components. The components shall be stored off the ground on level surface in such a manner as to prevent damage.

3. Installation:

The manufacturer shall furnish such personnel, tools, equipment, and materials as required to install the cover using the recommended procedure.

4. Contractor Installation:

The cover manufacturer can provide installation instructions, on site supervision, and inspection if desired.

5. OEM Manual:

The manufacturer shall provide an OEM Manual that includes drawings, maintenance instructions, and removal and replacement instructions for the installed cover.

Appendix FST-C

Clarifier Mechanism Proposals



ISO 9001:2015 CERTIFIED

ENVIRODYNE SYSTEMS INC.

Custom Water & Wastewater Treatment Equipment - Since 1971

75 Zimmerman Drive Camp Hill, PA, USA 17011

Phone: (717) 763-0500 | Fax: (717) 763-9308 | www.envirodynesystems.com

BUDGETARY PROPOSAL

March 1, 2023

TO THE CONTRACTORS BIDDING ON:

CITY OF NORWALK

WWTP Upgrade
Norwalk, CT



ENGINEER:

ARCADIS OF NEW YORK, INC.

100 Chestnut Street, Suite 1020
Rochester, NY 14604



Envirodyne Systems Inc., called the Seller, proposes to furnish to the General Contractor, called the Buyer, on the terms and conditions stated the equipment herein specified for installation in the WWTP, Norwalk, CT.

Detailed Specifications set forth below or which may be attached hereto are a part of this Proposal.

EQUIPMENT DESCRIPTION:

REPLACEMENT FINAL SETTLING TANK EQUIPMENT



Equipment

Ref.: Replacement Final Settling Tank Equipment

Four (4) **CLARIFIER MECHANISMS**, each to be Model HBS-2AB half-bridge, center feed/peripheral overflow, suction header design for installation in existing concrete tank 110'-0" dia. x approx. 15'-0" SWD x approx. 18'-0" TSD with 1/16:12 bottom floor slope & inboard concrete effluent launder Price for each includes and is limited to:

Hercules™ Drive Mechanism, rated per AGMA criteria for 10 FPM tip speed with Motor, min. 3/4 HP TEFC Cl. B insl. for 230/460/3/60
Primary & Secondary Gear Reducers, ea. with C.I. enclosure, 1.4 S.F., oil-bath lubricated
Chain, self-lube type, and Sprockets with S.S. guard
Pinion & Bearing, 4-point contact precision design, with internal spur gear in H.D. weldment encl., oil-bath lubricated
Torque O/L Device with dual micro-switches & indicator
Access Bridge, min. 36" wide HDG steel truss type with
Operating Platform, min. 3'-0" clear. with 3/8" alum. checkerplate
Handrail, double 1-1/2" (Sch. 40 rails/Sch. 80 posts) anod. alum. pipe, non-welded
Toeplate, 4" extruded anod. alum.
Walkway, 1-1/4" alum. I-bar grating, mill finish
<Note: truss sides serve as handrail & toeplate>
Center Column, 1/4" HDG steel
Center Cage, 1/4" HDG steel box-truss
EDI, 3/16" HDG steel, rotating design with full bottom & self-impinging nozzles
Feedwell, 3/16" HDG steel, rotating design with baffled scum ports & supports
Dual Suction Headers, 1/4" HDG steel, rectangular tapered X-sect. design with orifices at max. 30" o.c. and fluidizing vane
Sludge Manifold, min. 1/4" HDG steel, self-cleaning design with flat seals
Dual Skimmers, ea. 1/4" HDG steel, cantilevered design with neoprene wipers & supports
Scum Trough, 1/4" HDG steel, full-radius design with 6" Sch. 40 P.E. connection, "auto-flush" device & supports
Fasteners, S.S.
Anchor Bolts, S.S.

Option No. 1

Four (4) **CLARIFIER MECHNISMS**, as described above except uptake pipe type in lieu of suction header type.

Option No. 2

Four (4) **CLARIFIER MECHNISMS**, as described above except spiral blade type in lieu of suction header type, and including motors with integral VFDs for 16 FPM max. tip speed.

Equipment

Ref.: Replacement Final Settling Tank Equipment (cont'd.)

- NOTES:
- (1) Removal of and/or modifications to existing equipment, installation, concrete work & grout, shims, epoxy for anchor bolts, piping, flexible couplings, valves & fittings, conduit & wiring, lighting and light stanchions/supports, slide gates, field paint & painting, touchup galvanizing, insulation & heat tracing, caulking, lubricants & sealants NOT included.
 - (2) Access stairs, landings, handrailing & grating (other than on access bridge & operating platform) NOT included.
 - (3) Electrical controls (other than torque switches) NOT included.
 - (4) Effluent weir, scum baffles, & density current baffles NOT included.
 - (5) Buyer to provide Seller with all required field dimensions.
 - (6) All items not specifically described above are NOT included.
-

GENERAL

Reference may be made in this Proposal to certain Specification Sections. This is done strictly for identification purposes and is not to be construed that Envirodyne Systems Inc. proposes to furnish all items required by the referenced Sections. Only the items specifically mentioned or described in this proposal will be furnished.

Equipment and materials offered are of standard design and will comply with the general intent of the Specifications but may vary in some detail from that specified. Our tender is offered in good faith and we shall not be liable for any costs, direct or indirect, resulting from disapproval by the Owner.

Motors, speed reducers and castings will be given the manufacturer's standard paint and surface preparation and prime coat. Ferrous parts not galvanized to receive one shop coat of approved primer. Finish coats are not included except as noted herein.

DRAWINGS

Included in the price are the necessary General Arrangement and Approval Drawings, Parts Lists and Erection Drawings. Also included are detailed Erection, Maintenance and Operating Instructions. Seller's proprietary fabrication and piece part drawings are not included.

SERVICES

Also included in the price are the services of a qualified Field Representative for inspection and checkout of the Equipment after installation by others and for initial instruction of the Owner's personnel in the care, maintenance and operation of the Equipment according to the following schedule:

<u>Equipment</u>	<u>Days</u>	<u>Trips</u>
Clarifier Mechanisms	8	4

Additional service is available at a per diem rate of \$1500 plus travel and living expenses.

ESTIMATED SHIPMENT

Based upon present conditions, it is estimated shipment of the Equipment can be made within 20 to 30 weeks after receipt of approved drawings and release for manufacture. Schedule is subject to change at any time due to the direct and indirect supply chain effects of COVID-19.

If a delay in shipment, in excess of thirty (30) days is requested after shipment is scheduled then an additional charge of 2% per month of the total price will be added until shipment can be made.

BUDGETARY PRICES

Budgetary prices for EQUIPMENT, DRAWINGS and SERVICES described in this Proposal, F.O.B. Factory with truck freight allowed to the nearest accessible point to the jobsite are:

(a) Four (4) Clarifier Mechanisms (Suction Header type).....	****1,992,810.00***
(b) Option No. 1 – Uptake Pipe type mechanisms in lieu of Suction Header type.....	****2,462,330.00***
(c) Option No. 2 – Spiral Blade type mechanisms in lieu of Suction Header type.....	****1,992,810.00***

Budgetary prices do not include sales, use and/or other taxes.

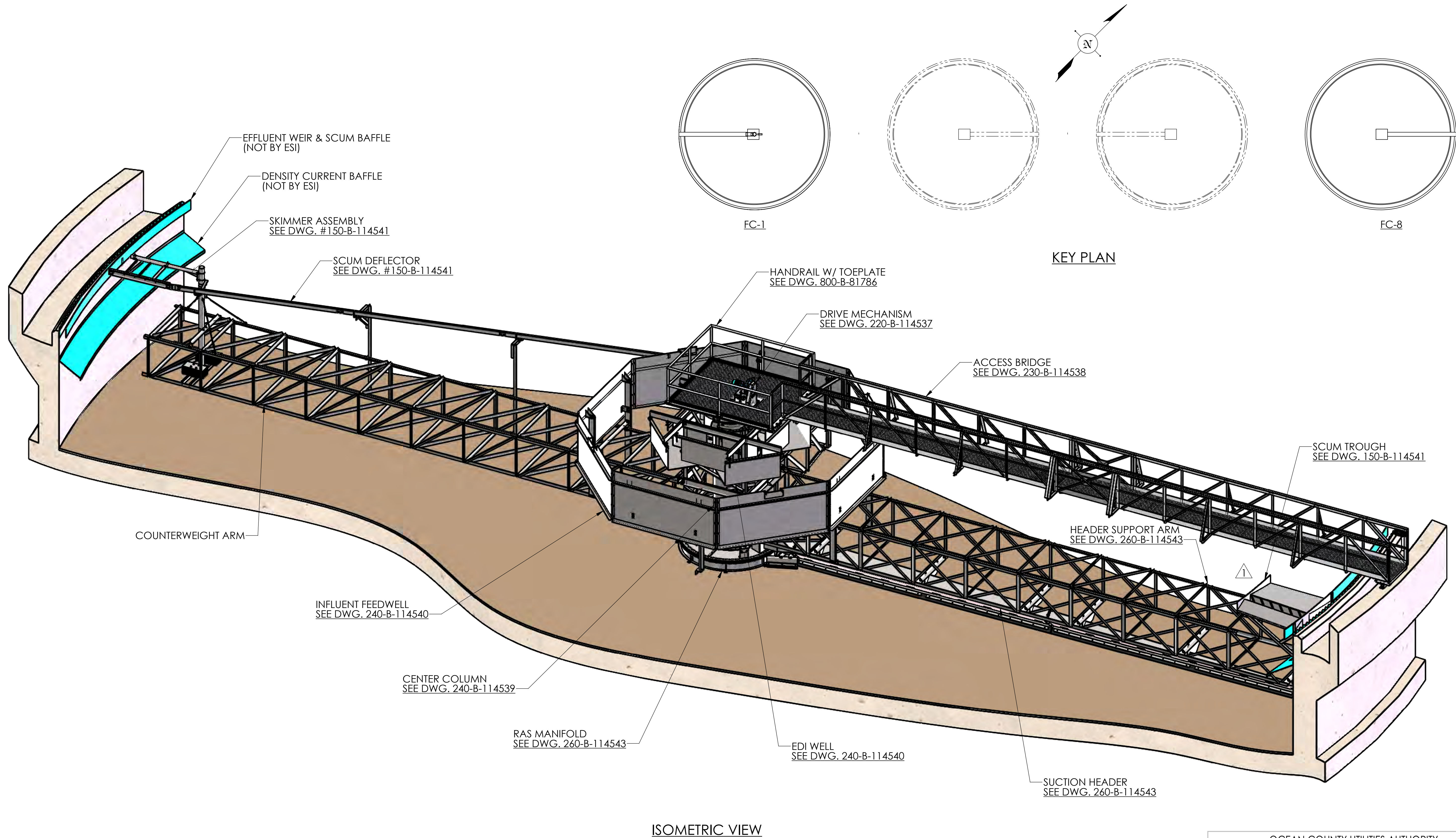
Prices quoted will be adjusted to reflect upward changes in the Metals and Metal Products Index (MMPI) published by the U.S. Dept. of Labor, Bureau of Labor Statistics. If the MMPI exceeds 325 at the time the Equipment is released for manufacture, then the price will be increased by the same percentage as the MMPI exceeds 325.

TERMS

Ten percent (10%) with approved shop drawing submittals. Balance net thirty (30) days after date of invoice for complete or partial shipments to be backed by irrevocable Letter of Credit or Payment Bond. The right is specifically reserved to make and invoice partial shipments.

Interest on past due accounts is charged at 1-1/2% per month. These terms are independent of and not contingent upon the time and manner in which the Buyer received its payments from the Owner.

* * * * *



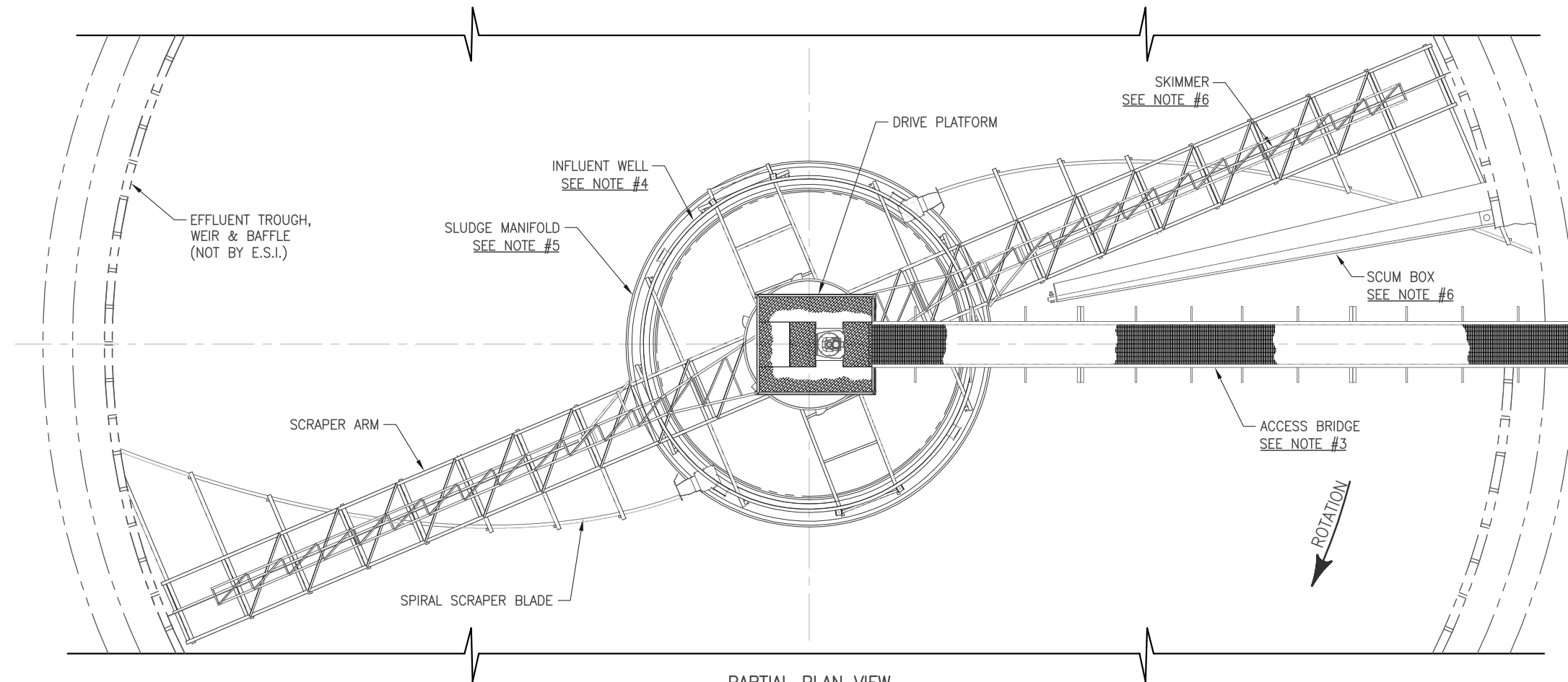
ISOMETRIC VIEW

KEY PLAN

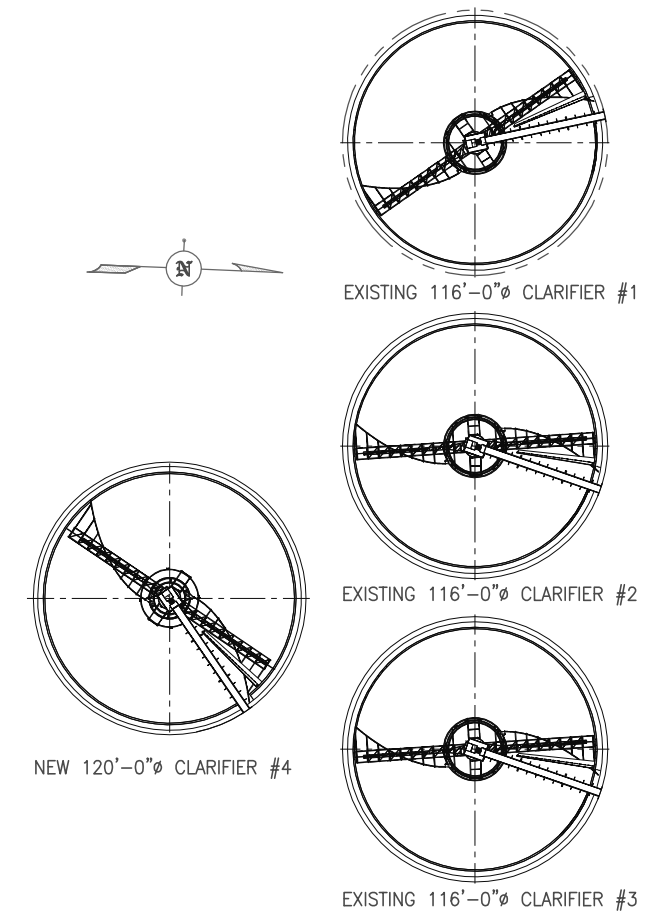
Contract ND1712
Brick, New Jersey

REV.	DESCRIPTION	DATE
1	AUTOFLUSHER REMOVED	3/30/2020
REVISIONS		

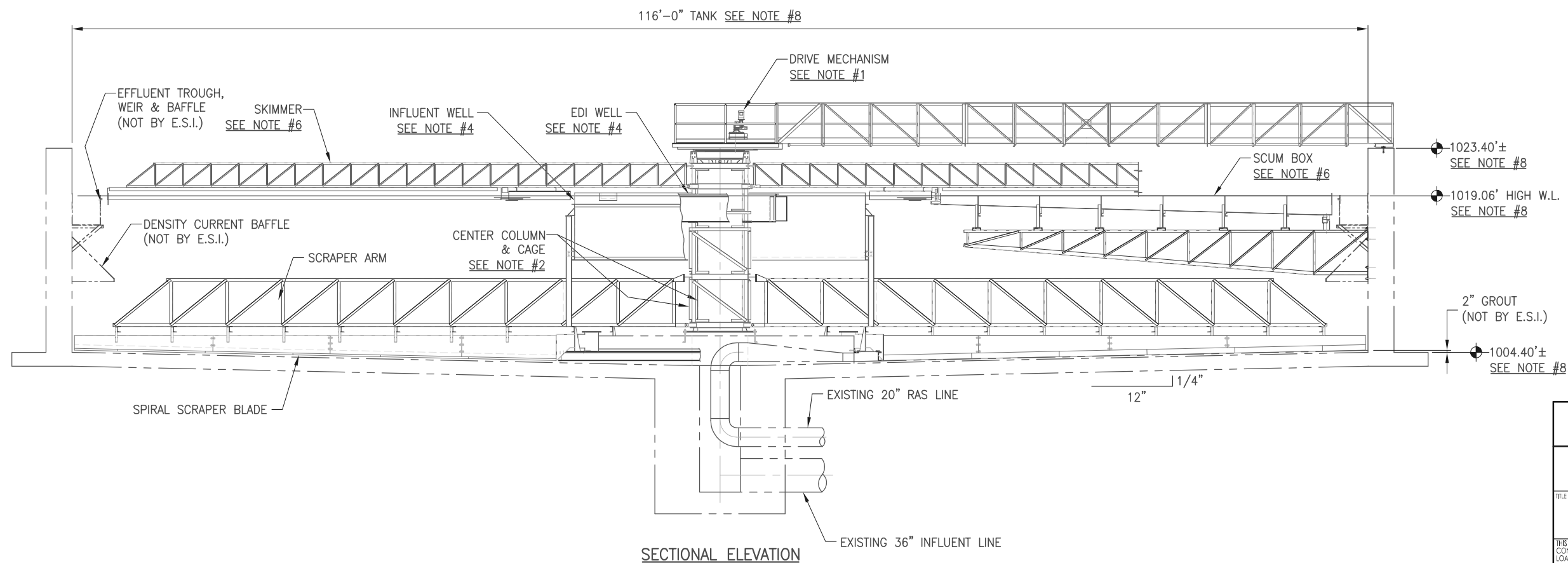
OCEAN COUNTY UTILITIES AUTHORITY BAYVILLE, NJ			
 ENVIRODYNE SYSTEMS INC. Camp Hill, Pennsylvania 17011			
TITLE GENERAL ARRANGEMENT 120'-0" DIA. FINAL CLARIFIER MECHANISM			
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SCALE -----	DWN. BY TAP	DATE 2/14/2020	DRAWING NO. 200-B-114535 REV. 1



PARTIAL PLAN VIEW



KEY PLAN



SECTIONAL ELEVATION

NOTES:

1. SEE DWG. 220-B-68760 FOR DRIVE MECHANISM DETAILS.
2. SEE DWG. 240-B-68747 FOR CENTER COLUMN, DRIVE AND DRIVE CAGE DETAILS.
3. SEE DWG. 230-B-68748 FOR OPERATING PLATFORM AND BRIDGE DETAILS.
4. SEE DWG. 250-B-68749 FOR EDI AND INFLUENT WELL DETAILS.
5. SEE DWG. 260-B-68750 FOR SLUDGE MANIFOLD DETAILS.
6. SEE DWG. 250-B-68751 FOR SKIMMER AND SCUM BOX DETAILS.
7. SEE DWG. 250-B-68752 FOR SCUM BAFFLE OPENING DETAIL.
8. EXISTING CONCRETE TANK DIMENSIONS MUST BE SUPPLIED OR CONFIRMED BY CONTRACTOR BEFORE EQUIPMENT CAN BE RELEASED FOR MANUFACTURE. SEE DWG. NO. 209-B-67932, 209-B-67933 & 209-B-67934 FOR FIELD DIMENSIONS REQUIRED.

ALTOONA WATER AUTHORITY
DUNCANSVILLE, BLAIR COUNTY, PA



ENVIRODYNE SYSTEMS INC.
Camp Hill, Pennsylvania 17011

TITLE
**GENERAL ARRANGEMENT
116'-0" DIA. CLARIFIER MECHANISM**
(EXISTING CLARIFIERS NO. 1-3)

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REV.	DESCRIPTION	DATE	SCALE	DWN. BY	DATE	DRAWING NO.	REV.
	REVISIONS		NTS	BA	4/6/10	201-B-68746	0



eVOQUA
WATER TECHNOLOGIES

Budgetary Proposal Circular Clarifier Mechanisms

Final settling tanks
Norwalk, CT
Engineer: Arcadis

For questions, please contact:

Ryan Boshart
GP Jager Inc.
Cell: (716) 697-5543
Email: rboshart@jagerinc.com

Version: 1
Date: 03-07-2023
Prepared by: Adele Heaton



SUMMARY:

Evoqua Water Technologies (Evoqua) is pleased to present our proposal for four (4) Tow-Bro circular clarifier mechanisms for installation in four (4) existing 110' diameter x 15' side water depth concrete tanks.

The scope of supply and pricing are based on Evoqua's standard equipment selection, standard terms of sale and warranty terms as described herein. Any variations from these standards may affect this budgetary quotation. Additionally, please note that this budgetary quotation is for review and informational purposes only and does not constitute an offer for acceptance.

EQUIPMENT DESCRIPTION

Four (4) Tow-Bro mechanisms
Four (4) Drive for mechanisms*

BUDGETARY PRICE

\$1,099,500
\$ 102,400

****Denotes breakup price. Add the breakup price of drives to mechanisms price for a total price of mechanisms.***

Equipment for each mechanism will consist of the following:

- Pony truss type access bridge with 1 1/4-inch aluminum grating walkway, 2-rail mechanically fastened aluminum handrail, center service platform and toe plate
- Drive mechanism with micro-switch overload device and shear pin
- Center influent column
- Center drive cage
- Influent flocculation well with supports
- FEDWA influent energy dissipating baffles
- One (1) skimmer assembly
- One (1) scum trough with flushing device
- One (1) truss arm
- Sludge collection manifold
- One (1) 1/4 inch thick unitube suction header
- Counterweights
- Associated anchor bolts and attachment bolts
- Freight – FOB Factory

MATERIALS OF CONSTRUCTION

Submerged and Non-submerged material: A36 carbon steel

Handrail: Aluminum

Walkway and platform flooring: Aluminum grating

SURFACE PROTECTION

The Tow-Bro unitube header will be hot-dip galvanized after fabrication per ASTM-A123.

Submerged and Non-submerged components will be prepared by blasting to SSPC-SP10 and prime painted with one (1) shop coat. Finish coats are to be applied in the field by the Contractor.

Ferrous chain: One (1) coat of slush oil.

Shafting and exposed machined surfaces: Solvent wiping, followed by one (1) coat of Evoqua's standard shop preservative.

Wood, nonferrous materials, stainless steel and galvanized surfaces: Unpainted.

Drive unit and controls: Evoqua's standard.

Touch-up and all additional coats shall be furnished and applied by others at the site.

Prices are based on paints and surface preparations as outline in this quotation. In the event an alternative paint system is selected, purchaser's order must advise of its selection. Evoqua will, at its sole discretion, either adjust its price as necessary to comply or ship the material unpainted if compliance is not possible due to price considerations, application problems, or environmental controls.

Evoqua does not guarantee primer's compatibility with purchaser's coating system unless approved by the coating system manufacturer. Primers will only protect for a minimal amount of time, usually thirty (30) days. Specific information should be obtained from coating system manufacturer.

FIELD SERVICES

Manufacturer to provide eight (8) trips and twelve (12) days total of on-site field service.

One day shall be dedicated to a pre-grout inspection. After installation, a post-grout inspection shall be conducted followed by a general training seminar.

An additional one (1) not less than one-half day shall be provided for operation assistance of the equipment supplied.

ELECTRICAL/CONTROLS

Drive mechanism motor will conform to NEMA standards and be suitable for operation on 230/460 volt, 3 phase, 60 Hertz current.

Electrical controls will consist of the two (2) micro-switches (one N.O. and one N.C.) in the drive mechanism overload device housing for high torque alarm and motor shut-down.

WEIRS AND BAFFLES

Effluent overflow weirs and scum baffles are not included.

SPARE PARTS

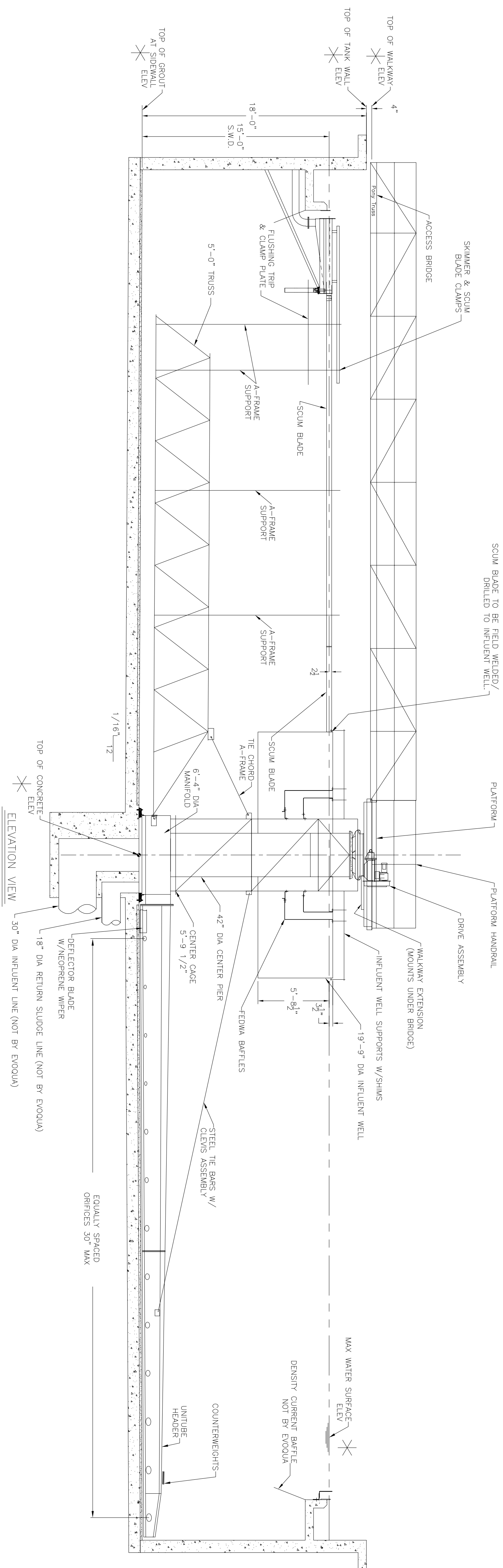
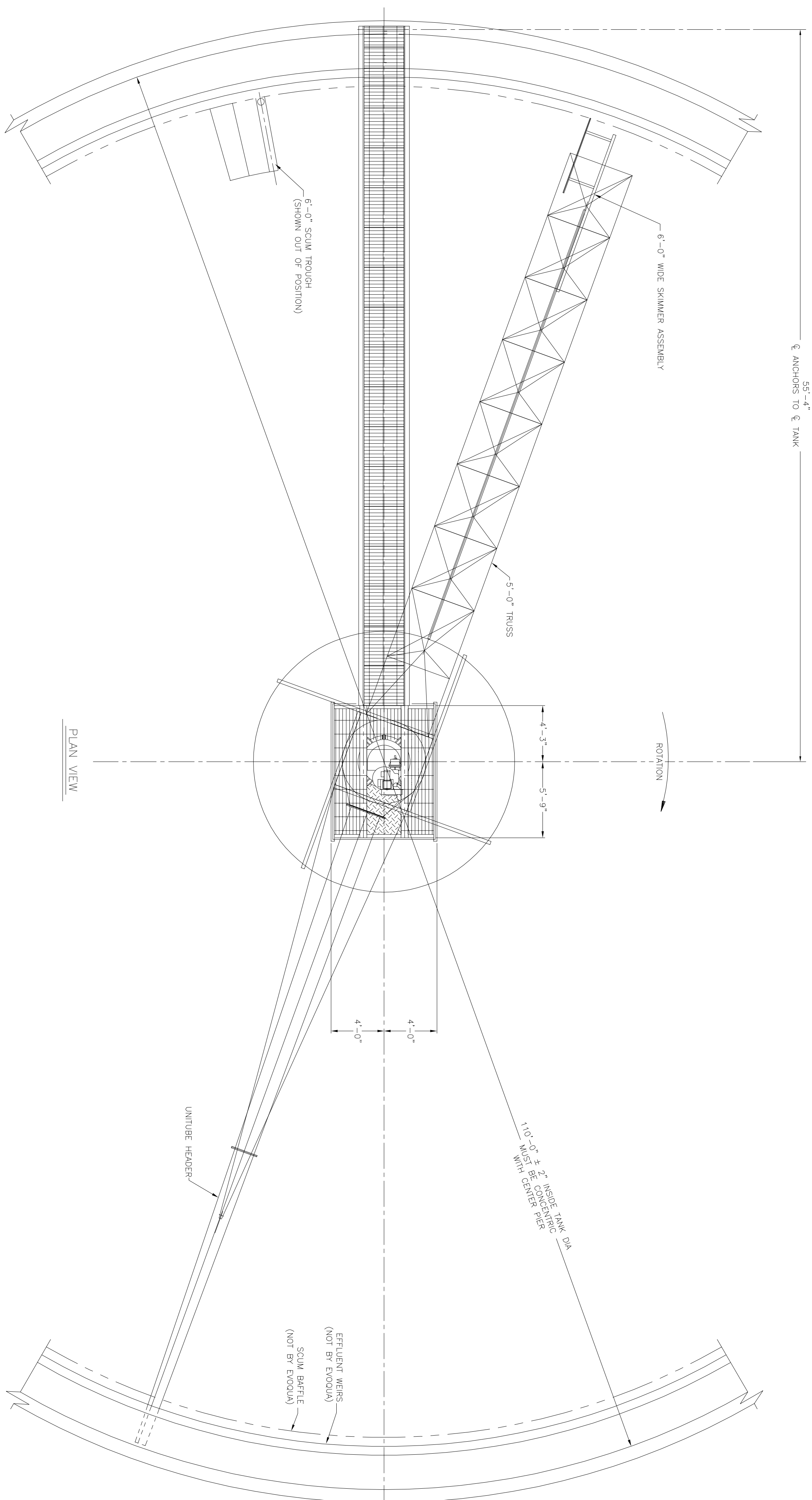
No spare parts are included.

No special tools are required for the installation or maintenance of this equipment.

EXCLUDED ITEMS (including but not limited to):

- Scum spray system
- Weirs and baffles
- Pumps
- Misc. access bridges, walkways, stairs, etc.
- Controls or control equipment
- Unloading of equipment and storage
- Concrete work of any sort, grout, mastic, sealing compounds, shims
- Lubricants
- Pipe supports
- Conduit or wiring in the field
- Cable trays, fittings, and supports
- Instrumentation
- Motor control centers
- Variable frequency drives

* ELEVATIONS TO BE ADJUSTED PER ACTUAL JOB SITE SURVEY. FOR EXISTING TANKS ELEVATIONS SHOULD BE FIELD VERIFIED BY CONTRACTOR.

[illegible]

BUDGET EQUIPMENT PROPOSAL

DATE: March 1, 2023
QUOTE NO.: KW/103323/AH/rw
TO: Maddy Harp, EIT
PROJECT: City of Norwalk, Connecticut
SECTION: N/A
ENGINEER: Arcadis
REPRESENTATIVE: G. P. Jager

Dear Sir or Madam:

We are pleased to provide our budget proposal for equipment in accordance with the above referenced bid specifications.

ITEM A - Secondary Clarifiers

Four (4) 110'-0" Diameter, Kusters Water Model **HBMS**, Half Bridge Manifold Suction Clarifiers.

Items Included:

- Access Bridge (3'-0" Wide Truss Style - Full Span) w/ 1 1/4" Aluminum Bar Grating
- Drive Unit Service Platform (24" Clear) w/ 1 1/4" Aluminum Bar Grating
- Service Platform Handrail - 2 Rail - Mechanical Handrail
- Drive Cage - 4'-1" Square
- EDI Well - 11'-0" Diameter x 3'-0" x 3/16" pl.
- Influent Feedwell - 27'-6" Diameter x 8'-0" Deep x 1/4" pl.
- Influent Column - 42" Diameter x 1/4"
- Two (2) Sludge Header Support Truss Arms
- Two (2) Sludge Suction Headers - Hot Dip Galvanized
- Sludge Suction Manifold
- Two (2) Full Surface Scum Skimmer Assemblies
- Surface Scum Trough - Full Surface
- Assembly Hardware - 304 Stainless Steel
- Anchor Bolts - 304 Stainless Steel

Coatings:

- All Steel to be Shop Blast and Prime Painted after Fabrication, Unless Noted
 - Non-Submerged Ferrous Metals - SSPC-SP-6
 - One (1) Primer Coat Tnemec Series 1 - 2.5 - 3.5 Mils
 - Submerged Ferrous Metals - SSPC-SP-10
 - One (1) Primer Coat Tnemec Series 1 - 2.5 - 3.5 Mils

Site Service:

- Four (4) Trips and Eight (8) Days Field Service for Installation Inspection, Start-up, and Operator Training

TOTAL BUDGET PRICE FOR ITEM A: \$1,792,797

Items not listed above will be provided by others

ITEM B - Secondary Clarifier Drive Units

Four (4) Clarifier Drive Units

Items Included:

- Four (4) Clarifier Drive unit w/ Overload Protection
- Drive Unit to be Factory Finish Painted

TOTAL BUDGET PRICE FOR ITEM B: \$298,051

Items not listed above will be provided by others

Comments and Clarifications

- 1.) Kusters Water is furnishing its standard equipment as outlined in this proposal. The equipment proposed meets the full intent of the specifications, drawings and /or addenda.

Exclusions:

- | | |
|---|--|
| <ul style="list-style-type: none"> • Taxes • Offloading • Installation • Erection or testing • Supervision of erection • Engineering re-design • Civil Design • Buildings • Dumpsters • Concrete, grout, or sealants • Thru-wall fittings • Hand railings except as noted • Stairways and Ladders • Interconnecting walkways • Lights or light posts • Field verification of dimensions • Hose reels and hose bibs • Tank covers • Grout/topping installation • Air vent piping | <ul style="list-style-type: none"> • Any piping not proposed above • Valves except as noted • Sandblasting or touch-up painting • Field / Finish painting • Disconnect switches and junction boxes • Electrical wiring or conduit • Electrical connections • Electrical installation and wiring • Controls except as noted • Special shipping procedures • Storage at our shop or jobsite • Oil and grease • Spare parts except as noted • Tank surveying • Field verification of elevations • Clarifier Spray systems • Weirs and Baffles • Density Baffles • Scum spray systems • Pipe couplings/connections except as noted |
|---|--|

Kusters Water will provide limit switches in section 44 42 23-2.18, solenoid valves by others

Absence of an exclusion herein will not be construed as meaning that the item is included, and Kusters Water will not issue credits, or accept deducts, for the provision of the items noted above.

Terms:

- NET 30 Days
- 15% at submittal approval
- 80% upon delivery to site
- 5% upon start-up and training completion or 120 days from delivery, whichever occurs first
- 1-1/2% interest charges per month for late amounts due

Submittals:

- 6 – 8 weeks from acceptance of order.

Delivery:

- To be Advised

Warranty:

- 12 months from equipment start up or 18 months after delivery, whichever occurs first.

Validity:

- Our price is budgetary and subject to change without notice.

Purchase Orders:

- All purchase orders are to be issued, and mailed to:

Zima Corporation,
Kusters Water Division
P.O. 6128
Spartanburg, SC 29304

Please provide a copy of your tax exempt or direct pay certificate, project contact, and a copy of the project payment bond with your purchase order.

Notes:

All spares and site service for start-up and operator training is available from our Spartanburg National Service Center.

Liquidated Damages:

- Zima Corporation will not consider the addition of liquidated damages to our contract unless it has been specifically identified and negotiated prior to the bid. Zima Corporation equipment supply contract will not be tied to the General Contractor's overall contract, and our delivery commitments shall be as stated in this proposal.

Bonding:

- Bonding or bonding expenses are not included in this proposal and will not be considered unless specifically identified and authorized by Zima Corporation prior to the bid.

Zima Corporation
physical address
101 Zima Park Drive
Spartanburg • SC 29301 • USA
mailing address
P.O. Box 6128

Spartanburg • SC 29301 • USA
☎ +1 864 576-0660
www.zimacorp.com/water
www.kusterswater.com



dependable, cost-effective solutions for water and wastewater treatment
Headworks • Biological • Clarification • Thickening • Biosolids

Insurance:

- Pricing includes general liability policy with 1 million per occurrence, 2 million aggregate, and 4 million umbrella. If higher limit(s) is required, all costs will be paid by the Buyer in addition to the quoted equipment price.

Freight:

- All prices are quoted F.O.B. shipping point, with freight allowed to the Jobsite. Buyer will be responsible for equipment off-loading. All claims for damage or loss in shipment shall be initiated by the Buyer. Buyer requests for selective shipments, early shipments, or separate shipment may directly affect the freight allowance. Any additional costs incurred due to this request by the Buyer will be an additional cost to the purchase price and invoiced accordingly.

Sincerely,



Alan E. Houtz
Sales Manager – Municipal Products
Kusters Water Division
O. 864-208-9043
C. 864-641-5168
alan.houtz@kusterswater.com
www.kusterswater.com

Cc:

ZIMA CORPORATION (ZC)
CONDITIONS OF SALE

1. CONTRACT

All terms and conditions of this CONTRACT are fully set forth herein and no agent, employee, representative or other party is authorized to bind the Seller by any agreement or warranty not expressed herein. If any terms and conditions of subsequent orders are in addition to or inconsistent with the terms and conditions herein expressed, such terms will not be binding upon the Seller unless they are expressly accepted in writing by the Seller.

2. QUOTATIONS

- (a) Prices indicated on our quotations are valid 30 days, unless indicated otherwise. All Federal, State and local taxes, including any tariffs, are the responsibility of the Buyer.
- (b) Our quotations are not legally binding until we have received and executed a Purchase Order and issued a written ZC Order Confirmation.
- (c) Surety bonds, or bonding expenses, are not included by ZC and will not be considered unless specifically identified and authorized by ZC. If bonding is required, all costs will be paid by the Buyer in addition to the quoted equipment price.
- (d) Pricing includes general liability policy with \$1 million per occurrence, \$ 2 million aggregate, and \$ 4 million umbrella. If higher limit(s) is required, all costs will be paid by the Buyer in addition to the quoted equipment price.

3. DELIVERY

- (a) Delivery periods and dates quoted are approximate, unless otherwise stated in the Purchase Order and ZC Order Confirmation.
- (b) Shipping Terms: All equipment will be shipped at the risk of the Buyer FOB shipping point or Ex Works, as indicated in the ZC Proposal. Incidental costs for unloading, delivery, and installation of equipment in the Buyer's plant shall be paid by the Buyer. Seller is not responsible for any loss after shipment, including delays of carrier, damage to equipment in transit, or otherwise, regardless of delivery terms, so long as the carrier has receipted for the goods in good order.
- (c) Storage, delay charges and similar costs incurred because Buyer does not immediately accept delivery are Buyer's responsibility.
- (d) Seller may postpone delivery (1) in case Buyer fails to pay as agreed; (2) if Buyer fails to provide necessary technical information; (3) if Buyer fails to abide by the terms of our Order Confirmation; (4) on account of delay in receipt of necessary materials, parts or equipment; or (5) in case of force majeure, including strikes, lockouts, fire, adverse weather, state of war, etc.

4. SECURITY

- (a) Seller reserves a purchase money security interest and vendor's lien on all goods until the purchase price is paid in full, and Buyer may not sell, pledge or mortgage the goods until payment has been made in full. Buyer authorizes Seller to record a copy or signed original of this Contract as a financing statement pursuant to SC Code 36-9-402, and Buyer agrees to sign any other document reasonably requested by Seller to perfect or to continue perfection of the security interest granted herein.
- (b) Credit approval - shipment, delivery, and performance of work shall always be subject to the approval of the Seller's Credit Department. If the Buyer should fail to pay according to terms; or if in the opinion of the Seller, the financial condition of the Buyer at any time should become impaired, the Seller reserves the right, without prejudice to any claims for damage or otherwise, to withhold shipment or suspend performance of its obligations hereunder, until receipt of payment upon terms and conditions satisfactory with Seller.

5. DAMAGES

Zima Corporation will not consider the addition of incidental, consequential or liquidated damages to our contract unless it has been specifically identified and negotiated prior to the bid.

6. EXTENT OF SELLER'S WARRANTY

- (a) Subject to Subparagraphs (b) and (d), below, all equipment shall be covered by ZC's standard warranty as identified in the ZC proposal and written order confirmation. . Our obligation under this warranty is strictly limited to repair or replacement, without charge F.O.B. our works, of any defective parts. WE MAKE NO WARRANTY WHATSOEVER FOR equipment or materials supplied that are not of our manufacture, which shall carry only the supplier's warranty. Replacement parts supplied under this provision will be credited only upon receipt F.O.B. our works of the defective parts.
- (b) Improper use, installation, modification or alteration of the equipment by the Buyer will void the above warranty.
- (c) WE WILL NOT BE RESPONSIBLE FOR INDIRECT OR RESULTING DAMAGES SUCH AS PRODUCTION LOSSES, LOSS OF PROFITS, TRADING LOSSES, LOSS OF GOOD WILL OR REPUTATION SUFFERED BY THE BUYER, THIRD PARTIES, NOR FOR PUNITIVE DAMAGES.
- (d) ALL IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ARE EXCLUDED.

7. PAYMENT

- (a) Payment terms are set forth in the Quotation/Order Confirmation and are not contingent upon testing or performance of equipment. Each shipment will be invoiced as shipped and each invoice settled per terms specified. All payments shall be made in United States funds, free of expense to the Seller for collection charges. If in the opinion of the Seller, shipments are delayed unreasonably by the Buyer, the Seller shall have the right to render an invoice for equipment ready for shipment.
- (b) All payments not received on the due date shall bear interest at 1.5% per month; in the event of suit for collection against the Buyer, Seller shall be entitled to recover attorney's fees, court costs and other expenses.

8. CANCELLATION

No purchase order may be canceled after acceptance of our Order Confirmation except in the discretion of the Seller, in which case the Buyer shall be required to pay for all costs and expenses

incurred by the Seller in the performance of the work through the date of cancellation, plus a fee of no less than fifteen percent (15%).

9. ERECTION

- (a) Unless specifically included in our Order Confirmation charges for erectors and erection supervisors are not part of the equipment price.
- (b) At the Buyer's request, we will assist the Buyer in arranging for an erection supervisor at our normal rates.

10. NO ALTERATION OF SAFETY DEVICES

Buyer understands and agrees that no safety devices or equipment, or safety labels or warnings are to be altered or removed from the equipment without first obtaining our written permission to do so. Should any such devices, equipment, labels or warnings be altered or removed, Buyer shall be solely responsible for any injuries, damage or loss resulting therefrom, and agrees to indemnify and save Seller harmless of and from all claims, demands, suits, and or losses, including attorney's fees, resulting from such removal or alteration.

11. LAW

This contract is governed by the substantive laws of the State of South Carolina, excluding, however, its principles governing the conflicts of laws.

12. DISPUTES

All disputes will be settled exclusively by arbitration at Spartanburg, South Carolina in accordance with the Commercial Arbitration rules of the American Arbitration Association and the Federal Arbitration Act; the parties expressly agree that the South Carolina Arbitration Act and notice provisions thereof shall not apply to this Contract.

13. RESPONSIBILITIES OF THE BUYER

The Buyer is to furnish and install the following in addition to any items previously mentioned herein: (1) Buyer is to provide suitable foundations or building floor strength to maintain machinery in level position (2) all necessary labor for erection of the equipment (erection supervision will be supplied at Customer expense) (3) permits, pollution controls, and other approvals such as may be required by insurance or Governmental Agencies (4) necessary guards for the exposed moving parts of the machine in accordance with the laws of the state in which the machine is to be located (5) the necessary piping, including material and labor for gas, air, hydraulic, water and steam feed and drain lines (6) exhaust ductwork with suitable dampers from exhaust outlets to out-of-doors (7) all electric power wiring including material and labor from and to the starters, motors, and control elements, plus disconnect switches as required (8) all starters and controls not specifically included (9) provisions for dyestuff and chemical preparation including tanks, piping, pumps, instrumentation, structural platforms, hoist or elevator, etc. (10) all necessary utilities such as forklift trucks, welding equipment, elevators, and cranes where necessary for the installation of the equipment, (11) all drawings furnished by us will remain our property.

Ovivo USA, LLC

4246 Riverboat Road - Suite 300
Salt Lake City, Utah
84123-2583 USA

Telephone: 801.931.3000
Facsimile: 801.931.3080
www.ovivowater.com



To: Jim Konatsotis – Sherwood Logan & Associates, Inc.
Cc: Maddy Harp EIT – Arcadis, U.S., Inc.
From: Chad Layton – Aftermarket Rebuild Manager – Ovivo USA, LLC
Phone (801) 931-3240 Email: chad.layton@ovivowater.com
Date: 3/6/2023
Subject: Norwalk, CT WWTP – (4) 110' EIMCO C3D-FTS Clarifiers – Ovivo Budget Quote

Ovivo USA, LLC is pleased to offer the following budgetary pricing for four (4) 110' C3D-FTS clarifiers as direct in-kind replacements for the four (4) 110' existing EIMCO C3D-FTS clarifiers installed in 1996 under serial #25436-01. The design of the proposed components will be based upon Ovivo standard engineering practices and details.

This equipment is to be installed by others; installation is not by OVIVO.

(4) 110' C3D-FTS Clarifiers

Ovivo will manufacture and supply four (4) complete clarifier mechanisms to include the following:

- Cage 4' sq.
- Feedwell 25' dia. x 6'-6 1/4" Dp x 1/4" PI
- Feedwell supports & baffles
- Center column 42" x 3/8" PI
- Epoxy anchor bolts (304 SS)
- Rake arm 3'-10" sq.
- Rake blades w/V-separator
- Sludge suction header duct 3'-10" sq.
- Sludge header supports & back up bars
- Sludge suction manifold 70" dia. x 30" x 1/4" PI
- Sludge header squeegees, gaskets & seals – neoprene
- EDI 10' dia. x 3' Dp x 1/4" PI
- Walkway (steel) 3'-6" wide Pony Truss full span. Truss bridge members above walkway shall serve as handrail along both sides. I-bar grating surface and 4" toe kick plate along both sides of walkway
- Drive access platform (steel) 9' Sq. w/aluminum I-bar grating surface, two-rail aluminum handrail and 4" toe kick plate around platform
- Scum trough, tapered radial scum beach w/supports
- Skimmer arms - (2) per mechanism
- Tension rods
- FTS neoprene wipers

THIS BUDGETARY PROPOSAL CONSTITUTES A NON-BINDING ESTIMATE OF PRICE(S) FOR CERTAIN GOODS AND/OR SERVICES THAT MAY BE PROVIDED BY OVIVO USA, LLC FROM TIME TO TIME, BUT SHALL NOT BE CONSTRUED AS AN OFFER BY OVIVO USA, LLC TO PROVIDE SUCH GOODS AND/OR SERVICES.



- Flush valve
- Counter balance
- Installation fasteners – 304SS
- Anchor bolts – 304SS
- Paint coating – All fabricated mild steel to be SPCC 10 blasted with one (1) prime coat Tnemec N69 epoxy. 4-6 mils DFT total
- O & M manual
- Engineering
- FCA freight
- One (1) year mechanical warranty for new components only - 12 months from initial operation, not to exceed 18 months from delivery. Ovivo is not providing any sort of guarantee or warranty regarding process or performance as part of this proposal
- Startup/checkout services - one (1) Ovivo serviceman visit for one (1) day on site per clarifier mechanism (four (4) visits total), after installation is complete to perform checkout (start-up) and inspect new clarifier mechanism installations and provide operator training as necessary

Items NOT Included

- Submittals
- C40HT drive unit
- Control panel
- Weirs & baffles
- Density baffle
- Removal or installation services
- Draining or cleaning of tank prior to start of installation
- Electrical disconnect/installation or alteration of existing electrical supply
- Finish or touch up painting
- Lubricants or drive unit oil
- Disposal of any old lubricants/fluids
- Overtime work hours or removal of old debris
- Any other components not expressly listed above

Budget price for (4) 110' C3D-FTS clarifiers complete as described above \$ 1,755,000.⁰⁰

Lead time is estimated at 20-22 weeks after receipt of PO & Ovivo acknowledgement letter to customer

(4) C40HT Drive Units

Ovivo will manufacture and supply four (4) complete C40HT drive units to include the following:

- C40HT drive rated to match existing C40HT drive unit
- Drive torque control unit with micro switches and actuating pin
- Motor drive package (3/4 hp TEFC motor, reducer, sprockets, chain, and guard)
- Ovivo paint scheme, two (2) coats of Tnemec N69 epoxy @ 6-8 mils DFT
 - Top coated with (1) coat of Tnemec 73 Endura Shield urethane paint @ 2-3 mils DFT (sky blue color)
 - Top coat is highly resistant to abrasion, wet conditions, corrosive fumes, chemical contact, and weathering
- Installation fasteners & shim kit - 304SS

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- FCA freight
- Engineering
- One (1) year mechanical warranty for new components only - 12 months from initial operation, not to exceed 18 months from delivery. Ovivo is not providing any sort of guarantee or warranty regarding process or performance as part of this proposal

Items NOT Included

- Submittals
- Removal or installation services
- Draining or cleaning of tank prior to start of installation
- Electrical disconnect/installation or alteration of existing electrical supply
- Finish or touch up painting
- Lubricants or drive unit oil
- Disposal of any old lubricants/fluids
- Overtime work hours or removal of old debris
- Any other components not expressly listed above

Budget price for (4) C40HT drive units complete as described above \$ 155,000.⁰⁰

NOTE

The coronavirus situation may cause disruptions in our normal business practices, capacity, and supply chain. Any pricing listed & schedule statements made by Ovivo at this time are our best estimate and subject to change. Design, sourcing, and assembly will begin upon order acceptance and a formal submittal package will not be provided.

Pricing is only valid for 30 days from date listed on proposal. Ovivo will not accept purchase orders for this proposal past that date without reviewing pricing and delivery of items proposed.

Chad Layton

Aftermarket Rebuild Manager – USA Rebuild Group

Tel: +1 (801) 931-3240

Email: chad.layton@ovivowater.com

THIS BUDGETARY PROPOSAL CONSTITUTES A NON-BINDING ESTIMATE OF PRICE(S) FOR CERTAIN GOODS AND/OR SERVICES THAT MAY BE PROVIDED BY OVIVO USA, LLC FROM TIME TO TIME, BUT SHALL NOT BE CONSTRUED AS AN OFFER BY OVIVO USA, LLC TO PROVIDE SUCH GOODS AND/OR SERVICES.





Division of McNish Corporation

Dedicated to the
Water and
Wastewater Industry

Walker Process Equipment

Division of McNish Corporation

840 North Russell Avenue

Aurora, Illinois 60506-2853

E-Mail: walker.process@walker-process.com

Website: www.walker-process.com

Phone: 630-892-7921

Fax: 630-892-7951

February 28, 2023

Budgetary Proposal

PROJECT: Norwalk, CT

ENGINEER: Arcadis

Gentlemen:

We are pleased to submit this budgetary proposal as our offer to furnish the following equipment:

SCOPE OF SUPPLY

(4) Pier-Supported Collector Mechanism for installation in existing concrete tanks 110' diameter for a budgetary price of \$1,850,000.

WALKER PROCESS WILL SUPPLY FOR EACH MECHANISM:

- **Drive Assembly** – Motor, primary helical speed reducer, chain drive with shear pin coupling with limit switch, chain guard, worm gear, spur gear, electro-mechanical torque limiting device.
- **Catwalk** – Truss type constructed with structural shapes spanning from tank wall to tank wall, for access to the drive assembly. The catwalk includes an expanded center platform around the drive area, aluminum handrails and aluminum grating walkway deck.
- **Influent well**
- **Energy Dissipating Inlet**
- **Drive cage -**
- **Sludge Manifold Assembly –**
- **Center pier**
- **Sludge Suction Headers**
- **Rake arms** –(2) truss type constructed with structural shapes to support the dual headers .

- **Full radius Skimmer assembly and scum trough.**
- **Weir Plates and Scum Baffles**
 - **Weir plates 9' x 1/4"**
 - **Scum baffles 12" x 1/4"**
- **Density Current Baffle**
- **Electrical controls** – Basic Start-Stop and alarm control panel.
- **Spare parts** – as specified
- **Fasteners** – 304 stainless steel
- **Anchorage** – 304 stainless steel

MATERIALS OF CONSTRUCTION

Non-Submerged (Catwalk) – carbon steel

Submerged Components of the mechanism – carbon steel

Suction Header and manifold carbon steel hot dip galvanized

Weir Plates - fiberglass

Scum Baffles - fiberglass

Density Current Baffle – fiberglass

Squeegees – type 304 stainless steel

Fasteners – type 304 stainless steel

Anchorage – type 304 stainless steel

SHOP PAINTING:

Non-submerged ferrous surfaces except the suction header will be prepared in accordance with SSPC-SP6 and given one (1) coat of Sherwin-Williams Macropoxy 646 PW Red Oxide, 5.0 – 7.0 mils dft.

The suction header is hot dipped galvanized.

Submerged ferrous surfaces will be prepared in accordance with SSPC-SP10 and given one (1) coat of Sherwin-Williams Dura-Plate 235 epoxy, Red Oxide, 4.0 – 8.0 mils dft.

The drive unit will be shop assembled and finish painted with one (1) coat of Sherwin-Williams Macropoxy 646 PW Red Oxide, 5.0 -7.0 dft, followed by one (1) shop coat of Sherwin-Williams Acrolon 218 HS, ANSI #70 Gray, 3-0 – 5.0 mils dft. The motor and primary reducer will be provided with the original manufacturer's standard finish paint.

Aluminum, stainless steel, galvanized steel, plastic and other special materials will not be shop painted.

FIELD SERVICE: As required, but not to exceed four(4) trips and eight (8) days of mechanical service.

ESTIMATED SCHEDULE: Approval Schedule is shown in weeks after receipt of order with complete information. SCHEDULE COMMITMENTS ARE SUBJECT TO REVISION AND MUST BE CONFIRMED AT TIME OF ORDER.

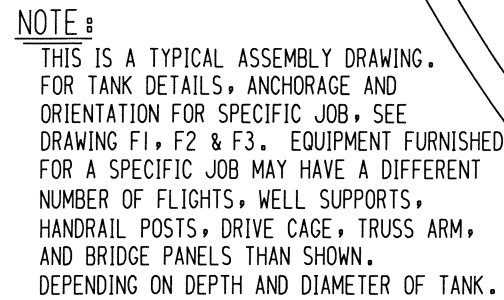
Submittal of Approval Drawings	8-10 weeks
Shipment, after Receipt of Approval . .	22-24 weeks

EXCLUSIONS: Although possibly shown on the plans and/or specified, the following are not included in this offering.

1. Access stairway or platform to the equipment bridge
2. Handrail around the perimeter of the tank
3. Neoprene gasket, caulking, or mastic sealant between weir plates and concrete wall – if required
4. Weir and trough brush cleaning system
5. Influent pipe and supports
6. Sludge or scum piping, fittings and valves
7. Electrical conduit, wiring, and supports
8. Light Fixtures and duplex receptacles
9. Unloading, hauling or storage, or erection
10. Any items that are not specifically listed above as being included

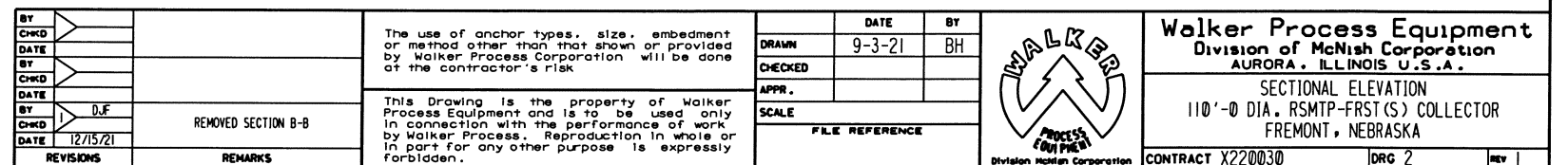
Sincerely,
WALKER PROCESS EQUIPMENT
Division of McNish Corporation

Jeffrey C. Thomas
Regional Sales Manager

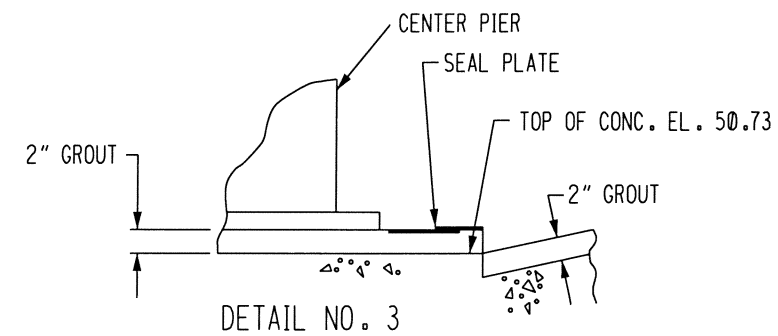
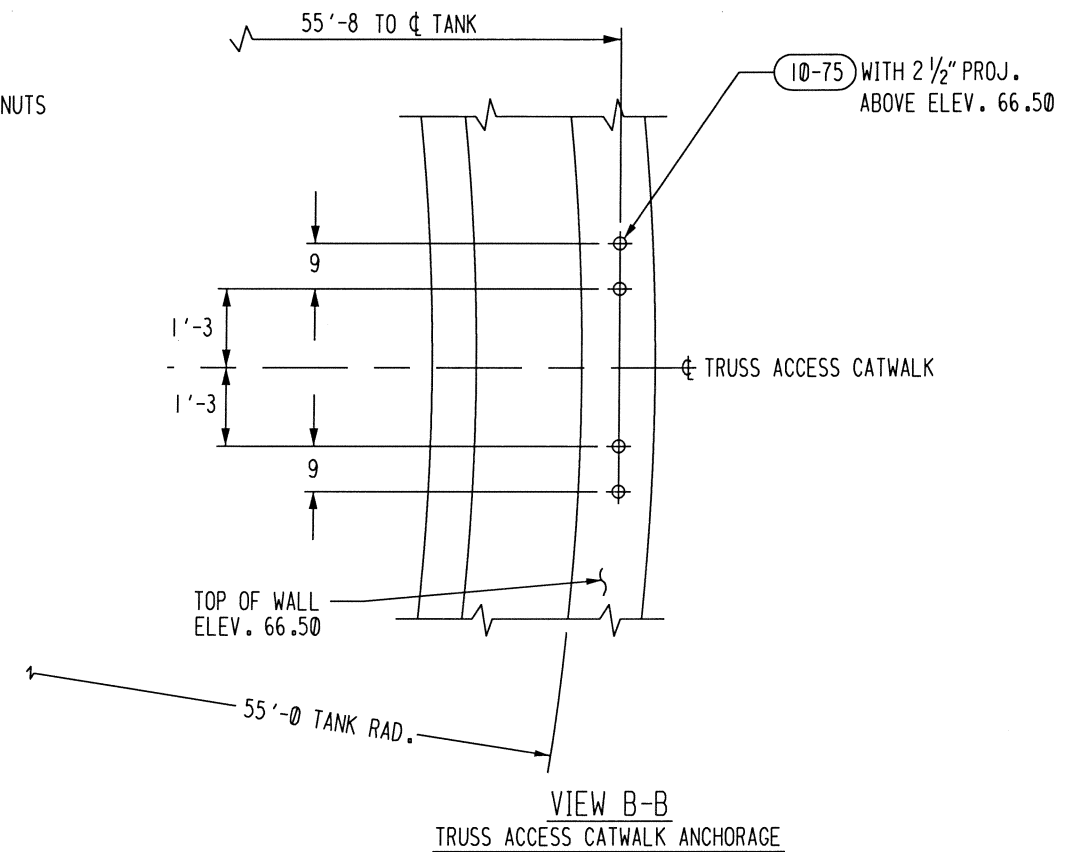
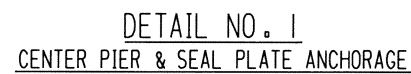
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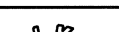
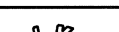
ROTATION

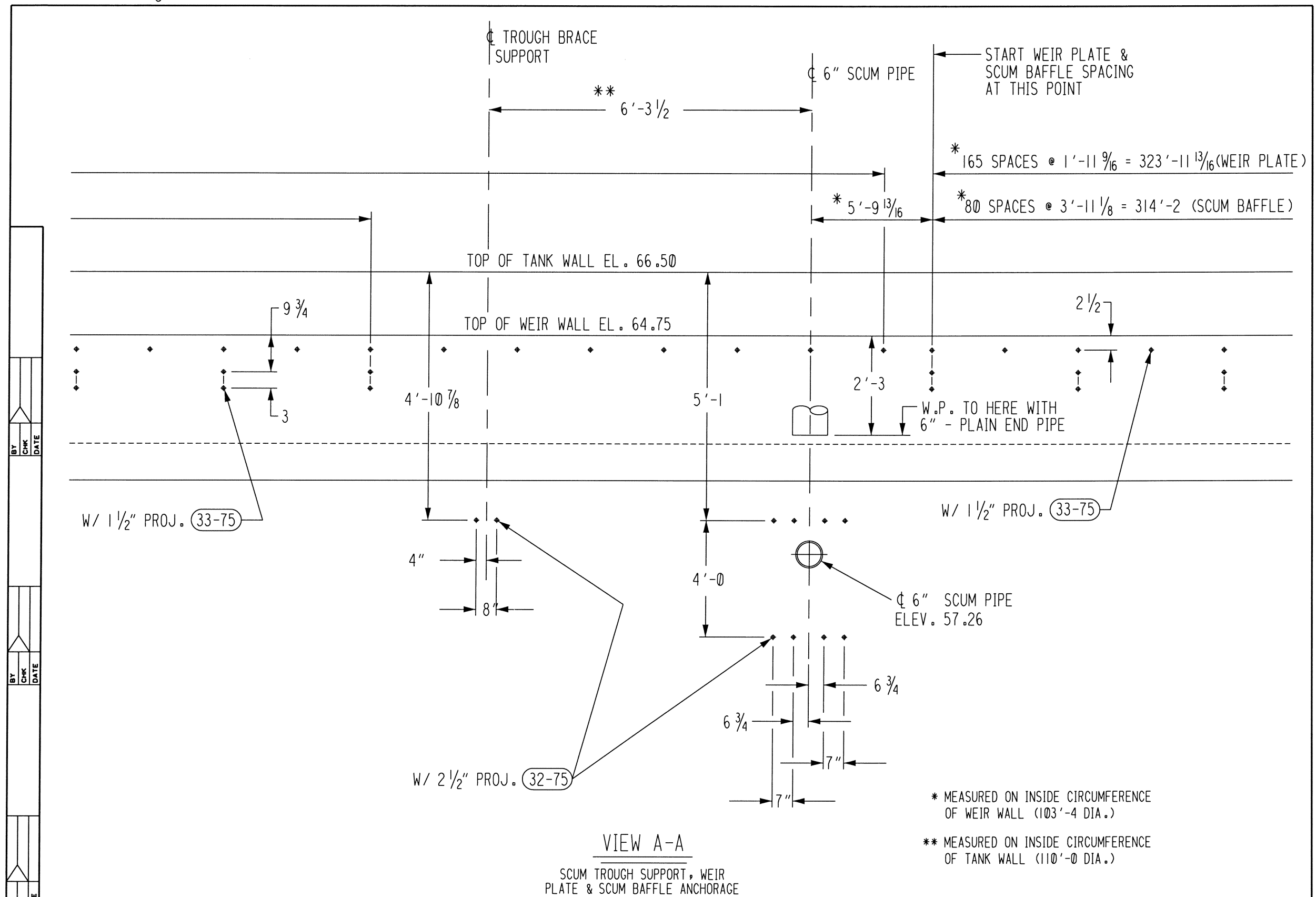
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CONTRACT	X220030	DRG	F	REV	
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BY		The use of anchor types, size, embedment or method other than that shown or provided by Walker Process Corporation will be done at the contractor's risk.	DATE	BY		Walker Process Equipment Division of McNish Corporation AURORA, ILLINOIS U.S.A.	
CHKD			DRAWN	9-3-21			BH
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The use of anchor types, size, embedment or method other than that shown or provided by Walker Process Corporation will be done at the contractor's risk

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Walker Process Equipment Division McNish Corporation AURORA, ILLINOIS U.S.A.			
FOUNDATION LAYOUT 110'-0 DIA. RSMTP-FRST(S) COLLECTOR FREMONT, NE.			
CONTRACT X220030	DRG	F3	REV

WALKER PROCESS EQUIPMENT
Division of McNish Corporation

Partial Installation List
Type RSMT(P)
Circular Collectors
Tapered Suction Header Type

JOB NAME / LOCATION	ST	QTY	DIA.	TYPE	YEAR	CONSULTING ENGINEER
TINKER AFB	OK	1	55	RSMT	1992	ARMY CORP. OF ENGINEERS
ST LOUIS	MO	12	150	RSMT(P)	1992	SVERDRUP / H & E
VILLA RICA	GA	2	38	RSMT(P)	1992	GERALD M. LEIGHT
UNOCAL: BEAUMONT	TX	1	110	RSM	1992	AWARE ENGINEERING
ROCKINGHAM	NC	1	110	RSMT(P)	1992	HAYES, SEAY, MATTERN & MATTERN
AVONDALE	AZ	2	75	RSMT(P)	1992	BROWN & CALDWELL
BIG STONE GAP	VA	2	40	RSMT(P)	1992	THOMPSON & LITTON
GREENVILLE	IL	2	65	RSMT(P)	1994	Crawford, Murphy & Tilly
LAS VEGAS	NV	6	140	RSMT(P)-D	1994	MMC, INC.
KNOX CO.	TN	2	135	RSMT(P)	1994	JORDAN, JONES & GOULDING
RABUN APPAREL	GA	1	120	RSMT(P)	1994	PIEDMONT, OLSEN & HENSLEY
MONTEVIDEO	MN	2		RSMT(P)	1993	BOLTON & MENK, INC.
LONGVIEW	TX	1	120	RSMT(P)	1994	KSA ENGINEERING
SAVANNAH	GA	3	120	RSMT(P)	1994	BROWN & CALDWELL
BRONSON	MI	2	50	RSMT(P)	1994	WW ENGINEERING & SCIENCE
BLUEFIELD	WV	4		RSMT(P)	1994	THOMPSON & LITTON
GREENVILLE	NC	2	125	RSMT(P)	1994	PIEDMONT, OLSEN & HENSLEY
JEFFERSON CO.	AL	2	105	RSMT(P)	1994	PAUL B. KREBS & ASSOCIATES
GREELEY	CO	1	120	RSMT(P)	1995	BROWN & CALDWELL
WINDOM	MN	2	60	RSMT(P)	1994	BOLTON & MENK, INC.
SEATTLE-RENTON	WA	4	100	RSMT	1995	BROWN & CALDWELL
LECENTER	MN	2	40	RSMT(P)	1994	BOLTON & MENK, INC.
MARYVILLE	TN	1	110	RSMT(P)	1995	J R WAUFORD & CO
LANCASTER	OH	1	103	RSMT(P)	1995	Malcolm Pirnie
WHEATON	IL	1	75	RSM	1995	BAXTER & WOODMAN
CORAOPOLIS	PA	1	44	SQ RSMP	1995	NIRA
STEPAN CHEM	IL	1	65	RSMT(P)	1995	STEPAN CHEMICAL COMPANY
HUNTLEY	IL	2	60	RSMT(P)	1995	BAXTER & WOODMAN
COOKEVILLE	TN	2	100	RSMT(P)-D	1996	J R WAUFORD & CO
New Ulm	MN	2	65	RSMT(P)	1995	BOLTON & MENK, INC.
PASCO	WA	1	95	RSMT(P)	1996	HDR ENGINEERING INC.
PASCO	WA	1	95	RSMT(P) (CCW)	1996	HDR ENGINEERING INC.
LEWISVILLE	TX	2	95	RSMT(P)	1996	NRS CONSULTING ENGINEERS
LANCASTER	OH	1	103	RSMT(P)	1997	Malcolm Pirnie
LEMARS	IA	1	65	RSMT(P)	1996	McClure Engineering
DEKALB	IL	2	56	RSMT(P)	1997	BELING CONSULTANTS
DARDANELLE	AR	1	32	RSMT(P)	1996	McCLELAND CONSULTING ENGINEERS
NW COBB CO.	GA	2	110	RSMT(P)	1997	METCALF & EDDY, INC.
ELKHORN	NE	2		RSMT(P)	1997	JOHNSON, ERICKSON & O'BRI
KNOXVILLE	TN	2	100	RSMT(P)	1997	LAMAR DUNN & ASSOCIATES
CHAMBERLAIN	SD	2	35	RSMT(P)	1997	CLARK ENGRG/BOLTON & MENK
ANTIGO	WI	2	55	RSMT(P)	1997	RUST ENVIRONMENTAL & INFR
LAS VEGAS	NV	1	140	RSMT(P)-D	1998	HDR ENGINEERING INC.
VIRGINIA FIBER	VA	1	75	RSMT	1998	Unknown
MONUMENT	CO	1	50	RSMT(P)	1998	ROTHBERG, TAMBURINI & WIN
PINELLAS CO	FL	8	120	RSMT(P)-RST	1998	PARSONS ENGINEERING
JACKSON	WI	2	65	RSMT(P)	1999	GRAEF, ANHALT, ASHLOEMER & ASSOC.
FRANKENMUTH	MI	1	50	RSMT(P)	1998	McNAMEE, PORTER & SEELEY
ST CHARLES	MO	1	100	RSMT(P)	1999	Crawford, Murphy & Tilly
FORTUNA	CA	1	60	RSMT(P)	1998	WHITLEY BURCHETT & ASSOCIATES
HAVRE	MT	1	50	RSMT(P)	1998	MORRISON - MAIERLE
BOROUGH OF NE	PA	1	95	RSMT(P)	1999	Hill Engineering

RSMT - Pier Supported, Tapered Suction Header(s)

(S) All Stainless Steel Construction

P - Skimmer(s)

D- Ducking Skimmer

FRST - Full Radius ScumTrough/Skimmer

RST - Rotating Scum Trough

CC/CCW - Clockwise/Counterclockwise

WALKER PROCESS EQUIPMENT

Division of McNish Corporation

Partial Installation List

Type RSMT(P)

Circular Collectors

Tapered Suction Header Type

JOB NAME / LOCATION	ST	QTY	DIA.	TYPE	YEAR	CONSULTING ENGINEER
LENOX	IA	2	40	RSMT-P	1998	BOLTON & MENK, INC.
GREIF BROS CORP	VA	2	75	RSMT-P	2000	Unknown
SEDALIA	MO	2	75	RSMT-P-FRST	1999	ARCHER ENGINEERS
FLORENCE	OR	2	65	RSMT-P	2000	BROWN & CALDWELL
PULASKI	TN	1	60	RSMT-P	1999	J R WAUFORD & CO
HUMBOLT	IA	2	50	RSMT-P	1999	Fox Engineering Associates
MARSHFIELD	MO	2	50	RSMT-P	2000	BRANCO ENGINEERING
CONE MILLS CO: MEXICO	MEX	2	40	RSMT-P	2000	Applied Technology & Engineering
MAYNARDVILLE	TN	1	60	RSMT-P	2000	LAMAR DUNN & ASSOCIATES
CITIZENS: ORLAND PARK	IL	1	90	RSMT-P	2000	Applied Technology & Engineering
KNOXVILLE	TN	1	135	RSMT-P	2001	CAMP, DRESSER & MCKEE
WEBSTER CITY	IA	2	60	RSMT-P	2001	BOLTON & MENK, INC.
BTM SEWER DIST: MALVERN	OH	2	45	RSMT-P	2000	BURGESS & NIPPLE
CRYSTAL LAKE	IL	1	80	RSMT-P	2001	BAXTER & WOODMAN
DOTHAN	AL	2	80	RSMT-P	2001	POLY ENGINEERING
LONGMONT	CO	2	60	RSMT-P	2001	ROTHBERG, TAMBURINI & WIN
HUNTSVILLE	AL	2	65	RSMT-P	2001	WISENBAKER, FIX & ASSOCIATES
NEDERLAND	TX	2	120	RSMT-P	2001	Schaumburg & Polk, Inc.
LONGMONT	CO	1	50	RSMT-P	2001	ROTHBERG, TAMBURINI & WIN
PLAINFIELD	IL	3	75	RSMT-P	2001	BAXTER & WOODMAN
NATIONAL BY-PRODUCTS	IA	1	25	RSMT-P	2001	Unknown
N LITTLE ROCK	AR	2	120	RSMT-P (EXIST)	2001	CRIST ENGINEERS, INC.
N LITTLE ROCK	AR	1	120	RSMT-P (NEW)	2001	CRIST ENGINEERS, INC.
TETON VILLAGE	WY	1	35	RSMT-P	2001	NELSON ENGINEERING
ROCKINGHAM	NC	2	90	RSMT-P	2002	HAYES, SEAY, MATTERN & MATTERN
WASHINGTON	NC	1	95	RSMT-P-D	2002	RIVERS & ASSOCIATES
PORT LAVACA	TX	2	65	RSMT-P	2002	Schaumburg & Polk, Inc.
UNION GROVE	WI	2	85	RSMT-P	2002	BAXTER & WOODMAN
PINELLAS CO	FL	2	85	RSMT-P	2002	PARSONS ENGINEERING
CLAYTON CO	GA	3	160	RSMT-P	2002	CH2M Hill
VINCENNES	IN	2	60	RSMT-P	2002	HNTB CORPORATION
VINCENNES	IN	2	95	RSMT-P	2002	HNTB CORPORATION
WELLS DAIRY: ST GEORGE	UT	1	40	RSMT-P	2002	BOLTON & MENK, INC.
SANTA MARGARITA	CA	2	90	RSMT-P	2002	CAROLLO ENGINEERS
LOCKPORT	IL	2	110	RSMT-P	2002	ROBINSON ENGINEERING
LINCOLN	IL	1	75	RSMT-P	2002	Donahue & Associates
JEFFERSON	NC	1	41	RSMT-P	2003	McGILL & ASSOCIATES
GENEVA	IL	1	95	RSMT-P	2003	BAXTER & WOODMAN
TRA: MIDLOTHIAN	TX	2	85	RSMT-P	2003	THE WALLACE GROUP
FISHERVILLE	VA	2	65	RSMT-FRST	2003	Hazen & Sawyer
COLUMBUS	NE	2	75	RSMT-P-FRST	2003	HDR ENGINEERING INC.
NEW ALBANY	IN	3	130	RSMT-P	2003	Donahue & Associates
GRAND RAPIDS	MI	6	100	RSMT-P	2003	TETRA TECH MPS
HAMPTON ROADS	VA	3	130	RSMT-P-RST	2004	Hazen & Sawyer
VILLA PARK	IL	2	75	RSMT-P	2004	WALTER DEUCHLER & ASSOCIATES
BURLEY	ID	2	90	RSMT-P	2004	FORSGREN ASSOCIATES
ROME	GA	2	120	RSMT-P	2004	JORDAN, JONES & GOULDING
NORTHGLENN	CO	2	65	RSMT-P	2004	INTEGRA ENGINEERING
CHOLOMA, HONDURAS	HND	1	70	RSMT-P	2004	INDUSTRIAL TEXTILE TECHNOLOGY
GLYNN CO	GA	2	80	RSMT-P	2005	HUSSEY, GAY, BELL & DEYOUNG, INC.
HARNETT CO	NC	2	110	RSMT-P	2005	MARZIANO AND MINIER
SAVANNAH	GA	3	60	RSMT-P	2005	HUSSEY, GAY, BELL & DEYOUNG, INC.

RSMT - Pier Supported, Tapered Suction Header(s)

(S) All Stainless Steel Construction

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RST - Rotating Scum Trough

CC/CCW - Clockwise/Counterclockwise

WALKER PROCESS EQUIPMENT
Division of McNish Corporation

Partial Installation List
Type RSMT(P)
Circular Collectors
Tapered Suction Header Type

JOB NAME / LOCATION	ST	QTY	DIA.	TYPE	YEAR	CONSULTING ENGINEER
ROMEOWILLE	IL	2	85	RSMT-P	2005	BAXTER & WOODMAN
RLA: CHOLOMA, HONDURAS	HND	1	85	RSMT-P	2006	IT3, INC.
CENTENNIAL	CO	2	80	RSMT-P	2006	RICHARD P. ARBOR ASSOCIATES
ST LOUIS	MO	2	100	RSMT-P	2006	HDR ENGINEERING INC.
SWIFT & CO: GREELEY	CO	2	102	RSMT-P-D	2007	CARTER & BURGESS
CLIFTON	CO	2	55	RSMT-P-FRST	2007	RTW
LANCASTER	SC	1	85	RSMT-P	2007	W.K. DICKSON & COMPANY, INC.
CONE DENIM, NICARAGUA	NIC	1	40	RSMT-P	2007	IT3, INC.
CULPEPER	VA	2	105	RSMT-P-RST	2007	Hazen & Sawyer
KALISPELL	MT	1	75	RSMT-P	2007	MORRISON - MAIERLE
FISHERSVILLE	VA	1	65	RSMT-P-FRST	2007	BLACK & VEATCH
WAVERLY	NE	2	45	RSMT-P	2008	JEO Consulting Group
EAST ALTON	IL	2	35	RSMT-P	2008	CURRY & ASSOCIATES
OZARK	MO	2	55	RSMT-P	2008	ARCHER ENGINEERS
WAYNESBORO	VA	2	120	RSMT-P-RST	2008	Hazen & Sawyer
PLAINFIELD	IL	3	75	RSMT-P	2008	BAXTER & WOODMAN
AURORA	MN	1	36	RSMT-P-FRST	2008	RMA ENGINEERING COMPANY
JEANNETTE	PA	2	50	RS-S	2008	GANNETT FLEMING, INC.
KEWASKUM	WI	3	40	RSMT-P	2008	MCMAHON ASSOCIATES
HBI: EL SALVADOR	ESL	1	85	RSMT-P	2008	IT3, INC.
WILLMAR	MN	1	93	RSMT-P	2008	Donahue & Associates
WILLMAR	MN	2	106	RSMT-P	2008	Donahue & Associates
ALLEGAN	MI	2	45	RSMT-P	2009	Moore & Bruggink, Inc.
WYMORE	NE	1	30	RSMT-P	2009	KIRKHAM, MICHAEL & ASSOCIATES
FARMINGTON	MO	1	50	RSMT-P-FRST	2009	HORNER & SHIFRIN, INC.
MONON	IN	2	30	RSMT-P	2009	Wessler Associates
KINGMAN	AZ	2	110	RSMT-P	2009	BROWN & CALDWELL
BUFFALO	WY	2	50	RSMT-P-FRST	2009	TETRA TECH / RTW
WESTBOROUGH	MA	1	105	RSMT-P-FRST	2009	AECOM / FST
WESTBOROUGH	MA	2	105	RSMT-P-FRST	2009	AECOM / FST
TALLAHASSEE	FL	3	120	RSP-S-FRST	2009	Hazen & Sawyer
WASHINGTON	IL	2	65	RSMT-P	2009	STRAND & ASSOCIATES
MADISON JCT.	WY	1	20	RSMT-P	2010	TETRA TECH MPS
FRUITA	CO	2	53	RSMT-P-S-FRST	2010	TETRA TECH / RTW
ROXANA	IL	2	50	RSMT-P	2010	CURRY & ASSOCIATES
JANESVILLE	WI	1	120	RSMT-P (NEW)	2010	AECOM
JANESVILLE	WI	2	120	RSMT-P (EXIST)	2010	AECOM
KEWAUNEE	WI	2	35	RSMT-P	2010	Donahue & Associates
CARLISLE	PA	1	100	RSMT-P-FRST	2010	BLACK & VEATCH
CARLISLE	PA	1	100	RSMT-P-FRST	2010	BLACK & VEATCH
CARLISLE	PA	1	100	RSMT-P-FRST	2010	BLACK & VEATCH
CARLISLE	PA	1	100	RSMT-P-FRST	2010	BLACK & VEATCH
BLUE SPRINGS	MO	2	125	RSMT-P-FRST	2010	HDR/ARCHER
AURORA	MN	1	36	RSMT-P-FRST	2010	GRIDOR CONSTR., INC.
L'Anse	MI	2	40	RSMT-P	2010	Gogebic Mechanical Inc.
Danville	PA	2	60	RSMT-P	2010	GANNETT FLEMING, INC.
Danville	PA	1	60	RSMT-P	2010	GANNETT FLEMING, INC.
Grandville	MI	2	60	RSMT-P	2010	Moore & Bruggink, Inc.
JBS Swift/Grand Island	NE	1	100	RSMT-P	2010	Gonzalez Companies
Bush Brothers Co.	WI	1	40	RSMT	2010	Donahue & Associates
Fountain	CO	2	60	RSMT-P	2011	GMS Inc.
Wentzville	MO	2	80	RSMT-P	2011	CAROLLO ENGINEERS

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WALKER PROCESS EQUIPMENT
Division of McNish Corporation

Partial Installation List
Type RSMT(P)
Circular Collectors
Tapered Suction Header Type

JOB NAME / LOCATION	ST	QTY	DIA.	TYPE	YEAR	CONSULTING ENGINEER
Wausau	WI	2	90	RSMT	2011	BECHER-HOPPE ASSOCIATES
Winnebago	MN	2	45	RSMT	2011	BOLTON & MENK, INC.
Fox Metro	IL	2	135	RSMT	2011	WALTER DEUCHLER & ASSOCIATES
Firestone	CO	2	100	RSMT-S-FRST	2011	Frachetti Engineering
Paddock Lake	WI	2	55	RSMT	2011	BAXTER & WOODMAN
Moore County	NC	2	90	RSMT	2011	HOBBS, UPCHURCH & ASSOCIATES
Moore County	NC	1	90	RSMT	2011	HOBBS, UPCHURCH & ASSOCIATES
Moore County	NC	2	105	RSMT	2011	HOBBS, UPCHURCH & ASSOCIATES
Moore County	NC	1	105	RSMT	2011	HOBBS, UPCHURCH & ASSOCIATES
St. Charles	MO	1	125	RSMT	2011	Donahue & Associates
Clearwater	FL	4	75	RSMT	2011	King Engineering
Virginia	MN	1	83	RSMT	2011	SEH, Inc.
Tallahassee	FL	1	90	RSMT	2011	MWH Constructors Inc.
Tallahassee	FL	1	90	RSMT	2011	MWH Constructors Inc.
Midlothian	TX	1	85	RSMT	2011	Chaing, Patel, Yerby
Pekin	IL	1	106	RSMT	2012	Farnsworth Group
Pekin	IL	1	106	RSMT	2012	Farnsworth Group
Iowa City	IA	2	115	RSMT	2012	Stanley Consultants, Inc.
Wood Dale	IL	1	65	RSMT	2012	Howard R. Green
Crest Hill	IL	2	75	RSMT	2012	BAXTER & WOODMAN
Clearwater	FL	4	100	RSMT	2012	King Engineering
Kamloops BC	CND	1	144	RSMT (CW)	2012	Urban Systems
Kamloops BC	CND	1	144	RSMT (CW)	2013	Urban Systems
North Olmsted	OH	3	105	RSMT	2012	Hazen & Sawyer
North Olmsted	OH	3	105	RSMT	2013	Hazen & Sawyer
Winston Salem (Muddy Creek)	NC	1	125	RSMT	2013	Hazen & Sawyer
Clarksville	TN	4	140	RSMT-FRST	2013	Hazen & Sawyer
Clarksville	TN	2	140	RSMT-FRST	2013	Hazen & Sawyer
LeMars	IA	2	40	RSMT	2013	BOLTON & MENK, INC.
Michael Foods, Inc.		1	80	RSMT	2013	BOLTON & MENK, INC.
Eau Claire	WI	2	115	RSMT	2013	Donahue & Associates
Eau Claire	WI	1	115	RSMT	2013	Donahue & Associates
Fostoria, OH	OH	2	100	RSMT	2013	Crawford, Murphy & Tilly
Middlebury, IN	IN	1	50	RSMT	2013	Donahue & Associates
Tuskegee, AL-North WWTP	AL	1	60	RSMT	2013	Associated Mech. Contractors, Inc
Nashville	AR	2	67	RSMT	2013	Civil Engineering Associates
Bensenville, IL	IL	2	90	RSMT	2014	STRAND & ASSOCIATES
Fort Polk North Fort WWTP	LA	3	45	RSMT	2014	MWH Americas Inc
Fort Polk South Fort WWTP	LA	3	75	RSMT	2014	MWH Americas Inc
High Point	NC	2	90	RSMT-RST	2014	Hazen & Sawyer
High Point	NC	1	130	RSMT-RST	2014	Hazen & Sawyer
Middletown	OH	1	125	RSMT	2014	BROWN & CALDWELL
Middletown	OH	1	125	RSMT	2014	BROWN & CALDWELL
Middletown	OH	1	125	RSMT	2014	BROWN & CALDWELL
Superior	CO	2	50	RSMT	2014	Ramey Environmental
Guntersville	AL	2	90	RSMT	2014	Krebs Engineering
Moline	IL	2	95	RSMT	2014	STRAND & ASSOCIATES
Cleveland	OH	5	110	RSMT	2014	Kokosing Construction Co., Inc.
Madison	IN	1	70	RSMT-FRST	2014	Donahue & Associates
Warren	MI	4	100	RSMT	2014	HUBBELL, ROTH & CLARK, INC.
Greensboro	NC	3	160	RSMT	2014	Hazen & Sawyer
Northumberland	PA	2	65	RSMT	2015	Hazen & Sawyer

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Type RSMT(P)
Circular Collectors
Tapered Suction Header Type

JOB NAME / LOCATION	ST	QTY	DIA.	TYPE	YEAR	CONSULTING ENGINEER
Aurora Fox Metro	IL	1	135	RSMT-P	2015	Deuchler Assoc.
Louisville	KY	3	130	RSMT-P	2015	Hazen & Sawyer
Zeeland	MI	1	35	RSMT-P	2015	Moore & Bruggink, Inc.
Zeeland	MI	2	46	RSMT-P	2015	Moore & Bruggink, Inc.
Greenwich	CT	3	115	RSMT-P	2015	GANNETT FLEMING, INC.
Fulton	MO	2	50	RSMT-P-FRST	2015	HDR ENGINEERING INC.
Fulton	MO	1	90	RSMT-P-FRST	2015	HDR ENGINEERING INC.
Fox Metro - Aurora	IL	2	135	RSMT-P	2016	WALTER DEUCHLER & ASSOCIATES
San Antonio	TX	2	140	RSMT-P	2016	CHIANG, PATEL & YERBEY
San Antonio	TX	2	140	RSMT-P	2016	CHIANG, PATEL & YERBEY
Fox Metro - Aurora	IL	1	135	RSMT-P	2016	Deuchler Assoc.
Northglenn	CO	1	65	RSMT-P	2016	Providence Infrastructure Consultants
Perry (Tyson Fresh Meats)	IA	2	42	RSMT-P-FRST	2016	BOLTON & MENK, INC.
Perry (Tyson Fresh Meats)	IA	1	42	RSMT-P-FRST	2016	BOLTON & MENK, INC.
Hoquiam	WA	1	100	RSMT-P	2016	HDR ENGINEERING INC.
JEA Jacksonville, Arlington East	FL	1	160	RSMT-P	2016	Hazen & Sawyer
Rehoboth Beach	DE	2	98	RSMT-P-FRST	2017	GHD, Inc
York	NE	2	60	RSMT-P-FRST (S)	2017	HDR ENGINEERING INC.
Dekalb	IL	3	115	RSMT-P	2017	BAXTER & WOODMAN
Schereville	IN	1	65	RSMT-P	2017	Nies Engineering
Schereville	IN	1	100	RSMT-P	2017	Nies Engineering
Snowmass	CO	2	55	RSMT-P	2018	SGM
Geneva	IL	2	95	RSMT-P	2018	CDM Smith
Sioux Center	IA	2	85	RSMT-P(S)	2018	BOLTON & MENK, INC.
MELROSE	MN	2	38	RSMT-P(S)	2018	BOLTON & MENK, INC.
NEORS D SOUTHERLY	OH	10	110	RSMT-X	2019	BROWN & CALDWELL
MIDLAND	TX	3	110	RSMT-P	2019	CH2M HILL
ZEELAND	MI	3	46	RSMT-P	2019	MOORE & BRUGGINK, INC.
SUMMITT CO	OH	2	90	RSMT-P	2019	MS CONSULTANTS
AURORA (FOX METRO)	IL	1	135	RSMT-P	2019	WALTER DEUCHLER & ASSOCIATES
RICHMOND	IN	4	105	RSMT-P	2020	DONOHUE & ASSOC.
TIFFIN	OH	1	80	RSMT-P	2020	AECOM
SIMI VALLEY	CA	1	90	RSMT-P	2020	SCHNEIDER ELECTRIC
SIMI VALLEY	CA	1	90	RSMT-P	2020	SCHNEIDER ELECTRIC
SIMI VALLEY	CA	1	90	RSMT-P	2020	SCHNEIDER ELECTRIC
SIMI VALLEY	CA	1	90	RSMT-P	2020	SCHNEIDER ELECTRIC
NORTHERN MORAINES ISLAND LAKE	IL	1	85	RSMT-P(S)	2020	NONE
YORKTOWN	IN	2	40	RSMT-P	2020	BUTLER, FAIRMAN, & SEUFERT INC
FRANKFORT	IN	2	90	RSMT-P	2020	WESSLER ASSOCIATES
CENTENNIAL	CO	1	80	RSMT-P	2021	MOTT MACDONALD
NORTH EAST BOROUGH	PA	1	95	RSMT-P	2021	GREENMAN-PEDERSEN INC
FORT MADISON CONAGRA BRANDS	IA	1	50	RSMT-P(S)-FRST	2021	BOLTON & MENK, INC.
SAN DIEGO	CA	4	150	RSMT-P	2022	CH2M HILL
FREMONT	NE	1	110	RSMT-P(S)-FRST	2022	HDR ENGINEERING INC.
EAST LANSING	MI	2	75	RSMT-P	2022	TETRA TECH
EAST LANSING	MI	3	90	RSMT-P	2022	TETRA TECH
PERRY	IA	2	85	RSMT-P(S)	2022	BOLTON & MENK, INC.
CHEBOYGAN	MI	1	60	RSMT-P	2022	HUBBELL, ROTH & CLARK, INC.
CHEBOYGAN	MI	2	50	RSMT-P	2022	HUBBELL, ROTH & CLARK, INC.
CALEDONIA	MN	1	35	RSMT-P	2022	DONOHUE & ASSOC.
CALEDONIA	MN	1	35	RSMT-P	2022	DONOHUE & ASSOC.
CAMBRIDGE CITY	IN	2	56	RSMT-P	2022	WESSLER ASSOCIATES

RSMT - Pier Supported, Tapered Suction Header(s)

(S) All Stainless Steel Construction

P - Skimmer(s)

D - Ducking Skimmer

FRST - Full Radius ScumTrough/Skimmer

RST - Rotating Scum Trough

CC/CCW - Clockwise/Counterclockwise

WALKER PROCESS EQUIPMENT
Division of McNish Corporation

Partial Installation List
Type RSMT(P)
Circular Collectors
Tapered Suction Header Type

JOB NAME / LOCATION	ST	QTY	DIA.	TYPE	YEAR	CONSULTING ENGINEER
BARTLETT	IL	2	85	RSMT	2022	NONE
DELTA TOWNSHIP	MI	1	100	RSMT LA-EDI	2022	TETRA TECH
NORTHGLENN	CO	2	65	RSMT	2022	CITY
ST. LOUIS	MO	3	130	RSMT(S)	2022	HDR ENGINEERING INC.
DUNN	NC	1	80	RSMT	2023	DAVIS-MARTIN-POWELL
DUNN	NC	1	60	RSMT	2023	DAVIS-MARTIN-POWELL
CREST HILL	IL	2	60	RSMT	2023	STRAND & ASSOCIATES

RSMT - Pier Supported, Tapered Suction Header(s)
(S) All Stainless Steel Construction
P - Skimmer(s)
D- Ducking Skimmer
FRST - Full Radius ScumTrough/Skimmer
RST - Rotating Scum Trough
CC/CCW - Clockwise/Counterclockwise



Norwalk WPCF

Connecticut

Engineer

Arcadis

Representative

Mike Ademovic
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Contact

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Matt Pearson
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Proposal Number: 1760172
Friday, February 24, 2023



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Technical Proposal

Item A – Clarifier Mechanisms Model CLC18G

General Scope of Supply		
Item	Unit	Value/Description
Number of Mechanisms	Each	4
Application	-	Activated Sludge Secondary
Tank Diameter	ft	110
Tank Side Wall Depth	ft	18
Tank Side Water Depth	ft	15
Tank Bottom Slope	-	0.125:12
Design Flow Rate	MGD	7.5
Max Flow Rate	MGD	10
Influent MLSS Concentration	mg/L	3000**
SVI	mL/g	130**

**Assumed Value

Detailed Scope of Supply - Each Mechanism Includes the Following			
Item	Qty	Size/Description	Material
Walkway Bridge	1	36" wide Truss Bridge	Steel
Walkway Handrail	-	Truss Serves as Handrail Component	Steel
Walkway Flooring	-	1.25" Grating	Aluminum
Drive Platform	1	24" Minimum Drive Clearance	Steel
Platform Handrail	-	2 Rail Component Handrail, Pop Rivet	Aluminum
Platform Flooring	-	0.25" Checker Plate	Aluminum
Center Column	1	48" dia. x 0.25" thick	Steel
Center Cage	1	4' Square	Steel
Dual Gate EDI	1	11' dia. x 4' deep x 0.1875" plate	Steel
Feedwell	1	28' dia. x 6' deep x 0.1875" plate	Steel
Suction Headers	2	Rectangular Tapered Cross-Section	304 SS
Suction Header Support Arm	2	Box Truss Header Supports, 4' wide	Steel
Rotating Suction Manifold	1	9' dia. x 0.25" thick	Steel
Skimmer Blade & Supports	2	Extends from feedwell to hinged skimmer	Steel
Hinged Skimmer Assembly	2	With neoprene wipers	HDG/304 SS/Alum
Scum Box & Supports	1	5' Scum Box	Steel
Scum Flushing Valve	1	Skimmer Actuated	Polymer/SS
Effluent Weir	1	9" deep x 0.25" thick	FRP
Scum Baffle & Supports	1	12" deep x 0.25" thick	FRP
Electrical Control Panel	1	NEMA 4X	304 SS
Drive Unit	1	See Drive Unit Table for description	
Anchor Bolts & Fasteners	-	-	304 SS

Drive Unit		
Description	Unit	Value/Description
Drive Type	C42	Cage Drive w/ Precision Bearing
Housing Material	-	Fabricated Steel
Continuous Rated Torque	ft·lbs	45,500
Momentary Peak Torque	ft·lbs	91,000
Rake Tip Speed	ft/min	14.1
Motor Size	HP	1
Motor Voltage/Frequency/Phase	V / Hz / Phase	460 / 60 / 3
Torque Control Settings	Alarm: ft·lbs	100%: 45,500
	Motor Cutout: ft·lbs	120%: 54,600
Main Gear and Pinion Lubrication	-	Oil
Main Bearing and Reducer Lubrication	-	Grease

Surface Preparation and Coating		
Application Surfaces	Surface Preparation	Finish
Submerged	SSPC-SP10	One (1) Coat Tnemec N140-1255, 4-6 mils DFT, and One (1) Coat Tnemec N140-B5712, 4-6 mils DFT
Non-Submerged	SSPC-SP6	One (1) Coat Tnemec N140-1255, 4-6 mils DFT, and One (1) Coat Tnemec 1074U-B5712, 3-5 mils DFT
Stainless Steel	Cleaning Grade "C"	See Below for Details
Drive Unit	SSPC-SP6	One (1) coat Tnemec N140F-1255 Epoxy, 4-6 mils DFT, and one (1) coat Tnemec 1074U-B5712 Polyurethane, 3-5 mils DFT

Stainless Steel Finish

CLEANING GRADE "C"

1. PRE-CLEAN ALL SURFACES IN ACCORDANCE WITH THE WESTECH WORKMANSHIP STANDARD (QR-00-063) SECTIONS 12 & 13, TO ENSURE THAT ALL SHARP EDGES, BURRS, WELD SPATTER, WELD SLAG ARE REMOVED.
2. A MINIMUM AMOUNT OF FREE IRON MAY REMAIN ON SURFACES. THESE LOCATIONS SHALL BE LIMITED TO SMALL PIN-POINT AREAS 1/16" (1mm) IN DIAMETER OR LESS, SCATTERED IN A RANDOM PATTERN, AND SHALL BE LESS THAN 1% OF THE TOTAL SURFACE AREA.
3. ALL SURFACES SHALL BE FREE FROM:
 - a. HEAT TINT (REGARDLESS OF HEAT SOURCE; WELDING, THERMAL CUTTING, OR GRINDING).
 - b. OXIDES AND TARNISH (FROM THERMAL CUTTING, AND TIGHTLY ADHERENT BROWN OR BLACK TARNISH FORMED ALONG THE TOE OF A WELD).
4. THIS REQUIRED CLEANING APPLIES TO INTERNAL AND EXTERNAL SURFACES SUBJECT TO CORROSIVE MEDIA ATTACK; SUCH AS INTERNAL SURFACES OF PIPING.



CLEANING GRADE "C"

Approximate Weights

Item	Weight	Unit
Center Column	2800	lbs
Center Cage, Suction Headers, Suction Header Support Arm, Rotating Suction Manifold	12400	lbs
Dual Gate EDI, Feedwell, Feedwell Supports	10650	lbs
Standard Skimmer, Scum Box & Supports	3350	lbs
Bridge & Platform	4000	lbs
Drive Unit	4000	lbs
Heaviest Single Item (Drive Unit)	4000	lbs

Additional Services and Equipment

WesTech has included on-site technical assistance for inspection, observation of torque testing, startup, and instruction of plant personnel. Additional on-site services may be purchased at standard WesTech daily rates plus travel and living expenses.

On-Site Technical Service

Item	Quantity
Total Number of Trips	4
Total Number of Days	4

Items Not Included in WesTech's Base Scope of Supply (unless specifically noted)

- Concrete/Grout
- Concrete and Anchor Reinforcement
- Conduits and Wiring
- Erection or Assembly
- Lubricants
- Piping, Valves, or Fittings
- Unloading or Storage

Item B – Clarifier Mechanisms Model COPC1G

General Scope of Supply		
Item	Unit	Value/Description
Number of Mechanisms	Each	4
Application	-	Activated Sludge Secondary
Tank Diameter	ft	110
Tank Side Wall Depth	ft	18
Tank Side Water Depth	ft	15
Tank Bottom Slope	-	0.125:12
Design Flow Rate	MGD	7.5
Max Flow Rate	MGD	10
Influent MLSS Concentration	mg/L	3000**
SVI	mL/g	130**

**Assumed Value

Detailed Scope of Supply - Each Mechanism Includes the Following			
Item	Qty	Size/Description	Material
Walkway Bridge	1	36" wide Truss Bridge	Steel
Walkway Handrail	-	Truss Serves as Handrail Component	Steel
Walkway Flooring	-	1.25" Grating	Aluminum
Drive Platform	1	24" Minimum Drive Clearance	Steel
Platform Handrail	-	2 Rail Component Handrail, Pop Rivet	Aluminum
Platform Flooring	-	0.25" Checker Plate	Aluminum
Center Column	1	48" dia. x 0.25" thick	Steel
Center Cage	1	4' Square	Steel
Dual Gate EDI	1	11' dia. x 4' deep x 0.1875" plate	Steel
Feedwell	1	28' dia. x 6' deep x 0.1875" plate	Steel
Full Radius Rake Arms	2	Box Truss w/ Spiral Scrapers	Steel
Sludge Withdrawal Ring	1	20% Tank Diameter w/ Evenly Spaced Ports	Steel
Skimmer Blade & Supports	2	Extends from feedwell to hinged skimmer	Steel
Hinged Skimmer Assembly	2	With neoprene wipers	HDG/304 SS/Alum
Scum Box & Supports	1	5' Scum Box	Steel
Scum Flushing Valve	1	Skimmer Actuated	Polymer/SS
Effluent Weir	1	9" deep x 0.25" thick	FRP
Scum Baffle & Supports	1	12" deep x 0.25" thick	FRP
Electrical Control Panel	1	NEMA 4X	304 SS
Drive Unit	1	See Drive Unit Table for description	
Anchor Bolts & Fasteners	-	-	304 SS

Drive Unit		
Description	Unit	Value/Description
Drive Type	C42	Cage Drive w/ Precision Bearing
Housing Material	-	Fabricated Steel
Continuous Rated Torque	ft·lbs	45,500
Momentary Peak Torque	ft·lbs	91,000
Rake Tip Speed	ft/min	14.1
Motor Size	HP	1
Motor Voltage/Frequency/Phase	V / Hz / Phase	460 / 60 / 3
Torque Control Settings	Alarm: ft·lbs	100%: 45,500
	Motor Cutout: ft·lbs	120%: 54,600
Main Gear and Pinion Lubrication	-	Oil
Main Bearing and Reducer Lubrication	-	Grease

Surface Preparation and Coating		
Application Surfaces	Surface Preparation	Finish
Submerged	SSPC-SP10	One (1) Coat Tnemec N140-1255, 4-6 mils DFT, and One (1) Coat Tnemec N140-B5712, 4-6 mils DFT
Non-Submerged	SSPC-SP6	One (1) Coat Tnemec N140-1255, 4-6 mils DFT, and One (1) Coat Tnemec 1074U-B5712, 3-5 mils DFT
Drive Unit	SSPC-SP6	One (1) coat Tnemec N140F-1255 Epoxy, 4-6 mils DFT, and one (1) coat Tnemec 1074U-B5712 Polyurethane, 3-5 mils DFT

Approximate Weights		
Item	Weight	Unit
Center Column	2750	lbs
Center Cage, Rake Arms, Spiral Rake Blades, Sludge Withdrawal Ring	11200	lbs
Dual Gate EDI, Feedwell, Feedwell Supports	10650	lbs
Standard Skimmer, Scum Box & Supports	3350	lbs
Bridge & Platform	4000	lbs
Drive Unit	4000	lbs
Heaviest Single Item (Drive Unit)	4000	lbs

Additional Services and Equipment

WesTech has included on-site technical assistance for inspection, observation of torque testing, startup, and instruction of plant personnel. Additional on-site services may be purchased at standard WesTech daily rates plus travel and living expenses.

On-Site Technical Service	
Item	Quantity
Total Number of Trips	4
Total Number of Days	4

Items Not Included in WesTech's Base Scope of Supply (unless specifically noted)

- Concrete/Grout
- Concrete and Anchor Reinforcement
- Conduits and Wiring
- Erection or Assembly
- Lubricants
- Piping, Valves, or Fittings
- Unloading or Storage

Clarifications and Exceptions

General Clarifications

Terms & Conditions: This proposal, including all terms and conditions contained herein, shall become part of any resulting contract or purchase order. Changes to any terms and conditions, including but not limited to submittal and shipment days, payment terms, and escalation clause shall be negotiated at order placement, otherwise the proposal terms and conditions contained herein shall apply.

Paint: If your equipment has paint included in the price, please take note to the following. Primer paints are designed to provide only a minimal protection from the time of application (usually for a period not to exceed 30 days). Therefore, it is imperative that the finish coat be applied within 30 days of shipment on all shop primed surfaces. Without the protection of the final coatings, primer degradation may occur after this period, which in turn may require renewed surface preparation and coating. If it is impractical or impossible to coat primed surfaces within the suggested time frame, WesTech strongly recommends the supply of bare metal, with surface preparation and coating performed in the field. All field surface preparation, field paint, touch-up, and repair to shop painted surfaces are not by WesTech.

Escalation: If between the proposal date and actual procurement and through no fault of the Seller, the relevant cost of labor, material, freight, tariffs, and other Seller costs combined relating to the contract, increase by greater than 2.5% of the overall contract price, then the contract price shall be subject to escalation and increased. Such increase shall be verified by documentation and the amount of contract price escalation shall be calculated as either the actual increased cost to the Seller or, if agreed by the Parties, the equivalent increase of a relevant industry recognized third-party index, and in both cases without any additional profit or margin being added.

USA Tariffs and Current Trade Laws: All prices are based on current USA and North America tariffs and trade laws/agreements at time of bid. Any changes in costs due to USA Tariffs and trade laws/agreements will be passed through to the purchaser at cost.

The Infrastructure Investment and Jobs Act of 2021 (IIJA) includes potentially significant changes to historical “Buy American” or “American Iron and Steel” (AIS) requirements for federally funded projects, including water-related infrastructure projects as administered by the Environmental Protection Agency (EPA). The IIJA was signed into law on Nov 15, 2021. However the EPA has yet to issue additional information and guidance clarifying the application and interpretation of these changes. Although WesTech makes every effort to source the steel for our equipment and products domestically, not everything is reasonably or commercially available to meet all project specific constraints. Consequently, any proposal or offer for sale by WesTech, including any resulting equipment order, does not guarantee compliance with the Buy American provisions of the Infrastructure Investment and Jobs Act of 2021 at this time.

Commercial Proposal

Proposal Name: Norwalk WPCF

Proposal Number: 1760172

Friday, February 24, 2023

1. Bidder's Contact Information

Company Name	WesTech Engineering, LLC
Primary Contact Name	Greg Payne
Phone	(801) 265-1000
Email	gpayne@westech-inc.com
Address: Number/Street	3665 S West Temple
Address: City, State, Zip	Salt Lake City, UT 84115

2. Budget Pricing

Currency: USD

Scope of Supply

A	Four (4) 110' Diameter Clarifier Mechanisms Model CLC18G	\$2,039,500
	Drives	\$206,400
	Total	\$2,245,900
B	Four (4) 110' Diameter Clarifier Mechanisms Model COPC1G	\$1,707,200
	Drives	\$206,400
	Total	\$1,913,600
	Taxes (sales, use, VAT, IVA, IGV, duties, import fees, etc.)	Not Included

Prices are valid for a period not to exceed 30 days from date of proposal and are subject to escalation adjustments (see Pricing and Cost Escalation section below).

Additional Field Service

Daily Rate (Applicable Only to Field Service Not Included in Scope)	\$1,200
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Pricing does not include field service unless noted in scope of supply, but is available at the daily rate plus expenses. The greater of a two week notice or visa procurement time is required prior to departure date. Our field service policy can be provided upon request for more details.

3. Payment Terms

Purchase Order Acceptance and Contract Execution	10%
Submittals Provided by WesTech	15%
Release for Fabrication	35%
Notification of Ready to Ship	40%

All payments are net 30 days. Partial shipments are allowed. An approved Letter of Credit is required if Incoterms CIF, CFR, DAP, CIP, or CPT are applicable. Payment is required in full for all other Incoterms prior to international shipment. Other terms per WesTech proforma invoice. Please note that the advising bank must be named as: Wells Fargo Bank, International Department, 9000 Flair Drive, 3rd Floor, El Monte, California 91731, USA.

4. Schedule

Submittals, after Purchase Order Acceptance and Contract Execution	11 to 13 weeks
Ready to Ship, after Receipt of Final Submittal Approval	24 to 26 weeks
Estimated Weeks to Ready to Ship	35 to 39 weeks*

*Customer submittal approval is typically required to proceed with equipment fabrication and is not accounted for in the schedule above. Project schedule will be extended to account for time associated with receipt of customer submittal approval.

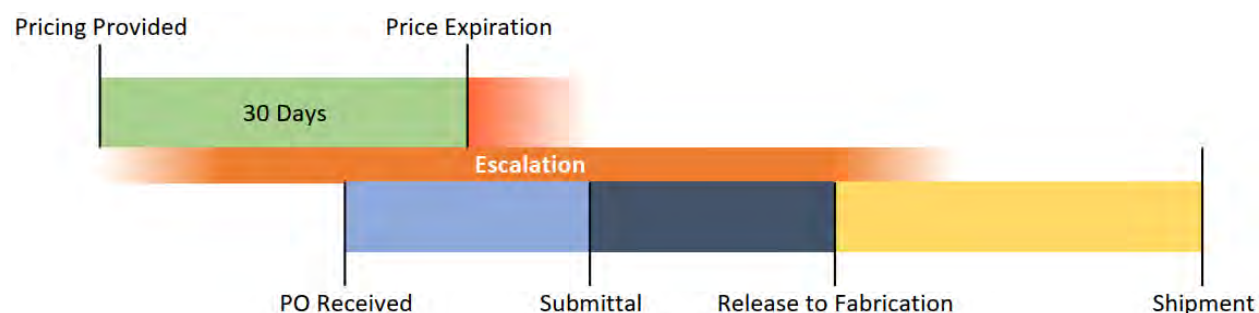
5. Freight

Domestic	FOB Shipping Point - Full Freight Allowed to Jobsite (FSP-FFA)	
From	Final Destination	Number of Trucks or Containers
WesTech Shops	Norwalk, CT	TBD

Pricing and Cost Escalation

Pricing

Price Validity: To protect our customers from inflated pricing due to volatile markets, inflation, and significant cost increases, WesTech seeks to provide the most fair and competitive pricing at the time of bid. Because of this, WesTech can only keep their price valid for 30 days from the time of quote (proposal date), regardless of the prime contract bid date. WesTech also requires an escalation clause as a part of the purchase agreement to account for cost escalations from the time of quote to the time of procurement. This allows for only cost to be passed to the buyer if the market increases, rather than the customer paying higher prices upfront that include inflated contingency budgets to consider the potential cost increases.



Escalation

Escalation Terms: WesTech's standard terms and conditions state "If between the proposal date and actual procurement and through no fault of the Seller, the relevant cost of labor, material, freight, tariffs, and other Seller costs combined relating to the contract, increase by greater than 2.5% of the overall contract price, then the contract price shall be subject to escalation and increased. Such increase shall be verified by documentation and the amount of contract price escalation shall be calculated as either the actual increased cost to the Seller or, if agreed by the Parties, the equivalent increase of a relevant industry recognized third-party index, and in both cases without any additional profit or margin being added."

Index and Calculating Escalation

Third Party Index: Calculating and providing 3rd party cost verification of escalation has been challenging and time consuming for all parties. There is not a single index that perfectly identifies market trends for our complete product. The price adjusting methodology for escalation will be based on industry recognized indices applicable to the different areas of the project that do have indices. WesTech has chosen to use index data from the FRED (Federal Reserve Economic Data) Indices. These are open and free to the public via their website: fred.stlouisfed.org.

"FRED is an online database consisting of hundreds of thousands of economic data time series from scores of national, international, public, and private sources. FRED, [is] created and maintained by the Research Department at the Federal Reserve Bank of St. Louis." (FRED, 2022)

The following list (not limited) identifies indices applicable to our equipment components:

Producer Price Index by Commodity: Metals and Metal Products: Nickel and Nickel-Base Alloy Mill Shapes
Producer Price Index by Industry: Motor and Generator Manufacturing
Producer Price Index by Industry: Mechanical Power Transmission Equipment Manufacturing
Producer Price Index by Industry: Steel Product Manufacturing from Purchased Steel
Producer Price Index by Commodity: Professional Services (Partial): Engineering Services
Producer Price Index by Industry: Other Electrical Equipment and Component Manufacturing
Producer Price Index by Commodity: All Other Reinforced and Fiberglass Plastics Products
Producer Price Index by Commodity: Metals and Metal Products: Aluminum Extruded and Drawn Pipe
Producer Price Index by Commodity: Metals and Metal Products: Extruded Aluminum Rod, Bar
Producer Price Index by Industry: Aluminum Sheet, Plate, and Foil Manufacturing: Primary Products
Producer Price Index by Industry: General Freight Trucking, Long-Distance Truckload

The price increase will be calculated as follows: costs subject to escalation will be allocated to the industry appropriate index as a percentage of the applicable project specific component and then multiplied by the associated increase in the materials index (Contract price X % of Component in contract price) X (% Increase in material index for that component).

Below is an example of a typical WesTech project:

Customer PO Value:	\$	500,000.00							
Base Price (input):	\$	500,000.00	Bid Date:	Release Date:	Ship Date:				
			12/15/2021	5/1/2022	11/11/2022				
Equipment Components	% of Total Cost	Index Value	Index Value	Previous Price	Multiplier	Adjusted Price	Bid Index Date:	Index Date:	% Difference
Stainless Steel	14%	134.714	161.494	\$ 70,000.00	1.199	\$ 83,915.41	12/1/2021	5/1/2022	19.9%
Motors	0%	237.30	259.46	\$ -	1.093	\$ -	12/1/2021	5/1/2022	9.3%
Drive Units	5%	304.59	323.91	\$ 25,000.00	1.063	\$ 26,585.50	12/1/2021	5/1/2022	6.3%
Mild Steel	8%	357.97	373.36	\$ 40,000.00	1.043	\$ 41,719.68	12/1/2021	5/1/2022	4.3%
Professional Services	0%	124.69	130.33	\$ -	1.045	\$ -	12/1/2021	5/1/2022	4.5%
Electrical Equipment	1%	200.02	212.33	\$ 2,800.00	1.062	\$ 2,972.29	12/1/2021	5/1/2022	6.2%
FRP Buyouts	6%	197.50	215.95	\$ 30,000.00	1.093	\$ 32,802.56	12/1/2021	5/1/2022	9.3%
Aluminum Handrail	1%	121.28	143.09	\$ 3,500.00	1.180	\$ 4,129.35	12/1/2021	5/1/2022	18.0%
Aluminum Grating	1%	156.46	192.32	\$ 2,700.00	1.229	\$ 3,318.83	12/1/2021	5/1/2022	22.9%
Aluminum Plate	1%	237.07	274.04	\$ 2,900.00	1.156	\$ 3,352.28	12/1/2021	5/1/2022	15.6%
Freight	7%	187.74	207.13	\$ 35,000.00	1.103	\$ 38,615.44	12/1/2021	6/1/2022	10.3%
42.4%			Price subject to escalation:	\$ 211,900.00	Total Adjusted Price:	\$ 237,411.34			
					Price Difference:	\$ (25,511.34)			
					% of PO Value:	5.10%			

Frequently Asked Questions

1. What if my prime contract requires me to hold my price beyond 30 days?

Answer: WesTech does not provide pricing valid beyond 30 days. An updated price can be provided prior to your final bid submission. WesTech can also help you assess market trends and how pricing may change after your bid.

2. Question: Will WesTech accept escalation terms that require owner acceptance?

Answer: No, WesTech does not accept any conditional or contingent escalation terms. (i.e, "...upon acceptance from the owner." or "if allowed by the terms of the prime contract.") Escalation terms must be between the Seller (WesTech) and the buyer only.

3. Question: How will the escalations be included as a part of the contract?

Answer: WesTech will provide the escalation amount as calculated by the indices after the appropriate milestone is achieved (procurement, shipment) and seek a change order to account for the increase, if required.

4. Question: Can we lock in material pricing and/or escalations at the time of PO Receipt?

Answer: Unfortunately, we cannot procure material upon po receipt. Our suppliers/fabricators typically purchase the material specifically for our order. Because we do not have “customer approved” design drawings we are not able to provide 100% of our fabrication detail drawings to the supplier. This gives them hesitancy to place their material orders from mills and distributors, especially when they have been held to allotments and limitations. Doing this also complicates the procurement process. When there are comments or changes during the submittal process it creates revisions and redesign loops all through our design and procurement processes that ultimately create delays and possible change associated costs.

One-Year Warranty

WesTech is meeting a global need for clean water through technology treatment solutions. We are proud that the equipment and systems we design, build, maintain, and operate are making the world a better place and creating a more sustainable environment for future generations.

Equipment manufactured or sold by WesTech Engineering, LLC, once paid for in full, is backed by the following warranty:

Subject to the terms below, WesTech warrants all new equipment manufactured or sold by WesTech Engineering, LLC to be unencumbered and free from defects in material and workmanship, and WesTech will replace or repair, F.O.B. its factories or other location it chooses, any part or parts returned to WesTech which WesTech's examination and analysis determine have failed within the warranty period because of defects in material and workmanship. The warranty period is either, one calendar year immediately following start-up, or eighteen (18) months from when WesTech sent its ready-to-ship notification to the purchaser, whichever expires sooner. All repair or replacement parts qualifying under this warranty shall be free of charge. Purchaser will provide timely written notice to WesTech of any defects it believes should be repaired or replaced under this warranty. WesTech will reject as untimely any warranty defect claim that purchaser submits more than thirty (30) days after the possible warranty defect first occurred. Unless specifically stated otherwise, this warranty does not cover normal wear or consumables. This warranty is not transferable.

This warranty shall be void and shall not apply where the equipment or any part thereof

- a) has been dismantled, modified, repaired or connected to other equipment, outside of a WesTech factory, or without WesTech's written approval, or
- b) has not been installed in complete adherence to all WesTech's or parts manufacturer's requirements, recommendations, and procedures, or
- c) has been subject to misuse, abuse, neglect, or accident, or has not at all times been operated and maintained in strict compliance with all of WesTech's requirements and recommendations therefor, including, but not limited to, the relevant WesTech Operations & Maintenance Manual and any other of WesTech's specified guidelines & procedures, or
- d) has been subject to force majeure events; use of chemicals not approved in writing by WesTech; electrical surges; overloading; significant power, water or feed supply fluctuations; or non-compliance with agreed feedwater or chemical volumes, specifications or procedures.

In any case where a part or component of equipment under this warranty is or may be faulty and the component or part is also covered under the warranty of a third party then the purchaser shall provide reasonable assistance to first pursue a claim under the third party warranty before making a claim under this warranty from WesTech. WesTech Engineering, LLC gives no warranty with respect to parts, accessories, or components purchased other than through WesTech. The warranties which apply to such items are those offered by the respective manufacturers.

This warranty is expressly given by WesTech and accepted by purchaser in lieu of all other warranties whether written, oral, express, implied, statutory or otherwise, including without limitation, warranties of merchantability and fitness for particular purpose. WesTech neither accepts nor authorizes any other person to assume for it any other liability with respect to its equipment. WesTech shall not be liable for normal wear and tear, corrosion, or any contingent, incidental, or consequential damage or expense due to partial or complete inoperability of its equipment for any reason whatsoever. The purchaser's exclusive and only remedy for breach of this warranty shall be the repair and or replacement of the defective part or parts within a reasonable time of WesTech's accepting the validity of a warranty claim made by the purchaser.

Terms & Conditions

Terms and Conditions appearing in any order based on this proposal which are inconsistent herewith shall not be binding on WesTech Engineering, LLC. The sale and purchase of equipment described herein shall be governed exclusively by the foregoing proposal and the following provisions:

1. SPECIFICATIONS: WesTech Engineering, LLC is furnishing its standard equipment as outlined in the proposal and as will be covered by final approved drawings. The equipment may not be in strict compliance with the Engineer's/Owner's plans, specifications, or addenda as there may be deviations. The equipment will, however, meet the general intention of the mechanical specifications of these documents.

2. ITEMS INCLUDED: This proposal includes only the equipment specified herein and does not include erection, installation, accessories, nor associated materials such as controls, piping, etc., unless specifically listed.

3. PARTIES TO CONTRACT: WesTech Engineering, LLC is not a party to or bound by the terms of any contract between WesTech Engineering, LLC's customer and any other party. WesTech Engineering, LLC's undertakings are limited to those defined in the contract between WesTech Engineering, LLC and its direct customers.

4. PRICE AND DELIVERY: All selling prices quoted are subject to change without notice after 30 days from the date of this proposal unless specified otherwise. Unless otherwise stated, all prices are F.O.B. WesTech Engineering, LLC or its supplier's shipping points. All claims for damage, delay or shortage arising from such equipment shall be made by Purchaser directly against the carrier. When shipments are quoted F.O.B. job site or other designation, Purchaser shall inspect the equipment shipped, notifying WesTech Engineering, LLC of any damage or shortage within forty-eight hours of receipt, and failure to so notify WesTech Engineering, LLC shall constitute acceptance by Purchaser, relieving WesTech Engineering, LLC of any liability for shipping damages or shortages.

5. PAYMENTS: All invoices are net 30 days. Delinquencies are subject to a 1.5 percent service charge per month or the maximum permitted by law, whichever is less on all past due accounts. Pro rata payments are due as shipments are made. If shipments are delayed by the Purchaser, invoices shall be sent on the date when WesTech Engineering, LLC is prepared to make shipment and payment shall become due under standard invoicing terms. If the work to be performed hereunder is delayed by the Purchaser, payments shall be based on the purchase price and percentage of completion. Products held for the Purchaser shall be at the risk and expense of the Purchaser. Unless specifically stated otherwise, prices quoted are for equipment only. These terms are independent of and not contingent upon the time and manner in which the Purchaser receives payment from the owner.

6. PAYMENT TERMS: Credit is subject to acceptance by WesTech Engineering, LLC's Credit Department. If the financial condition of the Purchaser at any time is such as to give WesTech Engineering, LLC, in its judgment, doubt concerning the Purchaser's ability to pay, WesTech Engineering, LLC may require full or partial payment in advance or may suspend any further deliveries or continuance of the work to be performed by the WesTech Engineering, LLC until such payment has been received.

7. ESCALATION: If between the proposal date and actual procurement and through no fault of the Seller, the relevant cost of labor, material, freight, tariffs, and other Seller costs combined relating to the contract, increase by greater than 2.5% of the overall contract price, then the contract price shall be subject to escalation and increased. Such increase shall be verified by documentation and the amount of contract price escalation shall be calculated as either the actual increased cost to the Seller or, if agreed by the Parties, the equivalent increase of a relevant industry recognized third-

party index, and in both cases without any additional profit or margin being added.

8. APPROVAL: If approval of equipment submittals by Purchaser or others is required, a condition precedent to WesTech Engineering, LLC supplying any equipment shall be such complete approval.

9. INSTALLATION SUPERVISION: Prices quoted for equipment do not include installation supervision. WesTech Engineering, LLC recommends and will, upon request, make available, at WesTech Engineering, LLC's then current rate, an experienced installation supervisor to act as the Purchaser's employee and agent to supervise installation of the equipment. Purchaser shall at its sole expense furnish all necessary labor equipment, and materials needed for installation.

Responsibility for proper operation of equipment, if not installed by WesTech Engineering, LLC or installed in accordance with WesTech Engineering, LLC's instructions, and inspected and accepted in writing by WesTech Engineering, LLC, rests entirely with Purchaser; and any work performed by WesTech Engineering, LLC personnel in making adjustment or changes must be paid for at WesTech Engineering, LLC's then current per diem rates plus living and traveling expenses.

WesTech Engineering, LLC will supply the safety devices described in this proposal or shown in WesTech Engineering, LLC's drawings furnished as part of this order but excepting these, WesTech Engineering, LLC shall not be required to supply or install any safety devices whether required by law or otherwise. The Purchaser hereby agrees to indemnify and hold harmless WesTech Engineering, LLC from any claims or losses arising due to alleged or actual insufficiency or inadequacy of the safety devices offered or supplied hereunder, whether specified by WesTech Engineering, LLC or Purchaser, and from any damage resulting from the use of the equipment supplied hereunder.

10. ACCEPTANCE OF PRODUCTS: Products will be deemed accepted without any claim by Purchaser unless written notice of non-acceptance is received by WesTech Engineering, LLC within 30 days of delivery if shipped F.O.B. point of shipment, or 48 hours of delivery if shipped F.O.B. point of destination. Such written notice shall not be considered received by WesTech Engineering, LLC unless it is accompanied by all freight bills for said shipment, with Purchaser's notations as to damages, shortages and conditions of equipment, containers, and seals. Non-accepted products are subject to the return policy stated below.

11. TAXES: Any federal, state, or local sales, use or other taxes applicable to this transaction, unless specifically included in the price, shall be for Purchaser's account.

12. TITLE: The equipment specified herein, and any replacements or substitutes therefore shall, regardless of the manner in which affixed to or used in connection with realty, remain the sole and personal property of WesTech Engineering, LLC until the full purchase price has been paid. Purchaser agrees to do all things necessary to protect and maintain WesTech Engineering, LLC's title and interest in and to such equipment; and upon Purchaser's default, WesTech Engineering, LLC may retain as liquidated damages any and all partial payments made and shall be free to enter the premises where such equipment is located and remove the same as its property without prejudice to any further claims on account of damages or loss which WesTech Engineering, LLC may suffer from any cause.

13. INSURANCE: From date of shipment until the invoice is paid in full, Purchaser agrees to provide and maintain at its expense, but for WesTech Engineering, LLC's benefit, adequate insurance including, but not limited

to, builders risk insurance on the equipment against any loss of any nature whatsoever.

14. SHIPMENTS: Any shipment of delivery dates recited represent WesTech Engineering, LLC's best estimate but no liability, direct or indirect, is assumed by WesTech Engineering, LLC for failure to ship or deliver on such dates.

WesTech Engineering, LLC shall have the right to make partial shipments; and invoices covering the same shall be due and payable by Purchaser in accordance with the payment terms thereof. If Purchaser defaults in any payment when due hereunder, WesTech Engineering, LLC may, without incurring any liability therefore to Purchaser or Purchaser's customers, declare all payments immediately due and payable with maximum legal interest thereon from due date of said payment, and at its option, stop all further work and shipments until all past due payments have been made, and/or require that any further deliveries be paid for prior to shipment.

If Purchaser requests postponements of shipments, the purchase price shall be due and payable upon notice from WesTech Engineering, LLC that the equipment is ready for shipment; and thereafter any storage or other charge WesTech Engineering, LLC incurs on account of the equipment shall be for the Purchaser's account.

If delivery is specified at a point other than WesTech Engineering, LLC or its supplier's shipping points, and delivery is postponed or prevented by strike, accident, embargo, or other cause beyond WesTech Engineering, LLC's reasonable control and occurring at a location other than WesTech Engineering, LLC or its supplier's shipping points, WesTech Engineering, LLC assumes no liability in delivery delay. If Purchaser refuses such delivery, WesTech Engineering, LLC may store the equipment at Purchaser's expense. For all purposes of this agreement such tender of delivery or storage shall constitute delivery.

15. WARRANTY: WesTech Engineering LLC warrants equipment it supplies only in accordance with the attached WesTech Warranty. This warranty is expressly given by WesTech and accepted by purchaser in lieu of all other warranties whether written, oral, express, implied, statutory or otherwise, including without limitation, warranties of merchantability and fitness for particular purpose. WesTech neither accepts nor authorizes any other person to assume for it any other liability with respect to its equipment. WesTech shall not be liable for normal wear and tear, corrosion, or any contingent, incidental, or consequential damage or expense due to partial or complete inoperability of its equipment for any reason whatsoever. The purchaser's exclusive and only remedy for breach of this warranty shall be the repair and or replacement of the defective part or parts within a reasonable time of WesTech's accepting the validity of a warranty claim made by the purchaser.

16. PATENTS: WesTech Engineering, LLC agrees that it will, at its own expense, defend all suits or proceedings instituted against Purchaser and pay any award of damages assessed against it in such suits or proceedings, so far as the same are based on any claim that the said equipment or any part thereof constitutes an infringement of any apparatus patent of the United States issued at the date of this Agreement, provided WesTech Engineering, LLC is given prompt notice in writing of the institution or threatened institution of any suit or proceeding and is given full control of the defense, settlement, or compromise of any such action; and Purchaser agrees to give WesTech Engineering, LLC needed information, assistance, and authority to enable WesTech Engineering, LLC so to do. In the event said equipment is held or conceded to infringe such a patent, WesTech Engineering, LLC shall have the right at its sole option and expense to a) modify the equipment to be non-infringing, b) obtain for Purchaser the license to continue using said equipment, or c) accept return of the equipment and refund to the Purchaser the purchase price thereof less a reasonable charge for the use thereof. WesTech Engineering, LLC will reimburse Purchaser for actual out-of-pocket expenses, exclusive of legal fees, incurred in preparing such information and rendering such assistance

at WesTech Engineering, LLC's request. The foregoing states the entire liability of WesTech Engineering, LLC, with respect to patent infringement; and except as otherwise agreed to in writing, WesTech Engineering, LLC assumes no responsibility for process patent infringement.

17. SURFACE PREPARATION AND PAINTING: If furnished, shop primer paint is intended to serve only as minimal protective finish. WesTech Engineering, LLC will not be responsible for the condition of primed or finish painted surfaces after equipment leaves its shops. Purchasers are invited to inspect paint in shops for proper preparation and application prior to shipment. WesTech Engineering, LLC assumes no responsibility for field surface preparation or touch-up of shipping damage to paint. Painting of fasteners and other touch-up to painted surfaces will be by Purchaser's painting contractor after mechanism installation.

Motors, gear motors, and other components not manufactured by WesTech Engineering, LLC will be painted with that manufacturer's standard paint system. It is WesTech Engineering, LLC's intention to ship major steel components as soon as fabricated, often before drive, motors, and other manufactured components. Unless Purchaser can ensure that shop primed steel shall be field painted within thirty (30) days after arrival at the job site, WesTech Engineering, LLC encourages the Purchaser to order these components without primer.

WesTech Engineering, LLC's prices are based on paints and surface preparations as outlined in the main body of this proposal. In the event that an alternate paint system is selected, WesTech Engineering, LLC requests that Purchaser's order advise of the paint selection. WesTech Engineering, LLC will then either adjust the price as may be necessary to comply or ship the material unpainted if compliance is not possible due to application problems or environmental controls.

18. CANCELLATION, SUSPENSION, OR DELAY: After acceptance by WesTech Engineering, LLC, this proposal, or Purchaser's order based on this proposal, shall be a firm agreement and is not subject to cancellation, suspension, or delay except upon payment by Purchaser of appropriate charges which shall include all costs incurred by WesTech Engineering, LLC to date of cancellation, suspension, or delay plus a reasonable profit. Additionally, all charges related to storage and/or resumption of work, at WesTech Engineering, LLC's plant or elsewhere, shall be for Purchaser's sole account; and all risks incidental to storage shall be assumed by Purchaser.

19. FORCE MAJEURE: Neither party hereto shall be liable to the other for default or delay in delivery caused by extreme weather or other act of God, strike or other labor shortage or disturbance, fire, accident, war or civil disturbance, act of government, pandemic, delay of carriers, failure of normal sources of supply, complete or partial shutdown of plant by reason of inability to attain sufficient raw materials or power, and/or other similar contingency beyond the reasonable control of the respective parties. The time for delivery specified herein shall be extended during the continuance of such conditions, or any other cause beyond such party's reasonable control. Escalation resulting from a Force Majeure event shall be equitably adjusted per the escalation policy stated above.

20. RETURN OF PRODUCTS: No products may be returned to WesTech Engineering, LLC without WesTech Engineering, LLC's prior written permission. Said permission may be withheld by WesTech Engineering, LLC at its sole discretion.

21. BACKCHARGES: WesTech Engineering LLC will not approve or accept backcharges for labor, materials, or other costs incurred by Purchaser or others in modification, adjustment, service, or repair of WesTech Engineering LLC furnished materials unless such back charge has been authorized in advance in writing by a WesTech Engineering LLC purchase order, or work requisition signed by WesTech Engineering LLC.

22. INDEMNIFICATION: Purchaser agrees to indemnify WesTech Engineering, LLC from all costs incurred, including but not limited to court costs and reasonable attorney fees, from enforcing any provisions of this contract, including but not limited to breach of contract or costs incurred in collecting monies owed on this contract.

23. ENTIRE AGREEMENT: This proposal expresses the entire agreement between the parties hereto superseding any prior understandings and is not subject to modification except by a writing signed by an authorized officer of each party.

24. MOTORS AND MOTOR DRIVES: In order to avoid shipment delays of WesTech Engineering, LLC equipment, the motor drives may be sent directly to the job site for installation by the equipment installer. Minor fit-up may be required.

25. EXTENDED STORAGE: Extended storage instructions will be part of information provided to shipment. If equipment installation and start-up is delayed more than 30 days, the provisions of the storage instructions must be followed to keep WARRANTY in force.

26. LIABILITY: Professional liability insurance, including but not limited to, errors and omissions insurance, is not included. In any event, liability for errors and omissions shall be limited to the lesser of \$100,000 USD or the value of the particular piece of equipment (not the value of the entire order) supplied by WesTech Engineering LLC against which a claim is sought.

27. ARBITRATION NEGOTIATION: Any controversy or claim arising out of or relating to the performance of any contract resulting from this proposal or

contract issued, or the breach thereof, shall be settled by arbitration in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association, and judgment upon the award rendered by the arbitrator(s) may be entered to any court having jurisdiction.

ACCEPTED BY PURCHASER

Customer Name: _____

Customer Address: _____

Contact Name: _____

Contact Phone: _____

Contact Email: _____

Signature: _____

Printed Name: _____

Title: _____

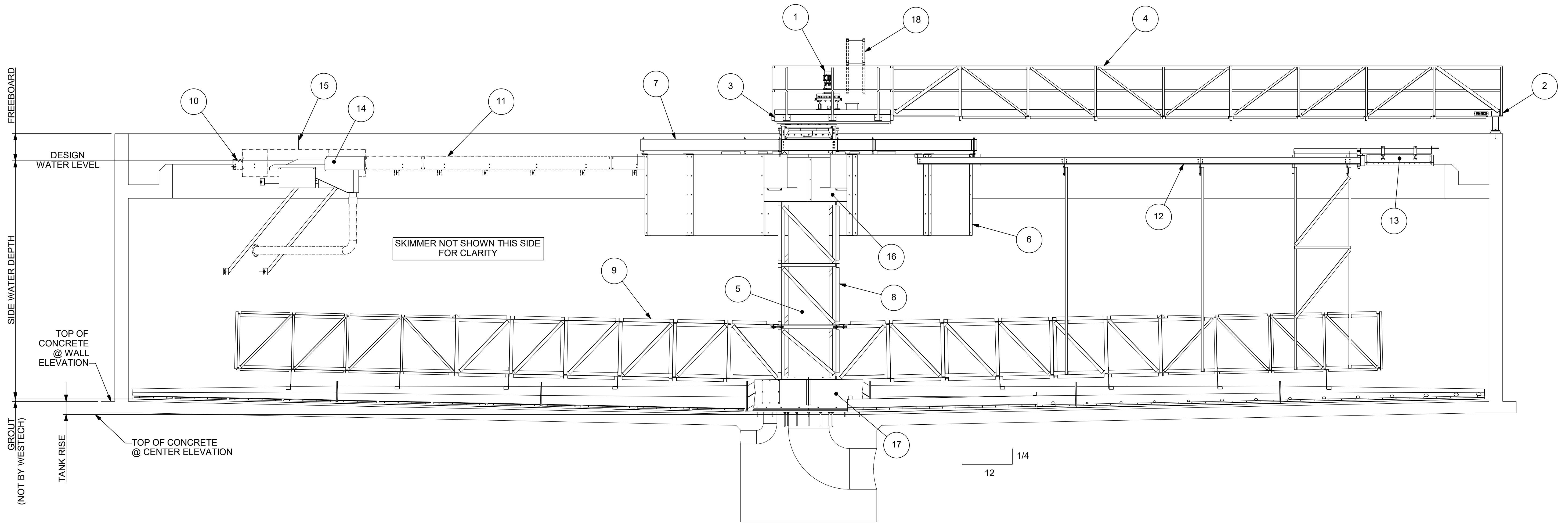
Date: _____

Supplemental Information

Drawings
Installation Lists



REV	REVISION DESCRIPTION	ECN	DESIGNER	APPROVER	DATE	REFERENCE DOCUMENTS
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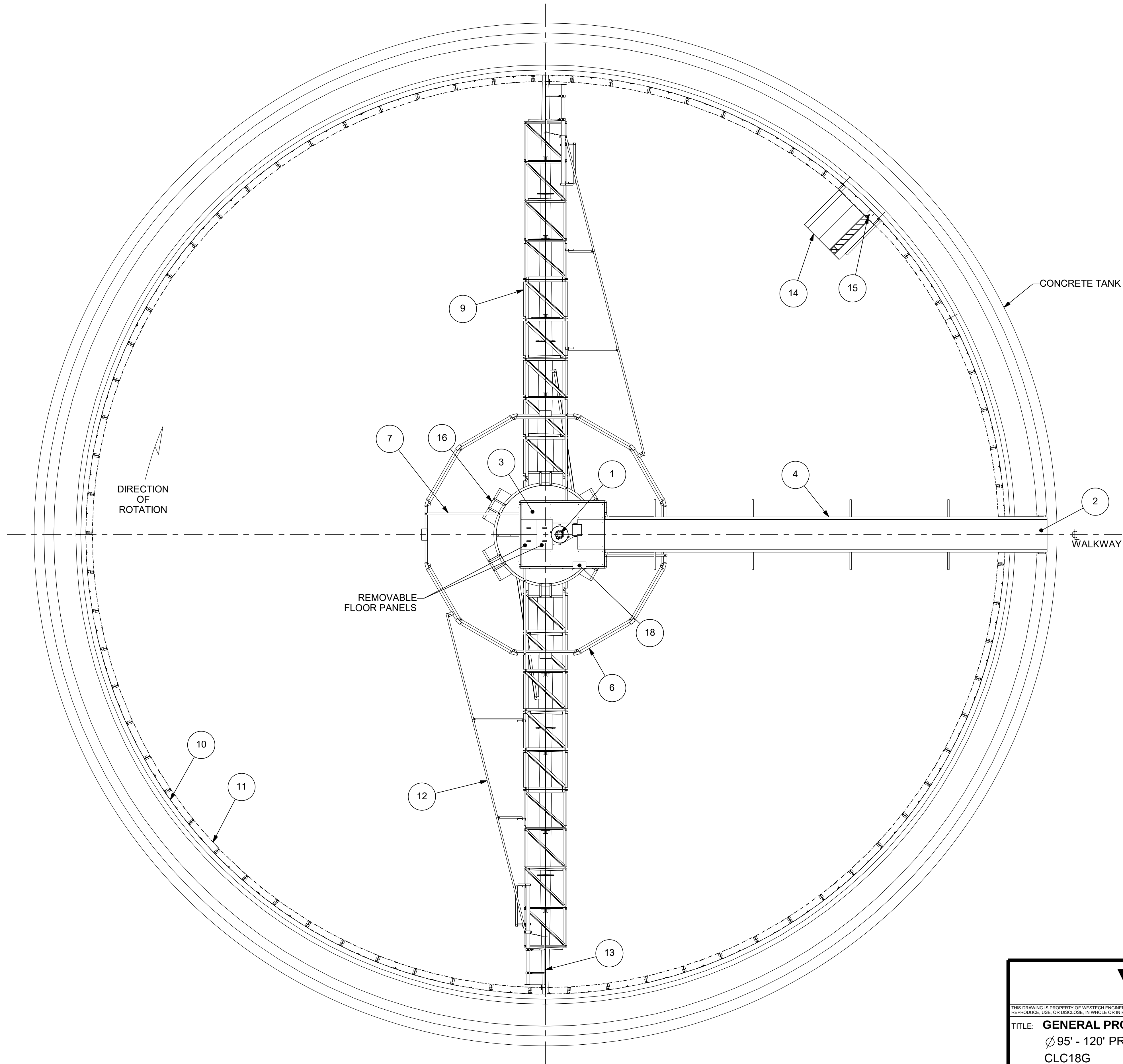
ELEVATION VIEW

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TITLE: **GENERAL PROPOSAL**
Ø 95' - 120' PRIMARY CLARIFIER
CLC18G

DESIGNER	CHECKER	APPROVER	DATE	
ME121	CH72	LY13	06/20/2022	
JOB NUMBER	DOCUMENT NUMBER		SHEET	REV
PROP 126		2 OF 5	-	



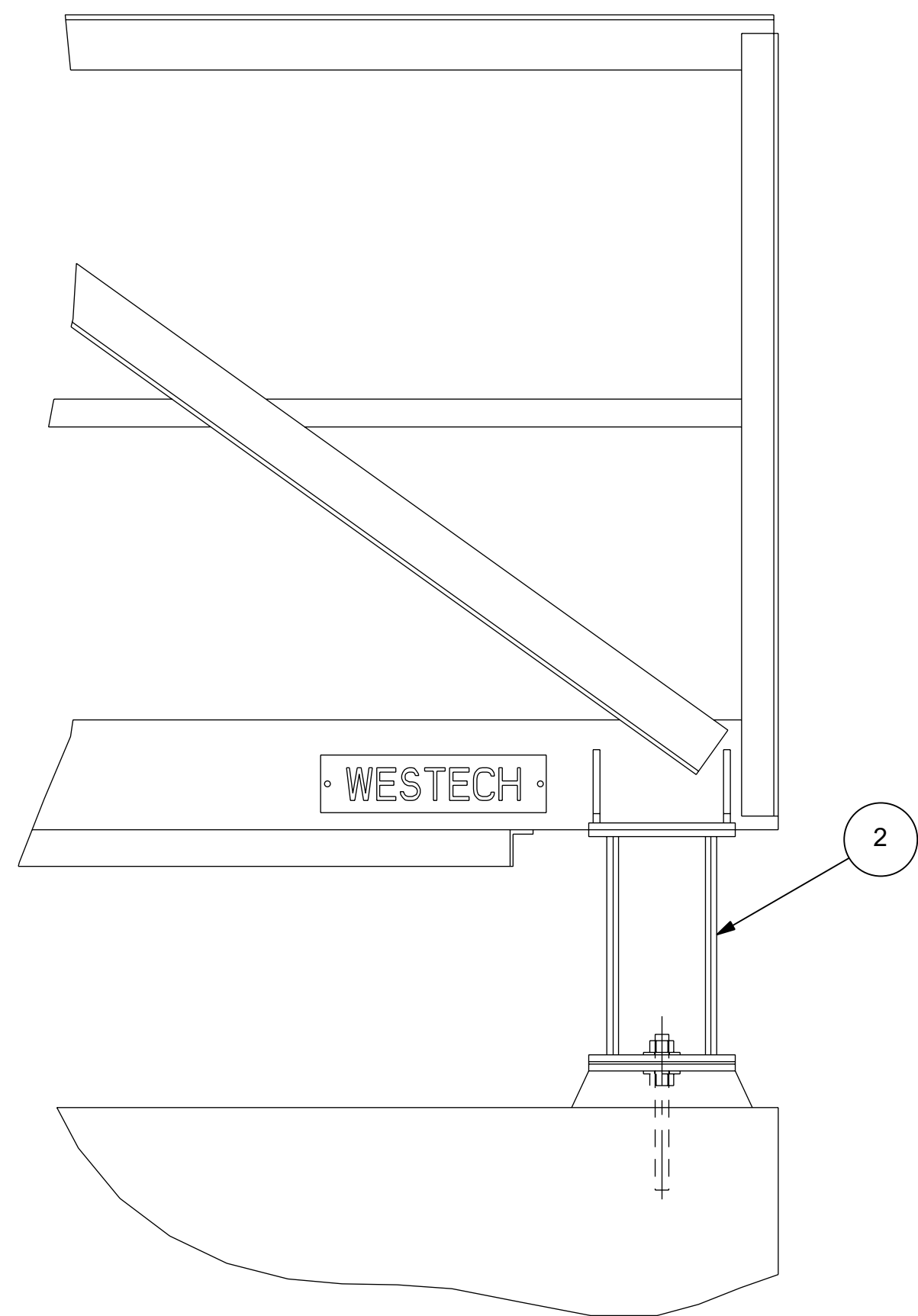
PLAN VIEW

WestTech[®]

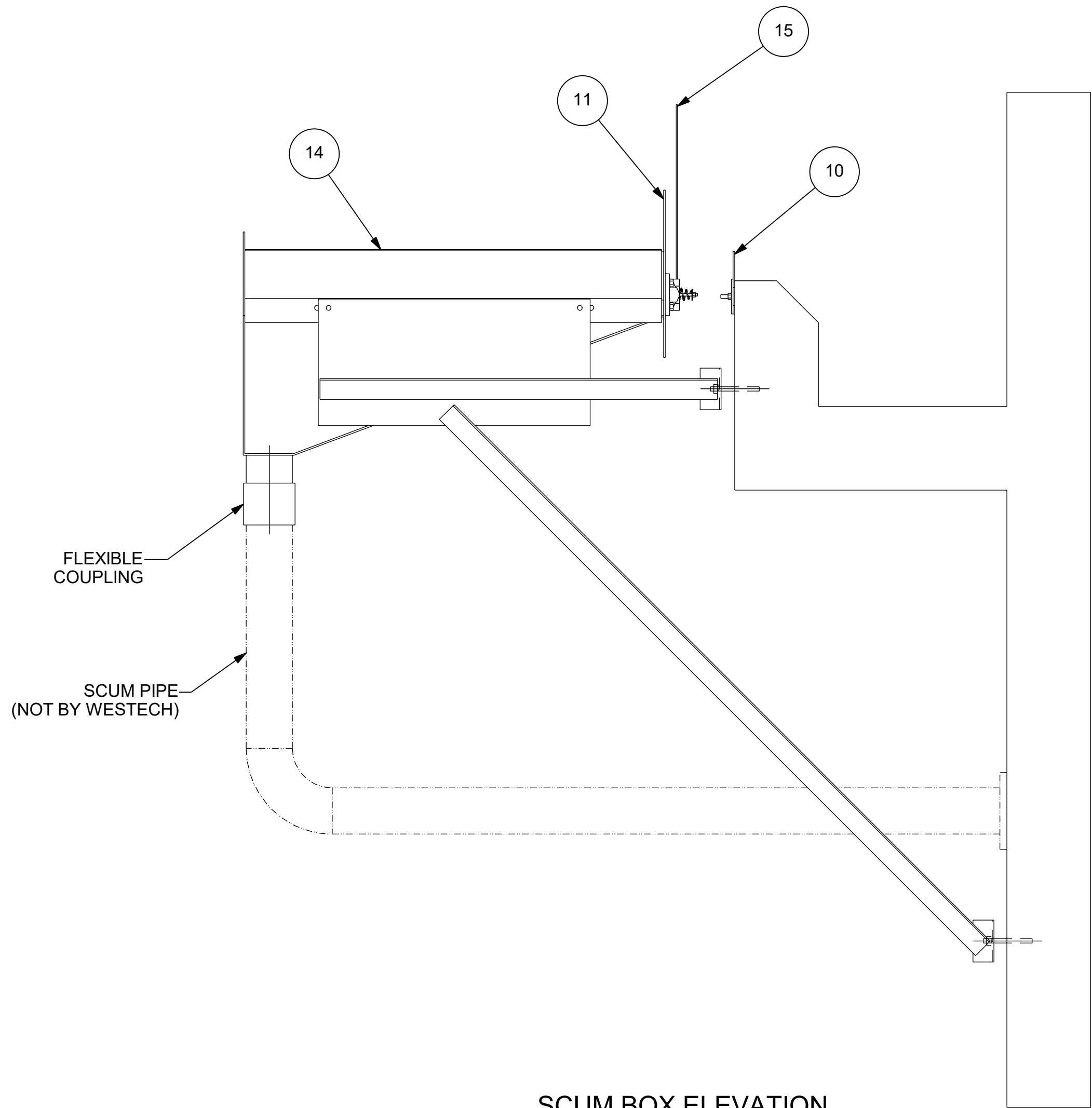
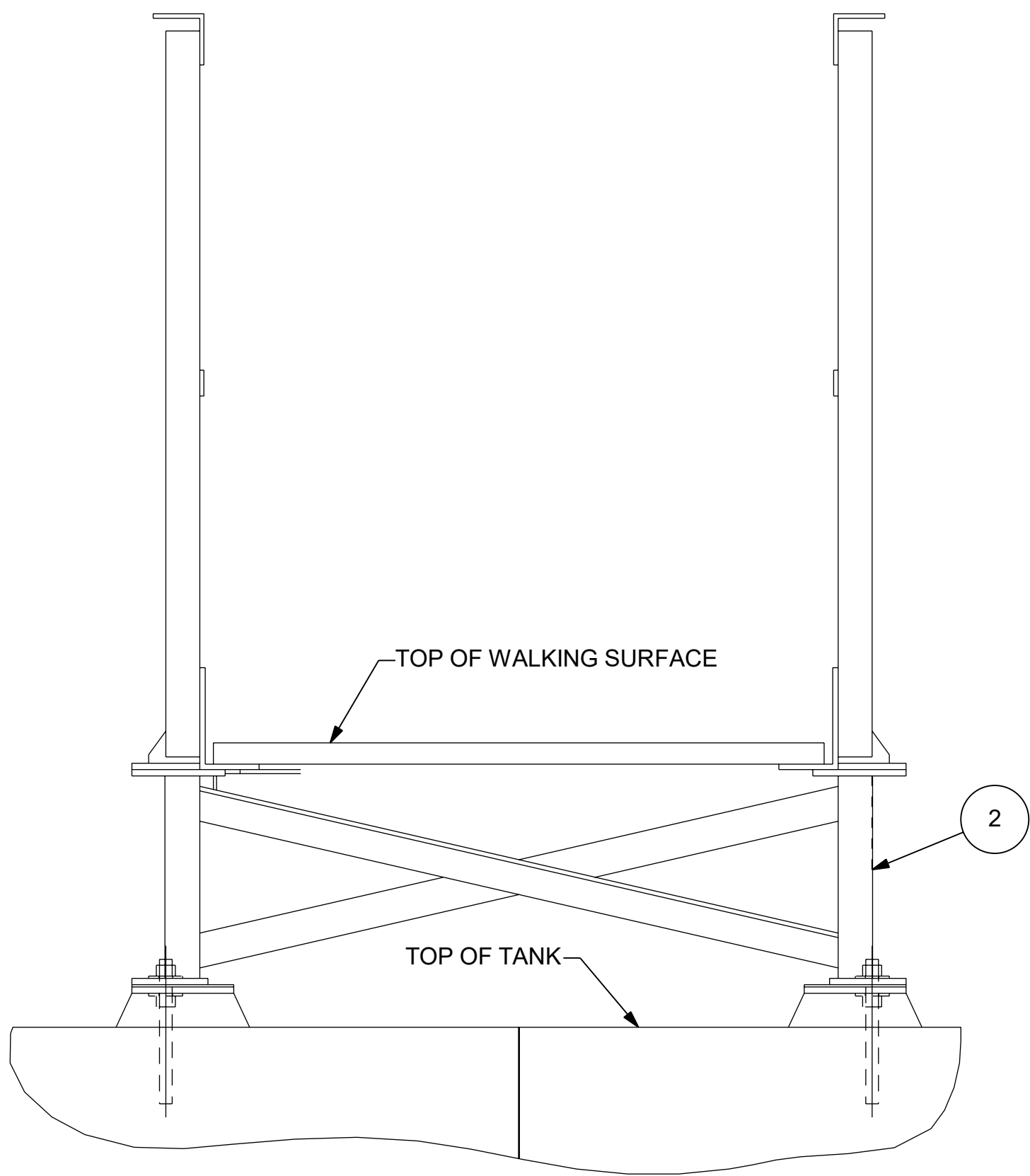
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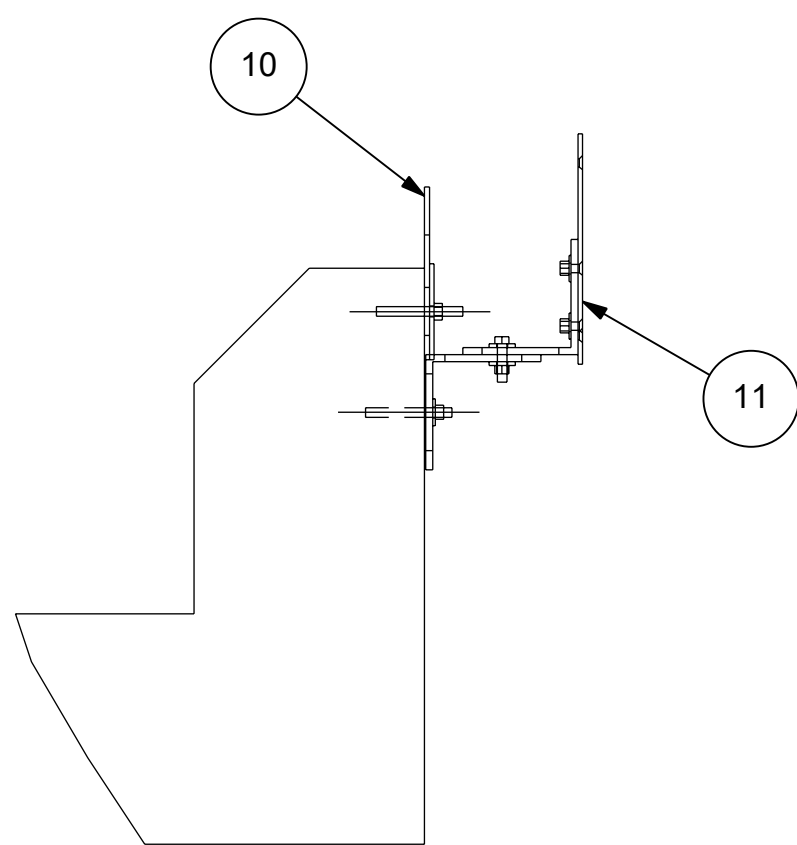
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JOB NUMBER	DOCUMENT NUMBER		SHEET	REV
	PROP 126		3 OF 5	-



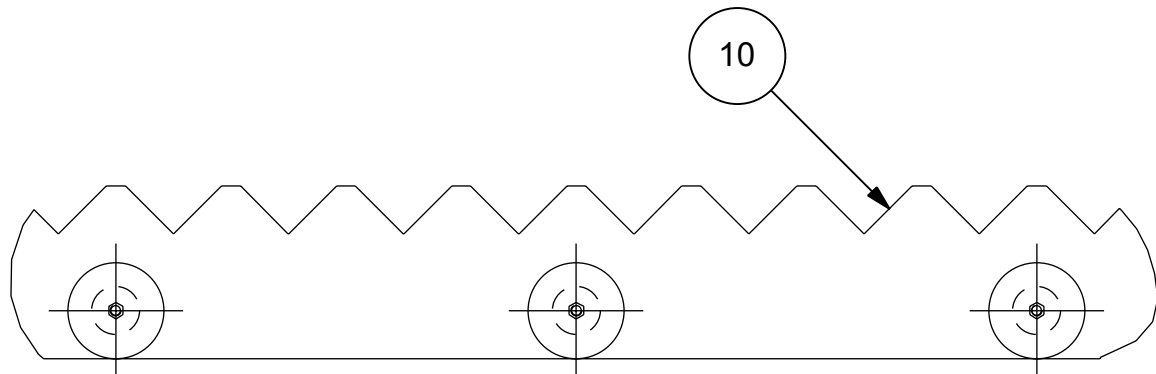
WALKWAY TO TANK



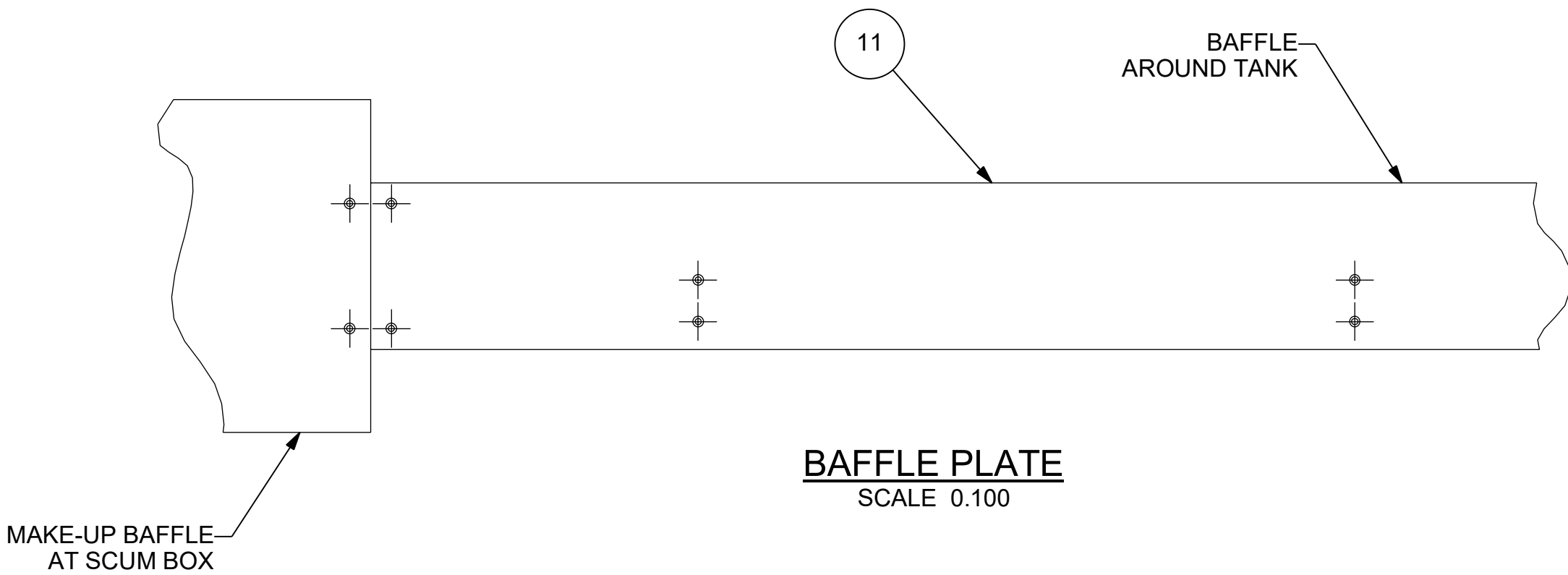
SCUM BOX ELEVATION
SCALE 0.070



WEIR/BAFFLE DETAIL
SCALE 0.100

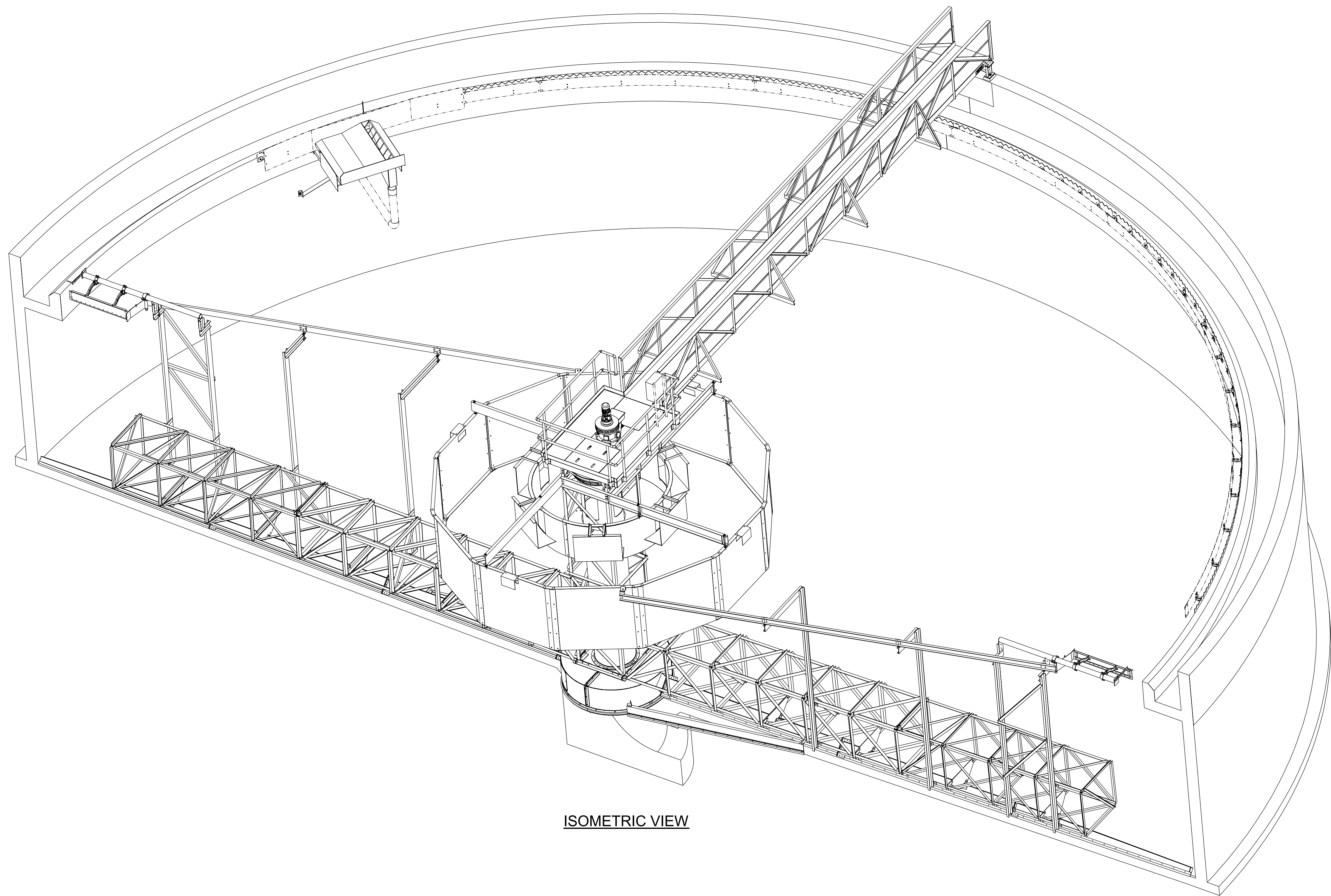


WEIR DETAIL
SCALE 0.100



BAFFLE PLATE
SCALE 0.100

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TITLE: GENERAL PROPOSAL Ø 95' - 120' PRIMARY CLARIFIER CLC18G				
DESIGNER	CHECKER	APPROVER	DATE	
ME121	CH72	LY13	06/20/2022	
JOB NUMBER	DOCUMENT NUMBER		SHEET	REV
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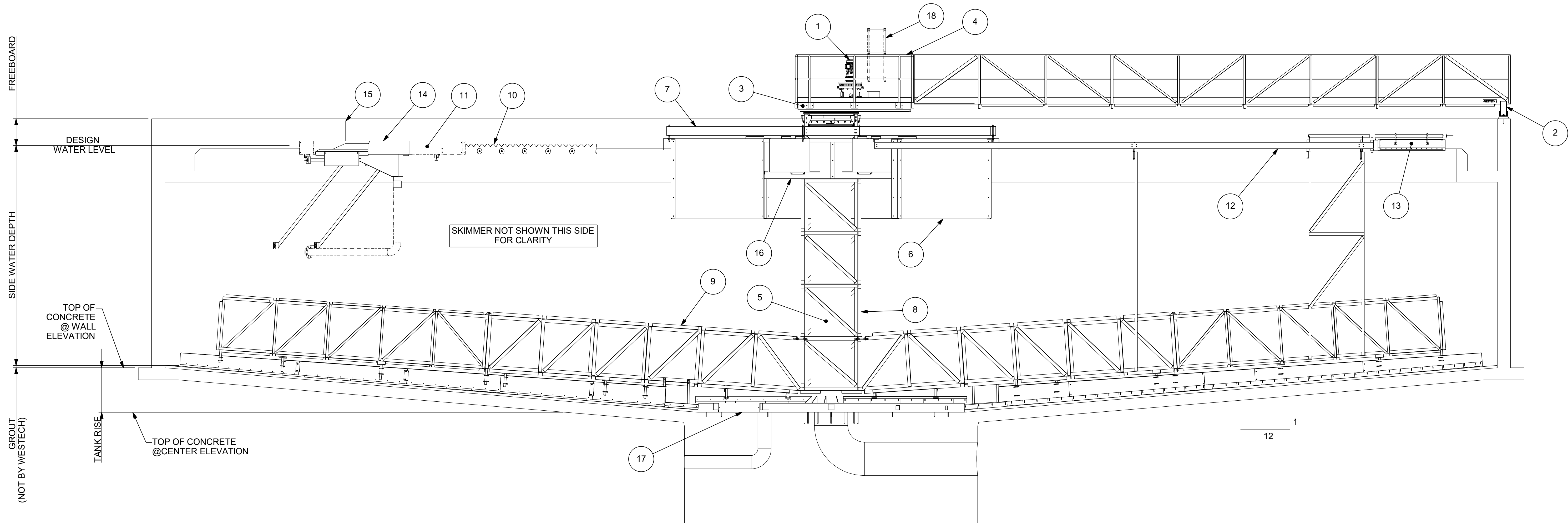
ISOMETRIC VIEW

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CLC18G

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JOB NUMBER	DOCUMENT NUMBER		SHEET	REV
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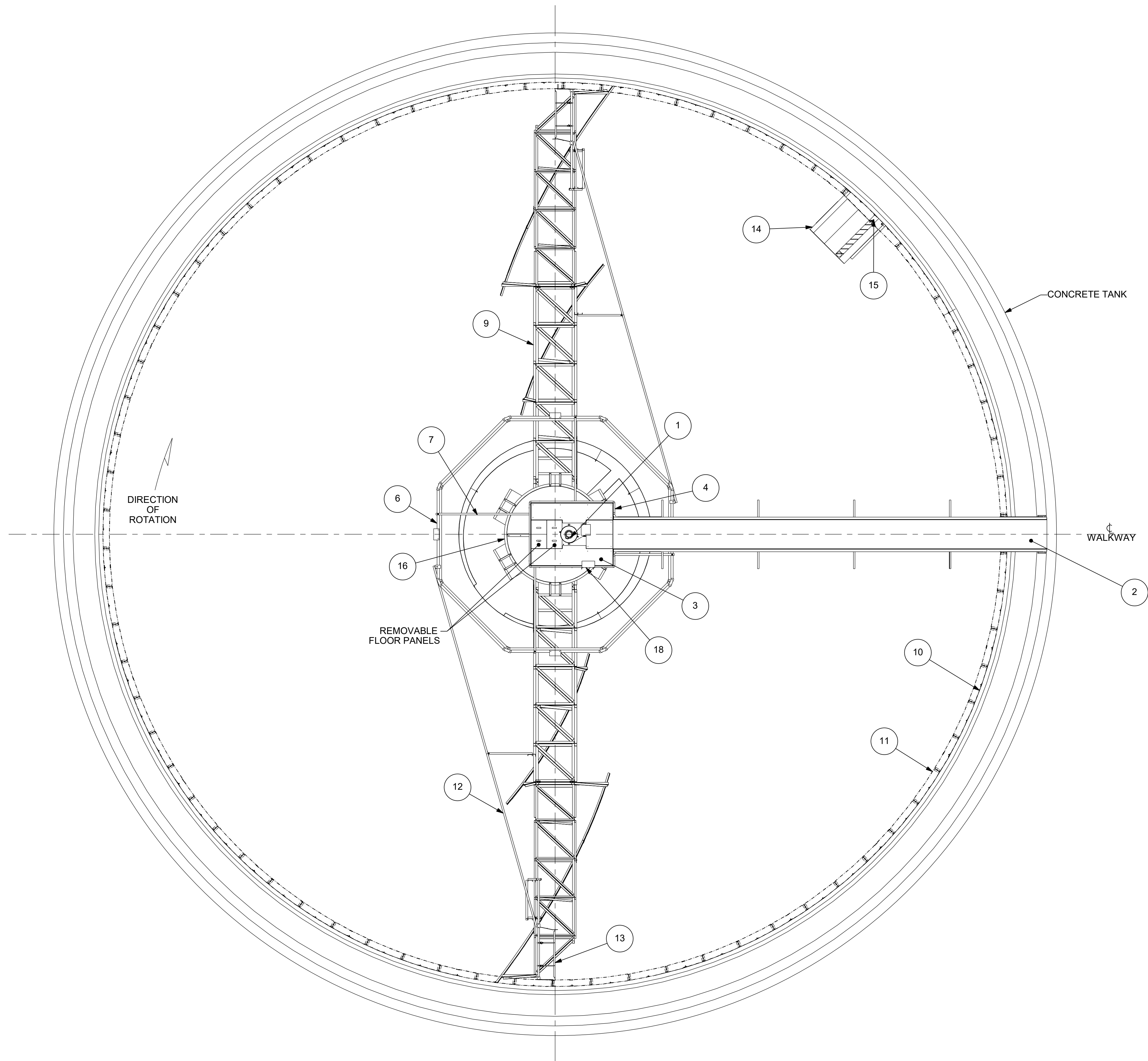


ELEVATION VIEW

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TITLE: GENERAL PROPOSAL			
Ø 95-120' SECONDARY CLARIFIER			
COPC1G			
DESIGNER	CHECKER	APPROVER	DATE
BL50	CH72	LY13	7/19/2022
JOB NUMBER	DOCUMENT NUMBER		SHEET
	PROP 104		2 OF 5
			REV
			-



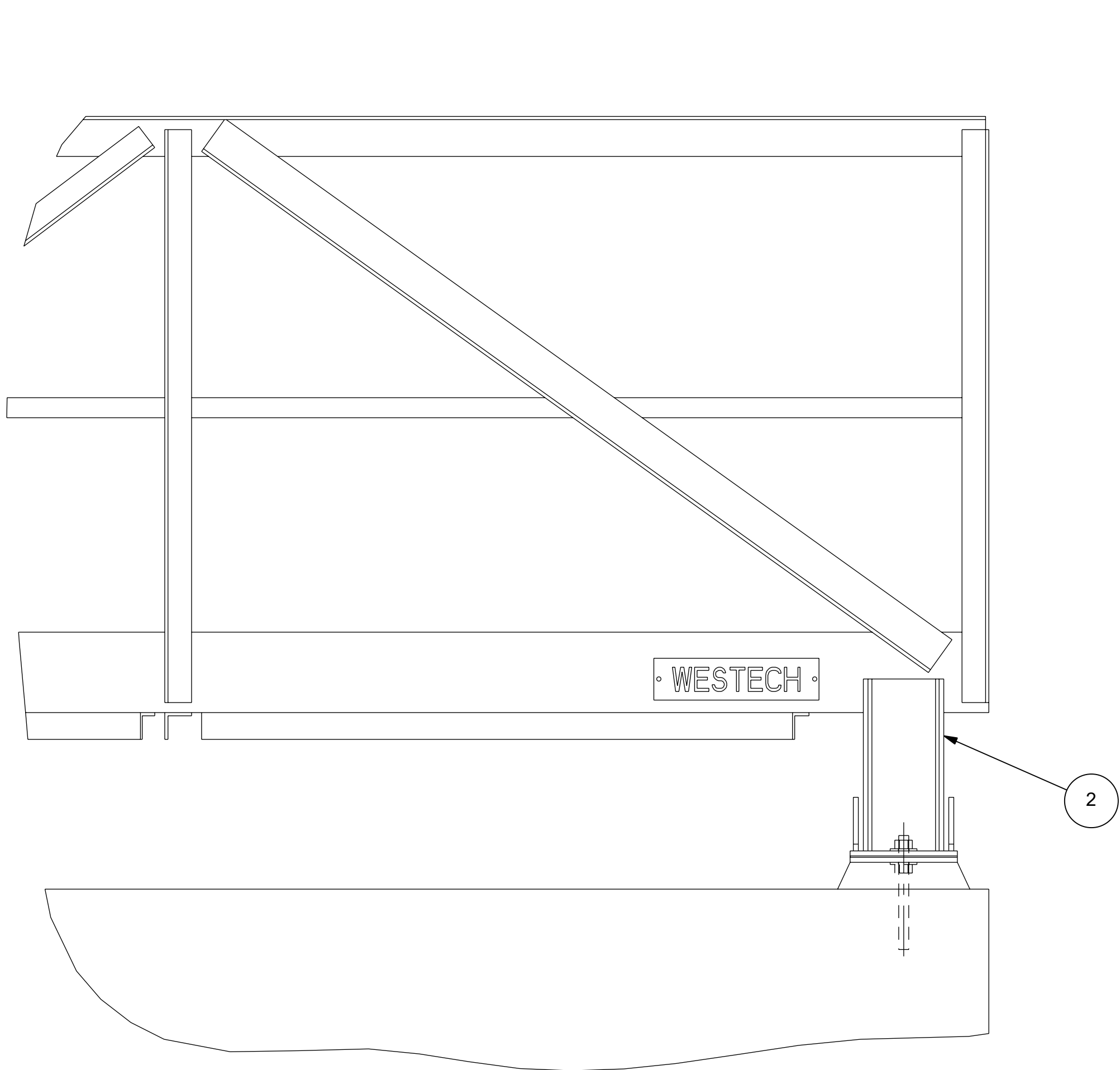
PLAN VIEW

WestTech[®]

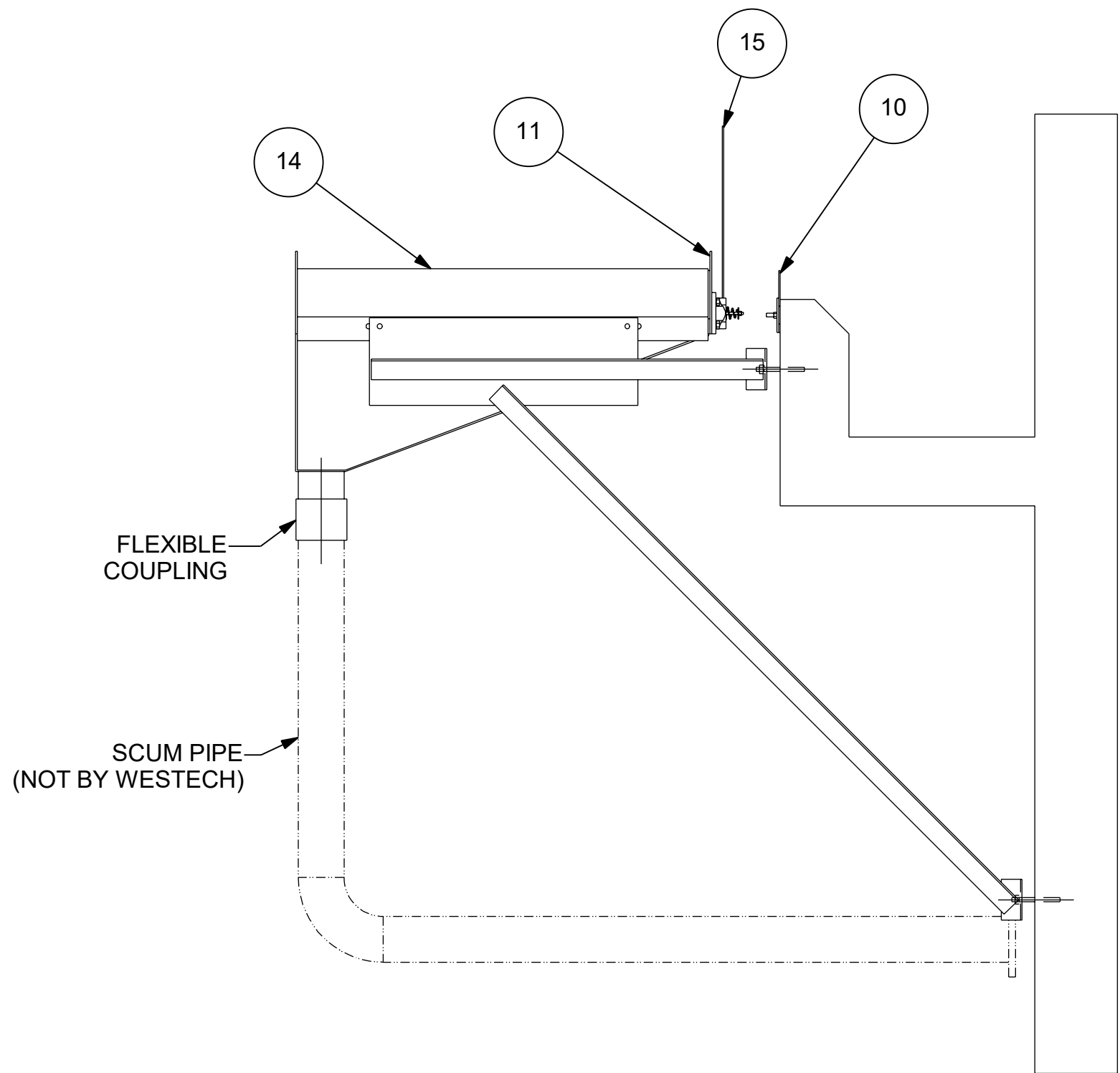
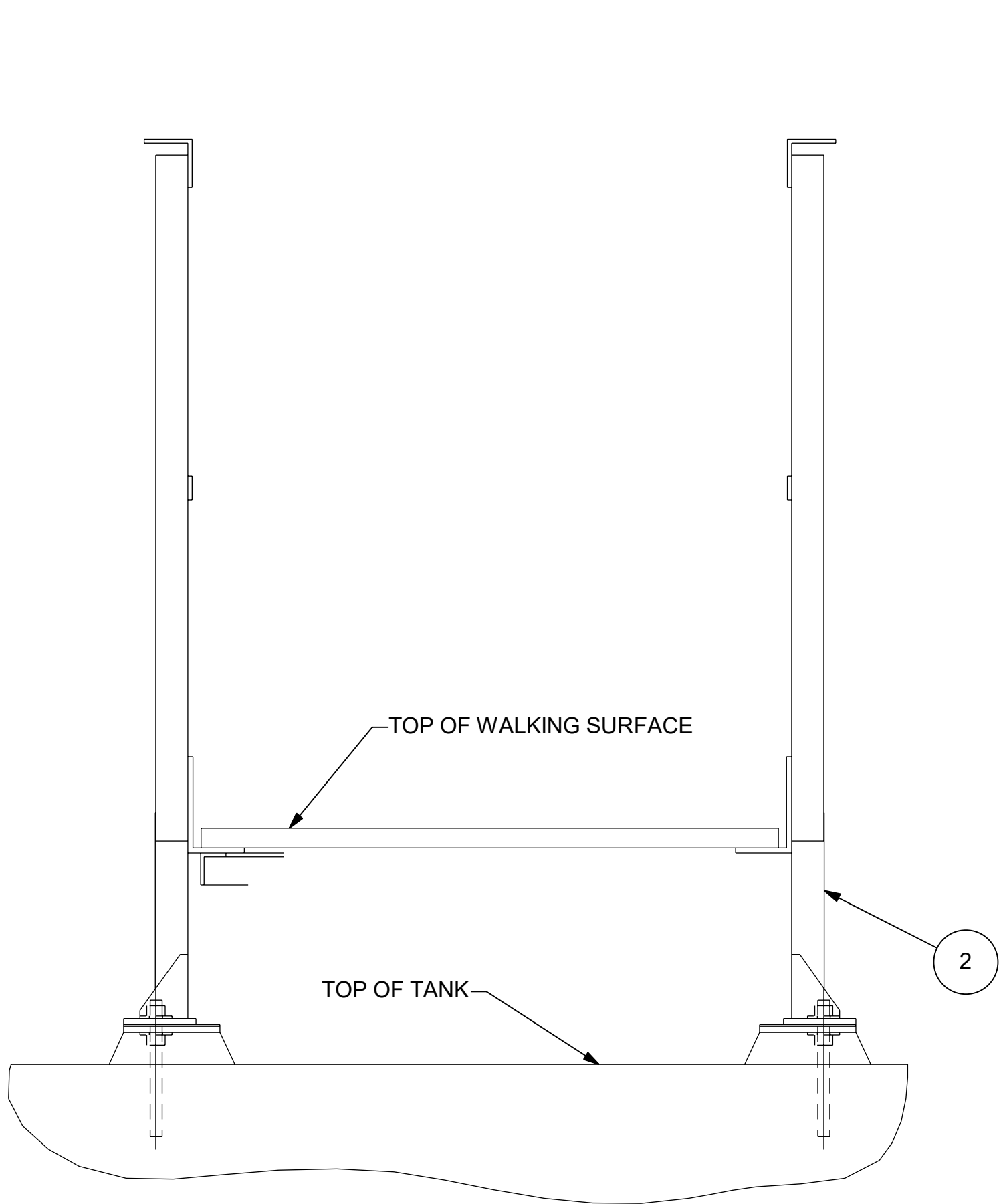
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TITLE: **GENERAL PROPOSAL**
Ø 95-120' SECONDARY CLARIFIER
COPC1G

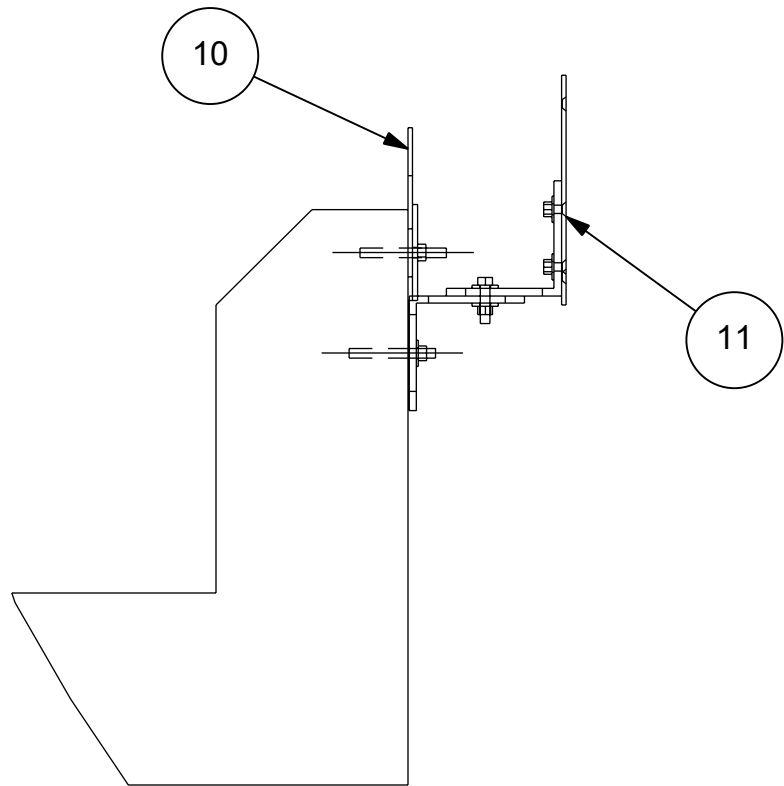
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JOB NUMBER	DOCUMENT NUMBER		SHEET	REV
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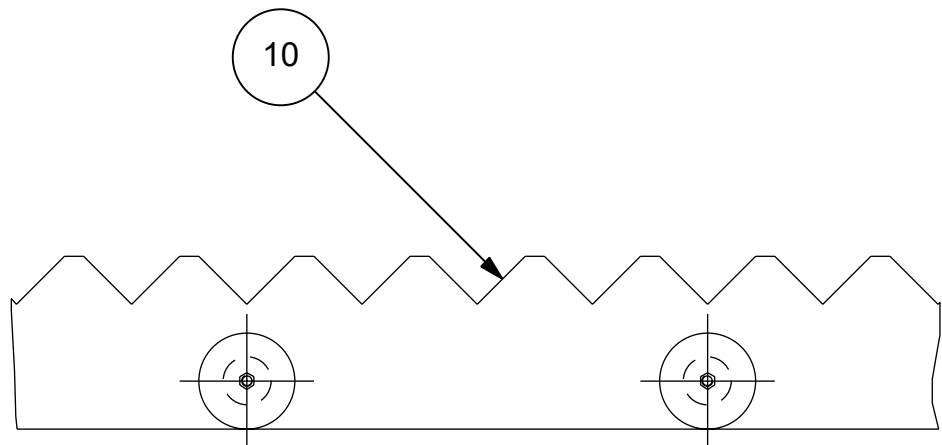
WALKWAY TO TANK



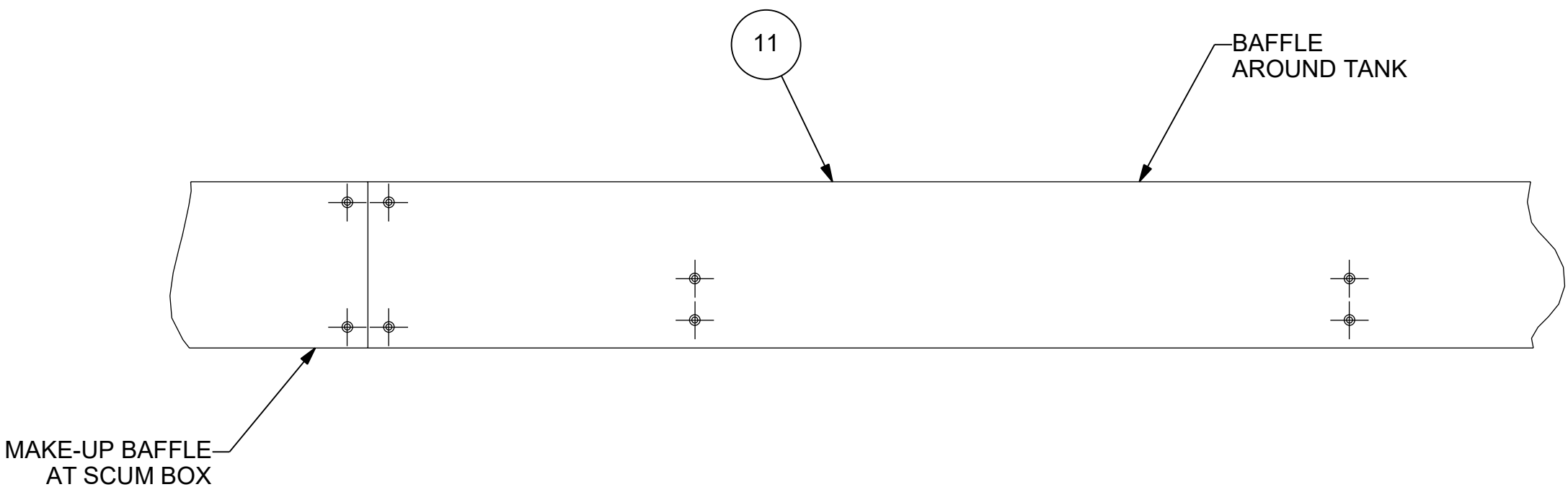
SCUM BOX ELEVATION
SCALE 0.050



WEIR/BAFFLE DETAIL
SCALE 0.100



WEIR DETAIL
SCALE 0.100



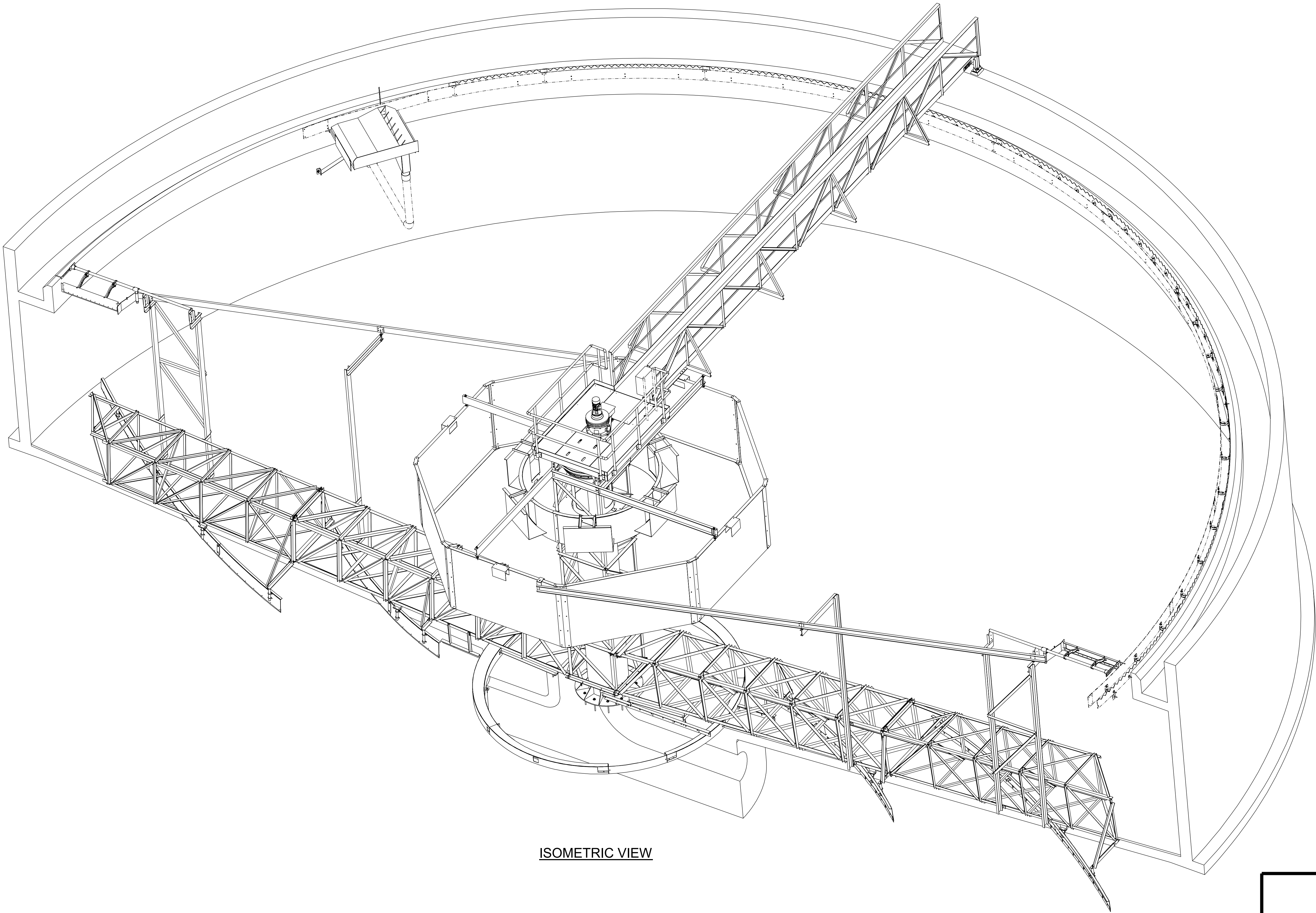
BAFFLE PLATE
SCALE 0.100

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COPC1G

DESIGNER	CHECKER	APPROVER	DATE	
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JOB NUMBER	DOCUMENT NUMBER		SHEET	REV
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ISOMETRIC VIEW

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DESIGNER	CHECKER	APPROVER	DATE	
BL50	CH72	LY13	7/19/2022	
JOB NUMBER	DOCUMENT NUMBER		SHEET	REV
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Job No.	Year		Location			Qty	Size	Equipment/Model
18197	2000	MANUKAU/CONSEPT PTY LIMITED	AUCKLAND	NSW	NZ	3	52 m DIA	DRIVES & ENGINEERING CLC18E
18341	2000	HOWELL, MI WWTP/JOHN E GREEN CO.	HOWELL	MI	US	1	55' DIA	CLARIFIER FLAT FLOOR CLC18
18370	2000	GRASS VALLEY, CA WWTP/RUTHERFOR D AND SMITH	GRASS VALLEY	CA	US	1	75' DIA	CLARIFIER SECONDARY FLAT FLOOR CLC18E
18426	2000	FUJI PHOTO FILM	GREENWOOD	SC	US	1	79' DIA	CLARIFIER CLC18E
18559	2001	DISCOVERY BAY, CA STP/NV HEATHORN	DISCOVERY BAY	CA	US	1	50' DIA	CLARIFIER CLC18E
18530	2001	DUBLIN SAN RAMON WWTP PLEASANTON, CA	PLEASANTON	CA	US	1	110' DIA	CLARIFIER SUCTION FLAT FLOOR CLC18T
18390	2002	HENRICO COUNTY, VA WRF	RICHMOND	VA	US	5	160' DIA	CLARIFIERS SECONDARY FLATFLOOR CLC18T
18749	2002	SAN LUIS REY WWTP	OCEANSIDE	CA	US	2	70' DIA	CLARIFIERS CLC18D
18792	2002	ELDEN KUEHL WPF	VALPARAISO	IN	US	2	80' DIA	CLARIFIERS CLC18R
18852	2002	TRACY, CA	TRACY	CA	US	1	100' DIA	CLARIFIER FLAT FLOOR CLC18
18947	2002	PINOLE	PINOLE	CA	US	1	45' DIA	CLARIFIER CLC18E
18938	2002	ASHLAND, OH	ASHLAND	OH	US	2	80' DIA	CLARIFIER RETROFITS FLAT FLOOR CLC18
18915	2002	RIPON WWTP	RIPON	WI	US	2	70' DIA	CLARIFIERS CLC18R
18983	2003	MYRTLE CREEK	MYRTLE CREEK	OR	US	2	65' DIA	CLARIFIERS CLC18E
18833	2003	ALCOSAN PITTSBURGH, PA/ALLEGHENY COUNTY	Pittsburgh	PA	US	2	141' DIA	SS CLARIFIERS CLC18E
19087	2003	SOUTH TRUCKEE MEADOWS SPARKS, NV	RENO	NV	US	2	80' DIA	SS CLARIFIERS CLC18E

Job No.	Year	Location				Qty	Size	Equipment/Model
19189	2003	LILLY DEL CARIBE	CAROLINA	S.C.	PR	1	40' DIA	CLARIFIER CLC18E
19102	2003	AMHERST, OH WPCC	AMHERST	OH	US	2	70' DIA	CLARIFIER RETROFITS CLC18R
19168	2003	CELANESE WWTP	CUMBERLAND	MD	US	1	55' DIA	CLARIFIER CLC18E
19285	2004	LONGMONT WWTP	LONGMONT	CO	US	2	120' DIA	CLARIFIER RETROFITS CLC18
19265	2004	DISCOVERY BAY	DISCOVERY BAY	CA	US	1	50' DIA	CLARIFIER CLC18
19267	2004	OTSEGO, MN WWTP/RICE LAKE CONSTR.	OTSEGO	MN	US	2	40' DIA	CLARIFIERS CLC18
19359	2004	MOREHEAD, KY WWTP/SMITH CONTRACTORS	MOREHEAD	KY	US	2	105' DIA	CLARIFIERS CLC18R
19434	2004	LEWISTOWN, MT WWTP	LEWISTOWN	MT	US	2	70' DIA	CLARIFIER RETROFITS CLC18
19413	2004	SLIDELL TERRACE AVENUE	SLIDELL	LA	US	2	85' DIA	CLARIFIER RETROFITS CLC18G
19518	2005	STEAD WWTP RENO, NV	RENO	NV	US	1	70' DIA	CLARIFIER CLC18E
19489	2005	EVELETH, MN WWTP/RICE LAKE CONSTR.	EVELETH	MN	US	1	52.5' DIA	CLARIFIER CLC18
19613	2005	KALISPELL	KALISPELL	MT	US	2	75' DIA	CLARIFIERS CLC18E
19399	2005	WAXAHACHIE	WAXAHACHIE	TX	US	2	60' DIA	CLARIFIERS CLC18E
19622	2005	OTSEGO EAST	OTSEGO	MN	US	2	65' DIA	CLARIFIERS CLC18
19476	2005	TRACY WWTP	TRACY	CA	US	2	100' DIA	COP CLARIFIERS FLAT FLOOR CLC18E
19528	2005	LITTLETON/SOUTH PLATTE WATER RENEWAL PARTNERS	ENGLEWOOD	CO	US	2	135' DIA	CLARIFIERS CLC18E
19653	2005	FORTUNA	FORTUNA	CA	US	1	60' DIA	CLARIFIER CLC18E

Job No.	Year	Location				Qty	Size	Equipment/Model
19682	2005	BP WHITING, IN	HAMMOND	IN	US	1	150' DIA	CLARIFIER CLC18
19716	2006	CHATFIELD	CHATFIELD	MN	US	2	35' DIA	CLARIFIERS CLC18E
19778	2006	CLARIANT WWTP ELGIN, SC	ELGIN	SC	US	1	50' DIA	CLARIFIER CLC18E
19411	2006	TRUCKEE MEADOWS WRF/RENO, NV/WESTERN SUMMIT	RENO	NV	US	1	92' DIA	316L SS CLARIFIER CLC18D
19807	2006	LITITZ	LITITZ	PA	US	1	70' DIA	CLARIFIER RETROFIT COMPONENTS CLC18
19828	2006	RENO STEAD	RENO	NV	US	1	70' DIA	CLARIFIER CLC18E
19768	2006	OAKS WWTP	OAKS	PA	US	2	110' DIA	CLARIFIERS CLC18
19528	2006	LITTLETON/SOUTH PLATTE WATER RENEWAL PARTNERS	ENGLEWOOD	CO	US	5	135' DIA	CLARIFIERS CLC18E
19867	2006	CONOCO FERNDAL, WA	FERNDAL	WA	US	2	70' DIA	CLARIFIERS CLC18E
19712	2006	MILAN, MI WWTP/MONROE PLUMBING	MILAN	MI	US	3	50' DIA	CLARIFIERS CLC18C
19972	2006	BP WHITING, IN	WHITING	IN	US	1	150' DIA	CLARIFIER CLC18E
19519	2007	NORTH STAR DEVELOPMENT	VALLEY CITY	OHIO	US	2	46' DIA	SECONDARY CLARIFIERS CLC18D
19833	2007	UKIAH	UKIAH	CA	US	2	90' DIA	CLARIFIERS CLC18T
19925	2007	EUGENE- SPRINGFIELD WPCF	EUGENE	OR	US	2	130' DIA	CLARIFIERS CLC18G
19855	2007	WHITE WATER CREEK WPCF/FAYETTEVILL E, GA/REYNOLDS	FAYETTEVILL E	GA	US	4	50' DIA	CLARIFIERS CLC18
19938	2007	LARGO	LARGO	FL	US	2	80' DIA	CLARIFIERS CLC18
19837	2007	ELLIS CREEK	PETALUMA	CA	US	2	125' DIA	CLARIFIERS CLC18

Job No.	Year	Location	Qty	Size	Equipment/Model
20139	2007	DELTA DIABLO SANITATION DISTRICT	ANTIOCH CA US 1	90' DIA	CLARIFIER CLC18E
19925	2007	EUGENE- SPRINGFIELD WPCF	EUGENE OR US 8	130' DIA	CLARIFIERS CLC18G
20098	2007	WEST END WPCC	WINNIPEG MB CA 1	30 M DIA	CLARIFIER CLC18E
20098	2008	WEST END WPCC	WINNIPEG MB CA 2	30 M DIA	CLARIFIERS CLC18E
20380	2008	WHITE SLOUGH WWTP LODI, CA/WESTERN WATER CONSTR.	LODI CA US 1	100' DIA	CLARIFIER CLC18D
20410	2008	VALERO CORPUS CHRISTI, TX	CORPUS CHRISTI TX US 2	85' DIA	CLARIFIERS CLC18
20470	2008	REDMOND WPCF	REDMOND OR US 1	60' DIA	CLARIFIER CLC18A
20299	2008	CHICO WPCP	CHICO CA US 1	100' DIA	CLARIFIER CLC18E
20385	2008	CLEAR CREEK WWTP REDDING, CA/RAY TONEY ASSOC.	ANDERSON CA US 1	120' DIA	CLARIFIER CLC18R
20486	2008	REEDSPORT WWTP	REEDSPORT OR US 2	60' DIA	CLARIFIERS CLC18A
20253	2009	NOVATO	NOVATO CA US 2	125' DIA	CLARIFIERS CLC18E
20627	2009	LEXINGTON, OH	LEXINGTON OH US 2	34' DIA	CLARIFIERS CLC18
20635	2009	FOSTER POULTRY FARMS	LIVINGSTON CA US 2	115' DIA	CLARIFIERS CLC18
20657	2009	LARGO WWRF	LARGO FL US 3	80' DIA	CLARIFIERS CLC18
20672	2009	CHELSEA WWTP	CHELSEA MI US 2	50' DIA	CLARIFIERS CLC18G
20624	2009	DELTA DIABLO	ANTIOCH CA US 4	90' DIA	CLARIFIERS CLC18C
20720	2009	GAUTIER WWTP	GAUTIER MS US 1	90' DIA	CLARIFIER CLC18A
20491	2009	CLARK COUNTY WRD	LAS VEGAS NV US 4	140' DIA	SS CLARIFIERS CLC18E

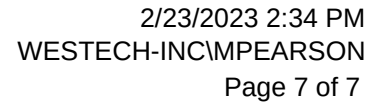


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Job No.	Year	Location				Qty	Size	Equipment/Model
20770	2009	BOZEMAN, MT WWTP	BOZEMAN	MT	US	2	85' DIA	CLARIFIER CLC18G
20753	2010	COLLINSVILLE, IL WWTP	COLLINSVILLE	IL	US	3	65' DIA	CLARIFIERS CLC18E
20830	2010	JOHNSONBURG, PA WWTP	JOHNSONBURG	PA	US	2	46' DIA	SECONDARY CLARIFIERS CLC18E
20931	2010	ZUAZUA-CLYCSA	ZUAZUA		MX	2	65' DIA	CLARIFIERS CLC18
20797	2010	MULBERRY WRP	FORT COLLINS	CO	US	1	110' DIA	CLARIFIER CLC18R
20850	2010	NORESTE	MONTERREY		MX	1	48 M	SUCTION HEADER CLARIFIER CLC18
20850	2010	NORESTE	MONTERREY		MX	1	48 M	SUCTION HEADER CLARIFIER CLC18
20729	2010	MORENO VALLEY WWTP	ESCONDIDO	CA	US	2	125' DIA	SS SECONDARY CLARIFIER CLC18E
20780	2010	VERMILLION WWTP	VERMILLION	SD	US	2	66' DIA	FINAL CLARIFIER CLC18E
20881	2010	ELI LILLY	CAROLINA	PR	PR	1	40' DIA X 17'9"	SUCTION HEADER CLARIFIER CLC18
20843	2010	AUBURN WWTP	LIVERMORE	CA	US	1	65' DIA	SECONDARY CLARIFIER CLC18A
20941	2010	MAUMEE RIVER STP	WATERVILLE	OH	US	2	105' DIA	CLARIFIERS FLAT FLOOR CLC18
20799	2010	BLUE LAKE WWTP SHAKOPEE, MN/KNUTSON CONSTR.	MINNEAPOLIS	MN		8	125'	CLARIFIERS CLC18D
20968	2010	MUD CREEK	VALDOSTA	GA	US	2	95' DIA	CLARIFIERS CLC18E
20997	2010	ST. CLOUD, MN	ST. CLOUD	MN	US	4	110' DIA	SUCTION HEADER CLARIFIERS CLC18D
21216	2011	PESQUERIA	DE LOS LERMAS GUADALUPE N L		MX	1	70' DIA	CLARIFIER CLC18

Job No.	Year		Location			Qty	Size	Equipment/Model
20910	2011	LINDA COUNTY WWTP UPGRADE	MARYSVILLE	CA	US	2	100' DIA	SECONDARY CLARIFIERS CLC18E
21032	2011	SPRING CREEK, IL WWTP/PLOCHER CONSTRUCTION	SPRINGFIELD	IL	US	6	140' DIA	SECONDARY CLARIFIERS CLC18G
21178	2011	LEPRINO FOODS WAVERLY, NY	WAVERLY	NY	US	2	33 FT	SUCTION HEADER CLARIFIERS CLC18
21130	2011	INA ROAD AZ	TUCSON	AZ	US	4	135' DIA	SECONDARY CLARIFIERS CLC18E
21130	2011	INA ROAD AZ	TUCSON	AZ	US	1	135' DIA	SECONDARY CLARIFIERS CLC18E
21291	2011	MERIDIAN WWTP	MERIDIAN	ID	US	1	80' DIA	SUCTION HEADER CLARIFIER CLC18E
21203	2011	WOODLAKE, CA WWTF PHASE 1/CW ROEN CONSTR.	WOODLAKE	CA	US	2	55' DIA	SECONDARY SUCTION HEADER CLARI CLC18A
21284	2011	ENTERPRISE WWTF IMPROVEMENTS	ENTERPRISE	AL	US	2	90' DIA	SUCTION HEADER CLARIFIERS CLC18G
20968	2011	MUD CREEK	VALDOSTA	GA	US	4	65' DIA	SECONDARY CLARIFIERS CLC18E
21303	2012	GOLETA	GOLETA	CA	US	2	80' DIA	SUCTION HEADER CLARIFIERS CLC18E
21403	2012	SAC REGIONAL	SACRAMENTO	CA	US	1	22' DIA	SECONDARY CLARIFIER CLC18E
21274	2012	GRAND RAPIDS, MI	GRAND RAPIDS	MI	US	4	140' DIA	SECONDARY CLARIFIER CLC18C
21319	2012	RIDDLE WWTP	RIDDLE	OR	US	2	30' DIA	SUCTION HEADER CLARIFIER CLC18E
21452	2012	LEWISTOWN WWTF	LEWISTOWN	PA	US	3	60' DIA	SECONDARY CLARIFIER CLC18
21503	2012	MAPLE AVENUE WWTP	SOUTH BOSTON	VA	US	1	90' DIA	SECONDARY CLARIFIER RETROFIT CLC18E
21466	2012	MOUNT MORRIS, IL WWTF/WILLIAMS BROS CONSTR.	MOUNT MORRIS	IL	US	2	55' DIA	FINAL CLARIFIERS CLC18G



Job No.	Year		Location			Qty	Size	Equipment/Model
18344	2000	WINTER HAVEN PLANT #3	WINTER HAVEN	FL	US	1	80' DIA	COP CLARIFIER COPC1
18432	2000	CADEREYTA	DE LOS LERMAS GUADALUPE N L		MX	2	74' DIA	COP CLARIFIER DRIVE & ENG. COPC1
18381	2000	COCOA BEACH, FL WRF/INDIAN RIVER INDUSTRIAL CONT.	COCOA BEACH	FL	US	1	79' DIA	COP CLARIFIER COPC1
18381	2000	COCOA BEACH, FL WRF/INDIAN RIVER INDUSTRIAL CONT.	COCOA BEACH	FL	US	1	80' DIA	COP CLARIFIER COPC1
18344	2000	WINTER HAVEN PLANT #3	WINTER HAVEN	FL	US	2	80' DIA	COP CLARIFIER RETROFITS COPC1
18347	2000	LAURINBURG MAXTON WWTP	MAXTON	NC	US	1	60' DIA	COP CLARIFIER COPC1R
18363	2000	DRY CREEK WWTP	EDEN	NC	US	1	40' DIA	COP CLARIFIER RETRO FLAT FLOOR COPC1
18334	2000	ROCK CREEK PHASE 5A	HILLSBORO	OR	US	1	140' DIA	COP CLARIFIER COPC1
18399	2000	REXBURG WWTP	REXBURG	ID	US	1	80' DIA	COP CLARIFIER COPC1
18440	2000	UPPER THOMPSON	ESTES PARK	CO	US	1	55' DIA	COP CLARIFIER COPC1R
18165	2000	GARDEN CITY, KS WWTP	GARDEN CITY	KS	US	3	75' DIA	COP CLARIFIERS COPC1
18295	2000	FORT PAYNE	FORT PAYNE	AL	US	2	90' DIA	COP CLARIFIERS COPC1
18379	2000	SOUTH WWTP	TOMBALL	TX	US	2	70' DIA	COP CLARIFIERS COPC1
18423	2000	MAC DILL AFB	TAMPA	FL	US	2	55' DIA	COP CLARIFIERS COPC1
18419	2000	ELIZABETHTON, TN	ELIZABETHTON	TN	US	2	100' DIA	COP CLARIFIERS COPC1
18226	2000	WEST BOISE, ID WWTP	BOISE	ID	US	2	120' DIA	COP CLARIFIERS COPC1
18473	2000	TWIN FALLS WWTF	Twin Falls	ID	US	1	100' DIA	COP CLARIFIER COPC1

Job No.	Year	Location				Qty	Size	Equipment/Model
18459	2000	WOODLAND	Woodland	CA	US	2	92' DIA	COP CLARIFIERS COPC1
18464	2000	FORMOSA PLASTICS	POINT COMFORT	TX	US	1	95' DIA	COP CLARIFIER COPC1
18447	2000	MAKENA RESORT WRF	KIHEI	HI	US	1	60' DIA	COP CLARIFIER COPC1
18459	2000	WOODLAND	Woodland	CA	US	2	92' DIA	COP LAUNDERS COPC1
18255	2000	AUGUSTA	AUGUSTA	KS	US	2	55' DIA	COP CLARIFIERS COPC1R
18437	2000	LINDSAY WWTF	LINDSAY	CA	US	2	50' DIA	COP CLARIFIER RETROFITS COPC1
18546	2000	SOUTHSIDE	DALLAS	TX	US	9	30' DIA	COP SLUDGE RINGS COPC1
18583	2000	TWISP	TWISP	WA	US	1	30' DIA	COP SLUDGE RING COPC1
18584	2001	LOWELL WWTP	LOWELL	IN	US	2	50' DIA	COP CLARIFIERS COPC1
18391	2001	MAIN STREET WWTP	PENSACOLA	FL	US	4	125' DIA	COP CLARIFIERS COPC1
18660	2001	NORESTE			MX	1	48 M DIA	COP CLARIFIER COPC1
18547	2001	PURCELLVILLE	PURCELLVILLE	VA	US	2	40' DIA	COP CLARIFIERS COPC1
18368	2001	ORE-IDA ONTARIO, OR	ONTARIO	OR	US	1	85' DIA	COP CLARIFIER RETROFIT COPC1
18605	2001	PARAGOULD WWTP	PARAGOULD	AR	US	1	80' DIA	COP CLARIFIER COPC1R
18568	2001	KONA INTL. AIRPORT WWTP	NORTH KONA	HI	US	1	30' DIA	COP CLARIFIER COPC1
18618	2001	JEA DISTRICT II WRF	JACKSONVILLE	FL	US	1	100' DIA	COP CLARIFIER COPC1
18649	2001	GRANDVIEW WWTP	GRANDVIEW	WA	US	2	50' DIA	COP CLARIFIERS COPC1
18227	2001	FAIRMONT, NC WWTP	FAIRMONT	NC	US	2	75' DIA	COP CLARIFIER COPC1

Job No.	Year	Location	Qty	Size	Equipment/Model
18735	2001	TURKEY STORE WWTP	BARRON WI US 1	75' DIA	COP CLARIFIER COPC1
18726	2001	BLUE RIVER WWTP/SILVERTHORNE, CO/EVERED INDUSTRIAL	SILVERTHORNE CO US 1	50' DIA	COP CLARIFIER COPC1
18723	2001	LIAOYUAN L1	KOWLOON HK CN 4	42 M DIA	COP CLARIFIERS COPC1
18791	2001	MILTON-FREEWATER WWTP	MILTON-FREEWATER OR US 1	50' DIA	COP CLARIFIER COPC1
18752	2001	COAL CITY, IL WWTP/WILLIAMS BROS CONSTR.	COAL CITY IL US 2	48' DIA	COP CLARIFIERS COPC1
18401	2001	ROCK CREEK PHASE 5B	HILLSBORO OR US 3	140' DIA	COP CLARIFIERS COPC1
18599	2001	PAYSON CITY, UT WWRF	PAYSON UT US 1	70' DIA	COP CLARIFIER COPC1
18739	2001	TZ OSBORNE PHASE IV	MC LEANSVILLE NC US 1	130' DIA	COP CLARIFIER COPC1
18758	2002	GENOA OCEOLA WWTP/PROCESS PIPING	HOWELL MI US 2	65' DIA	COP CLARIFIERS COPC1
18811	2002	MASSARD WWTP	BARLING AR US 3	80' DIA	SLUDGE RINGS COPC1
18772	2002	JELICO	JELICO TN US 1	60.5' DIA	COP CLARIFIER RETROFIT COPC1
18804	2002	WESTTOWN-CHESTER CREEK WWTP	WEST TOWN PA US 2	34' DIA	COP CLARIFIERS COPC1D
18899	2002	PECAN CREEK	DENTON TX US 4		SLUDGE RINGS COPC1
18885	2002	STILLWATER WWTP	STILLWATER OK US 2	125' DIA	SLUDGE RINGS COPC1
18736	2002	MARION WWTP	MARION OH US 4	75' DIA	COP CLARIFIERS COPC1R
18826	2002	NORTHWEST STP #3 WICHITA, KS/DONDLINGER & SONS CON	WICHITA KS US 2	60' DIA	COP CLARIFIERS COPC1R

Job No.	Year	Location				Qty	Size	Equipment/Model
18870	2002	PETOSKEY	PETOSKEY	MI	US	3	50' DIA	COP CLARIFIERS COPC1
18884	2002	WAVERLY WWTP	WAVERLY	OH	US	2	50' DIA	COP CLARIFIERS COPC1
18936	2002	AGUAS NEGRAS	TIHUANA	CA	MX	1	12.7 M DIA	COP CLARIFIER COPC1
18851	2002	SANTA CLAUS/REYNOLDS INC.	SANTA CLAUS	IN	US	2	55' DIA	COP CLARIFIERS COPC1D
18856	2002	MANTECA, CA WWQCF PHASE III/ANDERSON PACIFIC ENG.	MANTECA CENTER	CA	US	3	85' DIA	COP CLARIFIER RETRO FLAT FLOOR COPC1
18942	2002	SOUTHWEST-JEA	JACKSONVILLE	FL	US	1	100' DIA	COP CLARIFIER COPC1
18892	2002	BUTLER, MO WWTP	BUTLER	MO	US	2	62' DIA	COP CLARIFIERS COPC1
18886	2002	P STREET WWTP FORT SMITH, AR/BRANCO ENTERPRISES	FT. SMITH	AR	US	1	100' DIA	COP CLARIFIER COPC1
18737	2002	BAY CITY WWTP	BAY CITY	MI	US	2	110' DIA	COP CLARIFIERS COPC1
18927	2002	NIXA, MO WWTP/JOHN T JONES CONSTR.	NIXA	MO	US	2	105' DIA	COP CLARIFIERS COPC1
18907	2002	LEITH CREEK WWTP	LAURINBURG	NC	US	2	50' DIA	COP CLARIFIERS COPC1R
18886	2002	P STREET WWTP FORT SMITH, AR/BRANCO ENTERPRISES	FT. SMITH	AR	US	2	100' DIA	COP CLARIFIERS COPC1
18982	2003	CHESTERTON WWTP	PORTER	IN	US	1	65' DIA	COP CLARIFIER COPC1
18920	2003	MASSILLON, OH	MASSILLON	OH	US	2	90' DIA	COP CLARIFIERS FLAT FLOOR COPC1A
18957	2003	CENTRALIA, WA	CENTRALIA	WA	US	2	70' DIA	COP CLARIFIERS COPC1
19074	2003	SANTA FE 2	OAKHURST	CA	MX	1	65.1' DIA.	COP CLARIFIER COPC1
19082	2003	CORTEZ	CORTEZ	CO	US	2	60' DIA	COP CLARIFIERS COPC1

Job No.	Year	Location				Qty	Size	Equipment/Model
19056	2003	FOUR MILE CREEK	WICHITA	KS	US	1	80' DIA	COP CLARIFIER COPC1R
19056	2003	FOUR MILE CREEK	WICHITA	KS	US	1	60' DIA	COP CLARIFIER COPC1R
19000	2003	LINCOLN, CA WWTP/SJ AMOROSO CONSTRUCTION CO.	LINCOLN	CA	US	1	110' DIA	COP CLARIFIER COPC1
18920	2003	MASSILLON, OH	MASSILLON	OH	US	3	90' DIA	COP CLARIFIER RETRO FLAT FLOOR COPC1
19100	2003	HUTCHINSON	HUTCHINSON	KS	US	1	110' DIA	COP CLARIFIER COPC1
19167	2003	SOUTH CENTRAL WWTP PETERSBURG, VA	PETERSBURG	VA	US	2	110' DIA	COP CLARIFIERS COPC1
19209	2003	E.A. MILLER	HYRUM	UT	US	1	52' DIA	COP CLARIFIER COPC1
19016	2003	POLK RUN WWTP	LOVELAND	OH	US	2	70' DIA	COP CLARIFIERS COPC1R
19112	2003	POCATELLO, ID WWTP	POCATELLO	ID	US	1	120' DIA	COP CLARIFIER COPC1C
18977	2003	BEE RIDGE WWTP	SARASOTA	FL	US	2	120' DIA	COP CLARIFIERS COPC1G
18687	2003	LITTLE PATUXENT WRF	SAVAGE	MD	US	4	90' DIA	COP CLARIFIERS COPC1D
19177	2003	EAGLE LAKE WWTP/KANASASVIL LE, WI/WESTRA CONSTR.	KANSASVILLE	WI	US	1	55' DIA	COP CLARIFIER COPC1
19076	2003	YANKTON, SD WWTP/JOHN T JONES CONSTR.	YANKTON	SD	US	1	92' DIA	COP CLARIFIER COPC1
19203	2003	SALMON ARM WWTP	BRITISH COLUMBIA	CANADA	CA	1	15.2 M DIA	COP CLARIFIER COPC1
19027	2003	SPANISH FORK, UT WWTP	SPANISH FORK	UT	US	1	90' DIA	COP CLARIFIER COPC1
19112	2004	POCATELLO, ID WWTP	POCATELLO	ID	US	2	120' DIA	COP CLARIFIERS COPC1C

Job No.	Year		Location			Qty	Size	Equipment/Model
19038	2004	DELAFIELD-HARTLAND/STAAB CONSTRUCTION CORP.	DELAFIELD	WI	US	1	85' DIA	COP CLARIFIER COPC1R
18918	2004	LYONS	LYONS	KS	US	1	40' DIA	COP CLARIFIER COPC1
19227	2004	NORTH BRANCH	NORTH BRANCH	MN	US	2	60' DIA	COP CLARIFIERS COPC1R
19256	2004	JIZHUANGZI WWTP	TIANJIN	TIANJIN	CN	8	45 M DIA	COP CLARIFIERS COPC1
19038	2004	DELAFIELD-HARTLAND/STAAB CONSTRUCTION CORP.	DELAFIELD	WI	US	2	55' DIA	COP CLARIFIERS COPC1R
19239	2004	WESTPORT WWTP PORT ST LUCIE, FL	PORT ST. LUCIE	FL	US	2	80' DIA	COP CLARIFIERS COPC1R
19196	2004	ROSS CORRECTIONAL WWTP	CHILLICOTHE	OH	US	1	65' DIA	COP CLARIFIER COPC1
19362	2004	PATTERSON WWTP	PATTERSON	CA	US	1	80' DIA	COP CLARIFIER COPC1
19196	2004	ROSS CORRECTIONAL WWTP	CHILLICOTHE	OH	US	2	45' DIA	COP CLARIFIERS COPC1
19381	2004	OOSTANAULA WWTP	ATHENS	TN	US	4	85.6 ' DIA	COP CLARIFIERS COPC1
19394	2004	MANTECA	MANTECA CENTER	CA	US	2	110' DIA	COP CLARIFIERS COPC1D
19393	2004	WENATCHEE, WA WWTP	WENATCHEE	WA	US	2	80' DIA	COP CLARIFIERS COPC1A
19478	2004	CASTLEGAR, BC	CALSTEGAR	BRITISH COLUMBIA	CA	1	14 M DIA	COP CLARIFIER COPC1
19479	2004	RAINSVILLE WWTP	RAINSVILLE	AL	US	2	60' DIA	COP CLARIFIERS COPC1
19448	2005	NEW BRIGHTON	NEW BRIGHTON	PA	US	1	70' DIA	COP CLARIFIER COPC1
19525	2005	KENTLAND	KENTLAND	IN	US	1	50' DIA	COP CLARIFIER COPC1

Job No.	Year	Location				Qty	Size	Equipment/Model
19329	2005	SALT LAKE CITY , UT WRP	SALT LAKE CITY	UT	US	2	159' DIA	COP CLARIFIERS COPC1
19563	2005	AJINOMOTO	EDDYVILLE	IA	US	1	60' DIA	COP CLARIFIER COPC1
19512	2005	SOUTH HOPKINS WWTP NORTONVILLE, KY	NORTONVILLE	KY	US	2	60' DIA	COP CLARIFIERS FLAT FLOOR COPC1R
19554	2005	SAND HILL ROAD WRF	KISSIMMEE	FL	US	2	130' DIA	COP CLARIFIER RETROFITS COPC1
19600	2005	CORNING WWTF	CORNING	CA	US	3	56' DIA	COP CLARIFIERS COPC1
18741	2005	SPOKANE, WA WWTP	SPOKANE	WA	US	5	160' DIA	COP CLARIFIERS COPC1A
19636	2005	BROOKSTON	BROOKSTON	IN	US	1	46' DIA	COP CLARIFIER COPC1G
19718	2005	DEL PRADO	SAN DIEGO	CA	MX	1	62' DIA	COP CLARIFIER COPC1
19629	2005	FORT CAMPBELL WWTP	FORT CAMPBELL	KY	US	1	55' DIA	COP CLARIFIER COPC1R
19661	2005	HEARNE, TX	HEARN	TX	US	2	85' DIA	COP CLARIFIERS FLAT FLOOR COPC1
19674	2005	SELLERSBURG WWTP	SELLERBURG	IN	US	1	72' DIA	COP CLARIFIER COPC1R
19523	2005	GLADES	PORT ST. LUCIE	FL	US	2	100' DIA	COP CLARIFIERS COPC1R
19676	2006	WILLOWS	WILLOWS	CA	US	2	50' DIA	COP CLARIFIERS COPC1R
19787	2006	PENSACOLA BEACH WWTP	GULF BREEZE	FL	US	1	60' DIA	COP CLARIFIER COPC1
19767	2006	FOWLERVILLE WWTP	FOWLERVILLE	MI	US	2	50' DIA	COP CLARIFIERS COPC1
19642	2006	VICTOR VALLEY	VICTORVILLE	CA	US	2	80' DIA	COP CLARIFIERS COPC1R
19792	2006	BELGRAVE	LITTLE NECK	NY	US	1	70' DIA	COP CLARIFIER COPC1
19095	2006	WOODLAND, CA	Woodland	CA	US	1	130' DIA	COP CLARIFIER COPC1

Job No.	Year	Location				Qty	Size	Equipment/Model
19817	2006	ROSARITO NORTE II	ROSARITO	CA	MX	2	75' DIA	COP CLARIFIERS COPC1
19842	2006	MERIDIAN	MERIDIAN	ID	US	1	100' DIA	COP CLARIFIER COPC1
19870	2006	MADERA WWTP	MADERA	CA	US	4	90' DIA	COP CLARIFIERS COPC1
19696	2006	STRODES CREEK WWTP WINCHESTER, KY	WINCHESTER	KY	US	4	105' DIA	COP CLARIFIERS COPC1
19909	2006	SUNCOR REFINERY	COMMERCE CITY	CO	US	1	56' DIA	COP CLARIFIER COPC1
19779	2006	TIMBER LANE	SPRING	TX	US	1	75' DIA	COP CLARIFIER COPC1A
19816	2006	29 PALMS, CA WWTP	TWENTYNINE PALMS	CA	US	3	40' DIA	COP CLARIFIERS COPC1
19946	2006	GALLUP WWTP	GALLUP	NM	US	1	65' DIA	COP CLARIFIER COPC1
19879	2006	HUAINAN/GREENTE CH ENGINEERING	HUANGJIAHU	CHINA	CN	2	38.1 M DIA	COP CLARIFIERS COPC1
20037	2006	LAKE DARBY WWTP/GALLOWAY, OH	WESTERVILLE	OH	US	1	40' DIA	COP CLARIFIER FLAT FLOOR COPC1G
19808	2006	COACHELLA VALLEY MID-VALLEY WRP PH4	COACHELLA	CA	US	2	80' DIA	COP CLARIFIERS COPC1R
20000	2006	URBI GEO	SAN DIEGO	CA	MX	1	58.8' DIA	COP CLARIFIER COPC1
20011	2007	KIHEI WWTP	KIHEI, MAUI	HI	US	1	75' DIA	COP CLARIFIER COPC1
19860	2007	NAMPA, ID	NAMPA	ID	US	2	120' DIA	COP CLARIFIERS COPC1
19931	2007	WAIMANALO WWTP	WAIMANALO	HI	US	1	50' DIA	COP CLARIFIER COPC1
19963	2007	MERCED WWTP	MERCED	CA	US	2	110' DIA	COP CLARIFIERS COPC1
20140	2007	UNIVERSITY OF TIJUANA	SAN DIEGO	MX	MX	1	22.34' DIA	COP CLARIFIER COPC1
20206	2007	PEMEX	CD. GUADALUPE, NUEVO LEON		MX	1	130' DIA	COP CLARIFIER COPC1

Job No.	Year		Location			Qty	Size	Equipment/Model
20137	2007	SUMMERVILLE WWTP	SUMMERVILLE	GA	US	2	75' DIA	COP CLARIFIERS COPC1
20135	2007	BUTLER	BUTLER	IN	US	1	40' DIA	COP CLARIFIER COPC1
19779	2007	TIMBER LANE	SPRING	TX	US	1	75' DIA	COP CLARIFIER COPC1A
20042	2007	MUNCIE WWTP	MUNCIE	IN	US	2	110' DIA	COP CLARIFIERS COPC1
20068	2007	PACE WWTP	PACE	FL	US	2	70' DIA	COP CLARIFIERS COPC1R
20042	2007	MUNCIE WWTP	MUNCIE	IN	US	2	80' DIA	COP CLARIFIERS COPC1
20173	2007	LAHAINA WWRF	LAHAINA, MAUI	HI	US	2	75' DIA	COP CLARIFIER RETROFITS COPC1
20172	2007	KIHEI WWRF	KIHEI, MAUI	HI	US	1	75' DIA	COP CLARIFIER COPC1
20169	2007	HARRIS MUD 150	HOUSTON	TX	US	2	59' DIA	COP CLARIFIERS COPC1A
20165	2008	MOUNT FOREST	MOUNT FORREST	ON	CA	2	18 M DIA	COP CLARIFIERS COPC1R
20233	2008	POINT AQUARIUS WWTF/MONTGOMERY COUNTY, TX/RP CONST	WILLIS	TX	US	2	55' DIA	COP CLARIFIERS FLAT FLOOR COPC1R
20217	2008	McKEESPORT WWTP	MCKEESPORT	PA	US	2	115' DIA	COP CLARIFIERS RETROFIT COPC1G
20295	2008	WILLIAMS, AZ WWTP/CDM CONSTRUCTORS	WILLIAMS	AZ	US	2	45' DIA	COP CLARIFIERS COPC1R
20363	2008	SAN PEDRO	SAN DIEGO	CA	MX	1	75' DIA	COP CLARIFIER COPC1
20186	2008	GLADES WWTF	PORT ST. LUCIE	FL	US	2	100' DIA	COP CLARIFIERS COPC1R
20435	2008	HUAINAN	XIAOXINJIE, SHAPINGBA	CHONGQING, CHINA	CN	2	38.1 M DIA	COP CLARIFIER COPC1
20151	2008	SUGAR CREEK WRRF	SPRING VALLEY	OH	US	1	121' DIA	COP CLARIFIER COPC1R
20306	2008	GAS CITY, IN WWTP	GAS CITY	IN	US	2	80' DIA	COP CLARIFIERS COPC1

Job No.	Year	Location				Qty	Size	Equipment/Model
20356	2008	COLUSA, CA WWTP	COLUSA	CA	US	1	55' DIA	COP CLARIFIER COPC1A
20358	2008	VALLEY CENTER WWTP	VALLEY CENTER	KS	US	1	55' DIA	COP CLARIFIER COPC1R
20247	2008	RIGBY WWTP	RIGBY	ID	US	2	50' DIA	COP CLARIFIERS COPC1
20195	2008	MEDIO CREEK WWTP	SAN ANTONIO	TX	US	2	120' DIA	COP CLARIFIERS COPC1D
20207	2008	CAYEY WWTP	SAN JUAN	PR	PR	3	105' DIA	COP CLARIFIERS COPC1
20310	2008	NORTHWEST RWRF TAMPA, FL	TAMPA	FL	US	2	110' DIA	COP CLARIFIERS COPC1
20362	2008	SPRINGVILLE	SPRINGVILLE	UT	US	2	80' DIA	COP CLARIFIERS COPC1
20515	2008	TICSA	SAN ANTONIO	TX	MX	2	24.5 M DIA	COP CLARIFIERS COPC1
20293	2008	MUDDY CREEK WWTP CINCINNATI, OH	CINCINNATI	OH	US	2	110' DIA	COP CLARIFIERS COPC1A
20310	2008	NORTHWEST RWRF	TAMPA	FL	US	2	110' DIA	COP CLARIFIER RETRO FLAT FLOOR COPC1
20454	2008	TRENTON, MO	TRENTON	MO	US	2	45' DIA	COP CLARIFIER FLAT FLOOR COPC1
20472	2008	DENHAM SPRINGS, LA WWTP	DENHAM SPRINGS	LA	US	2	85' DIA	COP CLARIFIER COPC1G
20523	2009	WEST KNOX UTILITY DISTRICT	KNOXVILLE	TN	US	2	80' DIA	COP CLARIFIER RETRO FLAT FLOOR COPC1
20483	2009	TOPPENISH WWTF	TOPPENISH	WA	US	1	70' DIA	COP CLARIFIER COPC1
20434	2009	SOUTH WALTON	DESTIN	FL	US	1	60' DIA	COP CLARIFIER COPC1R
20548	2009	MEADOWCREST WWTP	BEVERLY HILLS	FL	US	2	65' DIA	COP CLARIFIER COPC1R
20503	2009	ROSAMOND WWTP	ROSAMOND	CA	US	1	50' DIA	COP CLARIFIER COPC1
20600	2009	BENTON	BENTON	AR	US	1	120' DIA	COP CLARIFIER COPC1
20434	2009	SOUTH WALTON	DESTIN	FL	US	2	60' DIA	COP CLARIFIER RETROFITS COPC1R

Job No.	Year	Location				Qty	Size	Equipment/Model
20792	2009	BRIGHAM CITY	BRIGHAM CITY	UT	US	1	85' DIA	SECONDARY CLARIFIER COPC1
20581	2009	McCOMB WWTP	McCOMB	MS	US	3	90' DIA	COP CLARIFIER COPC1G
20307	2009	NORTH RIVER WWTF	MOUNT CRAWFORD	VA	US	2	116' DIA	COP CLARIFIERS COPC1
20362	2009	SPRINGVILLE	SPRINGVILLE	UT	US	1	80' DIA	COP CLARIFIER RETROFIT COPC1
20719	2009	HUBER RIDGE	WESTERVILLE	OH	US	1	50' DIA	CLARIFIER COPC1G
20492	2009	ECUA CENTRAL WRF PENSACOLA, FL	CANTONMENT	FL	US	4	125' DIA	COP CLARIFIERS COPC1A
20685	2009	BURBANK WRP	BURBANK	CA	US	2	65' DIA.	CLARIFIERS COPC1
20730	2009	SCOTTSBLUFF	SCOTTSBLUFF	NE	US	1	80' DIA	CLARIFIER COPC1G
20763	2009	UPPER THOMPSON	ESTES PARK	CO	US	2	40' DIA	SECONDARY CLARIFIERS COPC1A
20337	2009	PERRY WILLARD, UT WWTP	PERRY / WILLARD	UT	US	2	70' DIA	COP CLARIFIERS COPC1G
20700	2009	MIRAMAR WWFR	MIRAMAR	FL	US	1	100' DIA	CLARIFIER COPC1
20769	2009	STEEP BANK/FLAT BANK MISSOURI CITY, TX	MISSOURI CITY	TX	US	1	100' DIA	SECONDARY CLARIFIER COPC1
20709	2009	WESTPORT WWTP	PORT ST. LUCIE	FL	US	1	80' DIA	SECONDARY CLARIFIER COPC1
20713	2009	CORAL SPRINGS IMPROVEMENT DISTRICT	Coral Springs	FL	US	1	75'	CLARIFIER-BULLSEYE UNIT COPC1
20776	2009	WELLINGTON WWTF	WELLINGTON	KS	US	2	60'	SPIRAL BLADED CLARIFIERS COPC1R
20878	2010	PINAL CREEK	GLOBE	AZ	US	1	50' DIA	COP CLARIFIER FLAT FLOOR COPC1G
20835	2010	DONNA	DONNA	TX	US	1	70' DIA	CLARIFIER COPC1

Job No.	Year	Location	Qty	Size	Equipment/Model
20779	2010	S. MESQUITE CREEK, TX WWTP/BAR CONSTR.	MESQUITE TX US 2	150' DIA	CLARIFIER COPC1
20779	2010	S. MESQUITE CREEK, TX WWTP/BAR CONSTR.	MESQUITE TX US 1	180' DIA	CLARIFIER COPC1
20887	2010	ERIE NORTH WRF	ERIE CO US 2	70' DIA	CLARIFIERS COPC1G
20740	2010	POST FALLS WWTP EXPANSION	POST FALLS ID US 2	80' DIA	CLARIFIER COPC1R
20772	2010	VALLEY CREEK WWTP ELIZABETHTOWN, KY	ELIZABETHTO WN KY US 1	112' DIA	SPIRAL BLADED CLARIFIER COPC1
20857	2010	BIG COVE WWTP	OWENS CROSS ROADS AL US 1	90' DIA	COP CLARIFIER COPC1
20906	2010	HUTCHINSON	HUTCHINSON KS US 2	110' DIA	SEC CLARIFIERS FLAT FLOOR COPC1
20927	2010	AIRPORT PARKWAY, SO. BURLINGTON, VT/PIZZAGALLI	SOUTH BURLINGTON VT US 1	55' DIA	CLARIFIER COPC1
20852	2010	LIVE OAK WWTP	LIVE OAK CA US 2	57' DIA	SECONDARY CLARIFIERS COPC1A
20880	2010	LITTLE PATUXENT	SAVAGE MD US 5	90' DIA	FLAT FLOOR RETRO FINAL CLARS 4 COPC1A
20954	2010	TAMPICO	LAREDO TX MX 3	154' DIA	COP CLARIFIERS P & E ONLY COPC1
20886	2010	FISHING CREEK WWTP	YORK SC US 1	65' DIA	SECONDARY CLARIFIER COPC1
20751	2010	SOMERTON, AZ WWTP/KIEWIT WESTERN	SOMERTON AZ US 2	60' DIA	CLARIFIERS COPC1G
21015	2010	JBS	NIBLEY UT US 1	52' DIA	COP CLARIFIER COPC1

Job No.	Year	Location	Qty	Size	Equipment/Model
20962	2010	PRINCE'S LAKES WWTP/EDINBURGH, IN/THIENEMAN CONSTR	EDINBURGH IN US 2	55' DIA	FINAL CLARIFIERS COPC1G
20880	2010	LITTLE PATUXENT	SAVAGE MD US 4	90' DIA	CLARIFIER 13 COPC1A
20942	2010	BANCROFT, ON, CA	BANCROFT ON CN 1	50' DIA	SECONDARY CLARIFIER COPC1
20849	2010	WILLIAMS, CA WWTP/SYBLON REID CO.	WILLIAMS CA US 1	60' DIA	SECONDARY CLARIFIER COPC1A
21058	2010	TAMPICO MORELOS	LAREDO TX MX 2	26M DIA	CLARIFIERS COPC1
20952	2010	VILLAGE OF PATCHOGUE, NY	PATCHOGUE NY US 2	55' DIA	FINAL CLARIFIERS COPC1G
20983	2010	TELL CITY	TELL CITY IN US 2	65' DIA	CLARIFIERS COPC1G
20992	2010	BELLEFONTAINE WWTP	BELLEFONTAI NE OH US 1	80' DIA	SECONDARY CLARIFIER COPC1R
20908	2010	OREM WRF	OREM UT US 1	120' DIA	SECONDARY CLARIFIER COPC1G
20928	2010	SIERRA VISTA WWTP	SIERRA VISTA AZ US 2	60' DIA	SECONDARY CLARIFIERS COPC1G
20834	2010	MUNSTER WWTP	MERAUX LA US 1	100' DIA	SECONDARY CLARIFIERS COPC1
21101	2010	HARVEY AVENUE WWTP	PIPERSVILLE PA US 2	55' DIA	COP™ SECONDARY CLARIFIERS COPC1R
21006	2011	CHATHAM WWTP	CHATHAM MA US 2	55' DIA	CLARIFIERS COPC1R
20989	2011	PRAIRIE GROVE WWTF	PRAIRIE GROVE AR US 2	60'	FINAL CLARIFIERS COPC1R
20957	2011	IRVINE REGIONAL WWTP	IRVINE KY US 2	82' DIA	CLARIFIERS COPC1
21147	2011	BUHL WWTP	BUHL ID US 2	65' DIA	SECONDARY CLARIFIER COPC1
21187	2011	HARTFORD	HARTFORD CT US 2	125' DIA	CLARIFIERS SLUDGE RING ONLY COPC1

Job No.	Year	Location				Qty	Size	Equipment/Model
21215	2011	EAST PENNSBORO	CAMP HILL	PA	US	3	75' DIA	SECONDARY CLARIFIERS COPC1
21154	2011	CARUTHERSVILLE WWTP	CARUTHERSVILLE	MO	US	1	50' DIA	SECONDARY CLARIFIER COPC1
21168	2011	MEDFORD, OR WWTP/SLAYDEN CONSTR.	CENTRAL POINT	OR	US	1	90' DIA	SECONDARY FLAT FLOOR CLARIFIER COPC1G
21168	2011	MEDFORD OR, WWTP/SLAYDEN CONSTR.	CENTRAL POINT	OR	US	4	90' DIA	SECONDARY FLAT FLOOR CLARIFIER COPC1G
21211	2011	LOWER EAST FORK WWTP	MILFORD	OH	US	1	120' DIA	FINAL CLARIFIER COPC1A
21250	2011	EASTERLY ALTOONA, PA WWTF	ALTOONA	PA	US	1	105' DIA	SECONDARY FLAT FLOOR CLARIFIER COPC1R
21210	2011	LOWER HOWARDS CREEK/WINCHESTER, KY/SMITH CONTR.	WINCHESTER	KY	US	3	70' DIA	SECONDARY CLARIFIERS COPC1
21311	2011	NORTH LONDONDERRY TOWNSHIP AUTHORITY WWTP	ANNVILLE	PA	US	2	56' DIA	SECONDARY CLARIFIERS COPC1G
21484	2011	GEO VALLE DE LAS PALMAS	SAN DIEGO	BAJA CALIFORNIA	MX	1	72' DIA	COP CLARIFIER COPC1
21485	2011	ROSARITO 1 AMPLIACION A 120	ROSARITO	BAJA CALIFORNIA	MX	1	72' DIA	COP CLARIFIER COPC1
21205	2012	BRATTLEBORO	BRATTLEBORO	VT	US	2	68' DIA	SECONDARY CLARIFIERS COPC1
21479	2012	PINAL CREEK	GLOBE	AZ	US	1	50' DIA	COP CLARIFIER COPC1G
21250	2012	EASTERLY ALTOONA, PA WWTF	ALTOONA	PA	US	3	105' DIA	SECONDARY FLAT FLOOR CLARIFIER COPC1R
20864	2012	GREATER HAZLETON JSA WWTP UPGRADE	HAZLETON	PA	US	2	75' DIA	SECONDARY CLARIFIER RETROFITS COPC1G



Installation List

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Job No.	Year		Location			Qty	Size	Equipment/Model
21482	2012	HEBER PUD 1.2 MILLION GALLON WWTP EXPANSION	HEBER	CA	US	2	55' DIA	SECONDARY COP CLARIFIERS COPC1G
21579	2012	HAZLEHURST WWTF	HAZLEHURST	MS	US	2	44' DIA	COP CLARIFIERS COPC1
21614	2012	DUMAS, TX WWTP	DUMAS	TX	US	2	85' DIA	COP CLARIFIERS COPC1
21595	2012	VALLEY CREEK WWTP	ELIZABETH TO WN	KY	US	2	112.33' DIA	COP CLARIFIERS COPC1
21599	2012	MOOREFIELD WWTP	MOOREFIELD	WV	US	2	95' DIA	COP SECONDARY CLARIFIERS COPC1G
Total Qty =						433		

Section ____ - Circular Suction Header Clarifier

Part 1 General

1.1 Scope

- A. There shall be furnished and installed equipment for four (4) circular suction header cage drive clarifiers. The equipment shall include a walkway bridge, drive platform, center column, center cage, dual gate EDI, feedwell, suction header(s), suction header support arms, rotating suction manifold, skimmer blade & supports, hinged skimmer assembly, scum box & supports, scum flushing valve, effluent weir, scum baffle & supports, electrical control panel, drive unit, anchor bolts & fasteners, and all other appurtenances required or shown on the drawings.

1.2 Definitions

Continuous Running Torque: The 100 percent AGMA torque to be continuously applied 24 hours a day to the drive system.

Momentary Peak Torque: The maximum torque rating of the drive mechanism components. Momentary peak torque shall be 2.0 times the continuous running torque.

Average Flow: The average flow per day for the whole year.

Design Flow: The average of the highest single day flows per month for the whole year.

Maximum Flow: Average flow per day for the month with the highest flows.

Peak Flow: The highest single hourly flowrate.

Return Activated Sludge (RAS): The settled solids removed from the bottom of clarifier and recycled to the biological process upstream of the clarifier.

1.3 Supplier

- A. The clarifier equipment specified in this section shall be WesTech Model CLC18G. Substitute equipment must be modified as necessary to provide the specified features and to meet the specified operating conditions.

1.4 Design Criteria

Design Criteria (per clarifier)	Unit	Value
Influent Flow Rates		
Average Flow	MGD	5.3125
Design Flow	MGD	7.5
Maximum Flow	MGD	10
Peak Flow	MGD	14.165
Recycle Rate		
Minimum RAS	MGD	1
Design RAS	MGD	2.54
Max RAS	MGD	5.3125

MLSS	mg/l	3000
SVI	ml/g	130
Tank Diameter	ft	110
Side Water Depth	ft	15
Freeboard	in	36
Bottom Slope	in/ft	0.125
Influent Column Outside Diameter	in	48
EDI		
EDI Diameter	ft	11
EDI Depth	ft	4
Feedwell		
Feedwell Diameter	ft	28
Feedwell Depth	ft	6
Scum Box Width	ft	5
Suction Header Quantity		2
Manifold Diameter	ft	9
Collector Tip Speed	fpm	14.1
Motor HP	hp	1
Torque		
Continuous Torque	ft-lbs	45,500
Momentary Peak Torque	ft-lbs	91,000
Ball Race Diameter Min	in	47.25
Drive Overturning Moment	ft-lbs	465,781

1.5 Warranty

- A. A written supplier's warranty shall be provided for the equipment specified in this section. The warranty shall be for a minimum period of one (1) year from start-up or 18 months from time of equipment shipment, whichever comes first. Such warranty shall cover all defects or failures of materials or workmanship which occur as the result of normal operation and service except for normal wear parts (i.e. squeegees, skimmer wipers, etc.).

1.6 Submittals

- A. Two copies of all materials required to establish compliance with these specifications shall be submitted for review. Submittals shall include at least the following:

1. General arrangement drawings showing all important details and materials of construction, dimensions, loads on supporting structures, and anchor bolt locations.
2. Descriptive literature, bulletins, and/or catalogs of the equipment.
3. Complete data on motors and speed reducers.
4. Wiring diagrams and electrical schematics for all control equipment to be furnished.
5. Calculations documenting the AGMA rating of the drive unit and life of the main bearing; prepared and signed by a registered professional engineer.
6. Complete descriptive information and electrical schematic for the torque overload device.
7. Complete process calculations substantiating the sizing of the center column and ports, EDI and outlets, and outer feedwell. These calculations shall be based on parameters from the manufacturers operating experience.
8. Complete hydraulic calculations prepared and signed by a registered professional engineer. Calculations shall verify uniform sludge withdrawal over the tank bottom for the flow conditions stated in these specifications. Data at each orifice shall include orifice diameter, spacing, headloss, flow, and velocity in the header. Calculations shall be based on hydraulic data from full scale tests. Test data shall verify the choice of orifice and headloss coefficients along the suction header. Complete test data shall be available for inspection by the engineer.

1.7 Experience

- A. The equipment supplier shall have at least 15 years of experience in the design, application, and supply of circular clarifiers in water or wastewater treatment plants, and shall submit a list of not less than 25 operating installations of clarifiers with suction headers and EDI as evidence of meeting the experience requirement.
- B. To show evidence of being able to provide the quality of equipment and services described in this specification, the equipment supplier shall submit their ANAB-accredited ISO 9001 quality system certification. AIAO-BAR accredited systems are not a recognized equivalent and are therefore specifically prohibited. The quality procedures shall provide for a means of qualifying all sub-vendors and shall specify that the fabrication facility is a critical vendor and shall require inspection. The quality system shall be audited on-site by a third-party independent registrar at least annually. Certification shall remain in effect throughout the project start-up. Mechanism shall be manufactured according to requirements of Machinery Directive 98/37/EC.

1.8 Shop Assembly and Inspection

- A. The equipment specified herein shall be factory assembled as far as practical to verify that all mating parts can be field assembled. All mating parts shall be trial fit and match-marked. The manufacturer shall submit certification of shop trial assembly and photographs of assembly before shipment. The customer and installing contractor shall be given the opportunity to witness the shop assembly.
- B. Shop inspection shall be performed by a qualified inspector and certified by the manufacturer. The inspection shall be documented, and all deficiencies noted, corrected, re-inspected and final completion formally authorized. Final shipment authorization shall be by the manufacturer to ensure completion of all fabrication, assembly, and inspection requirements. Inspection records and evidence of inspector qualification shall be submitted to the owner upon request.

Part 2 Products

2.1 General Design

- A. Description

- A. The clarifier mechanism shall be of the center drive type, supported on a stationary influent column, with the flow entering at the bottom of the influent column and flowing upward into the energy dissipating inlet. The flow shall then proceed into the feedwell through gates arranged for impinging flow near the water level for further energy dissipation and settling. The clarifier shall be designed to remove settled sludge from the bottom of the tank and floating scum from around the periphery of the tank.
- a. The clarifier shall perform the following integrated functions:
- 1) Dissipate energy and control localized currents.
 - 2) Separate solids from the clear liquid.
 - 3) Evenly withdraw the clear liquid.
 - 4) Transport and thicken settled sludge.
 - 5) Prevent sludge dilution at withdrawal point.
 - 6) Remove scum from the clarifier surface.

B. Materials

1. All structural steel shall conform to AISC – Steel Construction Manual latest edition. All steel plates shall conform to ASTM A36. All structural steel shape series of M, MT, S, ST, C, MC, and L shall conform to ASTM A36. Structural steel shapes W, WT, HP shall conform to ASTM A992/A572. All pipe shall be ASTM A53, Grade B. All square and rectangular tubing shall be ASTM A500, Grade C, unless otherwise noted. Steel members in contact with liquids, either continuously or intermittently, shall have a minimum thickness of 1/4 inch unless otherwise noted. All aluminum shall be type 5052, 6061, 6063, or 2014 alloy unless noted. All stainless steel shall be ASTM A276 for rolled shapes, ASTM A1069 for laser-fused shapes, ASTM A312 for pipe, ASTM AA554 for HSS and ASTM A240 for plate, type carbon steel unless noted.

Component Location	Material of Construction
Submerged	Carbon Steel
Non-Submerged	Carbon Steel

C. Fabrication

1. Shop fabrication and welding of structural members shall be in accordance with the latest edition of the "Structural Welding Code", AWS D1.1, (AWS D1.2-Aluminum, AWS D1.6-Stainless Steel), of the American Welding Society. All joined or lapped surfaces shall be completely seal welded with a minimum 3/16 inch fillet weld. Intermittent welding shall not be allowed, except on non-ferrous metals.

D. Edge Grinding

1. Sharp projections of cut or sheared edges of ferrous metals shall be ground to a radius by multiple passes of a power grinder as required to ensure satisfactory coating adhesion.

E. Shop Surface Preparation/Coating

1. All iron and steel surfaces, except the drive unit, shall be field cleaned and painted by the contractor to ensure paint compatibility and assign unit responsibility for the coating system. The drive unit shall be coated with the supplier's standard enamel paint system.

F. Structural Design

1. All steel design shall be in accordance with the AISC Manual of Steel Construction, latest edition and the International Building Code (IBC), latest edition.

2.2 Drive Unit

A. Design Parameters

1. The drive unit shall be designed and manufactured by the clarifier equipment supplier to ensure unit responsibility. The drive unit shall be designed for the torque values previously listed. It shall turn the mechanism at the design collector tip speed. The drive main bearing shall be designed for the total rotating mechanism loads with a minimum L-10 life of 50 years or 438,000 hours. The drive unit shall be capable of producing and withstanding the previously listed momentary peak torque while starting. The drive main gear shall be designed to a minimum AGMA 6 rating when rated in accordance with the latest AGMA standard. Gear teeth shall be designed for proper load distribution and sharing. Stub tooth design and surface hardening of the main gear shall not be allowed. The main bearing shall be capable of withstanding the listed overturning moment without the aid of any underwater guides or bearings to ensure correct tooth contact for AGMA rating of the main gear.
 - a. All spur gearing shall be designed to the latest AGMA spur gear standard for strength and surface durability, based on a life of 175,000 hours. The design running torque rating of the drive gearing shall be based on the smaller of the strength and durability values determined from the above AGMA standard. To ensure safety and ease of maintenance, all components of the drive shall be direct coupled.
 - b. No overhung pinions shall be allowed on the speed reducing unit. The lower pinion bearing shall not be located below the turntable base.
 - c. Any and all welding on the drive unit shall be done using E70XX weld rod.

B. Physical Characteristics

1. The drive unit shall consist of a solid internal main spur gear, bearing turntable, pinion, secondary speed reducer, support base, and drive unit bearing. The drive shall be mounted on the center column and support the entire rotating load of the mechanism. The main internal gear shall be forged of alloy hardened steel. The pinion shall be heat treated alloy steel. Support base for the drive shall be of welded steel to assure rigidity. Dust shields shall be provided. The drive bearing shall include a forged steel precision gear/bearing set, with fully contoured raceways hardened to a minimum 58-62 Rc and protected by a neoprene seal. The drive shall be designed so that the balls and nylon spacers can be replaced without removing the access walkway. The main gear to pinion gear mesh shall be oil lubricated. An oil sight glass, fill pipe, and drain shall be provided for the reservoir. Lubrication fittings shall be readily accessible.

C. Overload Protection

1. An overload device shall be provided in a stainless steel, weatherproof enclosure. The device shall be actuated by torque generated from the main drive, which shall operate two independently adjustable switches (the alarm switch at 100 percent of design running torque and the motor cutout switch at 120 percent of design running torque). Devices that require the worm to float and measure the thrust of the worm gear shall not be acceptable. These two switches shall be factory adjusted to accurately calibrate the alarm torque value and the overload position. A visual torque indicator shall be provided and oriented so that it may be read from the walkway. It shall be calibrated from 0 to 160 percent of design running torque.

D. Turntable

1. The turntable base shall have an annular bearing raceway upon which the rotating assembly rests. It shall have a maximum allowable deflection in accordance with the bearing specifications. The allowable modulus of elasticity shall be a minimum of 29×10^6 psi. The center cage shall be

fastened to and supported from the gear casing. Ball bearings shall be of high carbon chrome alloy 52100 steel running in fully contoured races, as part of a precision gear/bearing set. The balls shall be grease lubricated and protected by elastomer seals. Felt seals that allow the entrance of moisture from outside the drive (i.e. rain water, condensate, etc.) will not be allowed.

E. Speed Reducing Unit

1. The speed reducing unit shall consist of cycloidal, helical, or planetary speed reducers directly connected to a motor without the use of chains or v-belts, and shall be keyed to the pinion.
 - a. The main ring gear of cycloidal drives shall be made of high carbon chromium bearing steel and be fixed to the drive casing. An eccentric bearing on the high speed shaft shall roll cycloidal discs of the same material around the internal circumference of this main ring gear. The lobes of the cycloid disc shall engage successively with pins in the fixed ring gear. The movement of the cycloid discs shall be transmitted then by pins to the low speed shaft. Speed reducer efficiency shall be a minimum of 90% per reduction stage.
 - b. Speed reducer helical or planetary gearing shall be manufactured to AGMA standards and shall provide at least 95% power transmission efficiency per stage. The speed reducer shall have a minimum service factor of 1.25 based on the output torque rating of the drive.
 - c. The reducers shall be fitted with radial and thrust bearings of proper size for all mechanism loads and be grease lubricated. As a safety feature, the speed reducer shall be back drivable to release any stored energy as the result of an over torque condition.

F. Motor

1. The motor shall be a squirrel cage, induction type, TEFC, ball bearing heavy duty unit of ample power for starting and operating the mechanism without overload, with a minimum service factor of 1.15.
 - a. Power supply to the equipment shall be 240/480 volt, 60 hertz, 3 phase.

2.3 Walkway and Platform

A. Walkway

1. One (1) 36 inch wide walkway and platform with handrails shall be supported by the drive unit and influent column at the center and the tank wall at its outer end, and shall be designed to safely withstand a live load of 50 pounds per square foot. Deflection shall not exceed $L/360$ when both the dead load and live loads are applied. It shall consist of two trusses or beams with 1-1/4 inch aluminum I-bar grating between the trusses or beams. The walkway shall be diagonally braced against lateral movement, and provided with handrails 42 inches high, of double-row 1-1/2 inch diameter horizontal aluminum pipe, and 4 inch high kickplates on both sides. Walkway trusses may serve as the handrail if the top chord is 3 feet-6 inches above the walking surface.
 - a. Stainless steel bearing plates, UHMW-PE slide plates, and anchor bolts for the wall support shall be provided by the equipment supplier and installed by the contractor. Bearing plate dimensions and anchor bolt diameter, length, quantity, and arrangement shall be per the equipment supplier. The contractor shall block out or otherwise modify the tank or support structure to accommodate walkway and supports, if required.

B. Center Drive Platform

1. A center drive platform shall be provided which allows 24 inches of clearance outside the center drive components. It shall consist of 0.25 inch aluminum checkered plate with necessary stiffeners and supports, resting on the drive unit and center column, and provided with

connections to the walkway. The entire platform shall be surrounded by handrails 42 inches high of double-row 1-1/2 inch diameter horizontal aluminum pipe with 4 inch high kickplates.

2.4 Influent and Sludge Removal

A. Stationary Center Influent Column

1. A stationary cylindrical steel influent column of 1/4 inch minimum wall thickness shall be provided. One end shall have a support flange for bolting to the tank floor over the influent line, with a similar flange at the top for supporting the drive unit and walkway. The structure and anchor bolts shall provide adequate support for the entire mechanism dead load plus live loads and torque with an adequate factor of safety to eliminate excessive deflection or vibration. Suitable openings shall be provided in the upper portion of the column just below the sludge collection box to allow unrestricted passage of the flow into the energy dissipating inlet.
2. Prior to the center column being grouted in place, the drive unit shall be installed, positioned, and leveled.

B. Dual Gate Energy Dissipating Inlet

1. A dual gate rotating circular energy dissipating inlet with bottom shall be supported by the cage and be designed to diffuse the liquid into the feedwell in an impinged flow direction without excessive disturbance or formation of vertical velocity currents. The DG-EDI shall be designed to positively prevent sludge from depositing within the DG-EDI and shall include bottom drain holes.
 - a. The diameter, depth, and detention time of the DG-EDI shall be included in the submittal with the design calculations and shall show proper process application as evidenced by the required successful operating installations.
 - b. The rotating DG-EDI shall be designed with a full bottom extending to within 1 inch of the center column. It shall include an upper rim angle for stiffness. Multiple, discharge ports shall be provided to induce impinged flow. The gates shall have a fixed bottom to prevent vertical currents as the flow exits the DG-EDI.
 - c. The DG-EDI shall be made of not less than 3/16 inch thick steel plate with necessary stiffening angles.
 - d. EDI Test Data – The submittal shall include data from side-by-side tests on identical full-scale operating clarifiers at least ____ ft. in diameter, with identical feed and underflow rates. The data shall show that installation of an EDI equivalent in design to that proposed for this project produced a decrease in effluent suspended solids of at least 25 percent.

C. Feedwell

1. The flocculating feedwell shall be located outside of the EDI to diffuse the liquid into the tank without disturbance or formation of velocity currents. Baffled openings shall be provided near the water surface to allow scum to exit the feedwell.
 - a. The supports for the feedwell shall be located either above the liquid extending from the cage or bridge, or on the rake arms. Submerged supports from the rake arms shall be designed to minimize horizontal flow disruption.
 - b. No feedwell support or feedwell spliced connection shall be contained within the annular space formed between the feedwell and EDI. The depth of the feedwell shall be such as to provide proper detention time and an exit velocity at maximum flow that will not scour the settled sludge. The diameter, depth, detention time, and exit velocities shall match the process application calculations as evidenced by the required successful operating installations.

- c. The feedwell shall be made of not less than 3/16 inch thick steel plate with necessary stiffening angles.

D. Center Cage

1. The center cage shall be of steel box truss construction. It shall be provided with connections for the two sludge rake arms and feedwell supports if required. The cage top shall be bolted to the main gear which shall rotate the cage with the attached arms and feedwell. The cage and each arm shall be designed to withstand 150 percent of the design running torque of the drive without over stressing the members. Loading to develop the torque shall be considered as uniform loads applied to each arm individually.

E. Suction Header(s) Arms

1. The mechanism shall include two (2) suction header arm(s) attached to a manifold about the lower end of the center column. The header(s), of rectangular-shaped full tapered cross section, shall vary in size from a maximum near the tank center to a minimum at the outer end to provide uniform sludge draw-off velocities throughout and shall be fabricated of 1/4 inch minimum thick steel plate. The header(s) shall be sized for a minimum flow velocity of 0.5 fps and shall be constructed of 304 stainless steel. The longitudinal cross sectional axis of the header(s) shall be mounted at an angle of 45 degrees with the tank bottom to provide a peaked top. The leading edge of the header(s) shall extend downward 2" to provide a fluidizing vane as an integral part of the header and to direct the sludge into the area of influence of the orifices. At the inner end of the header(s), a flange shall be provided for bolting to the center outlet manifold. The header(s) shall have a scraper of 1/4" steel plate with a neoprene blade to clean the tank bottom around the manifold directing the sludge to the first orifice.
2. At regular intervals, not to exceed 30", inlet orifices varying in size from a minimum diameter near the tank center to a maximum diameter at the outer end, shall be accurately located in the header(s). The minimum orifice size shall be 2" diameter. The design of each orifice shall be proportionate to the volume of sludge withdrawn and the design of the orifices and header(s) shall be such as to insure hydraulic balance in the tank and uniform sludge withdrawal from the entire tank bottom at all flows.
3. The header support(s) shall be of steel truss construction designed so as to not require the use of tie rods, shall be rigidly connected to the cage and manifold, and shall have connections so that the header(s) may be adjusted to the slope of the floor.

F. Manifold

1. There shall be a sludge manifold attached to the bottom of the rotating cage at the center of the tank, designed for the transfer of the sludge from the header(s) to the outlet pipe. The manifold shall be constructed of 1/4" minimum steel plate, and fitted with two (2) sealing rings; one at the center column, and one at a bottom guide ring on the tank floor.
 - a. A circular bottom guide ring shall be securely anchored to the concrete floor around the center column and grouted in place after proper leveling and aligning.

2.5 Scum Skimming

A. General

1. The clarifier manufacturer shall furnish two (2) skimming device(s) as part of each clarifier mechanism. Each skimming mechanism shall be arranged to sweep the surface of the sedimentation compartment, automatically removing scum and floating material to a scum box at the periphery of the tank.

B. Skimmer Construction

1. The rotating scum skimmer shall include a horizontal steel plate skimmer blade supported by vertical steel members extending up from the rake arms. The blade shall extend from a point 6 inches away from the influent feedwell to the hinged scum skimmer assembly at the tank periphery.

C. Scum Skimmer Assembly

1. A hinged scum skimmer assembly shall be mounted on the outer end of the skimmer blade. The hinged scum skimmer assembly shall be designed to form a pocket for trapping the scum. The hinged arrangement shall insure continual contact and proper alignment between wiper blade, scum baffle, and ramp as the blade travels up the scum box ramp. The wiper blade shall have a wearing strip on its outer end which contacts the scum baffle and a neoprene strip on its lower and inner edge. The neoprene wipers shall be a minimum 1/4 inch thickness. The scum is trapped as the wiper blade meets the ramp and is raised up the ramp to be deposited into the scum trough for disposal.

D. Scum Box

1. The scum box shall be of the size specified, supported from the tank wall and connected to the scum withdrawal piping. It shall be made of 1/4 inch thick welded steel plate. The box shall have a scum trough, vertical steel sides, and a sloping approach ramp that extends from 1-1/2 inches above water level to 5-1/2 inches below. A similar ramp shall be provided at the opposite end to allow the skimmer blade to lower back to the operating position. A flexible connector shall be provided for connection to the contractor supplied scum withdrawal piping in the tank wall.

E. Scum Flushing Valve

1. A valve shall be attached to the scum box which automatically opens and allows clarified liquid into the scum box to flush out solids. The valve shall actuate at every pass of the scum skimmer over the scum box, allowing sufficient delay after deposit of the solids before flushing begins. Delay and flush duration shall be adjustable. The opening and closing of the scum flushing valve shall be one smooth continuous movement. The valve shall provide 2 to 5 gallons of flush water per each pass of the skimmer assembly.

2.6 clarifier Accessories

A. Launder

1. A rectangular effluent launder shall be provided around the perimeter of the tank. The launder shall be formed as part of the concrete wall. A drop-out box shall be provided in the bottom of the launder at one point for collection and discharge of the clarified effluent.

B. Scum Baffle

- a. The baffle shall consist of 0.25 inch thick x 12 inches deep FRP sections. In the area of the scum box the scum baffle shall extend to 12 inches starting approximately 6 feet before and ending 2 feet after the scum box. The baffle sections shall be curved and fastened to the launder wall with adjustable FRP support brackets, stainless steel fasteners, and anchor bolts.

C. Weir

1. An adjustable weir shall be provided around the periphery of the tank at the water surface for removal of clarified effluent.
 - a. The weir shall consist of 0.25 inch thick x 9 inches deep fiberglass sections with 2.5 inch deep 90 degree v-notches at 6 inch intervals. The weir sections shall be curved and fastened to the

launder wall with special large washers, anchor bolts, and hex nuts to allow vertical adjustment.

2.7 Electrical

- A. The clarifier manufacturer shall provide a NEMA 4X, 304 stainless steel control panel to control and protect the clarifier mechanism. The control panel shall be wired to accept a 480-volt power feed, a control power transformer shall be provided to power all internal controls. The control panel shall be built in a UL508A/698 certified panel shop.
- B. The control panel shall be provided with the following devices mounted on the exterior of the enclosure:
 - 1. Top mounted amber strobing alarm light, Federal Signal LP3P.
 - 2. Top mounted alarm horn, Federal Signal 350B.
 - 3. Door mounted rotary disconnect handle, manufactured by Square D.
 - 4. Door mounted red rake running light, Idec 30.5mm.
 - 5. Door mounted amber torque cutout light, Idec 30.5mm.
 - 6. Door mounted amber motor overload light, Idec 30.5mm.
 - 7. Door mounted rake hand/off/auto 3 position selector switch, 30.5mm.
 - 8. Door mounted red alarm silence pushbutton, Idec 30.5mm.
 - 9. Door mounted black reset pushbutton, Idec 30.5mm.
- C. The control panel shall be provided with the following devices mounted on the interior of the enclosure:
 - 1. Molded case main breaker, Square D HDL series.
 - 2. 250 VA control power transformer, Acme.
 - 3. NEMA size 1, FVNR motor starter, Square D TeSys N series.
 - 4. Control relays, Idec series RH.
 - 5. Time delay relay, Idec series RTE.
 - 6. Terminal blocks, Phoenix Contact series UT4.
- D. The following signals shall be made available as dry contacts for remote monitoring by the plant SCADA:
 - 1. Rake drive running.
 - 2. Rake drive overload.
 - 3. Rake drive in auto.
 - 4. High torque alarm.
 - 5. Cutout torque alarm.
- E. Workmanship shall be of the highest quality with all wiring on the enclosure back panel routed through plastic wire way and all door routed wire securely fastened with adhesive feet and nylon ty-wraps. Wires that cross enclosure hinges shall be protected with nylon spiral wrap and must have adequate slack to allow the door to open 180 degrees. All components on the back panel shall be mounted using #14 machine screws. Rivets and self-tapping screws are not acceptable.

- F. The control panel shall be mounted by the electrical contractor on the platform handrail adjacent to the clarifier drive unit. All conduit and wiring between the clarifier control panel, drive torque monitor, power distribution system and the SCADA system shall be provided and installed by the electrical contractor.

2.8 Anchorage and Fasteners

A. Anchor Bolts

1. All anchor bolts shall be a minimum of 1/2 inch diameter and made of type 304 stainless steel. The equipment supplier shall furnish all anchor bolts, nuts, and washers required for the equipment.

B. Fasteners

1. All structural fasteners shall be a minimum of 1/2 inch diameter and made of type 304 stainless steel. The equipment supplier shall furnish all fasteners required for the assembly of the equipment.

Part 3 Installation

3.1 General

- A. The equipment shall be installed properly to provide a complete working system. Installation shall follow the supplier's recommendations.

3.2 Manuals

- A. The equipment supplier shall furnish an electronic copy of the operation and maintenance manual, which will be retained at the installation site to assist plant operators. The manual shall include the supplier's erection and assembly recommendations and a complete list of recommended spare parts.

3.3 Field Service

- A. The equipment supplier shall provide the service of a qualified representative for one trip and one day per mechanism to inspect the mechanism installation, assist in start-up, and instruct plant personnel in the proper operation and maintenance of the mechanism.

3.4 Field Testing

A. Torque Tests

1. The entire sludge collector mechanism shall be statically load tested by loading the rake arm with 150 percent of the specified design running torque. The test shall verify the torque overload control device settings for alarm and motor cutout. One truss arm shall be anchored and the load measured to demonstrate the rake arms', cage's, and drive unit's ability to withstand the specified torque. Sketches and calculations shall be submitted illustrating how the torque will be applied prior to the test taking place.

B. Operation Tests

1. The contractor shall operate the mechanism in a dry tank for a minimum of 4 continuous hours before flow is allowed to enter the system. There shall be no binding, jerky, or unusual motion exhibited during this run in period. Motor amperage shall be checked at least hourly for any unusual or higher than normal figures. After the unit has successfully passed this initial test, flow shall be introduced into the tank and the same 4 hour observation test run. If the unit should fail under any of these conditions, the test shall be halted and the problem corrected. If, after several attempts, the unit does not successfully pass the field test, the faulty portion of the equipment shall be repaired or replaced and the test re-run.

– End of Section –

Section ____ - Circular Spiral Scraper Clarifier

Part 1 General

1.1 Scope

- A. There shall be furnished and installed equipment for four (4) circular spiral scraper cage drive clarifiers. The equipment shall include a walkway bridge, drive platform, center column, center cage, dual gate EDI, feedwell, full radius rake arms, sludge withdrawal ring, skimmer blade & supports, hinged skimmer assembly, scum box & supports, scum flushing valve, effluent weir, scum baffle & supports, electrical control panel, drive unit, anchor bolts & fasteners, rake arm with spiral blades, and all other appurtenances required or shown on the drawings.

1.2 Definitions

Continuous Running Torque: The 100 percent AGMA torque to be continuously applied 24 hours a day to the drive system.

Momentary Peak Torque: The maximum torque rating of the drive mechanism components. Momentary peak torque shall be 2.0 times the continuous running torque.

Average Flow: The average flow per day for the whole year.

Design Flow: The average of the highest single day flows per month for the whole year.

Maximum Flow: Average flow per day for the month with the highest flows.

Peak Flow: The highest single hourly flowrate.

Return Activated Sludge (RAS): The settled solids removed from the bottom of clarifier and recycled to the biological process upstream of the clarifier.

1.3 Supplier

- A. The clarifier equipment specified in this section shall be WesTech Model COPC1G. Substitute equipment must be modified as necessary to provide the specified features and to meet the specified operating conditions.

1.4 Design Criteria

Design Criteria (per clarifier)	Unit	Value
Influent Flow Rates		
Average Flow	MGD	5.3125
Design Flow	MGD	7.5
Maximum Flow	MGD	10
Peak Flow	MGD	14.165
Recycle Rate		
Minimum RAS	MGD	1
Design RAS	MGD	2.54
Max RAS	MGD	5.3125

MLSS	mg/l	3000
SVI	ml/g	130
Tank Diameter	ft	110
Side Water Depth	ft	15
Freeboard	in	36
Bottom Slope	in/ft	0.125
Influent Column Outside Diameter	in	48
EDI		
EDI Diameter	ft	11
EDI Depth	ft	4
Feedwell		
Feedwell Diameter	ft	28
Feedwell Depth	ft	6
Scum Box Width	ft	5
Collector Tip Speed	fpm	14.1
Motor HP	hp	1
Torque		
Continuous Torque	ft-lbs	45,500
Momentary Peak Torque	ft-lbs	91,000
Ball Race Diameter Min	in	47.25
Drive Overturning Moment	ft-lbs	465,781

1.5 Warranty

- A. A written supplier's warranty shall be provided for the equipment specified in this section. The warranty shall be for a minimum period of one (1) year from start-up or 18 months from time of equipment shipment, whichever comes first. Such warranty shall cover all defects or failures of materials or workmanship which occur as the result of normal operation and service except for normal wear parts (i.e. squeegees, skimmer wipers, etc.).

1.6 Submittals

- A. Two copies of all materials required to establish compliance with these specifications shall be submitted for review. Submittals shall include at least the following:
1. General arrangement drawings showing all important details and materials of construction, dimensions, loads on supporting structures, and anchor bolt locations.
 2. Descriptive literature, bulletins, and/or catalogs of the equipment.

3. Complete data on motors and speed reducers.
4. Wiring diagrams and electrical schematics for all control equipment to be furnished.
5. Calculations documenting the AGMA rating of the drive unit and life of the main bearing; prepared and signed by a registered professional engineer.
6. Complete descriptive information and electrical schematic for the torque overload device.
7. Complete sludge transport calculations substantiating the rake blade design, rake tip speed, and floor slope.
8. Complete process calculations substantiating the sizing of the center column and ports, EDI and outlets, and outer feedwell. These calculations shall be based on parameters from the manufacturers operating experience.
9. Calculations showing withdrawal rates and headlosses of the sludge withdrawal ring.

1.7 Experience

- A. The equipment supplier shall have at least 15 years of experience in the design, application, and supply of circular clarifiers in water or wastewater treatment plants, and shall submit a list of not less than 25 operating installations of clarifiers with spiral rake blades and EDI as evidence of meeting the experience requirement.
- B. To show evidence of being able to provide the quality of equipment and services described in this specification, the equipment supplier shall submit their ANAB-accredited ISO 9001 quality system certification. AIAO-BAR accredited systems are not a recognized equivalent and are therefore specifically prohibited. The quality procedures shall provide for a means of qualifying all sub-vendors and shall specify that the fabrication facility is a critical vendor and shall require inspection. The quality system shall be audited on-site by a third-party independent registrar at least annually. Certification shall remain in effect throughout the project start-up. Mechanism shall be manufactured according to requirements of Machinery Directive 98/37/EC.

1.8 Shop Assembly and Inspection

- A. The equipment specified herein shall be factory assembled as far as practical to verify that all mating parts can be field assembled. All mating parts shall be trial fit and match-marked. The manufacturer shall submit certification of shop trial assembly and photographs of assembly before shipment. The customer and installing contractor shall be given the opportunity to witness the shop assembly.
- B. Shop inspection shall be performed by a qualified inspector and certified by the manufacturer. The inspection shall be documented, and all deficiencies noted, corrected, re-inspected and final completion formally authorized. Final shipment authorization shall be by the manufacturer to ensure completion of all fabrication, assembly, and inspection requirements. Inspection records and evidence of inspector qualification shall be submitted to the owner upon request.

Part 2 Products

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1. The drive unit shall be designed and manufactured by the clarifier equipment supplier to ensure unit responsibility. The drive unit shall be designed for the torque values previously listed. It shall turn the mechanism at the design collector tip speed. The drive main bearing shall be designed for the total rotating mechanism loads with a minimum L-10 life of 50 years or 438,000 hours. The drive unit shall be capable of producing and withstanding the previously listed momentary peak torque while starting. The drive main gear shall be designed to a minimum AGMA 6 rating when rated in accordance with the latest AGMA standard. Gear teeth shall be designed for proper load distribution and sharing. Stub tooth design and surface hardening of the main gear shall not be allowed. The main bearing shall be capable of withstanding the listed overturning moment without the aid of any underwater guides or bearings to ensure correct tooth contact for AGMA rating of the main gear.
 - a. All spur gearing shall be designed to the latest AGMA spur gear standard for strength and surface durability, based on a life of 175,000 hours. The design running torque rating of the drive gearing shall be based on the smaller of the strength and durability values determined from the above AGMA standard. To ensure safety and ease of maintenance, all components of the drive shall be direct coupled.
 - b. No overhung pinions shall be allowed on the speed reducing unit. The lower pinion bearing shall not be located below the turntable base.
 - c. Any and all welding on the drive unit shall be done using E70XX weld rod.

B. Physical Characteristics

1. The drive unit shall consist of a solid internal main spur gear, bearing turntable, pinion, secondary speed reducer, support base, and drive unit bearing. The drive shall be mounted on the center column and support the entire rotating load of the mechanism. The main internal gear shall be forged of alloy hardened steel. The pinion shall be heat treated alloy steel. Support base for the drive shall be of welded steel to assure rigidity. Dust shields shall be provided. The drive bearing shall include a forged steel precision gear/bearing set, with fully contoured raceways hardened to a minimum 58-62 Rc and protected by a neoprene seal. The drive shall be designed so that the balls and nylon spacers can be replaced without removing the access walkway. The main gear to pinion gear mesh shall be oil lubricated. An oil sight glass, fill pipe, and drain shall be provided for the reservoir. Lubrication fittings shall be readily accessible.

C. Overload Protection

1. An overload device shall be provided in a stainless steel, weatherproof enclosure. The device shall be actuated by torque generated from the main drive, which shall operate two independently adjustable switches (the alarm switch at 100 percent of design running torque and the motor cutout switch at 120 percent of design running torque). Devices that require the worm to float and measure the thrust of the worm gear shall not be acceptable. These two switches shall be factory adjusted to accurately calibrate the alarm torque value and the overload position. A visual torque indicator shall be provided and oriented so that it may be read from the walkway. It shall be calibrated from 0 to 160 percent of design running torque.

D. Turntable

1. The turntable base shall have an annular bearing raceway upon which the rotating assembly rests. It shall have a maximum allowable deflection in accordance with the bearing specifications. The allowable modulus of elasticity shall be a minimum of 29×10^6 psi. The center cage shall be fastened to and supported from the gear casing. Ball bearings shall be of high carbon chrome alloy 52100 steel running in fully contoured races, as part of a precision gear/bearing set. The balls shall be grease lubricated and protected by elastomer seals. Felt seals that allow the entrance of moisture from outside the drive (i.e. rain water, condensate, etc.) will not be allowed.

E. Speed Reducing Unit

1. The speed reducing unit shall consist of cycloidal, helical, or planetary speed reducers directly connected to a motor without the use of chains or v-belts, and shall be keyed to the pinion.
 - a. The main ring gear of cycloidal drives shall be made of high carbon chromium bearing steel and be fixed to the drive casing. An eccentric bearing on the high speed shaft shall roll cycloidal discs of the same material around the internal circumference of this main ring gear. The lobes of the cycloid disc shall engage successively with pins in the fixed ring gear. The movement of the cycloid discs shall be transmitted then by pins to the low speed shaft. Speed reducer efficiency shall be a minimum of 90% per reduction stage.
 - b. Speed reducer helical or planetary gearing shall be manufactured to AGMA standards and shall provide at least 95% power transmission efficiency per stage. The speed reducer shall have a minimum service factor of 1.25 based on the output torque rating of the drive.
 - c. The reducers shall be fitted with radial and thrust bearings of proper size for all mechanism loads and be grease lubricated. As a safety feature, the speed reducer shall be back drivable to release any stored energy as the result of an over torque condition.

F. Motor

1. The motor shall be a squirrel cage, induction type, TEFC, ball bearing heavy duty unit of ample power for starting and operating the mechanism without overload, with a minimum service factor of 1.15.
 - a. Power supply to the equipment shall be 240/480 volt, 60 hertz, 3 phase.

2.3 Walkway and Platform

A. Walkway

1. One (1) 36 inch wide walkway and platform with handrails shall be supported by the drive unit and influent column at the center and the tank wall at its outer end, and shall be designed to safely withstand a live load of 50 pounds per square foot. Deflection shall not exceed $L/360$ when both the dead load and live loads are applied. It shall consist of two trusses or beams with 1-1/4 inch aluminum I-bar grating between the trusses or beams. The walkway shall be diagonally braced against lateral movement, and provided with handrails 42 inches high, of double-row 1-1/2 inch diameter horizontal aluminum pipe, and 4 inch high kickplates on both sides. Walkway trusses may serve as the handrail if the top chord is 3 feet-6 inches above the walking surface.
 - a. Stainless steel bearing plates, UHMW-PE slide plates, and anchor bolts for the wall support shall be provided by the equipment supplier and installed by the contractor. Bearing plate dimensions and anchor bolt diameter, length, quantity, and arrangement shall be per the equipment supplier. The contractor shall block out or otherwise modify the tank or support structure to accommodate walkway and supports, if required.

B. Center Drive Platform

1. A center drive platform shall be provided which allows 24 inches of clearance outside the center drive components. It shall consist of 0.25 inch aluminum checkered plate with necessary stiffeners and supports, resting on the drive unit and center column, and provided with connections to the walkway. The entire platform shall be surrounded by handrails 42 inches high of double-row 1-1/2 inch diameter horizontal aluminum pipe with 4 inch high kickplates.

2.4 Influent and Sludge Removal

A. Stationary Center Influent Column

1. A stationary cylindrical steel influent column of 1/4 inch minimum wall thickness shall be provided. One end shall have a support flange for bolting to the tank floor over the influent line,

with a similar flange at the top for supporting the drive unit and walkway. The structure and anchor bolts shall provide adequate support for the entire mechanism dead load plus live loads and torque with an adequate factor of safety to eliminate excessive deflection or vibration. Suitable openings shall be provided in the upper portion of the column just below the sludge collection box to allow unrestricted passage of the flow into the energy dissipating inlet.

2. Prior to the center column being grouted in place, the drive unit shall be installed, positioned, and leveled.

B. Dual Gate Energy Dissipating Inlet

1. A dual gate rotating circular energy dissipating inlet with bottom shall be supported by the cage and be designed to diffuse the liquid into the feedwell in an impinged flow direction without excessive disturbance or formation of vertical velocity currents. The DG-EDI shall be designed to positively prevent sludge from depositing within the DG-EDI and shall include bottom drain holes.
 - a. The diameter, depth, and detention time of the DG-EDI shall be included in the submittal with the design calculations and shall show proper process application as evidenced by the required successful operating installations.
 - b. The rotating DG-EDI shall be designed with a full bottom extending to within 1 inch of the center column. It shall include an upper rim angle for stiffness. Multiple, discharge ports shall be provided to induce impinged flow. The gates shall have a fixed bottom to prevent vertical currents as the flow exits the DG-EDI.
 - c. The DG-EDI shall be made of not less than 3/16 inch thick steel plate with necessary stiffening angles.
 - d. EDI Test Data – The submittal shall include data from side-by-side tests on identical full-scale operating clarifiers at least ____ ft. in diameter, with identical feed and underflow rates. The data shall show that installation of an EDI equivalent in design to that proposed for this project produced a decrease in effluent suspended solids of at least 25 percent.

C. Feedwell

1. The flocculating feedwell shall be located outside of the EDI to diffuse the liquid into the tank without disturbance or formation of velocity currents. Baffled openings shall be provided near the water surface to allow scum to exit the feedwell.
 - a. The supports for the feedwell shall be located either above the liquid extending from the cage or bridge, or on the rake arms. Submerged supports from the rake arms shall be designed to minimize horizontal flow disruption.
 - b. No feedwell support or feedwell spliced connection shall be contained within the annular space formed between the feedwell and EDI. The depth of the feedwell shall be such as to provide proper detention time and an exit velocity at maximum flow that will not scour the settled sludge. The diameter, depth, detention time, and exit velocities shall match the process application calculations as evidenced by the required successful operating installations.
 - c. The feedwell shall be made of not less than 3/16 inch thick steel plate with necessary stiffening angles.

D. Center Cage

1. The center cage shall be of steel box truss construction. It shall be provided with connections for the two sludge rake arms and feedwell supports if required. The cage top shall be bolted to the main gear which shall rotate the cage with the attached arms and feedwell. The cage and each arm shall be designed to withstand 150 percent of the design running torque of the drive without

over stressing the members. Loading to develop the torque shall be considered as uniform loads applied to each arm individually.

E. Spiral Blade Rake Arms

1. The mechanism shall include two long sludge rake arms of steel truss construction with spiral-shaped steel scraper blades and adjustable stainless steel squeegees. Squeegees shall be fastened to the rake blades with stainless steel fasteners.
 - a. Scraper blades shall be designed for sufficient sludge transport capacity to handle the design solids loading rate, with the depth of the blade varying from a minimum at the tank periphery to a maximum at the tank center.
 - b. Blades shall properly convey settled sludge to the sludge withdrawal ring. Blades which move sludge away from the center column to the orifices of the withdrawal ring shall also be provided. The arms shall be adjustable at the cage to assure an even grout thickness over the tank bottom.
 - c. The rake speed shall be sufficient to transport the necessary volume of sludge to the sludge outlet, but shall not re-suspend settled sludge.

F. Sludge Withdrawal Ring

1. The tank floor slope and sludge withdrawal ring design shall be verified by the clarifier equipment manufacturer. The sludge withdrawal ring shall be located and sized to prevent short-circuiting of the influent to the underflow. It shall be placed at a point of high sludge concentration. It shall be rectangular in cross section as shown on the drawings and shall remove sludge uniformly around the center of the tank.
2. The sludge withdrawal ring shall surround the center column and shall include appropriate anchorage to the tank floor. The cross section shall be tapered along its length to assure a constant sludge velocity through the ring. Equally spaced orifices shall be cut into the outer ring wall. The orifices shall be sized to avoid plugging. The outer ring wall shall be at a constant radius. The annulus between the column and the ring shall be filled with grout.
3. The submittal shall include data from side-by-side tests on identical full-scale operating clarifiers at least 80 feet in diameter, with identical feed and underflow rates. The data shall show that installation of a sludge collection ring equivalent in design to that proposed for this project produced an average sludge blanket depth approximately one foot lower than a clarifier with only a conventional central sludge hopper.

2.5 Scum Skimming

A. General

1. The clarifier manufacturer shall furnish two (2) skimming device(s) as part of each clarifier mechanism. Each skimming mechanism shall be arranged to sweep the surface of the sedimentation compartment, automatically removing scum and floating material to a scum box at the periphery of the tank.

B. Skimmer Construction

1. The rotating scum skimmer shall include a horizontal steel plate skimmer blade supported by vertical steel members extending up from the rake arms. The blade shall extend from a point 6 inches away from the influent feedwell to the hinged scum skimmer assembly at the tank periphery.

C. Scum Skimmer Assembly

1. A hinged scum skimmer assembly shall be mounted on the outer end of the skimmer blade. The hinged scum skimmer assembly shall be designed to form a pocket for trapping the scum. The hinged arrangement shall insure continual contact and proper alignment between wiper blade, scum baffle, and ramp as the blade travels up the scum box ramp. The wiper blade shall have a wearing strip on its outer end which contacts the scum baffle and a neoprene strip on its lower and inner edge. The neoprene wipers shall be a minimum 1/4 inch thickness. The scum is trapped as the wiper blade meets the ramp and is raised up the ramp to be deposited into the scum trough for disposal.

D. Scum Box

1. The scum box shall be of the size specified, supported from the tank wall and connected to the scum withdrawal piping. It shall be made of 1/4 inch thick welded steel plate. The box shall have a scum trough, vertical steel sides, and a sloping approach ramp that extends from 1-1/2 inches above water level to 5-1/2 inches below. A similar ramp shall be provided at the opposite end to allow the skimmer blade to lower back to the operating position. A flexible connector shall be provided for connection to the contractor supplied scum withdrawal piping in the tank wall.

E. Scum Flushing Valve

1. A valve shall be attached to the scum box which automatically opens and allows clarified liquid into the scum box to flush out solids. The valve shall actuate at every pass of the scum skimmer over the scum box, allowing sufficient delay after deposit of the solids before flushing begins. Delay and flush duration shall be adjustable. The opening and closing of the scum flushing valve shall be one smooth continuous movement. The valve shall provide 2 to 5 gallons of flush water per each pass of the skimmer assembly.

2.6 clarifier Accessories

A. Launder

1. A rectangular effluent launder shall be provided around the perimeter of the tank. The launder shall be formed as part of the concrete wall. A drop-out box shall be provided in the bottom of the launder at one point for collection and discharge of the clarified effluent.

B. Scum Baffle

- a. The baffle shall consist of 0.25 inch thick x 12 inches deep FRP sections. In the area of the scum box the scum baffle shall extend to 12 inches starting approximately 6 feet before and ending 2 feet after the scum box. The baffle sections shall be curved and fastened to the launder wall with adjustable FRP support brackets, stainless steel fasteners, and anchor bolts.

C. Weir

1. An adjustable weir shall be provided around the periphery of the tank at the water surface for removal of clarified effluent.
 - a. The weir shall consist of 0.25 inch thick x 9 inches deep fiberglass sections with 2.5 inch deep 90 degree v-notches at 6 inch intervals. The weir sections shall be curved and fastened to the launder wall with special large washers, anchor bolts, and hex nuts to allow vertical adjustment.

2.7 Electrical

- A. The clarifier manufacturer shall provide a NEMA 4X, 304 stainless steel control panel to control and protect the clarifier mechanism. The control panel shall be wired to accept a 480-volt power feed, a control power transformer shall be provided to power all internal controls. The control panel shall be built in a UL508A/698 certified panel shop.

- B. The control panel shall be provided with the following devices mounted on the exterior of the enclosure:
1. Top mounted amber strobing alarm light, Federal Signal LP3P.
 2. Top mounted alarm horn, Federal Signal 350B.
 3. Door mounted rotary disconnect handle, manufactured by Square D.
 4. Door mounted red rake running light, Idec 30.5mm.
 5. Door mounted amber torque cutout light, Idec 30.5mm.
 6. Door mounted amber motor overload light, Idec 30.5mm.
 7. Door mounted rake hand/off/auto 3 position selector switch, 30.5mm.
 8. Door mounted red alarm silence pushbutton, Idec 30.5mm.
 9. Door mounted black reset pushbutton, Idec 30.5mm.
- C. The control panel shall be provided with the following devices mounted on the interior of the enclosure:
1. Molded case main breaker, Square D HDL series.
 2. 250 VA control power transformer, Acme.
 3. NEMA size 1, FVNR motor starter, Square D TeSys N series.
 4. Control relays, Idec series RH.
 5. Time delay relay, Idec series RTE.
 6. Terminal blocks, Phoenix Contact series UT4.
- D. The following signals shall be made available as dry contacts for remote monitoring by the plant SCADA:
1. Rake drive running.
 2. Rake drive overload.
 3. Rake drive in auto.
 4. High torque alarm.
 5. Cutout torque alarm.
- E. Workmanship shall be of the highest quality with all wiring on the enclosure back panel routed through plastic wire way and all door routed wire securely fastened with adhesive feet and nylon ty-wraps. Wires that cross enclosure hinges shall be protected with nylon spiral wrap and must have adequate slack to allow the door to open 180 degrees. All components on the back panel shall be mounted using #14 machine screws. Rivets and self-tapping screws are not acceptable.
- F. The control panel shall be mounted by the electrical contractor on the platform handrail adjacent to the clarifier drive unit. All conduit and wiring between the clarifier control panel, drive torque monitor, power distribution system and the SCADA system shall be provided and installed by the electrical contractor.

2.8 Anchorage and Fasteners

- A. Anchor Bolts

1. All anchor bolts shall be a minimum of 1/2 inch diameter and made of type 304 stainless steel. The equipment supplier shall furnish all anchor bolts, nuts, and washers required for the equipment.

B. Fasteners

1. All structural fasteners shall be a minimum of 1/2 inch diameter and made of type 304 stainless steel. The equipment supplier shall furnish all fasteners required for the assembly of the equipment.

Part 3 Installation

3.1 General

- A. The equipment shall be installed properly to provide a complete working system. Installation shall follow the supplier's recommendations.

3.2 Manuals

- A. The equipment supplier shall furnish an electronic copy of the operation and maintenance manual, which will be retained at the installation site to assist plant operators. The manual shall include the supplier's erection and assembly recommendations and a complete list of recommended spare parts.

3.3 Field Service

- A. The equipment supplier shall provide the service of a qualified representative for one trip and one day per mechanism to inspect the mechanism installation, assist in start-up, and instruct plant personnel in the proper operation and maintenance of the mechanism.

3.4 Field Testing

A. Torque Tests

1. The entire sludge collector mechanism shall be statically load tested by loading the rake arm with 150 percent of the specified design running torque. The test shall verify the torque overload control device settings for alarm and motor cutout. One truss arm shall be anchored and the load measured to demonstrate the rake arms', cage's, and drive unit's ability to withstand the specified torque. Sketches and calculations shall be submitted illustrating how the torque will be applied prior to the test taking place.

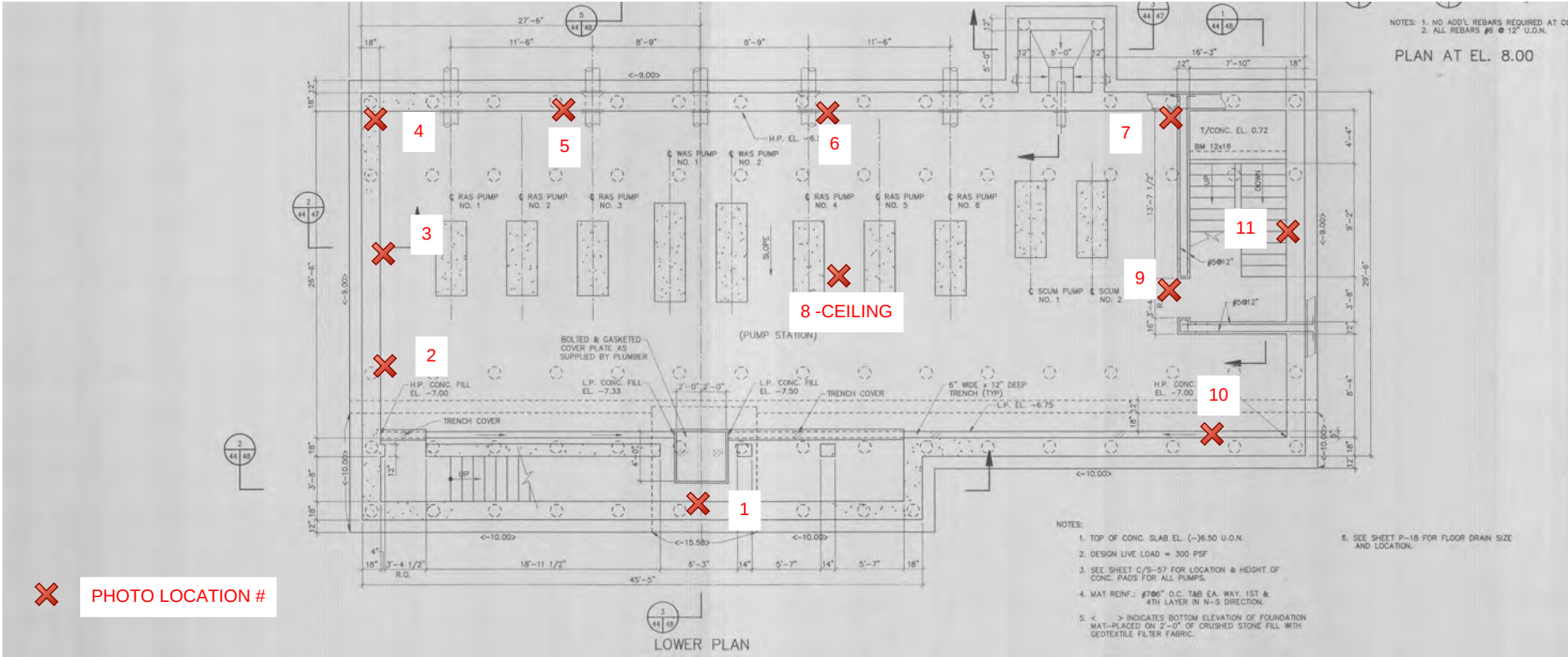
B. Operation Tests

1. The contractor shall operate the mechanism in a dry tank for a minimum of 4 continuous hours before flow is allowed to enter the system. There shall be no binding, jerky, or unusual motion exhibited during this run in period. Motor amperage shall be checked at least hourly for any unusual or higher than normal figures. After the unit has successfully passed this initial test, flow shall be introduced into the tank and the same 4 hour observation test run. If the unit should fail under any of these conditions, the test shall be halted and the problem corrected. If, after several attempts, the unit does not successfully pass the field test, the faulty portion of the equipment shall be repaired or replaced and the test re-run.

- End of Section -

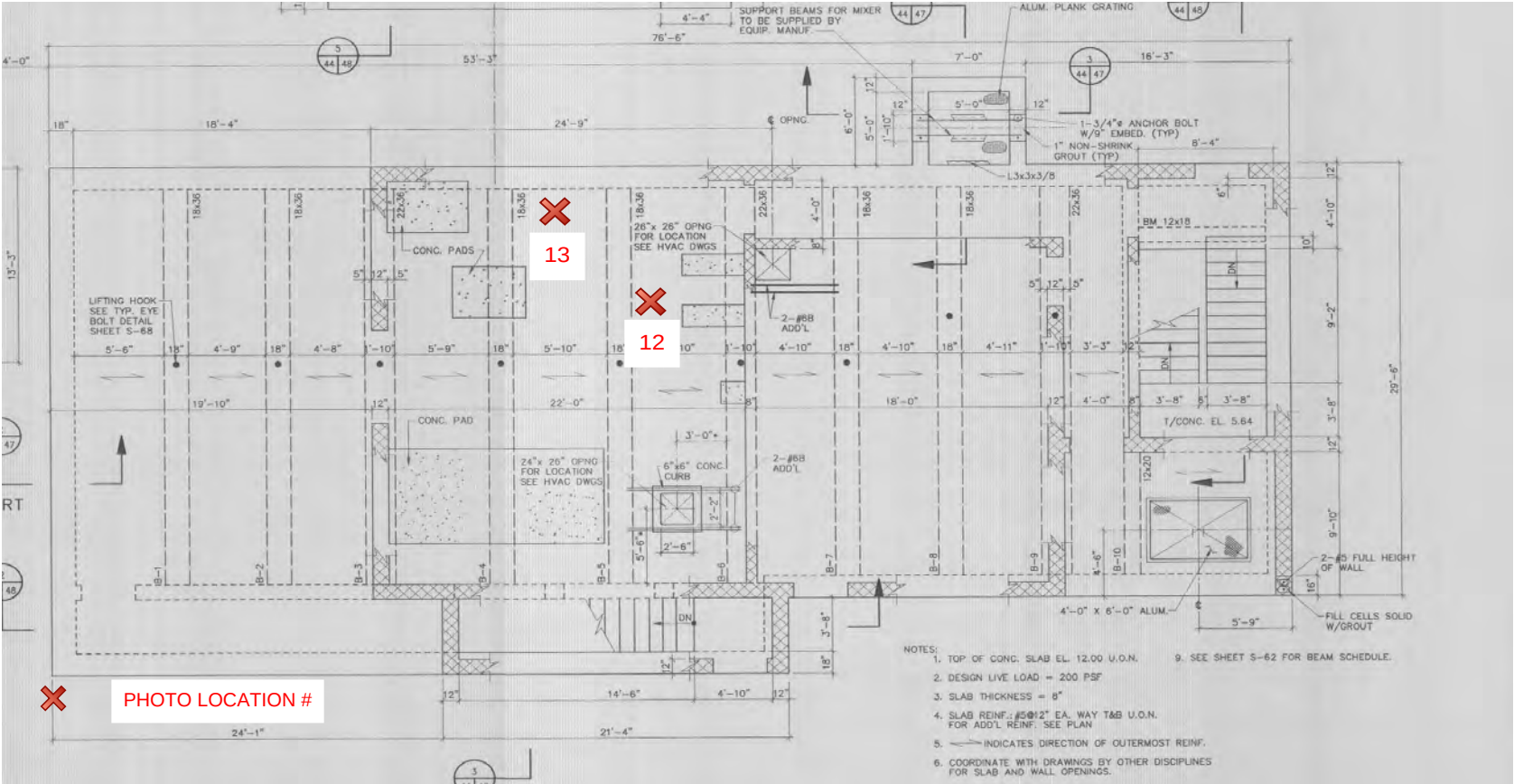
Appendix FST-D

Return Sludge Pump Station Structural Conditions Assessment Photolog



LOWER FLOOR PLAN

- NOTES:
- 1. LOCATIONS INDICATED ON THESE PLANS ARE APPROXIMATE.
 - 2. REFER TO PHOTOS FOR MORE INFORMATION.



FIRST FLOOR PLAN



#1 -Efflorescence on Wall



#2 -Efflorescence on Wall



#3 -Efflorescence on Wall



#4 -Efflorescence on Wall

REF:



#5 -Efflorescence on Wall



#6 -Efflorescence on Wall



#7 -Efflorescence on Wall

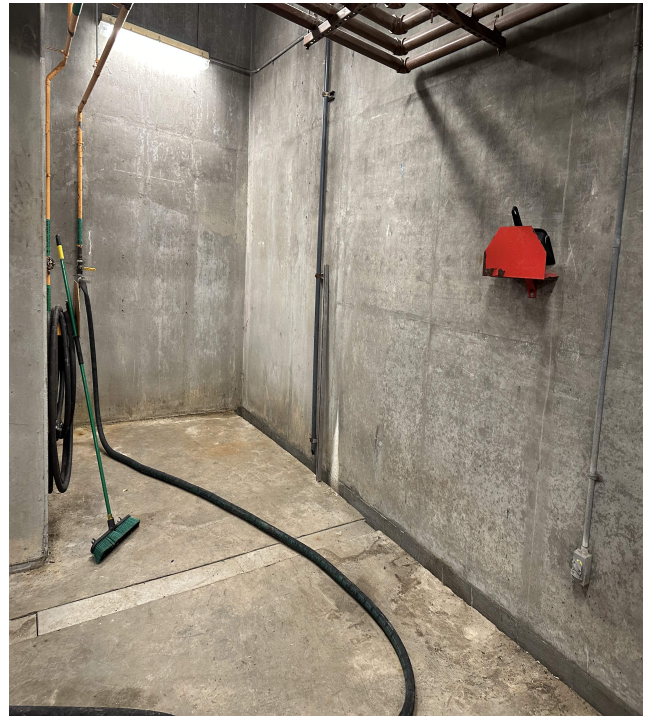


#8 -Ceiling

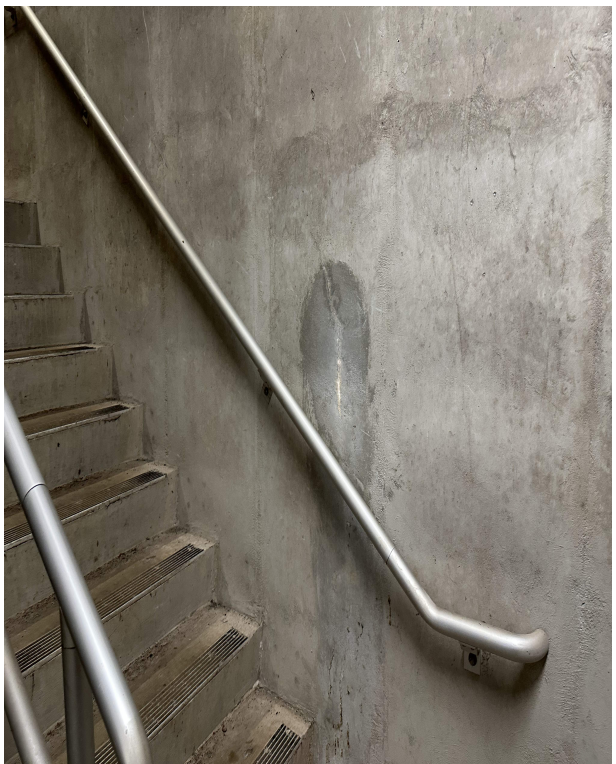
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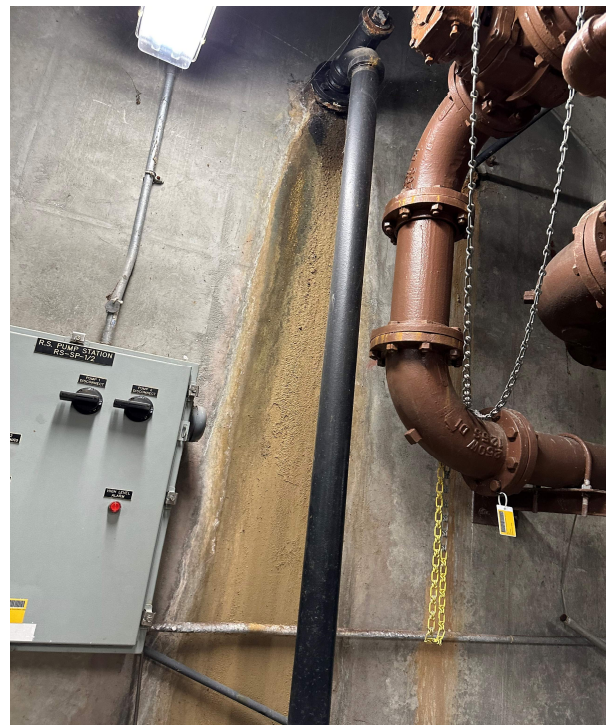
#9 -Efflorescence on Wall



#10 -Efflorescence on Wall



#11 -Efflorescence on Wall



#12 -Damage at pipe penetration

REF:



#13 -Cracked Topping on First Floor



#14 -damaged Topping on First Floor

REF:



#15 -External Fuel Tank Stairs - Damage



#16 -External Fuel Tank Stairs - Damage Close up

REF:

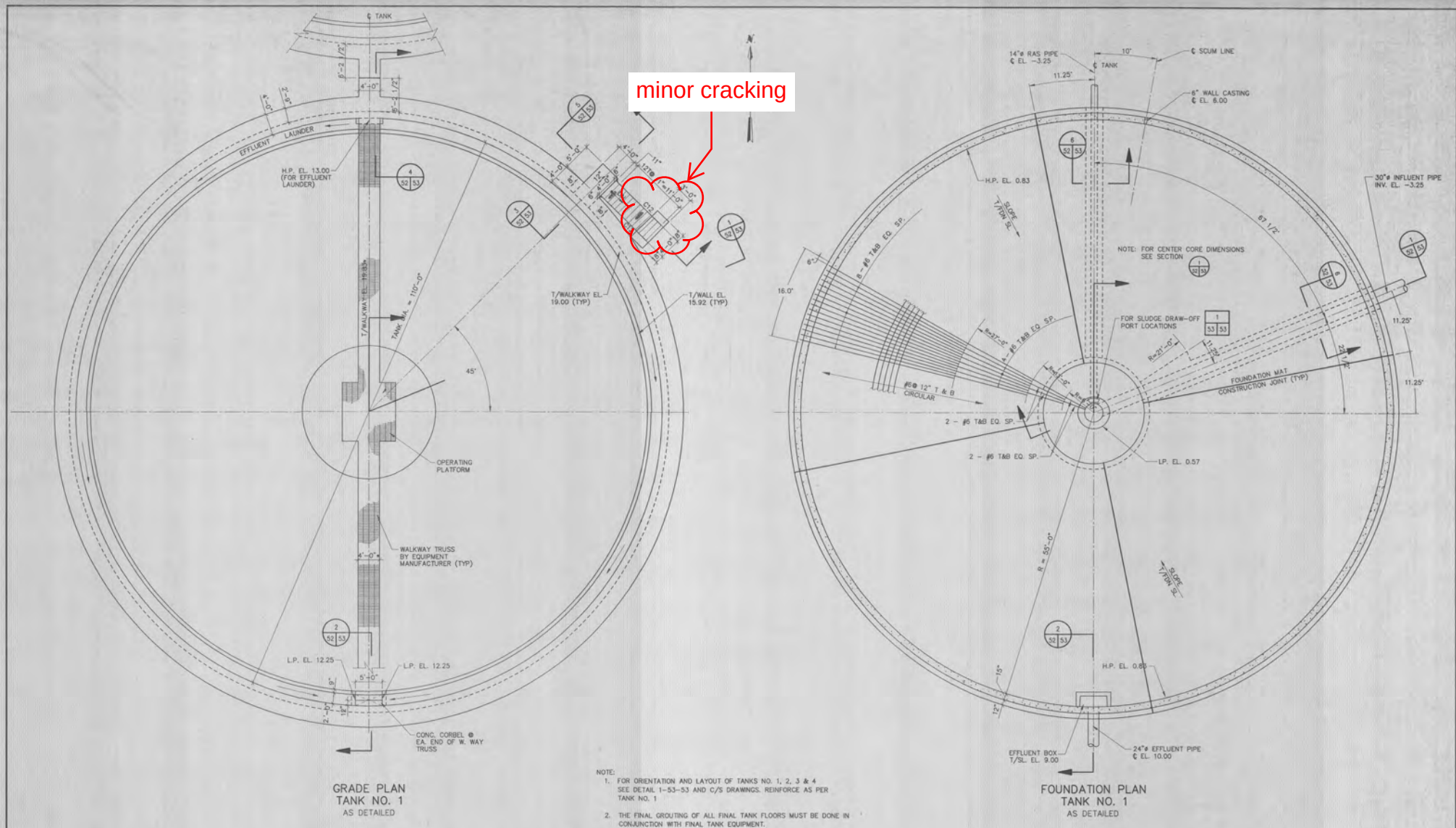
 ARCADIS Design & Consultancy for natural and built assets	CLIENT NORWALK WPCP- FACILITY PLAN	FACILITY RETURN SLUDGE PUMP STATION-EXTERNAL FUEL TANK- STAIRS	DATE
			SK —

Appendix FST-E

Plant SCADA Network Diagram

Appendix FST-F

Final Settling Tanks Structural Assessment Photolog



**MALCOLM
PIRNIE**



REVISIONS			
NO.	BY	DATE	REVISION

DESIGNED BY: A.H.
DRAWN BY: C.B.M.
CHECKED BY: H.L.C.
NOTED BY: HEC

DEPARTMENT OF PUBLIC WORKS
CITY OF NORWALK, CONNECTICUT
**WASTEWATER TREATMENT PLANT
EXPANSION AND UPGRADE**

**SECONDARY FACILITIES-FINAL SETTLING TANKS
TYPICAL PLANS**

SCALE: 1/8"=1'-0"

COPYRIGHT © 1995
MALCOLM PIRNIE, INC.
DATE: MARCH, 1996
SHEET 52 OF 70
CAD REF. NO. NOR589



Crack at Access Stair

REF:

DATE

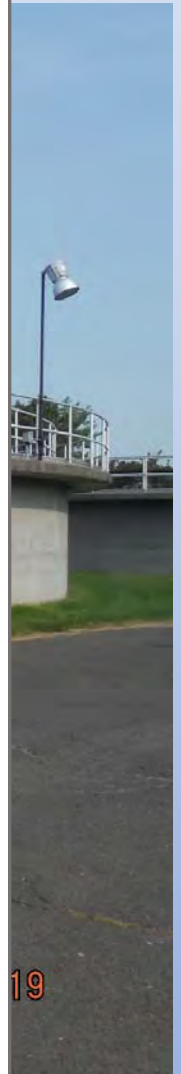
Appendix FST-G

KSE Final Settling Tank Inspection and Survey Report



Norwalk Settling Tanks Inspection

Norwalk WPCA Facility Plan Update



19

KSE

KS ENGINEERS, P.C.
2 Riverfront Plaza, 3rd Fl.
Newark, NJ 07102



E n g i n e e r s . S u r v e y o r s . C o n s t r u c t i o n M a n a g e r s

2 Riverfront Plaza, 3rd Floor, Newark, NJ 07102 . Tel: 973.623.2999 . Fax: 973.242.2955 . www.kseng.com

July 13, 2023

ARCADiS-US, Inc.
44 S. Broadway, Suite 1200
White Plains, NY 10601

**RE: Final Settling Tank Concrete Inspection Services required to support the Norwalk WPCA
Facility Plan Update
Settling Tank Inspections Report**

Attention: Mary Penny

Dear Ms. Penny:

We are pleased to provide the results of the Final Settling Tanks inspections performed for 4 tanks.

Presented herewith are the results of our inspection as well as a compilation of the survey.

Sincerely,
KS Engineers, P.C.

Jacob Perlmutter, PE
Project Manager

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Concrete Tank Inspection

KSE performed the inspection of the settling tanks located on 15 S Smith Street in Norwalk, CT, on May 19, 2023. The purpose of the inspection was to determine the overall condition of the structures and to identify any structure deficiencies via a visual inspection.

The tanks were numbered 1 through 4. See attached tank layout.

The water in Tank #4 had been drained up to a remaining of about 3' deep. The inside faces of Tank #4 were inspected from walking the top catwalk along the diameter of the tank, and also from walking the top catwalk along the perimeter of the tank. The concrete in the inside faces of Tank #4 is in overall good condition.

The inspection of the outside faces of all Tanks #1 through #4 was done by walking around the perimeter at ground level.

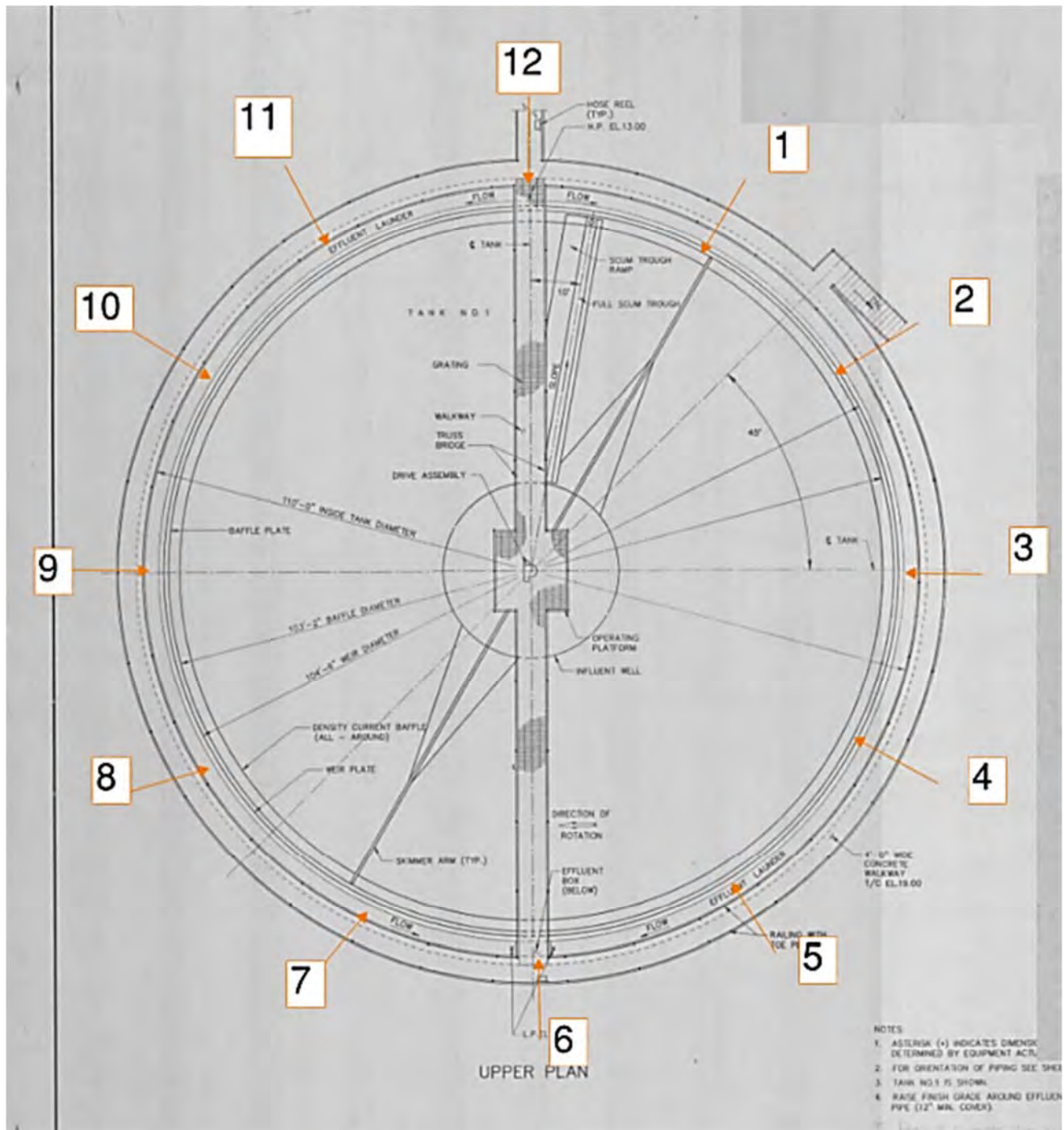
Some random areas on the outside faces and bottom of the top catwalk were sounded with a handheld hammer. No hollow areas were found.

The overall condition of the concrete on the outside faces for all tanks is good, except for some isolated longitudinal and vertical hairline cracks, some with efflorescence. The underside of the top concrete catwalk exhibits a typical pattern of hairline transverse cracks with efflorescence throughout the perimeter of the tanks.

We have attached general and typical condition photos for all tanks.



General Site Plan



Typical Tank Layout Showing Segment Labels



Tank #4 - General View, looking north.



Tank #4 – General view of the inside face of segment 4-5, looking south. Note 40' ladder installed.



Tank #4 – General view of the inside face of Segment 1-12, looking north.



Tank #4 – General view of the inside face of segment 4-3, looking north.



Tank #4 – General view of the top of catwalk at Segment 4-5, looking north.



Tank #4 - Bottom of catwalk at Segment 12-1. Note transversal hairline cracks with efflorescence (typical for all segments, all tanks)



Tank #4 - Outside face of Segment 7-8, looking northeast. Note longitudinal hairline crack at the lower wall.



Tank #4 - Outside face of Segment 6-7, looking northeast. Note longitudinal hairline crack at the lower wall.



Tank #3 - General View, looking north.



Tank #3 - Outside face of Segment 6-5, looking north. Note longitudinal hairline crack with efflorescence at lower wall.



Tank #3 - Outside face of Segment 11-12, looking south. Note vertical hairline crack.



Tank #3 - Bottom of catwalk at Segment 5-4, looking northwest. Note transversal hairline cracks with efflorescence.



Tank #2 - General View, looking north.



Tank #2 - Outside face at Segment 6-7, looking north. Note longitudinal hairline crack with efflorescence at lower wall.



Tank #2 - Bottom of catwalk at Segment 6-7, looking north. Note transversal hairline cracks with efflorescence.



Tank #2 - Outside face of Segment 10-11, looking south. Note vertical hairline crack.



Tank #1 - General View, looking north.



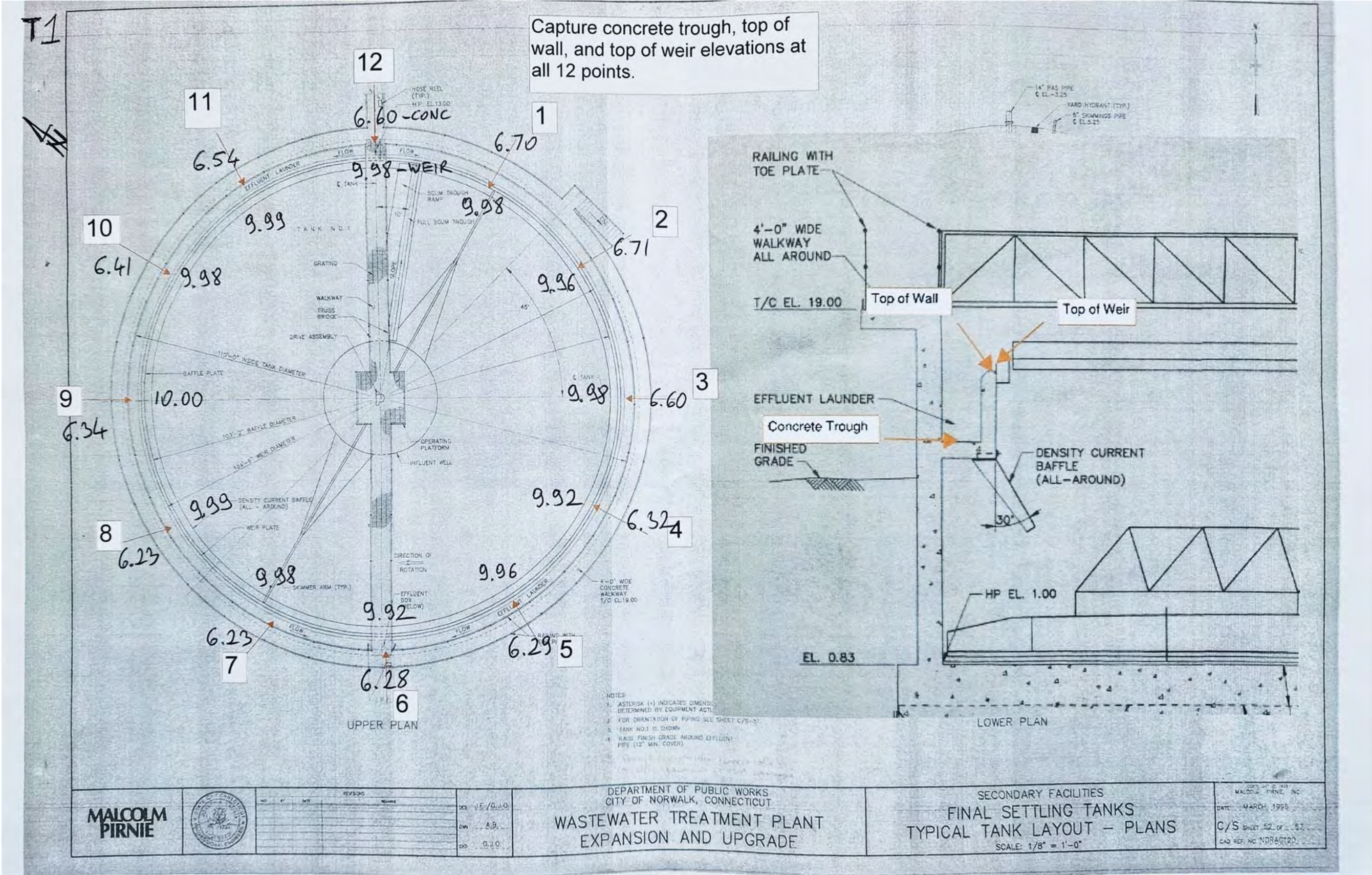
Tank #1 - Outside face of Segment #4-3, looking west. Note longitudinal hairline crack at lower wall.

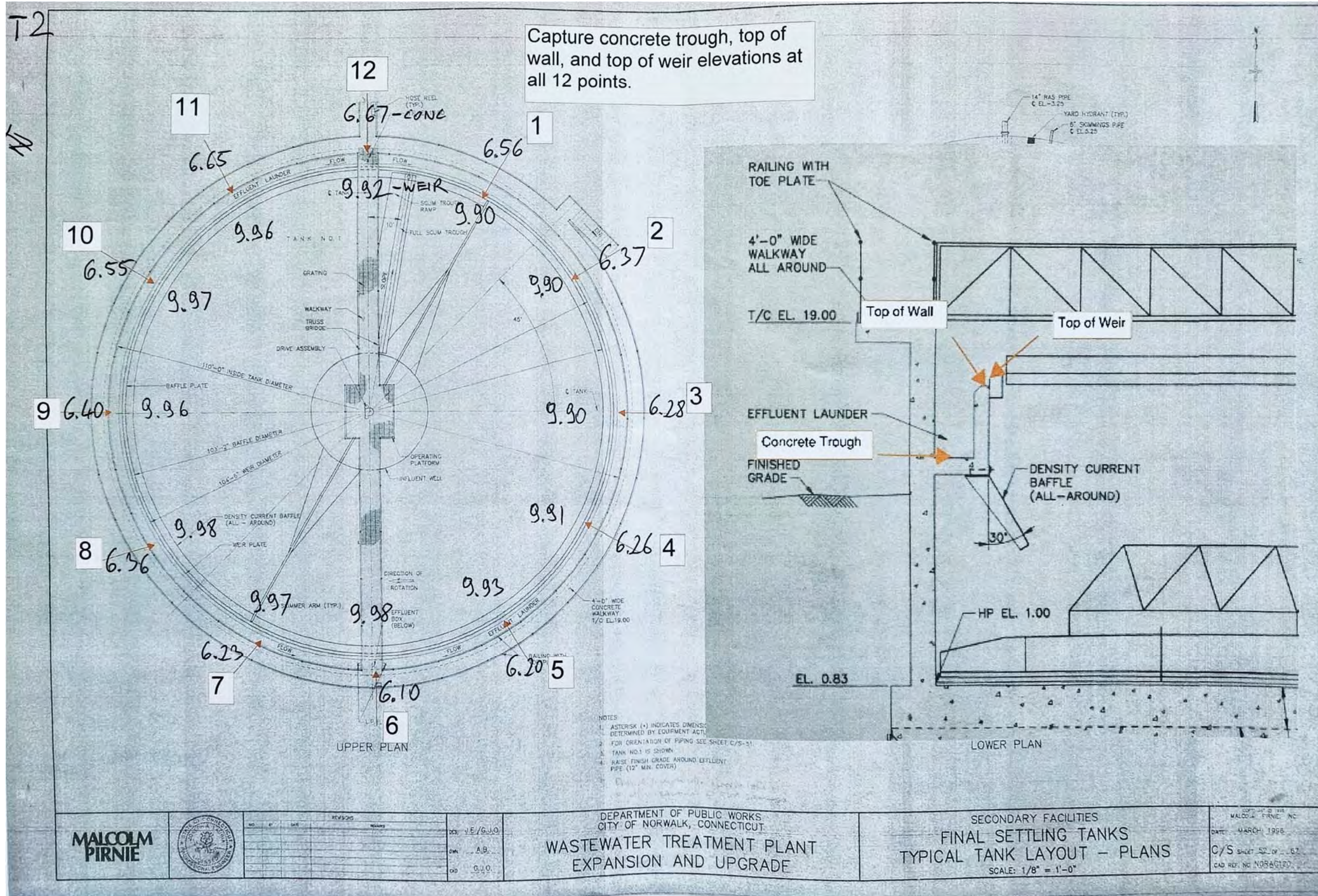


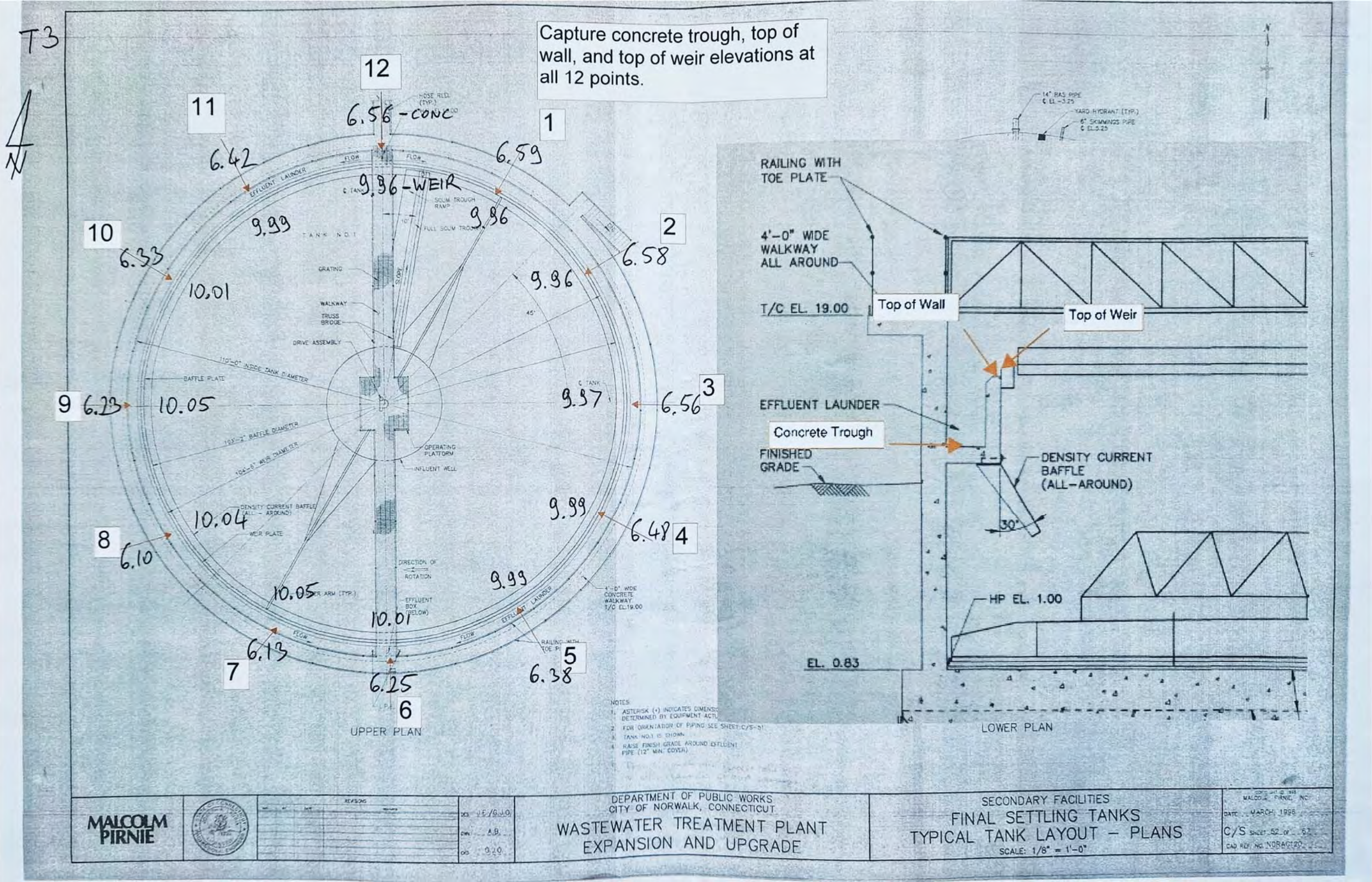
Tank #1 - Small (1/4 SF) shallow spall at fascia of catwalk at Segment 11-12, looking south.

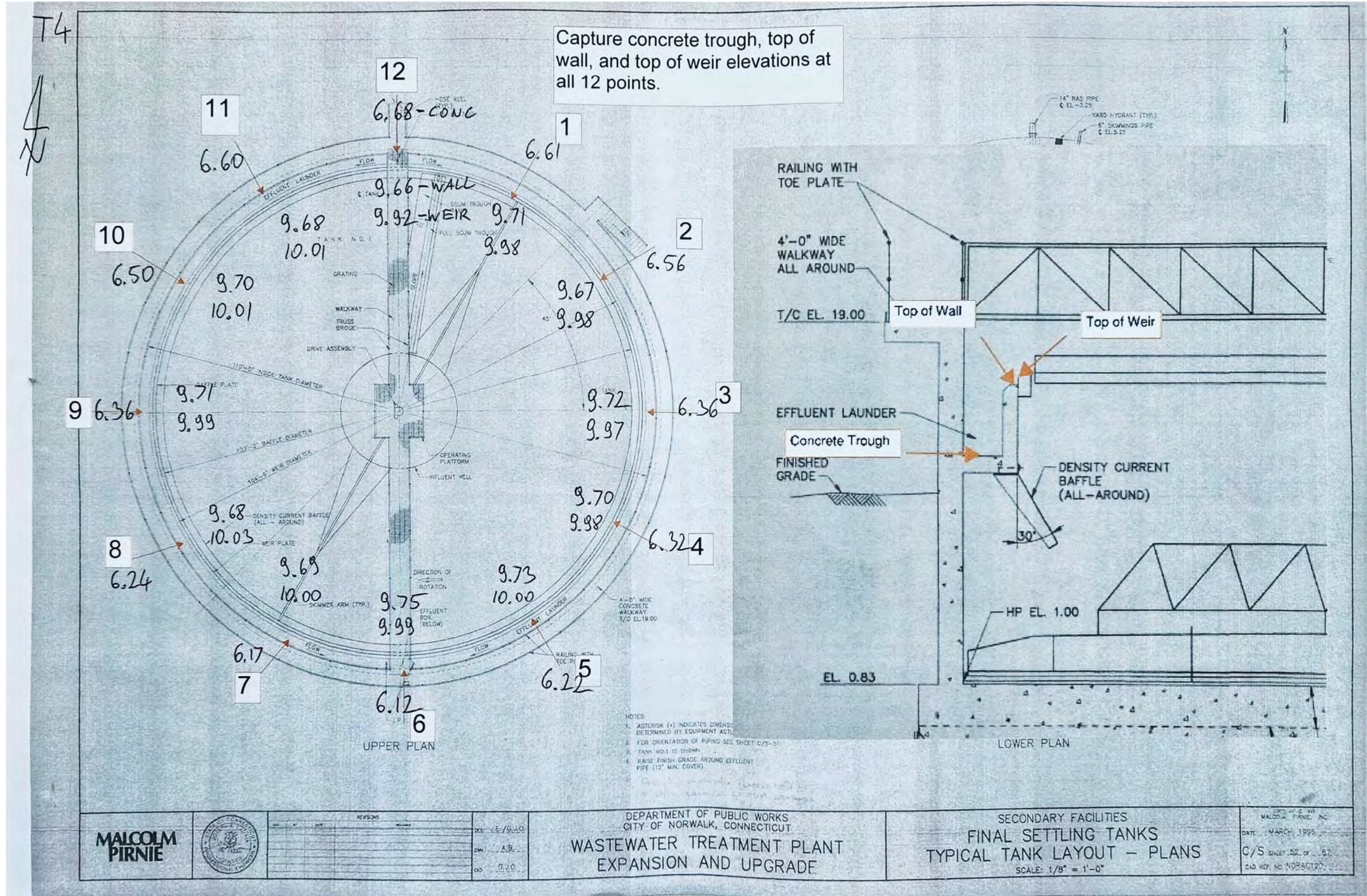


TANK #1

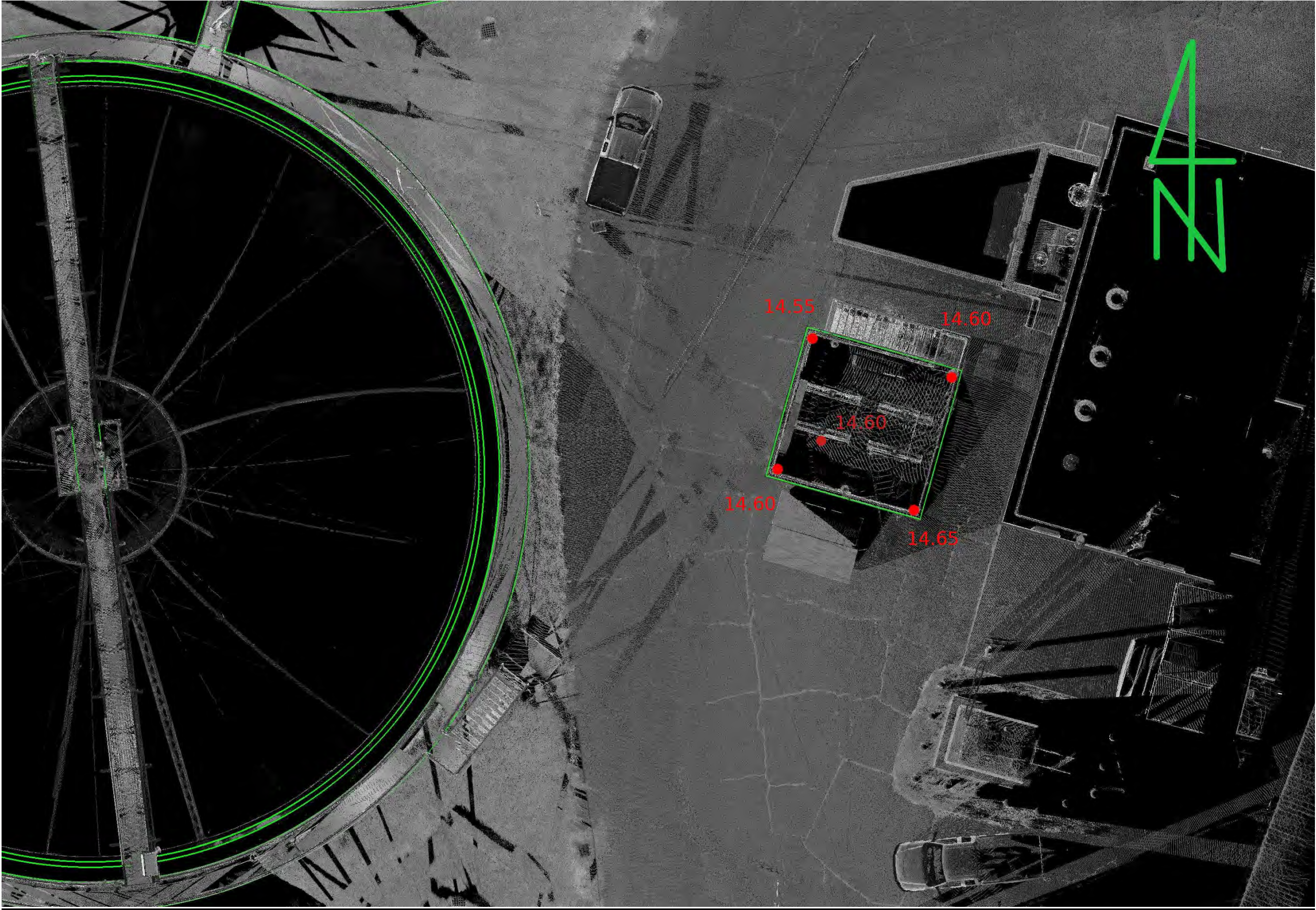








FINAL SETTLING TANK SPLITTER BOX



Appendix FST-H

Probable Total Project Cost Estimate

Estimate Totals

NORWALK WATER POLLUTION CONTROL AUTHORITY NORWALK WPCF UPGRADES FACILITY PLAN ESTIMATE

Description	Rate	Amount	Rate	Amount	Cost Basis
<u>FINAL SETTLING TANK LUMP SUM WORK</u>		Prime Contractor Work	Sub-Contractor Work		
Labor		967,250		960,467	
Material		3,026,407		786,958	
Equipment		464,818		35,529	
Other		227,600		1,223,900	
Subtotal		4,686,075		3,006,854	
General Conditions	15.00%	702,911	15.00%	451,028	
Subtotal		5,388,986		3,457,882	
Incidental Overtime Allowance (Calculated On Labor)	5.00%	48,363	5.00%	48,023	Category
Small Tools (Calculated On Labor)	5.00%	48,363	5.00%	48,023	Category
Equipment Sales Tax (Calculated On Equipment)	6.35%	29,516	6.35%	2,256	Category
Subtotal		5,515,227		3,556,185	
Escalation	10.87%	599,604	10.87%	386,621	Total
Subtotal		6,114,831		3,942,806	
Contractor Overhead	10.00%	611,483	10.00%	394,281	Total
Subtotal		6,726,314		4,337,086	
Contractor Profit	10.00%	672,631	10.00%	433,709	Total
Subtotal		7,398,945		4,770,795	
Prime Contractor OH & P (On Subs)	5.00%	238,540	0.00%		Total
Subtotal		7,637,485		4,770,795	
Design Contingency	30.00%	2,291,246	30.00%	1,431,238	Total
Subtotal		9,928,731		6,202,033	
Contractor Bonds & Insurance	3.00%	297,862	3.00%	186,061	Total
Subtotal		10,226,593		6,388,094	
<u>FINAL SETTLING TANK LUMP SUM WORK, TOTAL</u>			\$16,614,687		
<u>(ALLOW 2% OF LUMP SUM)</u>			\$332,294		
<u>TOTAL, FINAL SETTLING TANKS</u>			\$16,946,981		
AACE CLASS 4 ACCURACY RANGE					
-30%			\$11,862,887		
To + 50%			\$25,420,471		

Spreadsheet Level	Labor Hours	Labor Amount	Material Amount	Equip Amount	Other Amount	Total Amount
10 FINAL SETTLING TANK IMPROVEMENTS						
20 FINAL SETTLING TANKS						
20 ARCHITECTURAL & STRUCTURAL WORK					200,000	200,000
30 PROCESS MECHANICAL WORK	12,341.666	932,352	2,838,407	464,818	47,600	4,283,178
20 FINAL SETTLING TANKS	12,341.666	932,352	2,838,407	464,818	247,600	4,483,178
21 RETURN SLUDGE PUMP STATION						
20 ARCHITECTURAL & STRUCTURAL WORK	1,413.407	112,058	82,917	4,138	100,000	299,113
30 PROCESS MECHANICAL WORK	384.000	34,897	188,000		160,000	382,897
40 BUILDING MECHANICAL WORK					402,000	402,000
50 ELECTRICAL WORK	5,849.819	484,810	589,041	31,390	521,900	1,627,141
60 I&C WORK	2,020.000	363,600	115,000		20,000	498,600
21 RETURN SLUDGE PUMP STATION	9,667.226	995,365	974,958	35,529	1,203,900	3,209,752
10 FINAL SETTLING TANK IMPROVEMENTS	22,008.892	1,927,717	3,813,365	500,347	1,451,500	7,692,929

Project name	23-0068, Norwalk WPCF
Labor rate table	CT PW Fairfield 23
Equipment rate table	FACL2023
Report format	Sorted by 'Area/Process/System/Division/Work Pack./Assembly' 'Detail' summary Print sort level notes Paginate
Alternates	Prime, Prime, Alt. 3, Sub

Spreadsheet Level	Takeoff Quantity	Prime/Sub	Labor Hours	Labor Cost/Unit	Labor Amount	Material Cost/Unit	Material Amount	Equip Cost/Unit	Equip Amount	Other Cost/Unit	Other Amount	Total Cost/Unit	Total Amount	Notes
10 FINAL SETTLING TANK IMPROVEMENTS														
20 FINAL SETTLING TANKS														
20 ARCHITECTURAL & STRUCTURAL WORK														
03 CONCRETE														
0305 Concrete Restoration														
030590 Concrete Repair Allowance														
FST Concrete Repair Allowance	4.00 ea	Sub				-	-	-	-	50,000.00 /ea	200,000	50,000.00 /ea	200,000	ALLOW
030590 Concrete Repair Allowance	1.00 LS			/LS		/LS		/LS		200,000.00 /LS	200,000	200,000.00 /LS	200,000	
0305 Concrete Restoration											200,000		200,000	
03 CONCRETE											200,000		200,000	
20 ARCHITECTURAL & STRUCTURAL WORK											200,000		200,000	
30 PROCESS MECHANICAL WORK														
01 GENERAL REQUIREMENTS														
0170 Cleaning & Waste Management														
017011 FST Tank Cleaning														
Removal of residuals within the existing tanks including sludge, grit, floatables, screenings	352.00 cy	Prime	302.016	58.52 /cy	20,598	-	-	21.33 /cy	7,509	-	-	79.85 /cy	28,107	Allow 3" thk.
Disposal of tank residuals	476.00 ton	Prime		-	-	-	-	-	-	100.00 /ton	47,600	100.00 /ton	47,600	
Tank cleaning	4.00 ea	Prime	256.000	4,208.32 /ea	16,833	-	-	416.93 /ea	1,668	-	-	4,625.25 /ea	18,501	
017011 FST Tank Cleaning	4.00 EA		558.016	9,357.92 /EA	37,432	/EA		2,294.11 /EA	9,176	11,900.00 /EA	47,600	23,552.03 /EA	94,208	
017020 Tank Dewatering														
Tank dewatering, attended 8 hours per day including, suction & discharge hoses	160.00 day	Prime	1,280.000	649.36 /day	103,898	-	-	396.16 /day	63,386	-	-	1,045.52 /day	167,283	Assume incidental water at leaking bulkheads
017020 Tank Dewatering	160.00 DAY		1,280.000	649.36 /DAY	103,898	/DAY		396.16 /DAY	63,386	/DAY		1,045.52 /DAY	167,283	
0170 Cleaning & Waste Management			1,838.016		141,329				72,562		47,600		261,491	
01 GENERAL REQUIREMENTS			1,838.016		141,329				72,562		47,600		261,491	
03 CONCRETE														
0350 Grouting														
035010 Tank Grouting														
Grout bottom of tank, 2" average thk	38,066.00 sf	Prime	570.990	1.23 /sf	47,007	1.35 /sf	51,389	0.17 /sf	6,321	-	-	2.75 /sf	104,717	
Roughen concrete & apply bonding agent	38,066.00 sf	Prime	380.660	0.65 /sf	24,553	0.85 /sf	32,356			-	-	1.50 /sf	56,909	
Fibrous reinforcing, synthetic fibers, add to concrete, 1-1/2 lb./C.Y.	177.00 cy	Prime		-	-	13.05 /cy	2,310	-	-	-	-	13.05 /cy	2,310	
035010 Tank Grouting	38,066.00 SF		951.650	1.88 /SF	71,560	2.26 /SF	86,055	0.17 /SF	6,321	/SF		4.31 /SF	163,936	
0350 Grouting			951.650		71,560		86,055		6,321				163,936	
03 CONCRETE			951.650		71,560		86,055		6,321				163,936	
46 WATER & WASTEWATER EQUIPMENT														
4620 Sludge Collection Equipment														
462010 Spiral Scraper Clarifier Mechanism Replacement														
Painting & coatings	4.00 ea	Prime	128.000	2,230.34 /ea	8,921	1,000.00 /ea	4,000			-	-	3,230.34 /ea	12,921	
Removal of 110' diameter clarifier mechanism	4.00 ea	Prime	1,920.000	35,459.04 /ea	141,836			22,733.12 /ea	90,932	-	-	58,192.16 /ea	232,769	
110' Diameter spiral scraper clarifier mechanisms	4.00 ea	Prime	3,840.000	70,918.08 /ea	283,672	426,800.00 /ea	1,707,200	45,466.24 /ea	181,865	-	-	543,184.32 /ea	2,172,737	WesTech Quote
Startup & testing	4.00 ea	Prime	192.000	3,369.65 /ea	13,479					-	-	3,369.65 /ea	13,479	
462010 Spiral Scraper Clarifier Mechanism Replacement	4.00 EA		6,080.000	111,977.10 /EA	447,908	427,800.00 /EA	1,711,200	68,199.36 /EA	272,797	/EA		607,976.46 /EA	2,431,906	
462020 Remove & Replace Clarifier Mechanism Drives														
Removal of clarifier mechanism drives	4.00 ea	Prime	384.000	7,091.81 /ea	28,367			4,546.63 /ea	18,187	-	-	11,638.43 /ea	46,554	
Clarifier mechanisms drives	4.00 ea	Prime	768.000	14,183.62 /ea	56,734	51,600.00 /ea	206,400	9,093.25 /ea	36,373	-	-	74,876.86 /ea	299,507	WesTech Quote
462020 Remove & Replace Clarifier Mechanism Drives	4.00 EA		1,152.000	21,275.42 /EA	85,102	51,600.00 /EA	206,400	13,639.87 /EA	54,559	/EA		86,515.29 /EA	346,061	
462030 Launder Cover Replacement														
Chemical anchor, in concrete, incl layout, drilling & epoxy cartridge	800.00 ea	Prime	400.000	16.13 /ea	12,900	7.50 /ea	6,000	3.69 /ea	2,954	-	-	27.32 /ea	21,854	
Removal of launder covers	4.00 ea	Prime	640.000	14,462.72 /ea	57,851			4,635.36 /ea	18,541	-	-	19,098.08 /ea	76,392	
Aluminium launder cover system	4.00 ea	Prime	1,280.000	28,925.44 /ea	115,702	207,188.00 /ea	828,752	9,270.72 /ea	37,083	-	-	245,384.16 /ea	981,537	Hallsten Quote
462030 Launder Cover Replacement	4.00 EA		2,320.000	46,613.26 /EA	186,453	208,688.00 /EA	834,752	14,644.48 /EA	58,578	/EA		269,945.74 /EA	1,079,783	

Spreadsheet Level	Takeoff Quantity	Prime/Sub	Labor Hours	Labor Cost/Unit	Labor Amount	Material Cost/Unit	Material Amount	Equip Cost/Unit	Equip Amount	Other Cost/Unit	Other Amount	Total Cost/Unit	Total Amount	Notes
4620 Sludge Collection Equipment			9,552.000		719,463		2,752,352		385,935				3,857,750	
46 WATER & WASTEWATER EQUIPMENT			9,552.000		719,463		2,752,352		385,935				3,857,750	
30 PROCESS MECHANICAL WORK			12,341.666		932,352		2,838,407		464,818		47,600		4,283,178	
20 FINAL SETTLING TANKS			12,341.666		932,352		2,838,407		464,818		247,600		4,483,178	
21 RETURN SLUDGE PUMP STATION														
20 ARCHITECTURAL & STRUCTURAL WORK														
02 EXISTING CONDITIONS														
0280 Hazardous Materials														
028090 Hazardous Materials Abatement Allowance														
Hazardous Materials Abatement Allowance	1.00 ls	Sub						-	-	25,000.00 /ls	25,000	25,000.00 /ls	25,000	ALLOW
028090 Hazardous Materials Abatement Allowance	1.00 LS			/LS		/LS		/LS		25,000.00 /LS	25,000	25,000.00 /LS	25,000	
0280 Hazardous Materials											25,000		25,000	
02 EXISTING CONDITIONS											25,000		25,000	
03 CONCRETE														
0305 Concrete Restoration														
030510 Replace Concrete Topping														
Remove concrete topping	1,478.00 sf	Sub	23.958	1.05 /sf	1,545	7.35 /sf	10,863			-	-	8.40 /sf	12,409	
Cement topping, pumped, 3/4" thick	1,478.00 sf	Sub	31.954	1.59 /sf	2,347	7.35 /sf	10,863	0.56 /sf	826	-	-	9.50 /sf	14,036	
030510 Replace Concrete Topping	1,478.00 SF		55.913	2.63 /SF	3,892	14.70 /SF	21,727	0.56 /SF	826	/SF		17.89 /SF	26,444	
030590 Concrete Repair Allowance														
Concrete Repair Allowance	1.00 ls	Sub				-	-	-	-	50,000.00 /ls	50,000	50,000.00 /ls	50,000	ALLOW
030590 Concrete Repair Allowance	1.00 LS			/LS		/LS		/LS		50,000.00 /LS	50,000	50,000.00 /LS	50,000	
0305 Concrete Restoration			55.913		3,892		21,727		826		50,000		76,444	
03 CONCRETE			55.913		3,892		21,727		826		50,000		76,444	
04 MASONRY														
0405 Masonry Restoration														
040520 Exterior Masonry Restoration														
Pointing masonry, block	645.00 sf	Sub	51.600	6.64 /sf	4,285	0.38 /sf	245	-	-	-	-	7.02 /sf	4,530	Allow 25% of total area
Cleaning masonry, heavy restoration	2,580.00 sf	Sub	103.200	3.32 /sf	8,570	0.18 /sf	464	-	-	-	-	3.50 /sf	9,034	Allow 15' High Walls
Paints & coatings exterior masonry walls, waterproof sealer, spray	2,580.00 sf	Sub	25.800	0.70 /sf	1,798	1.00 /sf	2,580	-	-	-	-	1.70 /sf	4,378	
040520 Exterior Masonry Restoration	2,580.00 SF		180.600	5.68 /SF	14,653	1.28 /SF	3,290	/SF		/SF		6.95 /SF	17,943	
0405 Masonry Restoration			180.600		14,653		3,290						17,943	
04 MASONRY			180.600		14,653		3,290						17,943	
05 METALS														
0520 Metal Fabrications														
052090 Miscellaneous Metal Fabrications Replacement/Restoration Allowance														
Miscellaneous Metal Fabrications Replacement/Restoration Allowance	1.00 ls	Sub								25,000.00 /ls	25,000	25,000.00 /ls	25,000	
052090 Miscellaneous Metal Fabrications Replacement/Restoration Allowance	1.00 LS			/LS		/LS		/LS		25,000.00 /LS	25,000	25,000.00 /LS	25,000	
0520 Metal Fabrications											25,000		25,000	
05 METALS											25,000		25,000	
07 THERMAL MOISTURE PROTECTION														
0720 Roofing														
072010 Membrane Roofing System Replacement														
Selective demolition, rubbish handling, dumpster	1.50 ton	Sub		-	-	88.00 /ton	132	-	-	-	-	88.00 /ton	132	
Selective demolition, rubbish handling	24.00 lcy	Sub	23.273	62.55 /lcy	1,501	-	-	-	-	-	-	62.55 /lcy	1,501	
Selective demolition, thermal and moisture protection, membrane roofing system	1,530.00 sf	Sub	114.750	4.93 /sf	7,545	-	-	-	-	-	-	4.93 /sf	7,545	
Membrane roofing system, complete with insulation & flashings	1,530.00 sf	Sub	267.750	14.47 /sf	22,135	8.00 /sf	12,240	2.17 /sf	3,313	-	-	24.63 /sf	37,688	
072010 Membrane Roofing System Replacement	1,530.00 SF		405.773	20.38 /SF	31,182	8.09 /SF	12,372	2.17 /SF	3,313	/SF		30.63 /SF	46,866	

Spreadsheet Level	Takeoff Quantity	Prime/Sub	Labor Hours	Labor Cost/Unit	Labor Amount	Material Cost/Unit	Material Amount	Equip Cost/Unit	Equip Amount	Other Cost/Unit	Other Amount	Total Cost/Unit	Total Amount	Notes
40 PROCESS INTEGRATION														
4010 Process Piping														
401090 Miscellaneous Process Mechanical Piping Allowance														
Miscellaneous Process Mechanical Piping Removal & Replacement Allowance	1.00 ls	Prime								100,000.00 /ls	100,000	100,000.00 /ls	100,000	ALLOW
401090 Miscellaneous Process Mechanical Piping Allowance	1.00 LS			/LS		/LS		/LS		100,000.00 /LS	100,000	100,000.00 /LS	100,000	
4010 Process Piping											100,000		100,000	
40 PROCESS INTEGRATION											100,000		100,000	
43 PROCESS GAS & LIQUID HANDLING, PURIFICATION & STORAGE EQUIPMENT														
4310 Process Pumps														
431010 RAS Pump Replacement														
RAS pumps, 2170 GPM, 20 HP	4.00 ea	Prime	288.000	6,564.67 /ea	26,259	47,000.00 /ea	188,000	-	-	-	-	53,564.67 /ea	214,259	HPI 2018 Quote Escalated x 1.73 based on ENR material price index
Startup & testing	6.00 ea	Prime	96.000	1,439.79 /ea	8,639			-	-	-	-	1,439.79 /ea	8,639	
431010 RAS Pump Replacement	4.00 EA		384.000	8,724.36 /EA	34,897	47,000.00 /EA	188,000	/EA		/EA		55,724.36 /EA	222,897	
431012 RAS Pump Impeller Replacement Allowance														
Replace Impellar, RAS pumps, 2700 GPM, 30 HP, Allow	2.00 ea	Prime						-	-	30,000.00 /ea	60,000	30,000.00 /ea	60,000	
431012 RAS Pump Impeller Replacement Allowance	2.00 EA			/EA		/EA		/EA		30,000.00 /EA	60,000	30,000.00 /EA	60,000	
4310 Process Pumps			384.000		34,897		188,000				60,000		282,897	
43 PROCESS GAS & LIQUID HANDLING, PURIFICATION & STORAGE EQUIPMENT			384.000		34,897		188,000				60,000		282,897	
30 PROCESS MECHANICAL WORK			384.000		34,897		188,000				160,000		382,897	
40 BUILDING MECHANICAL WORK														
23 HVAC														
2390 Miscellaneous HVAC														
239090 HVAC Allowance														
HVAC replacement, complete system	4,020.00 gsf	Sub				-	-	-	-	100.00 /gsf	402,000	100.00 /gsf	402,000	
239090 HVAC Allowance	1.00 LS			/LS		/LS		/LS		402,000.00 /LS	402,000	402,000.00 /LS	402,000	
2390 Miscellaneous HVAC											402,000		402,000	
23 HVAC											402,000		402,000	
40 BUILDING MECHANICAL WORK											402,000		402,000	
50 ELECTRICAL WORK														
26 ELECTRICAL														
2605 Electrical Demolition														
260520 Electrical Circuitry Demolition														
Circuitry Demolition	1.00 ls	Sub	160.000	13,260.16 /ls	13,260	-	-	-	-	-	-	13,260.16 /ls	13,260	
260520 Electrical Circuitry Demolition	1.00 LS		160.000	13,260.16 /LS	13,260	/LS		/LS		/LS		13,260.16 /LS	13,260	
2605 Electrical Demolition			160.000		13,260								13,260	
2620 Power Circuitry														
262022 RAS Pumps														
Wire, copper, stranded, 600 volt, #14, type XHHW, in wireway, conduit, cable tray, incl terminations	79.20 clf	Sub	73.102	76.49 /clf	6,058	24.00 /clf	1,901	-	-	-	-	100.49 /clf	7,959	
Wire, copper, stranded, 600 volt, #8, type XHHW, in wireway, conduit, cable tray, incl terminations	13.20 clf	Sub	19.800	124.31 /clf	1,641	80.00 /clf	1,056	-	-	-	-	204.31 /clf	2,697	
Wire, copper, stranded, 600 volt, #6, type XHHW, in wireway, conduit, cable tray, incl terminations	6.60 clf	Sub	12.185	153.00 /clf	1,010	121.00 /clf	799	-	-	-	-	274.00 /clf	1,808	
Conduit hangers, boxes, cores, fittings, etc.	1.00 ls	Sub	26.400	2,187.93 /ls	2,188	2,552.00 /ls	2,552	-	-	-	-	4,739.93 /ls	4,740	
RGS plastic coated conduit, 40 mil thick, 3/4" diameter, incl 2 terminations, 2 elbows, 11 beam clamps, and 11 couplings per 100 LF	160.00 lf	Sub	27.360	14.17 /lf	2,267	15.85 /lf	2,536	-	-	-	-	30.02 /lf	4,803	

Spreadsheet Level	Takeoff Quantity	Prime/Sub	Labor Hours	Labor Cost/Unit	Labor Amount	Material Cost/Unit	Material Amount	Equip Cost/Unit	Equip Amount	Other Cost/Unit	Other Amount	Total Cost/Unit	Total Amount	Notes
262022 RAS Pumps														
RGS plastic coated conduit, 40 mil thick, 1" diameter, incl 2 terminations, 2 elbows, 11 beam clamps, and 11 couplings per 100 LF	150.00 lf	Sub	32.625	18.03 /lf	2,704	19.15 /lf	2,873	-	-	-	-	37.18 /lf	5,576	
RGS plastic coated conduit, 40 mil thick, 1-1/4" diameter, incl 2 terminations, 2 elbows, 11 beam clamps, and 11 couplings per 100 LF	300.00 lf	Sub	72.000	19.89 /lf	5,967	24.50 /lf	7,350	-	-	-	-	44.39 /lf	13,317	
Motor connections, flexible conduit and fittings	6.00 ea	Sub	9.000	124.31 /ea	746	10.00 /ea	60	-	-	-	-	134.31 /ea	806	
Control stations, NEMA 7	6.00 ea	Sub	18.000	248.63 /ea	1,492	680.00 /ea	4,080	-	-	-	-	928.63 /ea	5,572	
Variable frequency drives, 20 HP motor size	4.00 ea	Sub	144.000	2,983.54 /ea	11,934	5,000.00 /ea	20,000	-	-	-	-	7,983.54 /ea	31,934	
Variable frequency drives, 30 HP motor size	2.00 ea	Sub	100.000	4,143.80 /ea	8,288	10,000.00 /ea	20,000	-	-	-	-	14,143.80 /ea	28,288	
262022 RAS Pumps	6.00 EA		534.471	7,382.47 /EA	44,295	10,534.32 /EA	63,206	/EA		/EA		17,916.79 /EA	107,501	
262025 Final Settling Tank Drives														
Wire, copper, stranded, 600 volt, #14, type XHHW, in wireway, conduit, cable tray, incl terminations	291.28 clf	Sub	268.851	76.49 /clf	22,281	24.00 /clf	6,991	-	-	-	-	100.49 /clf	29,272	
Wire, copper, stranded, 600 volt, #10, type XHHW, in wireway, conduit, cable tray, incl terminations	119.68 clf	Sub	143.616	99.45 /clf	11,902	45.00 /clf	5,386	-	-	-	-	144.45 /clf	17,288	
Conduit hangers, boxes, cores, fittings, etc.	1.00 ls	Sub	23.400	1,939.30 /ls	1,939	2,113.00 /ls	2,113	-	-	-	-	4,052.30 /ls	4,052	
RGS plastic coated conduit, 40 mil thick, 3/4" diameter, incl 2 terminations, 2 elbows, 11 beam clamps, and 11 couplings per 100 LF	280.00 lf	Sub	47.880	14.17 /lf	3,968	15.85 /lf	4,438	-	-	-	-	30.02 /lf	8,406	
RGS plastic coated conduit, 40 mil thick, 1" diameter, incl 2 terminations, 2 elbows, 11 beam clamps, and 11 couplings per 100 LF	320.00 lf	Sub	69.600	18.03 /lf	5,768	19.15 /lf	6,128	-	-	-	-	37.18 /lf	11,896	
Conduit cleaning, existing ductbanks	560.00 lf	Sub	28.000	4.14 /lf	2,321	0.25 /lf	140	-	-	-	-	4.39 /lf	2,461	
Motor connections, flexible conduit and fittings	4.00 ea	Sub	6.000	124.32 /ea	497	10.00 /ea	40	-	-	-	-	134.32 /ea	537	
Install CP	4.00 ea	Sub	48.000	994.51 /ea	3,978	150.00 /ea	600	-	-	-	-	1,144.51 /ea	4,578	
262025 Final Settling Tank Drives	4.00 EA		635.347	13,163.77 /EA	52,655	6,458.83 /EA	25,835	/EA		/EA		19,622.60 /EA	78,490	
2620 Power Circuitry			1,169.819		96,950		89,041						185,991	
2630 Control Circuitry														
263090 Control Point Circuitry														
Control point circuitry (hardwired I/O)	500.00 pt	Sub	4,000.000	663.01 /pt	331,504	1,000.00 /pt	500,000	-	-	-	-	1,663.01 /pt	831,504	
263090 Control Point Circuitry	1.00 LS		4,000.000	331,504.00 /LS	331,504	500,000.00 /LS	500,000	/LS		/LS		831,504.00 /LS	831,504	
2630 Control Circuitry			4,000.000		331,504		500,000						831,504	
2650 Lighting														
265090 Lighting & Device Replacement Allowance														
Lighting & Device Allowance	1,480.00 gsf	Sub						-	-	20.00 /gsf	29,600	20.00 /gsf	29,600	
Lighting & Device Allowance (Classified Areas)	2,540.00 gsf	Sub						-	-	30.00 /gsf	76,200	30.00 /gsf	76,200	
265090 Lighting & Device Replacement Allowance	1.00 LS			/LS		/LS		/LS		105,800.00 /LS	105,800	105,800.00 /LS	105,800	
2650 Lighting											105,800		105,800	
2690 Electrical Requirements														
269010 Temporary Power & Phasing Allowance														
Temporary power & phasing, allow 25% of total electrical cost	1.00 ls	Sub		-	-			-	-	400,000.00 /ls	400,000	400,000.00 /ls	400,000	
269010 Temporary Power & Phasing Allowance	1.00 LS			/LS		/LS		/LS		400,000.00 /LS	400,000	400,000.00 /LS	400,000	
269090 Miscellaneous Electrical Requirements														
Rent aerial lift, scissor type, electric	160.00 day	Sub		-	-	-	-	196.19 /day	31,390	-	-	196.19 /day	31,390	
Start-up, testing & commissioning	1.00 ls	Sub	520.000	43,095.52 /ls	43,096	-	-	-	-	16,100.00 /ls	16,100	59,195.52 /ls	59,196	
269090 Miscellaneous Electrical Requirements	1.00 LS		520.000	43,095.52 /LS	43,096	/LS		31,390.40 /LS	31,390	16,100.00 /LS	16,100	90,585.92 /LS	90,586	

Spreadsheet Level	Takeoff Quantity	Prime/Sub	Labor Hours	Labor Cost/Unit	Labor Amount	Material Cost/Unit	Material Amount	Equip Cost/Unit	Equip Amount	Other Cost/Unit	Other Amount	Total Cost/Unit	Total Amount	Notes
2690 Electrical Requirements			520.000		43,096				31,390		416,100		490,586	
26 ELECTRICAL			5,849.819		484,810		589,041		31,390		521,900		1,627,141	
50 ELECTRICAL WORK			5,849.819		484,810		589,041		31,390		521,900		1,627,141	
60 I&C WORK														
40 PROCESS INTEGRATION														
4060 Instrumentation & Control														
406010 Control Panels														
PLC Panel	1.00 ea	Sub	400.000	72,000.00 /ea	72,000	100,000.00 /ea	100,000	-	-	-	-	172,000.00 /ea	172,000	
Network interface panel	1.00 ea	Sub	40.000	7,200.00 /ea	7,200	15,000.00 /ea	15,000	-	-	-	-	22,200.00 /ea	22,200	
406010 Control Panels	1.00 LS		440.000	79,200.00 /LS	79,200	115,000.00 /LS	115,000	/LS		/LS		194,200.00 /LS	194,200	
406020 Field Instruments Allowance														
Field Instruments Allowance	1.00 ls	Prime						-	-	20,000.00 /ls	20,000	20,000.00 /ls	20,000	
406020 Field Instruments Allowance	1.00 LS			/LS		/LS		/LS		20,000.00 /LS	20,000	20,000.00 /LS	20,000	
406030 Control Point Programming & Integration														
Control Point Programming, Integration	1.00 ls	Sub	1,500.000	270,000.00 /ls	270,000			-	-	-	-	270,000.00 /ls	270,000	
Start-up, Testing & Training	1.00 ls	Sub	80.000	14,400.00 /ls	14,400			-	-	-	-	14,400.00 /ls	14,400	
406030 Control Point Programming & Integration	1.00 LS		1,580.000	284,400.00 /LS	284,400	/LS		/LS		/LS		284,400.00 /LS	284,400	
4060 Instrumentation & Control			2,020.000		363,600		115,000				20,000		498,600	
40 PROCESS INTEGRATION			2,020.000		363,600		115,000				20,000		498,600	
60 I&C WORK			2,020.000		363,600		115,000				20,000		498,600	
21 RETURN SLUDGE PUMP STATION			9,667.226		995,365		974,958		35,529		1,203,900		3,209,752	
10 FINAL SETTLING TANK IMPROVEMENTS			22,008.892		1,927,717		3,813,365		500,347		1,451,500		7,692,929	

Partial Totals

Description	Amount	Totals	Hours	Percent of Total	
Labor	1,927,717		22,008.892 hrs	25.06%	
Material	3,813,365			49.57%	
Equipment	500,347		14,008.023 hrs	6.50%	
Other	1,451,500			18.87%	
TOTAL	7,692,929	7,692,929		100.00%	100.00%

Appendix H

FIRM - Map Number 09001C0531G

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations (BFEs)** and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Connecticut State Plane Zone (FIPS zone 0600). The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov> or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit its website at <http://www.ngs.noaa.gov>.

Base map information shown on FIRM panels produced for this coastal study revision was derived from United State Geological Survey 2008 High Resolution Orthophotography produced from 1 foot pixel cells from photography dated April 2008. The projection used in the preparation of this map was Connecticut State Plane Feet, FIPS Zone 0600. The horizontal datum used was North American Datum of 1983 (NAD 83).

The AE Zone category has been divided by a **Limit of Moderate Wave Action (LIMWA)**. The LIMWA represents the approximate landward limit of the 1.5 foot breaking wave. The effects of wave hazards between the VE Zone and the LIMWA (or between the shoreline and the LIMWA for areas where VE Zones are not identified) will be similar to, but less severe than those in the VE Zone.

The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Based on updated topographic information, this map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on the map. Also, the road to floodplain relationships for unrevised streams may differ from what is shown on previous maps.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at <http://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map**, how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA website at <http://www.fema.gov/business/nfp>.

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Fax: 914 328 3384
www.arcadis.com



**Norwalk Water
Pollution Control
Authority**

www.wpcanorwalk.org

September 29, 2023

VIA ELECTRONIC MAIL

Ms. Ann Straut
Sanitary Engineer 3
Department of Energy and Environmental Protection
Bureau of Water Protection and Land Reuse
Water Planning & Management Division
79 Elm Street
Hartford, CT 06106-5127

Subject: City of Norwalk, CT, Consent Order (# COWRMU22001)
Amended Collection System Master Plan

Dear Ms. Straut:

In accordance with Section B.19 of the above referenced Consent Order, please find attached an amended Collection System Master Plan (the "Master Plan"), originally filed September 30, 2022. As previously discussed with the Agency on June 20, 2023, this submission revises the Master Plan's flow calculations for Outfall 002-1 as shown in Tables ES-1, ES-2, 4-4, 5-2, 5-7, 5-8, 7-1, 7-2, 7-3, and 7-4.

Prior Master Plan calculations resulted in an over-estimation of wastewater volume directed to Outfall 002-1 in storm events. The revised calculations predict flows to Outfall 002-1 that are considerably lower for a range of rainfall events, including a 66-78% reduction for 24-Hour rainfall events.

Should you have any questions, please feel free to contact me at yvaladares@norwalkct.gov.

Sincerely,

A handwritten signature in blue ink, appearing to read "Vanessa Valadares", with a stylized flourish at the end.

Vanessa Valadares, P.E.
Chief of Operations and Public Works

Copy: Chris Torre, DPW (*via Electronic Mail*)
Ralph K. Kolb, P.E., WPCA (*via Electronic Mail*)
WPCA Board of Directors

2022 Norwalk Master Plan

Prepared for
City of Norwalk and its Water Pollution Control Authority
September 30, 2022
Amended September 29, 2023



175 Capital Boulevard, 4th Floor
Rocky Hill, CT, 06067

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List of Abbreviations

City	City of Norwalk
CTECO	CT Environmental Conditions Line
CSO	combined sewer overflow
DEM	digital elevation model
DWF	dry weather flow
GIS	Geographical Information System
gpd/in-mi	gallons per day per inch-mile
GPAD	gallons per acre per day
GPD	gallons per day
GWI	groundwater infiltration
HGL	hydraulic grade line
I/I	infiltration and inflow
MG	million gallons
MGD	million gallons per day
MH	manhole
O&M	operations and maintenance
RDII	Rainfall-derived inflow and infiltration
SSO	sanitary sewer overflow
SWMM	Storm Water Management Model
SWWTF	Supplemental Wet Weather Treatment Facility
WEF	Water Environment Federation
WERF	Water Environment Research Foundation
WPCA	Water Pollution Control Authority
WPCF	water pollution control facility

Executive Summary

This Collection System Master Plan (Master Plan) was prepared for the City of Norwalk (City) and its Water Pollution Control Authority (WPCA). The purpose of the Master Plan is to evaluate the existing characteristics, identify limiting constraints, and develop a long-term system-wide approach to enhance the performance of the City's collection system. This Master Plan was also prepared in satisfaction of the City's Consent Order, dated May 6, 2022.

The City's collection system includes 206 miles of gravity mains, 24 miles of gravity interceptors, 22 pump stations, and 7.4 miles of forcemains. The City's contract operator, Veolia Water Contract Operations USA, Inc. (Veolia), inspects, maintains, and operates the City's collection system.

Since development of the City's original Collection System Master Plan which was finalized in 2009, the WPCA has been diligently planning and implementing numerous enhancements to its collection system. Some key enhancements include: multiple lining and rehabilitation projects; several inflow and infiltration initiatives; various targeted sewershed rehabilitation projects; a system-wide pumpstation assessment and upgrade initiative; and a retooled contract operations service agreement that includes a comprehensive operation, maintenance, and management program. To further enhance its efforts to optimize performance of the City's collection system, the WPCA initiated this update to the original 2009 Collection System Master Plan.

Summary of Findings

In general, the Master Plan concluded that the City's collection system currently performs well. To develop the 2022 Master Plan, and the analysis that informed that conclusion, a temporary flow monitoring campaign and a collection system model, representing the collection system interceptors and critical trunk sewers, pump stations, and forcemains, were developed. Both the flow monitoring data and the collection system model were integral components of the evaluation that were used to assess and characterize the collection system conditions and performance under both existing and proposed improved future conditions.

- **Flow Metering:** A city-wide twenty-week metering campaign was conducted from March 15 to August 1, 2021. The temporary flow metering program was augmented by the collection of rainfall data and flow and level data at Norwalk's Water Pollution Control Facility (WPCF). Flow metering data collected under the city-wide program was used to characterize flow conditions during both dry and wet weather conditions at 40 discrete points within the collection system. Flow data from the WPCF was used to characterize flows into the plant under both dry and wet weather flow conditions. Flow metering data from both sources were used to calibrate the collection system model.
 - Five wet weather flow events were selected for model calibration. The rainfall events used for calibration ranged from sub-1-year to 10-year return frequencies.
- **Collection System Model:** The collection system model network includes approximately 25 percent of the total collection system pipe length and 9 of the 22 pump stations. The collection system model was developed primarily from the City's GIS datasets, augmented by field data collection where required. The collection system model network captures the interceptor system and critical trunk sewers. The collection system model provides a tool that can be used for the following:

- Characterizing the existing conditions and behavior of the collection system. The collection system model was calibrated using rainfall data collected during the flow metering campaign. The calibrated model was used to assess the collection system performance and identify system constraints.
- Predicting hydrologic inflows and hydraulic conditions in response to a specified rainfall event. The calibrated model was simulated using a range of synthetic rainfall events to characterize the system performance and benchmark its level of service.
- Assessing the impacts of change within the collection system. Proposed future conditions, representing reductions in extraneous flow entering the collection system or improvements in the collection system capacity were simulated to evaluate their benefits to the collection system performance.

The analysis of the flow metering data and application of the collection system model supported the characterization of the City's collection system and the identification of its limiting components. The relief of hydraulic bottlenecks and the reduction of extraneous flows entering the collection system are the most important areas identified for improvement of collection system performance. Prioritizing conveyance capacity improvements that relieve hydraulic bottlenecks provides an immediate reduction in the hydraulic grade line (HGL) and maximizes the volume of wastewater conveyed to the WPCF. Targeted reduction of extraneous flows entering the collection system provides a pathway for long-term improvements in the collection system's level of service.

Summary of Recommendations

The analysis performed as part of this Master Plan resulted in two categories of recommendations:

1. Consent Order Recommendations; and
2. Long-Term Recommendations

Consent Order Recommendations are recommendations made to specifically address and satisfy paragraphs B.3 and B.5 of Norwalk's Consent Order. Long-Term Recommendations are recommendations made specifically to further enhance and optimize performance of the City's collection system. Both recommendation categories are discussed further below and within the Master Plan.

Consent Order Recommendations

- Continue Prioritized Collection System Inspection and Maintenance: Analysis of flow metering data and the collection system model results indicate that some portions of the collection system perform at a level below their design conveyance capacity. In these locations, it is assumed that there is reduction in the available flow area of the sewer main, typically caused by debris accumulation or the presence of root balls. As such, the Master Plan recommends inspection and maintenance be prioritized in these areas. The inspection, maintenance, and operational recommendations have been identified as feasible to implement in a 1- to 3-year timeframe.
- Periodic Level Monitoring: Some of the sewers identified as performing below their design capacity have previously been identified by the City's contract operator as being subject to increased maintenance needs. Periodic level monitoring and trend analysis is recommended to assist in predicting when maintenance activities are necessary to restore the conveyance capacity in the sewer reach.
- Modification of the WPCF Influent Pumping Operations: The WPCF Influent Pumping Station is operated to maintain a constant wet well level. The maintained wet well level imposes a backwater condition on a significant portion of the interceptor system. Under backwater



conditions, velocities decrease, and the sewer becomes more susceptible to sediment aggradation. Lowering the wet well-set point would reduce the backwater influence and potentially improve the self-cleaning properties of the interceptor system.

- **Catch Basin Disconnection Program:** Directly connected catch basins capture and convey stormwater to the collection system. Directly connected catch basins are often significant sources of extraneous inflow. Disconnection of the directly connected catch basins identified as significant inflow contributors is included as a Consent Order Recommendation to specifically address paragraph B.3's objective of removing excess flow from the collection system. To implement this recommendation, the City and WPCA will develop a Catch Basin Disconnection Program. The program will confirm catch basin drainage areas, perform disconnection feasibility analyses, develop detailed design and disconnection specifications, and carry out project bidding, construction management, and project close out tasks. This program is necessary as the Master Plan recommendations are based on the assumption that the storm drain system has sufficient conveyance capacity to accept the additional flows and that construction of new storm drain assets required for catch basin disconnection are feasible. Both of these assumptions will need to be further verified through more detailed engineering analyses as part of the Consent Order recommended Catch Basin Disconnection Program. The estimated cost of the catch basin disconnections included in the Consent Order measures recommendation is approximately \$10.6 million.
- **Hubbells Lane Relief Sewer:** Modeling has indicated that rerouting flows from the East Wall Street trunk sewer to the East Interceptor downstream of the Moodys Lane Siphon, via a Hubbells Lane Relief Sewer, would lower the HGL in portions of the East Interceptor historically prone to significant surcharge. The model results indicate the Hubbells Lane Relief Sewer effectively mitigates the significant surcharging and prevents manhole overflows up to the 25-year, 6-hour return frequency event. Further, the model results show that with the Hubbells Lane Relief Sewer in service, the Wall Street Overflow outfall can be permanently closed and eliminated from the City's collection system. The estimated cost of the Hubbells Lane Relief Sewer project is approximately \$5.4 million and has been identified as feasible to implement in a 3- to 5-year timeframe.
- **Elimination of Ann Street Emergency Overflow:** The Ann Street Emergency Overflow (Emergency Overflow) has historically provided hydraulic relief to the Norwalk interceptor system, acting as a controlled point of discharge during emergency events such as periods of extreme weather or catastrophic infrastructure failure. Recently, the WPCA implemented additional engineering and administrative controls further reducing the likelihood of discharge from the Emergency Overflow. As a result of these controls and other collection system enhancements, discharges from the Emergency Overflow are incredibly rare events that have effectively been eliminated already. Further, the additional modeling analysis performed for the Master Plan predicts that, following completion of both Consent Order and Long-Term Recommendations, the Emergency Overflow will not discharge even under the 100 year, 24-hour return frequency event. For perspective, other CSO communities in Connecticut generally attempt to control overflows for much smaller events.

To comply with paragraph B.3 of the Consent Order, the Master Plan develops and discusses three viable and cost-effective measures or alternatives to accomplish elimination of the Emergency Overflow. Following the analysis presented in Sections 4 and 7 of the Master Plan, Alternative 2, which includes implementation of the Consent Order Recommendations and installation of a physical barrier functioning as an operational flow elimination structure, was selected as the recommended measure. Alternative 1, which includes implementation of the Consent Order Recommendations, was excluded given the potential for additional enhancement.



Alternative 3, which includes Consent Order Recommendations and removal of outlet pipes preventing discharges in all conditions, was excluded given the unacceptable level of risk posed to the health and safety of the public by the more than 1,000 parcels likely impacted by wastewater backups into basements under this alternative. The estimated cost of the Emergency Overflow Elimination project is approximately \$0.8 million and has been identified as feasible to implement in a 2- to 5-year timeframe.

Long-Term Recommendations

- Targeted Rainfall-Derived Infiltration and Inflow Reduction:** Eighteen meter-areas with significant rainfall-derived infiltration and inflow (RDII) rates were identified. These meter areas represent where cost-effective infiltration and inflow reductions can be achieved through the administration of a long-term infiltration and inflow reduction program. Reduction of such flows preserves and improves the performance in the collection system. The estimated total cost of the RDII and inflow reduction projects is approximately \$36.4 million. Due to the number of metered areas showing significant RDII and the nature of sewer investigations and infrastructure rehabilitation work, completion of the recommended RDII reductions is expected to be a multi-decade effort, estimated to require up to 20-years to effectively complete.

Summary of System Performance

Based on results from the calibrated model, the collection system performance, under existing conditions, is shown in Table ES - 1, as discharge volumes throughout the system for various design events. Discharge volumes in Table ES - 1 are expressed in million gallon (MG) units. Under existing conditions, the system generally performs well, with nominal systemwide SSO volumes for the 1- and 2-year return frequency events. Starting at the 1-year return frequency event, peak flows conveyed to the WPCF are predicted to exceed 30 million gallons per day (MGD), the secondary treatment capacity at the plant. As designed, flows at the WPCF greater than 30 MGD are diverted to the Supplemental Wet Weather Treatment Facility (SWWTF) where they receive primary treatment (or equivalent) and disinfection/dechlorination before being discharged from Outfall 002. The Emergency Overflow is not predicted to discharge for any return frequency events shown in the table.

Table ES - 1. CSO Volumes by Design Storm - Existing Conditions (MG)					
6-Hour	1-Year	2-Year	5-Year	10-Year	25-Year
Systemwide SSO	0.0	0.1	0.7	1.4	3.0
Ann Street Emergency Overflow	-	-	-	-	-
Outfall 002	1.5	2.2	4.0	6.0	9.0
12-Hour	1-Year	2-Year	5-Year	10-Year	25-Year
Systemwide SSO	0.1	0.5	1.6	3.0	6.1
Ann Street Emergency Overflow	-	-	-	-	-
Outfall 002	2.7	4.1	6.8	9.8	14.7
24-Hour	1-Year	2-Year	5-Year	10-Year	25-Year
Systemwide SSO	0.1	0.5	2.0	4.1	8.8
Ann Street Emergency Overflow	-	-	-	-	-
Outfall 002	3.0	5.1	8.9	13.6	22.7



To evaluate the projected future performance of the collection system, the model was run with the full set of design storms while incorporating all the recommended improvements, including both Consent Order and Long-Term Recommendations. Table ES - 2 shows the systemwide CSO and SSO volume reduction for every design storm from the 1-year, 6-hour event through the 25-year, 24-hour event.

Table ES - 2. CSO Volumes by Design Storm - Future Conditions (MG)					
6-Hour	1 Year	2 Year	5 Year	10 Year	25 Year
Systemwide SSO	0.0	0.0	0.1	0.3	1.1
Ann Street Emergency Overflow	-	-	-	-	-
Outfall 002	0.1	0.4	1.9	3.3	6.4
12-Hour	1 Year	2 Year	5 Year	10 Year	25 Year
Systemwide SSO	0.0	0.0	0.4	1.2	3.3
Ann Street Emergency Overflow	-	-	-	-	-
Outfall 002	0.8	1.9	4.3	7.4	12.3
24-Hour	1 Year	2 Year	5 Year	10 Year	25 Year
Systemwide SSO	0.0	0.1	0.7	1.9	5.6
Ann Street Emergency Overflow	-	-	-	-	-
Outfall 002	1.0	2.5	6.1	10.8	19.8

Based on the future conditions model results, the Master Plan recommended improvements are predicted to yield a significant further enhancement of the overall performance of the City's collection system.

Section 1

Introduction

The purpose of this Master Plan update is to assess the existing conditions and performance of the collection system and to develop a system-wide approach that enhances the level of service provided by the collection system.

1.1 Regulatory Requirements

Prior to the execution of the Consent Order, the City retained Brown and Caldwell (BC) to update the City's Collection System Master Plan (Master Plan). The Master Plan update was authorized by the WPCA to better understand and assess the collection system performance and needs for future enhancements.

This Master Plan update has been developed in satisfaction of the City's Consent Order, dated May 6, 2022, with the Connecticut Department of Energy and Environmental Protection. The Consent Order, in its entirety, is provided in Appendix A.

In accordance with Paragraph B.3 of the Consent Order, this Master Plan update has evaluated a range of viable and cost-effective measures to 1) remove excess flows, such as inflow/infiltration, from entering the collection system; and 2) eliminate the Ann Street Emergency Overflow (Emergency Overflow) from the collection system.

Section 2

Baseline Conditions

The City's collection system was originally constructed as a combined system, designed to convey both sanitary sewage and storm water during wet weather flow events. Prior to 1931, both sanitary and storm water flows were conveyed to a number of outfalls located along the Norwalk River and Harbor. In 1931, a Water Pollution Control Facility (WPCF) was constructed at South Smith Street, near Liberty Point, and flows were conveyed to the WPCF for treatment and discharge to the Norwalk River. As a designed combined system, the conveyance capacity of the collection system was regularly exceeded during wet weather flow events. During these events, the old outfalls served as high flow outfalls, providing hydraulic relief to the collection system.

As the City continued to expand, new sewers were designed and constructed as separated sanitary and storm water collection systems. Over time, the City separated portions of the existing combined collection system by constructing parallel storm drain sewers. In 1973 there was approximately 900 acres of combined sewer service area in the City. By 1979 the combined sewer service area was reduced to approximately 525 acres. Throughout the 1980s and 1990s, large scale sewer separation projects separated most of the remaining system. In 2021, 81 storm water catch basins, with a cumulative tributary drainage area of approximately 101 acres, were identified as still being directly connected to the sanitary sewer collection system.

The City's WPCF's influent pumping station (IPS) has a capacity of 95 million gallons per day (MGD), and the plant's secondary treatment train has a peak hydraulic capacity of 30 MGD. Flows in excess of 30 MGD are diverted to an on-site supplemental wet weather treatment facility (SWWTF). As designed, excess wet weather flows are diverted to the SWWTF and are discharged through Outfall 002 after receiving primary treatment (or equivalent) and disinfection/dechlorination.

2.1 Overview

Norwalk's collection system serves an approximate area of 10,625 acres and is comprised of approximately 206 miles of gravity mains, 22 pump stations, and seven miles of force mains owned by the City. The gravity mains range in size from 6 inches through 72 inches in diameter. Table 2-1 provides a list of the pump stations owned by the City and their respective pumping capacities. The locations listed in Table 2-1 represent the street address of the parcel nearest the pump station. The extent of the collection system assets is shown in Figure 2-1. During dry days, the collection system conveys an average of 12.4 MGD of wastewater to the WPCF for treatment.

Table 2-1. Sanitary Sewer Collection System Pump Station Locations and Capacities

Pump Station Name	Location	Rated Capacity (MGD)
Bell Island	33 S. Beach Drive	0.58
Bethel Street	12 Branford Street	0.26
Bouton Street	0 Bouton Street	0.92
Calf Pasture	0 Calf Pasture Beach Road	0.43
Erin Court	0 Erin Court	0.43
Five Mile River	770 Connecticut Avenue	2.59
Fort Point	10 Seaview Avenue	3.6
Fox Run	228 Fillow Street	0.14
Howard Avenue	68 Howard Avenue	1.15
Huckleberry Drive	3 Huckleberry Drive	1.73
Karen Drive	0 Karen Drive	2.59
Keeler Brook	473 Connecticut Avenue	5.33
Marvin Beach	9 River Drive	1.79
Old Trolley Way	0 Wilson Avenue	10.08
Perry Avenue	25 Perry Avenue	3.3
Red Oak Lane	9 Red Oak Lane	0.29
Sammis Street	0 Sammis Street	5.18
Shore Haven	25 Calf Pasture Beach Road	1.76
Strathmore Lane	11 Strathmore Lane	0.29
Westport Avenue	0 Westport Avenue	2.45
Winfield Street	152 Winfield Street	0.26
Woodward Avenue	167 Woodward Avenue	3.46

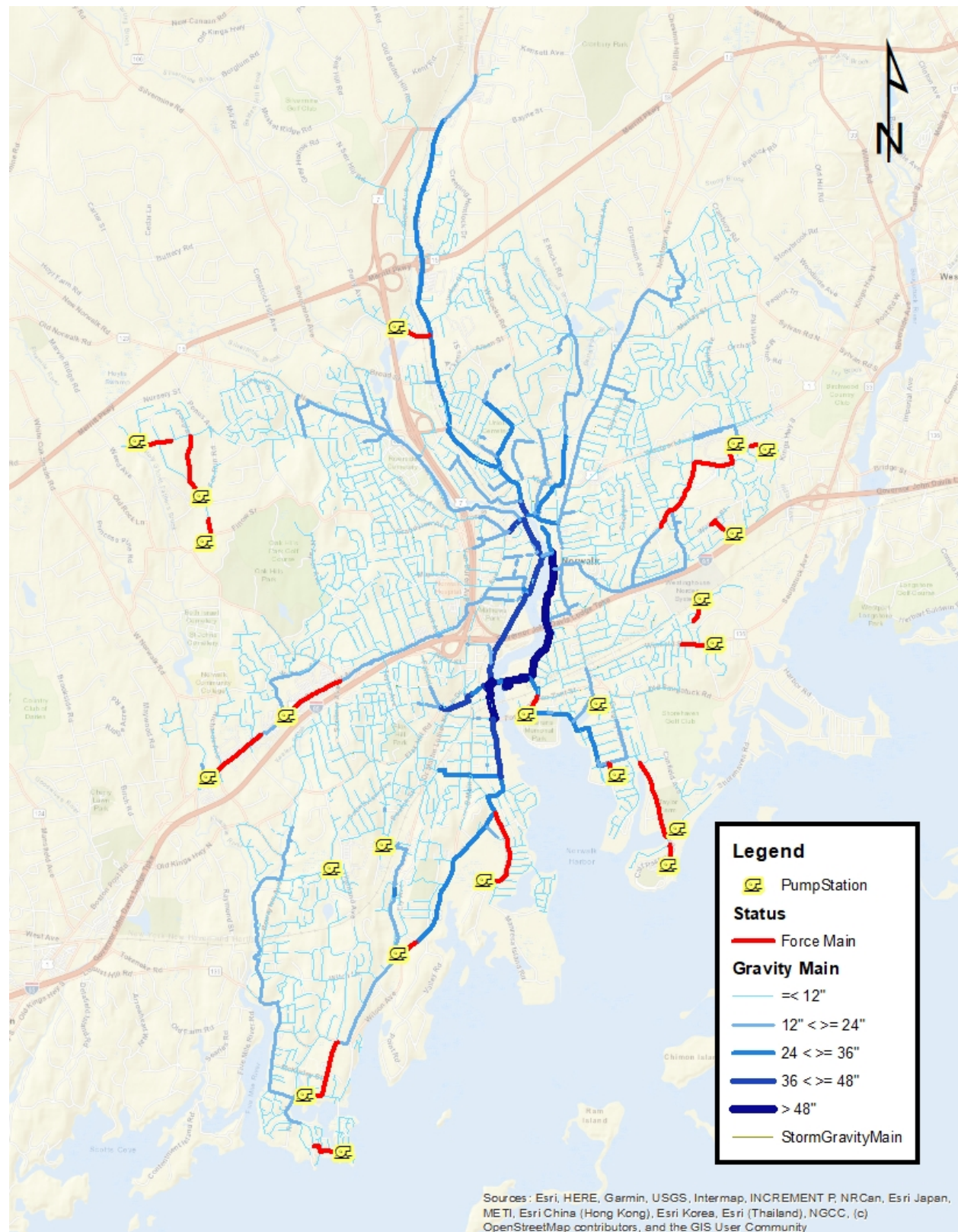


Figure 2-1. Norwalk Sanitary Sewer Collection System

2.2 Operations and Maintenance

On September 16, 2019, the City of Norwalk and Veolia Water Contract Operations USA, Inc. (Veolia) entered into a 10-year Wastewater Treatment System Service Agreement for operations, maintenance, and management of the City's wastewater treatment system. Veolia began operating the system on May 17, 2020.

Under the agreement, Veolia is responsible for the O&M of the sanitary sewer collection system, including pump stations, forcemains, pipes, siphons, and related manholes (MHs) and collection system appurtenances. Maintenance activities include TV inspection of all collection system components on a 10-year minimum cycle.

2.3 Recent Collection System Rehabilitation

In 2006, a draft Sanitary Sewer Collection System Master Plan (Original Plan) was issued for the WPCA by consultant Malcolm Pirnie, Inc. In 2009, this Original Plan was finalized using a number of new dynamic tools which allowed Malcolm Pirnie to characterize the City's collection system and identify its critical components. The WPCA used the Original Plan and its findings as a guide to address priority locations to reduce extraneous flows, alleviate capacity issues, reduce transport and treatment costs, and implement future enhancements. Beginning in 2006 and continuing through today, the WPCA has addressed a number of the recommendations in the Original Plan including interceptor rehabilitation projects and infiltration and inflow (I/I) and SSES rehabilitation projects. Some of these projects include the following:

- Fort Point (36-inch) Interceptor Replacement
- Seaview Ave (36-inch) and Cove Ave (30-inch) Interceptor CIPP Lining
- Norwalk River (48-inch) Interceptor CIPP Lining
- Beacon Street (15-inch) Interceptor CIPP Lining
- Orchard Street (24-inch) Interceptor Replacement and CIPP Lining
- Keeler Brook PS Sewer shed
- Wilton Avenue Sewer Separation
- Ann Street Siphon Chamber Rehabilitation & Tide Gates
- Beacon Street Service Area Sewer System
- Pine Point Sewer Replacement

These projects and their benefits are discussed more fully in Appendix B which discusses the diligent efforts made by the WPCA to plan and implement numerous enhancements to its collection system and infrastructure on a consistent basis over time.

2.4 Physical Characteristics of the Collection System

The City's existing Geographical Information System (GIS) was queried to assess the physical characteristics of the collection system. The collection system includes approximately 206 miles of gravity mains, 24 miles of gravity interceptors, and 6.7 miles of forcemains.

It is noted that the physical attributes of a sewer asset, including sewer pipes and MHs, such as age or material, are not necessarily an indicator of the asset's physical condition or its performance.

2.4.1 Pipe Size

Table 2-2 below shows the distribution of pipe sizes throughout the collection system. Over 88 percent of the system consists of pipes smaller than 24 inches in diameter.

Table 2-2. Pipe Size Distribution			
Diameter (in)	Length (ft)	Length (mi)	Percent of Total
6	6,431	1.2	0.6%
8	586,738	111.1	53.9%
10	115,040	21.8	10.6%
12	170,521	32.3	15.7%
14	1,568	0.3	0.1%
15	45,937	8.7	4.2%
18	36,852	7.0	3.4%
19.5	1,033	0.2	0.1%
20	7,271	1.4	0.7%
21	970	0.2	0.1%
24	33,207	6.3	3.1%
30	26,919	5.1	2.5%
31	1,243	0.2	0.1%
32	75	0.0	0.0%
36	12,010	2.3	1.1%
40	261	0.0	0.0%
41	209	0.0	0.0%
42	1,080	0.2	0.1%
43	146	0.0	0.0%
45	1,500	0.3	0.1%
45.5	518	0.1	0.0%
48	7,935	1.5	0.7%
51	28	0.0	0.0%
54	1,396	0.3	0.1%
60	5,647	1.1	0.5%
66	145	0.0	0.0%
68	81	0.0	0.0%
72	5,695	1.1	0.5%
Unknown	18,247	3.5	1.7%
Total:	1,088,703	206	100%

2.4.2 Pipe Material

Table 2-3 below shows the distribution of pipe material throughout the collection system. Most of the City's collection system consists of vitrified clay, along with large percentages of asbestos cement, PVC, and concrete pipes.

Table 2-3. Pipe Material Distribution

Material	Length (ft)	Length (mi)	Percent of Total
ACP	240,796	45.6	22.1%
Brick	8,305	1.6	0.8%
CI	693	0.1	0.1%
Concrete	149,771	28.4	13.8%
DI	7,466	1.4	0.7%
LP	11,783	2.2	1.1%
Other	67	0.0	0.0%
PVC	186,322	35.3	17.1%
VCP	460,808	87.3	42.3%
Unknown	22,692	4.3	2.1%
Total:	1,088,703	206	100%

2.4.3 Pipe Age

Table 2-4 shows a summary of pipe age and length of sewer mains that have been rehabilitated by pipe lining since 2005 throughout the collection system. The oldest sewers are generally located along the banks of the Norwalk River. These pre-1930 pipes represent 16.9 percent of the City's collection system. The majority of the collection system, 68.4 percent, was installed between 1950 and 1989. Sewer mains 50-years or older (installed prior to 1973) represent 69.3 percent of the total collection system length. Over 67,000 feet of sewer mains representing approximately 6.2 percent of the total collection system, have been lined by the WPCA.

Table 2-4. Pipe Age Distribution

Date Installed	Length (ft)	Length (mi)	Percent of Total	Lined Length (ft)	Percent Lined
1880-1889	46,007	8.7	4.2%	350	0.8%
1890-1899	23,703	4.5	2.2%	256	1.1%
1900-1909	34,240	6.5	3.1%	3,935	11.5%
1910-1919	7,224	1.4	0.7%	0	0.0%
1920-1929	40,103	7.6	3.7%	11,028	27.5%
1930-1939	45,435	8.6	4.2%	3,855	8.5%
1940-1949	34,646	6.6	3.2%	1,206	3.5%
1950-1959	207,757	39.3	19.1%	15,221	7.3%
1960-1969	176,025	33.3	16.2%	24,027	13.6%
1970-1979	194,337	36.8	17.9%	1,821	0.9%
1980-1989	117,455	22.2	10.8%	1,494	1.3%
1990-1999	27,131	5.1	2.5%	354	1.3%
2000-2009	6,369	1.2	0.6%	539	8.5%
2010-2019	2,239	0.4	0.2%	2,136	95.4%
Unknown	125,968	23.9	11.6%	818	0.6%
Total:	1,088,638	206	100%	67,040	6.2%

Section 3

Flow Metering Data

A twenty-week metering campaign was conducted from March 15 to August 1, 2021 in the City's collection system. The flow metering program was conducted to characterize dry weather flow (DWF) conditions and the flow response during wet weather flow events at various points within the collection system. The flow metering data was also used to calibrate the collection system model, described further in Section 4.

The temporary flow metering program included the installation and maintenance of a rain gage at the Broad River Fire Station and 40 flow meters at various locations throughout the collection system. Site sketches detailing the characteristics for each flow meter installation are provided in Appendix C. Locations of the flow meters are shown in Figure 3-1 and a flow meter schematic, showing the relationship between the flow meters is presented in Figure 3-2.

The temporary flow metering program was augmented by the collection of flow and level data collected at the WPCF. Flow data from a meter representing flow to the secondary treatment train was provided by the City. Flow discharged through Outfall 002 is monitored via level sensor at the WPCF grit chamber overflow weir.

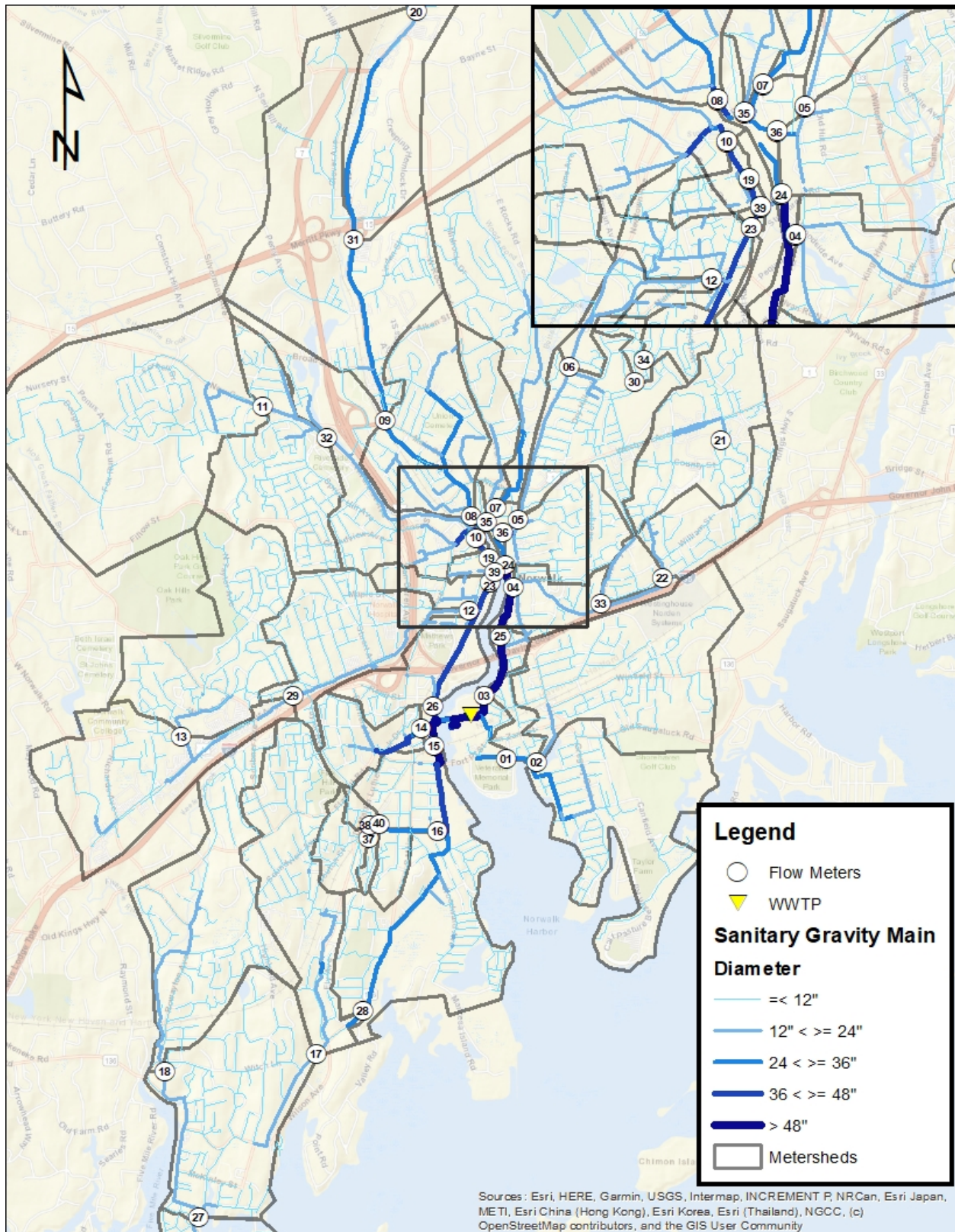


Figure 3-1. Flow Meter Locations

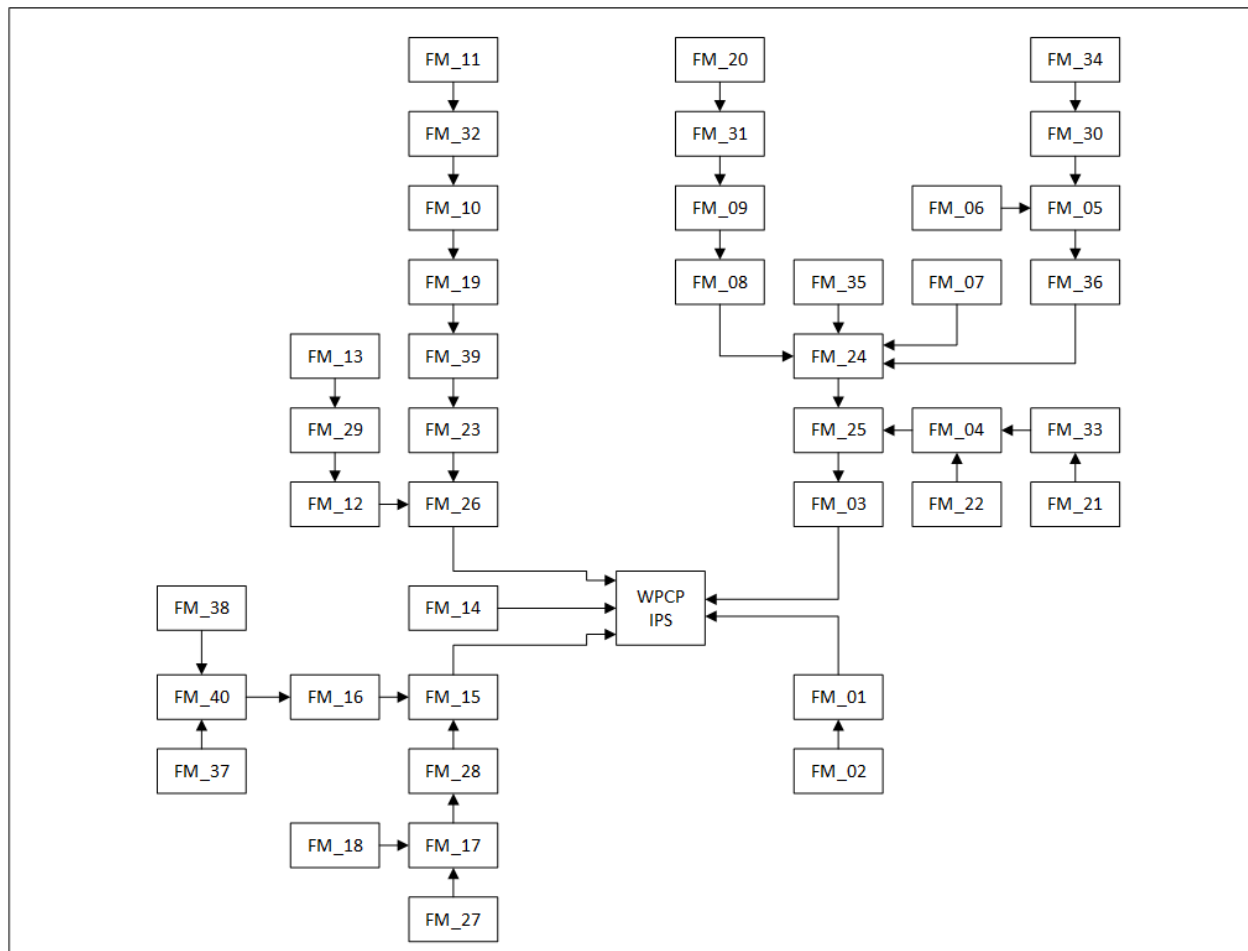


Figure 3-2. Flow Meter Schematic

3.1 Rainfall Metering Data

Rainfall was monitored using a tipping bucket rain gage capable of recording one hundredth of an inch of rain with each bucket tip. Rainfall depths were reported at a 5-minute increment timestep. Flow metering was performed using a continuously operating area-velocity flow meter. Each flow meter recorded a depth and velocity measurement at a five-minute interval. Based on the geometry of the pipe where the flow meter was installed, the depth reading is used to compute the flow area. Using the continuity equation, the flow area is multiplied by the measured velocity to calculate a flow rate at the flow meter location.

Eighteen rainfall events were identified as occurring during the metering period. A summary of the rainfall events is presented in Table 3-1. Of the identified rainfall events from the metering period, five were selected to be used as primary calibration events in the collection system model calibration.

Table 3-1. Rainfall Event Summary

Rainfall Event	Date	Duration (HRS:MIN)	Calibration Event	Total Rainfall Depth (in)	Maximum Intensity (in/hr)
1	03/18/2021	15:45	No	0.85	0.24
2	03/24/2021	08:35	No	0.65	0.24
3	03/28/2021	12:30	No	0.84	1.08
4	03/31/2021	13:10	No	0.49	0.24
5	04/11/2021	07:30	No	0.76	0.36
6	04/15/2021	12:10	Yes	1.35	0.48
7	04/25/2021	06:55	No	0.56	0.24
8	05/03/2021	02:20	No	1.54	0.84
9	05/09/2021	11:25	No	0.82	0.24
10	05/28/2021	08:50	Yes	2.77	0.48
11	06/03/2021	19:45	No	0.31	0.24
12	06/14/2021	03:30	No	0.41	1.68
13	06/19/2021	16:40	No	0.59	0.48
14	06/22/2021	04:50	No	0.49	0.96
15	06/30/2021	15:15	Yes	3.44	2.04
16	07/08/2021	08:35	Yes	5.24	2.76
17	07/12/2021	02:45	No	0.26	0.72
18	07/29/2021	07:05	Yes	1.60	4.68

The return frequency for the July 8, 2021 event (event 16) is approximately ten-years based on the Norwalk NOAA Atlas 14 precipitation frequency estimates. The return frequency of the other primary calibration rainfall events was less than 1-year. The depth-duration plots for the NOAA Atlas 14 precipitation frequency estimates and the five primary calibration rainfall events are shown in Figure 3-3.

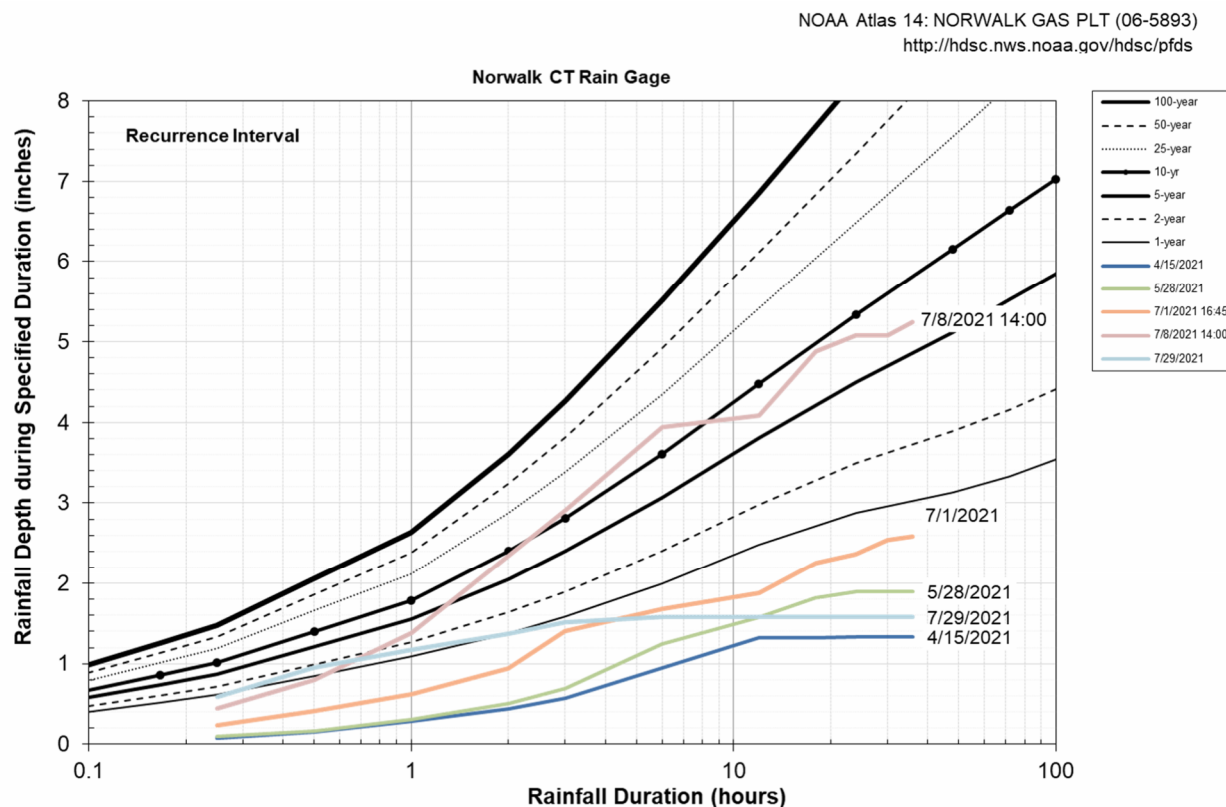


Figure 3-3. NOAA Atlas 14 and Calibration Rainfall Event Depth Duration Curves

3.2 Flow Metering Data Analysis

The collected flow metering data was reviewed and analyzed to determine average daily flow volumes, diurnal patterns, and assess infiltration and inflow response to rainfall in each metershed. A summary of the observed flows at the WPCF are presented in Table 3-2.

Table 3-2. Norwalk WPCF Flow Summary

Rainfall Event	Date	Total Rain (in)	Maximum Flow (MGD)	Minimum Flow (MGD)	Average Flow (MGD)
Average DWF	6/24/2021	0.06	14.19	5.19	10.0
1	3/18/2021	0.78	18.64	6.96	12.5
2	3/24/2021	0.48	18.91	6.82	11.7
3	3/28/2021	0.81	25.69	7.13	14.1
4	3/31/2021	0.39	19.73	8.34	12.9
5	4/11/2021	0.3	16.78	6.99	12.0
6	4/15/2021	1.32	25.35	7.71	15.3
7	4/25/2021	0.66	17.83	7.35	13.1
8	5/3/2021	0.72	15.45	6.83	11.2

Table 3-2. Norwalk WPCF Flow Summary

Rainfall Event	Date	Total Rain (in)	Maximum Flow (MGD)	Minimum Flow (MGD)	Average Flow (MGD)
9	5/9/2021	0.63	19.21	7.49	12.7
10	5/28/2021	2.85	23.14	6.12	13.4
11	6/3/2021	0.27	15.67	7.29	12.1
12	6/14/2021	0.39	20.89	6.66	11.5
13	6/19/2021	0.39	22.54	5.45	11.3
14	6/22/2021	0.45	17.97	5.37	11.0
15	7/1/2021	2.85	40.41	4.67	13.6
16	7/8/2021	5.22	76.53	5.62	27.3
17	7/12/2021	0.39	22.59	15.18	20.8
18	7/29/2021	1.14	29.99	7.46	14.0

During several wet weather flow events, surcharged conditions at some of the flow monitors were present in the flow meter data. Areas where surcharged conditions were observed in the flow monitoring data are presented in Table 3-3. Pipe surcharging during wet weather conditions provides inline storage that can reduce peak flows in the downstream portions of the system near the WPCF and Outfall 002, potentially reducing the frequency and volume of discharges from Outfall 002. During the July 8, 2021 rainfall event, the bar screens at the WPCF were blinded, and as a consequence, portions of the interceptor system experienced prolonged backwater conditions that were not induced by the flow in the collection system exceeding the conveyance capacity of the interceptor system.

Table 3-3. Flow Meter Surge Analysis

Metershed ID	Pipe Size (in)	Date	Total Rain (in)	Duration (HRS)	Maximum Depth (in)
FM_02	18	7/8/2021	5.24	11.5	40.4
FM_03	60	7/8/2021	5.24	293.9	140.6
		7/29/2021	1.60	3.1	84.5
FM_05	18	7/8/2021	5.24	0.43	29.6
FM_06	18	7/8/2021	5.24	5.5	73.1
FM_07	30	7/8/2021	5.24	1.4	43.6
FM_12	19.5	7/8/2021	5.24	0.9	21.2
FM_13	18	7/8/2021	5.24	15.1	114.8
FM_14	36	7/8/2021	5.24	1.0	53.22
FM_15	51	7/1/2021	3.44	0.1	52.0
		7/8/2021	5.24	48.9	126.2
FM_16	30	7/8/2021	5.24	1.6	64.9
FM_17	24	7/8/2021	5.24	8.1	71.5

Table 3-3. Flow Meter Surge Analysis

Metershed ID	Pipe Size (in)	Date	Total Rain (in)	Duration (HRS)	Maximum Depth (in)
FM_19	48	7/8/2021	5.24	0.6	57.2
FM_21	15	7/8/2021	5.24	6.3	81.4
		7/29/2021	1.60	0.1	16.1
FM_23	48	7/8/2021	5.24	3.8	109.9
FM_25	60	7/8/2021	5.24	254.1	152.4
		7/29/2021	1.60	0.6	66.3
FM_26	48	7/3/2021	3.44	3.4	65.2
		7/8/2021	5.24	246.6	141.12
		7/29/2021	1.60	1.6	56.5
FM_27	14	7/8/2021	5.24	36.22	123.6
FM_28	30	7/8/2021	5.24	10.2	84.8
FM_29	18	7/8/2021	5.24	19.0	24.2
FM_30	10	7/3/2021	3.44	0.3	11.8
		7/8/2021	5.24	15.7	74.6
		7/29/2021	1.60	0.8	25.4
FM_32	18	7/8/2021	5.24	5.1	79.3
FM_33	15	7/8/2021	5.24	2.2	17.1
FM_35	15	7/8/2021	5.24	1.0	21.7
		7/29/2021	1.60	0.2	22.0
FM_38	12	6/18/2021	0.59	0.1	13.1
		7/8/2021	5.24	1.6	15.4
FM_39	46	7/8/2021	5.24	3.3	103.7

3.2.1 Infiltration

Infiltration processes introduce extraneous flows from the soil column into the collection system. Water held in the soil column or pipe trench can enter the collection system through defects in MHs and sewer pipes. Peak infiltration typically occurs in spring, when the soil column is saturated and groundwater levels are highest. Peak infiltration was calculated as approximately ninety percent of the minimum nightly flow on April 18, 2021, a period in the flow monitoring record that exhibited dry weather and high groundwater conditions. Peak infiltration rates for each metershed were calculated. To allow for a more direct comparison between metersheds, the peak infiltration rates were normalized by the metershed area and by the inch-miles of sanitary sewer within the metershed area. The peak infiltration rates are presented in Table 3-4. The distribution of peak infiltration rates by metershed are shown in Figure 3-4.

It is noted that FM_23 was installed in the inlet MH to the Moodys Lane siphon which is a location subjected to turbulent flows. Review of the flow metering data indicated that data from flow meter FM_23 showed significant variations in reported flow. Data from flow meter FM_23 was deemed

invalid and was not used to assess the meter area infiltration rates and is therefore excluded from Table 3-4 and Table 3-5.

Table 3-4. Flow Meter Area Infiltration Rates

Metershed ID	Tributary Flow Meter Areas	Total Metered Flow (MGD)	Total Tributary Flow (MGD)	Metershed Area Flow (MGD)	Peak Metershed Area Infiltration (MGD)	Metershed Area Inch-Mile (in-mi)	Metershed Area Peak Infiltration Rate (gpd/in-mi)	Metershed Area (acres)	Metershed Area Peak Infiltration Rate (gpd/ac)
FM_01	FM_02	1.156	0.412	0.744	0.690	94.40	7,309	535	1,290
FM_02	--	0.412	0	0.412	0.262	81.64	3,209	546	480
FM_03	FM_25	3.412	3.021	0.391	0.098	33.35	2,939	27	3,630
FM_04	FM_22, FM_33	1.326	0.455	0.871	0.127	42.14	3,014	120	1,058
FM_05	FM_06, FM_30	0.443	0.3	0.143	0.067	88.18	760	312	215
FM_06	--	0.242	0	0.242	0.273	74.43	3,668	376	726
FM_07	--	0.257	0	0.257	0.316	96.46	3,276	648	488
FM_08	FM_09	1.412	1.076	0.336	0.005	122.07	41	356	14
FM_09	FM_31	1.076	1.014	0.062	0.187	107.81	1,735	787	238
FM_10	FM_32	0.804	0.529	0.274	0.010	91.23	110	352	28
FM_11	--	0.315	0	0.315	0.502	86.75	5,787	939	535
FM_12	FM_29	0.902	0.663	0.239	0.029	99.49	291	315	92
FM_13	--	0.610	0	0.61	0.514	81.54	6,304	452	1,137
FM_14	--	0.402	0	0.402	0.128	42.47	3,014	120	1,067
FM_15	FM_16, FM_28	2.636	1.367	1.269	1.283	159.84	8,027	601	2,135
FM_16	FM_40	0.371	0.191	0.18	0.101	27.93	3,616	50	2,020
FM_17	FM_18, FM_27	0.534	0.414	0.12	0.173	121.37	1,425	527	328
FM_18	--	0.258	0	0.258	0.174	97.34	1,788	508	343
FM_19	FM_10	0.897	0.804	0.094	0.107	20.21	5,294	21	5,095
FM_20	--	0.520	0	0.52	0.308	121.21	2,541	195	1,579
FM_21	--	0.334	0	0.334	0.170	53.55	3,175	278	612
FM_22	--	0.074	0	0.074	0.028	30.97	904	144	194
FM_24	FM_07, FM_08, FM_35, FM_36	2.659	2.634	0.025	0.310	24.65	12,576	21	14,762
FM_25	FM_04, FM_24	3.021	3.985	-0.964	0.047	21.34	2,202	15	3,133
FM_26	FM_12, FM_23	2.585	1.863	0.722	0.784	74.78	10,484	239	3,280
FM_27	--	0.156	0	0.156	0.065	28.23	2,303	141	461
FM_28	FM_17	0.996	0.534	0.462	0.043	95.20	452	410	105
FM_29	FM_13	0.663	0.61	0.053	0.085	55.27	1,538	396	215
FM_30	FM_34	0.058	0.025	0.033	0.022	9.40	2,340	35	629

Table 3-4. Flow Meter Area Infiltration Rates

Metershed ID	Tributary Flow Meter Areas	Total Metered Flow (MGD)	Total Tributary Flow (MGD)	Metershed Area Flow (MGD)	Peak Metershed Area Infiltration (MGD)	Metershed Area Inch-Mile (in-mi)	Metershed Area Peak Infiltration Rate (gpd/in-mi)	Metershed Area (acres)	Metershed Area Peak Infiltration Rate (gpd/ac)
FM_31	FM_20	1.014	0.52	0.494	0.311	64.22	4,843	334	931
FM_32	FM_11	0.529	0.315	0.214	0.007	81.04	86	360	19
FM_33	FM_21	0.381	0.334	0.047	0.086	29.48	2,917	146	589
FM_34	--	0.025	0	0.025	0.046	15.52	2,964	80	575
FM_35	--	0.304	0	0.304	0.034	25.52	1,332	120	283
FM_36	FM_05	0.661	0.443	0.218	0.235	53.83	4,366	201	1,169
FM_37	--	0.039	0	0.039	0.029	5.88	4,932	13	2,231
FM_38	--	0.045	0	0.045	0.023	6.00	3,833	19	1,211
FM_39	FM_19	0.705	0.897	0	0.000	0.92	0	2	0
FM_40	FM_37, FM_38	0.191	0.084	0.107	0.117	20.27	5,772	76	1,539

During the peak infiltration period, a total peak infiltration rate across all metershed areas was calculated at 7.9 MGD. During the same period, the average peak infiltration rate for the entire system was 3,845 gallons per day per inch-mile (gpd/in-mi). A priority ranking of peak infiltration rates, by metershed area, is shown in Table 3-5.

Table 3-5. Flow Meter Area Infiltration Rates

Priority Ranking	Metershed ID	Tributary Flow Meter Areas	Metershed Area Inch-Miles (in-mi)	Metershed Area Peak Infiltration Rate (gpd/in-mi)	Metershed Area (acres)	Metershed Area Peak Infiltration Rate (gpd/ac)
1	FM_24	FM_07, FM_08, FM_35, FM_36	24.65	12,576	21	14,762
2	FM_26	FM_12, FM_23	74.78	10,484	239	3,280
3	FM_15	FM_16, FM_28	159.84	8,027	601	2,135
4	FM_01	FM_02	94.40	7,309	535	1,290
5	FM_13	--	81.54	6,304	452	1,137
6	FM_11	--	86.75	5,787	939	535
7	FM_40	FM_37, FM_38	20.27	5,772	76	1,539
8	FM_19	FM_10	20.21	5,294	21	5,095
9	FM_37	--	5.88	4,932	13	2,231
10	FM_31	FM_20	64.22	4,843	334	931
11	FM_36	FM_05	53.83	4,366	201	1,169
12	FM_38	--	6.00	3,833	19	1,211
13	FM_06	--	74.43	3,668	376	726

Table 3-5. Flow Meter Area Infiltration Rates

Priority Ranking	Metershed ID	Tributary Flow Meter Areas	Metershed Area Inch-Miles (in-mi)	Metershed Area Peak Infiltration Rate (gpd/in-mi)	Metershed Area (acres)	Metershed Area Peak Infiltration Rate (gpd/ac)
14	FM_16	FM_40	27.93	3,616	50	2,020
15	FM_07	--	96.46	3,276	648	488
16	FM_02	--	81.64	3,209	546	480
17	FM_21	--	53.55	3,175	278	612
18	FM_04	FM_22, FM_33	42.14	3,014	120	1,058
19	FM_14	--	42.47	3,014	120	1,067
20	FM_34	--	15.52	2,964	80	575
21	FM_03	FM_25	33.35	2,939	27	3,630
22	FM_33	FM_21	29.48	2,917	146	589
23	FM_20	--	121.21	2,541	195	1,579
24	FM_30	FM_34	9.40	2,340	35	629
25	FM_27	--	28.23	2,303	141	461
26	FM_25	FM_04, FM_24	21.34	2,202	15	3,133
27	FM_18	--	97.34	1,788	508	343
28	FM_09	FM_31	107.81	1,735	787	238
29	FM_29	FM_13	55.27	1,538	396	215
30	FM_17	FM_18, FM_27	121.37	1,425	527	328
31	FM_35	--	25.52	1,332	120	283
32	FM_22	--	30.97	904	144	194
33	FM_05	FM_06, FM_30	88.18	760	312	215
34	FM_28	FM_17	95.20	452	410	105
35	FM_12	FM_29	99.49	291	315	92
36	FM_10	FM_32	91.23	110	352	28
37	FM_32	FM_11	81.04	86	360	19
38	FM_08	FM_09	122.07	41	356	14
39	FM_39	FM_19	0.92	0	2	0

Flow meter area FM_24 exhibits the highest peak infiltration rate at 12,576 gpd/in-mi. FM_24 measures flow from an area of approximately 21.4 acres and exhibits a significant increase in minimum nightly flows as compared to the cumulative minimum nightly flows measured at its upstream meters (FM_07, FM_08, FM_35, and FM_36).

Figure 3-4 shows the distribution of peak infiltration rates by metershed with an overlay of delineated wetland areas. The GIS feature class of Connecticut wetlands was obtained from the U.S. Fish and Wildlife Service website. The majority of the metersheds experiencing significant infiltration are located adjacent to or along either the Norwalk River or Norwalk Harbor. These areas are among the oldest parts of the city and have aged sewer assets. FM_11 and FM_13, located in the

northwestern portion of Norwalk, are noted as having a significant amount of wetland area in close proximity to the sanitary sewer.

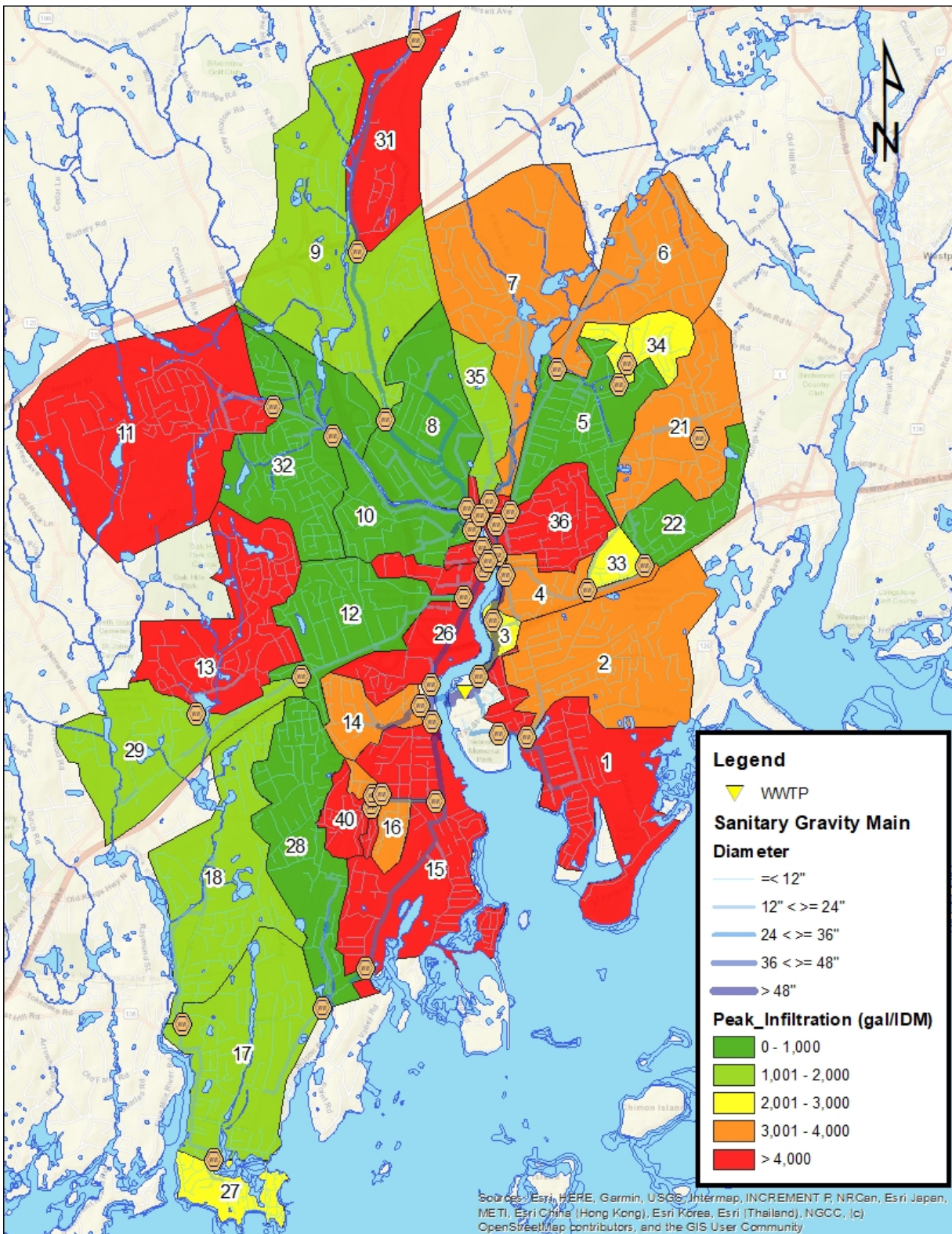


Figure 3-4. Metershed Peak Infiltration Rates

3.2.2 Rainfall Derived Inflow and Infiltration

Rainfall-derived inflow and infiltration (RDII) is extraneous stormwater, surface water, or groundwater flows which enter the sanitary collection system. Rainfall derived inflow enters the sanitary collection system through direct connections with stormwater catch basins, roof leaders, sump pumps and foundation drains, or through inundation from surface water bodies. Rainfall derived infiltration is the short-term increase in infiltration that is the direct result of rainfall. As rainfall percolates into the soil column, it may enter the pipe trench and enter the collection system through defects in sanitary sewer pipes and MHs.

Direct inflow volume was calculated as the difference between the typical DWF and the flow measured during a rainfall event. Indirect inflow volume was calculated as the difference between typical DWF and the measured flow from the end of the rainfall event until flow returns to dry weather conditions. The peak inflow rate is defined as the largest measured flow value during a rainfall event. A typical DWF pattern and volume, representing the baseflow conditions, were derived from the measured flow data for each flow meter area. The baseflow hydrograph was subtracted from the measured flow during rainfall events to determine the direct, indirect and total inflow volumes. Peaking factors for each rainfall event were calculated by dividing the peak inflow rate by the average daily DWF.

Total, direct, indirect inflow volumes, peak flow rates, and peaking factors were calculated for the five rainfall events used as the primary calibration events in the collection system model and are shown in Table 3-6, Table 3-7, Table 3-8, Table 3-9, and Table 3-10, respectively.

The April 15, 2021 rainfall event, which had a less than 1-year return frequency, produced peaking factors that ranged from a minimum of 1.3 to a maximum of 11.0 and a total inflow volume of 57.7 million gallons (MG). The May 28, 2021 rainfall event, which also had a less than 1-year return frequency, produced peaking factors that ranged from a minimum of 1.3 to a maximum of 10.0 and a total inflow volume of 47.7 MG. The June 30, 2021 rainfall event, which had a return frequency approaching a 1-year rainfall event, produced peaking factors that ranged from a minimum of 1.4 to a maximum of 24.3 and a total inflow volume of 44.0 MG. The July 8, 2021 rainfall event, the remnants of Hurricane Elsa, had a 10-year return frequency and produced peaking factors that ranged from a minimum of 2.1 to a maximum of 57.9 and a total inflow volume of 216.9 MG. The July 29, 2021 rainfall was a short duration high-intensity rainfall, having an approximate 2-year return frequency at a 30-minute duration. This event produced peaking factors ranged from a minimum of 1.7 to a maximum of 17.7 and a total inflow volume of 20.5 MG.

Table 3-6. Metershed Inflow Rates for the April 15, 2021 Rainfall Event

Metershed ID	Peak Inflow Rate (MGD)	Peaking Factor	Total Inflow (MG)	Direct Inflow Volume (MG)	Indirect Inflow Volume
FM_01	3.37	2.9	1.57	0.24	1.33
FM_02	1.49	3.6	0.66	0.15	0.50
FM_03	9.22	2.7	5.47	1.06	4.41
FM_04	1.67	1.3	0.92	0.23	0.69
FM_05	1.93	4.4	1.80	0.30	1.50
FM_06	0.54	2.2	0.69	0.01	0.68
FM_07	0.82	3.2	1.10	0.14	0.97
FM_08	3.79	2.7	1.62	0.47	1.15
FM_09	2.58	2.4	1.82	0.30	1.51
FM_10	2.72	3.4	1.67	0.50	1.17
FM_11	--	--	--	--	--
FM_12	2.16	2.4	1.45	0.32	1.13
FM_13	1.16	1.9	0.99	0.11	0.88
FM_14	1.35	3.3	0.13	0.12	0.01
FM_15	6.46	2.4	4.80	0.86	3.93
FM_16	1.18	3.2	0.80	0.13	0.66
FM_17	1.76	3.3	1.72	0.25	1.47
FM_18	0.56	2.1	0.15	0.08	0.07
FM_19	3.26	3.6	1.56	0.52	1.05
FM_20	1.05	2.0	0.50	0.00	0.50
FM_21	0.91	2.7	0.45	0.23	0.22
FM_22	0.16	2.2	0.23	0.06	0.17
FM_23	3.01	3.1	1.78	0.54	1.25
FM_24	8.26	3.1	5.02	1.95	3.08
FM_25	9.67	3.2	6.31	2.23	4.08
FM_26	6.80	2.6	3.64	0.74	2.90
FM_27	0.29	1.9	0.18	0.00	0.18
FM_28	2.26	2.3	2.40	0.48	1.92
FM_29	1.35	2.0	1.52	0.40	1.12
FM_30	0.29	5.0	0.28	0.10	0.18
FM_31	2.41	2.4	1.38	0.01	1.37
FM_32	1.74	3.3	0.66	0.16	0.49
FM_33	0.77	2.0	0.12	0.00	0.12
FM_34	0.28	11.0	0.10	0.00	0.10
FM_35	0.58	1.9	0.22	0.10	0.12
FM_36	2.62	4.0	2.05	0.42	1.62
FM_37	0.14	3.5	0.12	0.02	0.10
FM_38	0.24	5.4	0.04	0.03	0.01
FM_39	4.20	5.9	1.37	0.93	0.44
FM_40	0.76	4.0	0.50	0.15	0.35

Table 3-7. Metershed Inflow Rates for the May 28, 2021 Rainfall Event

Metershed ID	Peak Inflow Rate (MGD)	Peaking Factor	Total Inflow (MG)	Direct Inflow Volume (MG)	Indirect Inflow Volume
FM_01	3.02	2.6	3.04	0.87	2.17
FM_02	1.28	3.1	0.53	0.08	0.45
FM_03	4.45	1.3	4.02	0.58	3.44
FM_04	1.69	1.3	0.42	0.12	0.30
FM_05	1.78	4.0	1.70	0.19	1.51
FM_06	--	--	--	--	--
FM_07	0.62	2.4	0.77	0.01	0.76
FM_08	3.32	2.4	0.95	0.32	0.63
FM_09	1.93	1.8	0.21	0.00	0.21
FM_10	2.92	3.6	1.97	0.62	1.34
FM_11	0.90	2.9	0.78	0.12	0.66
FM_12	--	--	--	--	--
FM_13	1.03	1.7	0.59	0.03	0.56
FM_14	1.62	4.0	0.45	0.19	0.26
FM_15	6.12	2.3	5.12	0.69	4.44
FM_16	1.26	3.4	0.94	0.19	0.75
FM_17	1.31	2.4	1.12	0.02	1.10
FM_18	0.44	1.7	0.40	0.03	0.37
FM_19	2.74	3.1	1.29	0.43	0.86
FM_20	1.10	2.1	0.31	0.10	0.22
FM_21	0.74	2.2	0.28	0.09	0.19
FM_22	0.10	1.4	0.20	0.02	0.18
FM_23	2.85	3.0	1.77	0.73	1.04
FM_24	7.47	2.8	4.06	0.57	3.49
FM_25	8.49	2.8	4.36	0.89	3.47
FM_26	6.38	2.5	2.88	0.47	2.40
FM_27	0.35	2.2	0.37	0.00	0.37
FM_28	2.01	2.0	2.18	0.23	1.95
FM_29	1.15	1.7	1.32	0.23	1.10
FM_30	0.19	3.3	0.16	0.02	0.14
FM_31	1.78	1.8	0.42	0.22	0.21
FM_32	1.60	3.0	0.91	0.14	0.77
FM_33	0.65	1.7	0.10	0.00	0.10
FM_34	0.16	6.3	0.17	0.02	0.15
FM_35	0.63	2.1	0.22	0.15	0.07
FM_36	2.41	3.6	1.77	0.35	1.42
FM_37	0.19	4.7	0.13	0.02	0.12
FM_38	0.45	10.0	0.13	0.09	0.04
FM_39	5.13	7.3	1.05	0.37	0.69
FM_40	0.61	3.2	0.41	0.04	0.37

Table 3-8. Metershed Inflow Rates for the June 30, 2021 Rainfall Event

Metershed ID	Peak Inflow Rate (MGD)	Peaking Factor	Total Inflow (MG)	Direct Inflow Volume (MG)	Indirect Inflow Volume
FM_01	3.12	2.7	2.02	0.16	1.86
FM_02	3.03	7.4	1.02	0.25	0.77
FM_03	16.24	4.8	3.45	0.97	2.48
FM_04	1.80	1.4	0.22	0.18	0.03
FM_05	3.27	7.4	1.43	0.24	1.20
FM_06	--	--	--	--	--
FM_07	0.67	2.6	0.58	0.03	0.55
FM_08	6.15	4.4	1.12	0.41	0.71
FM_09	1.96	1.8	0.06	0.00	0.06
FM_10	3.97	4.9	1.51	0.65	0.86
FM_11	1.42	4.5	0.65	0.45	0.20
FM_12	2.99	3.3	1.38	0.19	1.19
FM_13	1.35	2.2	0.91	0.04	0.87
FM_14	3.56	8.9	0.75	0.46	0.29
FM_15	14.78	5.6	6.35	0.96	5.38
FM_16	2.75	7.4	1.09	0.30	0.79
FM_17	1.46	2.7	1.14	0.07	1.07
FM_18	0.63	2.4	0.49	0.02	0.47
FM_19	5.04	5.6	1.42	0.63	0.79
FM_20	0.83	1.6	0.05	0.03	0.02
FM_21	1.34	4.0	0.37	0.13	0.24
FM_22	0.19	2.5	0.14	0.02	0.12
FM_23	4.71	4.9	1.08	0.48	0.60
FM_24	--	--	--	--	--
FM_25	15.03	5.0	3.76	1.08	2.68
FM_26	11.04	4.3	2.04	0.67	1.37
FM_27	0.44	2.8	0.51	0.02	0.49
FM_28	3.61	3.6	2.78	0.35	2.43
FM_29	1.46	2.2	1.12	0.10	1.02
FM_30	0.46	7.9	0.14	0.02	0.12
FM_31	1.73	1.7	0.26	0.11	0.15
FM_32	1.69	3.2	1.32	0.11	1.22
FM_33	1.03	2.7	0.06	0.05	0.01
FM_34	0.24	9.4	0.13	0.02	0.11
FM_35	1.87	6.2	0.17	0.14	0.03
FM_36	4.97	7.5	1.86	0.49	1.37
FM_37	0.39	9.8	0.22	0.03	0.19
FM_38	1.09	24.3	0.21	0.15	0.06
FM_39	7.72	10.9	1.51	0.76	0.75
FM_40	1.71	8.9	0.64	0.17	0.47

Table 3-9. Metershed Inflow Rates for the July 8, 2021 Rainfall Event

Metershed ID	Peak Inflow Rate (MGD)	Peaking Factor	Total Inflow (MG)	Direct Inflow Volume (MG)	Indirect Inflow Volume
FM_01	--	--	--	--	--
FM_02	4.65	11.3	5.13	1.65	3.47
FM_03	40.67	11.9	20.17	5.55	14.63
FM_04	2.83	2.1	2.80	0.20	2.60
FM_05	5.29	11.9	7.71	0.90	6.80
FM_06	--	--	--	--	--
FM_07	3.28	12.7	4.11	0.45	3.66
FM_08	12.72	9.0	6.19	1.99	4.19
FM_09	5.17	4.8	2.84	0.60	2.23
FM_10	8.34	10.4	6.57	0.65	5.92
FM_11	3.91	12.4	4.22	0.41	3.80
FM_12	6.13	6.8	5.81	0.73	5.09
FM_13	3.11	5.1	5.99	0.17	5.82
FM_14	17.60	43.8	2.61	1.26	1.35
FM_15	18.68	7.1	23.01	6.04	16.97
FM_16	7.76	20.9	3.65	1.19	2.46
FM_17	4.13	7.7	6.27	1.44	4.84
FM_18	2.84	11.0	3.31	0.56	2.76
FM_19	11.17	12.5	6.86	1.07	5.78
FM_20	1.68	3.2	1.12	0.60	0.52
FM_21	--	--	--	--	--
FM_22	1.00	13.5	1.10	0.11	0.99
FM_23	5.04	5.2	1.93	0.82	1.11
FM_24	--	--	--	--	--
FM_25	38.23	12.7	19.64	5.52	14.12
FM_26	18.50	7.2	18.90	3.13	15.77
FM_27	--	--	--	--	--
FM_28	6.95	7.0	14.75	2.20	12.55
FM_29	3.80	5.7	7.10	0.54	6.56
FM_30	0.83	14.3	1.14	0.21	0.93
FM_31	4.34	4.3	2.06	0.48	1.58
FM_32	10.84	20.5	8.30	0.56	7.74
FM_33	3.46	9.1	2.15	0.63	1.51
FM_34	--	--	--	--	--
FM_35	3.66	12.1	0.76	0.50	0.26
FM_36	11.08	16.8	8.18	1.74	6.44
FM_37	--	--	--	--	--
FM_38	2.61	57.9	0.63	0.45	0.18
FM_39	17.81	25.2	9.48	2.70	6.78
FM_40	4.39	23.0	2.41	0.78	1.64

Table 3-10. Metershed Inflow Rates for the July 29, 2021 Rainfall Event

Metershed ID	Peak Inflow Rate (MGD)	Peaking Factor	Total Inflow (MG)	Direct Inflow Volume (MG)	Indirect Inflow Volume
FM_01	--	--	--	--	--
FM_02	2.81	6.8	0.33	0.07	0.25
FM_03	14.93	4.4	0.98	0.66	0.32
FM_04	2.83	2.1	3.10	0.20	2.90
FM_05	4.00	9.0	0.97	0.26	0.71
FM_06	--	--	--	--	--
FM_07	2.05	8.0	0.37	0.07	0.31
FM_08	11.14	7.9	0.98	0.38	0.59
FM_09	2.21	2.1	0.04	0.04	0.00
FM_10	5.58	6.9	0.92	0.25	0.66
FM_11	2.46	7.8	0.43	0.07	0.36
FM_12	2.82	3.1	0.37	0.10	0.26
FM_13	1.70	2.8	0.29	0.05	0.24
FM_14	3.74	9.3	0.46	0.13	0.33
FM_15	6.96	2.6	1.55	0.21	1.34
FM_16	2.23	6.0	0.19	0.05	0.14
FM_17	1.01	1.9	0.17	0.01	0.15
FM_18	0.48	1.9	0.20	0.05	0.15
FM_19	7.53	8.4	0.78	0.46	0.32
FM_20	1.04	2.0	0.14	0.07	0.07
FM_21	2.23	6.7	0.26	0.07	0.18
FM_22	0.16	2.1	0.10	0.01	0.08
FM_23	6.22	6.5	1.08	0.35	0.73
FM_24	--	--	--	--	--
FM_25	22.05	7.3	1.67	0.61	1.06
FM_26	9.81	3.8	1.23	0.36	0.87
FM_27	0.27	1.8	0.11	0.01	0.10
FM_28	1.74	1.7	0.92	0.00	0.92
FM_29	1.91	2.9	0.49	0.08	0.41
FM_30	0.68	11.7	0.14	0.04	0.10
FM_31	--	--	--	--	--
FM_32	1.95	3.7	0.41	0.13	0.28
FM_33	1.70	4.5	0.07	0.04	0.04
FM_34	0.31	12.3	0.08	0.02	0.06
FM_35	5.38	17.7	0.09	0.07	0.03
FM_36	8.76	13.2	0.89	0.31	0.58
FM_37	0.11	2.7	0.02	0.01	0.02
FM_38	0.56	12.4	0.03	0.01	0.02
FM_39	7.17	10.2	0.57	0.20	0.36
FM_40	1.41	7.4	0.07	0.02	0.05

Table 3-11 presents the priority ranking of each metershed area based on the average peak RDII inflow rates normalized by metershed area.

Table 3-11. Metershed RDII Priority Ranking						
Priority Rank	Metershed ID	Metershed Area (ac)	Average of Peak RDII Flow Rates (MGD)	Cumulative RDII Inflow Rate (MGD)	Average of Peak RDII Inflow Rates (GPAD)	Cumulative Inflow Contribution
1	FM_39 ¹	2	0.13	0.13	64,877	0.2%
2	FM_38 ¹	19	1.12	1.25	60,398	2.3%
3	FM_03 ¹	27	1.19	2.44	43,614	4.5%
4	FM_19 ¹	21	0.75	3.19	35,538	5.9%
5	FM_25 ¹	15	0.50	3.69	34,004	6.8%
6	FM_14 ¹	120	3.06	6.76	25,552	12.5%
7	FM_35 ¹	120	2.42	9.18	20,126	17.0%
8	FM_24 ¹	21	0.40	9.57	18,536	17.8%
9	FM_08 ¹	356	6.43	16.00	18,080	29.7%
10	FM_37	13	0.22	16.23	16,876	30.1%
11	FM_28 ¹	410	6.40	22.62	15,621	42.0%
12	FM_16 ¹	50	0.73	23.35	14,539	43.3%
13	FM_36 ¹	201	2.85	26.20	14,217	48.6%
14	FM_26 ¹	239	2.46	28.67	10,301	53.2%
15	FM_23	2	0.02	28.69	9,877	53.2%
16	FM_05 ¹	312	2.87	31.56	9,195	58.5%
17	FM_33 ¹	146	1.23	32.79	8,410	60.8%
18	FM_30 ¹	35	0.26	33.05	7,495	61.3%
19	FM_32	360	2.11	35.16	5,851	65.2%
20	FM_22 ¹	144	0.78	35.94	5,418	66.6%
21	FM_12	315	1.37	37.31	4,353	69.2%
22	FM_02 ¹	546	2.29	39.60	4,206	73.4%
23	FM_21 ¹	278	1.16	40.76	4,165	75.6%
24	FM_15	601	2.41	43.17	4,017	80.1%
25	FM_20	195	0.60	43.77	3,058	81.2%
26	FM_13	452	1.31	45.08	2,904	83.6%
27	FM_18	508	1.25	46.33	2,468	85.9%
28	FM_27	141	0.35	46.68	2,459	86.6%
29	FM_11	939	2.24	48.92	2,381	90.7%
30	FM_29	396	0.90	49.82	2,282	92.4%
31	FM_10	352	0.73	50.55	2,064	93.7%
32	FM_34	80	0.16	50.70	1,955	94.0%
33	FM_07	648	1.11	51.82	1,718	96.1%
34	FM_31	334	0.47	52.28	1,396	97.0%
35	FM_06	376	0.49	52.77	1,305	97.9%
36	FM_01	535	0.62	53.40	1,168	99.0%
37	FM_04	120	0.11	53.51	898	99.2%

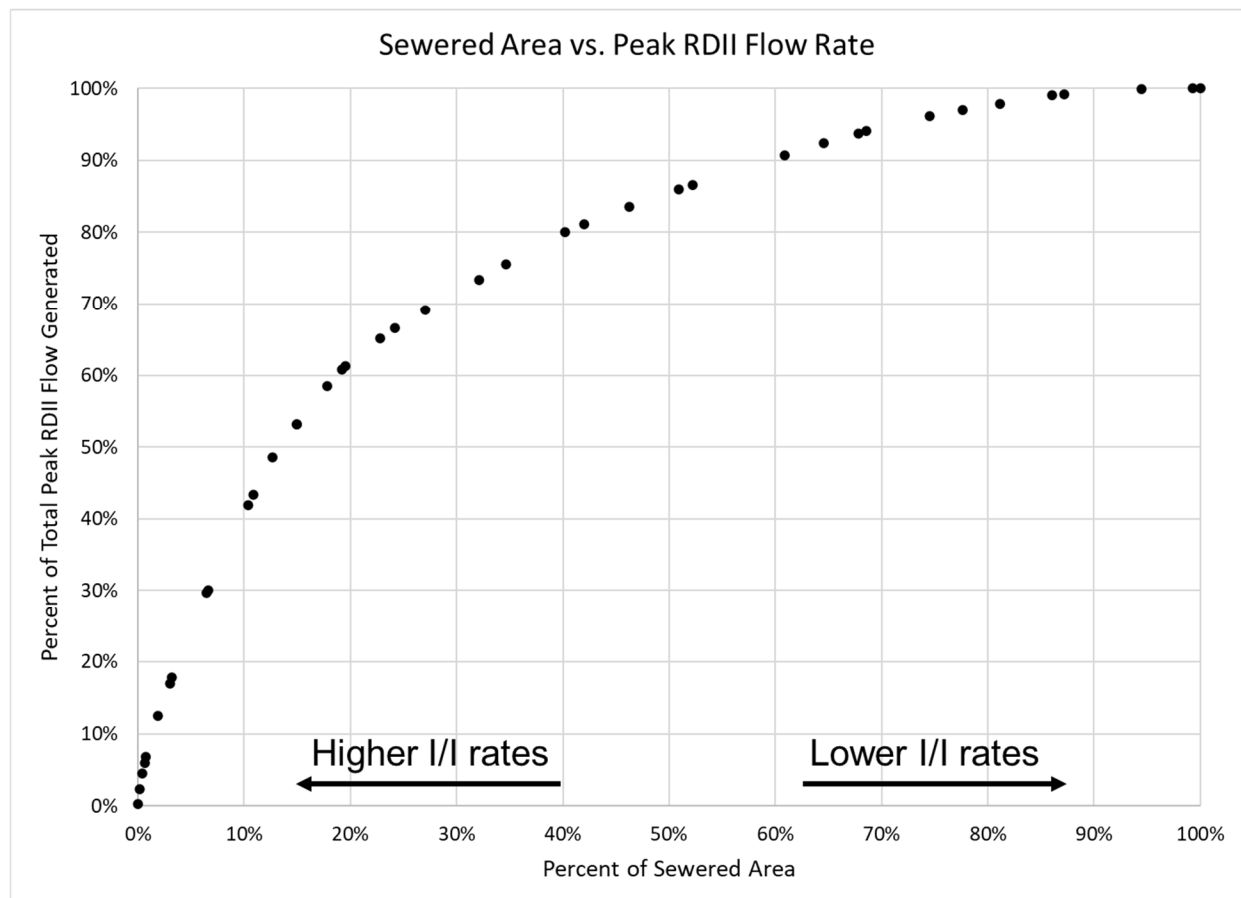
Table 3-11. Metershed RDII Priority Ranking

Priority Rank	Metershed ID	Metershed Area (ac)	Average of Peak RDII Flow Rates (MGD)	Cumulative RDII Inflow Rate (MGD)	Average of Peak RDII Inflow Rates (GPAD)	Cumulative Inflow Contribution
38	FM_09	787	0.34	53.84	429	99.9%
39	FM_17	527	0.07	53.92	142	100.0%
40	FM_40	76	0.00	53.92	0	100.0%

¹Metershed area is included in the 80 percent source group for all five rainfall events analyzed.

The average peak RDII inflow rates were calculated from the peak RDII inflow rate determined from the five rainfall events used in the calibration of the collection system model. An 80 percent source level is a commonly used threshold in considering significant inflow in sanitary collection systems. 24 of the 40 metershed areas account for 80.1 percent of the cumulative peak RDII flow from the rainfall events analyzed. 19 flow meter areas, denoted in Table 3-11, are included in the 80 percent source group for all five rainfall events that were analyzed.

Figure 3-5 shows the percent of the total peak RDII flow rate generated from the percent cumulative sewered area. Plotting the percent of the total RDII peak flow against the cumulative percent of sewered area shows that 80 percent of the peak RDII flow rate is generated from approximately 40 percent of the collection system tributary area.

**Figure 3-5. Cumulative Sewered Area vs. Cumulative Peak RDII Flow Rate**

Section 4

Collection System Model

The hydraulic model represents the collection system as a series of nodes (MHs, wet wells, and outfalls) connected by links (pipes, weirs, and pumps). The model includes the east and west interceptors as well as the major trunk sewers that feed into them. The model does not contain the smaller local sewer branches that are tributary to the trunk sewers. Locations where these smaller sewers connect into the modeled pipes were generally used as flow loading locations.

Pump stations, wet wells, and forcemains were included within the hydraulic model network. Wet well dimensions, pump capacity, and start/stop set points were added using drawings and information provided by the WPCA.

Dry weather and wet weather inflows are incorporated into the model. DWFs, representative of the sanitary sewage and persistent groundwater infiltration (GWI) volumes are represented as inflows at the subcatchment outlet nodes. Temporally varying GWI was modeled as a subcatchment outflow using modeled aquifers. A total of 121 subcatchments were created within the model, generally delineating areas in the collection system where local sewers connect into the main trunk and interceptor sewers as noted above.

As noted in Section 3, several rain events from the flow monitoring period were chosen as calibration events. The observed rainfall was applied to the model subcatchments and hydrologic parameters within the model were adjusted until a good fit between the observed meter data and modeled flows and levels were achieved. Targeted calibration goals for each rainfall event are noted below:

- Peak modeled flows within +/-30% of peak observed flows
- Volume of modeled flows within +/-30% of observed volume
- Peak depth of modeled flows within +/-30% of peak depth of observed flows
- Good visual fit (timing of peak, shape of hydrograph)

The calibration targets were generally achieved for a majority of the calibration events for nearly all 40 flow meter areas. Data from flow meter FM_04 showed increases in flow between it and the upstream meters FM_33 and FM_22 which is unlikely to be accurate due to the amount of sewered area between FM_04 and the upstream meters. Calibration targets for FM_04 were unable to be achieved due to this erroneous flow meter data.

4.1 Collection System Model

A computer model of the City's wastewater collection system was developed using the PCSWMM software, developed by Computational Hydraulics, Inc. The collection system model was developed and used for analysis of existing conditions and to support modeling of potential sewer improvement alternatives and future conditions. The collection system model includes both the east and west side interceptors and their major tributary sewers, the siphons at Moodys Lane and Ann Street, the Emergency Overflow, and all major pump stations. The model's downstream boundary is the Norwalk WPCF IPS which includes the wet well storage and pumping operations at the WPCF.

Table 4-1 summarizes the statistics of the modeled collection system relative to the City's entire sanitary collection system.

Table 4-1. Summary of Hydraulic Model Components

System Parameters	Existing Sanitary System	Model Network	Percent of Total System Included in the Model Network
Length of Collection System (ft)	1,088,703	237,874	21.8%
Pipe Diameter Range (in.)	8 - 72	8 - 72	-
Number of Pump Stations	22	11	50%

4.1.1 Hydraulic Model Development

Hydraulic model assets including pipes, MHs, pump stations, and forcemains were imported from the City's GIS dataset into the modeling software. MHs that were missing a defined rim elevation value in the City's sewer GIS dataset and were critical in the development of the hydraulic model, were identified. Rim elevation values for these MHs were assigned from a digital elevation model (DEM) obtained from the CT Environmental Conditions Line (CTECO website). MHs that were missing a defined invert elevation in the City's sewer GIS dataset and were critical in the development of the hydraulic model were marked for additional field investigation and surveying. The invert elevations for these MHs were calculated by subtracting the measured MH depth from the rim elevation. Figure 4-1 below shows the locations of MHs identified for field investigations.

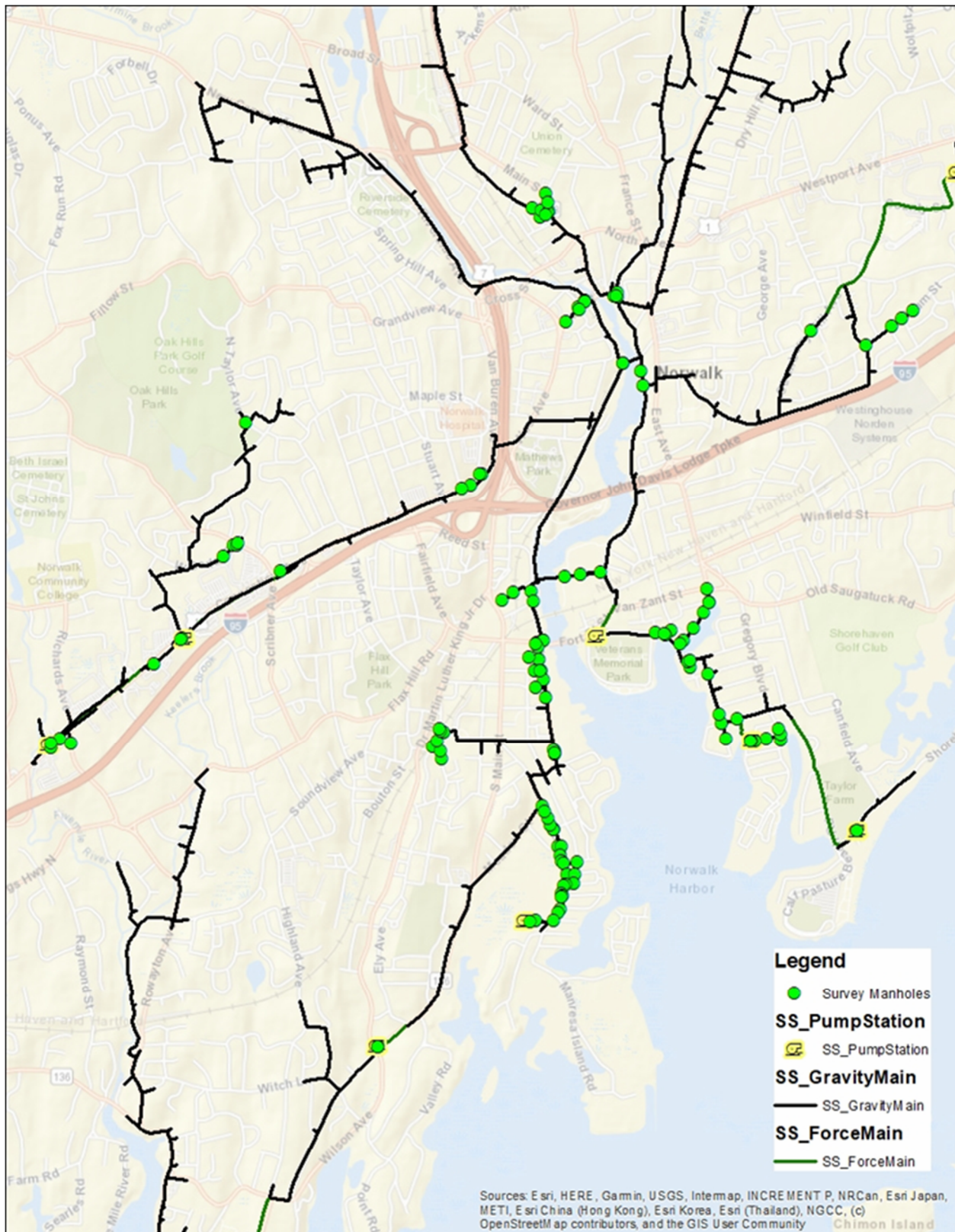


Figure 4-1. Manholes Identified for Field Survey

Missing elevation data for MHs that were located between two MHs with known elevations was assigned using length-weight interpolation, LIDAR/contour data, or a combination of the two.

4.1.2 Model Catchment Delineation

As described in Section 3 of this report, the collection system was divided into 40 metershed basins based on the location of the flow meters. A majority of these 40 flow meter basins were further divided into smaller subcatchments within the collection system model for a total of 121 subcatchments. The subdivision of the metershed basins was performed to increase the spatial resolution of flow loading to the collection system model network. Table 4-2 provides a summary of the model subcatchments.

Flow Meter Area	Number of Subcatchments	Total Area (acres)
FM_01	5	534.7
FM_02	1	545.6
FM_03	1	27.3
FM_04	2	120.0
FM_05	9	312.3
FM_06	5	375.6
FM_07	4	648.2
FM_08	4	355.6
FM_09	4	787.1
FM_10	3	351.7
FM_11	4	939.1
FM_12	7	314.7
FM_13	7	451.7
FM_14	1	119.9
FM_15	8	600.8
FM_16	1	50.0
FM_17	8	527.3
FM_18	6	507.7
FM_19	1	21.0
FM_20	1	1.0
FM_21	2	277.8
FM_22	2	143.9
FM_23	1	2.4
FM_24	1	21.4
FM_25	1	14.7
FM_26	3	239.1
FM_27	2	141.4
FM_28	1	409.6
FM_29	10	396.2
FM_30	1	34.6
FM_31	1	334.2
FM_32	4	360.3

Table 4-2. Model Subcatchment Summary

Flow Meter Area	Number of Subcatchments	Total Area (acres)
FM_33	2	146.0
FM_34	1	79.7
FM_35	1	120.3
FM_36	2	200.6
FM_37	1	13.2
FM_38	1	18.6
FM_39	1	2.1
FM_40	1	75.7
Total:	121	10,623

4.1.3 Dry Weather Flow Calibration

A dry weather period, between June 25 and June 30, 2021, was identified in the flow meter record. The dry weather period was selected because it was removed in time from rainfall events and the spring GWI rates had receded to the baseline persistent GWI rates. Flows during the period were used to determine the average daily DWF volume for each meter area. These average values were broken down further into the subcatchment loading nodes based on the proportional sewer length for that subcatchment. Diurnal patterns, for both weekday and weekend days, were derived from the flow metering data for each flow monitor metershed. The metershed specific diurnal patterns and average daily DWF volumes, inclusive of persistent GWI, were assigned to each model catchment area.

An initial model simulation was performed under DWF conditions. The results from the initial model simulation were compared against the measured flow data to assess how well the model results represented the measured flows. Where discrepancies between the modeled and measured flows were identified, the model was calibrated to improve the agreement with measured flows. The DWF calibration process involved adjusting the applied DWF volumes until a reasonable fit was achieved between the observed and modeled hydrographs for the selected DWF period.

Figure 4-1 shows an example comparison between the observed DWF meter data and the calibrated model at flow meter FM-05.

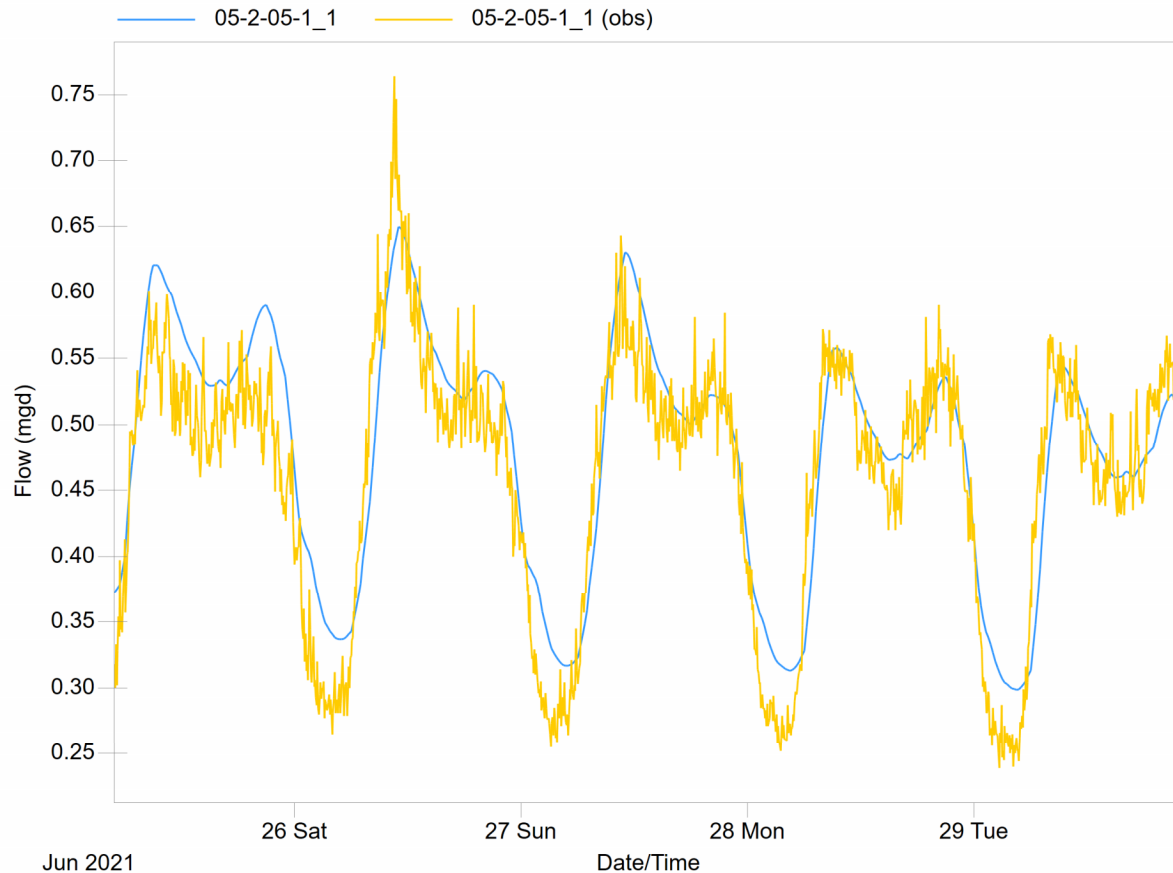


Figure 4-1. Observed vs Modeled DWF at FM-05

4.1.4 Groundwater Infiltration Calibration

In addition to the persistent base GWI that is present during both dry weather and wet weather flow periods, GWI may also increase and slowly recede back to base levels in response to rainfall events. In general, the flow meter data showed some degree of GWI increase following large rain events in almost all metersheds. This temporally varying GWI response was modeled using the SWMM groundwater routine.

Metershed specific aquifer and groundwater parameter groups were created within the model. These parameter groups were initially populated with the SWMM default parameter values and were assigned to their corresponding subcatchments within the model. A continuous simulation from March 11 to September 10, 2021 was performed. The model simulated flows, inclusive of both DWF and temporally varying GWI, were compared against measured flows during periods after rainfall events. Where discrepancies between the modeled and measured flows were identified, the model was calibrated to improve the agreement with measured flows. The GWI calibration process involved adjusting the subcatchment groundwater A1 coefficient and B1 exponent parameter values and multiple aquifer parameter values until a reasonable fit was achieved between the observed and modeled hydrographs. Figure 4-2 below shows observed flow meter data compared to modeled flows at flow meter FM_11 both with and without groundwater flows included for the July 8, 2021 calibration event. The groundwater response can be seen in the receding limb of the hydrographs, affecting both the peak and total volume of flows produced during rain events.

In general, all subcatchments within a flow meter basin were given the same groundwater parameters, though some subcatchments within certain meter basins were assigned individual parameters based on differing land use and model calibration.

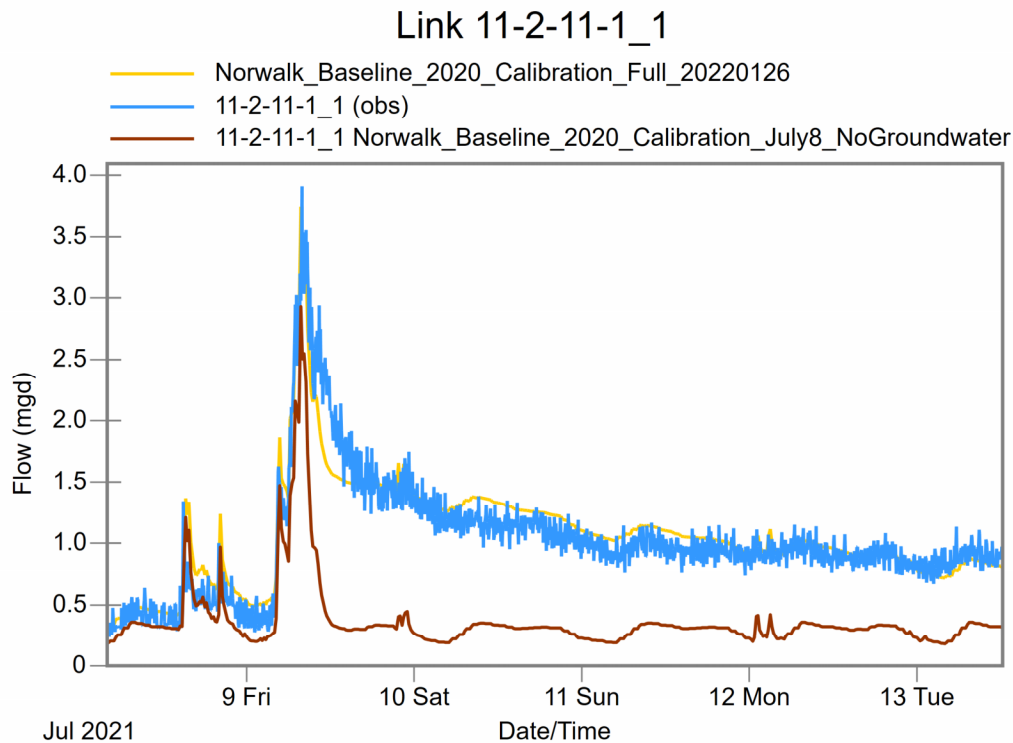


Figure 4-2. Model Flow Comparison – With and Without Groundwater Input at FM_11

4.1.5 Rainfall Derived Infiltration and Inflow Calibration

RDII is the extraneous flow that enters the sanitary collection system through either direct or indirect connections in response to rainfall. Infiltration is the extraneous flow that enters the collection system through cracks, breaks, or defects in sewer pipes, joints, or MHs. Inflow is the extraneous flow that enters the collection system through direct connections, such as directly connected catch basins or cross-connections with the storm drain system.

RDII responds directly to rainfall and peaks within minutes or hours of when the rain occurs. The model simulated RDII hydrograph volume and shape are computed using the RTK unit hydrograph approach available in SWMM. The RTK approach uses a tri-triangular unit hydrograph formulation, the parameters of which are shown in Figure 4-3.

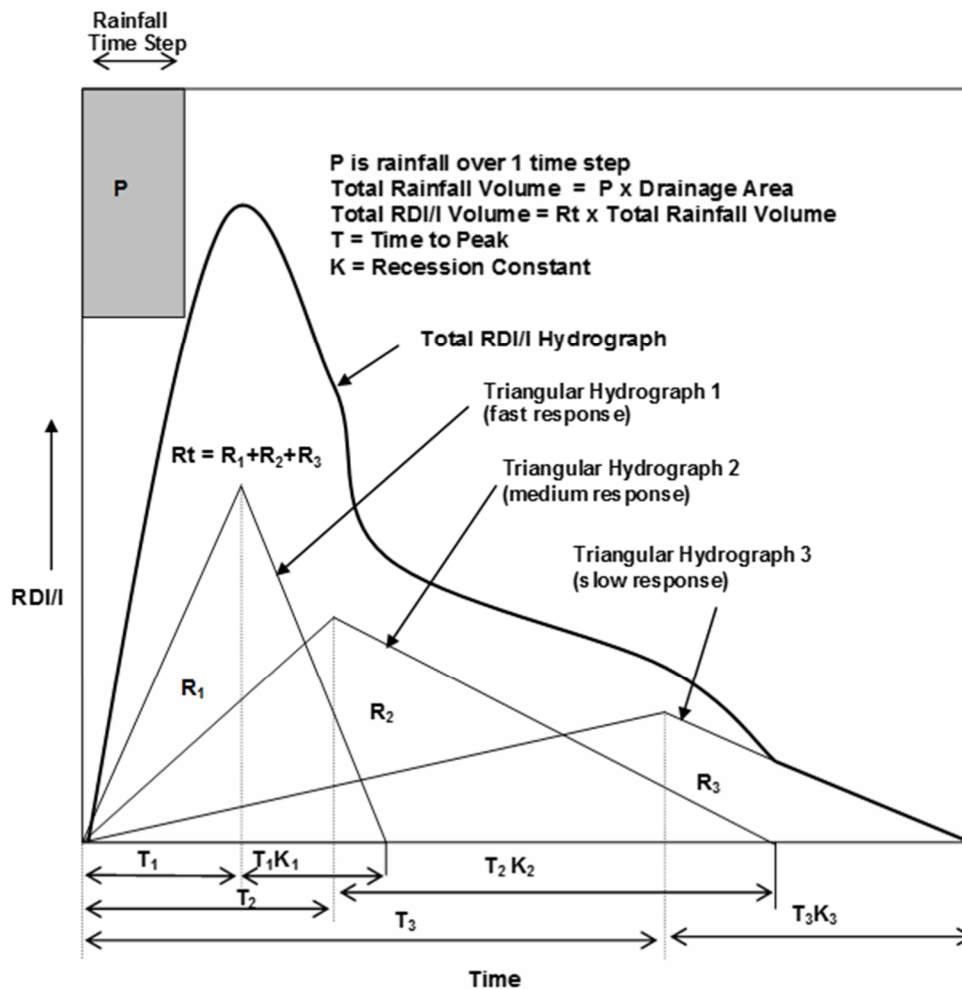


Figure 4-3. RTK Unit Hydrographs

The RTK unit hydrograph is the sum of three separate hydrographs. The R_1 , R_2 , and R_3 triangular hydrographs respectively depict the fast, medium, and slow response of RDI/I entering a collection system. The fast response hydrograph typically represents inflow components and direct connections to the sanitary system and typically have short timing parameters. The medium and slow response hydrographs typically represent the rainfall derived infiltration flow components and have longer timing parameters. Definitions for the RTK parameters are shown below:

- R – RDI/I volume
- T – Time to hydrograph peak
- K – Time to recession

RTK parameters with subscripts of 1, 2, and 3 correspond to the fast, medium, and slow response hydrographs, respectively. Figure 4-3 depicts the construction of the overall RTK hydrograph with the fast, medium, and slow response hydrographs as well.

The model simulated RDI/I flows were assigned to the loading nodes for each flow meter catchment area and were calibrated to the observed flows at their corresponding flow meter. For wet weather calibration, the rainfall hyetographs created from the precipitation monitoring data were applied

across the modeled system to generate wet weather inflows at each load point. Comparisons between the observed and simulated flow response at each meter basin for each rainfall event were made and adjustments were made to the RTK parameters until a single set of RTK parameter values for each flow meter basin produced an acceptable fit to the observed flows across all calibration events.

Figure 4-4 shows a typical modeled vs observed comparison within the collection system for a wet weather flow event. Appendix D includes the model calibration plots for all 40 flow meters.

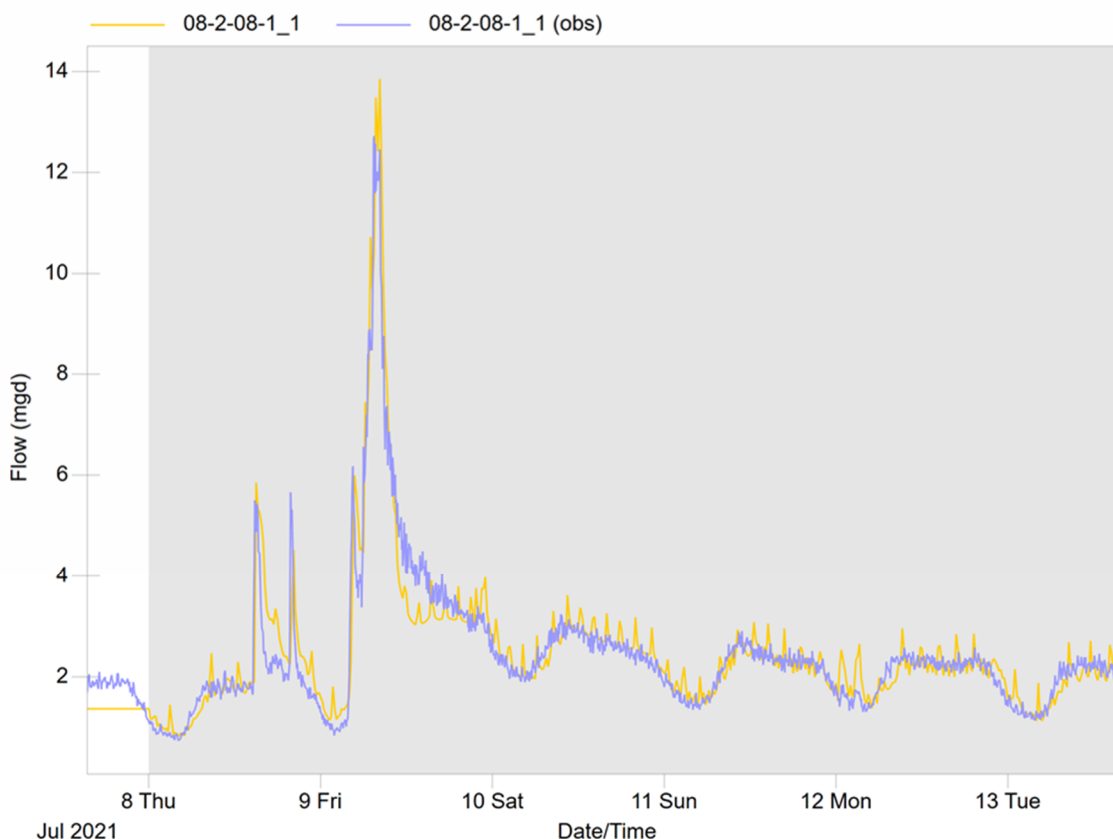


Figure 4-4. WWF Model Calibration – Modeled vs Observed Flows

4.1.6 Collection System Hydraulic Calibration

The hydrologic calibration of the model is detailed in the sections above, covering DWF, groundwater, and wet weather flow calibrations. Hydrologic calibration is concerned with flow generation within the model and the timing and volume of those flows.

Hydraulic calibration is concerned with replicating the flow routing and observed water levels and velocities that correspond to different flow rates within the collection system. Hydraulic calibration considers the following:

- System operations – e.g., pump stations, flow diversions, gates, siphons
- Flow routing – flow through the collection system network
- System head losses – minor losses as pipe friction and energy loss at MHs

- System conditions – presence of debris accumulation or flow obstructions that induce energy losses above normal expected conditions

The hydraulic calibration used the same dry weather and wet weather flow event periods as the hydrologic calibration. The DWF calibration period took place between June 25, 2021, and June 30, 2021. Five rain events were chosen as wet weather flow calibration events during the 2021 monitoring period – April 15, May 28, June 30, July 8, and July 29. These events varied in rainfall depth from 1.35 inches to 5.24 inches, and varied in peak rainfall intensity from 0.48 in/hr to 4.68 in/hr.

The following hydraulic components were added to the model and adjusted during calibration include:

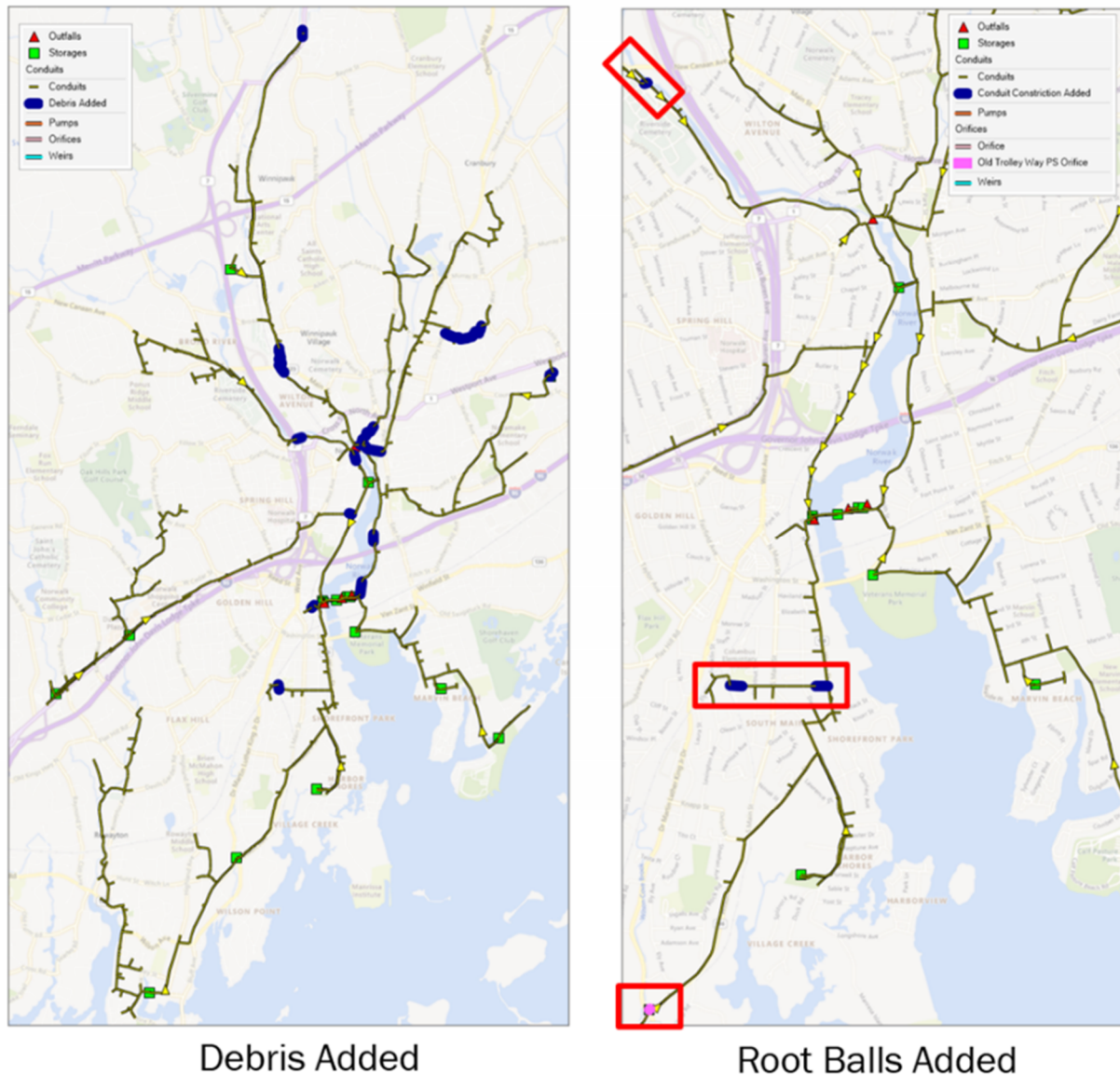
- Flow control structures – siphons, weirs, flow diversions, etc.
- Pump stations and forcemains – including wet well geometry, pump curves, pump on/off levels, and forcemain roughness
- System head losses – pipe roughness factors and application of sediment/blockages

These components were added to the model using data provided by the City including GIS data, record/as-built drawings, and operations and maintenance data and manuals.

The only adjustment/addition made to the flow control structures within the model during hydraulic calibration was the addition of a flow restriction orifice directly upstream of the Old Trolley Way pump station wet well. No other flow control locations needed adjustment during calibration.

Pump curves and set points and wet well geometries were added to the model and were not changed during hydraulic calibration. Pump station flows were calibrated by adjusting the forcemain roughness parameters to match the system curve to the pump curves until a good fit between observed and modeled data was achieved.

In areas where the modeled flow depths were lower than the observed meter data, system head losses were added to the model. These head losses consisted of increased pipe roughness factors to account for the condition of the pipes and the addition of sediment or blockages to the modeled pipes to account for the higher depths present in the observed flow data. Figure 4-5 shows the locations where debris and root balls were added to model conduits during hydraulic calibration.



Debris Added

Root Balls Added

Figure 4-5. Location of Debris and Root Balls Added to Model Conduits

There were two locations/instances in which these standard hydraulic calibration adjustments were not able to provide a strong fit between observed and modeled data.

Flow meter FM_04 showed virtually no increase in flow between itself and the upstream flow meters, FM_22 and FM_33, even though there are approximately 120 acres of sewered area between the meters. Therefore, adding any wet weather flow to the FM_04 metershed during calibration would cause disagreement between the modeled and observed data. Since having no additional flow increases within 120 sewered acres is unrealistic, it was assumed that the FM_04 meter data was faulty, and RTK parameters were assigned using nearby meter areas as a general estimate.

The remnants of Hurricane Elsa impacted the system area starting July 8. During the event, a large volume of debris in the collection system was mobilized and transported to the WPCF, causing the bar screens at the WPCF to become blinded. In turn, the blinded screens backed up flows and

caused an elevated hydraulic grade line (HGL) upstream into the collection system interceptors. This hydraulic operations issue was incorporated into the model by using WPCF IPS wet well level data as the hydraulic boundary condition. This allowed the model to accurately account for the induced backwater conditions experienced within the collection system during the event.

4.1.7 Norwalk Baseline Model Summary

As described in Section 3, 40 flow meters were installed throughout the City's collection system and were installed for RDII characterization and model calibration. The calibration effort was limited to primarily large trunk sewers and major pump stations to understand the system operating levels at a planning scale.

Overall, the calibrated systemwide model results match well with the observed data from flow meter data. This calibrated model was the baseline for assessing the existing performance of the collection system and evaluating improvements to the collection system performance resulting from I/I reduction and flow management strategies.

4.2 Baseline Collection System Performance

To assess the baseline collection system performance, the model was simulated under a range of SCS Type II synthetic design storm return frequencies and durations, ranging from the 1-year, 6-hour storm to the 25-year, 24-hour storm event.

The model results were interrogated to assess system surcharge and CSO/SSO discharge characteristics. The model results from the 5-year, 6-hour design rainfall were used to characterize the RDII production rates from each flow monitored metershed. The RDII production rates were used to prioritize and evaluate the improvements in collection system performance resulting from RDII reductions as presented in Section 5.2.4 of this report.

4.2.1 Collection System Surcharging

The model results from each design storm simulation were evaluated to assess system surcharge characteristics. The percent of the model network surcharged during the peak water levels predicted by the calibrated model are presented in Table 4-3.

Table 4-3. Percent of Model Network Surcharging - Existing Conditions					
Design Storm Duration	Design Storm Return Frequency				
	1-Year	2-Year	5-Year	10-Year	25-Year
6-Hour	27%	33%	38%	45%	48%
12-Hour	32%	36%	45%	48%	53%
24-Hour	32%	38%	46%	50%	55%

During model calibration, comparison of model-simulated depth against the observed flow monitor depth indicated that the depths at some locations were consistently greater than the design conditions depth of flow based on the diameter and slope of the sewer gravity main. At these locations, debris was added to conduits during model calibration to decrease the available conveyance area and calibrate the model to better agree with the measured depth. Under the design storm simulations, pipes in these areas were predicted to surcharge during the 1-year design event,

suggesting that the blockage within the pipes could be the cause of the surcharging. Locations where debris was added to model conduits are noted below:

- From the intersection of Newton Ave. and Carlin St to the intersection of Thorn Apple Way and Assisi Way
- From the intersection of Wall St. and King St. to the intersection of Brook St. and King St.
- From the intersection of Concord St. and Chestnut St. to the intersection of Ely Ave. and Lexington Ave.

Additionally, the model shows consistent surcharging in both the local lines and interceptor in the Wall St./Smith St. area. The diameter of the interceptor here is 36-inches and it receives flow from three upstream trunk sewer lines – two 36-inch diameter lines and a 15-inch diameter line. The interceptor here appears to be undersized for the amount of upstream flow it receives.

4.2.2 Collection System Overflow Characterization

After model calibration was complete, SCS Type II synthetic design storms of different durations and return frequencies were modeled to evaluate the collection system's existing conditions level of service and quantify the model predicted overflow volumes under existing conditions. This analysis provides baseline performance data points that can be compared against alternatives that represent potential improved future conditions. Table 4-4 below shows the CSO and SSO overflow volumes for the 6-, 12-, and 24-hour rainfall duration design storms for the 1-, 2-, 5-, 10-, and the 25-year return frequency events.

Table 4-4. CSO and SSO Volumes by Design Storm - Existing Conditions (MG)					
6-Hour	1-Year	2-Year	5-Year	10-Year	25-Year
Systemwide SSO	0.0	0.1	0.7	1.4	3.0
Ann Street Emergency Overflow	-	-	-	-	-
Outfall 002	1.5	2.2	4.0	6.0	9.0
12-Hour	1 Year	2 Year	5 Year	10 Year	25 Year
Systemwide SSO	0.1	0.5	1.6	3	6.1
Ann Street Emergency Overflow	-	-	-	-	-
Outfall 002	2.7	4.1	6.8	9.8	14.7
24-Hour	1 Year	2 Year	5 Year	10 Year	25 Year
Systemwide SSO	0.1	0.5	2.0	4.1	8.8
Ann Street Emergency Overflow	-	-	-	-	-
Outfall 002	3.0	5.1	8.9	13.6	22.7

As shown in Table 4-4, the calibrated model does not predict discharges from the Emergency Overflow until a rainfall larger than the 25-year return frequency design event. Two of the three most recent discharges from the Emergency Overflow (August 22, 2016 and July 8, 2021) have been caused by mechanical equipment failures and were likely not caused solely by the flows in the interceptor system grossly exceeding its conveyance capacity. The reported discharges at the Emergency Overflow that occurred for approximately 2.5-hours on September 1, 2021 to September 2, 2021 were associated with the historic rainfalls from Hurricane Ida. The rainfall depths in Norwalk associated with the Ida rainfall event exceed the 200-year return frequency. The calibrated model

predicts discharges at Outfall 002, located at the WPCF, starting with the 1-year return frequency design events indicating that flows conveyed to the WPCF exceed the secondary treatment capacity of 30 MGD during these events.

4.2.3 Ann Street Emergency Overflow Performance

Prior to the WPCA efforts to separate the collection system, when a larger percentage of the Norwalk collection system was a combined sewer service area, the Emergency Overflow provided hydraulic relief to the Norwalk interceptor system and acted as a controlled point of discharge. With the significant amounts of sewer separation Norwalk has accomplished since the 1970s, a reduced hydraulic load is placed on the interceptor system. With this reduced hydraulic load, the calibrated existing conditions model does not predict the Emergency Overflow to activate at the 25-year return frequency event. To evaluate when the Emergency Overflow would activate, additional model runs were conducted with the 50- and 100-year, 24-hour return frequency events. Model results showing the HGL at the Emergency Overflow for the 25-, 50-, and 100-year, 24-hour return frequency events are shown in Figure 4-6 below.

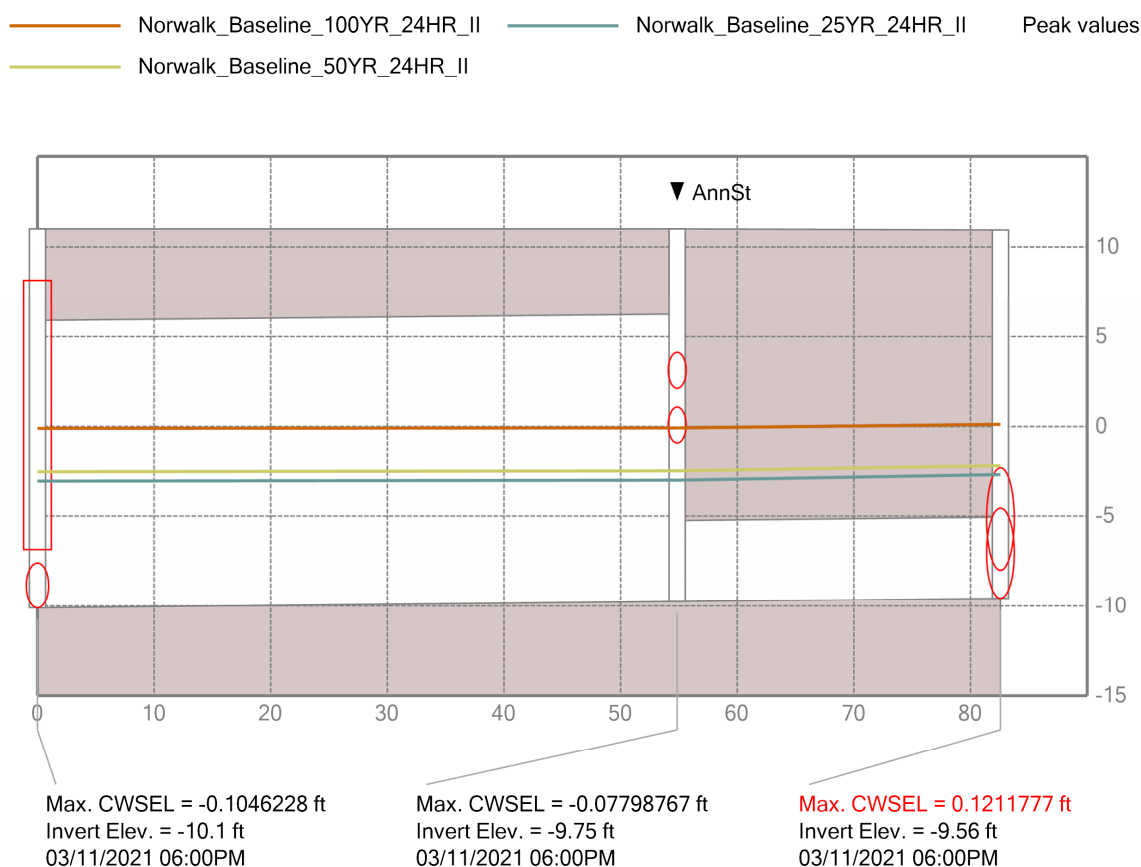


Figure 4-6. Ann Street Emergency Overflow Performance

The model predicts that under existing conditions, the collection system and the WPCF IPS has the capacity to convey and treat flows up to and including the 50-year, 24-hour return frequency events without discharging from the Emergency Overflow. During the 100-year, 24-hour event, the model

predicts that the water level in the interceptor system adjacent to the Emergency Overflow would result in a discharge from the facility to the Norwalk River.

In addition to providing the historical hydraulic relief during wet weather conditions, the Emergency Overflow has also provided hydraulic relief to the interceptor during periods of catastrophic infrastructure failure. Examples of catastrophic infrastructure failure that have been recently experienced by Norwalk include decreased pumping capacity at the WPCF IPS, gate opening failure due to operator error on the east side of the Ann Street Siphon, and blinding of the WPCF headworks bar screens. In each of these scenarios, the conveyance to the WPCF has been limited, resulting in surcharging of the interceptor system, and eventually, a discharge from the Emergency Overflow. Recently, the WPCA implemented additional engineering and administrative controls further reducing the likelihood of discharge from the Emergency Overflow. To evaluate the impacts of a permanent closure of the Emergency Overflow in the event of a catastrophic infrastructure failure, calibrated model simulations were performed using the 25-year, 6-hour return frequency rainfall event for the following conditions:

- Influent Control Gate at 42-inch barrel of Ann Street Siphon in closed position during wet weather flow event
- WPCF IPS operating at reduced capacity (4 of 6 pumps simulated as operating)
- Influent Control Gate at 42-inch barrel of Ann Street Siphon in closed position during wet weather flow event and WPCF IPS operating at reduced capacity (4 of 6 pumps simulated as operating)

Under these conditions, it was determined that the available conveyance capacity of the Ann Street Siphon, which conveys flows across the Norwalk River, from the west side of the City to the WPCF, essentially controls the HGL in the west side interceptor. Model simulations with the WPCF IPS operating at reduced capacity did not result in discharges at Emergency Overflow up to and including the 25-year, 6-hour event, but simulations with the influent control gate at the 42-inch barrel of the Ann Street Siphon modeled in the closed position, the HGL in the west side interceptor increased until an uncontrolled SSO was predicted at MH 23-7, located in Oyster Shell Park, south of I-95. The rim elevation at MH 23-7 is approximately 4.4 feet higher than the invert elevation of the lower relief conduits at the Emergency Overflow, meaning the west side interceptor would experience a significant increase in surcharge in the event of an operational disruption. The increased surcharging also places a significant number of properties at risk for basement backup and poses an increased health and safety risk to the public. The properties identified as being at an increased risk of basement backup due to the elimination of the Emergency Overflow are shown in red in Figure 4-7.

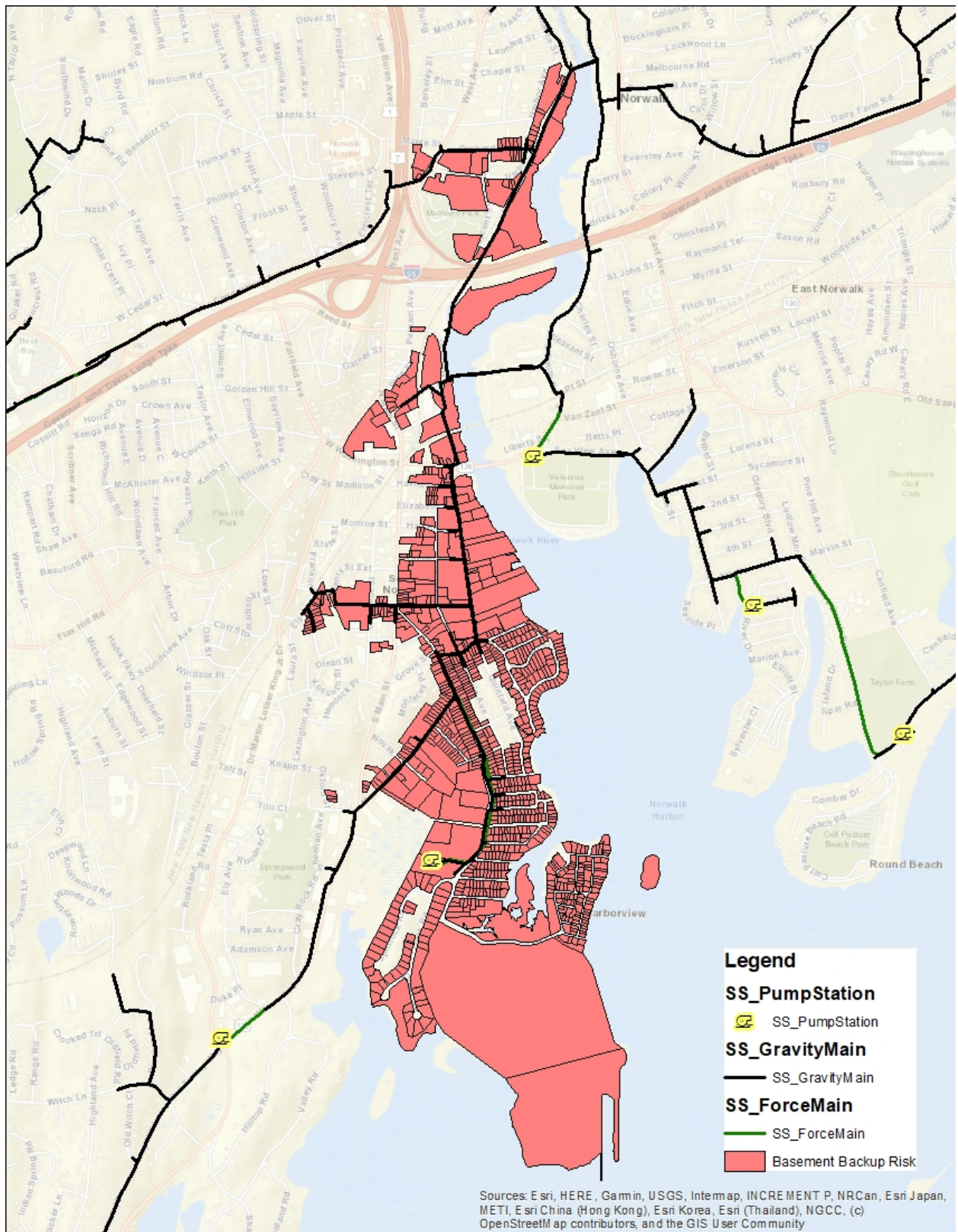


Figure 4-7. Properties at Increased Risk of Basement Backup with Ann Street Emergency Overflow Closure

4.2.4 RDII Production Rate Characterization

To assess the existing performance of the collection system and to set a baseline for comparison to any future conditions, the model was run with the 25-year 6-hour design event with all DWF generation turned off, so that only the RDII flows would be simulated. The model results were used to quantify the peak RDII flow rates from each metershed, in millions of gallons per day. These RDII flow rates were normalized by metershed area to facilitate the comparison and prioritization of RDII production rates across the collection system. Figure 4-8 shows the normalized RDII production rates by metershed in gallons per acre per day (GPAD).

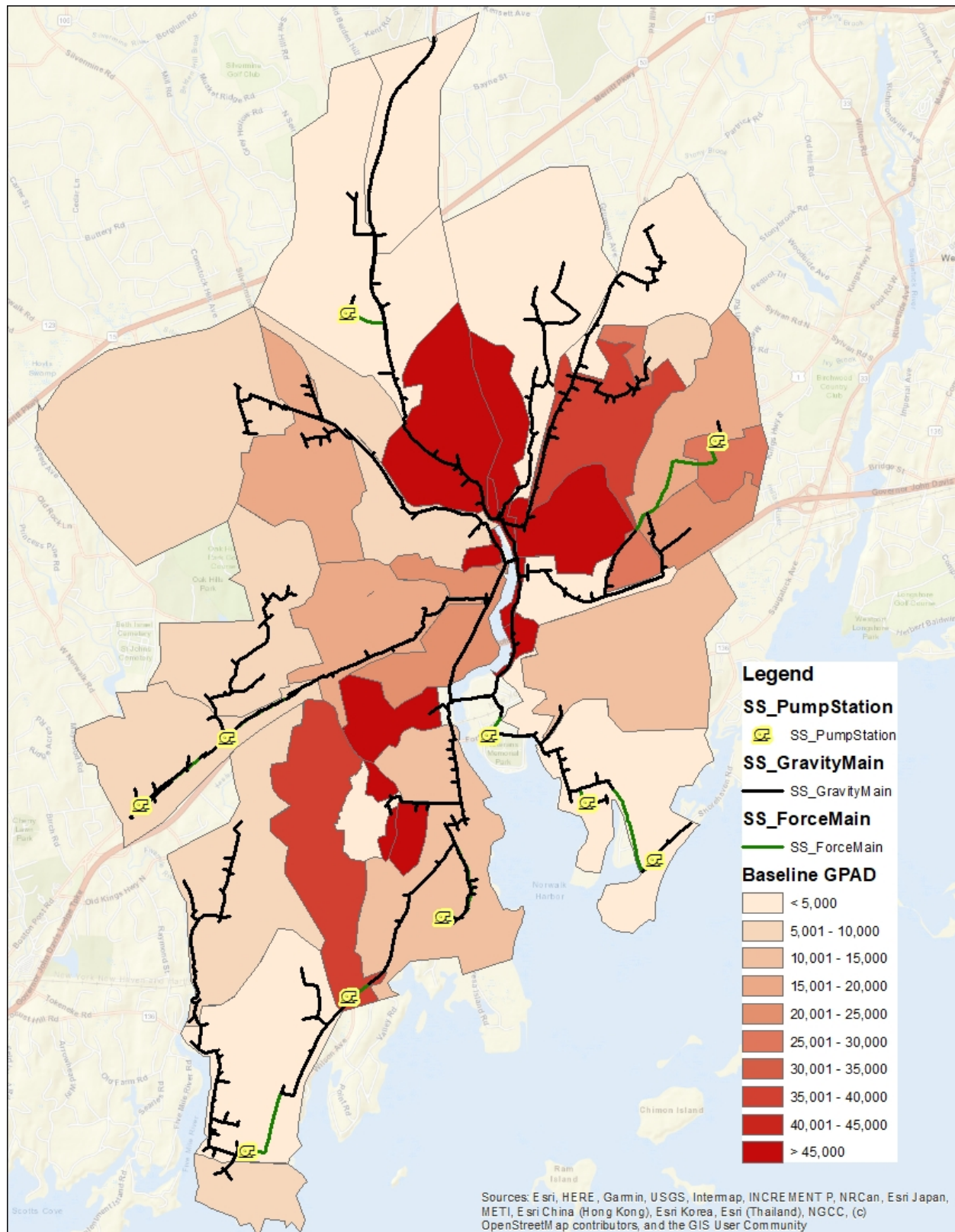


Figure 4-8. Existing Conditions RDII Production Rate by Metershed

Section 5

Collection System Flow Reduction and Flow Management Evaluation

5.1 Overview

The calibrated existing conditions model described in Section 4 was used as the starting point for the evaluation of all projected future conditions. In the modeling of all projected future conditions, it was assumed that the implementation of primary treatment, or its equivalent, at the WPCF as required by the City's May 6, 2022 Consent Order, would result in a negligible change in the hydraulics and conveyance capacity of the City's collection system.

Multiple strategies to improve the performance of the collection system and reduce SSO frequencies and volume of discharge from the collection system were evaluated. Strategies to reduce the volume of extraneous flows entering the collection system included disconnection of directly connected catch basins and the reduction of I/I from prioritized metersheds. These strategies seek to reduce the peak flows entering the collection system to levels that can be conveyed without resulting in excessive surcharging in the system.

Consistent with the current operation of the system and objectives of the City's CMOM Program, evaluated conveyance capacity improvements continued to consider allowing surcharge in the collection system to maximize storage and reduce discharges from Outfall 002. Conveyance capacity improvements to either convey or attenuate the peak flows were considered. Increased conveyance capacity through relief sewers and attenuation of peak flows using flow equalization storage at the WPCF were evaluated. Each strategy is discussed further in this section.

5.2 I/I and CSO Management Strategies

Under the existing collection system conditions, the conveyance capacity of the City's wastewater collection system is exceeded during certain wet weather flow events, leading to surcharging, MH flooding, and CSO discharges. Multiple strategies to improve the performance of the collection system and reduce the frequency and volume of SSO discharges from the collection system were evaluated. Strategies to reduce the volume of extraneous flows entering the collection system included disconnection of directly connected catch basins and the reduction of I/I from prioritized metersheds. These strategies seek to reduce the peak flows entering the collection system to levels that can be conveyed without resulting in excessive surcharging in the system. In addition to the flow reduction methods, strategies to either convey or attenuate the peak flows were also considered.

The following management strategies were evaluated, as listed below.

- Existing System Management – cleaning and maintenance in prioritized locations to maximize conveyance of wastewater to the WPCF
- Sewer Conveyance Capacity Improvements – increased conveyance capacity upgrades that alleviate identified hydraulic constrictions in the collection system at critical locations
- Storm Drainage Catch Basin Disconnection – disconnection of directly connected inflow sources to reduce excess flows from entering the collection system

- Targeted RDII Reduction – system rehabilitation in prioritized locations to reduce excess flows from entering the collection system
- Storage – use of storage at the WPCF to attenuate peak wet weather flow volumes and maximize the volume of wastewater receiving full secondary treatment

5.2.1 Existing System Management

The existing system management strategy looked at areas within the collection system where hydraulic performance could be improved by maintenance activities such as debris and root ball removal.

Using both observed flow meter data and a maintenance list provided by the City’s contract collection system operator Veolia, areas where hydraulic capacity was limited (likely due to the presence of debris or flow obstructions), were identified and incorporated into the calibrated model. As discussed in Section 4.1.6, and shown in Figure 4-5, sewer mains exhibiting limited hydraulic capacities were modeled using constricted pipe shapes, and elevated pipe roughness values. In areas of the collection system where debris and/or root balls significantly reduce the capacity of the sewer pipes, localized elevated HGLs, surcharging, and MH overflows can occur, especially during wet weather flow events.

To evaluate the improvements in collection system performance provided by removing debris and blockages from the identified pipes, the model was updated to restore the constricted pipes to their original design size and roughness values. Roughness values were changed from 0.02-0.03 to 0.01-0.013, depending on the observed hydraulic conditions.

Table 5-1 shows the change in MH overflows during the 25-year, 6-hour design event with maintenance improvements. Table 5-2 shows the differences in overflow volumes at various discharge locations during the 25-year, 6-hour design event with maintenance improvements. While performing system maintenance by removing pipe constrictions does not significantly reduce CSO volumes, it does increase system capacity and reduce MH overflows upstream of the constriction.

Table 5-1. Manhole Overflow with Maintenance Improvements

Asset ID	Baseline Overflow Volume (MG)	Overflow Volume with Maintenance (MG)	Change (MG)	Change (%)	Comment
03-109	0.01	0	-0.010	-100%	Eliminated
03-30	0.015	0	-0.015	-100%	Eliminated
03-31	0.014	0	-0.014	-100%	Eliminated
05-10	0.002	0	-0.002	-100%	Eliminated
05-264	0.001	0	-0.001	-100%	Eliminated
10-29	0.006	0	-0.006	-100%	Eliminated
16-306	0.005	0	-0.005	-100%	Eliminated
16-331.1	0.005	0	-0.005	-100%	Eliminated
16-4	0.011	0	-0.011	-100%	Eliminated
03-242	0.134	0.17	0.032	24%	Increased
05-36	0.037	0.06	0.024	65%	Increased
03-165.2	0.059	0.05	-0.005	-8%	Minor Reduction
05-110	0.018	0.02	-0.001	-6%	Minor Reduction

Table 5-1. Manhole Overflow with Maintenance Improvements

Asset ID	Baseline Overflow Volume (MG)	Overflow Volume with Maintenance (MG)	Change (MG)	Change (%)	Comment
05-257	0.014	0.013	-0.001	-7%	Minor Reduction
03-22	0.244	0.252	0.008	3%	No Change
04-94	0.044	0.044	0.000	0%	No Change
05-265	0.012	0.012	0.000	0%	No Change
08-179.1	0.015	0.015	0.000	0%	No Change
11-18	0.007	0.007	0.000	0%	No Change
12-155	0.164	0.161	-0.003	-2%	No Change
13-27	0.194	0.195	0.001	1%	No Change
15-115	1.828	1.832	0.004	0%	No Change
15-55	0.001	0.001	0.000	0%	No Change
22-3	0.004	0.004	0.000	0%	No Change
05-157	0.165	0.136	-0.029	-18%	Reduced
05-43	0.04	0.014	-0.026	-65%	Reduced
15-34	0.011	0.009	-0.002	-18%	Reduced
16-280.1	0.011	0.007	-0.004	-36%	Reduced
16-294	0.043	0.035	-0.008	-19%	Reduced
21-4	0.031	0.026	-0.005	-16%	Reduced
Total	3.15	3.06	-0.084	-3%	

Table 5-2. CSO Volume Comparison with Maintenance Improvements

	Peak Flow (MGD)			24HR Volume (MG)		
	Baseline	Existing Sewer Management	% Change	Baseline	Existing Sewer Management	% Change
Ann Street Emergency Overflow	0.0	0.0	-	0.0	0.0	-
Outfall 002	46.9	52.0	11%	9.0	9.2	2%
WPCF Total Inflow	76.9	80	4%	35.8	35.8	0%

5.2.2 Sewer Conveyance Capacity Improvements

As noted in Section 4.2.1 of this report, the calibrated model shows consistent surcharging in both the local lines and interceptor in the Wall St./Smith St. area. The diameter of the interceptor here is 36-inches and receives flow from three upstream trunk sewer lines – two 36-inch diameter lines and a 15-inch diameter line. The interceptor here appears to be undersized for the amount of upstream flow it receives.

The east side interceptor in the vicinity of Wall Street, Hubbells Lane, and Moodys Lane was identified as a potential area for sewer capacity improvements. At Wall Street, a large volume of flow is conveyed to the east side interceptor from the East Wall Street trunk sewer. The interceptor is 36-

inches in diameter at this location and continues at that diameter downstream to the confluence of the east side interceptor and the Moodys Lane siphon, where it increases to 60-inches in diameter. Figure 5-1 shows the existing layout of the sewer in this area.

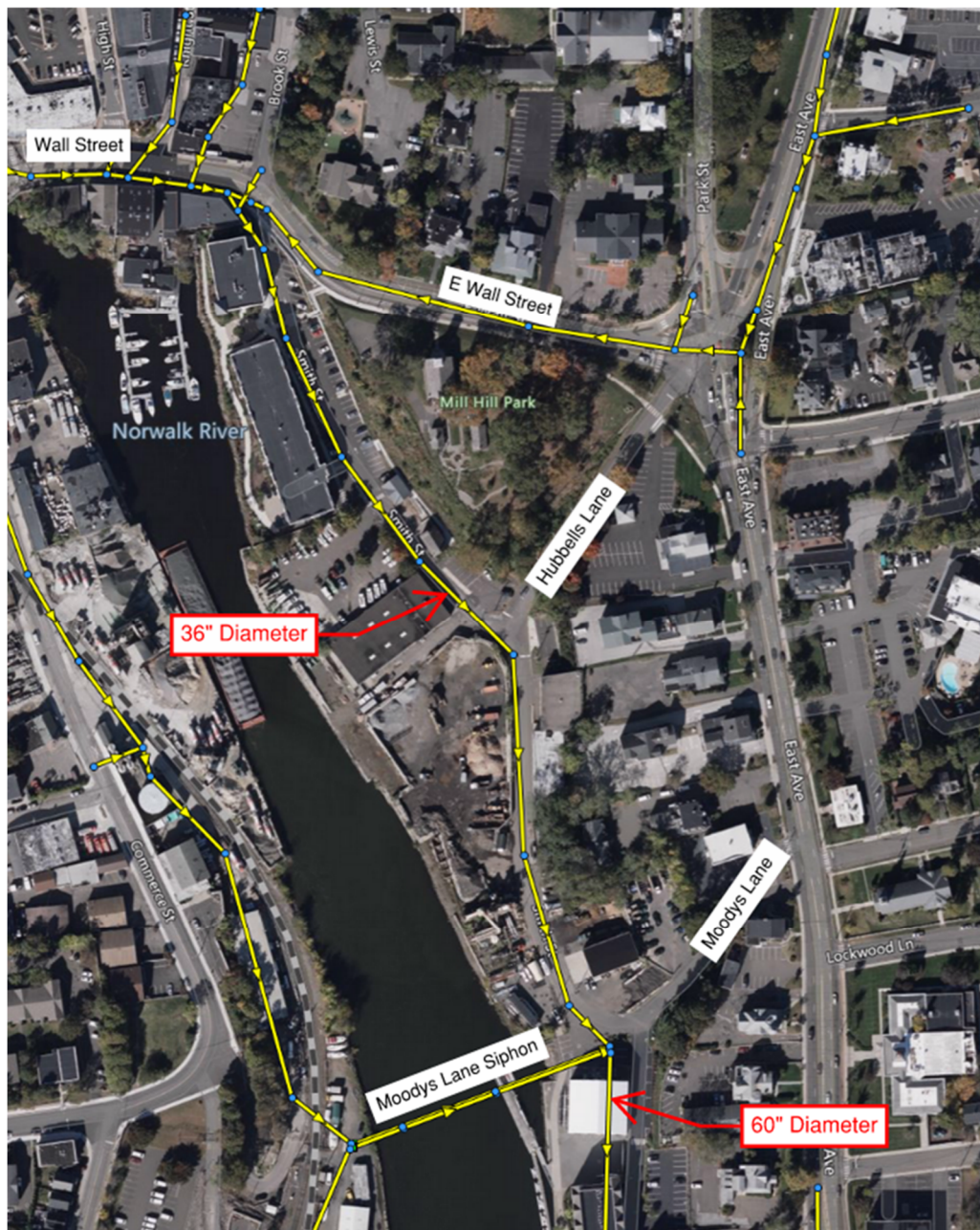


Figure 5-1. Sewer Layout Near Hubbells Lane

The calibrated model shows MH overflows in the interceptor between Wall Street and the Moodys Lane siphon. Overflow in this location was also noted by the City in the Five Day Report for the July 8, 2021 storm event, providing further confidence in the calibration of the model. The interceptor downstream of the Moodys Lane siphon has an increased conveyance capacity due to the increased

size of the sewer pipe. The local trunk sewer on East Avenue that turns onto East Wall Street and then drops into the interceptor has the potential to be rerouted down Hubbells Lane and connected to the interceptor just downstream of the Moodys Lane siphon where the interceptor gains additional conveyance capacity due to the increase in pipe diameter at this location. The reconfiguration of the sewer in the model to evaluate this is shown in Figure 5-2.

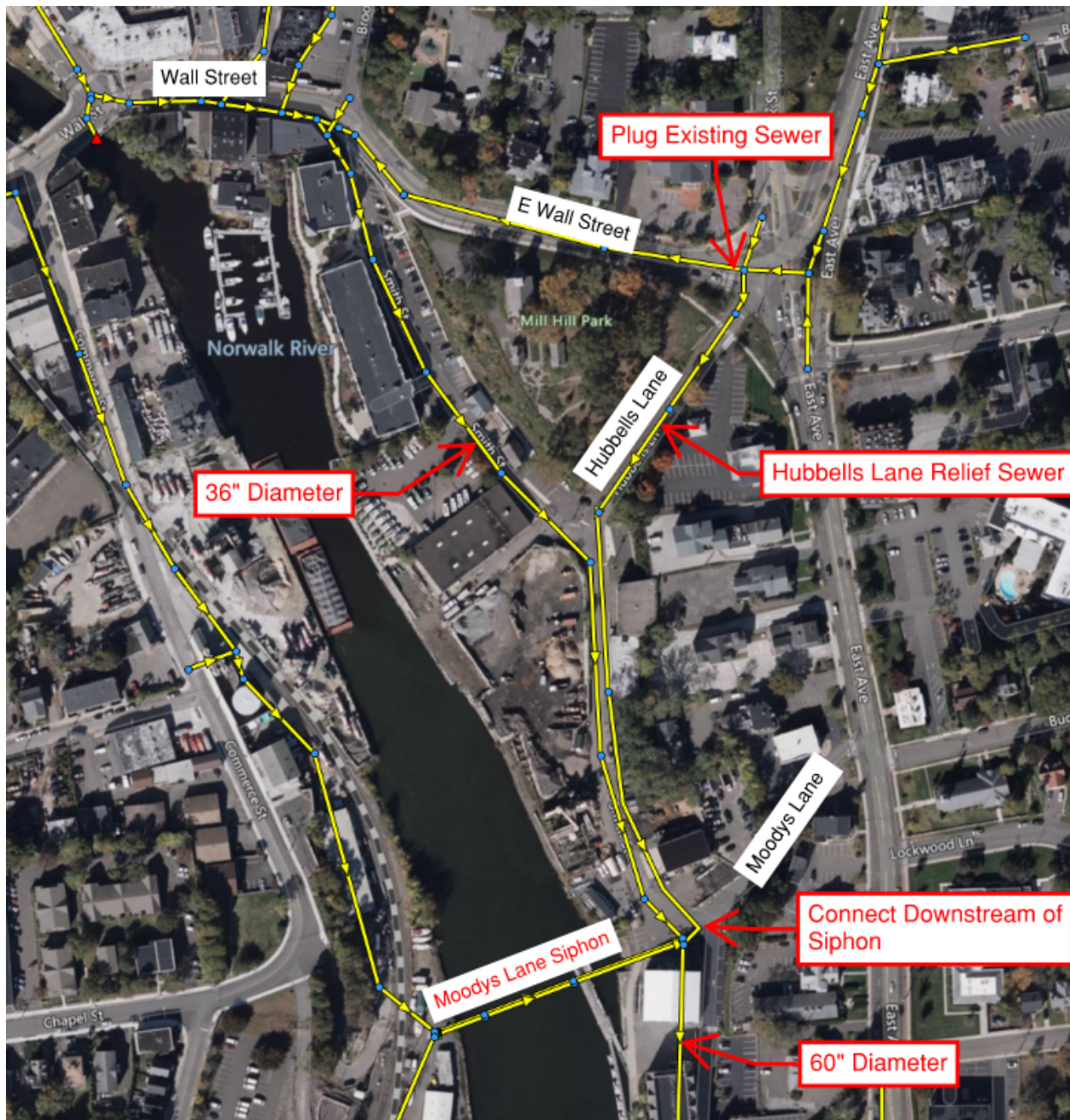


Figure 5-2. Hubbells Lane Relief Sewer Layout

The 25-year, 6-hour design storm, with the Hubbells Lane Relief Sewer included, was simulated using both the existing and future flow conditions models. The future flow conditions model includes the anticipated flow reductions resulting from the disconnection of directly connected catch basins and RDII reductions from public sewer rehabilitation. The model results, with the Hubbells Lane Relief Sewer, showed a reduction in the HGL along the east-side interceptor and elimination of MH overflow. The model predicted maximum water elevations for the existing conditions, existing flow conditions with the Hubbells Lane Relief Sewer, and future flow conditions with the Hubbells Lane Relief Sewer, are shown in Figure 5-3. As seen in Figure 5-3, the HGL reduction upstream of the siphon does not result in a significant increase in the HGL downstream of the siphon.

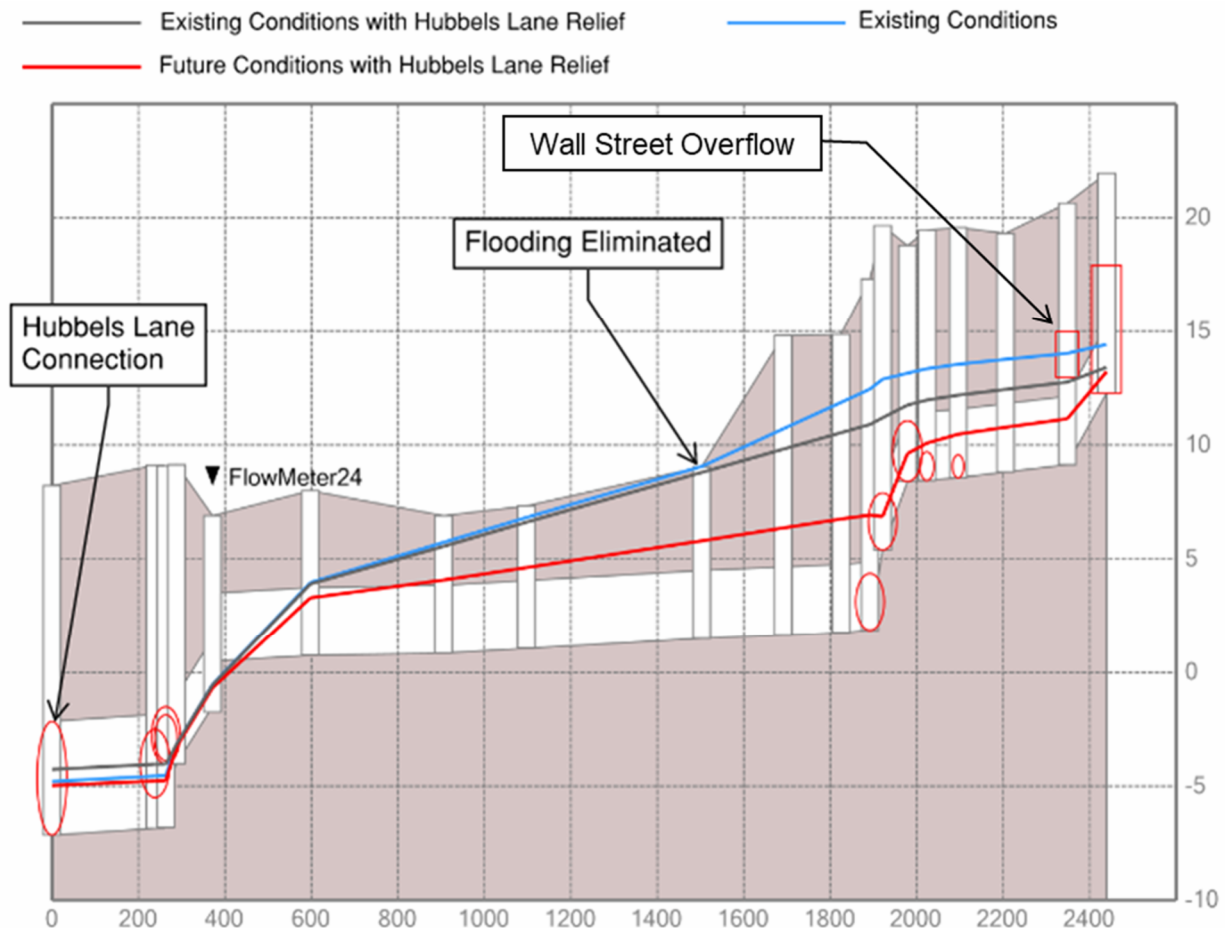


Figure 5-3. System Improvements After Hubbells Lane Relief Sewer Constructed for the 25-year, 6-hour Return Frequency Event

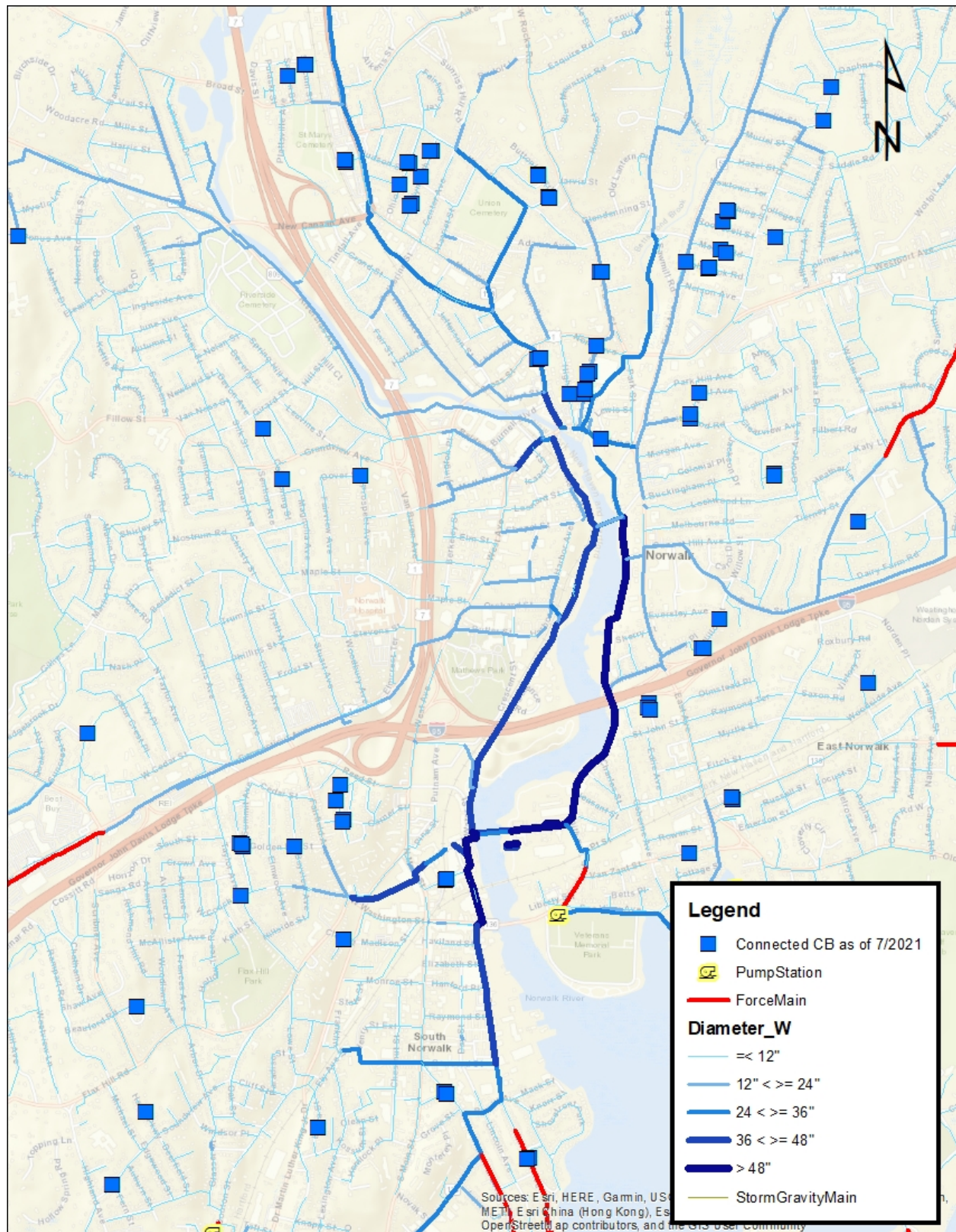
From Figure 5-3 it is evident that the Hubbells Lane Relief Sewer provides an immediate reduction to the HGL between MH 03-239 and MH 03-22 in the East Interceptor. This area has historically been prone to significant surcharge and SSOs. The reduction in HGL provided by the Hubbells Lane Relief Sewer reduces the amount of surcharging and the risk of an SSO event. Under the simulated future conditions, where RDII reductions are projected, the decrease in the HGL provided by the Hubbells Lane Relief Sewer further reduces surcharging. Modeling results under existing flow conditions, with the Hubbells Lane relief sewer implemented, indicate discharges at the Wall St. overflow structure

are eliminated for return frequency events up to and including the 25-year, 6-hour event. Modeling results with I/I reductions and the Hubbells Lane relief sewer implemented indicate discharges at the Wall St. overflow structure are eliminated for return frequency events up to and including the 100-year, 6-hour event.

5.2.3 Storm Drainage Catch Basin Disconnection

Through the large-scale sewer separation projects Norwalk completed in the 1970s and 1980s, the City's collection system is largely separated. While the collection system is primarily separated, 81 catch basins known to be directly connected to the wastewater collection system were identified at the outset of the development of this Master Plan. These directly connected catch basins are significant inflow sources that contribute high peak flows and RDII volumes that enter the sanitary system in very short periods of time. Inflow from these directly connected catch basins can overwhelm the conveyance capacity of the collection system adjacent to the catch basin and contribute to the high peak flows that reach the interceptor system. Disconnecting catch basins can be cost-effective relative to the amount of inflow removed, therefore identifying and prioritizing catch basins to disconnect was the second management strategy evaluated.

Figure 5-4 below shows the 81 catch basins that were identified as being directly connected to the collection system as of July 2021.



In a previously prepared *Inflow and Infiltration Control Plan*, completed in 2017 and revised in 2018 by Jacobs (CH2M Hill), 60 of the 81 catch basins identified in the City's GIS dataset as being directly connected to the collection system were evaluated for disconnection. In this study, the drainage areas for each catch basin were delineated using topographic and planimetric mapping provided by the City in GIS. Once the total drainage area was determined for each basin, contributing portions of impervious and pervious surface area were delineated using the City of Norwalk's most current impervious surface GIS layer. Subsequently, 25-year peak flows were calculated for each catch basin inlet.

Following the approach described in the Jacobs prepared *Inflow and Infiltration Control Plan*, drainage areas for the 21 additional directly connected catch basins identified between 2019 and 2022 were delineated using elevation data and satellite imagery. Following the methodology described in the *Inflow and Infiltration Control Plan*, peak flows from each catch basin were estimated using the rational method.

Further investigation of the magnitude of the peak flows estimated to arrive at the catch basin via overland flow, it was noted that the potential peak flows generated by the catch basin drainage areas were generally larger than the maximum capacity of the downstream sanitary sewer pipe the catch basin was connected to. In many cases, the downstream sanitary sewer pipe acts as a constriction point that limits the amount of flow that could realistically enter the collection system. To account for this, the estimated peak flows generated by the catch basins were restricted to the downstream pipe capacity if those flows were greater than the pipe capacity.

Catch basins where the estimated 25-year return frequency peak flow was 0.5 MGD or greater and where the downstream sanitary sewer capacity was also greater than 0.5 MGD were identified as significant inflow contributors to the collection system. Catch basins identified as significant inflow contributors to the collection system are shown in Table 5-3. After the start of this study in July of 2021, and prior to the submission of this report, 13 of the 81 known directly connected catch basins have already been disconnected by the City. Of these 13, four have been identified as significant inflow contributors and were disconnected by the City as of July 1, 2022 as shown in Table 5-3 below. The effective peak flow estimated to be eliminated from entering the collection system by disconnecting these four significant inflow sources is approximately 3.6 MGD.

Table 5-3. Catch Basins Identified as Significant Inflow Contributors			
Catch Basin Asset ID	Metershed ID	Q25-yr Rational Method (MGD)	Downstream Sewer Pipe Capacity (MGD)
1004	FM_02	9.1	0.5
7657	FM_02	1.7	0.6
7682	FM_02	1.5	0.6
15900	FM_02	1.6	0.8
2868	FM_04	1.4	0.5
7067	FM_05	2.4	0.6
7069	FM_05	6.1	5.2
7070	FM_05	6.9	0.6
33392	FM_05	8.7	0.6
33393	FM_05	1.8	0.6
5366*	FM_08	5.0	0.8

Table 5-3. Catch Basins Identified as Significant Inflow Contributors			
Catch Basin Asset ID	Metershed ID	Q25-yr Rational Method (MGD)	Downstream Sewer Pipe Capacity (MGD)
15286	FM_08	3.2	3.8
15287	FM_08	3.6	3.8
15569*	FM_08	3.0	0.8
15570*	FM_08	5.1	0.8
1001	FM_09	0.6	0.8
1002	FM_09	0.4	0.6
1003	FM_09	1.4	0.6
1006	FM_10	7.8	0.5
10955*	FM_10	3.9	1.2
10960	FM_10	10.2	0.5
1564	FM_13	3.2	1.2
1005	FM_14	2.4	0.8
10707	FM_14	5.2	0.8
1765	FM_15	1.7	0.6
1766	FM_15	11.4	0.6
10345	FM_15	6.7	0.8
8497	FM_24	9.5	1.2
10673	FM_26	2.1	0.6
48652	FM_26	3.9	0.6
9937	FM_28	2.1	0.5
9963	FM_28	3.4	0.5
49214	FM_28	14.2	0.5
7298	FM_35	9.8	0.9
7299	FM_35	3.6	0.9
3932	FM_36	6.5	0.6
3933	FM_36	6.5	0.6
3934	FM_36	7.4	0.6
Total		185.2	36.1

* Disconnected as of July 1, 2022

As shown in Table 5-3, 38 catch basins representing 47 percent of the known directly connected catch basins were identified as significant inflow contributors to the collection system. The sum of the sanitary sewer pipe capacities downstream of all 81 known directly connected catch basins was calculated as 46.9 MGD, whereas the sum of the sanitary sewer pipe capacities downstream of the 38 catch basins identified as significant inflow contributors was calculated as 36.1 MGD. By disconnecting 48 percent of the known directly connected catch basins, it is estimated that 77

percent of the peak flow contributions are removed. Further disconnection of additional catch basins beyond the 38 identified as significant inflow contributors removes relatively little peak inflow at a significant additional capital cost to the City. As cost-effectiveness of removal of excess flow from the collection system is an important consideration, only the catch basins identified as significant inflow contributors are identified for prioritized disconnection.

To model the flow reduction that disconnecting these catch basins would provide, the sum of the estimated catch basin peak flows, grouped by flow meter area, was compared to the total peak RDII flow rate for that entire meter area. The percentage of peak flow reduction the disconnections would provide was applied to the peak of the RTK unit hydrographs used to represent the RDII within the model. Table 5-4 shows the percentage of peak flow reduction for each meter area predicted after disconnection of the 38 catch basins identified as significant inflow contributors.

Metershed ID	Existing Conditions Peak 5yr-6hr RDII Flow Rate (MGD)	Post Catch Basin Disconnection Peak 5yr-6hr RDII Flow Rate (MGD)	Percent Peak RDII Flow Rate Reduction
FM_02	5.6	4.6	-19%
FM_04	0.2	0.2	0%
FM_05	8.5	4.7	-45%
FM_08	17.3	10.1	-41%
FM_09	0.9	0.9	0%
FM_10	2.1	2.1	0%
FM_13	2.4	1.8	-24%
FM_14	8.1	5.1	-36%
FM_15	2.6	2.5	-1%
FM_24	2.8	1.9	-31%
FM_26	4.4	3.7	-15%
FM_28	11.0	11.0	0%
FM_35	7.4	4.8	-35%
FM_36	8.1	5.9	-27%
Total	81.2	59.4	-27%

In some instances, the sum of predicted inflow removal in the metershed was greater than the existing conditions peak modeled inflow. While catch basins in these metersheds are still identified as significant inflow contributors, the model parameters for these areas were not adjusted since it is impossible to remove more flow than was measured during the temporary flow monitoring campaign described in Section 3. The peak flow reduction in these cases is zero percent. Any future projects related to disconnecting these identified catch basins should first verify the connection to the sanitary sewer. In addition to the peak RDII flow reduction, the model results also indicate catch basin disconnection reduces local MH overflow and SSO discharges. Figure 5-5 shows the reduction in MH overflow achieved by disconnecting these prioritized catch basins.

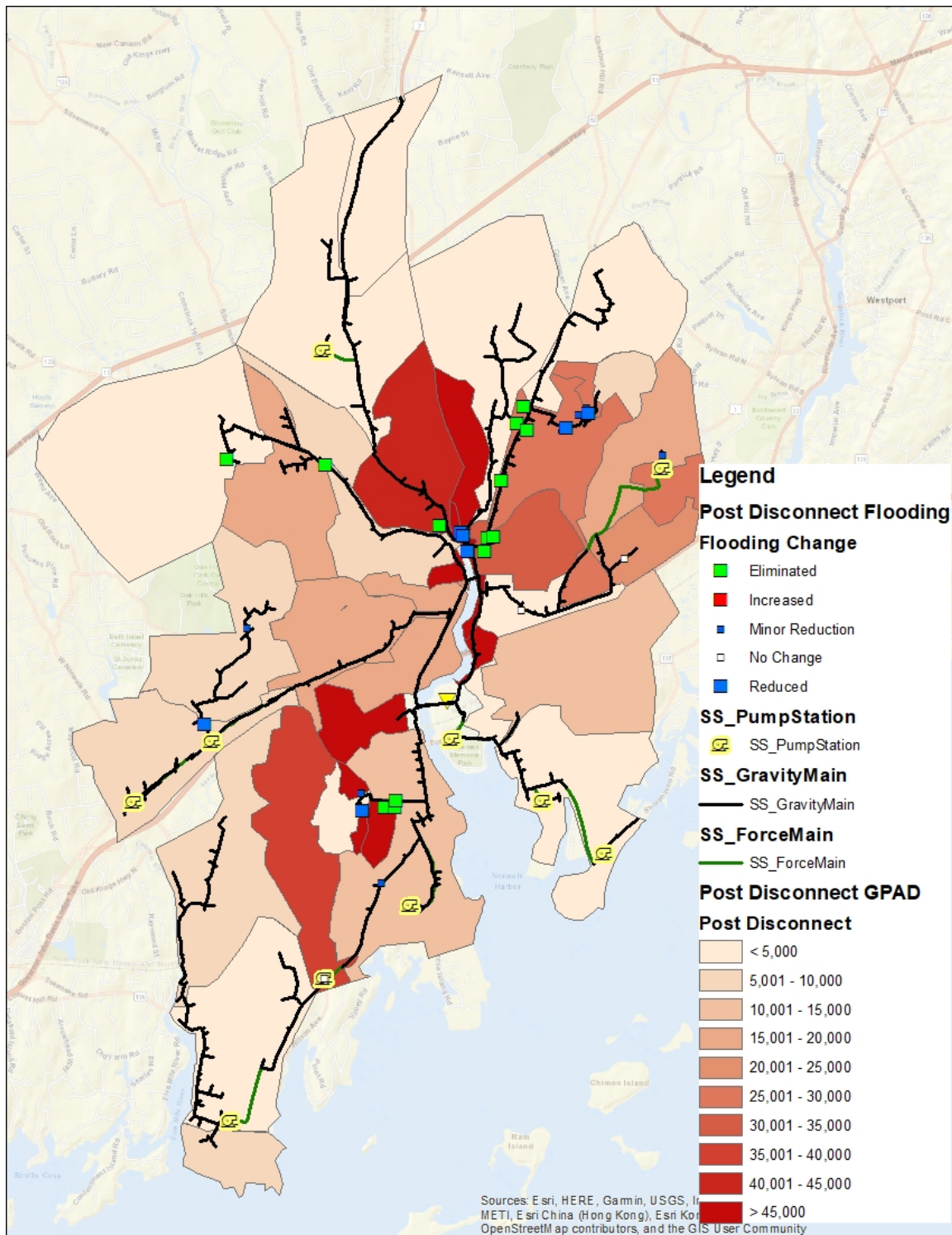


Figure 5-5. Reduction in Manhole Overflow After Catch Basin Disconnection

Figure 5-6 shows the post-catch basin disconnection percentage reduction in peak RDII flowrates rate by metershed.

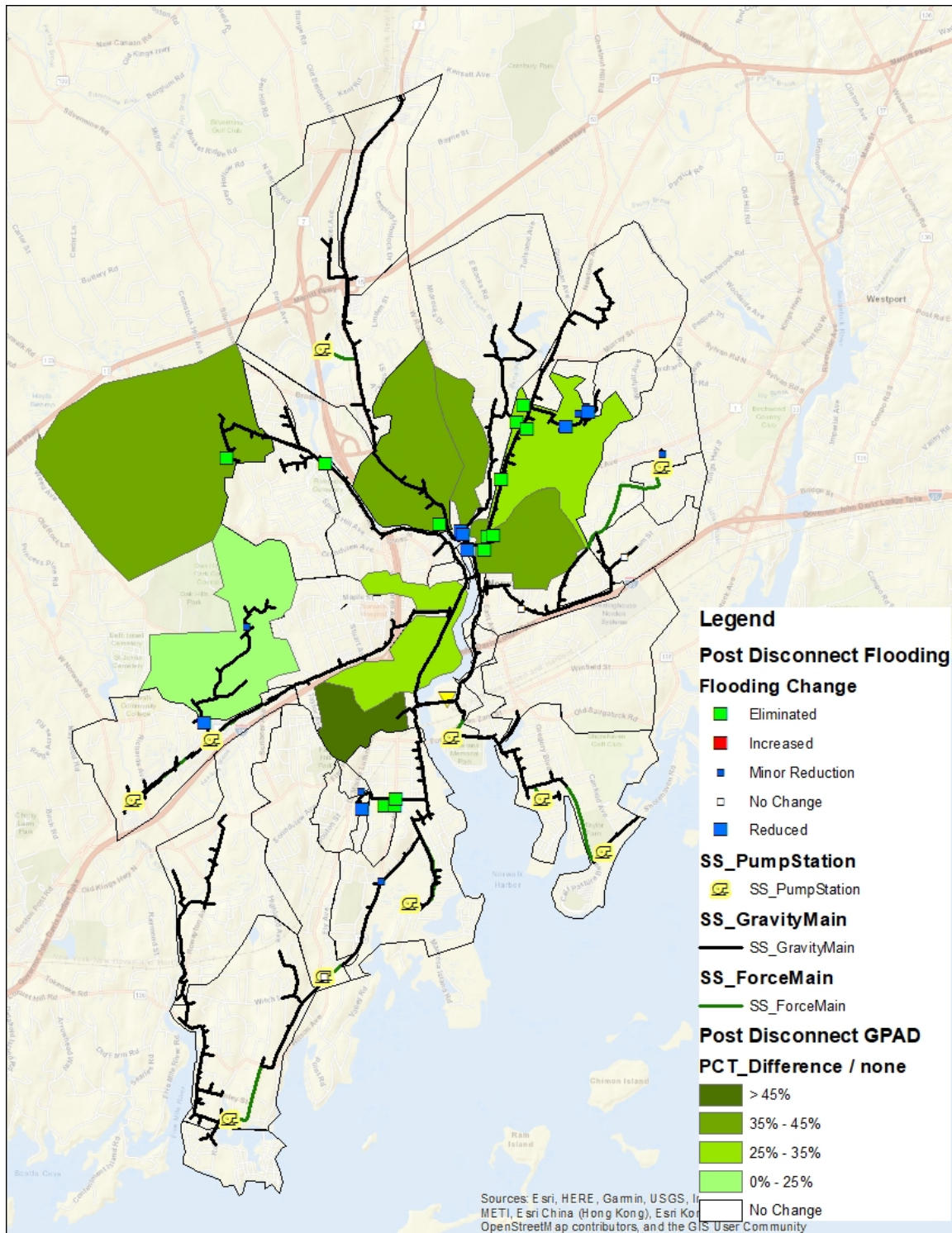


Figure 5-6. Percent Peak RDII Reduction After Catch Basin Disconnection

Disconnecting the prioritized directly connected catch basins improved system performance and reduced MH overflow and CSO volumes. Table 5-5 shows the estimated reduction in SSO volumes during the 25-year, 6-hour design event achieved by disconnecting the 38 priority catch basins.

Table 5-5. Manhole Flood Reduction Post-Catch Basins Disconnection					
MH ID	Baseline Flood Volume (MG)	Flood Volume Priority Disconnections (MG)	Change (MG)	Change (%)	Comment
03-109	0.01	0	-0.010	-100%	Eliminated
03-30	0.015	0	-0.015	-100%	Eliminated
03-31	0.014	0	-0.014	-100%	Eliminated
05-10	0.002	0	-0.002	-100%	Eliminated
05-257	0.014	0	-0.014	-100%	Eliminated
05-264	0.001	0	-0.001	-100%	Eliminated
05-265	0.012	0	-0.012	-100%	Eliminated
08-179.1	0.015	0	-0.015	-100%	Eliminated
10-29	0.006	0	-0.006	-100%	Eliminated
11-18	0.007	0	-0.007	-100%	Eliminated
16-306	0.005	0	-0.005	-100%	Eliminated
16-331.1	0.005	0	-0.005	-100%	Eliminated
16-4	0.011	0	-0.011	-100%	Eliminated
05-110	0.018	0.017	-0.001	-6%	Minor Reduction
05-157	0.165	0.134	-0.031	-19%	Minor Reduction
13-27	0.194	0.192	-0.002	-1%	Minor Reduction
15-34	0.011	0.009	-0.002	-18%	Minor Reduction
16-294	0.043	0.035	-0.008	-19%	Minor Reduction
21-4	0.031	0.026	-0.005	-16%	Minor Reduction
04-94	0.044	0.044	0.000	0%	No Change
15-115	1.828	1.828	0.000	0%	No Change
15-55	0.001	0.001	0.000	0%	No Change
22-3	0.004	0.004	0.000	0%	No Change
03-165.2	0.059	0.005	-0.054	-92%	Significant Reduction
03-22	0.244	0.140	-0.104	-43%	Significant Reduction
03-242	0.134	0.006	-0.128	-96%	Significant Reduction
05-36	0.037	0.023	-0.014	-38%	Significant Reduction
05-43	0.04	0.014	-0.026	-65%	Significant Reduction
12-155	0.164	0.130	-0.034	-21%	Significant Reduction
16-280.1	0.011	0.007	-0.004	-36%	Significant Reduction
Total	3.1	2.6	-0.530	-17%	

The catch basin disconnection analysis performed for this Master Plan assumed that the Storm Drain system has sufficient conveyance capacity to accept the additional flows and that construction of new storm drain assets required for catch basin disconnection are feasible. Both assumptions will need to be further verified through more detailed engineering analysis under a City-administered Catch Basin Disconnection Program. The Catch Basin Disconnection Program would serve to accomplish the following:

- Confirm the catch basin drainage area, land use, and peak flow reduction estimates calculated in either the *Inflow and Infiltration Control Plan* or this Master Plan.
- Perform catch basin disconnection feasibility analysis
 - Determine catch basin connection point to the City's Storm Drain system
 - Perform Storm Drain capacity assessment to confirm the existing Storm Drain system has capacity to convey the additional flow
 - Perform underground utility survey to identify potential conflicts and assess constructability of catch basin disconnection project
 - Determine sizing and perform preliminary design
- Perform detailed design and develop catch basin disconnection project specifications.
- Perform project bidding, construction management, and catch basin disconnection project close out.

5.2.4 Targeted RDII Reduction

Following system maintenance and catch basin disconnection, the next I/I and CSO management strategy evaluated was targeted RDII reductions that may be accomplished through system rehabilitation and renewal projects such as sewer main and MH lining and point repairs.

The amount of RDII that can be removed from a sewershed is largely dependent on the quantity and quality of sewer rehabilitation or renewal that are completed in the sewershed. While comprehensive rehabilitation in a sewershed can achieve significant RDII reduction, it is not always affordable or necessary, as non-defective sewer assets are rehabilitated in the same manner as defective ones. A more cost-effective approach to RDII reduction can be achieved through the targeted investigation and rehabilitation of prioritized sewersheds that exhibit high rates of RDII production.

The following activities are commonly included as part of the I/I reduction plan and are performed prior to the development of specific I/I reduction projects:

- Perform temporary flow monitoring within the metersheds prioritized for targeted RDII flow reduction to further identify specific areas within the metershed that exhibit the highest RDII production rates.
- Perform collection system condition assessment work to identify assets with significant defects that may act as I/I sources.
- Perform field investigations to identify specific inflow sources for disconnection. Examples of field investigation activities include, but are not limited to, smoke testing and dye testing.
- Perform field investigations, such as flow isolation studies, to identify areas with high infiltration rates.

Based on results of collection system inspections and field investigation activities, I/I reduction plans may be developed and customized to correct the specific types of defects and I/I sources identified, such as the disconnection of identified illicit cross-connections or comprehensive rehabilitation in

concentrated areas of the metershed where the highest I/I production rates have been identified. The I/I reduction plan should establish a methodology for the prioritization of I/I reduction projects and indicate an anticipated schedule for implementation.

The Water Environment Research Foundation (WERF) published report, *WERF 99-WWF-8: Reducing Peak Rainfall-Derived Infiltration/Inflow Rates – Case Studies and Protocol*, was designed to assist utilities confronted with the need to reduce peak RDII flows. The report discusses analytical methods used for quantifying RDII, approaches for determining reduction in peak and average RDII flows following sewer rehabilitation, provides an effectiveness evaluation reporting protocol, and compared case study projects to assess the cost-effectiveness of RDII removal. An update to the WERF report, *Update on a Nationwide I/I Reduction Project Database*, increasing the number of case study projects evaluated was published as part of the Water Environment Federation (WEF) 2007 Collection Systems Conference proceedings.

From both documents, the cost of RDII removal, expressed in dollars per gallon per day, increased as the RDII production rates, expressed as GPAD, decreased. This inverse relationship suggests that the cost-effectiveness of RDII removal diminishes as the peak RDII flow rates decrease. This may be due to the increasing amounts of sewer rehabilitation that are necessary to continuously remove RDII flows from the collection system.

Based on the diminishing cost-effectiveness of removing RDII from the collection system as peak RDII flow rates decrease, a peak area-flow rate of 15,000 GPAD during the 5-year design storm was set as a target goal for each meter area. The 15,000 GPAD target was established based on the cost effectiveness shown by the WERF study discussed further in Section 6 of this report. Additionally, the 15,000 GPAD RDII production threshold targets RDII reduction to 43 percent of the service area, which produces approximately 80 percent of the peak RDII flows entering the collection system. These metersheds represent the largest RDII contributors and offer the greatest chance to accomplish meaningful flow reductions.

While 15,000 GPAD was identified as the goal, studies have shown that approximately 50 percent of the RDII produced in a collection system may originate from private property. For this evaluation, it is assumed that rehabilitation work will only take place within the public right of way, leaving the private property sewer assets unrehabilitated.

Table 5-6 shows the subcatchments with peak flows greater than 15,000 GPAD identified for I/I reduction. Additionally, it shows the estimated peak flow reduction achievable by targeting only the 50 percent of total RDII peak flow that is estimated to originate from public sewer sources, calculated as 50 percent of the difference between the peak flow after catch basin disconnection and the targeted 15,000 GPAD.

Table 5-6. Residual RDII Reductions - Public Only				
Metershed ID	Sewered Area	5-yr I/I only (mgd)	Sewershed I/I Rate per Unit Area (GPAD)	Target GPAD
FM_38	18.6	5.0	269,114	142,057
FM_37	13.2	1.3	95,793	55,396
FM_24	21.4	1.9	89,524	52,262
FM_19	21.0	2.1	100,646	57,823
FM_03	27.3	2.5	93,223	54,112
FM_25	14.7	1.1	74,087	44,544

Table 5-6. Residual RDII Reductions - Public Only

Metershed ID	Sewered Area	5-yr I/I only (mgd)	Sewershed I/I Rate per Unit Area (GPAD)	Target GPAD
FM_14	119.9	5.1	42,873	28,936
FM_35	120.3	4.8	39,936	27,468
FM_08	355.6	10.1	28,465	21,732
FM_36	200.6	5.9	29,553	22,276
FM_16	50.0	1.8	35,037	25,019
FM_05	312.3	4.7	14,964	14,964
FM_28	409.6	11.0	26,885	20,943
FM_30	34.6	0.6	18,420	16,710
FM_33	146.0	2.6	17,599	16,300
FM_26	239.1	3.7	15,678	15,339
FM_23	2.4	0.0	18,108	16,554
FM_22	143.9	2.4	16,713	15,857

Similar to how the RDII flows were reduced for the catch basin disconnections, the percentage decrease in estimated peak flows were applied to the unit hydrographs of the respective meter areas, and the full range of design storms were modeled to evaluate the improved collection system performance.

Figure 5-7 shows the reduction in MH overflow achieved by performing public-side rehabilitation on the identified meter areas for the 25-year, 6-hour design event, along with the updated RDII production rates by metershed.

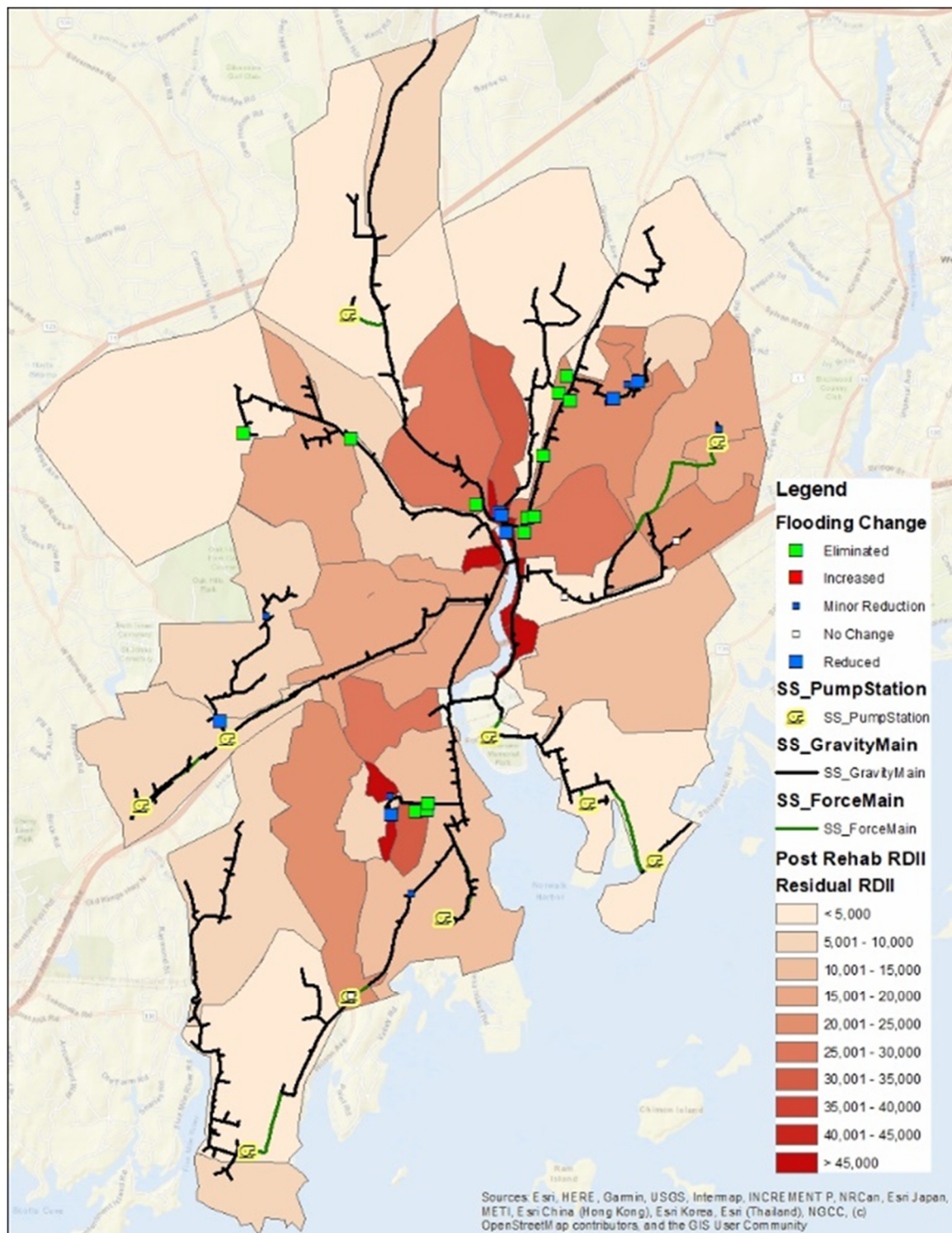


Figure 5-7. Reduction in Manhole Overflow After Residual I/I Management

Table 5-7 below shows the estimated reduction in CSO volumes achieved by performing public-side rehabilitation on the identified meter areas.

Table 5-7. CSO Volume Comparison						
	Peak Flow (MGD)			24-HR Volume (MG)		
	Baseline	I/I Management	% Change	Baseline	I/I Management	% Change
MH Overflow	-	-	-	3.1	2.6	-18%
Ann Street Emergency Overflow	0.0	0.0	-	0.0	0.0	-
Outfall 002	46.9	32.0	-32%	9.0	6.4	-29%
WPCF Total Inflow	76.8	62	-19%	93.7	90.8	-3%

5.2.5 Storage

While the previously detailed I/I and CSO management strategies significantly improved system performance and reduced CSO overflow volumes, there is still a significant amount of flow conveyed to the WPCF during storm events that exceeds the secondary treatment capacity at the WPCF. Flows above 30 MGD are diverted to the SWWTF for primary screening and disinfection/dechlorination. Flows from the SWWTF are discharged to the Norwalk River through Outfall 002. Table 5-8 shows the discharge volumes at Outfall 002, under the predicted future flow conditions, for various design storms.

Table 5-8. CSO Volumes by Design Storm - Future Conditions (MG)					
6-Hour	1-Year	2-Year	5-Year	10-Year	25-Year
Ann Street Emergency Overflow	-	-	-	-	-
Outfall 002	0.1	0.4	1.9	3.3	6.4
12-Hour	1-Year	2-Year	5-Year	10-Year	25-Year
Ann Street Emergency Overflow	-	-	-	-	-
Outfall 002	0.8	1.9	4.3	7.4	12.3
24-Hour	1-Year	2-Year	5-Year	10-Year	25-Year
Ann Street Emergency Overflow	-	-	-	-	-
Outfall 002	1.0	2.5	6.1	10.8	19.8

The use of storage at the WPCF was evaluated as a method to equalize flow during wet weather flow events. Wet weather volumes stored in a flow equalization tank could be re-introduced to the secondary treatment train at the WPCF after the wet weather flows subside. The residual storage volumes, representative of storage requirements that remain after other flow reduction activities would be completed, were assessed to determine the feasibility of flow equalization at the WPCF. The total potential storage volume at the plant is limited by the amount of available space. It is estimated that a storage tank with a maximum volume of 2.4 MG could reasonably be constructed on the current SWWTF footprint, which would temporarily store wet weather flows before being sent

to secondary treatment after the peak of the storm event. As seen in Table 5-8, the estimated constructable storage volume of 2.4 MG is exceeded at the 2-year, 24-hour, the 5-year, 12-hour, and the 10-year, 6-hour rainfall events. As the SWWTF is able to provide primary treatment for flows well beyond the level of service of flow equalization, storage was determined not to be viable or cost-effective.

Section 6

Capital Cost Estimates

6.1 Overview

This section provides a summary of the cost-benefit analysis conducted as part of this report. The overall goal was to identify the best course of action to improve system performance while minimizing costs and constructability issues.

6.1.1 Existing System Management

Portions of the collection system are currently underperforming due to maintenance issues such as accumulation of debris and presence of root balls, causing increased surcharging and MH overflows upstream of the location of the hydraulic constriction. The City currently contracts with Veolia to perform inspection and maintenance in the collection system. As part of this contract, it is recommended that inspection and maintenance be performed in the areas identified in Section 5.2.1 and Section 7.3.1. There are no additional capital costs associated with the inspection and maintenance activities recommended as part of this Master Plan.

6.1.2 Conveyance Capacity Improvements

Based on the alignment and profile of the Hubbells Lane Relief Sewer developed during the modeling evaluation, a Class 5 estimate of probable construction cost for this project was developed. The cost estimate details are included in Appendix E. The estimated capital costs for the Hubbells Lane Relief Sewer are \$5.4 million.

6.1.3 Catch Basin Disconnection

At the outset of the Master Plan development, there were 81 catch basins identified as being directly connected to the collection system. Of these 81, 38 are identified as significant inflow contributors and are recommended for disconnection as shown in Table 6-1. The associated estimated cost to disconnect is also shown in Table 6-1. A number of these catch basins were identified in a previous *Inflow and Infiltration Control Plan*, completed in 2017 and revised in 2018 by Jacobs (CH2M Hill). Where catch basins recommended for disconnection are located in close proximity to others, these were grouped together and are identified in Table 6-1 by the disconnection group identification number. It is envisioned that disconnection of catch basins in each disconnection group will be performed as a discrete construction project administered by the City under a Catch Basin Disconnection Program.

Cost estimates for catch basin disconnection projects from the Jacobs report were used for this cost analysis where they were developed for the 2018 report. These project costs were escalated to 2022 prices. For catch basins that were recommended for disconnection in this report but not included in the Jacobs study, an average cost per disconnection was determined from the previous project and applied to the catch basins included in this report.

Table 6-1. Catch Basins Recommended for Disconnection

Disconnection Group ID	CB Asset ID	Metershed ID	Q25-yr Rational Method (MGD)	DS Sewer Max Pipe Capacity (MGD)	Cost to Disconnect
1	1004	FM_02	9.1	0.5	\$563,000
2	7657	FM_02	1.7	0.6	\$318,000
	7682	FM_02	1.5	0.6	
3	15900	FM_02	1.6	0.8	\$269,000
4	2868	FM_04	1.4	0.5	\$340,000
5	7067	FM_05	2.4	0.6	\$823,000
	7070	FM_05	6.9	0.6	
6	7069	FM_05	6.1	5.2	\$381,000
7	33392	FM_05	8.7	0.6	\$406,000
	33393	FM_05	1.8	0.6	
8	5366	FM_08	5	0.8	\$747,000
9	15286	FM_08	3.2	3.8	\$552,000
	15287	FM_08	3.6	3.8	
10	15569	FM_08	3	0.4	\$392,000
	15570	FM_08	5.1	0.4	
11	1001	FM_09	0.6	0.8	\$227,000
12	1002	FM_09	0.4	0.6	\$102,000
	1003	FM_09	1.4	0.6	
13	1006	FM_10	7.8	0.5	\$234,000
14	10955	FM_10	3.9	1.2	\$300,000
15	10960	FM_10	10.2	0.5	\$706,000
16	1564	FM_13	3.2	1.2	\$6,000
17	1005	FM_14	2.4	0.8	\$340,000
18	10707	FM_14	5.2	0.8	\$737,000
19	1765	FM_15	1.7	0.6	\$264,000
	1766	FM_15	11.4	0.6	
20	10345	FM_15	6.7	0.8	\$491,000
21	8497	FM_24	9.5	1.2	\$276,000
22	10673	FM_26	2.1	0.6	\$275,000
	48652	FM_26	3.9	0.6	
23	9937	FM_28	2.1	0.5	\$276,000
24	9963	FM_28	3.4	0.5	\$276,000
25	49214	FM_28	14.2	0.5	\$276,000
26	7298	FM_35	9.8	0.9	\$552,000
	7299	FM_35	3.6	0.9	
27	3932	FM_36	6.5	0.6	\$486,000
	3933	FM_36	6.5	0.6	
	3934	FM_36	7.4	0.6	
Total			185.2	36.3	\$10,609,000

6.1.4 Targeted RDII Reduction

As stated in Section 5.2.3, flow meter areas with 5-year peak I/I production rates greater than 15,000 GPAD were identified as areas where cost effective I/I reduction could be accomplished. This Master Plan update analysis assumed that only public-side rehabilitation will take place, which was assumed to account for 50 percent of the total peak RDII flows entering the system. It is assumed that the other 50 percent of the RDII peak flow enters the system via infiltration and inflow that originates on private property. Therefore, the targeted I/I reduction for each meter area was half the difference between the existing conditions I/I rate and 15,000 GPAD.

While performing system maintenance and disconnecting catch basins are relatively inexpensive for the amount of flow removed from the system, a significant fraction of extraneous flows that enter the collection system are through defective sewers and unknown direct connections. Reducing these RDII sources through the administration of a comprehensive inspection and rehabilitation plan is necessary to reduce the peak RDII flows to levels that achieve the targeted I/I reductions necessary to improve collection system performance.

It is generally necessary to complete a sewer system evaluation survey (SSES) and multiple collection system rehabilitation projects to achieve a desired I/I reduction. An SSES generally consists of the following items:

- Physical inspection of collection system – Includes visual inspection of MHs and pipes.
- Rainfall and flow metering data collection – Includes analysis to delineate and prioritize portions of the collection system where cost-effective reductions are feasible.
- RDII Source Identification – Collection system testing that may include smoke testing, dye testing, and flow isolation studies.
- Final report and maps – Includes analysis and discussion on cost-effectiveness of rehabilitation alternatives.

The costs for these multi-step projects were accounted for in this analysis by performing a step-wise approach to I/I reduction where each step reduces I/I by 20 percent of the targeted reduction, finishing with the final I/I rate previously identified. The capital costs associated with the targeted rehabilitation of the public sewer infrastructure followed the methodology described in the *WERF 99-WWF-8: Reducing Peak Rainfall-Derived Infiltration/Inflow Rates – Case Studies and Protocol*, updated with additional case studies. The cost-effectiveness curve used to develop the capital costs associated with the targeted RDII reductions is shown in Figure 6-1.

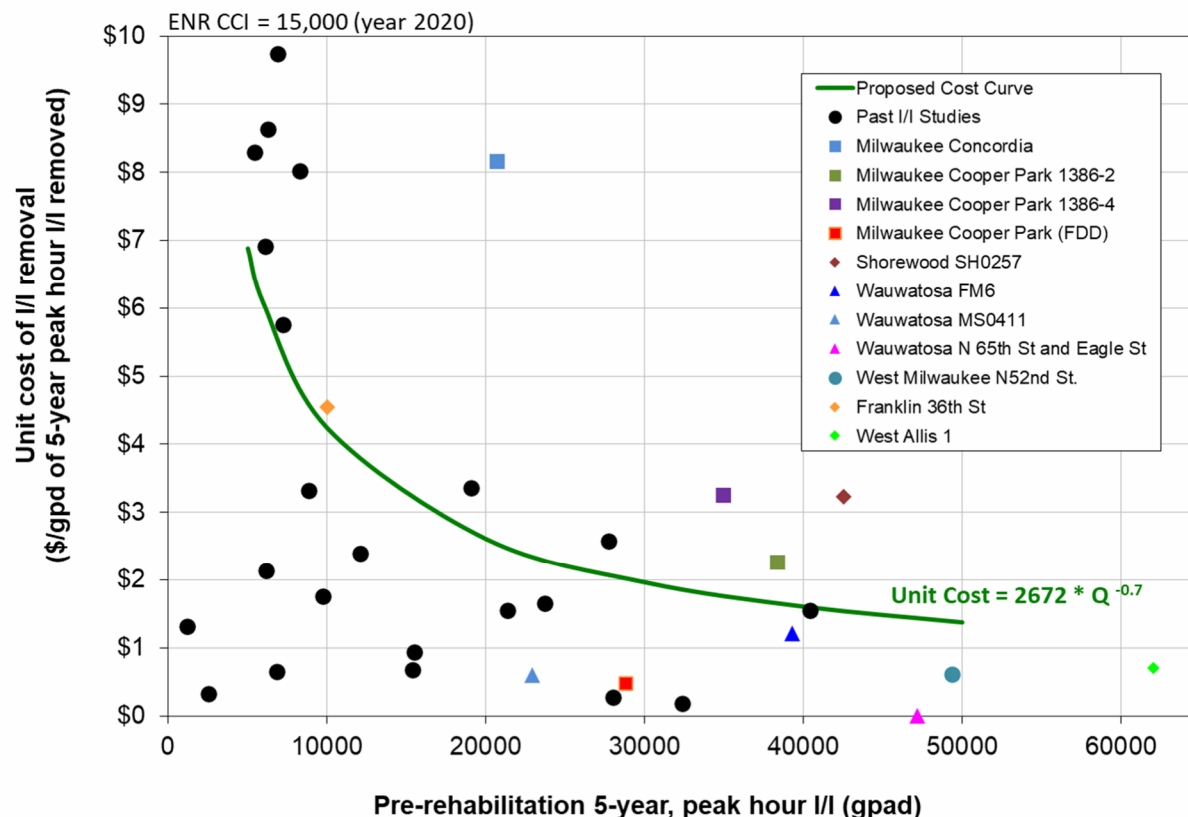


Figure 6-1. Unit Cost Curve - \$/Gal Removed

Using this curve and the step-wise approach, flow reduction unit costs were applied to the flow meter areas that exceeded the 15,000 GPAD, with each step removing approximately 5.5 MG of flow. Table 6-2 shows the cost breakdown of each step.

Step	Flow Removed (MG)	Cost to Remove (\$M)	Cost To Remove (\$/GPD)	Cumulative Flow Removed (MG)	Cumulative Cost to Remove (\$M)	Cumulative Cost to Remove (\$/GPD)
1	3.3	5.24	1.59	3.3	5.24	1.59
2	3.3	5.39	1.63	6.6	10.63	1.61
3	3.3	5.56	1.69	9.9	16.20	1.64
4	3.3	5.79	1.75	13.2	21.99	1.67
5	3.3	6.06	1.83	16.5	28.05	1.70

Including a 30 percent contingency associated with anticipated SSES, field investigations, and design of sewer rehabilitation projects, the total sewer rehabilitation costs to reduce 5-year peak flows to the target I/I rate is estimated at approximately \$36.4 million.

Section 7

Summary and Recommendations

7.1 Summary of Findings

The analysis of data collected under the temporary flow metering campaign, coupled with the development and calibration of a collection system model, supported the characterization of the City's collection system performance.

Based on results from the calibrated model, under existing conditions, the collection system generally performs well. Collection system performance is shown in Table 7-1 as discharge volumes throughout the system for various design events. Currently, the collection system experiences nominal systemwide SSO volumes for the 1- and 2-year return frequency events. Starting at the 1-year return frequency event, peak flows conveyed to the WPCF are predicted to exceed 30 MGD, the secondary treatment capacity at the WPCF. As designed, flows at the WPCF greater than 30 MGD are diverted to the SWWTF where it receives primary treatment (or equivalent) and disinfection/dechlorination before being discharged from Outfall 002. The Emergency Overflow is not predicted to discharge for any return frequency events as shown in the table. As discussed in Section 4.2.3, additional model runs performed with the 50- and 100-year, 24-hour return frequency events show that the Emergency Overflow does not discharge up to and including the 50-year event. Systemwide SSOs and discharges from Outfall 002 show an expected trend of increasing as the return frequency events get larger.

Table 7-1. CSO Volumes by Design Storm - Existing Conditions (MG)					
6 Hour	1 Year	2 Year	5 Year	10 Year	25 Year
Systemwide SSO	0.0	0.1	0.7	1.4	3.0
Ann Street Emergency Overflow	-	-	-	-	-
Outfall 002	1.5	2.2	4.0	6.0	9.0
12 Hour	1 Year	2 Year	5 Year	10 Year	25 Year
Systemwide SSO	0.1	0.5	1.6	3	6.1
Ann Street Emergency Overflow	-	-	-	-	-
Outfall 002	2.7	4.1	6.8	9.8	14.7
24 Hour	1 Year	2 Year	5 Year	10 Year	25 Year
Systemwide SSO	0.1	0.5	2	4.1	8.8
Ann Street Emergency Overflow	-	-	-	-	-
Outfall 002	3.0	5.1	8.9	13.6	22.7

There are approximately 30 MHs, shown in Figure 7-1, that are predicted by the model to overflow during the 25-year, 6-hour design event. The model also suggests that it is possible to reduce MH overflows by approximately 30 percent by performing basic system maintenance in key areas.

MH overflows are predicted to be eliminated in the following locations when maintenance is conducted:

- East Avenue between Morgan Avenue and Nelson Avenue
- Concord Street between Chestnut Street and Woodward Avenue
- Riverside Avenue at Ponus Avenue

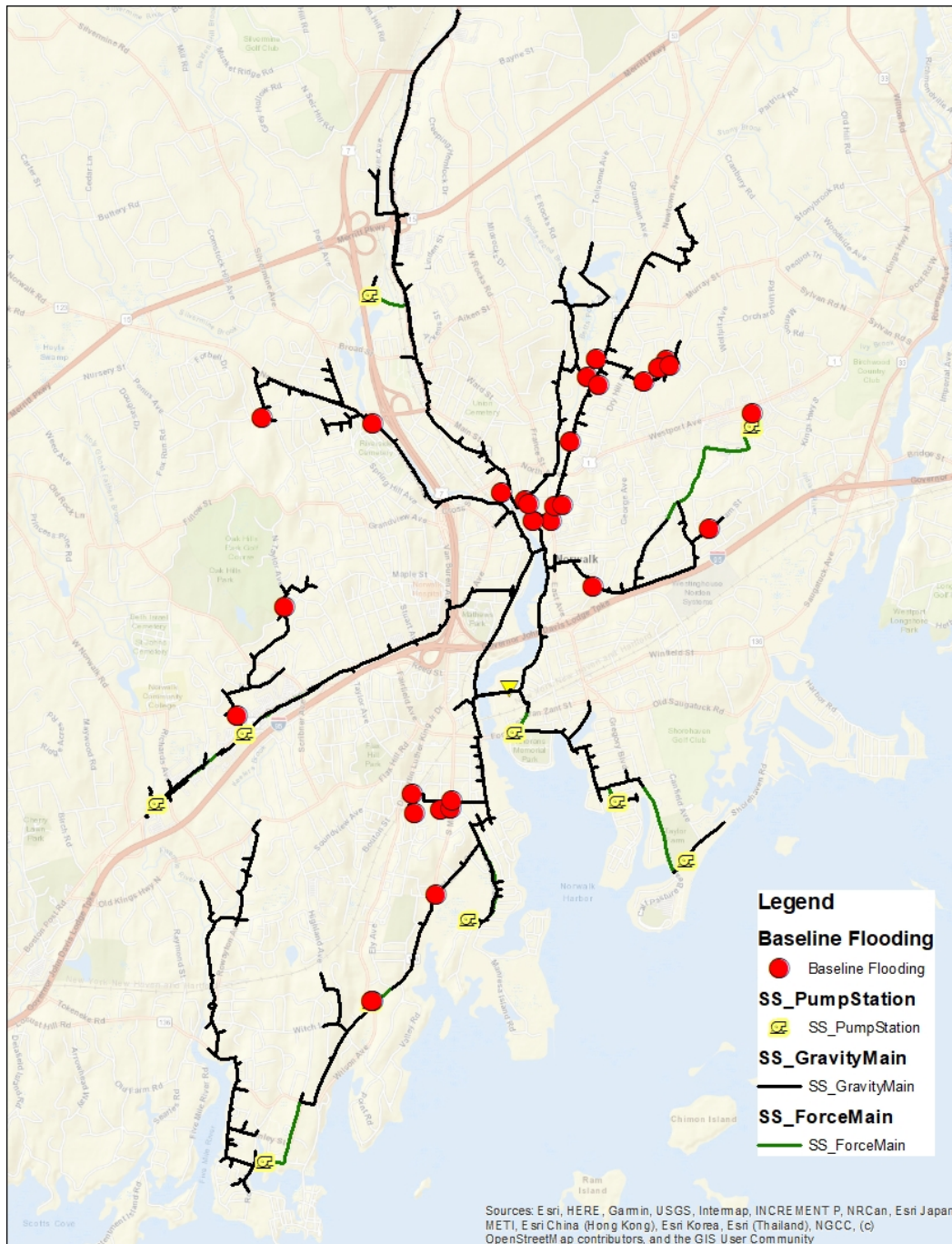


Figure 7-1. Locations of Predicted Manhole Overflow Under Existing Conditions During the 25-Year, 6-Hour Event

Under existing conditions, Outfall 002 discharge volumes range between 1.5 and 22.7 MG for the 1-year, 6-hour and 25-year, 24-hour events, respectively.

Completing all of the recommendations detailed within this Master Plan would reduce MH overflow volume and locations as well as overflow volumes at Outfall 002.

The number of MH overflows during the 25-year, 6-hour event would be reduced by approximately 60 percent. The total overflow volume throughout the system would be reduced from 3 MG to 1.1 MG for the same event.

Peak flows into the WPCF would be significantly reduced, resulting in a decrease in overflow volumes from Outfall 002. Overflows from Outfall 002, shown in Table 7-3, would range from 0.1 MG to 19.8 MG for the 1-year, 6-hour and 25-year, 24-hour events, respectively.

Analysis of the flow monitoring data indicated 12 of the 40 flow meter areas show a peak GWI rate of 4,000 gpd/in-mi or greater. The peak RDII flows, derived by subtracting the DWF pattern from the measured flow timeseries, was averaged for 5 rainfall events for each flow meter. Analysis of the average peak RDII flows show that 80 percent of the peak RDII flows entering the collection system are generated from approximately 40 percent of the flow monitored areas (24 of the 40 flow meter areas).

Development and calibration of a hydraulic model allowed the system performance to be referenced against specific design rainfall events. Analysis of the calibrated model results show significant portions of the service area contribute significant amounts of extraneous flows, which can exceed the conveyance capacity of the collection system during larger rainfall events. Analysis of the calibrated model simulation results from the 5-year, 6-hour design storm show high peak RDII inflows (greater than 15,000 GPAD) in 19 of the 40 flow metered areas. These high peak RDII flows are indicative of sewer deficiencies or direct inflow connections that act as RDII sources in the collection system.

Review of the calibrated model results also show that the performance of the collection system may be limited in specific locations by the accumulation of debris or development of flow blockages within the sewer pipes. Both conditions result in a decreased cross-sectional area in the sewer main available for flow conveyance and can act as critical hydraulic bottlenecks during wet weather flow events.

Under the modeled reduced inflow conditions, representative of post-catch basin disconnection and completion of the targeted RDII reductions, a segment of the east interceptor near Smith St. was found to still have insufficient capacity to convey the flows from three upstream trunk sewers. The addition of a relief sewer to redirect flows from East Wall Street down Hubbells Lane to the East Interceptor downstream of the Moodys Lane Siphon resulted in relieving a hydraulic overload and significantly decreasing the HGL in the East Interceptor between Burnell Boulevard and Moodys Lane.

7.2 Projected Performance of Collection System

The model was run with the full set of design storms while incorporating all the Long-Term Master Plan Recommendations, including improvements from system maintenance, priority catch basin disconnection, and RDII reduction via sewer rehabilitation. CSO and SSO volumes are significantly reduced throughout the system, and the volume of flow entering the plant to be treated is reduced as well. Table 7-2 shows the peak flow and volume reduction seen at the system CSO outfalls as well as the WPCF total inflow for the 25-year, 6-hour design event.

Table 7-2. CSO and SSO Volume Comparison (25-year, 6-hour Design Event)

	Peak Flow (MGD)			Volume (MG)		
	Baseline	I/I Management	% Change	Baseline	I/I Management	% Change
Ann Street Emergency Overflow	0.0	0.0	-	0.0	0.0	-
Outfall 002	46.9	32.0	-32%	9.0	6.4	-29%
WPCF Total Inflow	76.8	62.0	-19%	93.7	90.8	-3%

Table 7-3 shows the model-predicted CSO and SSO discharge volumes from simulations of return frequency design storm events ranging from the 1-year, 6-hour event through the 25-year, 24-hour event.

Table 7-3. CSO and SSO Volumes by Design Storm - Future Conditions (MG)

6 Hour	1 Year	2 Year	5 Year	10 Year	25 Year
Systemwide SSO	0.0	0.0	0.1	0.3	1.1
Ann Street Emergency Overflow	-	-	-	-	-
Outfall 002	0.1	0.4	1.9	3.3	6.4
12 Hour	1 Year	2 Year	5 Year	10 Year	25 Year
Systemwide SSO	0.0	0.0	0.4	1.2	3.3
Ann Street Emergency Overflow	-	-	-	-	-
Outfall 002	0.8	1.9	4.3	7.4	12.3
24 Hour	1 Year	2 Year	5 Year	10 Year	25 Year
Systemwide SSO	0.0	0.1	0.7	1.9	5.6
Ann Street Emergency Overflow	-	-	-	-	-
Outfall 002	1.0	2.5	6.1	10.8	19.8

Table 7-4 shows the model-predicted CSO and SSO discharge volume percent reductions for return frequency design storm events ranging from the 1-year, 6-hour event through the 25-year, 24-hour event, as compared to the existing conditions discharge volumes presented earlier in Table 4-4 from the same storm events.

Table 7-4. CSO and SSO Volumes Percent Reductions by Design Storm - Future Conditions (MG)					
6 Hour	1 Year	2 Year	5 Year	10 Year	25 Year
Systemwide SSO	100%	98%	86%	79%	63%
Ann Street Emergency Overflow	-	-	-	-	-
Outfall 002	93%	82%	53%	45%	29%
12 Hour	1 Year	2 Year	5 Year	10 Year	25 Year
Systemwide SSO	100%	100%	75%	60%	46%
Ann Street Emergency Overflow	-	-	-	-	-
Outfall 002	70%	54%	37%	24%	16%
24 Hour	1 Year	2 Year	5 Year	10 Year	25 Year
Systemwide SSO	100%	80%	65%	54%	36%
Ann Street Emergency Overflow	-	-	-	-	-
Outfall 002	67%	51%	31%	21%	13%

As shown in Table 7-4, under the future projected conditions, with all the Long-Term Master Plan Recommendations implemented, there is a significant reduction in discharge volume from Outfall 002 and a significant reduction in MH overflows throughout the system as evidenced from the change in Systemwide SSO volume reductions.

7.2.1 Ann Street Emergency Overflow Future Performance

Prior to the WPCA efforts to separate the collection system, when a significant portion of the Norwalk collection system was a combined sewer service area, the Emergency Overflow provided hydraulic relief to the Norwalk interceptor system and acted as a controlled point of discharge that prevented uncontrolled MH overflows from the west side interceptor. With the significant amounts of sewer separation Norwalk has accomplished since the 1970s, a reduced hydraulic load is placed on the interceptor system. With this reduced hydraulic load, the calibrated existing conditions model shows the Emergency Overflow is effectively eliminated, as it is not predicted to activate until a storm event larger than the 50-year, 24-hour return frequency.

In addition to the historical point of relief the Emergency Overflow provided when the Norwalk collection system was predominantly a combined sewer system, the Emergency Overflow continues to provide hydraulic relief, preventing excessive surcharge and uncontrolled SSOs from occurring, during periods of catastrophic infrastructure failure.

To comply with paragraph B.3 of the Consent Order, three viable and cost-effective measures or alternatives were developed and tested using the hydraulic model to evaluate the impacts of eliminating the Emergency Overflow. Each alternative was simulated under the projected 2027 conditions. The projected future 2027 conditions model implements all projected reductions in excess flow estimated to be achieved by the Consent Order Recommendations from this Master Plan. The Consent Order Recommendations are presented in Section 7.4.5. The projected 2027 conditions include the following system improvements incorporated into all three alternatives:

- System Conditions – improved conditions, recommended maintenance and cleaning measures are modeled

- System Conveyance – improved conditions, planned pump station capacity improvements and the Hubbells Lane Relief sewer are modeled
- System Flows – reduction in excess flow from disconnection of directly connected catch basins identified as significant inflow contributors is modeled

For each alternative, a different simulated configuration of the Emergency Overflow structure for each alternative was represented and is described below.

- Alternative 1 represents the projected 2027 conditions in the collection system with the following Emergency Overflow conditions:
 - Existing conditions, no modifications
- Alternative 2 represents the projected 2027 conditions in the collection system with the following Emergency Overflow conditions:
 - Flow elimination represented with an operational flow elimination structure (flow elimination structure) that acts as a physical barrier to flow.

In the Alternative 2 model, during Force Majeure events such as extreme rainfall events or instances of catastrophic infrastructure failure, the Emergency Overflow flow elimination structure can be opened to control the HGL in the west interceptor. Excessive surcharging that may occur in the west interceptor during Force Majeure events places a significant number of properties at risk for basement backup and poses an unacceptable health and safety risk to the public. The risk to the public created by Emergency Overflow Elimination is previously discussed in Section 4.2.3.

- Alternative 3 represents the projected 2027 conditions in the collection system with the following Emergency Overflow conditions:
 - Flow elimination conditions, outlet pipes are removed from the model preventing discharge under all conditions.

In the Alternative 3 model, discharge from the Emergency Overflow is not possible under any conditions, creating the possibility for excessive surcharging in the west interceptor during Force Majeure events such as extreme rainfall events or instances of catastrophic infrastructure failure. Excessive surcharging places a significant number of properties at risk for basement backup and poses an increased health and safety risk to the public. Increased risk to the public created by Emergency Overflow Elimination is discussed previously in Section 4.2.3.

Simulations for each alternative were performed using the 5-, 10-, 25-, 50-, 100-, and 200-Year, 24-Hour return frequency synthetic rainfall events. Table 7-5 presents a model simulation matrix describing the modifications and flow conditions simulated in the analysis.

Table 7-5. Ann Street Emergency Overflow Alternatives Analysis – Model Description

Alternative ID	Maintenance to Restore Conveyance Capacity	Hubbells Lane Relief Sewer	Pump Station Upgrades	Catch Basin Disconnection	Ann Street Emergency Overflow Elimination
Alternative 1	•	•	•	•	No modifications
Alternative 2	•	•	•	•	Flow Elimination Structure
Alternative 3	•	•	•	•	Structural removal of overflow pipes

Table 7-6 presents the model simulated discharge volumes from the Emergency Overflow and from MHs located along North Water Street for each alternative condition.

Table 7-6. Ann Street Emergency Overflow Alternatives Performance

Alternative ID	Facility ID	Rain Event Return Frequency					
		5-YR, 24-HR	10-YR, 24-HR	25-YR, 24-HR	50-YR, 24-HR	100-YR, 24-HR	200-YR, 24-HR
Alternative 1	Ann Street Emergency Overflow	0.00	0.00	0.00	0.02	0.72	1.96
	North Water Street MHs	0.00	0.00	0.00	0.00	0.00	0.00
	Basement Backup	0.00	0.00	0.00	0.00	0.00	0.00
Alternative 2	Ann Street Emergency Overflow	0.00	0.00	0.00	0.00	0.51	1.61
	North Water Street MHs	0.00	0.00	0.00	0.00	0.00	0.00
	Basement Backup	0.00	0.00	0.00	0.00	0.00	0.00
Alternative 3	Ann Street Emergency Overflow	0.00	0.00	0.00	0.00	0.00	0.00
	North Water Street MHs	0.00	0.00	0.00	0.00	0.00	1.05
	Basement Backup	0.00	0.00	0.00	0.00	IR ¹	IR ¹

1. IR denotes an increased risk of basement backup associated with the alternative and return frequency storm event. The increased risk of basement backup is caused by the increased HGL in the interceptor system associated with the alternative. While the model predicts basement backups are likely to occur, the volume of wastewater is not quantifiable from the Master Plan model.

Under the projected 2027 conditions, the Alternative 1 model results predict that, without any modifications to the Emergency Overflow structure, discharges would occur starting at the 50-year, 24-hour return frequency event. In the Alternative 1 model, the hydraulic relief provided by the Emergency Overflow effectively controls the water level in the west interceptor and prevents MH overflows along North Water Street from occurring during all the return frequency events simulated.

Under the projected 2027 conditions, the Alternative 2 model results show that the Emergency Overflow is predicted to activate at the 100-Year, 24-Hour return frequency. In the Alternative 2 model, the flow elimination structure reduces the activation frequency of the Emergency Overflow, as compared to Alternative 1, and also effectively controls the water level in the west interceptor, preventing MH overflows along North Water Street and significantly reduces the risk of basement flooding shown in Figure 4-7. At the 100-Year, 24-Hour and larger return frequency rainfall events, the flow elimination structure was predicted to open, providing hydraulic relief to maintain a maximum HGL in the interceptor system that reduces the risk of basement backups and is protective of public health and safety.

Under the projected 2027 conditions, the Alternative 3 model results show that no discharges occur from the Emergency Overflow for any return frequency event. Without the hydraulic relief provided by the Emergency Overflow structure, the HGL in the west interceptor is predicted to increase to a level that induces MH overflows along North Water Street at the 200-Year, 24-Hour return frequency event. The Alternative 3 model results indicate that elimination of the Emergency Overflow moves the point of hydraulic relief from a controlled point of discharge at the Emergency Overflow to uncontrolled discharges from low lying MHs located along North Water Street and increases the risk of basement flooding for properties served by the west interceptor. Given the greater than 1,000 parcels identified as likely to be impacted by basement backups under this alternative, starting at the 100-year, 24-hour return frequency, this level of risk to the City and the health and safety of the public is without parallel within the State. For additional perspective, other CSO communities in the state of Connecticut generally attempt to control overflows for return frequency events much smaller than the 25-year event.

As noted in Section 4.2.2, two of three the most recent discharges from the Emergency Overflow (August 22, 2016 and July 8, 2021) have been caused by catastrophic infrastructure failures and were likely not caused solely by the flows in the interceptor system grossly exceeding its conveyance capacity. The modeling results presented in Table 7-6 indicate that when all aspects of the collection system are working properly, the collection system currently provides the conveyance capacity to prevent a discharge from the Emergency Overflow that exceeds the level of control provided by other CSO communities in the state of Connecticut.

7.3 Consent Order Recommendations

The Consent Order Recommendations, to be completed within five years from the date of approval of the measure(s) required by paragraph B.3 of the Norwalk Consent Order, recommended in this Master Plan include the following:

- All Operations and Maintenance Recommendations from Section 7.3.1,
- Hubbells Lane Relief Sewer from Section 7.3.2.1,
- Catch Basin Disconnection Program from Section 7.3.2.2, and
- Emergency Overflow Elimination Measures from Section 7.3.2.3.

Additional details regarding each Consent Order Recommendation follow below.

7.3.1 Operations and Maintenance Recommendations

7.3.1.1 Priority Sewer Inspection and Maintenance

Veolia, as the City's collection system contract operator, continues to inspect and clean critical locations within the collection system. In addition, it is recommended that locations within the collection system identified during the model calibration receive priority inspection and maintenance going forward. The areas recommended for priority inspection and maintenance are provided in Table 7-7.

Table 7-7. Recommended Sewer Inspection Locations

Area ID	Area Description	Upstream Manhole ID	Downstream Manhole ID
1	East Interceptor, North of I-95	03-9	03-15
2	East Interceptor, South of I-95	03-6	23-1.9

Table 7-7. Recommended Sewer Inspection Locations

Area ID	Area Description	Upstream Manhole ID	Downstream Manhole ID
3	Knight Steet	03-168	03-237
4	East Wall Street	03-27	03-23
5	Brook Street	07-2	03-241
6	Margaret Street to Saddle Road	05-45	05-30
7	Main Street	09-6	08-133
8	Danbury Road/Main Avenue	Wilton Meter Chamber	09-77
9	North of Belden Avenue	10-14	10-11
10	Ann Street	14-3	23-96
11	Arthur J. Perschino Way	16-9.1	16-5
12	Commerce Street	19-24	19-5
13	Westport Ave PS	21-6.1	21-1
14	Orchard Street	12-3	23-12
15	Riverside Avenue	10-325	10-24
16	Concord Street	16-4	15-12

7.3.1.2 Periodic Level Monitoring for Predictive Maintenance

Periodic review of the depth of flow near MH locations presented in Table 7-7 is recommended to assist in proactive identification of cleaning or maintenance activities to maintain conveyance capacity within the collection system. Table 7-8 presents the associated DWF velocities at locations recommended for periodic depth of flow survey.

Table 7-8. Locations Recommended for Periodic Depth of Flow Survey

Manhole ID	Minimum Dry Weather Flow Velocity (fps)	Average Dry Weather Flow Velocity (fps)	Maximum Dry Weather Flow Velocity (fps)
03-1	0.5	0.8	1.1
03-11	1.1	1.7	2.0
03-164	0.3	0.7	1.0
03-25	1.0	1.5	2.0
05-42	0.2	0.5	0.7
09-1	0.8	1.2	1.7
14-1.1	0.7	1.4	1.8
16-1	1.5	1.7	2.1
16-8	0.3	0.5	0.7
19-23	1.1	1.7	2.3
21-1	1.2	1.7	2.2

7.3.1.3 WPCF IPS Setpoint Modification

During the July 8, 2021 wet weather event, the remnants of Hurricane Elsa resulted in a large increase in flows in the collection system. During this event, a large volume of debris was mobilized and conveyed to the WPCF, where it blinded the screens at the plant headworks. The operational setpoint of the WPCF IPS has historically maintained a depth of 15.5 feet in the IPS wet well. This depth results in a portion of the interceptor system being under a continuous backwater condition, where decreased velocities may increase the accumulation of debris in the backwatered portions of the interceptor system. Lowering the operational setpoint to maintain a lower water surface elevation at the WPCF IPS should reduce the backwater conditions and increase velocities in the interceptor system. In turn, the increase in flow velocity should help in maintaining self-cleaning velocities in the interceptor system for longer periods of time and reduce sediment accumulation. If feasible, it is recommended that the operational setpoint of the WPCF IPS be decreased to reduce the backwater conditions imposed on the interceptor system.

7.3.2 Capital Improvement Recommendations

7.3.2.1 Hubbells Lane Relief Sewer

The Hubbells Lane Relief Sewer project can provide immediate benefits to the collection system performance. Modeling has indicated that rerouting flows from the East Wall Street trunk sewer to the Hubbells Lane Relief Sewer and directing those flows to the East Interceptor downstream of the Moodys Lane Siphon, lowers the HGL in portions of the East Interceptor between the Main Street and Burnell Street and the Smith Street and Moodys Lane intersections. This reach of the East Interceptor, and the lower portion of the connected trunk sewer along Brook Street have historically been prone to significant surcharge. The model results indicate the Hubbells Lane Relief Sewer effectively mitigates the significant surcharging and prevents MH overflows up to the 25-year, 6-hour return frequency event.

The design and construction of the Hubbells Lane Relief Sewer project is recommended to alleviate significant surcharging in the East Interceptor, maximize flows conveyed to the WPCF, and improve the overall performance of the collection system during wet weather flow events.

7.3.2.2 Catch Basin Disconnection Program

There are 81 known directly connected catch basins identified in the City's GIS dataset. The inflow contributions from each catch basin varied due to differences in the tributary areas, land uses, and capacity of the sanitary collection system downstream of the catch basin connection point. The peak flows that can enter the collection system through these directly connected catch basins were estimated using the rational method and the capacity of the sanitary sewer conduit directly downstream of the catch basin. Catch basins where the peak flow rate from the 1-year return frequency rainfall event and the sanitary collection system capacity downstream of the catch basin exceeded 0.5 MGD were identified as significant inflow contributors.

Of the 81 directly connected catch basins, 38 were identified as significant inflow contributors. Disconnection of these 38 catch basins was estimated to remove 77 percent of the total peak inflows from the known direct inflow connections.

Based on the relative cost effectiveness of catch basin disconnection, it is recommended that the 38 catch basins identified in Table 6-1 as significant inflow contributors are targeted for disconnection through a Catch Basin Disconnection Program.

The Catch Basin Disconnection Program would serve to accomplish the following:

- Confirm the catch basin drainage area, land use, and peak flow reduction estimates calculated in either the *Inflow and Infiltration Control Plan* or this Master Plan.
- Perform catch basin disconnection feasibility analysis
 - Determine catch basin connection point to the City's Storm Drain system
 - Perform Storm Drain capacity assessment to confirm the existing Storm Drain system has capacity to convey the additional flow
 - Conduct underground utility survey to identify potential conflicts and assess constructability of catch basin disconnection project
 - Determine sizing and perform preliminary design
- Perform detailed design and develop catch basin disconnection project specifications.
- Perform project bidding, construction management, and catch basin disconnection project close out.

It is noted that the catch basin disconnection analysis performed for this Master Plan assumed that the storm drain system has sufficient conveyance capacity to accept the additional flows and that construction of new storm drain assets required for catch basin disconnection are feasible. Both assumptions will need to be further verified through more detailed engineering analyses as part of the Catch Basin Disconnection Program.

The additional analysis of the storm drainage system, performed under the Catch Basin Disconnection Program, is designed to determine if the catch basin disconnection is constructable and whether additional improvements to the storm drainage system are necessary to accept the additional flow from the catch basin drainage area will be required. Where either assumption is found to be false, the disconnection of the directly catch basin may not be constructable due to conflicts or constraints not considered as part of the Master Plan analysis or may not be economically feasible due to significant storm drain improvement requirements. Design and construction phases for each catch basin disconnection project will also be required to be administered by the City.

7.3.2.3 Ann Street Emergency Overflow Elimination

The Emergency Overflow has historically provided relief to the interceptor system when it is hydraulically overloaded as a result of significant rainfall events and during periods of catastrophic infrastructure failure. Examples of catastrophic infrastructure failure that have been recently experienced by Norwalk include: decreased pumping capacity at the WPCF IPS; gate opening failure on the second barrel of the Ann Street Siphon; and blinding of the WPCF headworks bar screens. In each of these scenarios, the conveyance to the WPCF has been decreased, resulting in surcharging of the interceptor system and, eventually, a discharge from the Emergency Overflow.

From Table 7-2, it can be seen that the calibrated model does not predict discharges from the Emergency Overflow to occur as a result of the 25-year, 6-hour return frequency rainfall event in either the baseline conditions or the future reduced inflow conditions. From this perspective, discharges from the Emergency Overflow have been essentially eliminated already. For additional perspective, other CSO communities in the state of Connecticut generally attempt to control overflows for return frequency events much smaller than the 25-year event. Put another way, in its current configuration, the Emergency Overflow already discharges much less frequently than most, if not all, similarly situated assets within the State.

To comply with paragraph B of the Consent Order, three alternatives for the Emergency Overflow elimination were tested under the projected 2027 system conditions and are discussed in Section 7.2.1. Alternative 1 represented the current configuration of the Emergency Overflow structure. Alternative 2 represented elimination of the Emergency Overflow through a flow elimination structure that provides a physical barrier to discharge from the structure during wet weather flow events. Alternative 3 represented elimination of the Emergency Overflow by a permanent physical closure of the overflow conduits. Under Alternative 3, no ability to control the water level in the west interceptor during either extreme wet weather flow events or during periods of catastrophic infrastructure failure (Force Majeure events) is available to the WPCA.

The consequence of the loss of ability to control the HGL in the west interceptor under Alternative 3 is that during Force Majeure events, the HGL in the west interceptor can continue to increase until an uncontrolled SSO occurs. Under the elevated surcharge conditions, the risk of basement flooding for more than 1,000 properties, shown in Figure 4-7, is significantly elevated. Conversely, under Alternative 2, the retained ability to control the HGL in the west interceptor during these extreme conditions provides a critical mechanism for the prevention of uncontrolled SSO events and potential basement flooding for more than 1,000 properties connected to the west interceptor.

Due to the unacceptable risk of basement backup and increased risk to the health and safety of the public associated with Alternative 3, it is recommended that the elimination of the Emergency Overflow be accomplished through the installation of the flow elimination structure from Alternative 2 and permanent level monitoring at the overflow structure. This approach provides a physical barrier to flow that eliminates the potential for discharges from the Emergency Overflow while maintaining a controlled point of hydraulic relief that protects the general health and safety of the public.

7.4 Long-Term Master Plan Recommendations

The targeted rehabilitation of public sewer assets is recommended as a long-term strategy to reduce the volume of extraneous flows entering the collection system that must be conveyed to and treated at the WPCF. Targeted RDII reduction is intended to address sources of extraneous flows entering the collection system originating from sources other than the known directly connected catch basins.

Reduction of extraneous flows, beyond what is projected to be achieved from the disconnection of directly connected catch basins, can be approached by either performing comprehensive sewer rehabilitation across large sewershed areas or by a more targeted RDII reduction approach. The comprehensive rehabilitation approach can achieve significant RDII reduction, however, it is not always cost-effective or necessary, as non-defective sewer assets are rehabilitated in the same manner as defective ones. A more cost-effective approach to RDII reduction can be achieved through the targeted investigation and rehabilitation of prioritized sewersheds that exhibit high rates of RDII production.

It is recommended that the City implement a long-term RDII reduction and flow management plan. The following activities are commonly included as part of a targeted RDII reduction plan and are performed prior to the development of specific I/I reduction projects:

- Perform temporary flow monitoring within the metersheds prioritized for targeted RDII flow reduction to further identify specific areas within the metershed that exhibit the highest RDII production rates.
- Perform collection system condition assessment work to identify assets with significant defects that may act as I/I sources.

- Perform targeted field investigations where supported by data to identify specific inflow sources for disconnection. Examples of field investigation activities include, but are not limited to, smoke testing and dye testing.
- Perform field investigations, such as flow isolation studies, to identify areas with high infiltration rates.

Based on results of collection system inspections and field investigation activities, I/I reduction plans may be developed and customized to correct the specific types of defects and I/I sources identified, such as the disconnection of identified illicit cross-connections or comprehensive rehabilitation in concentrated areas of the metershed where the highest I/I production rates have been identified. The I/I reduction plan should establish a methodology for the prioritization of I/I reduction projects and indicate an anticipated schedule for implementation.

Based on the RDII reduction cost-effectiveness curves, presented in Figure 6-1, the costs for I/I removal are shown to increase significantly when the RDII production rate in the sewershed is less than 15,000 GPAD. Using the RDII production rate of 15,000 GPAD as a threshold, 19 metershed areas were identified where targeted RDII reductions can be cost-effective to achieve. The 19 metershed areas recommended for targeted RDII reductions are shown in Figure 7-1.

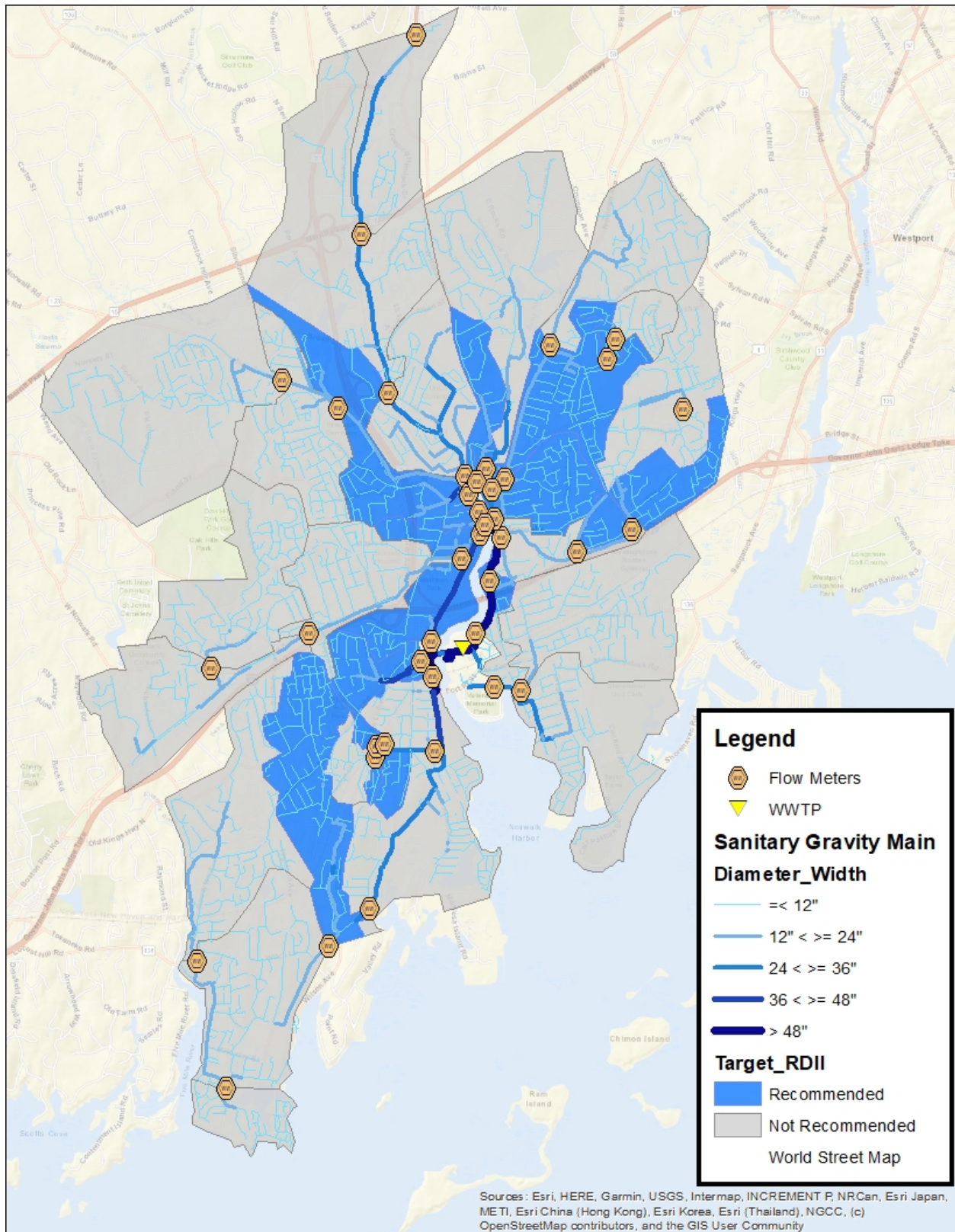


Figure 7-1. Metershed Areas Recommended for Targeted RDII Reduction

7.5 Implementation

The estimated costs associated with the recommended Consent Order Recommendations identified in this Master Plan are presented in Table 7-10.

Table 7-9. Consent Order Recommendations Cost Estimate

Consent Order Recommendation Name	Construction Costs	Engineering and Contingencies	Total Cost
Hubbells Lane Relief Sewer	\$4,500,000	\$900,000	\$5,400,000
Ann Street Emergency Overflow Elimination	\$700,000	\$100,000	\$800,000
Catch Basin Disconnections	\$8,800,000	\$1,800,000	\$10,600,000
Total Costs	\$14,000,000	\$2,800,000	\$16,800,000

The total estimated costs associated with both the Consent Order and the longer-term Master Plan recommended projects and improvements are presented in Table 7-10.

Table 7-10. Long-Term Master Plan Recommendations

Capital Project Name	Construction Costs	Engineering and Contingencies	Total Cost
Consent Order Recommendations	\$14,000,000	\$2,800,000	\$16,800,000
Targeted Collection System Rehabilitation	\$28,000,000	\$8,400,000	\$36,400,000
Total Program Costs	\$42,000,000	\$11,200,000	\$53,200,000

With an estimated total cost in excess of \$53 million to complete the recommended collection system capacity improvements, catch basin disconnections, and sewer rehabilitation work necessary to reduce RDII flows from entering the collection system, a multi-year effort will be required. Measures identified as Consent Order Recommendations can be designed and constructed within the next five years. Completion of the catch basin disconnections, beyond those identified as a Consent Order Recommendation, cannot be reasonably expected to be implemented within a five-year timespan. Disconnection of the remaining directly connected catch basins recommended for disconnection will require a multi-year effort to design and construct the discrete construction projects required. The targeted RDII reductions will need to be completed as part of a longer-term I/I reduction program administered by the City. The work completed as part of this Master Plan identified metersheds where cost-effective RDII reductions can be achieved and established a targeted post-rehabilitation RDII associated with an improved performance of the collection system. The nature and locations of RDII sources, and the specific types and quantities of sewer rehabilitation required to achieve the targeted RDII reductions will need to be identified and further developed as part of future engineering studies and design projects.

An implementation schedule for the activities recommended in this Master Plan update are provided in Figure 7-2.

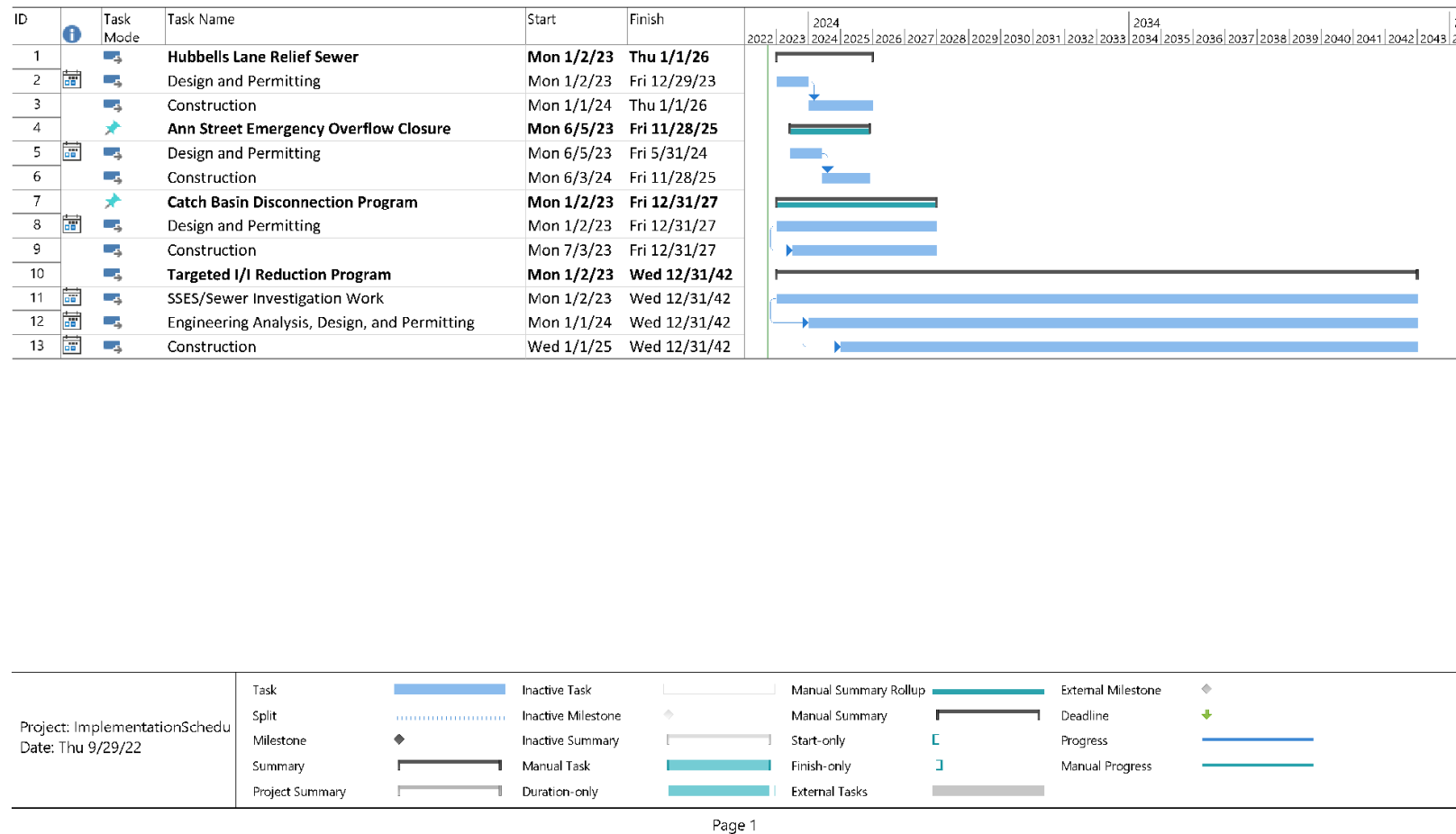


Figure 7-2. Master Plan Recommendation Implementation Schedule

Section 8

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Appendix A: Norwalk Consent Order



STATE OF CONNECTICUT
V.
CITY OF NORWALK

CONSENT ORDER

A. The Commissioner of Energy and Environmental Protection (“the Commissioner”) finds:

1. The City of Norwalk (“Respondent”) owns and operates a sanitary sewer collection system comprised of approximately 200 miles of pipe, 22 pump stations, more than 6,000 manholes, and a sewage treatment facility, hereafter referred to as the Norwalk Water Pollution Control Facility (“WPCF”), which discharges treated sanitary sewage under the terms and conditions of National Pollution Discharge Elimination System (“NPDES”) Permit No. CT0101249 (“Permit”).
2. The Norwalk WPCF has a design flow of 18 million gallons per day (“MGD”) and a secondary treatment capacity of 30 MGD. Flows up to 30 MGD must receive preliminary treatment, primary treatment and advanced treatment with denitrification followed by sodium hypochlorite disinfection and sodium bisulfite dechlorination prior to discharge to the Norwalk River through outfall number 001-1. The permit allows Respondent to direct flows above 30 MGD through the secondary bypass treatment system.
3. Flows above 30 MGD are required to receive either full treatment, or preliminary treatment followed by microscreen treatment, sodium hypochlorite disinfection and sodium bisulfite dechlorination prior to discharge to the Norwalk River through the Permit’s outfall number 002-1. In the 1970s, the Department approved the use of microscreens as the equivalent of primary treatment at the Norwalk WPCF.
4. On April 25, 2017, microscreens 1 and 3 were reported to DEEP as out of service by Respondent. On May 17, 2017, microscreens 2 and 4 were similarly reported as out of service. For both reports, the repair time was noted as “Long term repairs are being evaluated.” As a result, since May 17, 2017, Respondent has caused wet weather bypasses to occur without the equivalent of primary treatment. See Attachment A (entitled *NORWALK Permitted Outfall 002-1 Bypasses*) for a list of the discharges reported by Respondent since 2017 which received no or inadequate primary treatment or its equivalent.

5. The City of Norwalk's collection system is physically divided into two segments by the Norwalk River and the Norwalk Harbor: a western and eastern portion. The collection system's two segments are connected in two locations by siphons at Moody's Lane and Ann Street. The Ann Street siphon inlet chamber also includes an emergency outfall to the Norwalk River that may activate during weather events (as an Emergency Overflow) with extreme volume serving as the last controlled emergency relief point before wastewater enters the WPCF. On August 22, 2016, Respondent's Ann Street Siphon (Siphon) was activated due to a mechanical equipment failure discharging raw sewage directly to the Norwalk River. On June 28, 2018, Respondent's Siphon also activated allowing raw sewage to discharge directly to the Norwalk River. This Emergency Overflow is not metered so the amount of overflow cannot be quantified. The discharge is not authorized in the Respondent's permit. Respondent uses the Siphon, on an as-needed basis in cases of extreme flows in the sewage collection system from high precipitation events and the resulting infiltration/inflow of water and has activated the Siphon to alleviate excess flows from such system by discharging untreated domestic sewage.
6. By agreeing to the issuance of this Consent Order, the Respondent makes no admission as to the Commissioner's findings of fact or law with respect to the matters addressed herein except for those findings detailed in paragraphs A.1. to A.3, inclusive, of this Consent Order.
7. By virtue of the above, the Respondent is causing pollution of the waters of the state and is maintaining facilities or conditions that can reasonably be expected to create a source of pollution to the waters of the state.

B. The Commissioner, acting under §22a-6, §22a-424, §22a-425, §22a-427, §22a-428, §22a-430, and §22a-431 of the Connecticut General Statutes, orders the Respondent as follows:

1. Respondent shall retain one or more qualified consultants acceptable to the Commissioner to prepare the update of the City's Sanitary Sewer Collection System Master Plan and shall notify the Commissioner in writing of the identity of such consultants. The Respondent has retained Brown and Caldwell as the primary on-call collection system consultant and Woodard and Curran as the secondary on-call collection system consultant to prepare the documents and implement or oversee the actions required by paragraph B.3 of this Consent Order. Respondent shall retain one or more qualified consultants acceptable to the Commissioner until the actions required by this consent order have been completed, and within ten (10) days after retaining any consultant other than the one originally identified under this paragraph, Respondent shall notify the Commissioner in writing of the identity of such other consultant. The consultant(s) retained to perform the studies and oversee any remedial measures required pursuant to paragraph B.3. of this Consent Order shall be a qualified professional engineer licensed to practice in Connecticut. Respondent shall submit to the Commissioner a description of a consultant's education, experience and training which is relevant to the work required by this consent order within ten days after a request for such a description. Nothing in this paragraph shall preclude the Commissioner from finding a previously acceptable consultant unacceptable.

2. Respondent shall retain one or more qualified consultants acceptable to the Commissioner to prepare the update to the City's Wastewater Treatment Plant Facilities Plan and shall notify the Commissioner in writing of the identity of such consultants. The Respondent has retained Arcadis US, Inc. to prepare the documents and implement of oversee the actions required by paragraph B.4. of this Consent Order. Respondent shall retain one or more qualified consultants acceptable to the Commissioner until the actions required by this consent order have been completed, and within ten (10) days after retaining any consultant other than the one originally identified under this paragraph, Respondent shall notify the Commissioner in writing of the identity of such other consultant. The consultant(s) retained to perform the studies and oversee any remedial measures required pursuant to paragraph B.4 of this Consent Order shall be a qualified professional engineer licensed to practice in Connecticut. Respondent shall submit to the Commissioner a description of a consultant's education, experience and training which is relevant to the work required by this consent order within ten days after a request for such a description. Nothing in this paragraph shall preclude the Commissioner from finding a previously acceptable consultant unacceptable.
3. On or before September 30, 2022, Respondent shall submit, for the Commissioner's review and written approval, a comprehensive and thorough engineering report updating the Sanitary Sewer Collection System Master Plan which describes and evaluates a range of viable and cost-effective measures to 1) remove excess flow (such as infiltration/inflow) from the sewage collection system, and 2) eliminate the Ann Street Siphon Emergency Overflow from the sewage collection system. Such report shall:
 - a. Evaluate a range of viable and cost-effective measures to achieve compliance with paragraph B.3 of this Consent Order,
 - b. State in detail the most expeditious schedule for performing each measure,
 - c. List all permits and approvals required for each measure, including but not limited to any permits required under Sections 22a-32, 22a-42a, 22a-342, 22a-361, 22a-368 or 22a-430 of the CGS,
 - d. Propose a preferred measure or combination of measures with supporting justification therefore, and
 - e. Propose a detailed program and schedule to perform all actions required to implement the preferred measure(s), including but not limited to, a schedule for submission of engineering plans and specifications for any new equipment, the start and completion of any construction activities and applying for and obtaining all permits and approvals required for such actions.
4. On or before June 30, 2023, Respondent shall submit, for the Commissioner's review and written approval, a comprehensive and thorough engineering report which updates the Wastewater Treatment Plant Facilities Plan and describes and evaluates a range of viable and cost-effective measures to provide Outfall 002-1 with primary treatment or its

equivalent, or to eliminate Outfall 002-1. Such report shall:

- a. Evaluate a range of viable and cost-effective measure to achieve compliance with paragraph B.4 of this Consent Order,
 - b. State in detail the most expeditious schedule for performing each measure,
 - c. List all permits and approvals required for each measure, including but not limited to any permits required under Sections 22a-32, 22a-42a, 22a-342, 22a-361, 22a-368 or 22a-430 of the CGS,
 - d. Propose a preferred measure or combination of measures with supporting justification therefore, and
 - e. Propose a detailed program and schedule to perform all actions required to implement the preferred measure(s), including but not limited to a schedule for submission of engineering plans and specifications for any new equipment, the start and completion of any construction activities and applying for and obtaining all permits and approvals required for such actions.
5. Within sixty (60) days of the Commissioner's approval of the each of the reports required by paragraphs B.3 and B.4 above, Respondent shall begin to implement the preferred measure(s) described therein. Unless otherwise approved by the Commissioner in writing, in no event shall the implementation schedule of the proposed measure or combination of measures to complete those actions required by paragraphs B.3 and B.4 exceed a length of five (5) years from the date of approval of the measure(s) required by paragraph B.3 and ten (10) years from the date of approval of the measure(s) required by Paragraph B.4.
6. Progress Reports. On or before the last day of June of each year after the date of issuance of this Consent Order and continuing until all actions required by this consent order have been completed as approved and to the Commissioner's satisfaction, Respondent shall submit a progress report to the Commissioner describing the actions which Respondent has taken to date to comply with this consent order.
7. Full compliance. Respondent shall not be considered in full compliance with this consent order until all actions required by this consent order have been completed as approved and to the Commissioner's satisfaction.
8. Approvals. Respondent shall use best efforts to submit to the Commissioner all documents required by this consent order in a complete and approvable form. If the Commissioner notifies Respondent that any document or other action is deficient, and does not approve it with conditions or modifications, it is deemed disapproved, and Respondent shall correct the deficiencies and resubmit it within the time specified by the Commissioner or, if no time is specified by the Commissioner, within 30 days of the Commissioner's notice of deficiencies. In approving any document or other action under this consent order, the Commissioner may approve the document or other action as submitted or performed or

with such conditions or modifications as the Commissioner deems necessary to carry out the purposes of this Consent Order. Nothing in this paragraph shall excuse noncompliance or delay.

9. Definitions. As used in this consent order, “Commissioner” means the Commissioner or a representative of the Commissioner.

10. Dates. The date of “issuance” of this Consent Order is the date the consent order is deposited in the U.S. mail or personally delivered, whichever is earlier. The date of submission to the Commissioner of any document required by this consent order shall be the date such document is received by the Commissioner. The date of any notice by the Commissioner under this consent order, including but not limited to notice of approval or disapproval of any document or other action, shall be the date such notice is deposited in the U.S. mail, sent via email, or is personally delivered, whichever is earlier. Notwithstanding the foregoing, due to the COVID-19 pandemic, the following shall apply. The date of “issuance” of this Consent Order is the date the Consent Order is sent to the Respondent via electronic mail. In addition, for documents to be submitted to the Commissioner, until such time as the Commissioner notifies the Respondent that documents must be submitted via U.S. mail or by personal delivery, the Respondent may submit documents to the Commissioner electronically and the date of submission of any such document shall be the date such document is received by electronic mail. Nothing in the foregoing is intended preclude the Commissioner from requiring that a document submitted electronically also be submitted via U.S. mail or by personal delivery within the timeframe specified by the Commissioner. With respect to notices from the Commissioner under this Consent Order, until such time as the Commissioner notifies the Respondent that notices will be provided via U.S. mail or by personal delivery, such notices may be sent electronically and the date of any notice by the Commissioner under this Consent Order, including but not limited to notice of approval or disapproval of any document or other action, shall be the date such notice is sent via electronic mail. Except as otherwise specified in this consent order, the word “day” as used in this consent order means calendar day. Any document or action which is required by this consent order to be submitted or performed by a date which falls on a Saturday, Sunday or a Connecticut or federal holiday shall be submitted or performed by the next day which is not a Saturday, Sunday or Connecticut or federal holiday.

11. Certification of documents. Any document, including but not limited to any notice, which is required to be submitted to the Commissioner under this consent order shall be signed by Respondent or, if Respondent is not an individual, by Respondent’s chief executive officer or a duly authorized representative of such officer, as those terms are defined in §22a-430-3(b)(2) of the Regulations of Connecticut State Agencies, and by the individual(s) responsible for actually preparing such document, and each such individual shall certify in writing as follows:

“I have personally examined and am familiar with the information submitted in this document and all attachments thereto, and I certify, based on reasonable investigation, including my inquiry of those individuals responsible for obtaining the information, that

the submitted information is true, accurate and complete to the best of my knowledge and belief. I understand that any false statement made in the submitted information may be punishable as a criminal offense under §53a-157b of the Connecticut General Statutes and any other applicable law.”

12. False statements. Any false statement in any information submitted pursuant to this consent order may be punishable as a criminal offense under §53a-157b of the Connecticut General Statutes and any other applicable law.
13. Notice of transfer; liability of Respondent. Until Respondent has fully complied with this consent order, Respondent shall notify the Commissioner in writing no later than 15 days after transferring all or any portion of the facility, the operations, the site or the business which is the subject of this Consent Order or after obtaining a new mailing or location address. Respondent’s obligations under this consent order shall not be affected by the passage of title to any property to any other person or municipality.
14. Commissioner's powers. Nothing in this consent order shall affect the Commissioner's authority to institute any proceeding or take any other action to prevent or abate violations of law, prevent or abate pollution, recover costs and natural resource damages, and to impose penalties for past, present, or future violations of law. If at any time the Commissioner determines that the actions taken by Respondent pursuant to this consent order have not successfully corrected all violations by successfully completing all approved measures in accordance with paragraph B.5. of this Consent Order, fully characterized the extent or degree of any pollution, or successfully abated or prevented pollution, the Commissioner may institute any proceeding to require Respondent to undertake further investigation or further action to prevent or abate violations or pollution.
15. Respondent's obligations under law. Nothing in this consent order shall relieve Respondent of other obligations under applicable federal, state and local law.
16. No assurance by Commissioner. No provision of this Consent Order and no action or inaction by the Commissioner shall be construed to constitute an assurance by the Commissioner that the actions taken by Respondent pursuant to this consent order will result in compliance or prevent or abate pollution.
17. Access to site. Any representative of the Department of Energy and Environmental Protection may enter the facility without prior notice for the purposes of monitoring and enforcing the actions required or allowed by this consent order.
18. No effect on rights of other persons. This consent order neither creates nor affects any rights of persons or municipalities that are not parties to this consent order.
19. Notice to Commissioner of changes. Within 15 days of the date Respondent becomes aware of a change in any information submitted to the Commissioner under this consent order, or that any such information was inaccurate or misleading or that any relevant

information was omitted, Respondent shall submit the correct or omitted information to the Commissioner.

20. Notification of noncompliance. In the event that Respondent becomes aware that it did not or may not comply, or did not or may not comply on time, with any requirement of this Consent Order or of any document required hereunder, Respondent shall immediately notify by telephone or electronic mail the individual identified in the next paragraph and shall take all reasonable steps to ensure that any noncompliance or delay is avoided or, if unavoidable, is minimized to the greatest extent possible. Within five (5) days of the initial notice, Respondent shall submit in writing the date, time, and duration of the noncompliance and the reasons for the noncompliance or delay and propose, for the review and written approval of the Commissioner, dates by which compliance will be achieved, and Respondent shall comply with any dates which may be approved in writing by the Commissioner. Notification by Respondent shall not excuse noncompliance or delay, and the Commissioner's approval of any compliance dates proposed shall not excuse noncompliance or delay unless specifically so stated by the Commissioner in writing.
21. Submission of documents. Any document required to be submitted to the Commissioner under this consent order shall, unless otherwise specified in this consent order or in writing by the Commissioner, shall be provided in an electronic format, and be directed to:

Ann Straut, Sanitary Engineer 3
Department of Energy and Environmental Protection
Bureau of Water Protection and Land Reuse
Water Planning and Management Division
79 Elm Street
Hartford, Connecticut 06106-5127
ann.straut@ct.gov

Respondent consents to the issuance of this Consent Order without further notice.

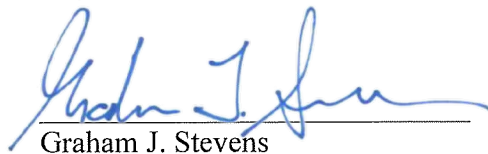
The undersigned certifies that he/she is fully authorized to enter into this consent order and to legally bind the Respondent to the terms and conditions of the consent order.

City of Norwalk

BY: Harry W. Rilling
Harry W. Rilling
Mayor

5/5/22
Date

Issued as a final order of the Commissioner of Energy and Environmental Protection.



Graham J. Stevens
Bureau Chief
Water Planning and Management Division

May 6, 2022

Date

COWRMU22001

ATTACHMENT A

NORWALK Permitted Outfall 002-1 Bypasses

YEAR	DATE	Duration (HRS:MIN)	Max Flow (MGD)	Total Volume (MG)	Rainfall (IN)	Comment
2017	4/4/2017	8:15	17.5	2.1	2.08	Partial primary treatment
2017	4/6/2017	1:55	0.58	0.1	1.03	Partial primary treatment
2017	5/5/2017	2:00	15.22	0.6	2.18	Partial primary treatment
2017	7/7/2017	2:00	16.2	0.8	2.17	No primary treatment
2017	10/29/2017	2:10	14.7	0.8	3.57	No primary treatment
2018	3/2/2018	8:55	14.8	1.9	2.15	No primary treatment
2018	4/16/2018	9:30	37	5	3.93	No primary treatment
2018	6/28/2018	2:30	37.3	2.1	2.32	No primary treatment
2018	9/6/2018	1:20	18.1	0.4	1.47	No primary treatment
2018	9/25/2018	6:45	42.2	7.9	5.7	No primary treatment
2018	9/26/2018	4:50	9	0.82	0	No primary treatment
2018	10/2/2018	3:50	44.3	3.7	4.08	No primary treatment
2018	10/3/2018	22:25	29	4.5	0.14	No primary treatment
2019	1/24/2019	6:05	10.16	0.88	1.75	No primary treatment
2019	7/18/2019	4:25	9.4	0.32	5.04	No primary treatment
2019	7/22/2019	1:12	4.2	0.11	1.55	No primary treatment
2019	10/27/2019	4:41	37.6	3.01	3.04	No primary treatment
2019	12/14/2019	13:40	14.11	2.1	2.68	No primary treatment
2020	7/1/2020	0:49	0.53	0.08	1.18	No primary treatment

Appendix B: Recent Collection System Enhancement Projects and Initiatives



The Original Sanitary Sewer Collection System Master Plan

In 2005, the WPCA executed an agreement with Malcolm Pirnie, Inc. to provide professional engineering services to develop a Sanitary Sewer Collection System Master Plan (Original Plan) with the purpose of developing a long-term system-wide approach for effective preservation of the City's collection system. The development of the Original Plan involved the creation of several dynamic tools, including a geographic information system (GIS) database to map the collection system, a hydraulic model of important interceptors, pump stations and force mains, and an interactive financial model.

In the spring of 2006, a city-wide flow metering program was implemented to identify areas of high inflow and infiltration and to provide data for developing and calibrating the hydraulic model.

The Original Plan was issued as a draft in 2006 with preliminary findings and recommendations to provide direction to the WPCA team for the purpose of accelerating collection system rehabilitation. The Original Plan continued to be updated using the dynamic tools developed and then issued as Final in December 2009. The analysis of existing data and the development of several dynamic tools enabled Malcolm Pirnie to characterize the City's collection system and identify its critical components. Structural deficiencies were identified as the most significant concern related to preserving the City's collection system. Addressing priority structural deficiencies alleviates health, safety, and cost concerns associated with disruption of service and emergency repairs, reduces extraneous flows, alleviates capacity issues, reduces transport and treatment costs, and prevents future deficiencies.

Based on the recommendations and findings of the Original Report, the WPCA proceeded with interceptor rehabilitation and completed multiple projects from 2006 through today including the following.

- Fort Point (36-inch) Interceptor Replacement
- Seaview Ave (36-inch) and Cove Ave (30-inch) Interceptor CIPP Lining
- Norwalk River (48-inch) Interceptor CIPP Lining
- Beacon Street (15-inch) Interceptor CIPP Lining
- Orchard Street (24-inch) Interceptor Replacement and CIPP Lining

In addition, the WPCA performed several I/I and SSES Rehabilitation projects including Keeler Brook pump station sewershed, Wilton Avenue Sewer Separation, Ann Street Siphon Chamber Rehabilitation and Tide Gates, Beacon Street Service Area Sewer System, Pine Point Sewer Replacement, Sanitary Sewer Rehabilitation (Various Priority), and other smaller areas.

Collection System Assessment for Rehabilitation

In 2016, the WPCA executed an agreement with CH2M Hill Engineers, Inc. (CH2M) to provide on-call professional engineering services related to the wastewater collection systems. CH2M was tasked with developing a basis of design report for system-wide collection system construction improvements.

In 2017, a preliminary engineering report was prepared by the WPCA's on-call collection system consultant, CH2M, to identify the major areas within the existing collection system that would benefit from rehabilitation or replacement. A risk assessment was defined for the level and consequence of individual pipe failure and preliminary planning was conducted for suggested pipe improvements such as replacement, CIPP lining, and permitting. Proposed improvements included deformed pipes with a high likelihood and consequence of failure, hot spot areas that could be removed from the list

by conducting sewer repairs, gravity mains downstream of force mains, and East Avenue Interceptor review.

Rehabilitation Projects and Upgrades

Beacon Street Interceptor Rehabilitation: In July 2014, the WPCA entered into a contract for construction with Heitkamp, Inc. to provide all materials, equipment, labor, and supervision for sanitary sewer system rehabilitation of the Beacon St. Interceptor Service Area, including trenchless rehabilitation in 8-inch through 18-inch diameter sewer pipe, cleaning and pre- and post-rehabilitation closed circuit television inspection; grinding of service connections; testing and chemical sealing of pipe joints; chemical sealing of service connections; cured-in-place spot repairs (CIPSR); cured-in-place pipe lining (CIPPL); reinstatement of service connection (post-CIPPL); and MH rehabilitation. MH rehabilitation includes cleaning, plugging covers, reset/replace frames and covers, chimney repair and sealing, monolithic and epoxy lining, chemical sealing of walls, joints, pipe connections, benches/inverts, and rebuilding of benches/inverts.

The work was completed in 2017 and consisted of CIPP lining of approximately 26,000 feet of 8-inch to 18-inch diameter gravity sewers, approximately 190 feet of cured-in-place spot repairs (CIPSR), testing and chemical sealing of approximately 700 service connections, and 295 MH rehabilitations.

Marvin Beach Pump Station Upgrade: In May 2018, the WPCA entered into a contract for construction with C. H. Nickerson & Co., Inc. to provide all materials, equipment, labor, and supervision for the comprehensive upgrade to the Marvin Beach pump station and was completed in December 2018. The upgrade project included installation of piping, site work, equipment systems, structures, instrumentation, control and electrical systems, two (2) new dry-pit submersible pumps, piping, valves and appurtenances, new pump controls, new fence, new electrical enclosure, and abatement of any hazardous materials. Renovation of concrete surfaces including concrete repairs and epoxy coatings of wet well and critical concrete areas. A new force main was installed as a change order to this project.

Bethel Street Pump Station Upgrade: A new force main was installed at the Bethel Street pump station in 2019.

Westport Pump Station Upgrade: The Westport pump station upgrade was finalized in May 2019. The upgrade project included installation of bypass connection, two (2) new dry-pit submersible pumps, piping, valves and appurtenances, new pump controls and VFDs, new flow meter. Renovation of concrete surfaces including concrete repairs and epoxy coatings of wet well and critical concrete areas.

Fort Point Pump Station Upgrade: The Fort Point pump station upgrade was finalized in May 2019. The upgrade project included installation of channel grinder in influent channel, piping and appurtenances, renovation of concrete surfaces including concrete repairs, and epoxy coatings of wet well and critical concrete areas.

Shady Beach Pump Station Upgrade: In February 2019, the Shady Beach pump station was upgraded that included the installation of two (2) new pumps, piping and valves, and bypass connection.

Various Other Sanitary Sewer Rehabilitation Projects: In April 2019, the WPCA entered into a contract for construction with Green Mountain Pipeline Services to provide all materials, equipment, labor, and supervision for collection system rehabilitation, including trenchless rehabilitation in 8-inch through 24-inch diameter sewer pipe, cleaning and pre and post-rehabilitation closed circuit

television inspection; grinding of service connections; traditional dig and replace point repairs; cured-in-place pipe lining (CIPP); reinstatement of service connection (post-CIPP); and MH rehabilitation. MH rehabilitation includes cleaning, plugging covers, reset/replace frames and covers, chimney repair and sealing, monolithic and epoxy lining, chemical sealing of walls, joints, pipe connections, benches/inverts, and rebuilding of benches/inverts.

To further enhance the collection system, the WPCA continued to add additional work and time extension (through the end of 2022) to the original contract that included additional CIPP lining and excavation replacement of gravity mains, and CIPP lining of 1,400 feet of Smith Street 36-inch interceptor between Wall Street and Moodys Lane. The final work consisted of over 50,000 feet of CIPP lining of 8-inch to 36-inch diameter gravity sewers, approximately 1,600 feet of traditional dig and replace point repairs, and approximately 400 vertical feet of MH rehabilitations with epoxy or cement.

Wastewater Treatment Plant Upgrades

In January 2019, the 30-inch and 42-inch sluice gates (at the WWTP) were automated to facilitate management of wet weather operations by maximizing storage within the collection system, reducing discharges from outfall 002, and significantly reducing the likelihood of the Ann Street Emergency Overflow discharging.

Improvements include a dedicated point to point radio connection from the Ann Street siphon chamber to the WWTP for instantaneous live monitoring of wastewater level and flow and automation of the 42-inch sluice gate to be controlled by SCADA with the following set points:

- 5.0 feet or below – gate is fully closed
- 6.0 feet – gate opens to 25%
- 7.0 feet – gate opens to 50%
- 7.5 feet – gate opens to 65%
- 7.7 feet – gate opens to 85%
- 8.0 feet – gate opens to 100% (fully open above 8.0 feet)

As the sewage level depth fluctuates (increases or decreases) within the Ann Street siphon chamber, the 42-inch sluice gate position changes (opens or closes) based on the pre-defined set points to increase/decrease flow to the WWTP. The 30-inch sluice gate is 100% open at all times.

Pump Stations Asset Management Plan

In April 2019, a Pump Stations Asset Management Plan was finalized by Wright-Pierce, the WPCA's pump station on-call consultant. The WPCA engaged Wright-Pierce to prepare this plan in order to protect the WPCA's investment in the collection system, to be able to strategically plan for expected maintenance/replacements of all 22 wastewater pumping stations, and to identify long-term capital needs including the need for upgrading aging equipment and structures, increasing capacity, energy efficiency improvements, flood protection, and resiliency improvements. This plan will be used to determine the basis, and probable timing, of future expenditures on the system and be used as a tool to comply with EPA requirements for Capacity, Management, Operation, and Maintenance (CMOM) regulations.

This plan includes an assessment of existing process equipment, building structures, electrical equipment, controls, and heating/ventilation equipment systems at each pump station. Flood

protection and resiliency requirements at each of the stations was also considered. Each pump station was assessed for its capacity, along with necessary pump redundancy and the capability of handling flows in the future. A review of existing drainage areas and plans for future sewer growth within them was conducted. Existing wet weather flows and the number of pumps running under peak flow conditions were noted.

New Chlorination and Dechlorination Dosing System

In November 2019, the WPCA entered into a contract for construction with C. H. Nickerson & Co., Inc. to provide all labor, materials, and equipment required to construct a new chlorination (sodium hypochlorite) and dechlorination (sodium bisulfite) dosing system for treatment of wet weather flows at the Norwalk Water Pollution Control Facility. The system included chemical feed pumps, controls, and sample systems complete with piping and appurtenances as well as modifications to the existing Wet Weather Chlorine Contact Tank.

Relocation of Westport Avenue Discharge

In September 2020, the WPCA relocated the Westport Avenue force main discharge location. The project included the installation of several isolation valves and approximately 50 feet of new force main. This improvement will prevent surcharging of the gravity system.

WPCA Website Updates

The WPCA website was updated to include new webpages and printable reference documents to assist with public education. The enhanced documents include the following.

- Additional information on the WPCA's Fats, Oil, and Grease program for both residential and commercial users.
- Additional information on the WPCA's Private Inflow/Infiltration efforts including background material.

Catch Basin Disconnections

In 2020, the City disconnected two catch basins on Woodward Avenue from the sanitary sewer and connected them to the storm drain system: one at the intersection of Meadow Street (Asset 8097) and one at the intersection of Sheridan Ct (Asset 8113).

In 2020, the CTDOT disconnected one catch basin (Asset 1946) on Osborne Avenue from the sanitary sewer and converted it to a dry well.

In 2022, the WPCA partnered with the City of Norwalk Department of Public Works to complete a Sanitary Sewer Separation Project in the Ohio Avenue, Plymouth Avenue, Prospect Street, Buttonball Trail, and Jarvis Street areas. The purpose of the project was to reduce flow from entering the sanitary sewer system and reduce stormwater flooding. The City's contractor, M. Rondano, Inc., disconnected thirteen (13) catch basins from the sanitary sewer and reconnected them to the City's stormwater system.

GIS Updates

In January 2021, SUEZ hired a GIS technician to assist with regularly updating the collection system GIS data and applications. The GIS technician worked closely with field crews and City GIS staff to ensure high quality data standards are met.

Remote Viewing of SCADA System

In early 2021, a mobile application was developed for remote viewing of the facilities Supervisory Control and Data Acquisition (SCADA) system. This system provides management 24/7 monitoring capabilities of the WWTP, Pump Stations, and the Ann Street Siphon Chamber to carefully monitor equipment on/off, flows, levels, chemical feed rates, pump stations, and alarms on any mobile device. The system also includes full visibility of the wet weather operations and Outfall 002 so that the operations team can monitor storm events from any location.

New Service Agreement with SUEZ

In September 2019, the WPCA and SUEZ Water Environmental Services Inc. (SUEZ) executed a new service agreement for the operation, maintenance, and management of its wastewater treatment system (Service Agreement). The Service Agreement includes an initial 10-year term with two additional five-year renewal options. The new contract went into effect on May 18, 2020.

As part of its operator transition plan, the WPCA worked collaboratively with the existing contract operator Operations Management International, Inc. (OMI) to complete a system-wide upgrade of critical equipment. In total, the WPCA invested \$600,000 in the upgrade while OMI contributed installation obligations. Equipment specifically related to the collection system included upgrading the Woodward Avenue Pump Station (installation of two (2) new dry-pit submersible pumps, new pump controls, VFD's, new pump station bypass connection, piping, valves, new flow meter, and appurtenances, upgrading the Fox Run Pump Station (installation of two (2) new dry-pit submersible pumps piping, valves and appurtenances, and new wet well), and upgrading the Bouton Street Pump Station (installation of two (2) new dry-pit submersible pumps, piping, valves and appurtenances). Replacement of generators to ensure operation of pump stations and to avoid bypasses potentially related to power outages. Generators, automatic transfer switches, venting, and wiring were replaced at the following pump stations: Bell Island, Bethel Street, Bouton Street, Fox Run, Howard Avenue, Karen Drive, Shady Beach, Strathmore Lane, and Westport Avenue. In addition, the WPCA purchased extra spare pumps for use at 17 of the 22 stations which are currently stored at the maintenance shop and can be deployed during an emergency to further limit the extent of a pump station release.

On May 18, 2020, the WPCA facilitated a smooth transition of its system operator from OMI, Inc. (OMI) to SUEZ. In addition to the SUEZ team's industry-leading experience operating and maintaining collections systems, the updated Service Agreement between the parties prioritizes asset preservation, enhanced operations, and high quality effluent.

As part of the new Service Agreement, SUEZ purchased approximately \$1.0 million in new equipment to assist with maintaining the collection system. This included a new CCTV Truck (with ITpipes software), a new combination Jet/Vactor Truck, and a utility vehicle equipped with tools and a six thousand pound crane. In addition, SUEZ has purchased and implemented SL RAT technology for the rapid assessment of sewer line conditions. A pole camera was also purchased along with various sewer jetting nozzles and cleaning tools.

In addition to the above purchases, the WPCA is pleased to report that its new Service Agreement with SUEZ includes a number of important provisions that will further enhance operation of its collection system. The provisions include the following highlights.

- Cleaning, CCTV and PACP scoring of collection system assets at a minimum of 2 miles per month.
- Acoustical inspections of the collection system to be performed using specialized equipment called Sewer Line Rapid Assessment Tool (SL-RAT). This innovative technology allows the collections team to receive a score, and based on that score, immediately determine if the pipe has any obstructions or sags. This tool is critical in reducing the amount of SSO's throughout the collection system. SL RAT technology is used to assess all 24-inch diameter and smaller gravity pipes within 5 years.
- Deployment of a minimum of 6 Smart Covers within the collection system.
- Access to the Collection System Major Repair and Replacement fund which is replenished on an annual basis.
- Deployment of a dedicated full time employee to perform FOG/IPP inspection and sampling. The employee must perform 475 inspections on an annual basis.
- Enzymes– biological enzymes are added to breakdown grease buildup in gravity mains and MHs. These enzymes are applied through multiple applications including spray foaming of the gravity sewer lines and slow release blocks located in MHs.
- Environmental guarantees that trigger fee assessments for a number of events such as releases, leaks or spills. More specifically, bypasses at pump stations and the Ann Street Siphon trigger the fee assessment.

As part of its transition agreement, SUEZ conducted an equipment baseline evaluation which included all assets (approximately 3,200) in the wastewater treatment facility and pump stations. As part of this evaluation a series of workshops were held to evaluate risks and consequences of failure of the individual assets. Through this evaluation, critical assets were identified and flagged in the computerized maintenance management system.

Through the asset condition evaluation completed in 2020, critical assets have been identified and flagged in the CMMS. Critical spare parts were identified for these assets and procured and stocked in-house where feasible. Maintenance tasks have been developed for all assets and are continuously optimized through feedback from the field staff and analysis of equipment.

Through this program the team is able to ensure consistent, reliable operation of the pumping stations and associated equipment to prevent backups and SSOs. This program includes comprehensive evaluation and preventative and predictive maintenance of the pump station emergency generators.

Important highlights in 2021 by the SUEZ Team include:

- SUEZ took delivery of their new vector truck to replace the rental unit utilized in 2020. The new vector truck was enhanced with a FOG system, which deploys degreasing and root-killing agents while jetting lines. SUEZ piloted several experimental new jetting nozzles to improve the effectiveness of sewer cleaning activities. The team purchased two new nozzles which were both highly successful in the piloting. SUEZ crew participated in an 8 hour training course on proper use and technique for the new vector nozzles.
- The team purchased an additional high definition CCTV camera and transporter for better access into smaller diameter pipes and to serve other challenges encountered in the field.
- SUEZ team installed carsonite MH markers for easy identification of MHs in easements.

- To increase data quality, accuracy, and efficiency, SUEZ purchased an SXBlue GPS receiver from Geneq Inc., to be implemented into daily workflows in early Report year 2022.
- Two pairs of aircraft grade wireless communication headsets were purchased to enhance hands-free communication between the vactor truck and CCTV truck crews while conducting operations.
- SUEZ and WPCA staff continued to use ITpipes software within the collection system. Staff continues to utilize this software to generate PACP scoring of pipeline video inspections. This software transmits video inspections from the camera truck to the ITpipes cloud to allow access from support staff.

In January 2022, the WPCA Board executed its First Amendment to the SUEZ contract for the purpose of providing consent to SUEZ's merger with Veolia Water Contract Operations USA, Inc. (Veolia) that occurred on March 17, 2022. In addition, the WPCA increased its base contract value with Veolia, staffing was increased to 27 persons from 24 to add additional collection system staffing, purchase of a second jet/vac truck, utility van, and additional smart covers (for a total of 14), weather stations, and monthly cleaning was increased to 3 miles.

Update to Collection System Master Plan

In October 2020, the WPCA launched the initial phase of a significant system-wide collection system engineering assessment. The WPCA requested qualification statements for professional services related to collection system on-call engineering services. In November 2020, the WPCA Board of Directors approved entry into two contracts to provide on-call professional engineering services for the wastewater collection system. In March 2021, the WPCA signed a \$1.0 million agreement with BC as the primary consultant and a \$250,000 agreement with Woodard & Curran as the secondary consultant.

The primary objective for BC is to update the WPCA's Sanitary Sewer Master Plan. The task includes assessing and updating the WPCA's collection system hydraulic model by conducting system-wide flow monitoring. The updated Master Plan will identify long-term capital improvement projects and estimated costs for planning and implementation. Among other improvements, the assessment should be a critical tool helping the WPCA achieve even greater reductions of overflows going forward.

Woodard & Curran was selected as secondary consultant to provide the WPCA with additional resources on current and future projects. The first task order (no. 1) signed with Woodard & Curran is to conduct a financial review of the WPCA and develop a dynamic financial model.

The second task order (no. 2) signed with Woodard & Curran is to conduct a Preliminary Analysis and Design of Sanitary Sewer Improvements for the Dreamy Hollow Area.

In July 2021, the WPCA signed task order (no. 2) with BC to conduct a Sanitary Sewer Evaluation and Design of sewer piping tributary to Sammis Street Pump Station and Bell Island Pump Station. This task order also includes evaluation and design of sewer piping in low lying areas, known areas of concern, and development of bid documents for the rehabilitation of selected sewer piping. Also in July 2021, the WPCA signed Task order (no. 3) with BC to provide site development review, coordination of data collection and analysis of data to determine hydraulic impacts of new developments on the City's sanitary sewer collection system.

In 2021, the WPCA's consultant, Woodard & Curran, developed a Dynamic Financial Model to be used as a financial planning tool for preparation of its capital and operating budgets. This model covers a forecast period of five years, from FY2023 through FY2027, and emphasizes the FY23

budget. The planning model can also be used by the Finance team to for future bonding and cash spending of capital projects. The WPCA anticipates updating the model at least annually for future financial planning and budget preparation.

New and Ongoing Rehabilitation Projects and Upgrades

Ongoing Pump Station Upgrades: In May 2021, the WPCA entered into a construction contract with Kovacs Construction Corporation to provide all materials, equipment, labor and supervision for Comprehensive Upgrades to the Five Mile, Old Trolley Way, Woodward Avenue and Karen Drive Pump Stations. The notice to proceed was issued on July 1, 2021. Once complete, these major pump station upgrades will extend the useful life of the stations and minimize the risk for failure and sewage overflows.

Ongoing Sewer Main Extension Installation: In July 2021, the WPCA entered into a contract for construction with A. Vitti Excavators, LLC to provide all materials, equipment, labor and supervision for the installation of approximately 260 feet of sewer main extension to redirect commercial customer sewer laterals on Belden Avenue to the existing sewer main on Burnell Boulevard to eliminate a hot spot in the collection system.

In July 2021, the WPCA entered into a contract for construction with L. Holzner Electric Company to provide all materials, equipment, labor and supervision for sanitary sewer system rehabilitation, including relocation of the existing 30" sanitary sewer from beneath the building footprint at 2 Knight Street and installation of a permanent high-flow bypass chamber with access MHs. The project includes bypass pumping and grouting the annular space in the tunnel beneath Wall Street to abandon the 30" sanitary sewer from 2 Knight Street.

Dreamy Hollow/Betts Brook Area Improvements: In 2022, the WPCA authorized the expenditure of approximately \$2.5 million to Colonna Concrete & Asphalt Paving LLC as part of the City of Norwalk's Dreamy Hollow/Betts Brook Area Drainage, Sanitary Sewer & Water Main Improvements Project being administered by the Department of Public Works for the purpose of relocating and improving conveyance within the sanitary sewer. This project aims to improve collection system conveyance for multiple homes.

Appendix C: Flow Meter Installation Site Sketches





RAIN GAUGE SITE INFORMATION FIELD LOG

PROJECT: Norwalk, CT

DATE: March 12, 2021

JOB#: 21026

LOCATION: 90 New Canaan Avenue

COMMENTS: 41.127431, -73.432287

LOCATION



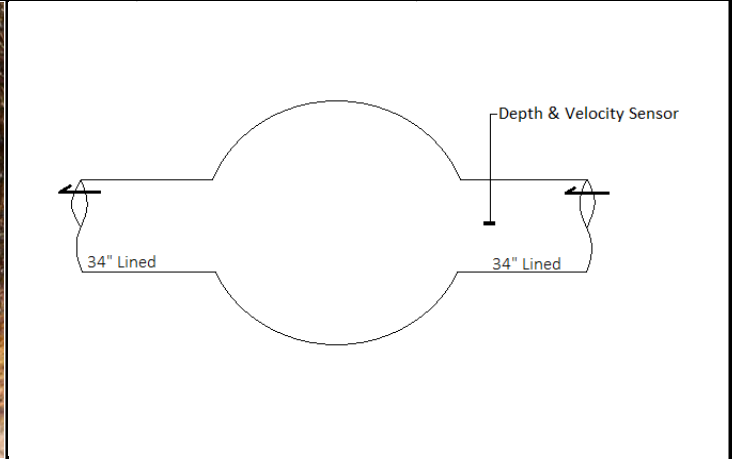


METER SITE INFORMATION FIELD LOG

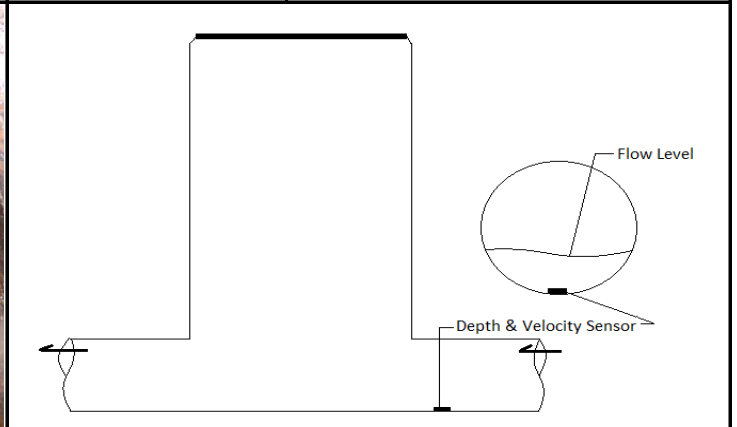
PROJECT: Norwalk, CT	DATE: March 12, 2021	JOB#: 21026
LOCATION: 39 Seaview Avenue	MH#:	METER SITE: 01
GPS/COMMENTS: 41.099476, -73.408710		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	34	Lined	8.5	0	Circular	13' 04"
Incoming						
Incoming						
Outgoing	34	Lined	8.5	0	Circular	13' 05"



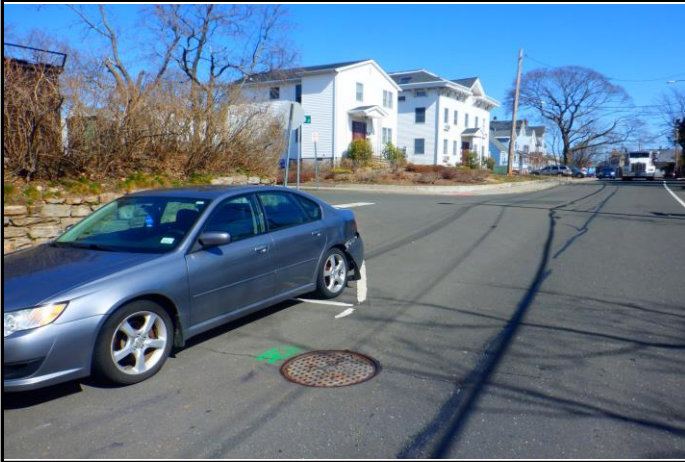
SURCHARGE INFORMATION		WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	LENGTH:	HEIGHT ABOVE WEIR:	
SURCHARGED MARKS TO: 13'	BREADTH:	OVERFLOW OCCURS AT:	
SURCHARGE CURRENTLY TO:	LEVEL:		



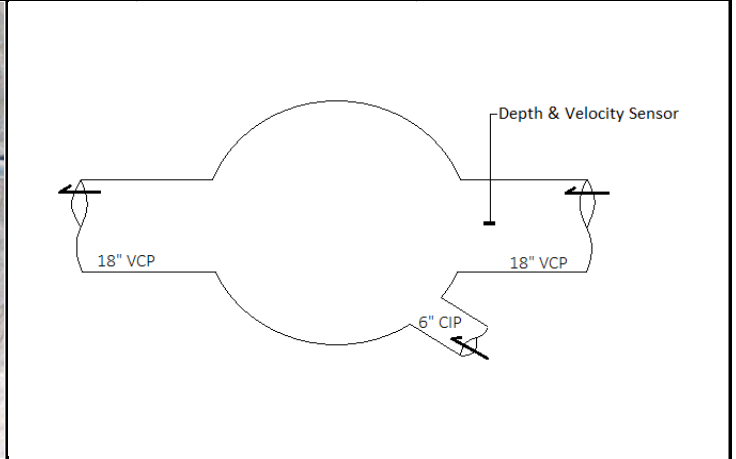


METER SITE INFORMATION FIELD LOG

PROJECT: Norwalk, CT	DATE: March 12, 2021	JOB#: 21026
LOCATION: East Avenue at Goodrow Street	MH#:	METER SITE: 02
GPS/COMMENTS: 41.099158, -73.405479		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	18	VCP	3.8	0	Circular	10' 00"
Incoming	6	CIP	0	0	Circular	04' 09"
Incoming						
Outgoing	18	VCP	3.8	0	Circular	10' 02"

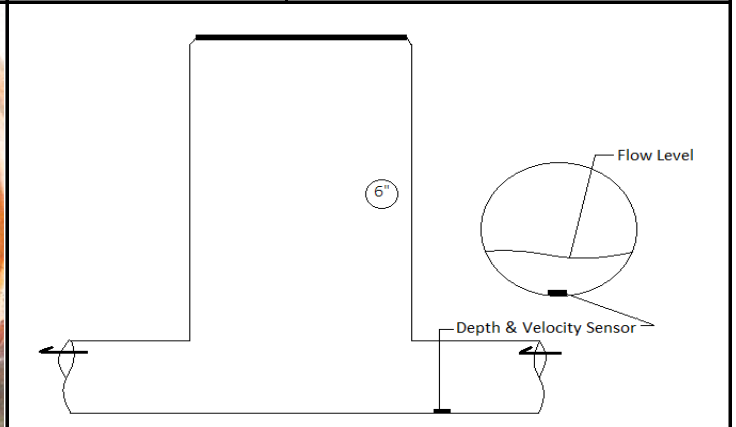


SURCHARGE INFORMATION

SURCHARGE NONE EVIDENT: X
SURCHARGED MARKS TO:
SURCHARGE CURRENTLY TO:

WEIR INFORMATION

LENGTH:	HEIGHT ABOVE WEIR:
BREADTH:	OVERFLOW OCCURS AT:
LEVEL:	



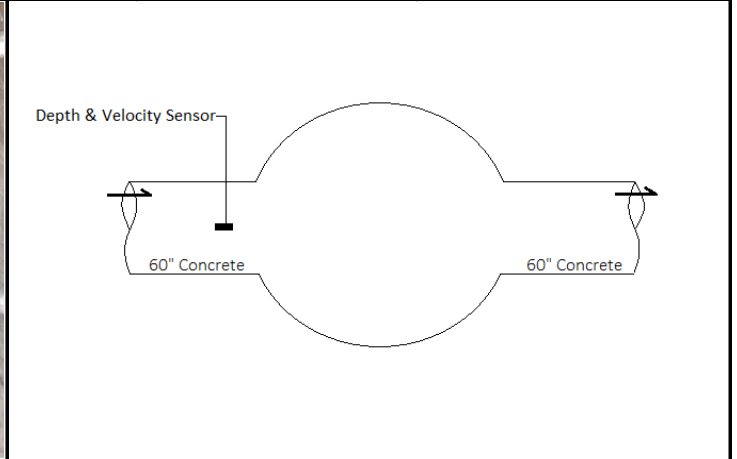


METER SITE INFORMATION FIELD LOG

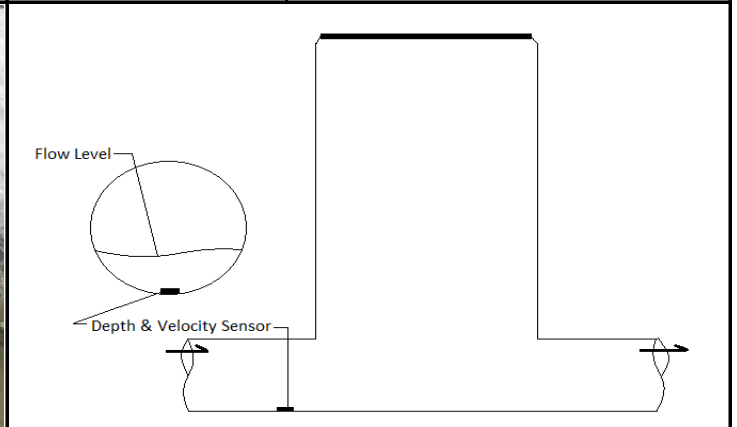
PROJECT: Norwalk, CT	DATE: March 11, 2021	JOB#: 21026
LOCATION: 15 South Smith Street	MH#:	METER SITE: 03
GPS/COMMENTS: 41.104482, -73.411104		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	60	Concrete	20	4	Circular	20' 02"
Incoming						
Incoming						
Outgoing	60	Concrete	20	4	Circular	20' 03"



SURCHARGE INFORMATION		WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	LENGTH:	HEIGHT ABOVE WEIR:	
SURCHARGED MARKS TO: Top	BREADTH:	OVERFLOW OCCURS AT:	
SURCHARGE CURRENTLY TO:	LEVEL:		



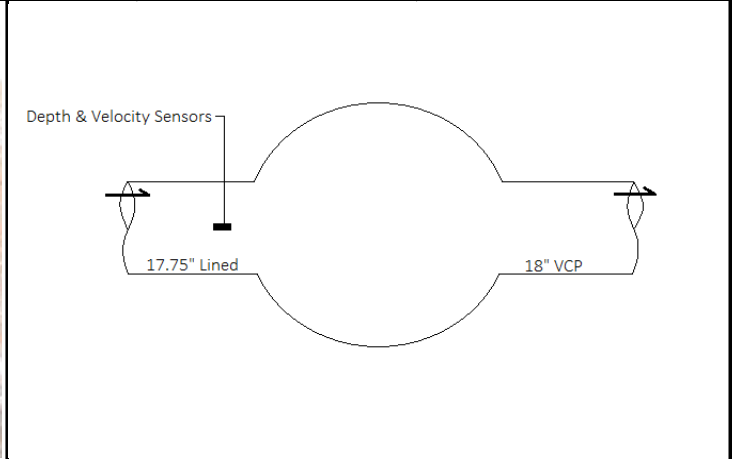


METER SITE INFORMATION FIELD LOG

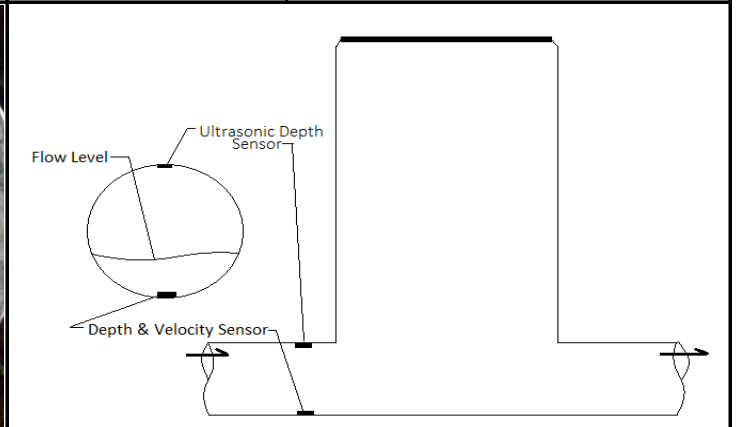
PROJECT: Norwalk, CT	DATE: March 11, 2021	JOB#: 21026
LOCATION: 124 East Avenue on Daskams Lane	MH#:	METER SITE: 04
GPS/COMMENTS: 41.113465, -73.408015		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	17.75	Lined	3	0	Circular	13' 08"
Incoming						
Incoming						
Outgoing	18	VCP	3	0	Circular	13' 09"



SURCHARGE INFORMATION		WEIR INFORMATION	
SURCHARGE NONE EVIDENT: X	LENGTH:	HEIGHT ABOVE WEIR:	
SURCHARGED MARKS TO:	BREADTH:	OVERFLOW OCCURS AT:	
SURCHARGE CURRENTLY TO:	LEVEL:		



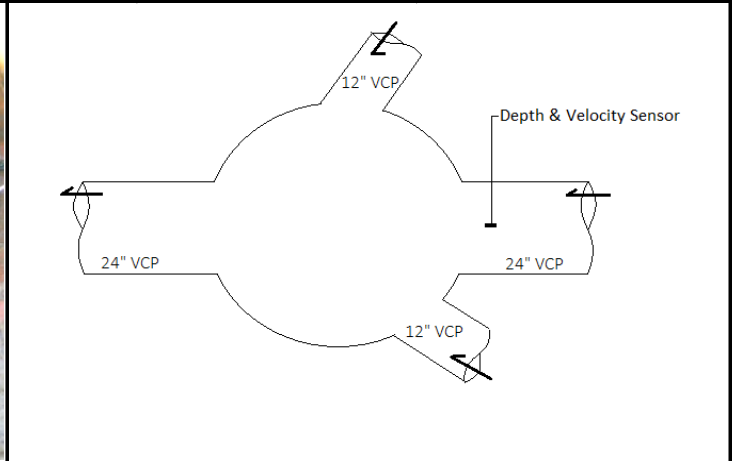


METER SITE INFORMATION FIELD LOG

PROJECT: Norwalk, CT	DATE: March 10, 2021	JOB#: 21026
LOCATION: 75 East Avenue	MH#:	METER SITE: 05
GPS/COMMENTS: 41.118954, -73.407665		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	24	VCP	5.4	0	Circular	07' 09"
Incoming	12	VCP	2	0	Circular	07' 06"
Incoming	12	VCP	2	0	Circular	07' 06"
Outgoing	24	VCP	5.4	0	Circular	07' 10"

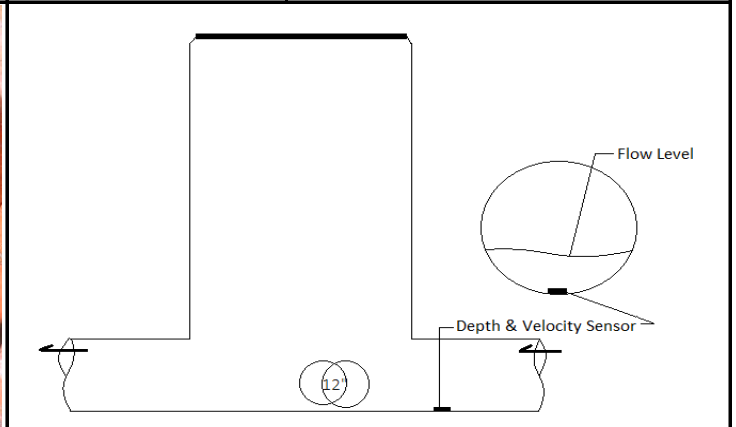


SURCHARGE INFORMATION

SURCHARGE NONE EVIDENT: X
SURCHARGED MARKS TO:
SURCHARGE CURRENTLY TO:

WEIR INFORMATION

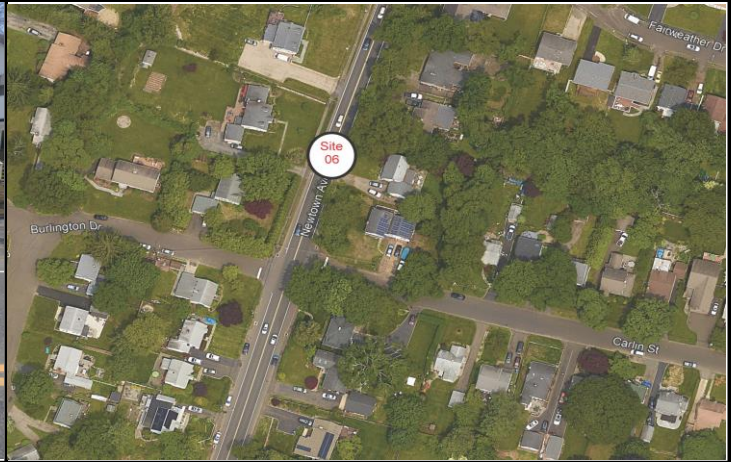
LENGTH:	HEIGHT ABOVE WEIR:
BREADTH:	OVERFLOW OCCURS AT:
LEVEL:	



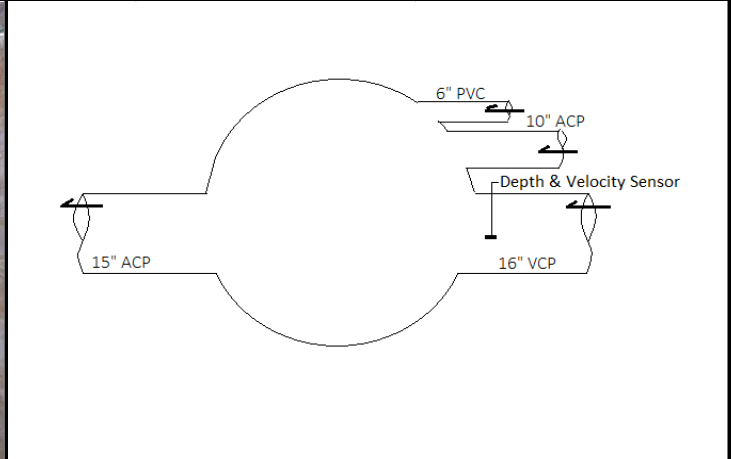


METER SITE INFORMATION FIELD LOG

PROJECT: Norwalk, CT	DATE: March 10, 2021	JOB#: 21026
LOCATION: 106 Newtown Avenue	MH#:	METER SITE: 06
GPS/COMMENTS: 41.131384, -73.402288		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	15	ACP	4	0	Circular	08' 09"
Incoming	10	ACP	4	0.5	Circular	08' 09"
Incoming	6	PVC	0	0	Circular	07' 10"
Outgoing	16	VCP	4	0	Circular	08' 10"

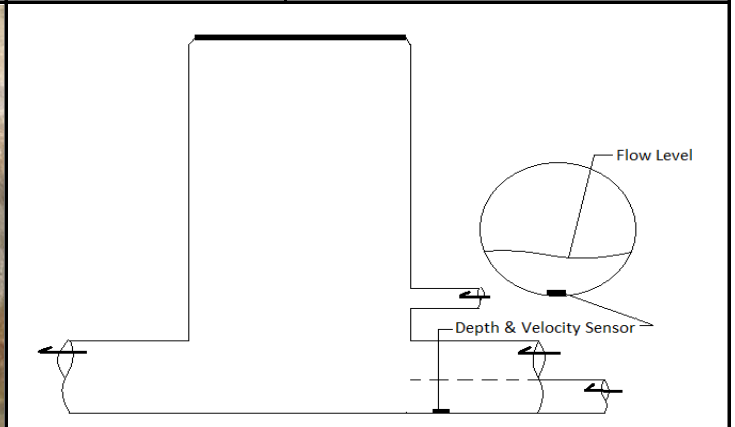


SURCHARGE INFORMATION

SURCHARGE NONE EVIDENT: X
SURCHARGED MARKS TO:
SURCHARGE CURRENTLY TO:

WEIR INFORMATION

LENGTH:	HEIGHT ABOVE WEIR:
BREATH:	OVERFLOW OCCURS AT:
LEVEL:	



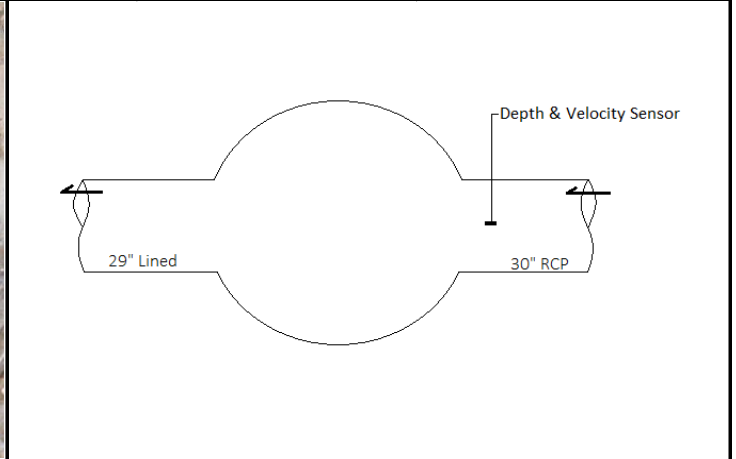


METER SITE INFORMATION FIELD LOG

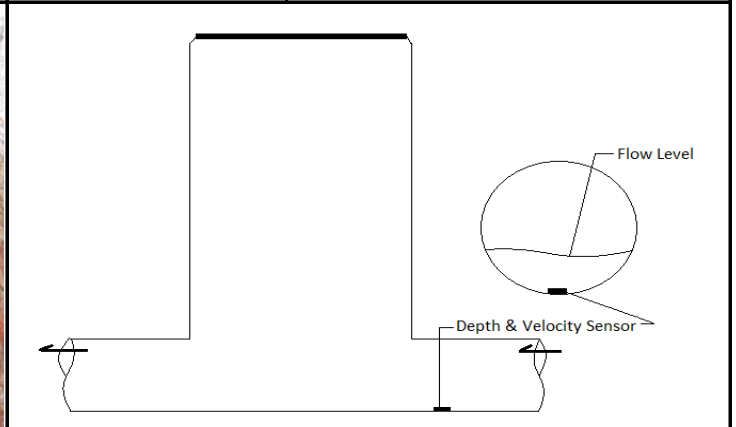
PROJECT: Norwalk, CT	DATE: March 10, 2021	JOB#: 21026
LOCATION: 28 Knight Street	MH#:	METER SITE: 07
GPS/COMMENTS: 41.119896, -73.410028		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	30	RCP	8	0.5	Circular	06' 11"
Incoming						
Incoming						
Outgoing	29	Lined	8	0.5	Circular	07' 00"



SURCHARGE INFORMATION		WEIR INFORMATION	
SURCHARGE NONE EVIDENT: X	LENGTH:	HEIGHT ABOVE WEIR:	
SURCHARGED MARKS TO:	BREADTH:	OVERFLOW OCCURS AT:	
SURCHARGE CURRENTLY TO:	LEVEL:		



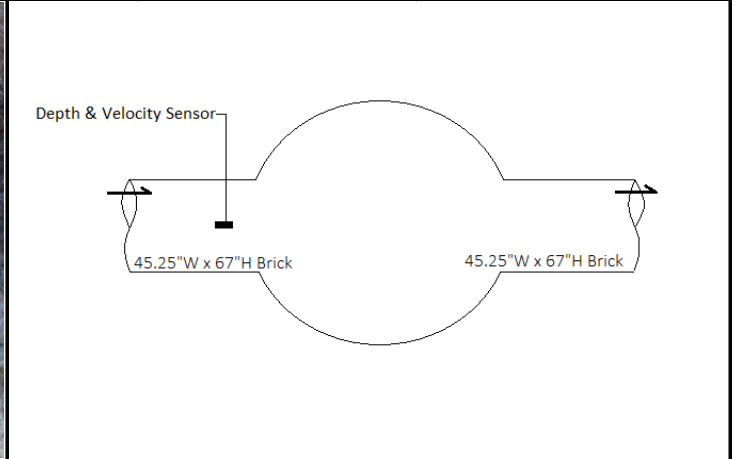


METER SITE INFORMATION FIELD LOG

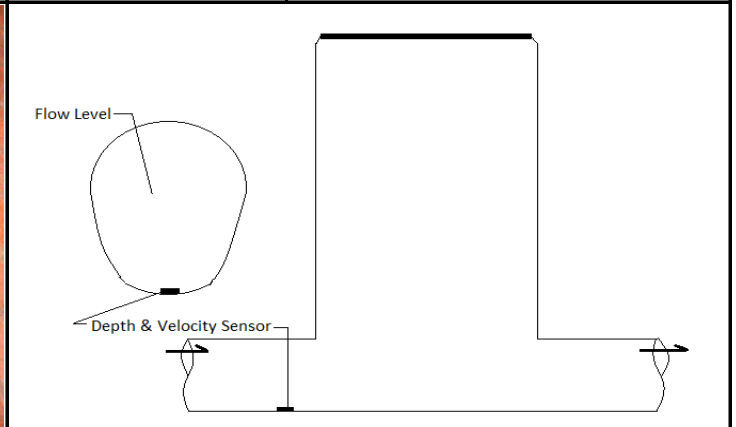
PROJECT: Norwalk, CT	DATE: March 11, 2021	JOB#: 21026
LOCATION: Main Street at Burnell Boulevard	MH#:	METER SITE: 08
GPS/COMMENTS: 41.119214, -73.412629		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	67x42.25	Brick	11.9	0	Inverted Egg	11' 07"
Incoming						
Incoming						
Outgoing	67x42.25	Brick	11.9	0	Inverted Egg	11' 08"



SURCHARGE INFORMATION		WEIR INFORMATION	
SURCHARGE NONE EVIDENT: X	LENGTH:	HEIGHT ABOVE WEIR:	
SURCHARGED MARKS TO:	BREADTH:	OVERFLOW OCCURS AT:	
SURCHARGE CURRENTLY TO:	LEVEL:		



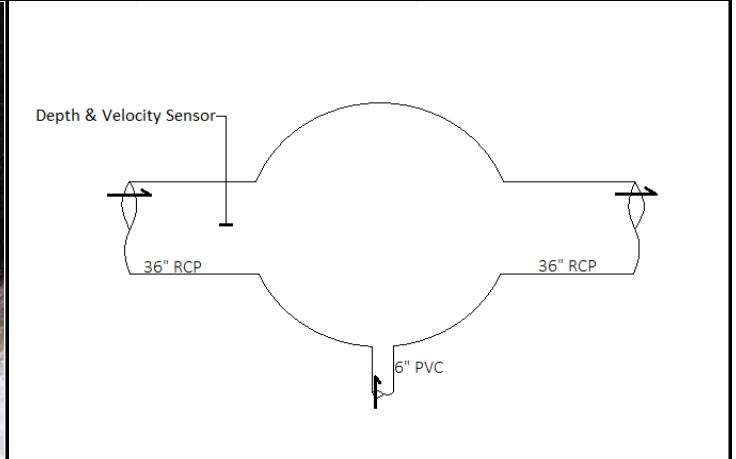


METER SITE INFORMATION FIELD LOG

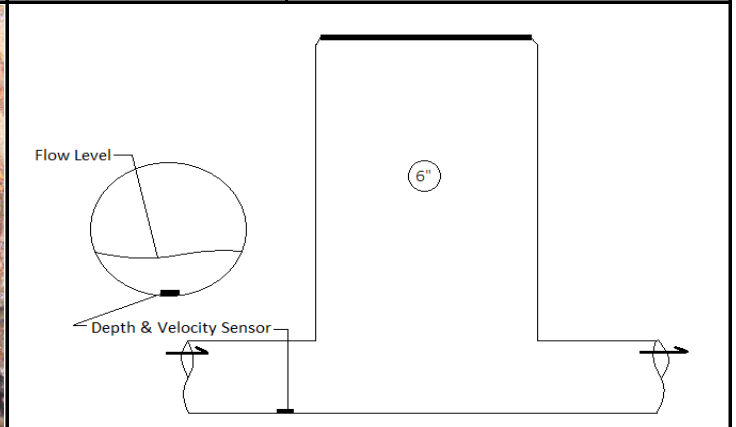
PROJECT: Norwalk, CT	DATE: March 11, 2021	JOB#: 21026
LOCATION: 195 Main Street (in grass)	MH#:	METER SITE: 09
GPS/COMMENTS: 41.126948, -73.422138		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	36	RCP	11	4	Circular	12' 11"
Incoming	6	PVC	0.75	0	Circular	06' 00"
Incoming						
Outgoing	36	RCP	11	5	Circular	13' 00"



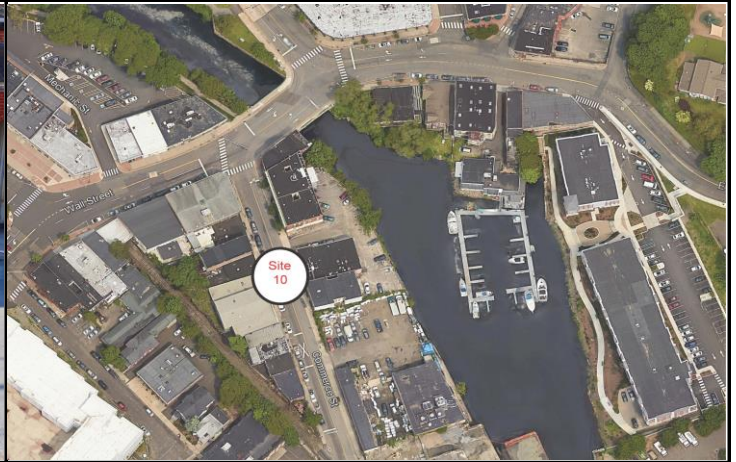
SURCHARGE INFORMATION		WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	LENGTH:	HEIGHT ABOVE WEIR:	
SURCHARGED MARKS TO: 12'	BREADTH:	OVERFLOW OCCURS AT:	
SURCHARGE CURRENTLY TO:	LEVEL:		



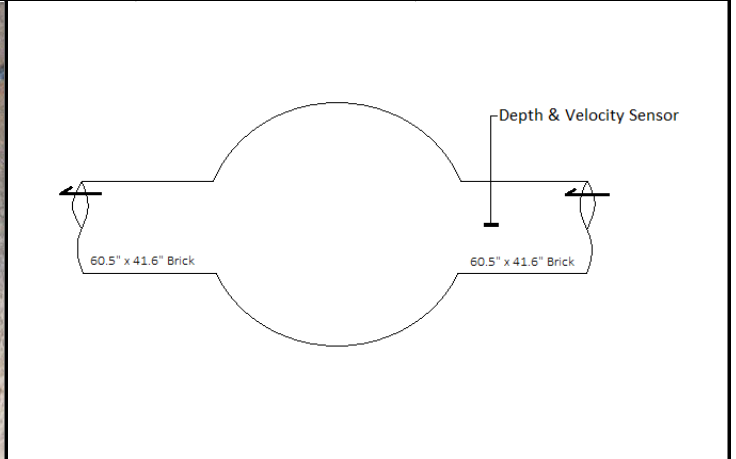


METER SITE INFORMATION FIELD LOG

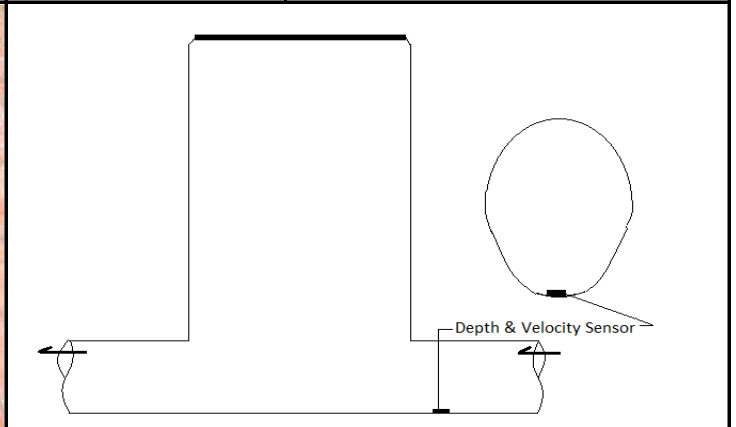
PROJECT: Norwalk, CT	DATE: March 10, 2021	JOB#: 21026
LOCATION: 12 Commerce Street	MH#:	METER SITE: 10
GPS/COMMENTS: 41.117708, -73.412244		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	60.5" x 41.6"	Brick	6.2	0	Egg	11' 09"
Incoming						
Incoming						
Outgoing	60.5" x 41.6"	Brick	6.2	0	Egg	12' 00"



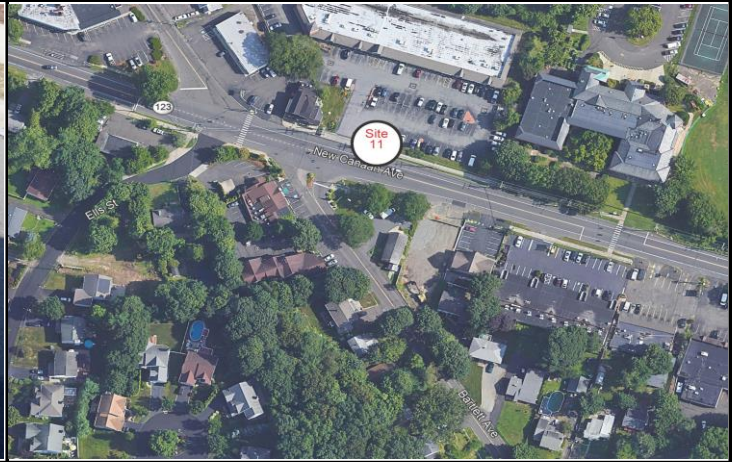
SURCHARGE INFORMATION		WEIR INFORMATION	
SURCHARGE NONE EVIDENT: X	LENGTH:	HEIGHT ABOVE WEIR:	
SURCHARGED MARKS TO:	BREADTH:	OVERFLOW OCCURS AT:	
SURCHARGE CURRENTLY TO:	LEVEL:		



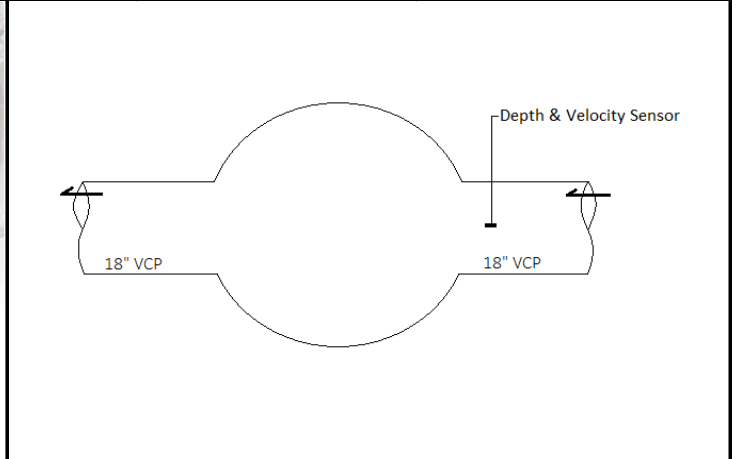
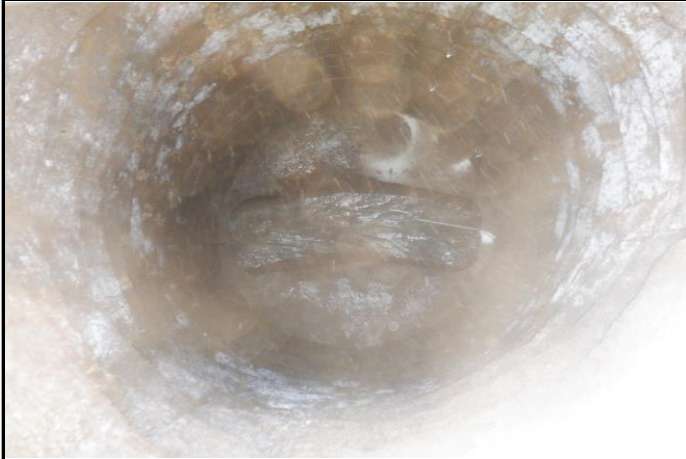


METER SITE INFORMATION FIELD LOG

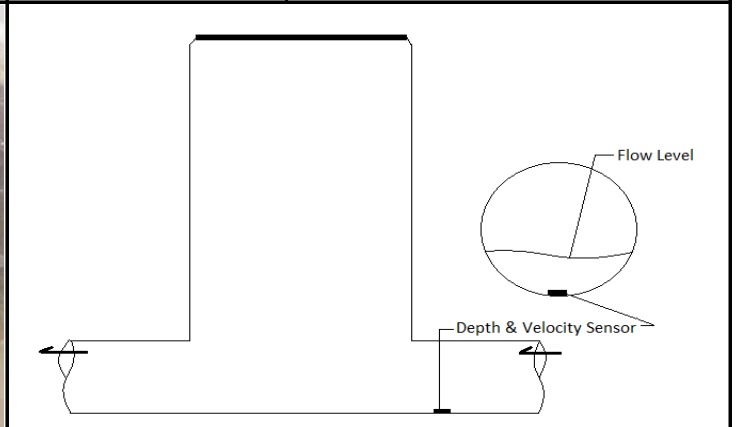
PROJECT: Norwalk, CT	DATE: March 10, 2021	JOB#: 21026
LOCATION: 120 New Canaan Avenue	MH#:	METER SITE: 11
GPS/COMMENTS: 41.128022, -73.435403		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	18	VCP	3	0	Circular	09' 10"
Incoming						
Incoming						
Outgoing	18	VCP	3	0	Circular	10' 02"



SURCHARGE INFORMATION		WEIR INFORMATION	
SURCHARGE NONE EVIDENT: X	LENGTH:	HEIGHT ABOVE WEIR:	
SURCHARGED MARKS TO:	BREADTH:	OVERFLOW OCCURS AT:	
SURCHARGE CURRENTLY TO:	LEVEL:		



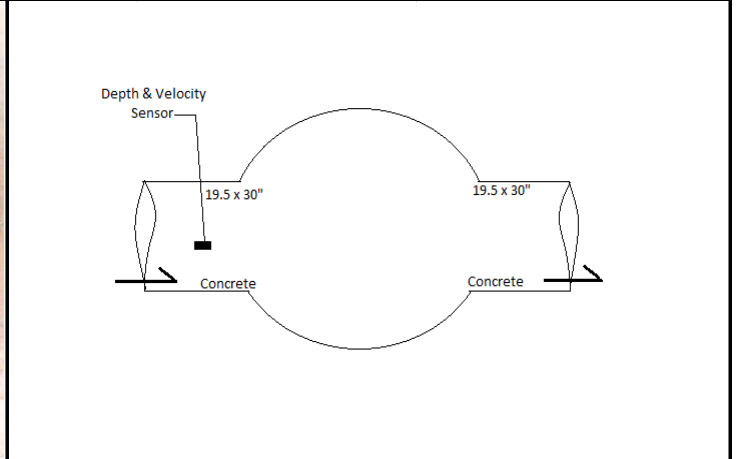


METER SITE INFORMATION FIELD LOG

PROJECT: Norwalk, CT	DATE: March 10, 2021	JOB#: 21026
LOCATION: 44 Orchard Street	MH#:	METER SITE: 12
GPS/COMMENTS: 41.111481, -73.412778		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	30H x 19.5W	Concrete	11	0	Egg	08' 03"
Incoming						
Incoming						
Outgoing	30H x 19.5W	Concrete	11	0	Egg	08' 05"

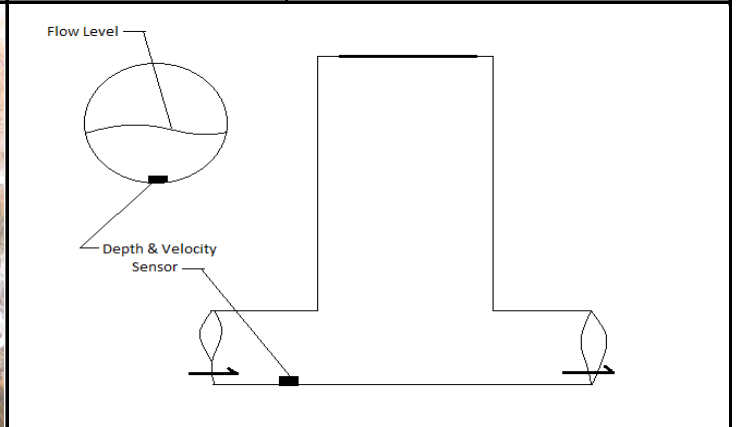


SURCHARGE INFORMATION

SURCHARGE NONE EVIDENT: X
SURCHARGED MARKS TO:
SURCHARGE CURRENTLY TO:

WEIR INFORMATION

LENGTH:	HEIGHT ABOVE WEIR:
BREADTH:	OVERFLOW OCCURS AT:
LEVEL:	



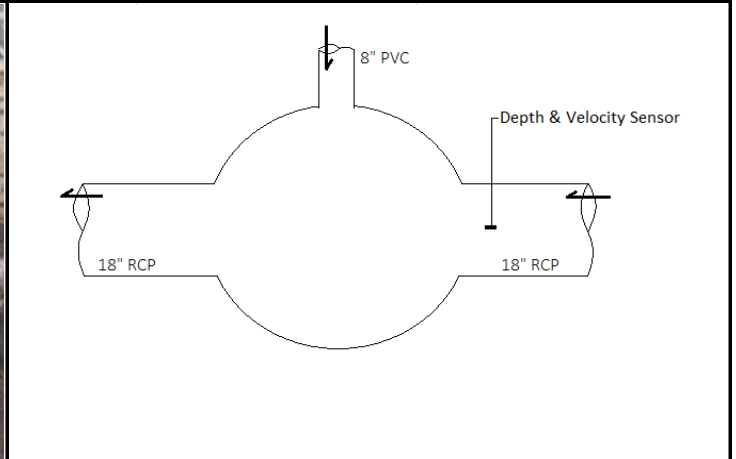


METER SITE INFORMATION FIELD LOG

PROJECT: Norwalk, CT	DATE: March 18, 2021	JOB#: 21026
LOCATION: Olive Lane R.O.W.	MH#:	METER SITE: 13
GPS/COMMENTS: 41.1009642, -73.4438865		

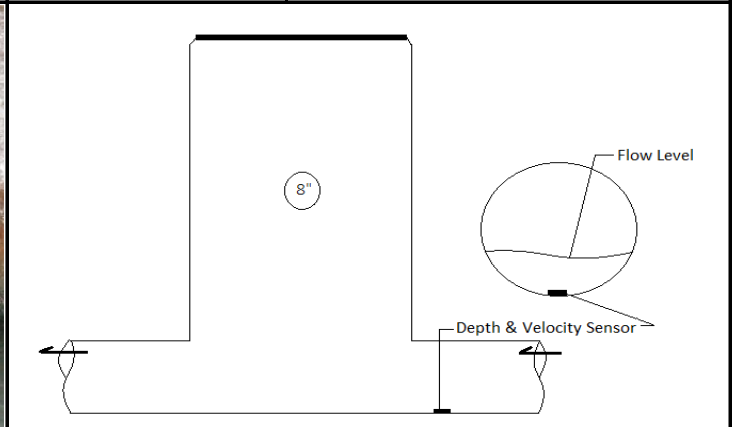


	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	18	RCP	5.75	0	Circular	14' 05"
Incoming	8	RCP	0.5	0	Circular	10' 00"
Incoming						
Outgoing	18	RCP	5.75	0	Circular	14' 06"



SURCHARGE INFORMATION

SURCHARGE NONE EVIDENT:	LENGTH:	HEIGHT ABOVE WEIR:
SURCHARGED MARKS TO: 7'	BREADTH:	OVERFLOW OCCURS AT:
SURCHARGE CURRENTLY TO:	LEVEL:	



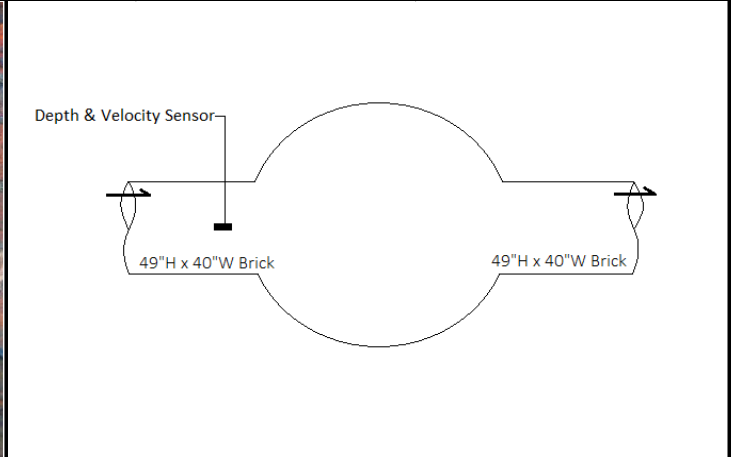


METER SITE INFORMATION FIELD LOG

PROJECT: Norwalk, CT	DATE: March 10, 2021	JOB#: 21026
LOCATION: 11 North Water Street	MH#:	METER SITE: 14
GPS/COMMENTS: 41.101867, -73.417831		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	44H x 40W	Brick	7.5	4	Inverted Egg	13' 09"
Incoming						
Incoming						
Outgoing	44H x 40W	Brick	7.5	4	Inverted Egg	13' 10"

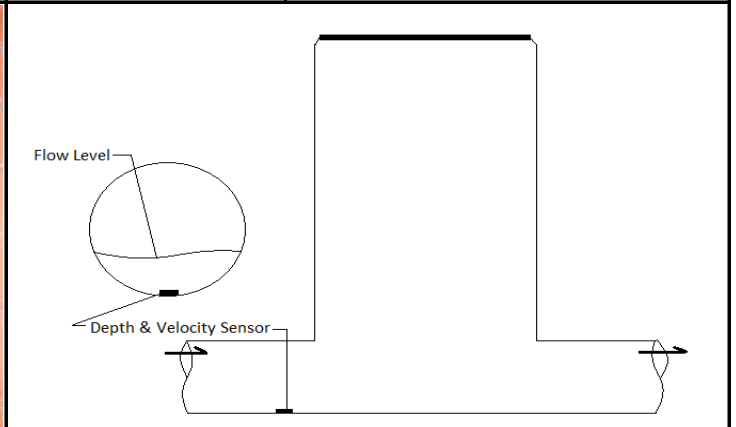


SURCHARGE INFORMATION

SURCHARGE NONE EVIDENT: X
SURCHARGED MARKS TO:
SURCHARGE CURRENTLY TO:

WEIR INFORMATION

LENGTH:	HEIGHT ABOVE WEIR:
BREADTH:	OVERFLOW OCCURS AT:
LEVEL:	



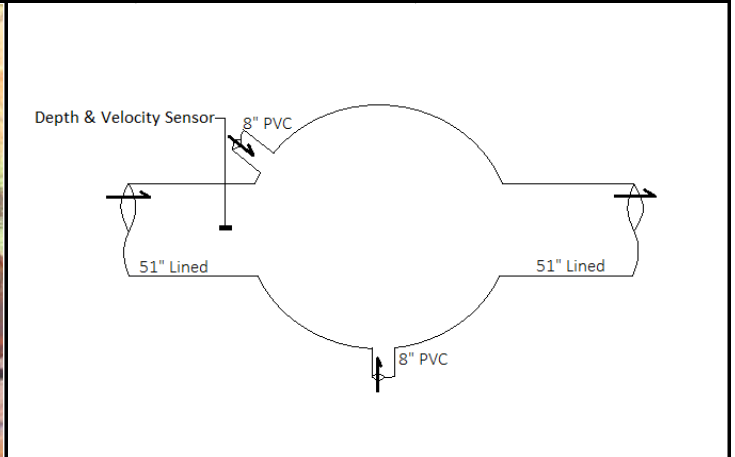


METER SITE INFORMATION FIELD LOG

PROJECT: Norwalk, CT	DATE: March 10, 2021	JOB#: 21026
LOCATION: 10 North Water Street	MH#:	METER SITE: 15
GPS/COMMENTS: 41.100361, -73.416479		

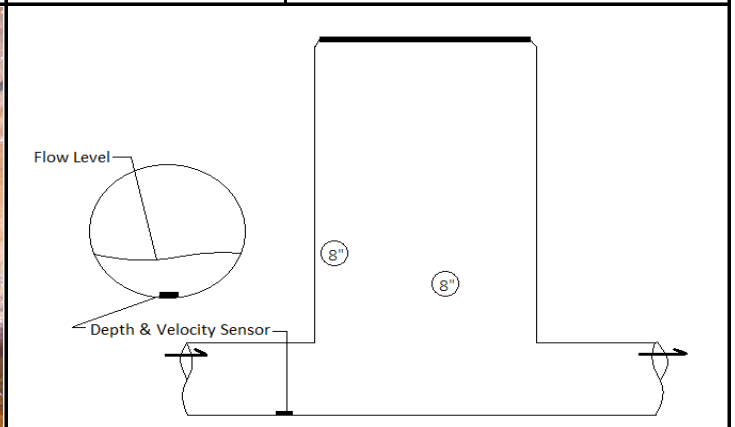


	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	51	Lined	12	0	Circular	13' 10"
Incoming	8	PVC	0.25	0	Circular	07' 01"
Incoming	8	PVC	0	0.5	Circular	06' 07"
Outgoing	51	Lined	12	0	Circular	13' 11"



SURCHARGE INFORMATION

SURCHARGE NONE EVIDENT:	LENGTH:	HEIGHT ABOVE WEIR:
SURCHARGED MARKS TO: 8'	BREADTH:	OVERFLOW OCCURS AT:
SURCHARGE CURRENTLY TO:	LEVEL:	



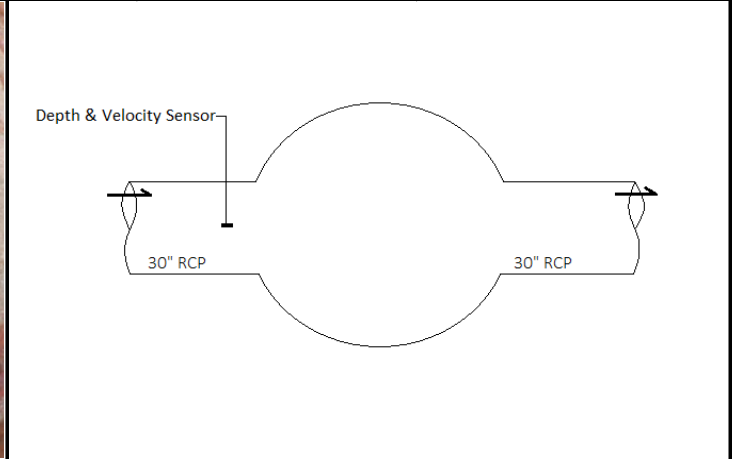


METER SITE INFORMATION FIELD LOG

PROJECT: Norwalk, CT	DATE: March 16, 2021	JOB#: 21026
LOCATION: 149 Water Street	MH#:	METER SITE: 16
GPS/COMMENTS: 41.093422, -73.415999		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	30	RCP	4.2	0	Circular	07' 08"
Incoming						
Incoming						
Outgoing	30	RCP	4.2	0	Circular	07' 09"

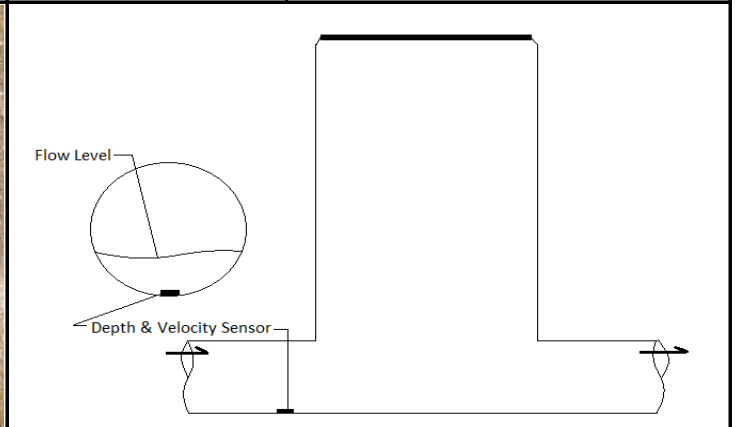


SURCHARGE INFORMATION

SURCHARGE NONE EVIDENT: X
SURCHARGED MARKS TO:
SURCHARGE CURRENTLY TO:

WEIR INFORMATION

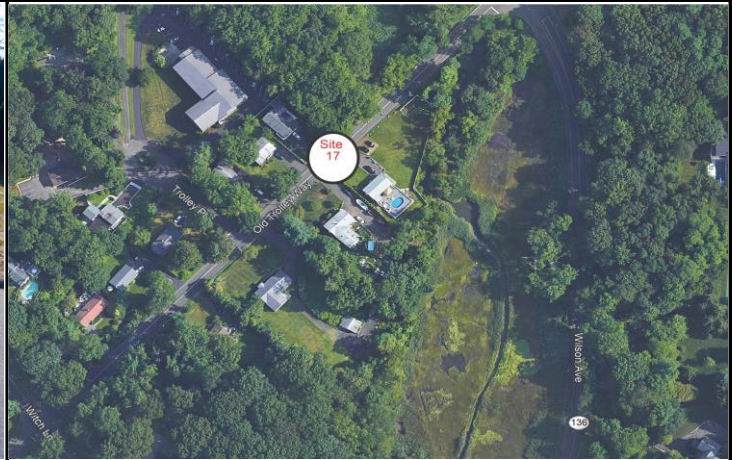
LENGTH:	HEIGHT ABOVE WEIR:
BREADTH:	OVERFLOW OCCURS AT:
LEVEL:	



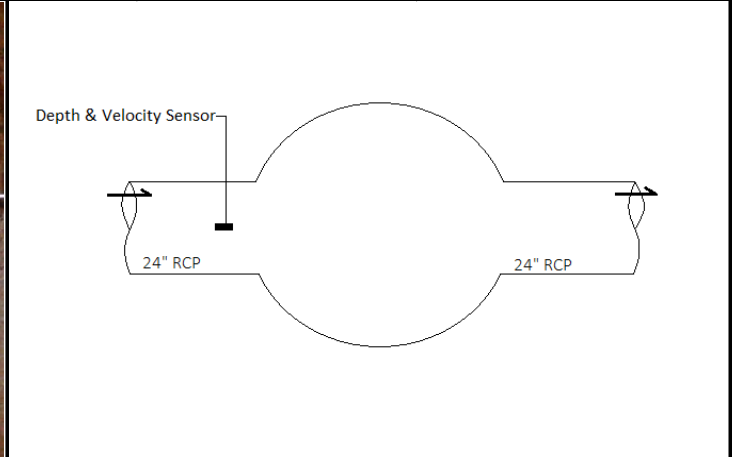


METER SITE INFORMATION FIELD LOG

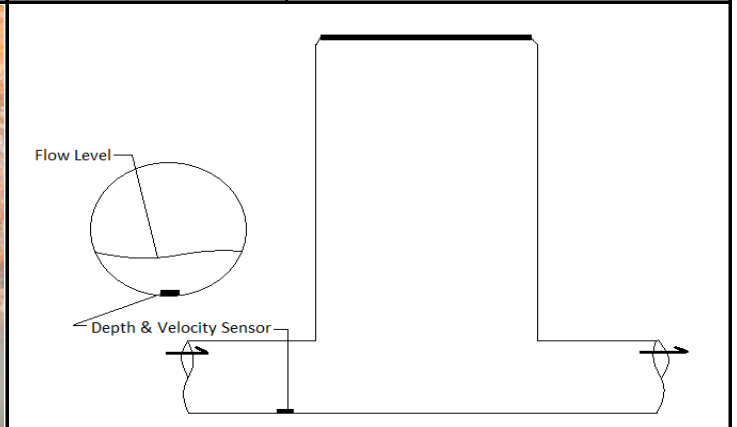
PROJECT: Norwalk, CT	DATE: March 11, 2021	JOB#: 21026
LOCATION: 21 Old Trolley Way	MH#:	METER SITE: 17
GPS/COMMENTS: 41.075095, -73.429074		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	24	RCP	9.2	6	Circular	06' 05"
Incoming						
Incoming						
Outgoing	24	RCP	9.2	6	Circular	06' 06"



SURCHARGE INFORMATION		WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	LENGTH:	HEIGHT ABOVE WEIR:	
SURCHARGED MARKS TO: 2'	BREADTH:	OVERFLOW OCCURS AT:	
SURCHARGE CURRENTLY TO:	LEVEL:		



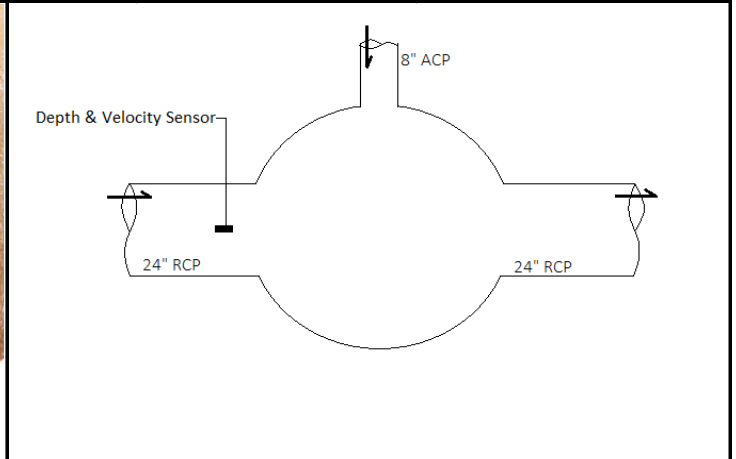


METER SITE INFORMATION FIELD LOG

PROJECT: Norwalk, CT	DATE: March 11, 2021	JOB#: 21026
LOCATION: Rowayton Avenue at Dibble Street	MH#:	METER SITE: 18
GPS/COMMENTS: 41.073613, -73.445317		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	24	RCP	3.75	0	Circular	16' 05"
Incoming	8	ACP	0	0	Circular	07' 08"
Incoming						
Outgoing	24	RCP	3.75	0	Circular	16' 06"

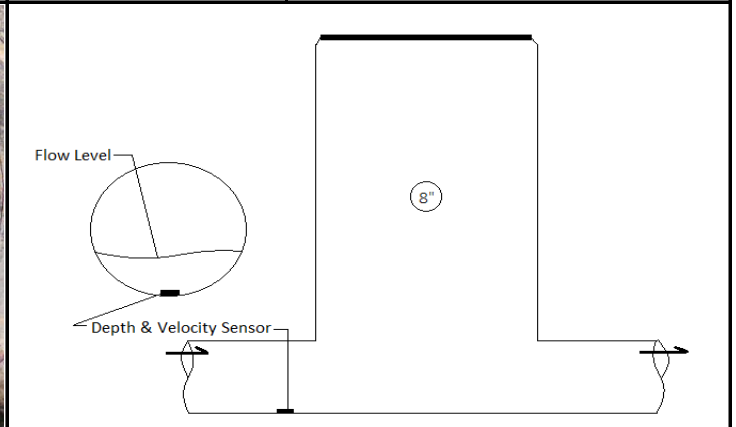


SURCHARGE INFORMATION

SURCHARGE NONE EVIDENT: X
SURCHARGED MARKS TO:
SURCHARGE CURRENTLY TO:

WEIR INFORMATION

LENGTH:	HEIGHT ABOVE WEIR:
BREADTH:	OVERFLOW OCCURS AT:
LEVEL:	



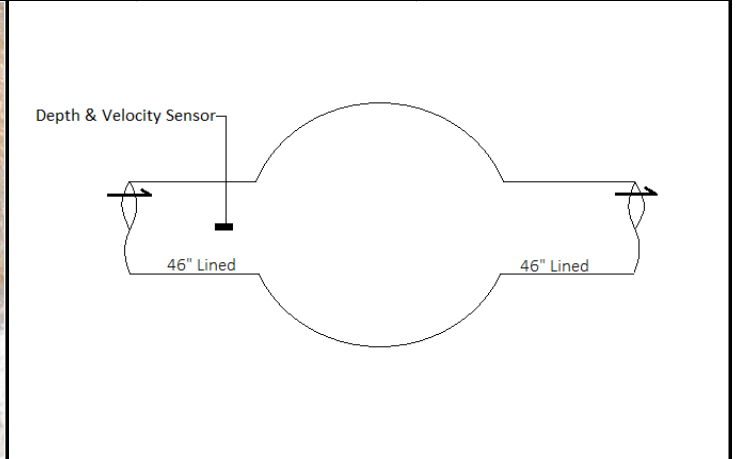


METER SITE INFORMATION FIELD LOG

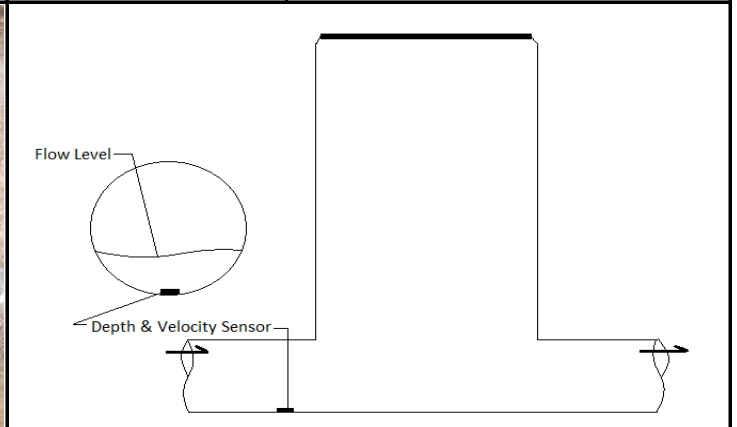
PROJECT: Norwalk, CT	DATE: March 11, 2021	JOB#: 21026
LOCATION: 41 Commerce Street	MH#:	METER SITE: 19
GPS/COMMENTS: 41.116045, -73.411047		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	46	Lined	8	0	Circular	11' 11"
Incoming						
Incoming						
Outgoing	46	Lined	8	0	Circular	12' 00"



SURCHARGE INFORMATION		WEIR INFORMATION	
SURCHARGE NONE EVIDENT: X	LENGTH:	HEIGHT ABOVE WEIR:	
SURCHARGED MARKS TO:	BREADTH:	OVERFLOW OCCURS AT:	
SURCHARGE CURRENTLY TO:	LEVEL:		



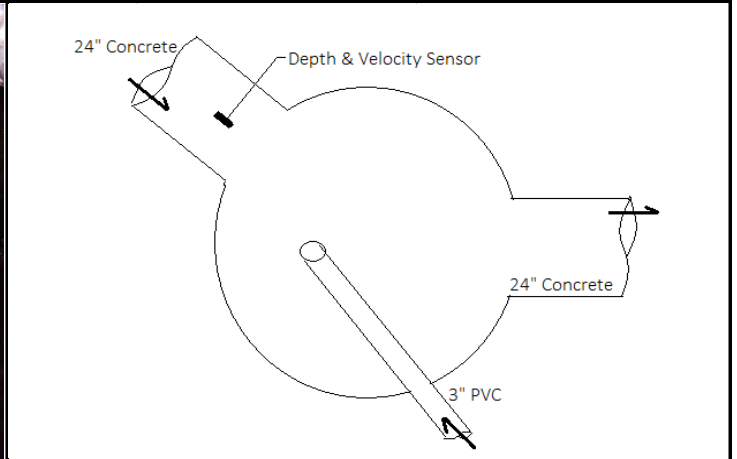


METER SITE INFORMATION FIELD LOG

PROJECT: Norwalk, CT	DATE: March 11, 2021	JOB#: 21026
LOCATION: 1 Danbury Road	MH#:	METER SITE: 20
GPS/COMMENTS: 41.160531, -73.419127		



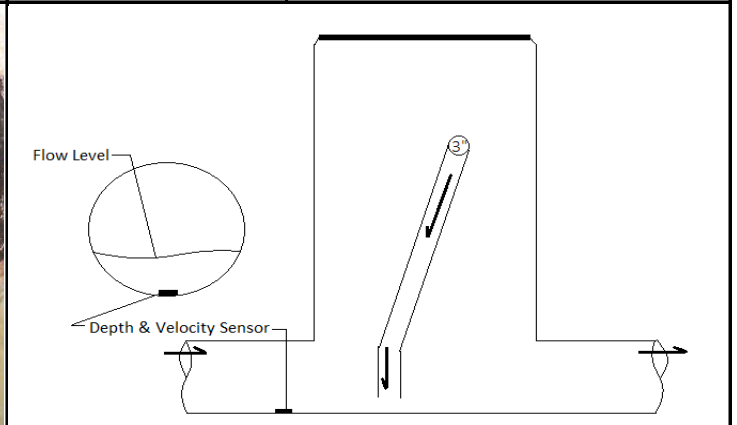
	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	24	Concrete	8	2	Circular	10' 09"
Incoming	3	PVC	0	0	Circular	03' 10"
Incoming						
Outgoing	24	Concrete	8	2	Circular	10' 10"



SURCHARGE INFORMATION

SURCHARGE NONE EVIDENT:	LENGTH:	HEIGHT ABOVE WEIR:
SURCHARGED MARKS TO: 3'	BREADTH:	OVERFLOW OCCURS AT:
SURCHARGE CURRENTLY TO:	LEVEL:	

WEIR INFORMATION



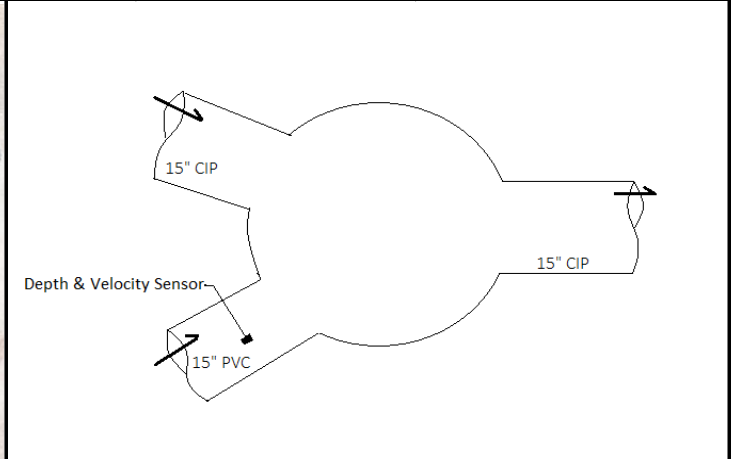


METER SITE INFORMATION FIELD LOG

PROJECT: Norwalk, CT	DATE: March 16, 2021	JOB#: 21026
LOCATION: 16 Leann Drive (Westport Avenue PS)	MH#:	METER SITE: 21
GPS/COMMENTS: 41.125505, -73.385687		

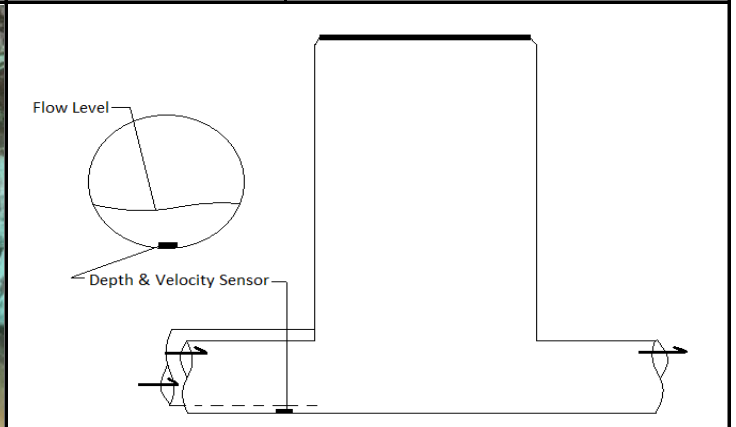


	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	15	PVC	3.75	0	Circular	07' 04"
Incoming	15	CIP	4	0.5	Circular	07' 04"
Incoming						
Outgoing	15	CIP	3.75	0	Circular	07' 05"



SURCHARGE INFORMATION

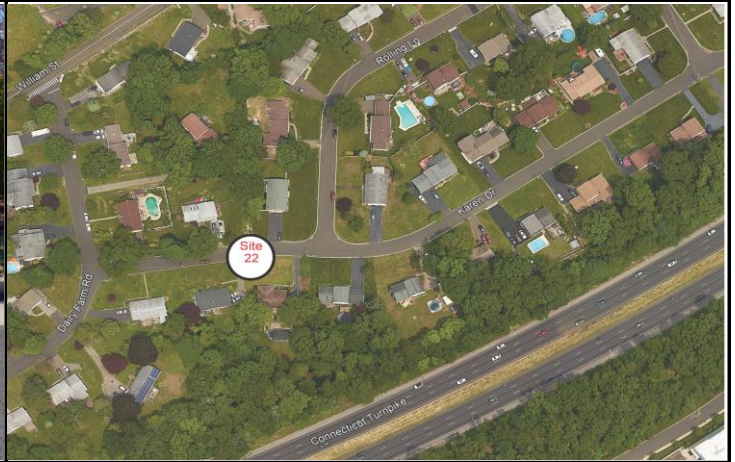
SURCHARGE NONE EVIDENT: X	LENGTH:	HEIGHT ABOVE WEIR:
SURCHARGED MARKS TO:	BREADTH:	OVERFLOW OCCURS AT:
SURCHARGE CURRENTLY TO:	LEVEL:	



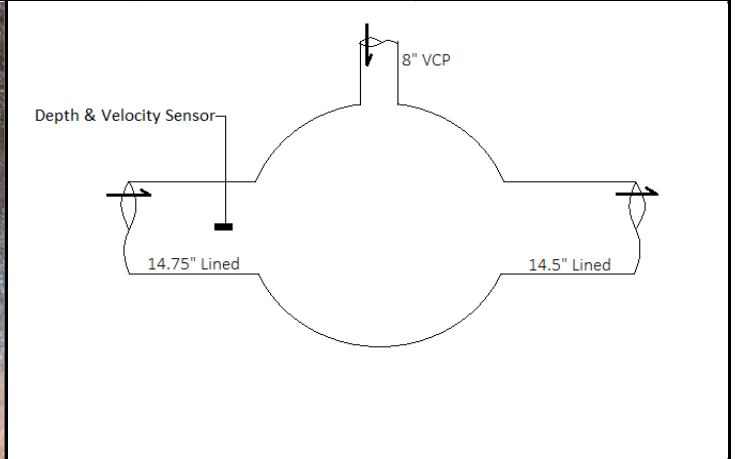


METER SITE INFORMATION FIELD LOG

PROJECT: Norwalk, CT	DATE: March 12, 2021	JOB#: 21026
LOCATION: 9 Karen Drive	MH#:	METER SITE: 22
GPS/COMMENTS: 41.114291, -73.391950		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	14.75	Lined	2.5	0	Circular	06' 00"
Incoming	8	VCP	0.5	0	Circular	05' 05"
Incoming						
Outgoing	14.5	Lined	2.5	0	Circular	06' 01"

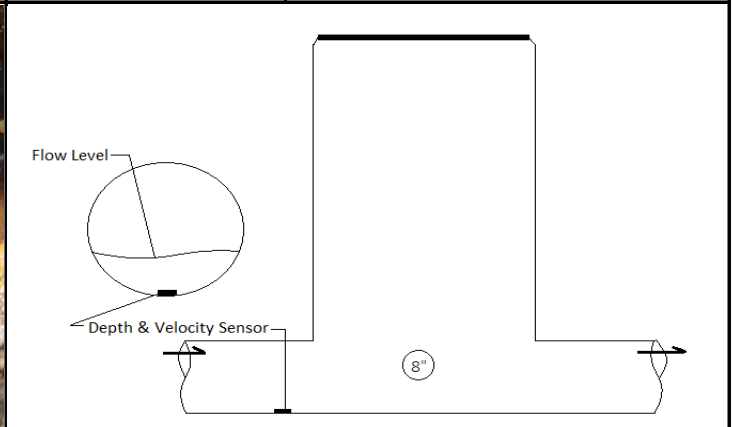


SURCHARGE INFORMATION

SURCHARGE NONE EVIDENT: X
SURCHARGED MARKS TO:
SURCHARGE CURRENTLY TO:

WEIR INFORMATION

LENGTH:	HEIGHT ABOVE WEIR:
BREADTH:	OVERFLOW OCCURS AT:
LEVEL:	



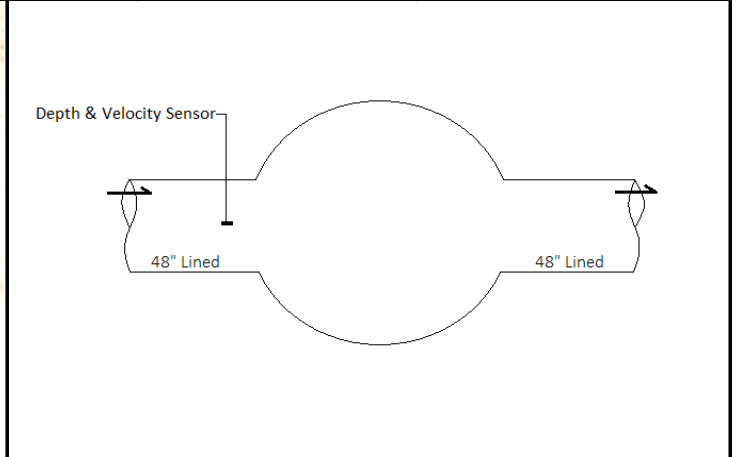


METER SITE INFORMATION FIELD LOG

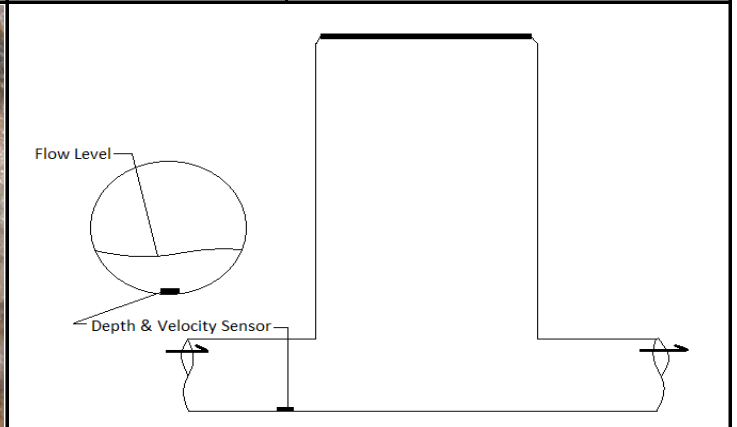
PROJECT: Norwalk, CT	DATE: March 9, 2021	JOB#: 21026
LOCATION: Railroad Place (marina)	MH#:	METER SITE: 23
GPS/COMMENTS: 41.113627, -73.410637		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	48	Lined	7	0	Circular	11' 08"
Incoming						
Incoming						
Outgoing	48	Lined	7	0	Circular	11' 09"



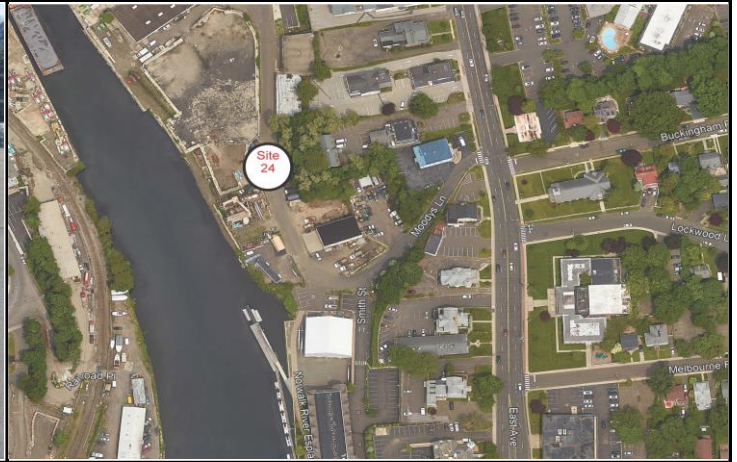
SURCHARGE INFORMATION		WEIR INFORMATION	
SURCHARGE NONE EVIDENT: X	LENGTH:	HEIGHT ABOVE WEIR:	
SURCHARGED MARKS TO:	BREADTH:	OVERFLOW OCCURS AT:	
SURCHARGE CURRENTLY TO:	LEVEL:		



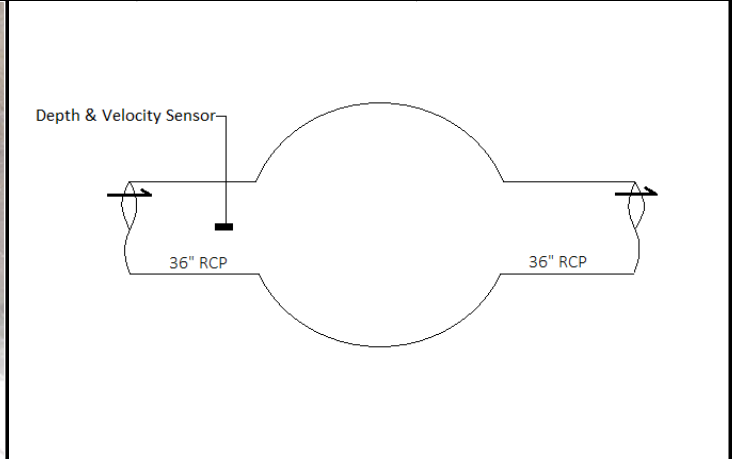


METER SITE INFORMATION FIELD LOG

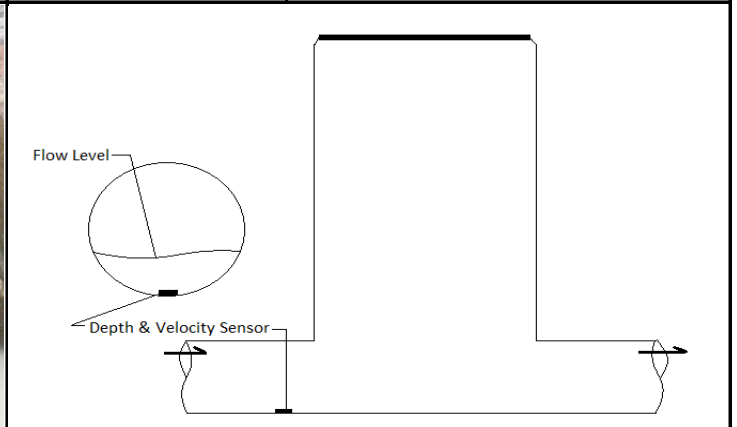
PROJECT: Norwalk, CT	DATE: March 11, 2021	JOB#: 21026
LOCATION: 34 Smith Street	MH#:	METER SITE: 24
GPS/COMMENTS: 41.115753, -73.409300		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	36	RCP	14	0	Circular	09' 00"
Incoming						
Incoming						
Outgoing	36	RCP	14	0	Circular	09' 00"



SURCHARGE INFORMATION		WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	LENGTH:	HEIGHT ABOVE WEIR:	
SURCHARGED MARKS TO: 8'	BREADTH:	OVERFLOW OCCURS AT:	
SURCHARGE CURRENTLY TO:	LEVEL:		



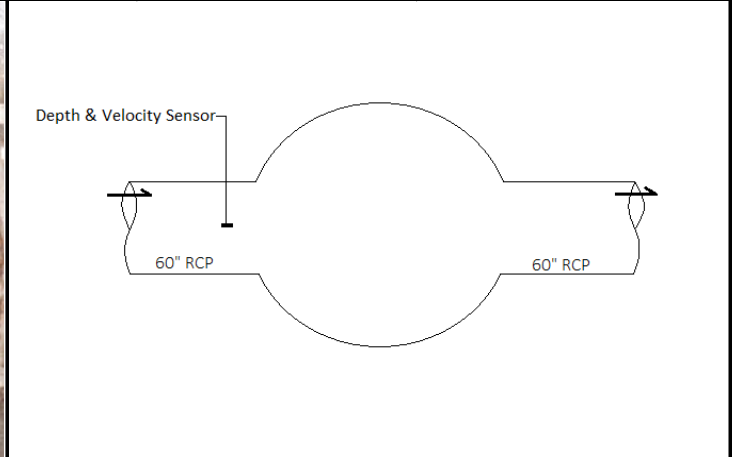


METER SITE INFORMATION FIELD LOG

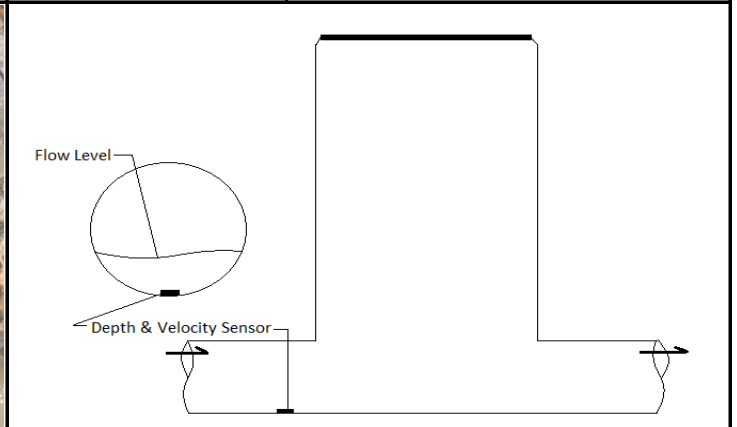
PROJECT: Norwalk, CT	DATE: March 16, 2021	JOB#: 21026
LOCATION: 148 East Avenue	MH#:	METER SITE: 25
GPS/COMMENTS: 41.109357, -73.409683		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	60	RCP	16.5	5	Circular	19' 08"
Incoming						
Incoming						
Outgoing	60	RCP	16.5	5	Circular	19' 09"



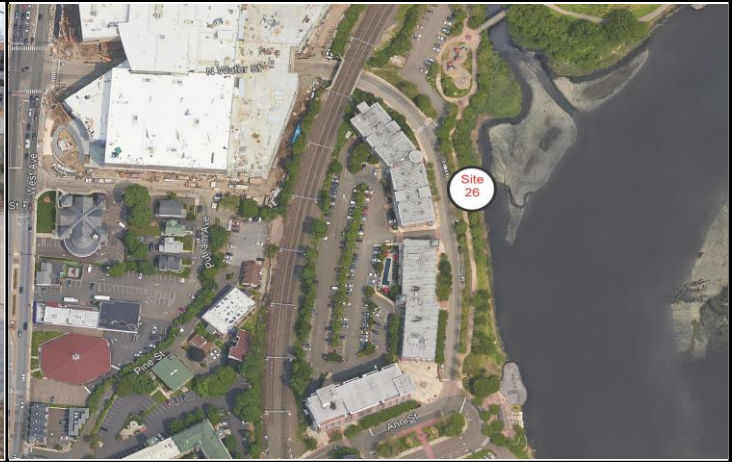
SURCHARGE INFORMATION		WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	LENGTH:	HEIGHT ABOVE WEIR:	
SURCHARGED MARKS TO: 11'	BREADTH:	OVERFLOW OCCURS AT:	
SURCHARGE CURRENTLY TO:	LEVEL:		



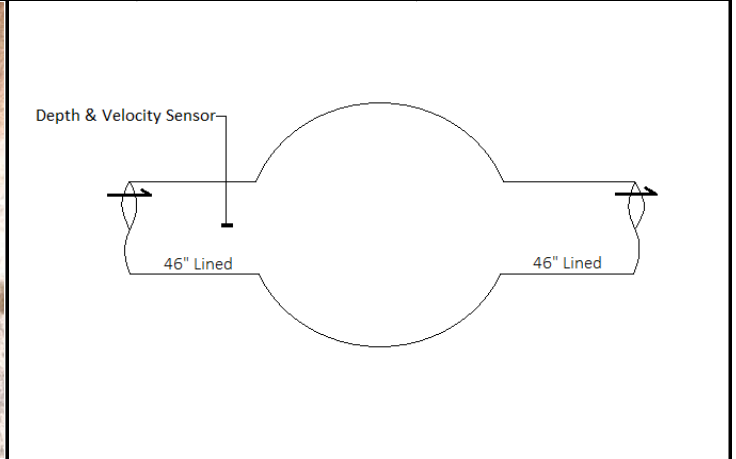


METER SITE INFORMATION FIELD LOG

PROJECT: Norwalk, CT	DATE: March 16, 2021	JOB#: 21026
LOCATION: 77 North Water Street	MH#:	METER SITE: 26
GPS/COMMENTS: 41.103611, -73.416712		

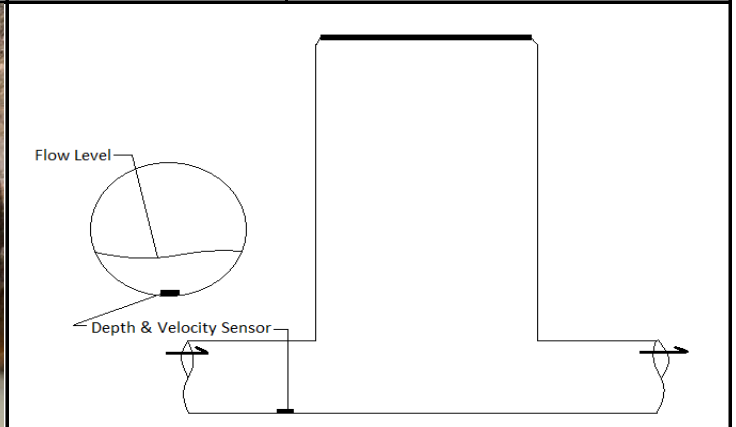


	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	46	Lined	15.5	0	Circular	20' 00"
Incoming						
Incoming						
Outgoing	46	Lined	15.5	0	Circular	20' 01"



SURCHARGE INFORMATION

SURCHARGE NONE EVIDENT:	LENGTH:	HEIGHT ABOVE WEIR:
SURCHARGED MARKS TO: 12'	BREADTH:	OVERFLOW OCCURS AT:
SURCHARGE CURRENTLY TO:	LEVEL:	



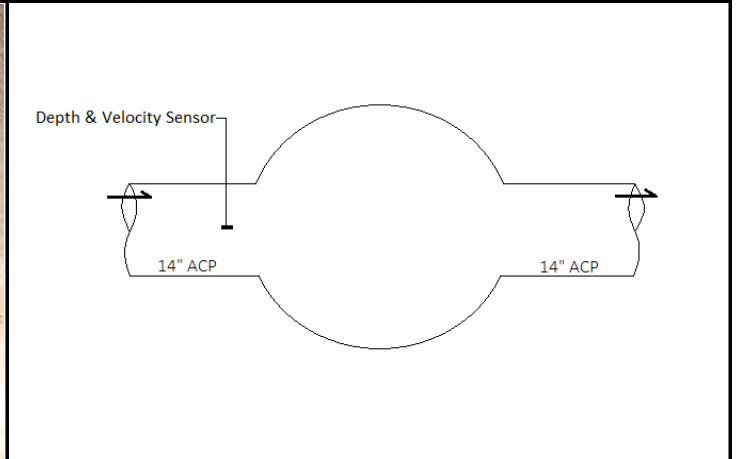


METER SITE INFORMATION FIELD LOG

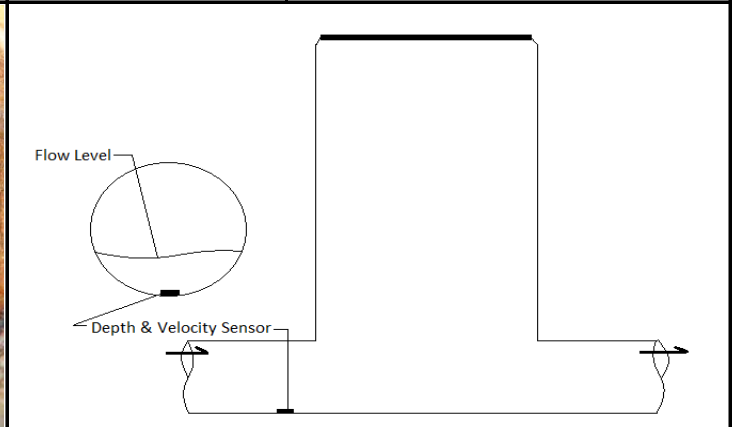
PROJECT: Norwalk, CT	DATE: March 11, 2021	JOB#: 21026
LOCATION: 69 Roton Avenue	MH#:	METER SITE: 27
GPS/COMMENTS: 41.061753, -73.441546		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	14	ACP	4	0.4	Circular	10' 11"
Incoming						
Incoming						
Outgoing	14	ACP	4	0.4	Circular	11' 00"



SURCHARGE INFORMATION		WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	LENGTH:	HEIGHT ABOVE WEIR:	
SURCHARGED MARKS TO: 3'	BREADTH:	OVERFLOW OCCURS AT:	
SURCHARGE CURRENTLY TO:	LEVEL:		



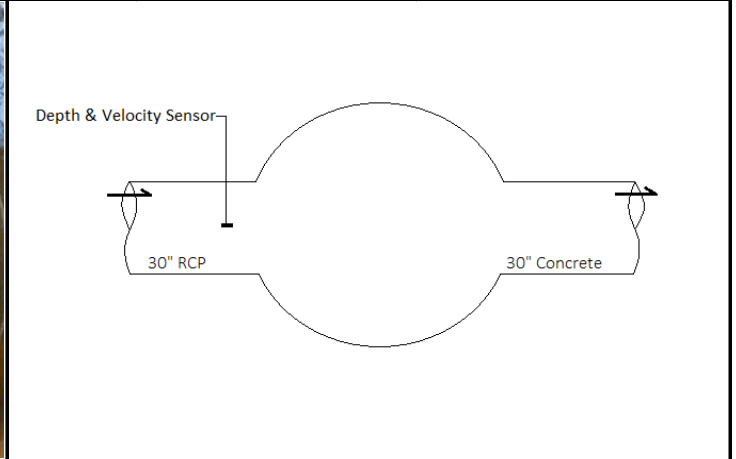


METER SITE INFORMATION FIELD LOG

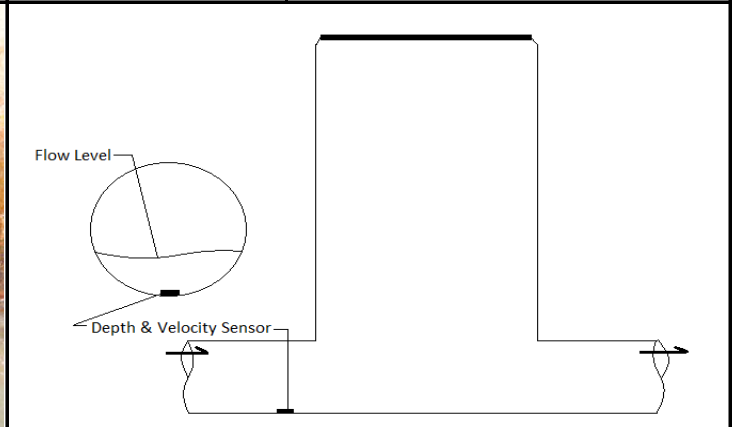
PROJECT: Norwalk, CT	DATE: March 11, 2021	JOB#: 21026
LOCATION: Wilson Avenue at Gray Rock Road	MH#:	METER SITE: 28
GPS/COMMENTS: 41.078689, -73.424029		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	30	RCP	10	0	Circular	10' 00"
Incoming						
Incoming						
Outgoing	30	Concrete	10	0	Circular	10' 01"



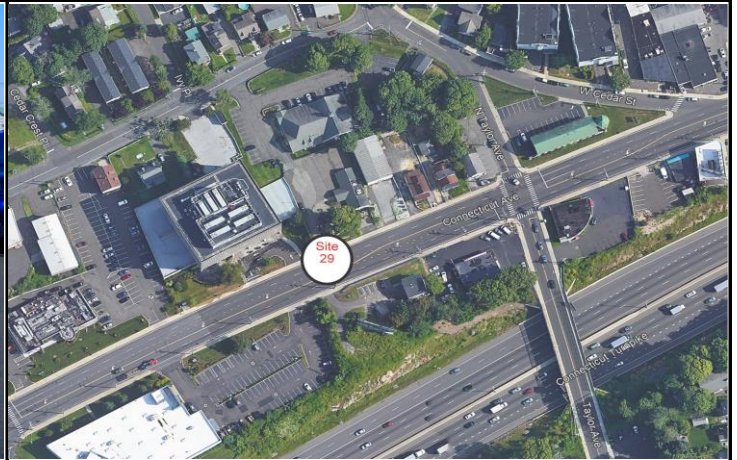
SURCHARGE INFORMATION		WEIR INFORMATION	
SURCHARGE NONE EVIDENT:	LENGTH:	HEIGHT ABOVE WEIR:	
SURCHARGED MARKS TO: 5'	BREADTH:	OVERFLOW OCCURS AT:	
SURCHARGE CURRENTLY TO:	LEVEL:		



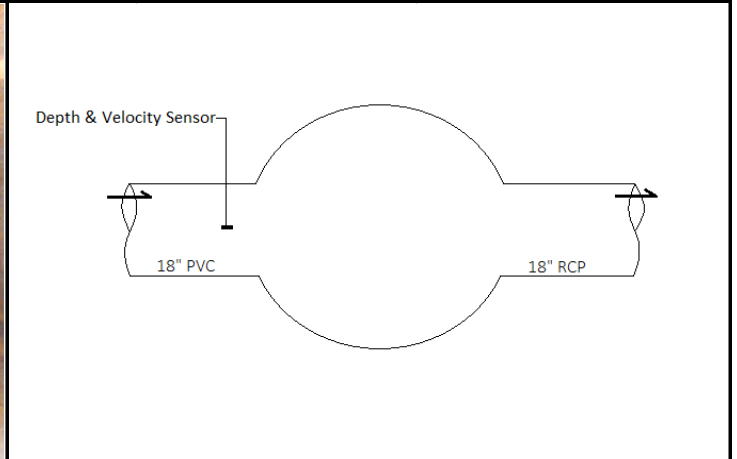


METER SITE INFORMATION FIELD LOG

PROJECT: Norwalk, CT	DATE: March 11, 2021	JOB#: 21026
LOCATION: 178 Connecticut Avenue	MH#:	METER SITE: 29
GPS/COMMENTS: 41.104447, -73.431477		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	18	PVC	11.5	0	Circular	13' 00"
Incoming						
Incoming						
Outgoing	18	RCP	11.5	0	Circular	13' 01"

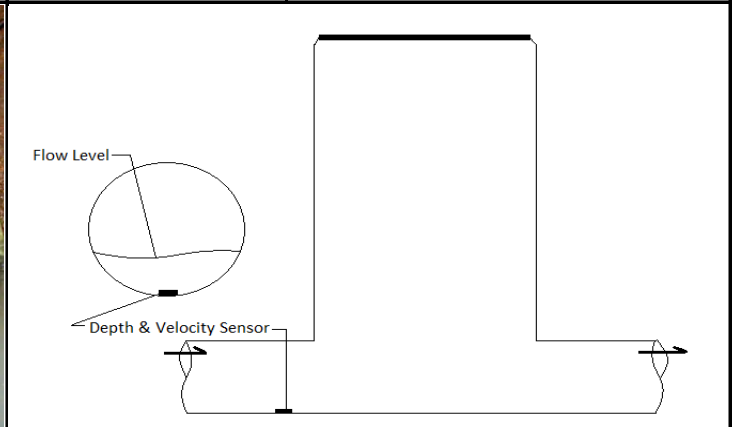


SURCHARGE INFORMATION

SURCHARGE NONE EVIDENT: X
SURCHARGED MARKS TO:
SURCHARGE CURRENTLY TO:

WEIR INFORMATION

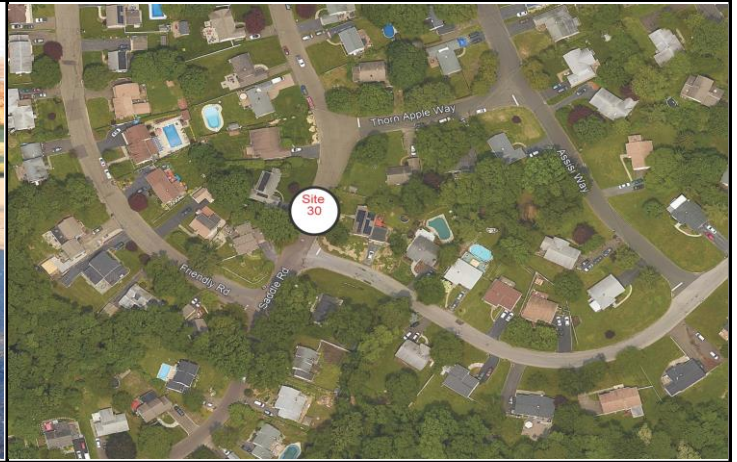
LENGTH:	HEIGHT ABOVE WEIR:
BREADTH:	OVERFLOW OCCURS AT:
LEVEL:	



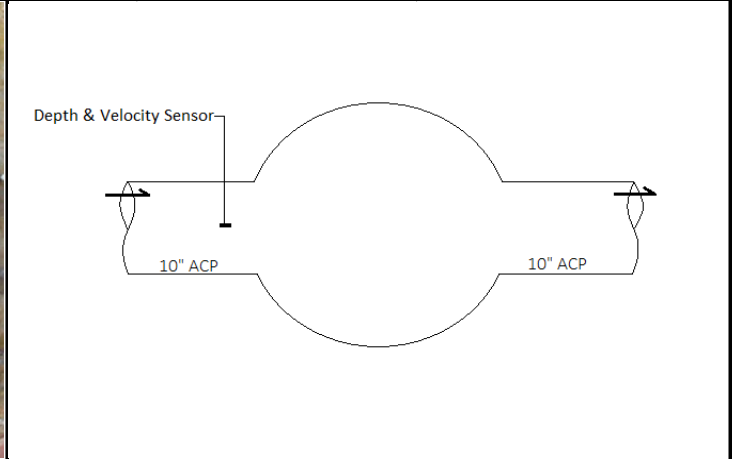


METER SITE INFORMATION FIELD LOG

PROJECT: Norwalk, CT	DATE: March 9, 2021	JOB#: 21026
LOCATION: 40 Saddle Road	MH#:	METER SITE: 30
GPS/COMMENTS: 41.130283, -73.395100		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	10	ACP	6.2	2	Circular	06' 07"
Incoming						
Incoming						
Outgoing	10	ACP	6.2	2	Circular	06' 08"

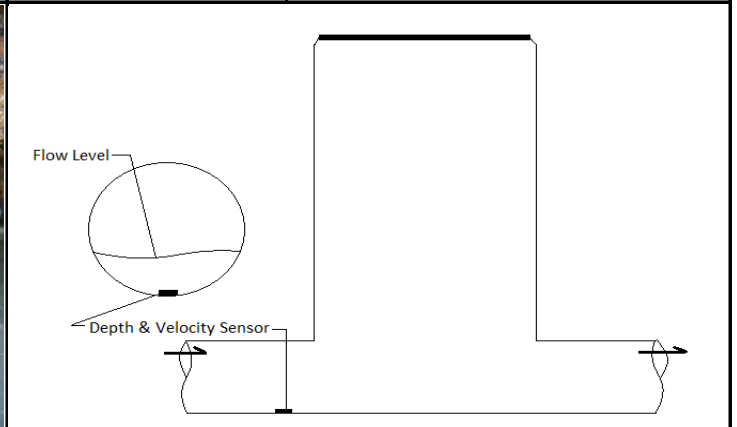


SURCHARGE INFORMATION

SURCHARGE NONE EVIDENT: X
SURCHARGED MARKS TO:
SURCHARGE CURRENTLY TO:

WEIR INFORMATION

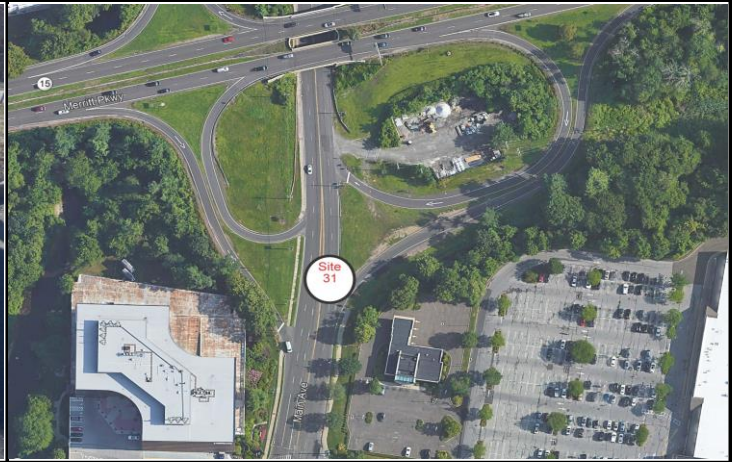
LENGTH:	HEIGHT ABOVE WEIR:
BREADTH:	OVERFLOW OCCURS AT:
LEVEL:	



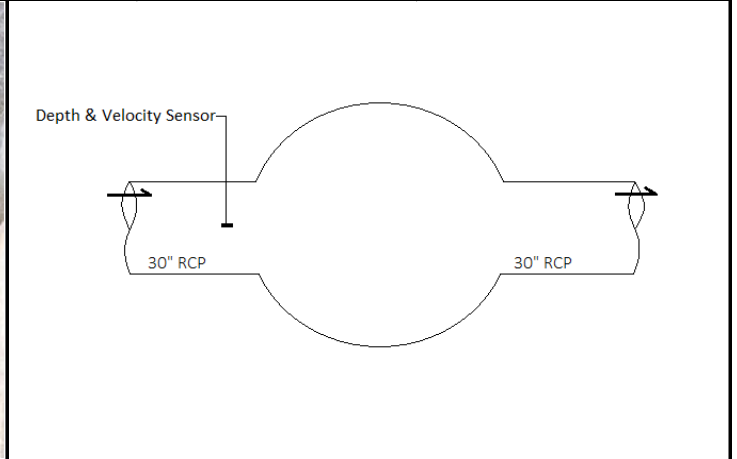


METER SITE INFORMATION FIELD LOG

PROJECT: Norwalk, CT	DATE: March 10, 2021	JOB#: 21026
LOCATION: Main Avenue near on ramp	MH#:	METER SITE: 31
GPS/COMMENTS: 41.141555, -73.425640		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	30	RCP	8	2.5	Circular	16' 01"
Incoming						
Incoming						
Outgoing	30	RCP	8	2.5	Circular	16' 02"

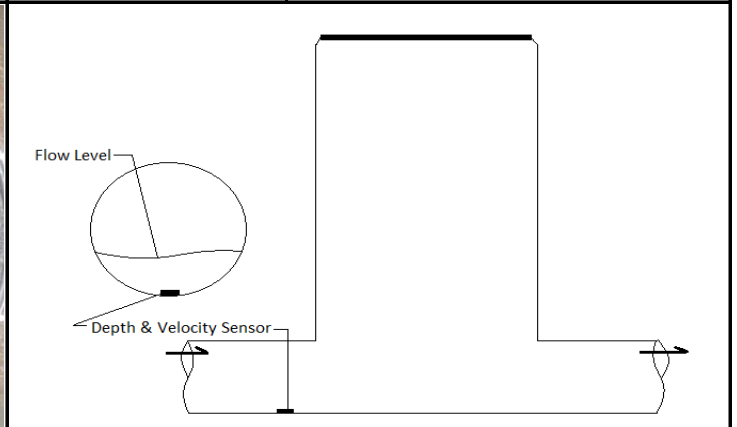


SURCHARGE INFORMATION

SURCHARGE NONE EVIDENT: X
SURCHARGED MARKS TO:
SURCHARGE CURRENTLY TO:

WEIR INFORMATION

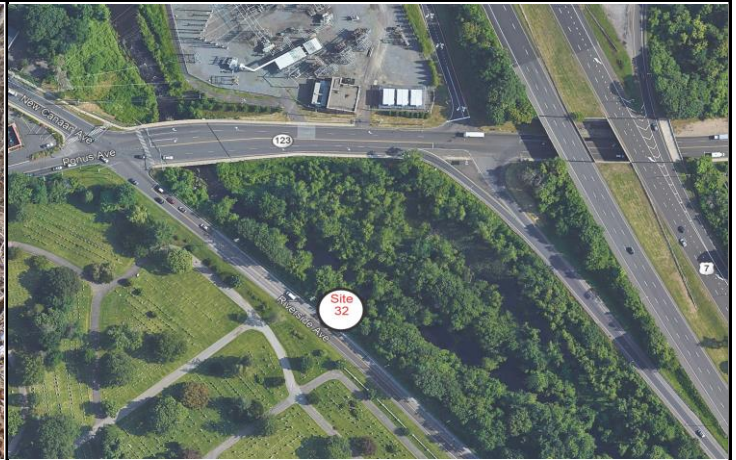
LENGTH:	HEIGHT ABOVE WEIR:
BREADTH:	OVERFLOW OCCURS AT:
LEVEL:	



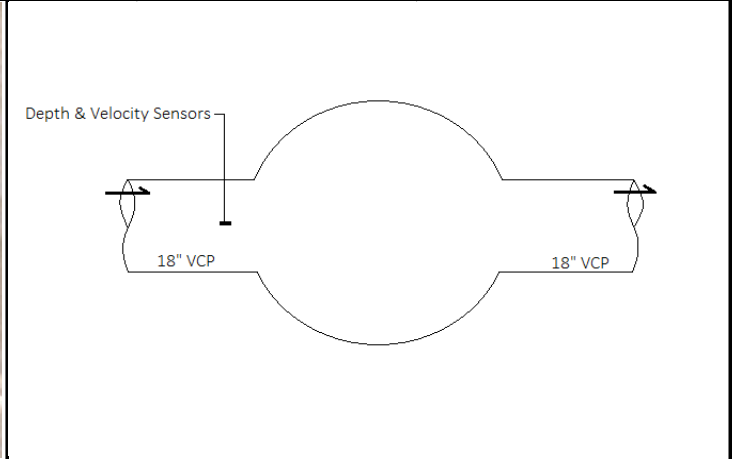


METER SITE INFORMATION FIELD LOG

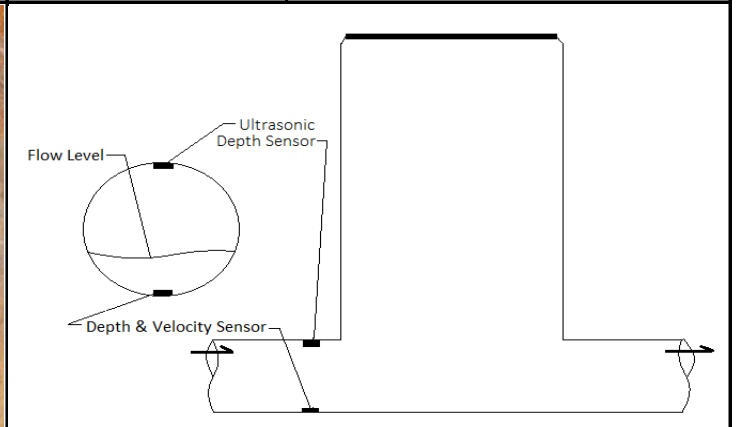
PROJECT: Norwalk, CT	DATE: March 10, 2021	JOB#: 21026
LOCATION: Riverside Avenue R.O.W.	MH#:	METER SITE: 32
GPS/COMMENTS: 41.125394, -73.428150		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	18	VCP	4	0	Circular	10' 04"
Incoming						
Incoming						
Outgoing	18	VCP	4	0	Circular	10' 11"



SURCHARGE INFORMATION		WEIR INFORMATION	
SURCHARGE NONE EVIDENT: X	LENGTH:	HEIGHT ABOVE WEIR:	
SURCHARGED MARKS TO:	BREADTH:	OVERFLOW OCCURS AT:	
SURCHARGE CURRENTLY TO:	LEVEL:		



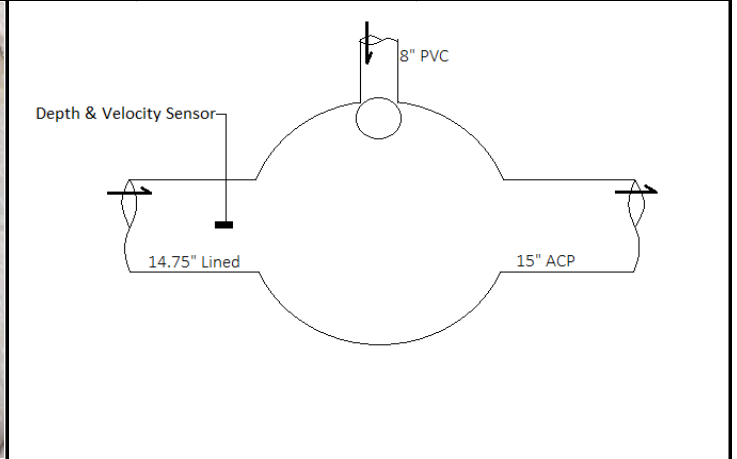


METER SITE INFORMATION FIELD LOG

PROJECT: Norwalk, CT	DATE: March 10, 2021	JOB#: 21026
LOCATION: 109 Strawberry Hill Avenue	MH#:	METER SITE: 33
GPS/COMMENTS: 41.112126, -73.398626		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	14.75	Lined	4	0	Circular	10' 00"
Incoming	8	PVC	0	0	Circular	04' 07"
Incoming						
Outgoing	15	ACP	4	0	Circular	10' 01"

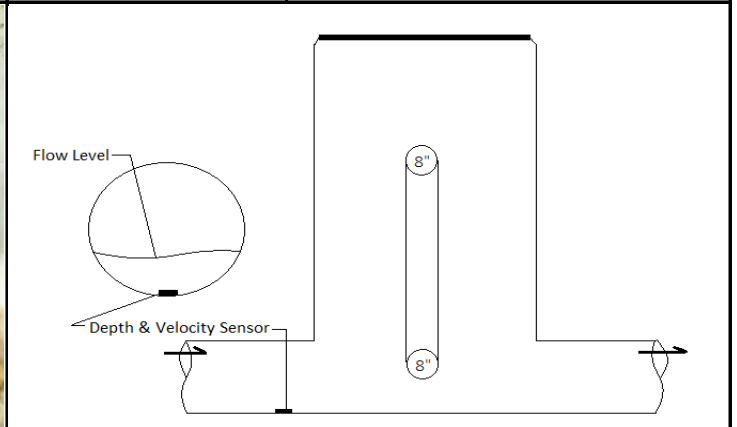


SURCHARGE INFORMATION

SURCHARGE NONE EVIDENT: X
SURCHARGED MARKS TO:
SURCHARGE CURRENTLY TO:

WEIR INFORMATION

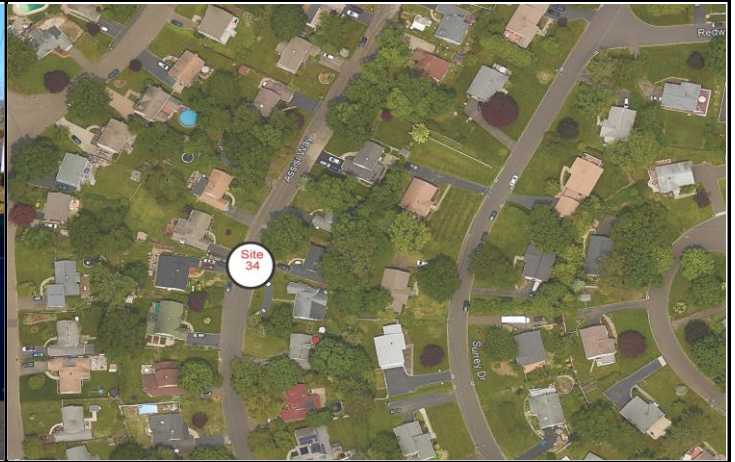
LENGTH:	HEIGHT ABOVE WEIR:
BREADTH:	OVERFLOW OCCURS AT:
LEVEL:	



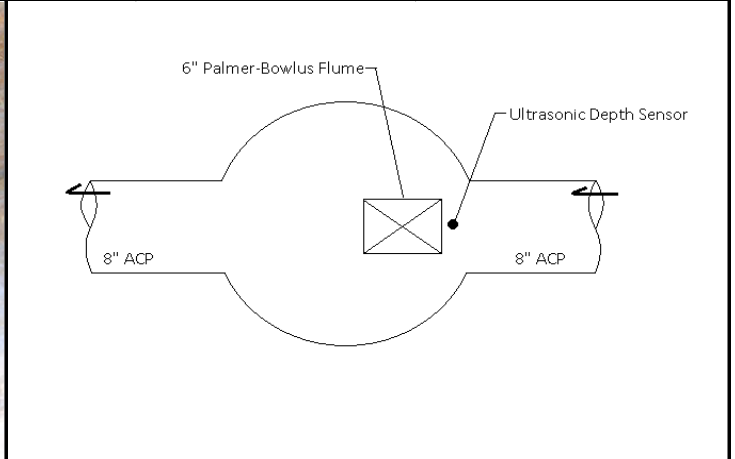


METER SITE INFORMATION FIELD LOG

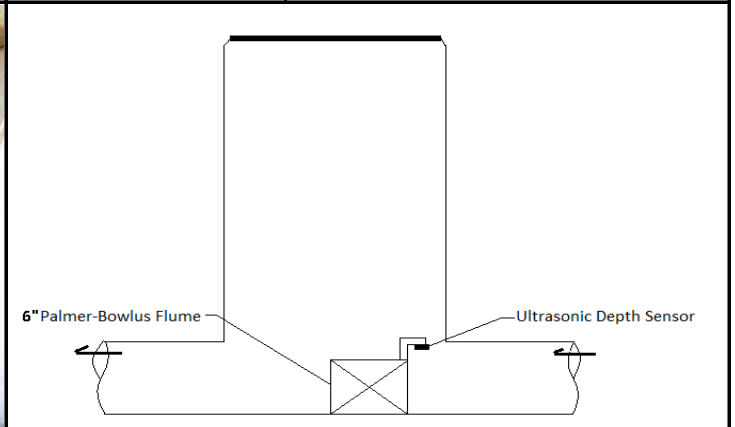
PROJECT: Norwalk, CT	DATE: March 9, 2021	JOB#: 21026
LOCATION: 29 Assisi Way	MH#:	METER SITE: 34
GPS/COMMENTS: 41.132030, -73.394164		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	8	ACP	2	0	Circular	06' 06"
Incoming						
Incoming						
Outgoing	8	ACP	2	0	Circular	06' 07"



SURCHARGE INFORMATION		WEIR INFORMATION	
SURCHARGE NONE EVIDENT: X	LENGTH:	HEIGHT ABOVE WEIR:	
SURCHARGED MARKS TO:	BREADTH:	OVERFLOW OCCURS AT:	
SURCHARGE CURRENTLY TO:	LEVEL:		



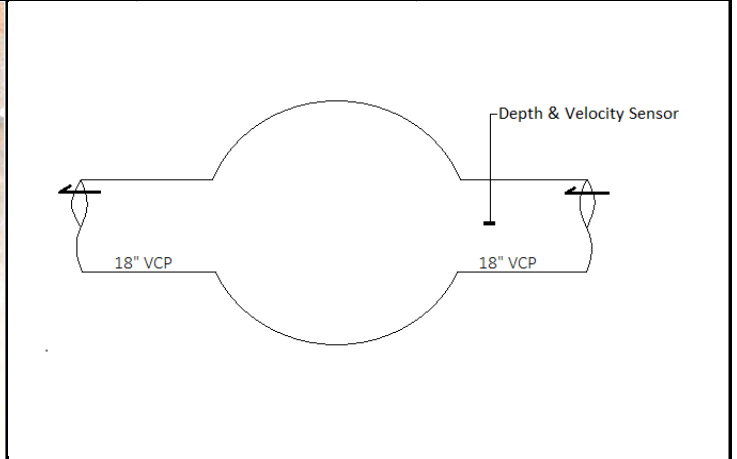


METER SITE INFORMATION FIELD LOG

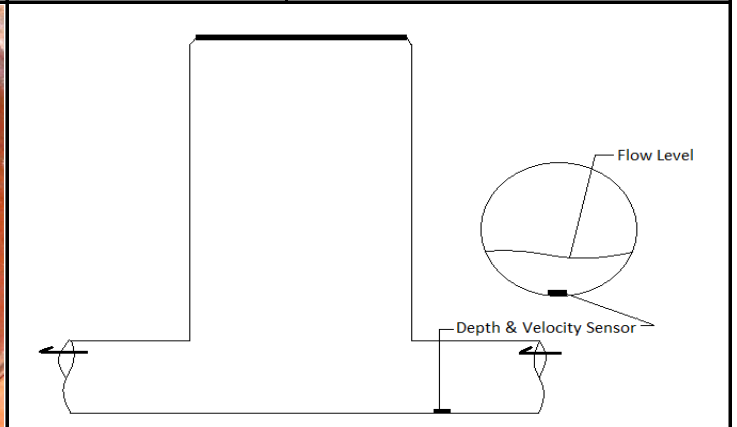
PROJECT: Norwalk, CT	DATE: March 10, 2021	JOB#: 21026
LOCATION: 2 Knight Street	MH#:	METER SITE: 35
GPS/COMMENTS: 41.118689, -73.411099		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	18	VCP	2	0	Circular	06' 02"
Incoming						
Incoming						
Outgoing	18	VCP	2	0	Circular	06' 03"



SURCHARGE INFORMATION		WEIR INFORMATION	
SURCHARGE NONE EVIDENT: X	LENGTH:	HEIGHT ABOVE WEIR:	
SURCHARGED MARKS TO:	BREADTH:	OVERFLOW OCCURS AT:	
SURCHARGE CURRENTLY TO:	LEVEL:		



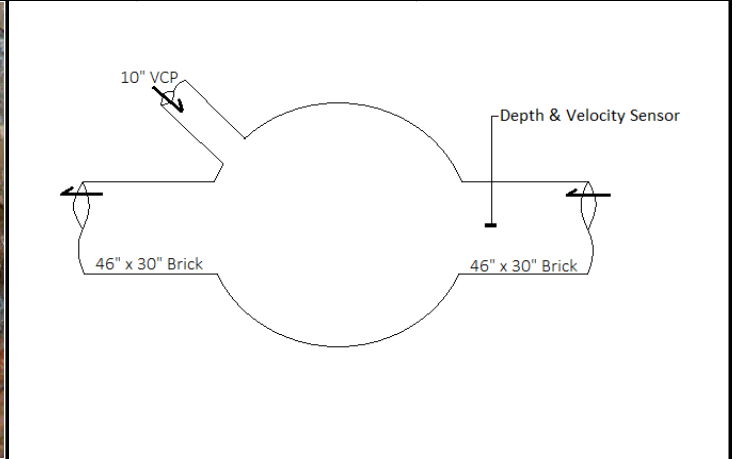


METER SITE INFORMATION FIELD LOG

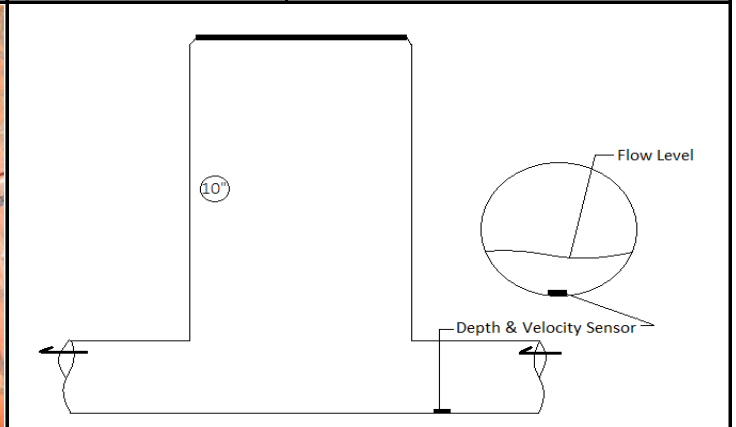
PROJECT: Norwalk, CT	DATE: March 10, 2021	JOB#: 21026
LOCATION: 5 East Wall Street	MH#:	METER SITE: 36
GPS/COMMENTS: 41.117864, -73.409162		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	46x30	Brick	11.5	0	Elliptical	10' 10"
Incoming	10	VCP	0	0	Circular	03' 09"
Incoming						
Outgoing	46x30	Brick	11.5	0	Elliptical	10' 10"



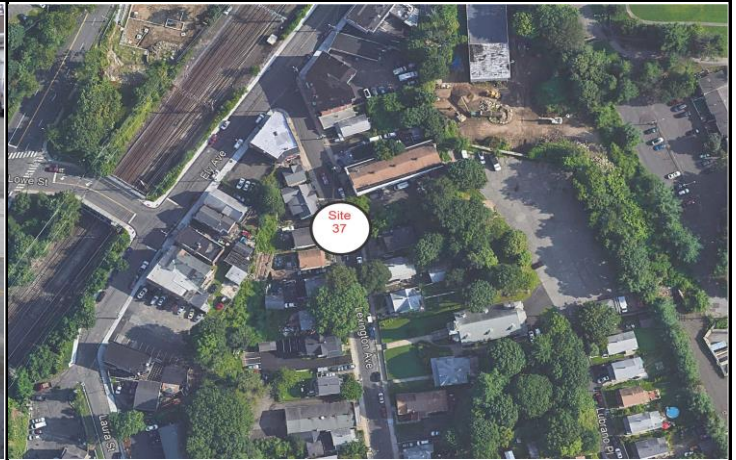
SURCHARGE INFORMATION		WEIR INFORMATION	
SURCHARGE NONE EVIDENT: X	LENGTH:	HEIGHT ABOVE WEIR:	
SURCHARGED MARKS TO:	BREADTH:	OVERFLOW OCCURS AT:	
SURCHARGE CURRENTLY TO:	LEVEL:		



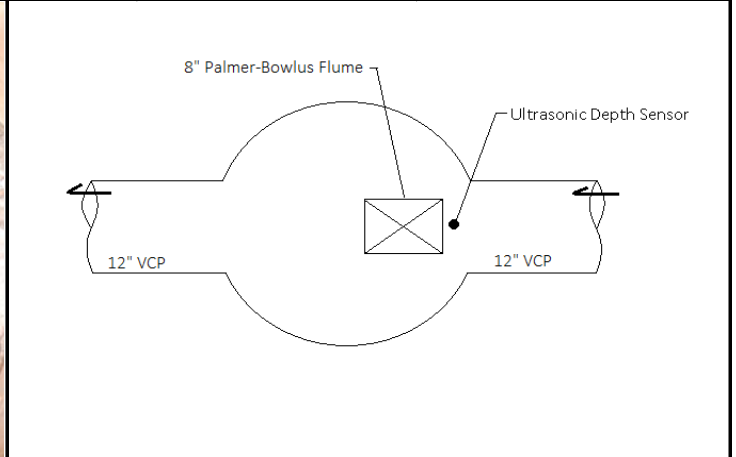


METER SITE INFORMATION FIELD LOG

PROJECT: Norwalk, CT	DATE: March 17, 2021	JOB#: 21026
LOCATION: 7 Lexington Avenue	MH#:	METER SITE: 37
GPS/COMMENTS: 41.0927611, -73.4234467		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	12	VCP	2	0	Circular	05' 11"
Incoming						
Incoming						
Outgoing	12	VCP	2	0	Circular	06' 00"

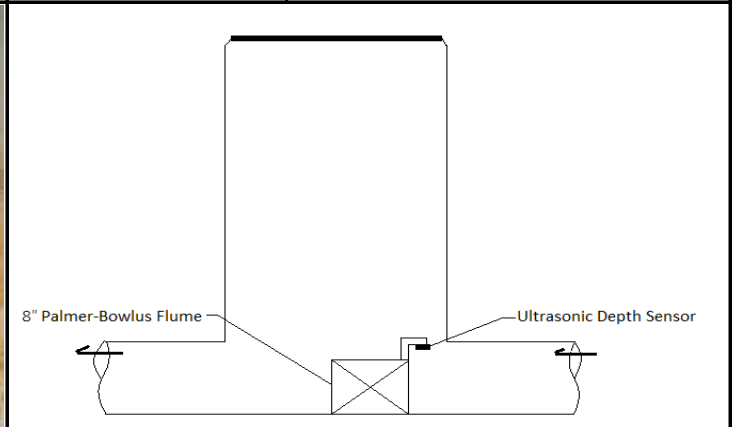


SURCHARGE INFORMATION

SURCHARGE NONE EVIDENT: X
SURCHARGED MARKS TO:
SURCHARGE CURRENTLY TO:

WEIR INFORMATION

LENGTH:	HEIGHT ABOVE WEIR:
BREADTH:	OVERFLOW OCCURS AT:
LEVEL:	



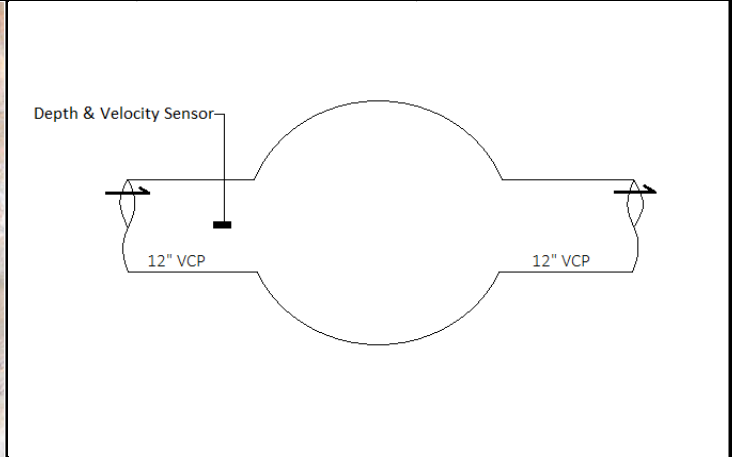


METER SITE INFORMATION FIELD LOG

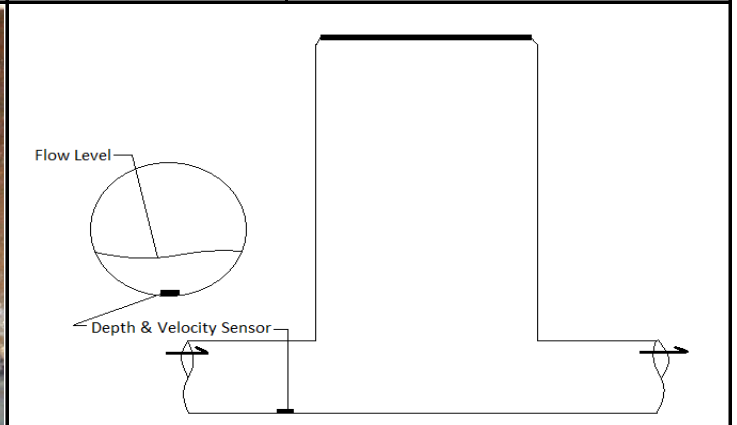
PROJECT: Norwalk, CT	DATE: March 11, 2021	JOB#: 21026
LOCATION: Franklin Street at Ely Avenue	MH#:	METER SITE: 38
GPS/COMMENTS: 41.093919, -73.423415		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	12	VCP	3	0	Circular	05' 06"
Incoming						
Incoming						
Outgoing	12	VCP	3	0	Circular	05' 07"



SURCHARGE INFORMATION		WEIR INFORMATION	
SURCHARGE NONE EVIDENT: X	LENGTH:	HEIGHT ABOVE WEIR:	
SURCHARGED MARKS TO:	BREADTH:	OVERFLOW OCCURS AT:	
SURCHARGE CURRENTLY TO:	LEVEL:		



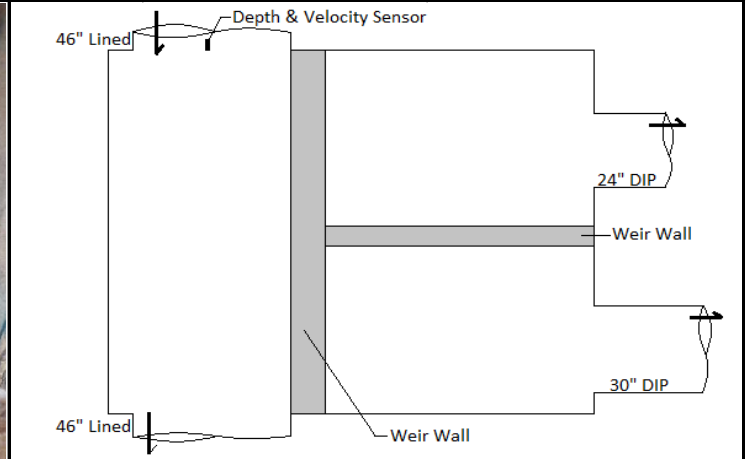


METER SITE INFORMATION FIELD LOG

PROJECT: Norwalk, CT	DATE: March 11, 2021	JOB#: 21026
LOCATION: 99 Commerce Street	MH#:	METER SITE: 39
GPS/COMMENTS: 41.114619, -73.410176		

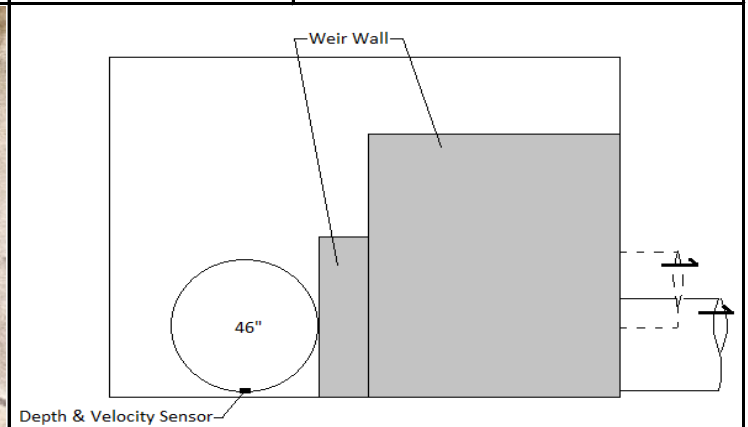


	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	46	Lined	9	0	Circular	
Outgoing	24	DIP	0	0	Circular	13' 00"
Outgoing	30	DIP	0.25	0	Circular	12' 08"
Outgoing	46	Lined	7	3	Circular	



SURCHARGE INFORMATION

SURCHARGE NONE EVIDENT: X	LENGTH: 16' 2"	HEIGHT ABOVE WEIR:
SURCHARGED MARKS TO:	BREADTH: 18"	OVERFLOW OCCURS AT: 29.5"
SURCHARGE CURRENTLY TO:	LEVEL: No	



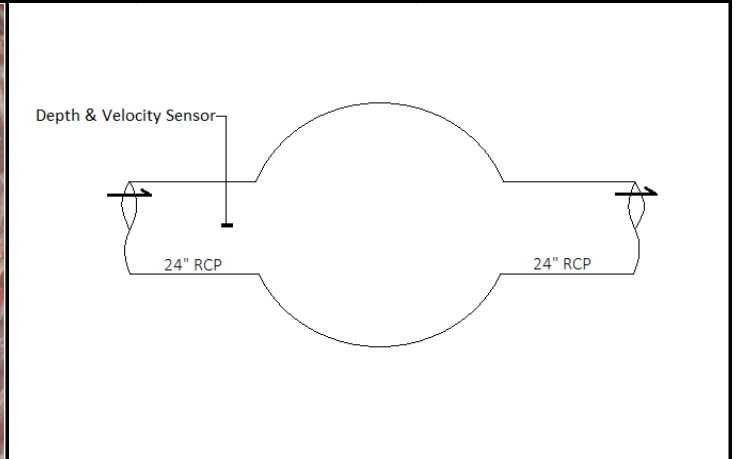


METER SITE INFORMATION FIELD LOG

PROJECT: Norwalk, CT	DATE: March 17, 2021	JOB#: 21026
LOCATION: Mulvoy Street at Henry Street (sidewalk)	MH#:	METER SITE: 40
GPS/COMMENTS: 41.0939122, -73.4224151		



	Size (")	Material	Flow Depth (")	Debris	Shape	MH Depth
Incoming	24	RCP	6.5	1.5	Circular	08' 04"
Incoming						
Incoming						
Outgoing	24	RCP	6.5	1.5	Circular	08' 05"

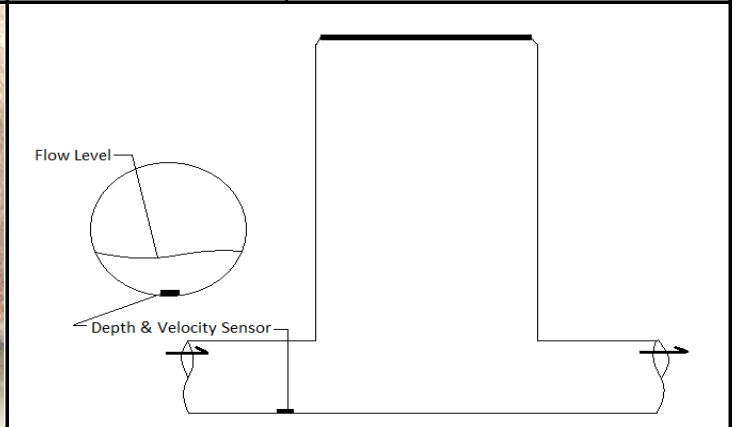


SURCHARGE INFORMATION

SURCHARGE NONE EVIDENT: X
SURCHARGED MARKS TO:
SURCHARGE CURRENTLY TO:

WEIR INFORMATION

LENGTH:	HEIGHT ABOVE WEIR:
BREADTH:	OVERFLOW OCCURS AT:
LEVEL:	

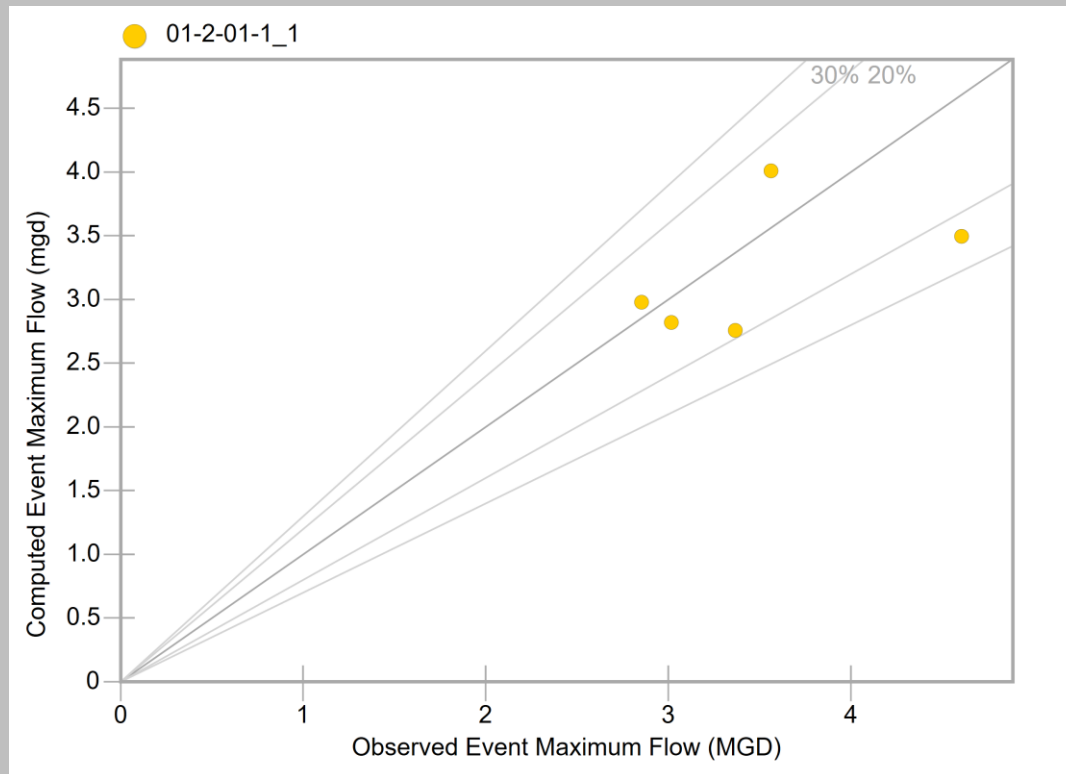


Appendix D: Hydraulic Model Calibration Plots

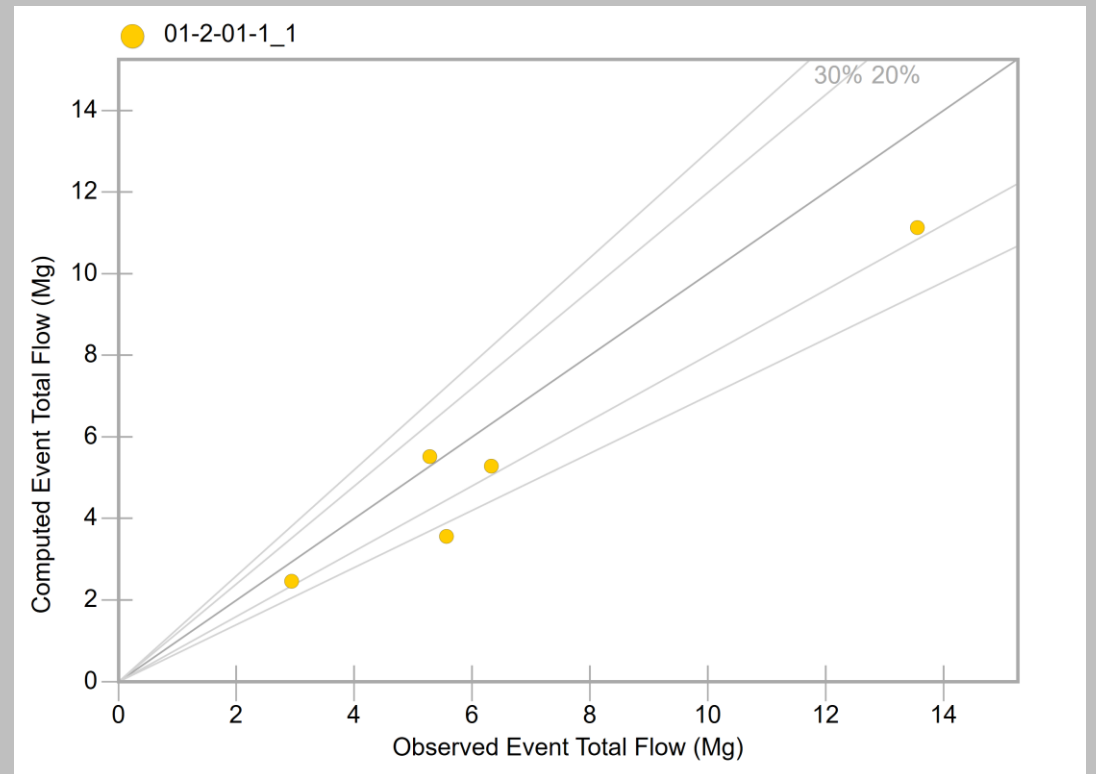


FM_01

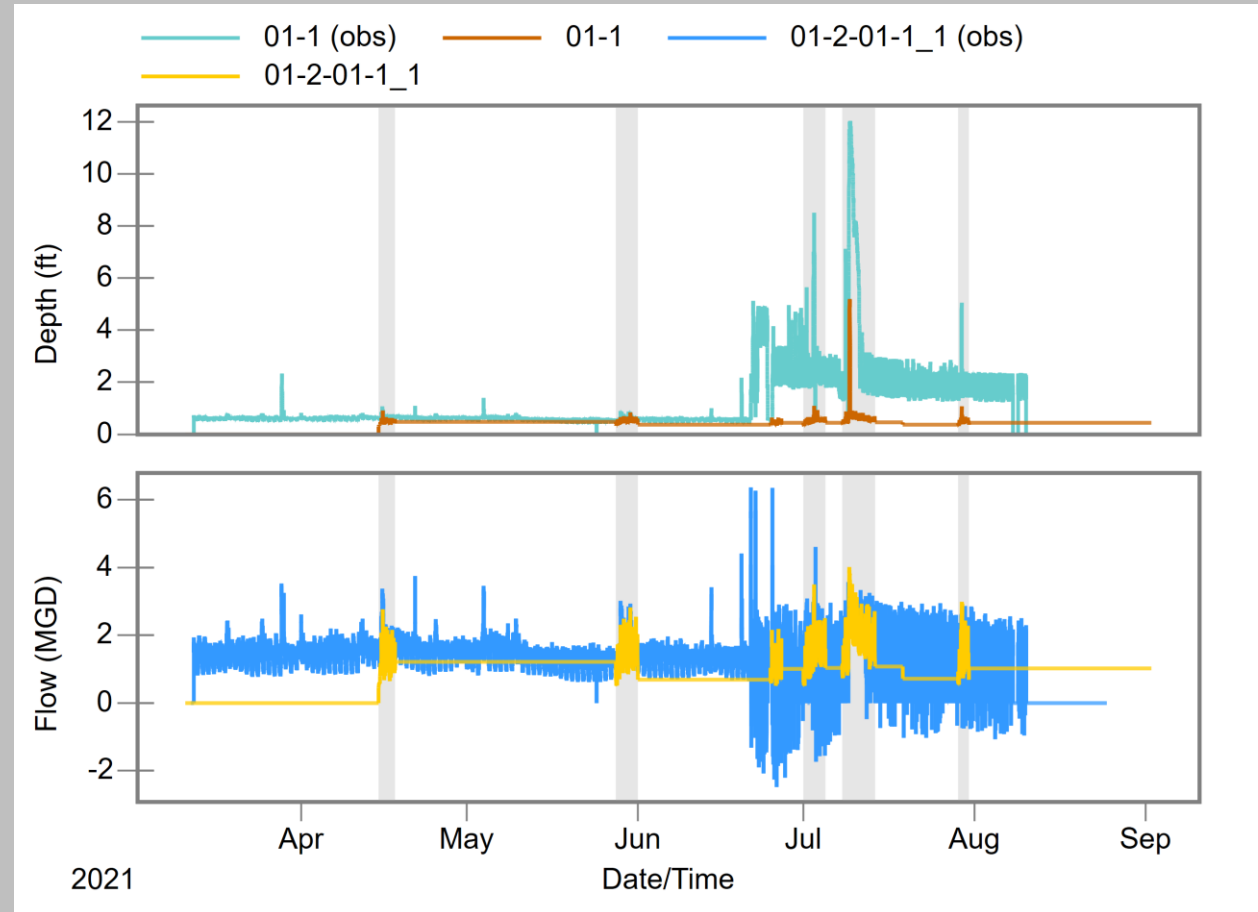
Peaks



Volumes

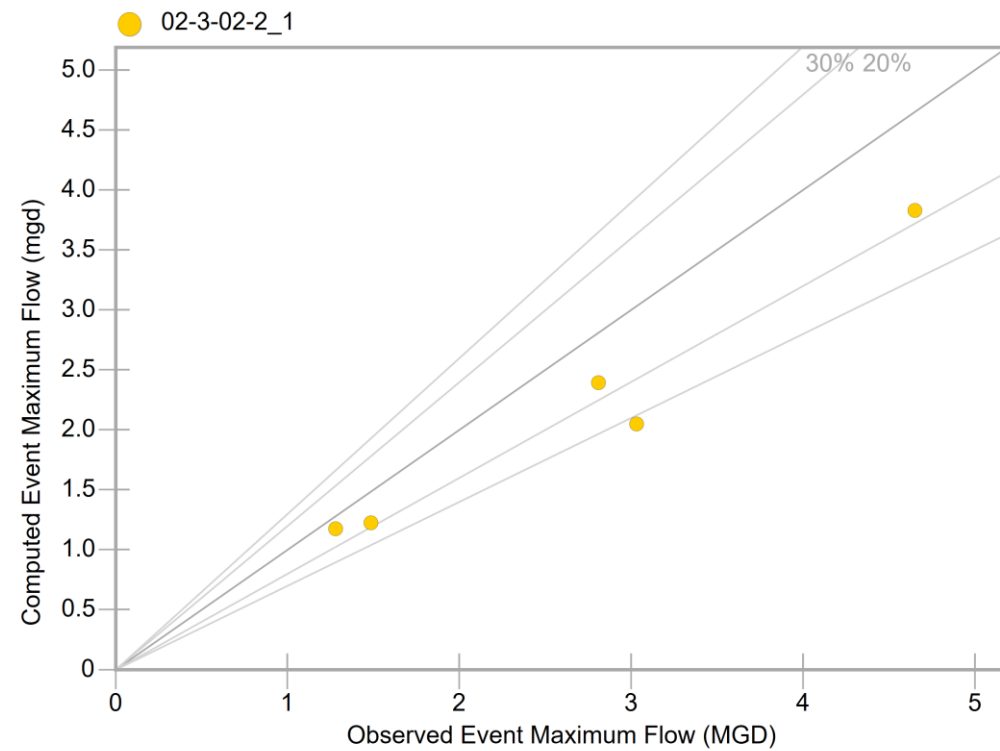


FM_01

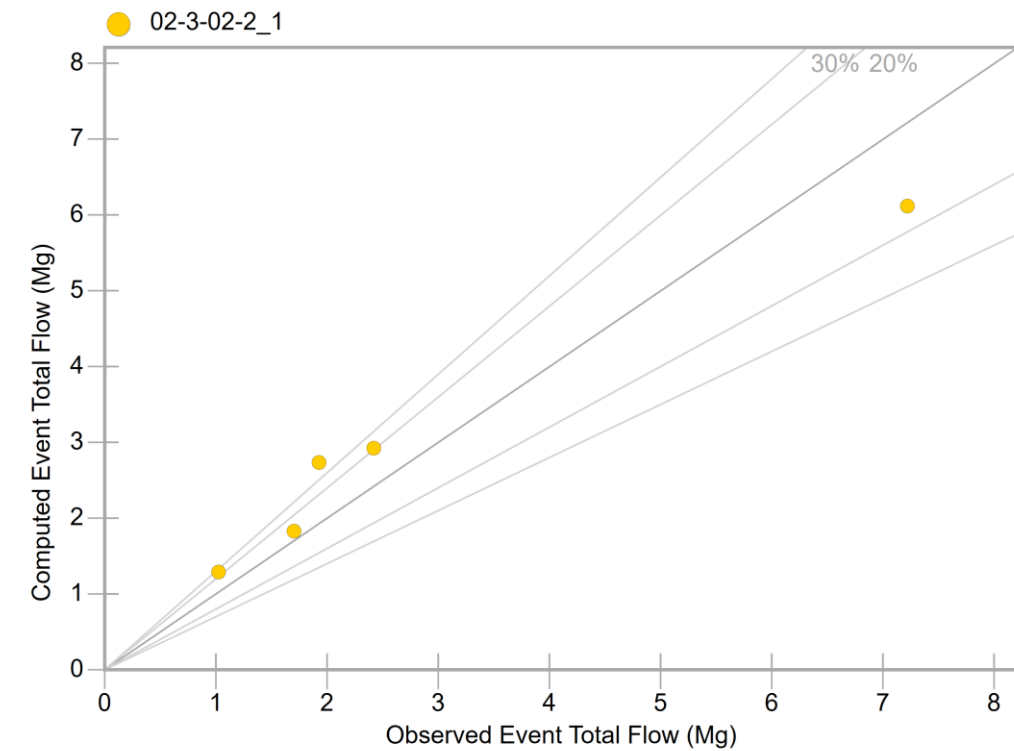


FM_02

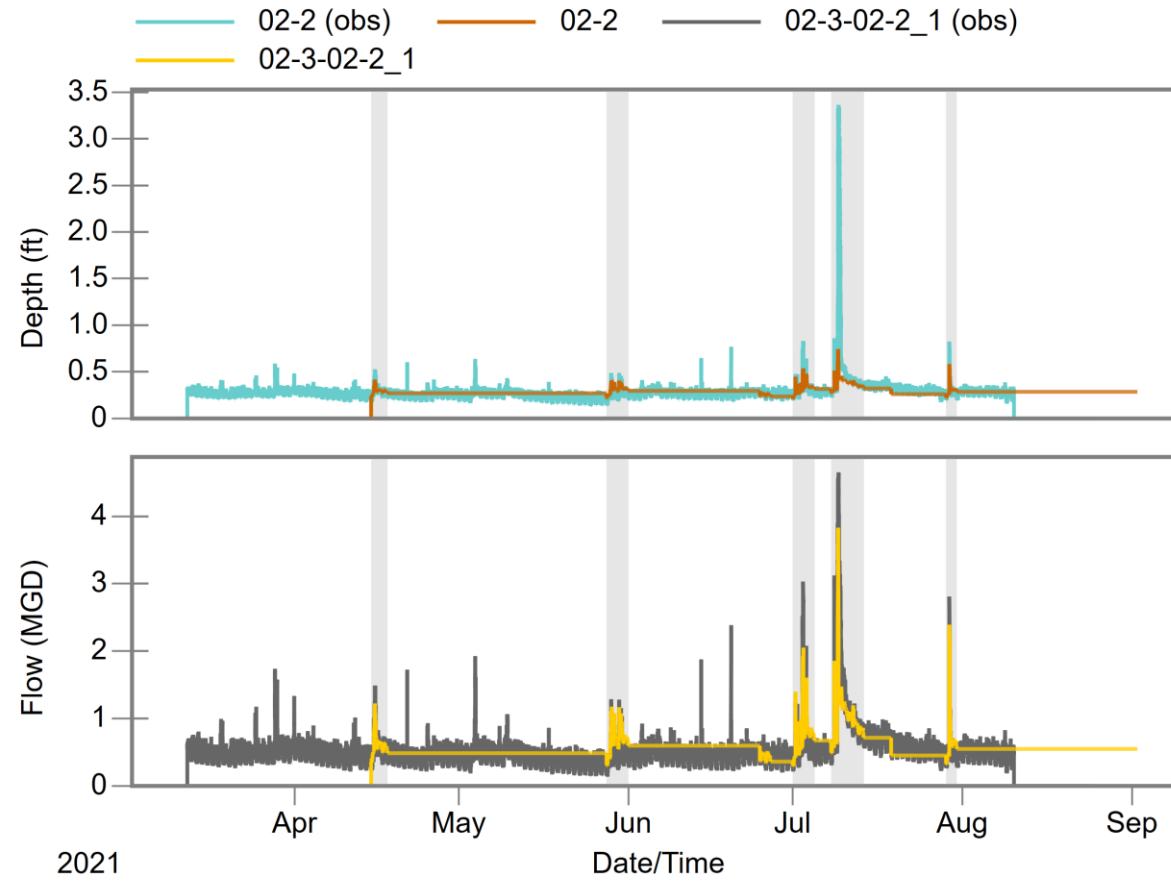
Peaks



Volumes

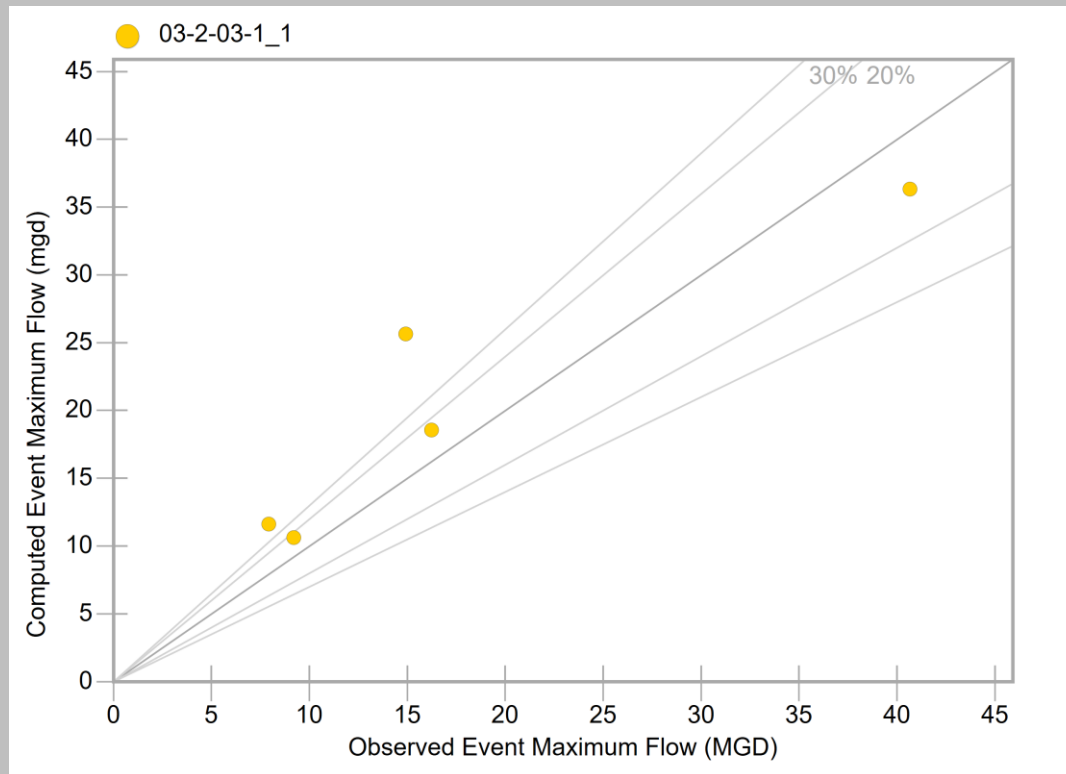


FM_02

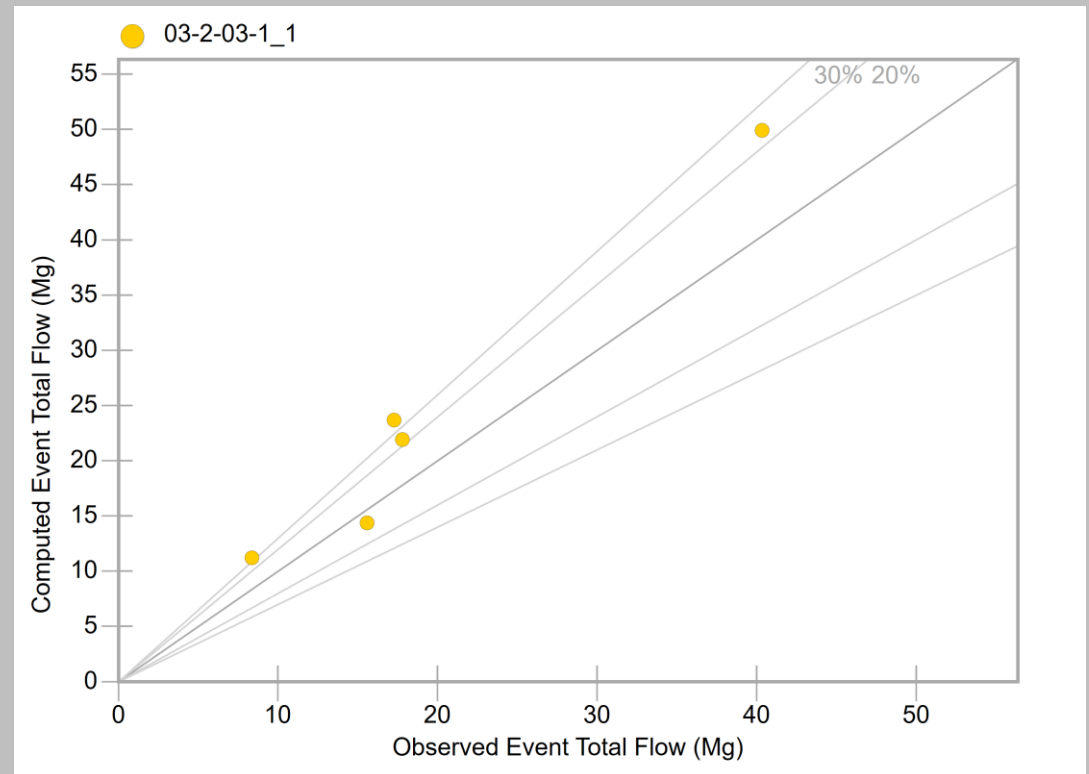


FM_03

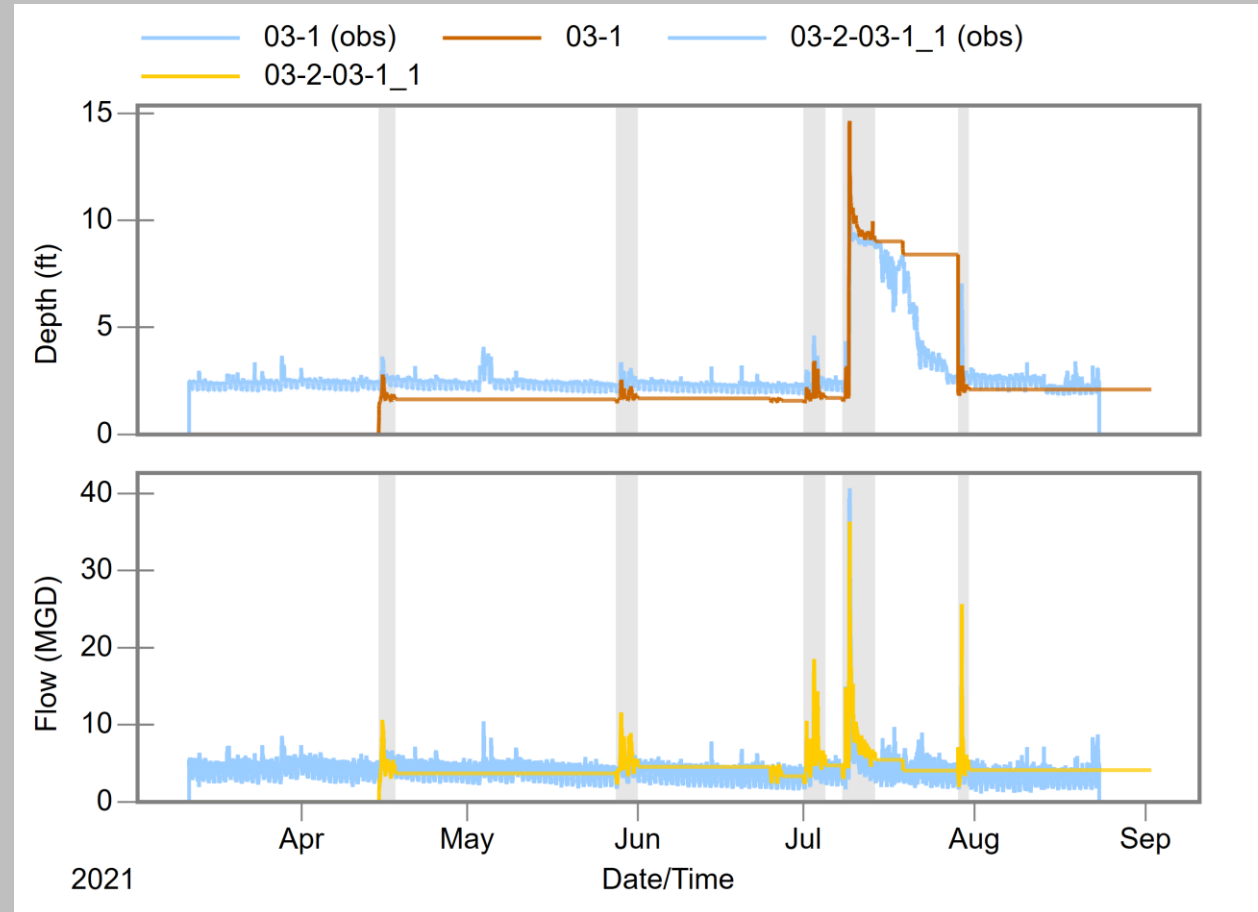
Peaks



Volumes

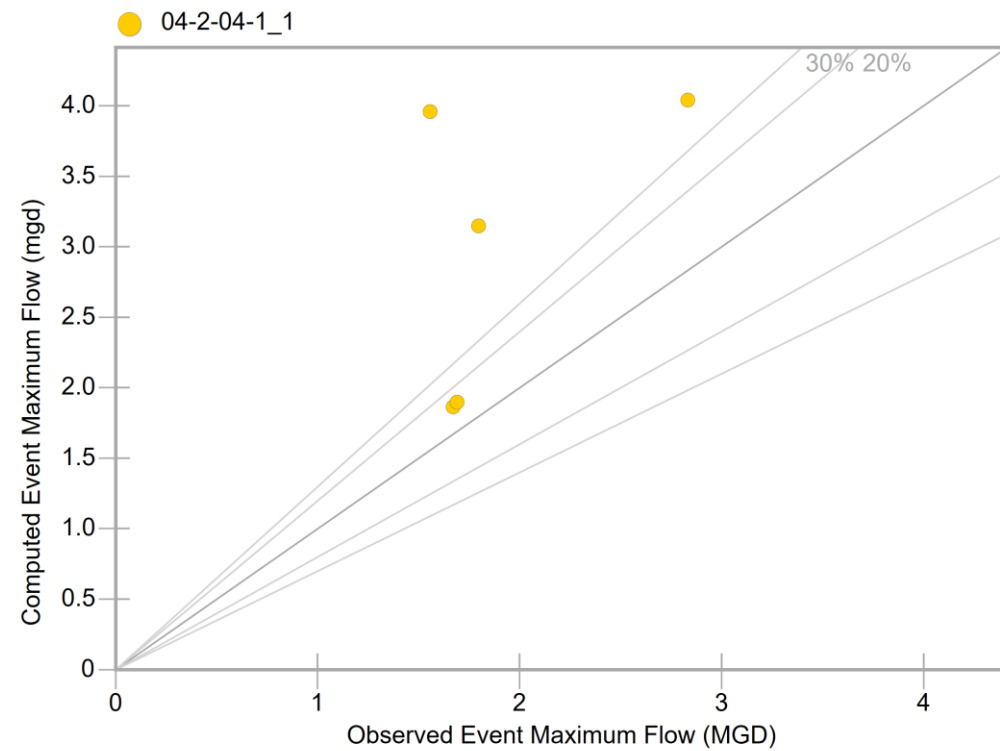


FM_03

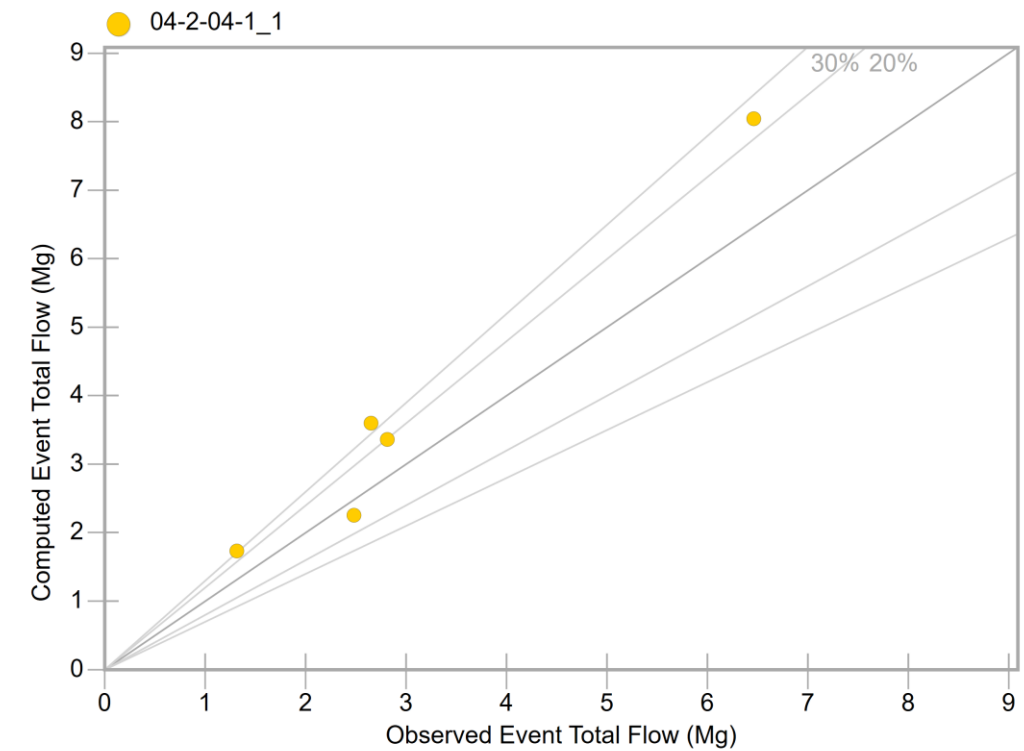


FM_04

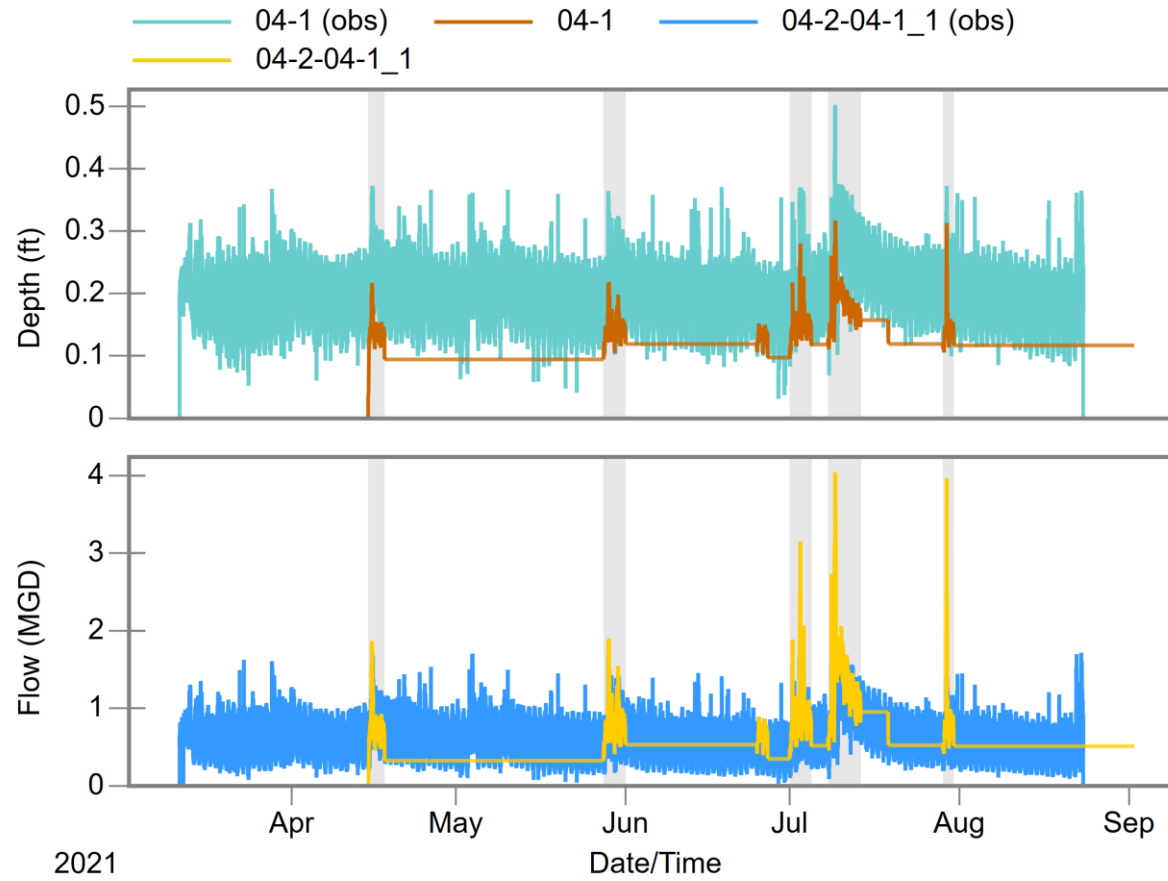
Peaks



Volumes

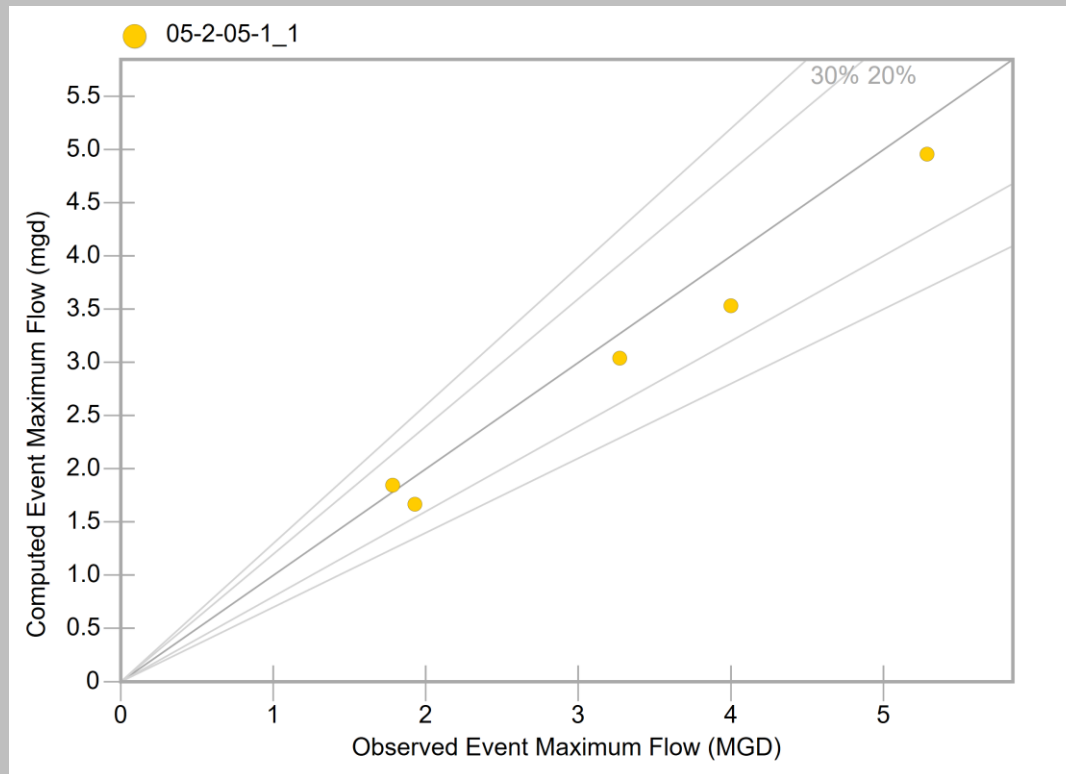


FM_04

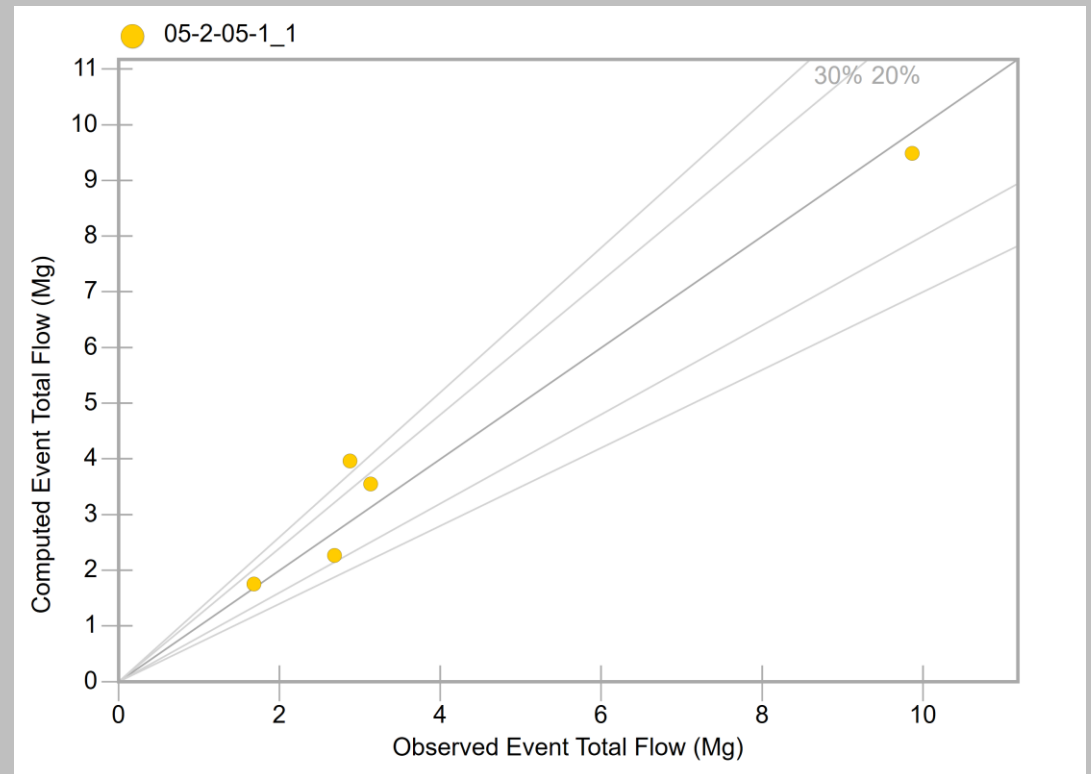


FM_05

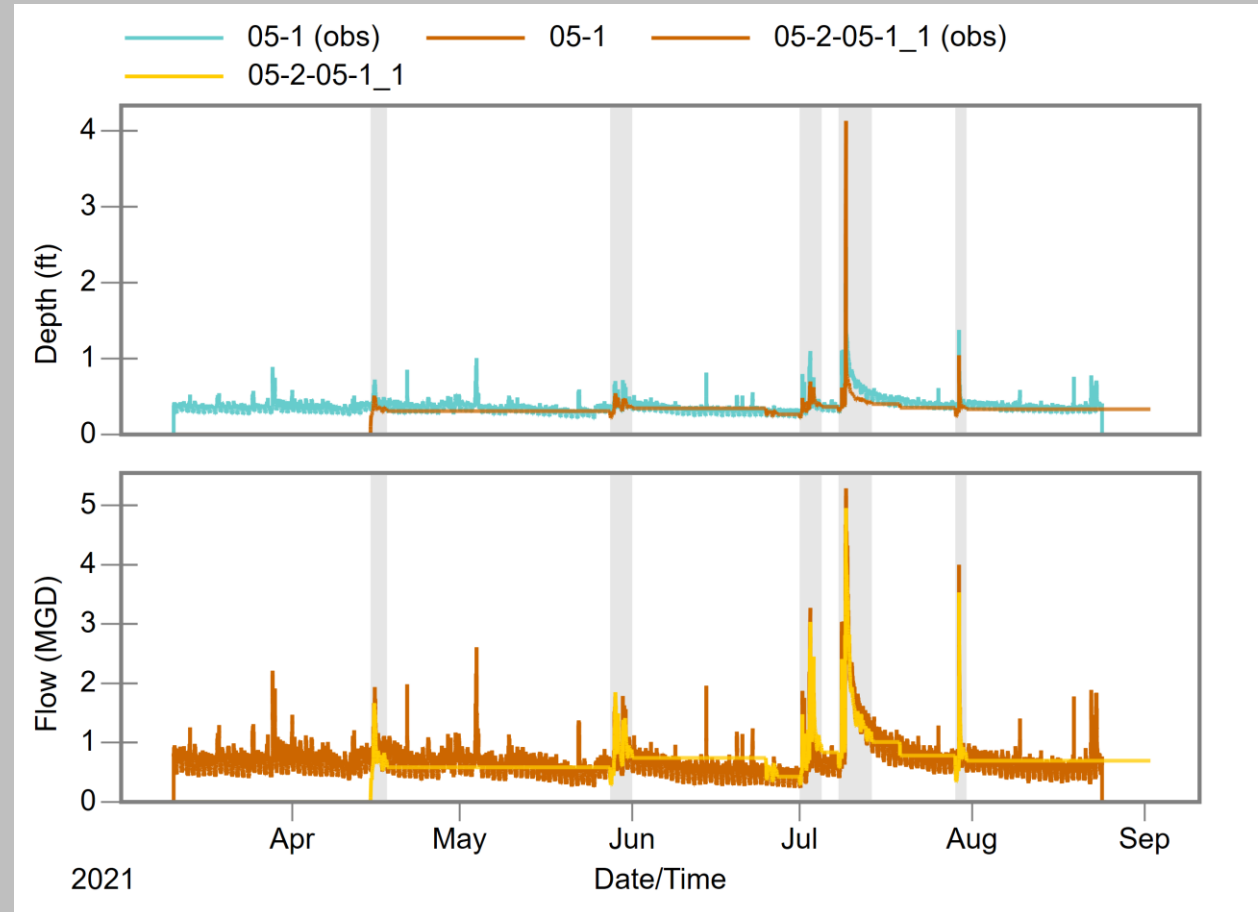
Peaks



Volumes

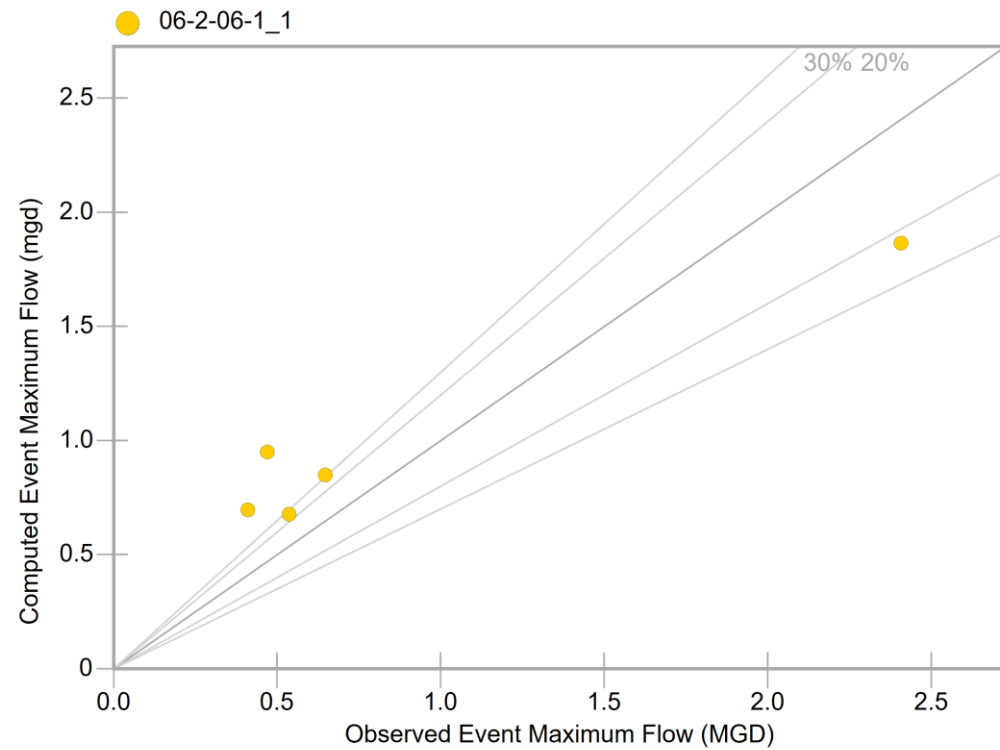


FM_05

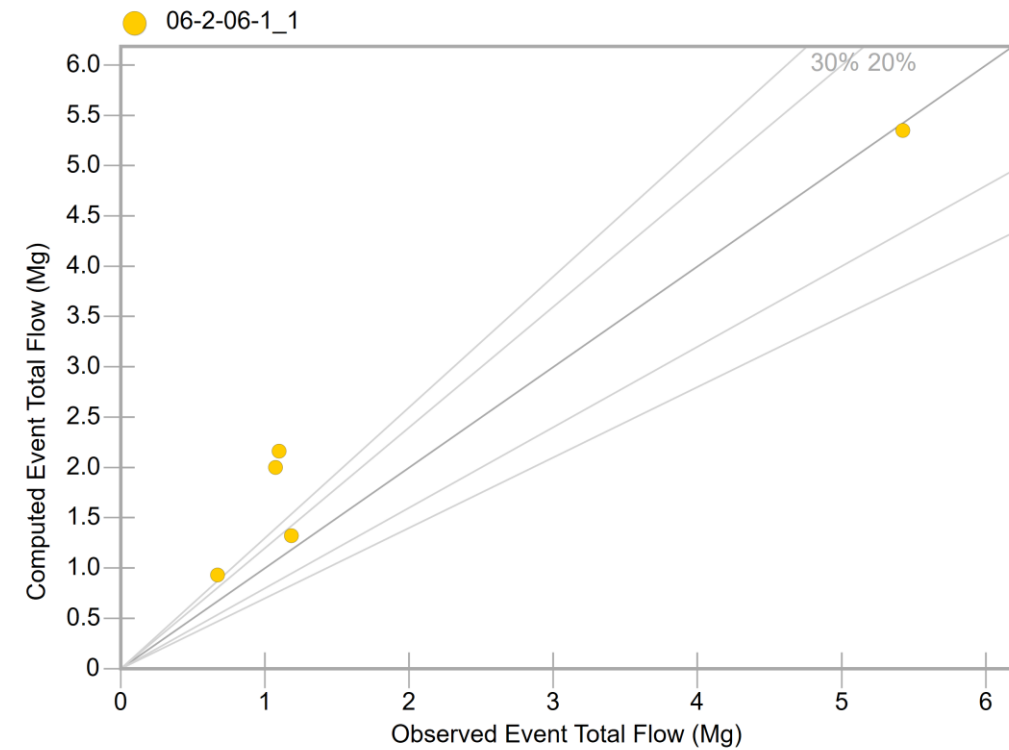


FM_06

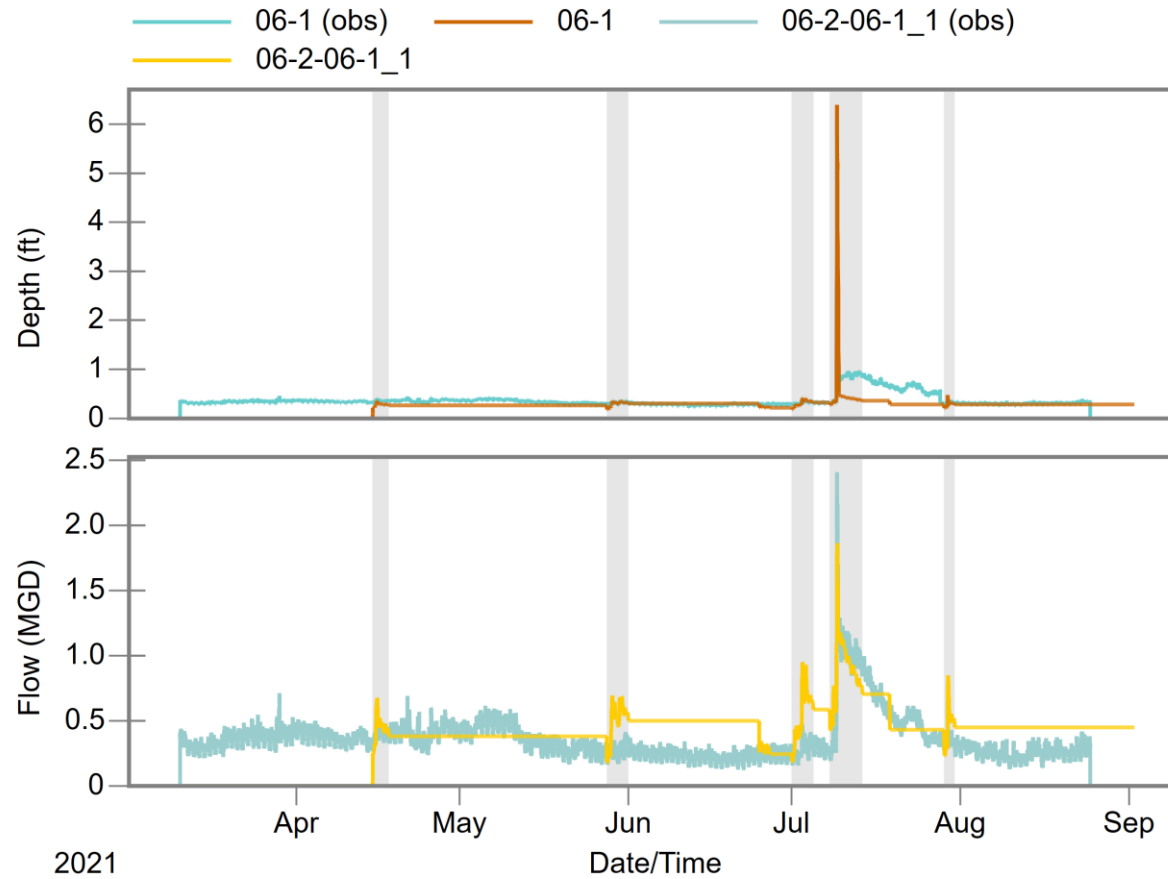
Peaks



Volumes

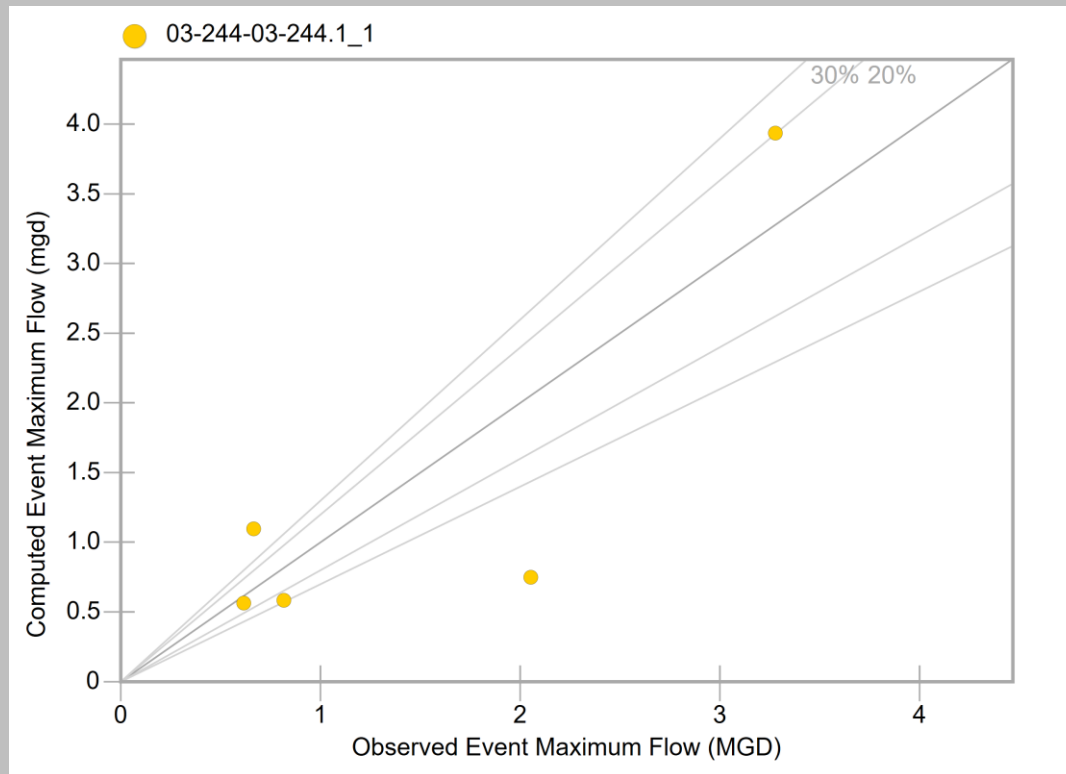


FM_06

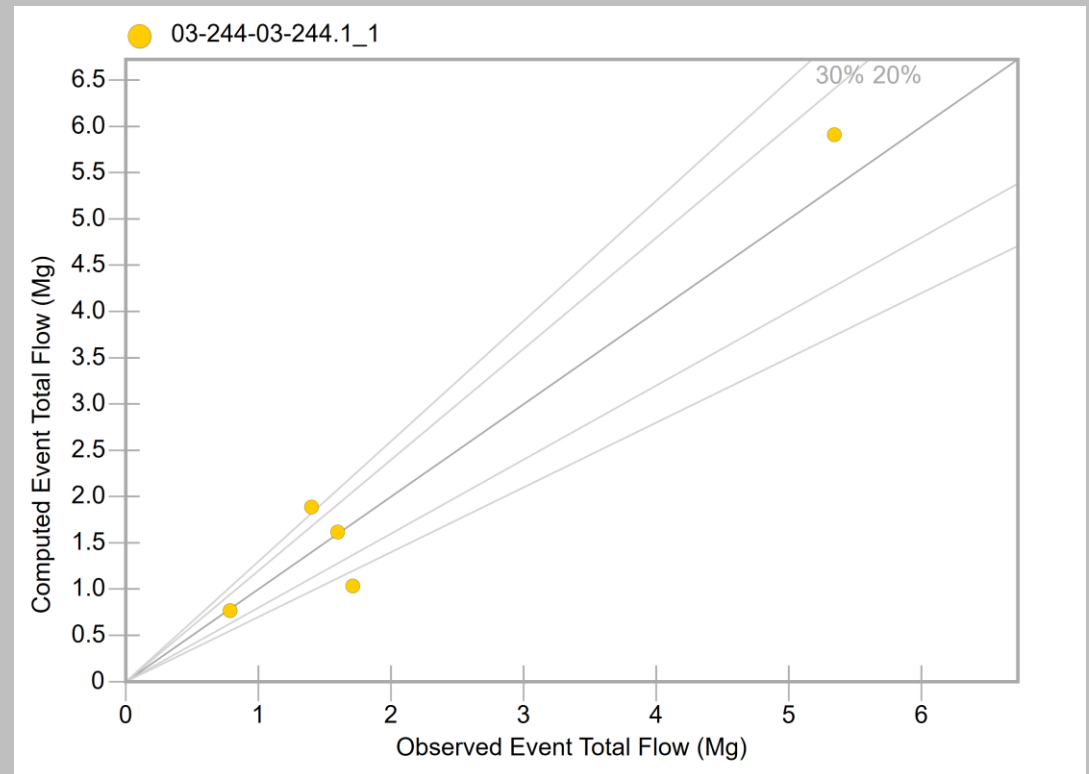


FM_07

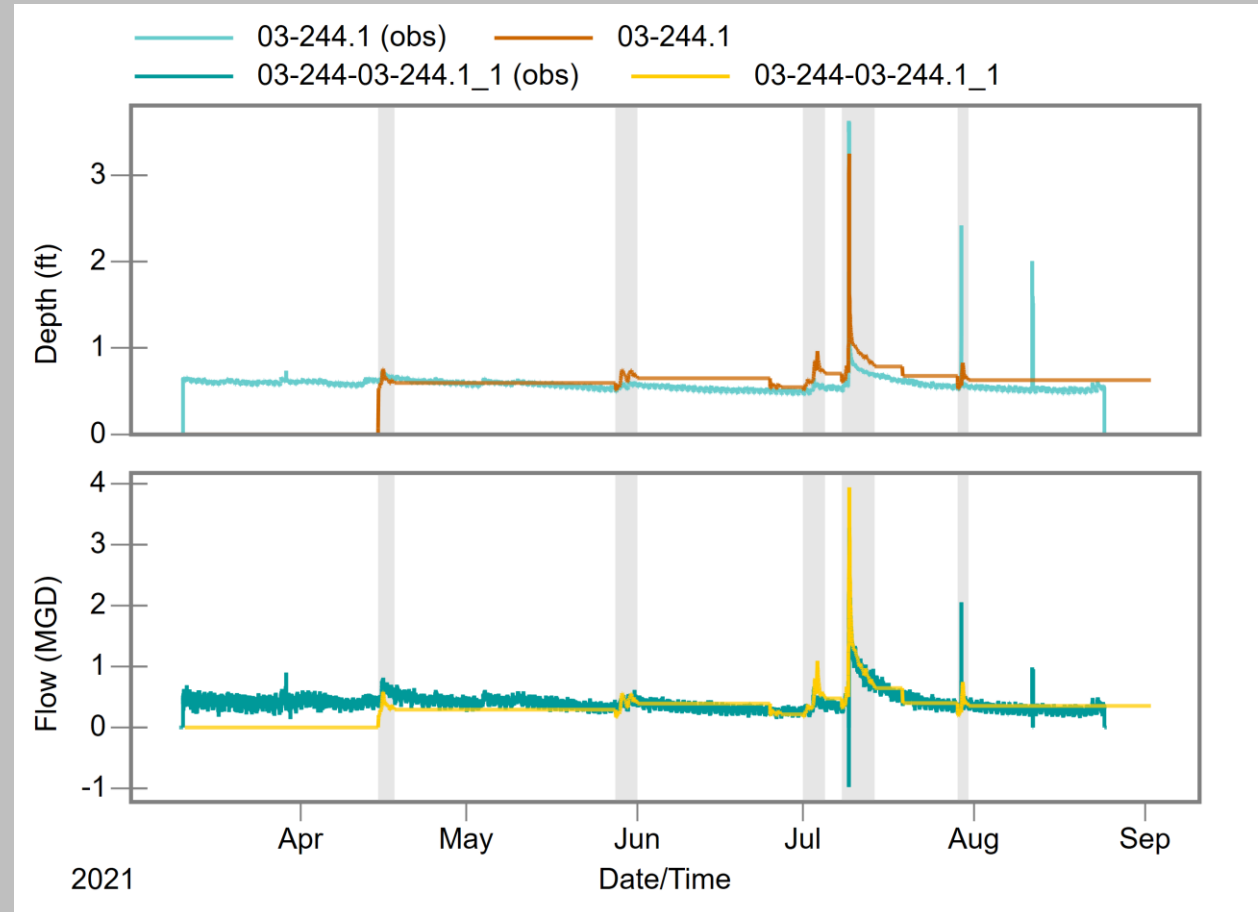
Peaks



Volumes

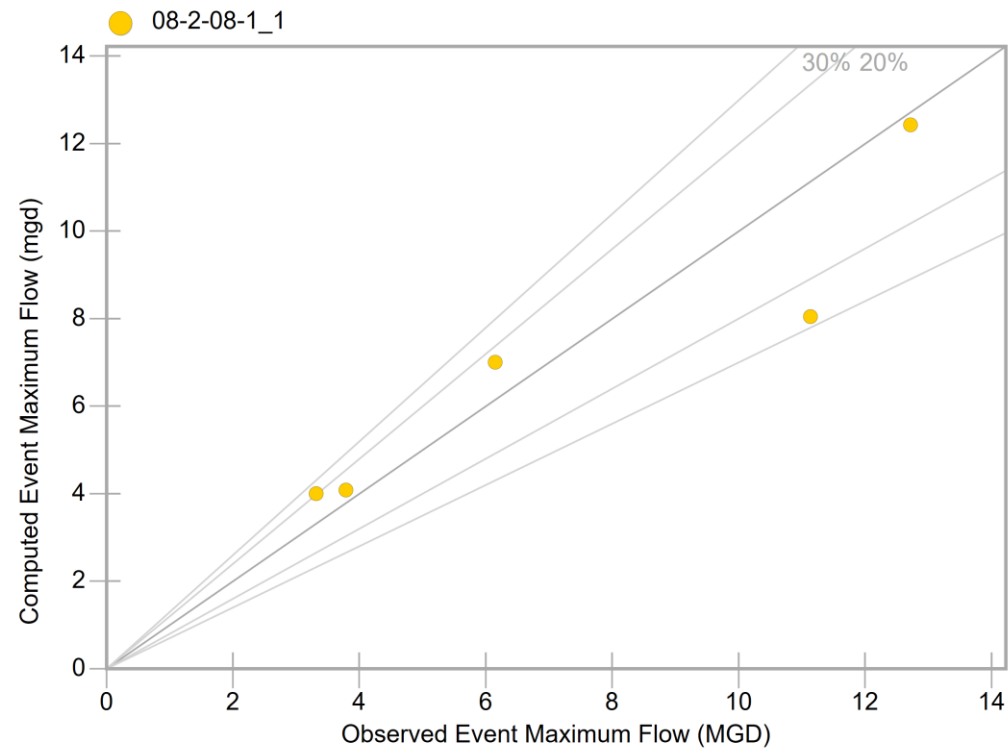


FM_07

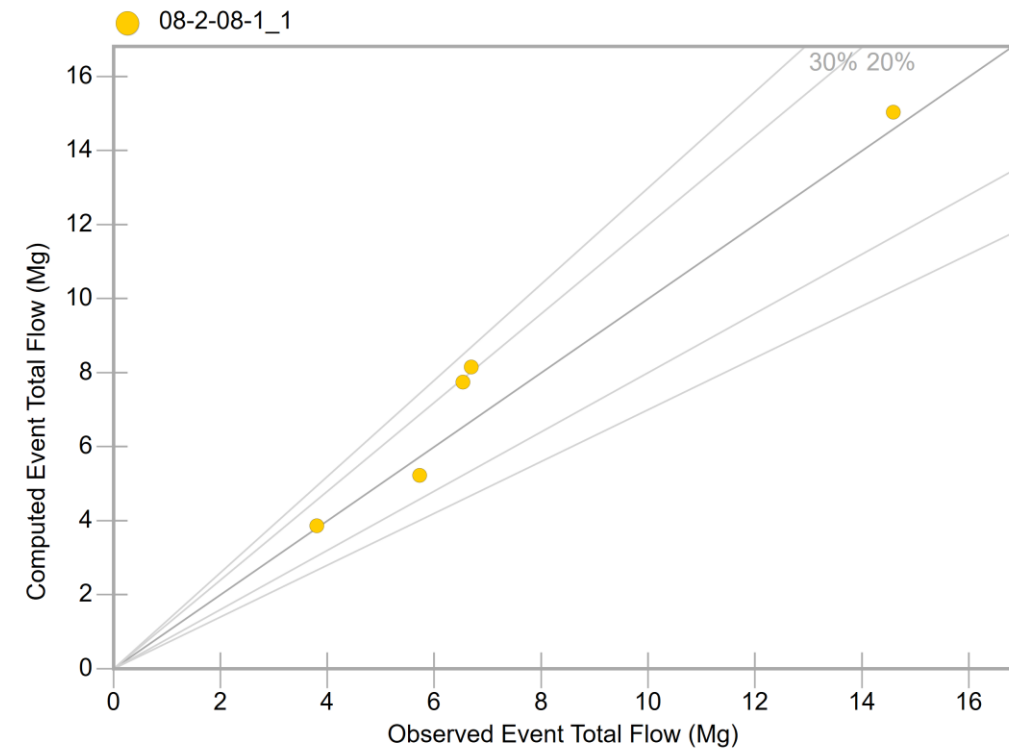


FM_08

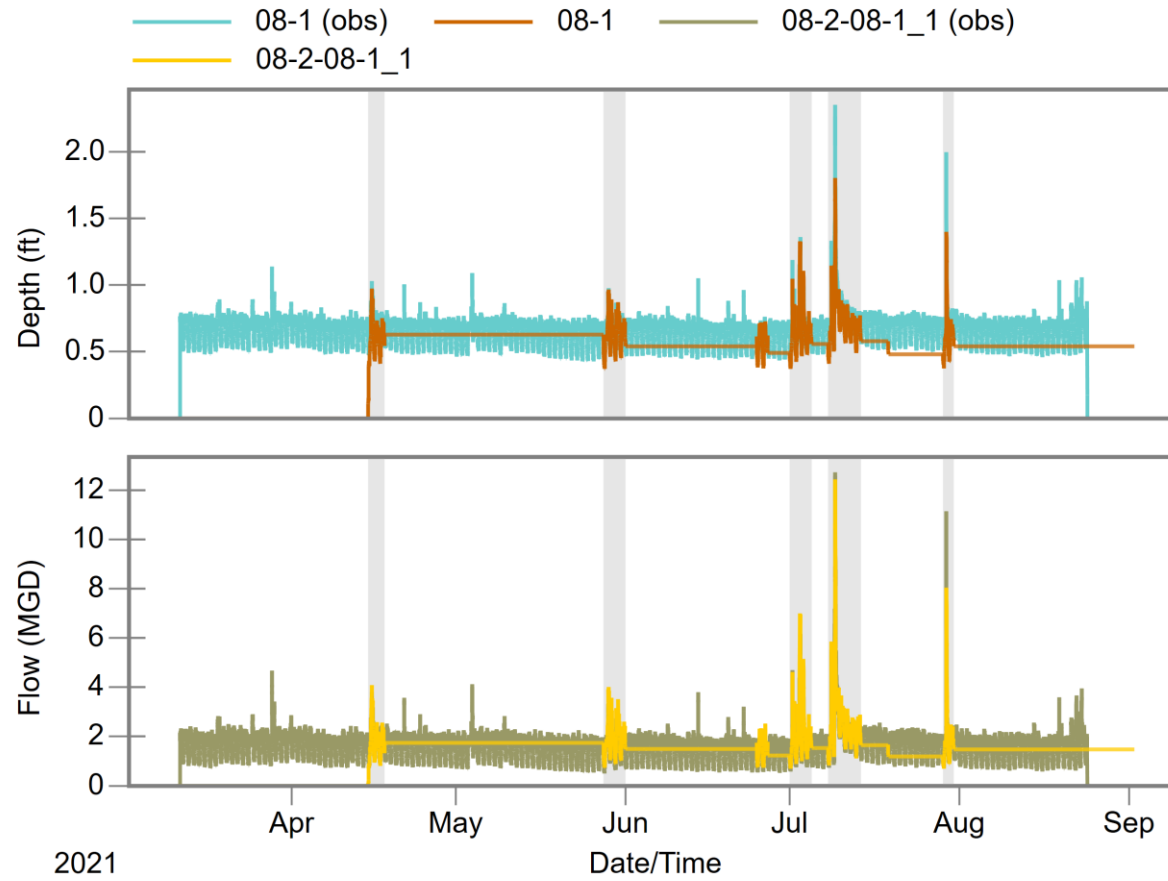
Peaks



Volumes

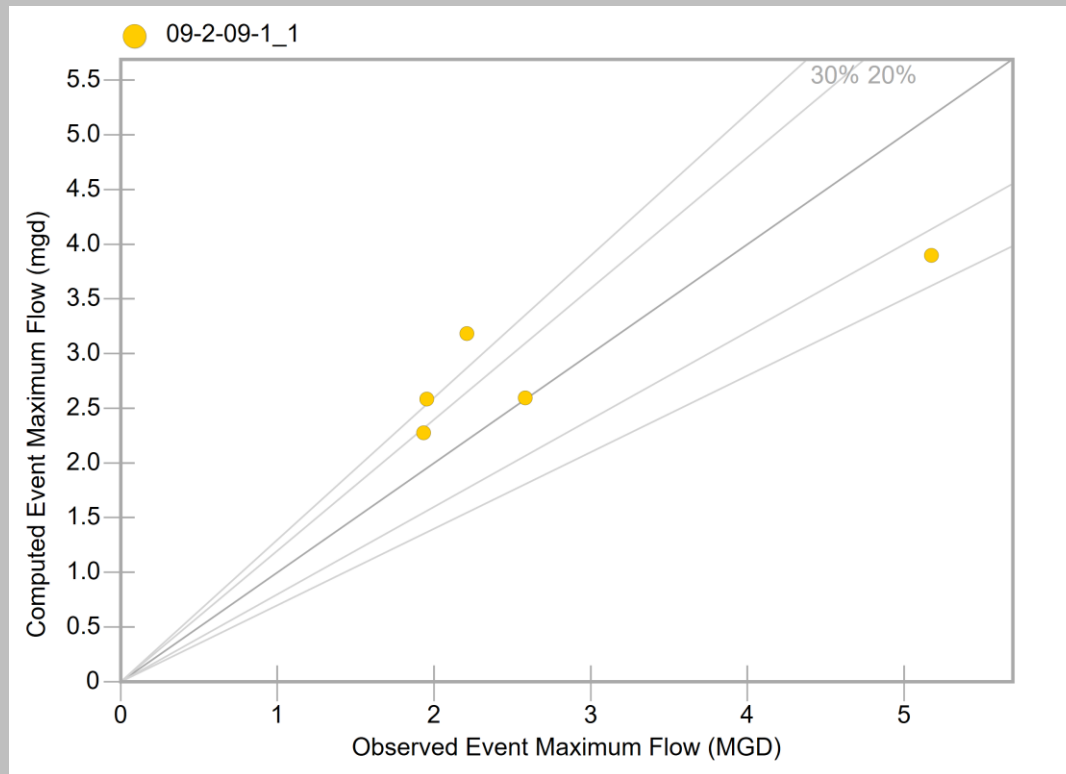


FM_08

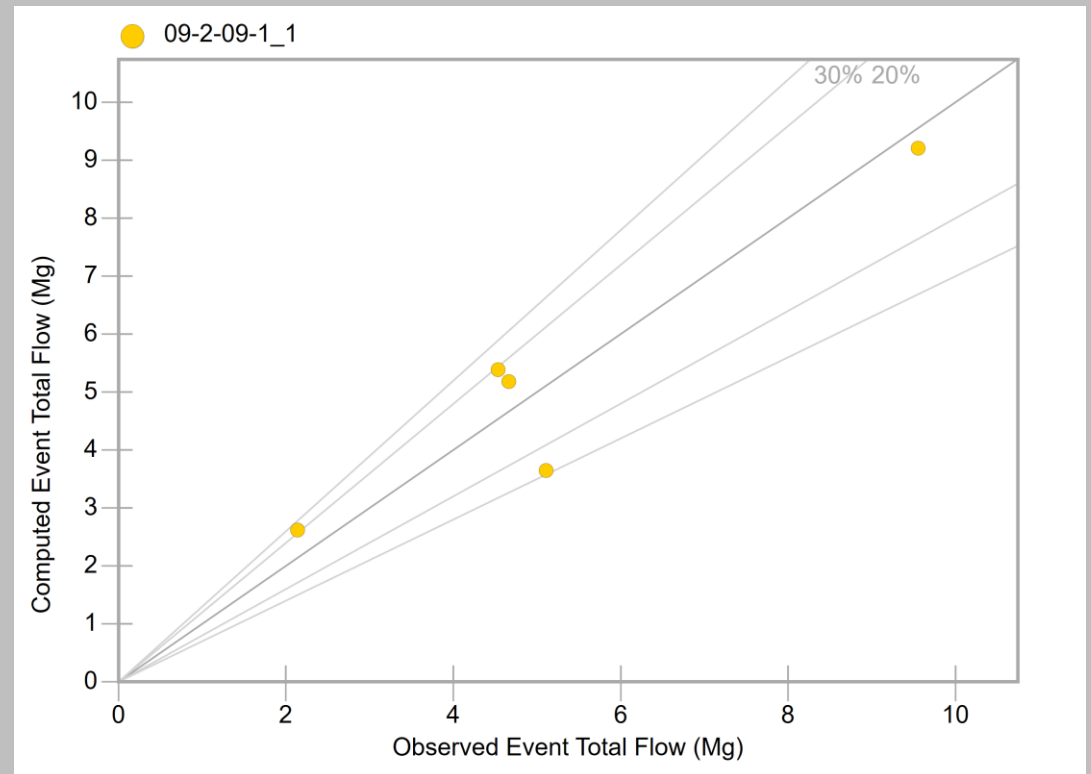


FM_09

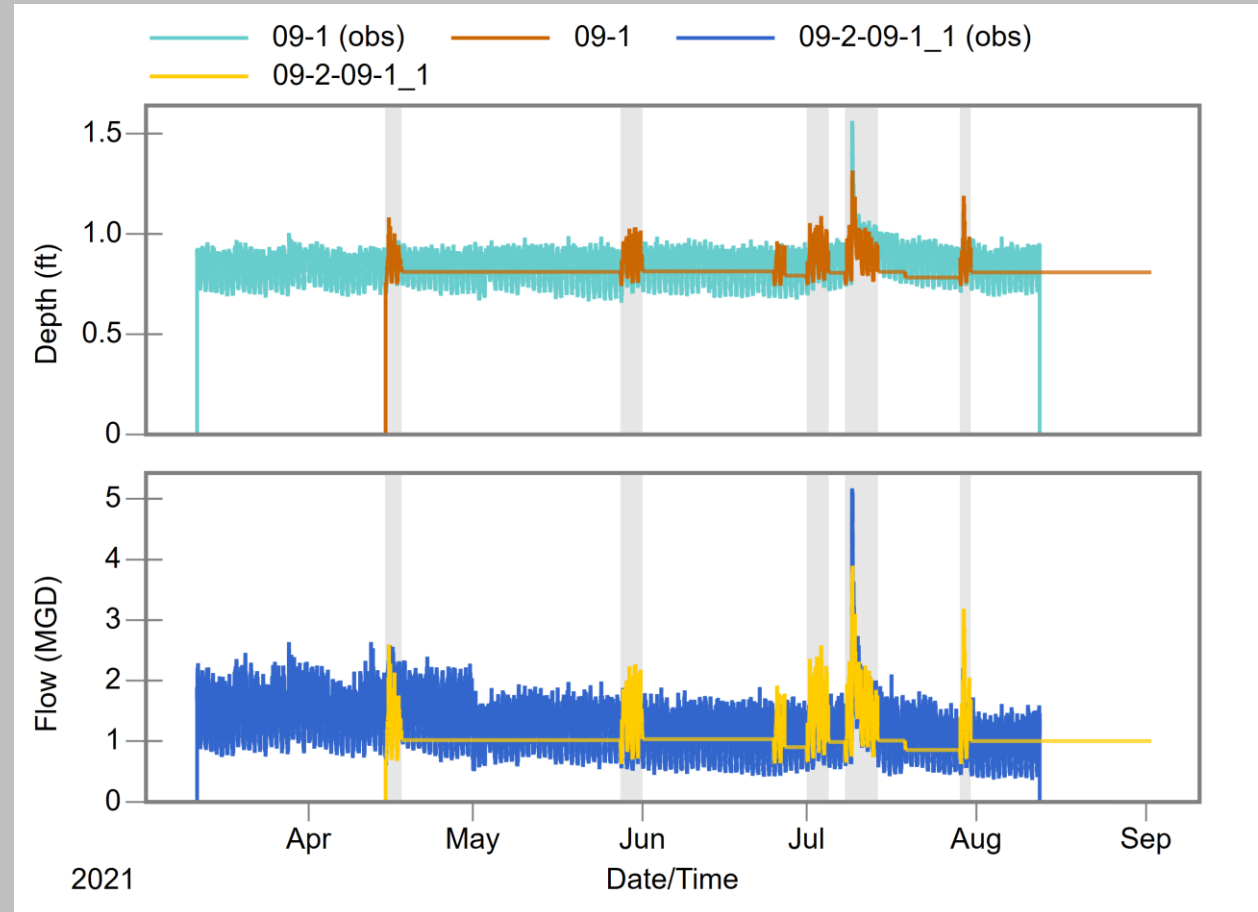
Peaks



Volumes

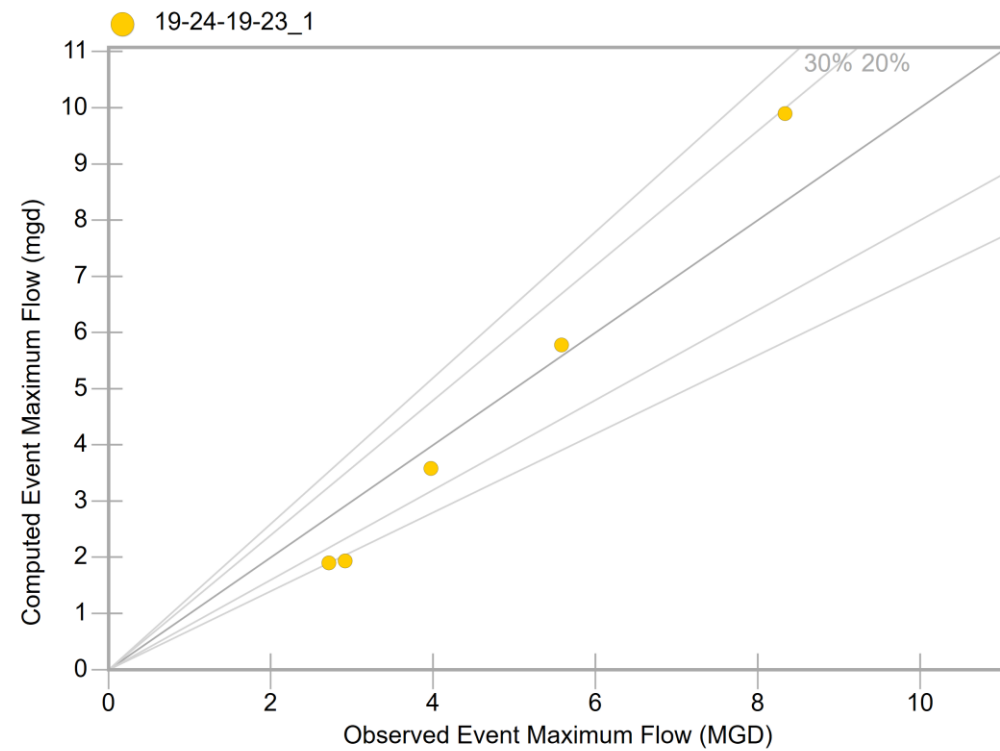


FM_09

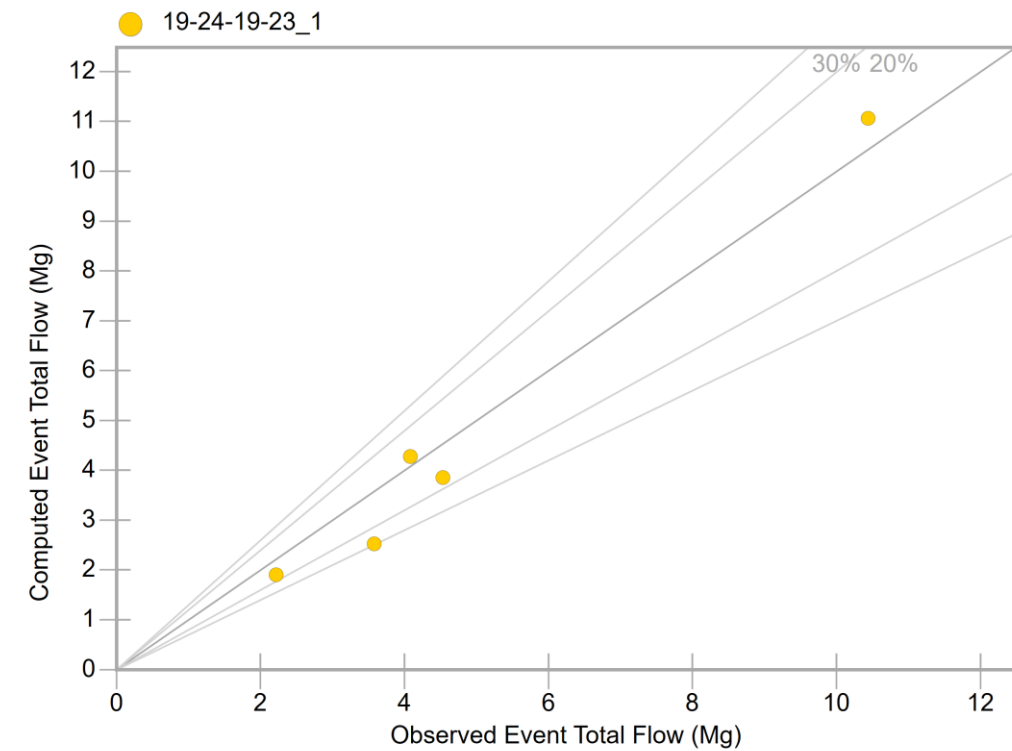


FM_10

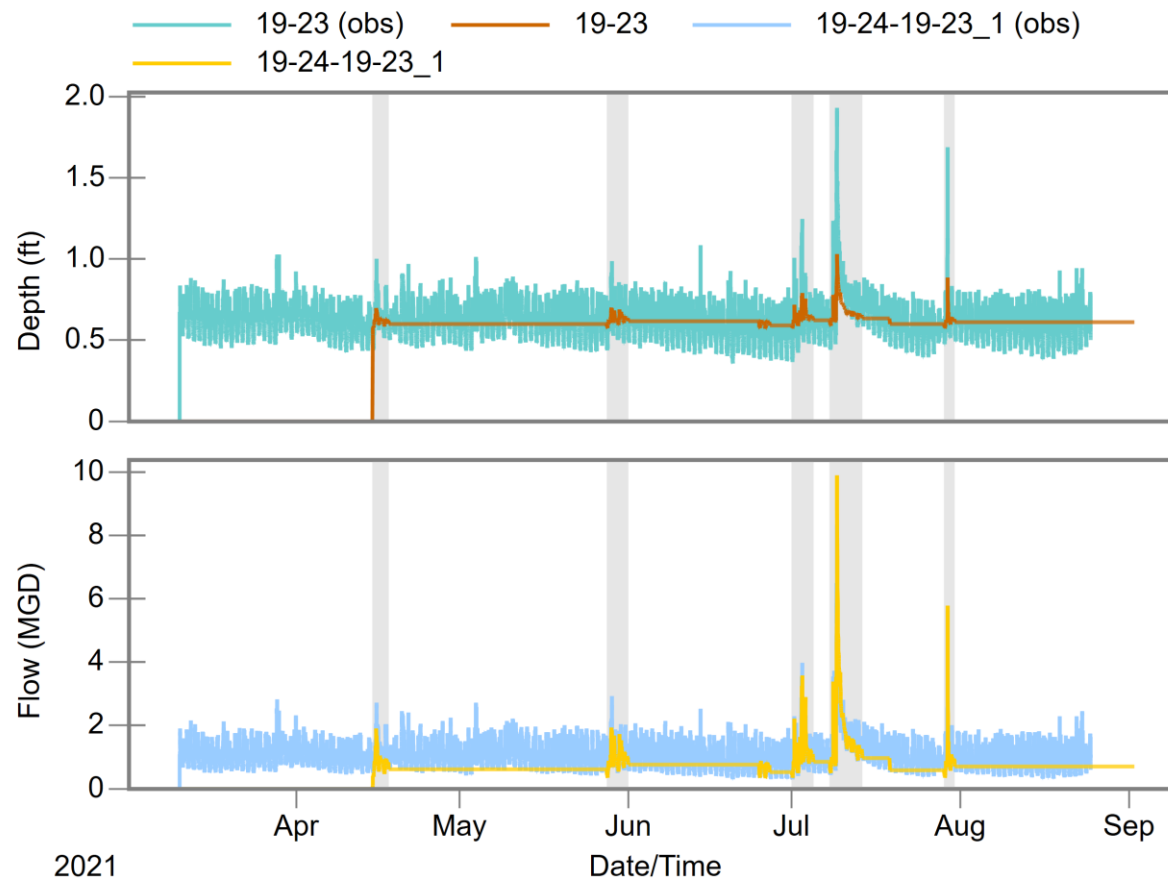
Peaks



Volumes

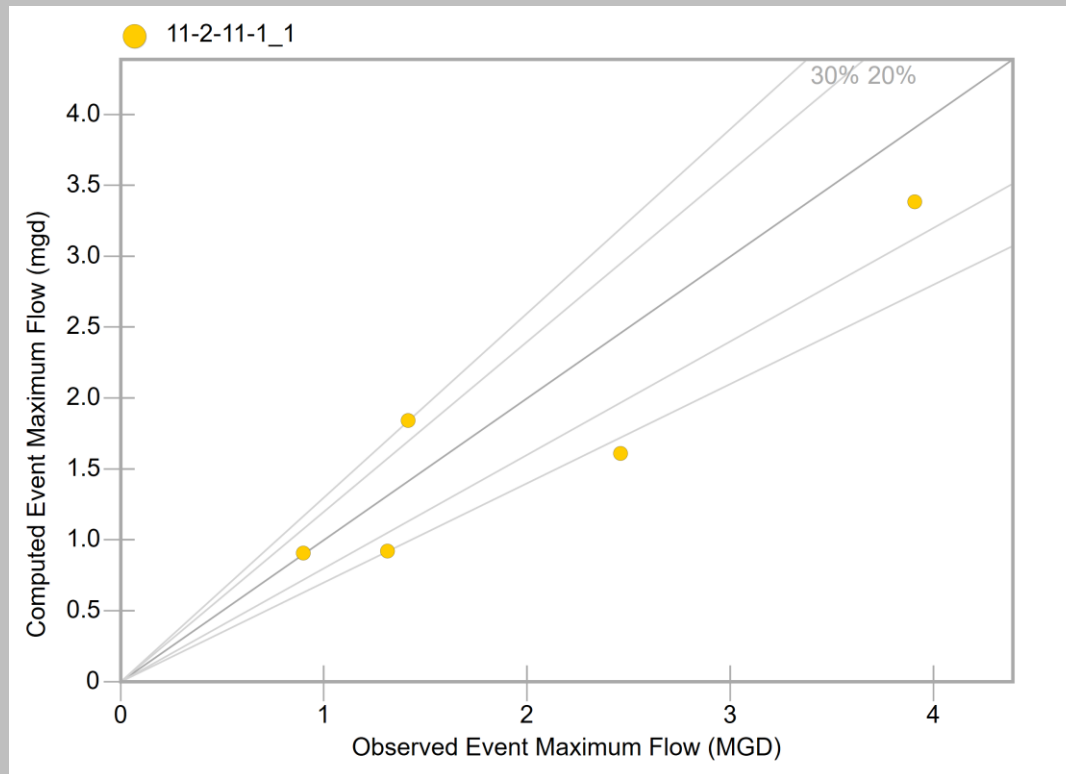


FM_10

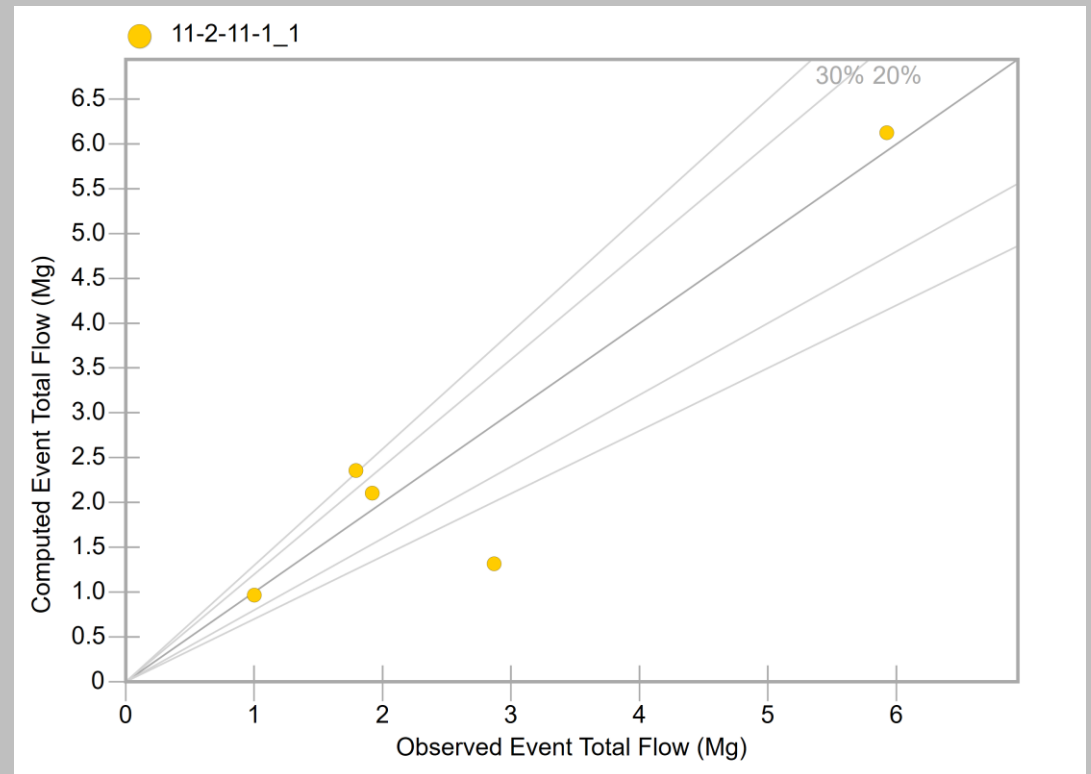


FM_11

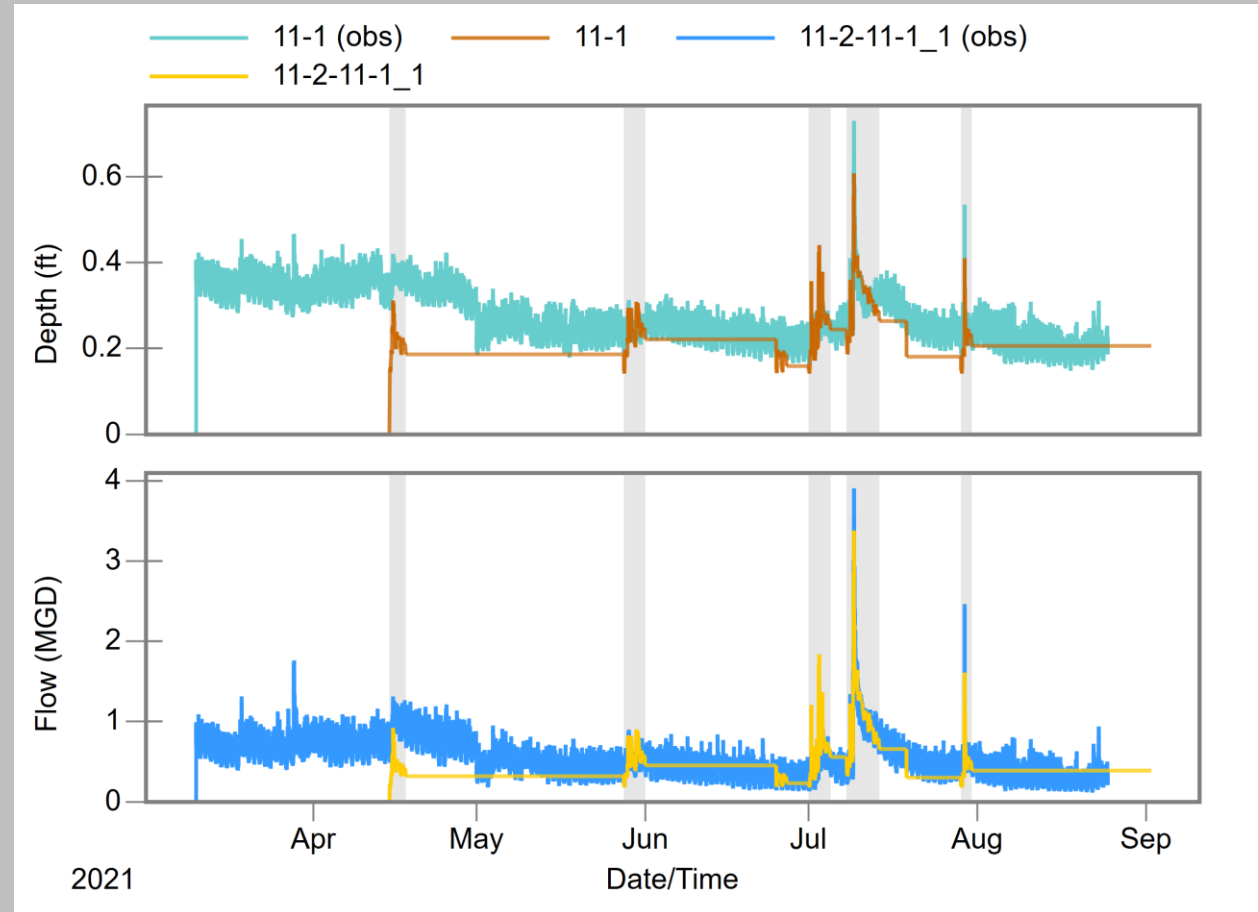
Peaks



Volumes

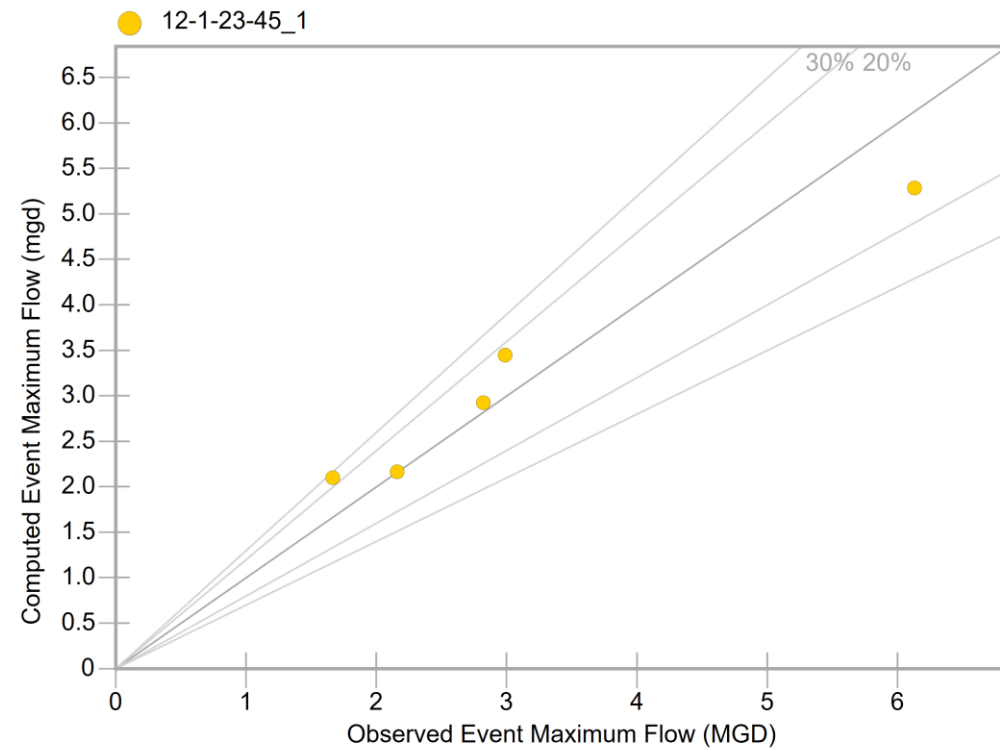


FM_11

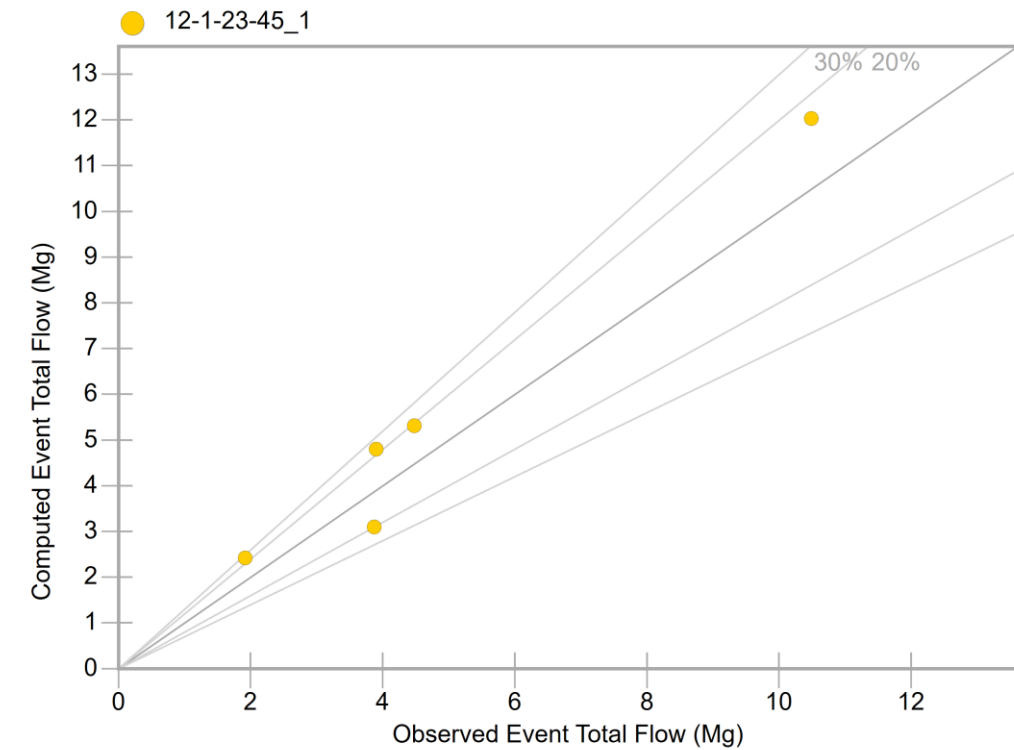


FM_12

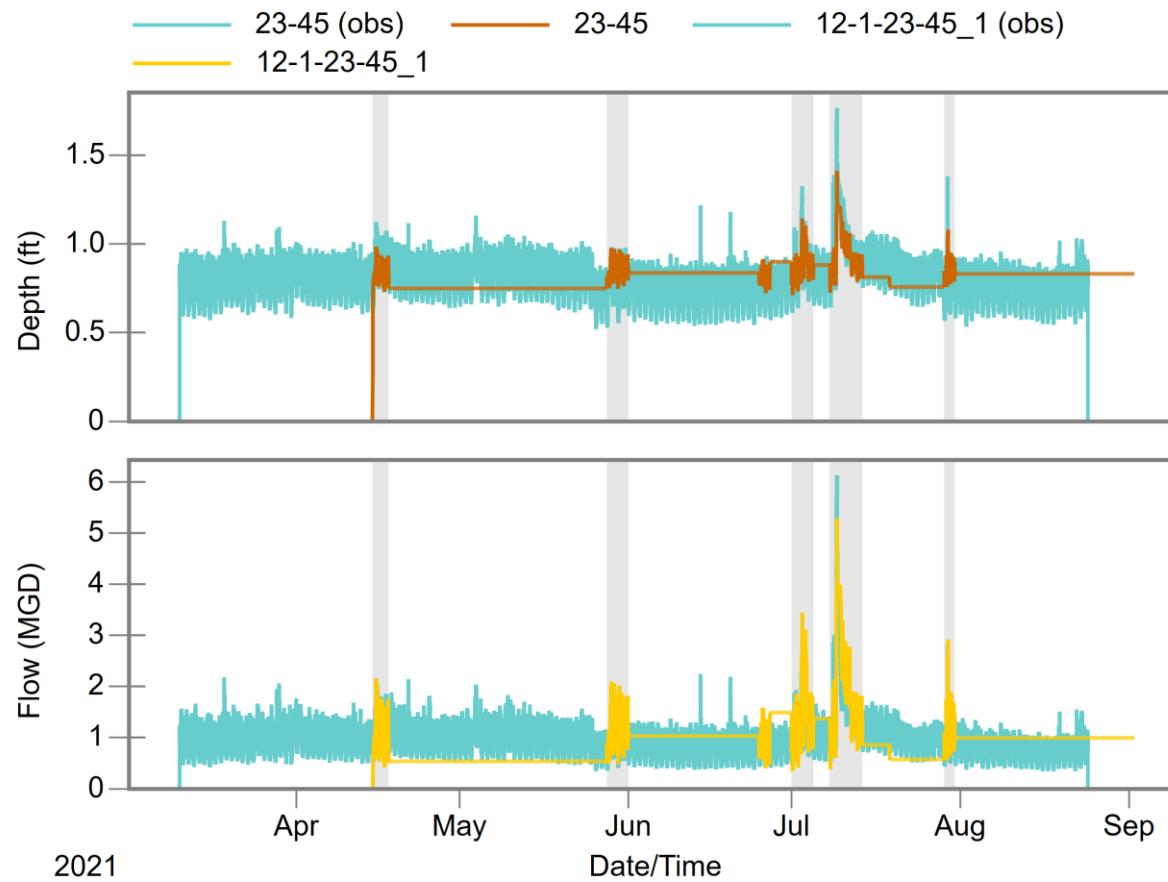
Peaks



Volumes

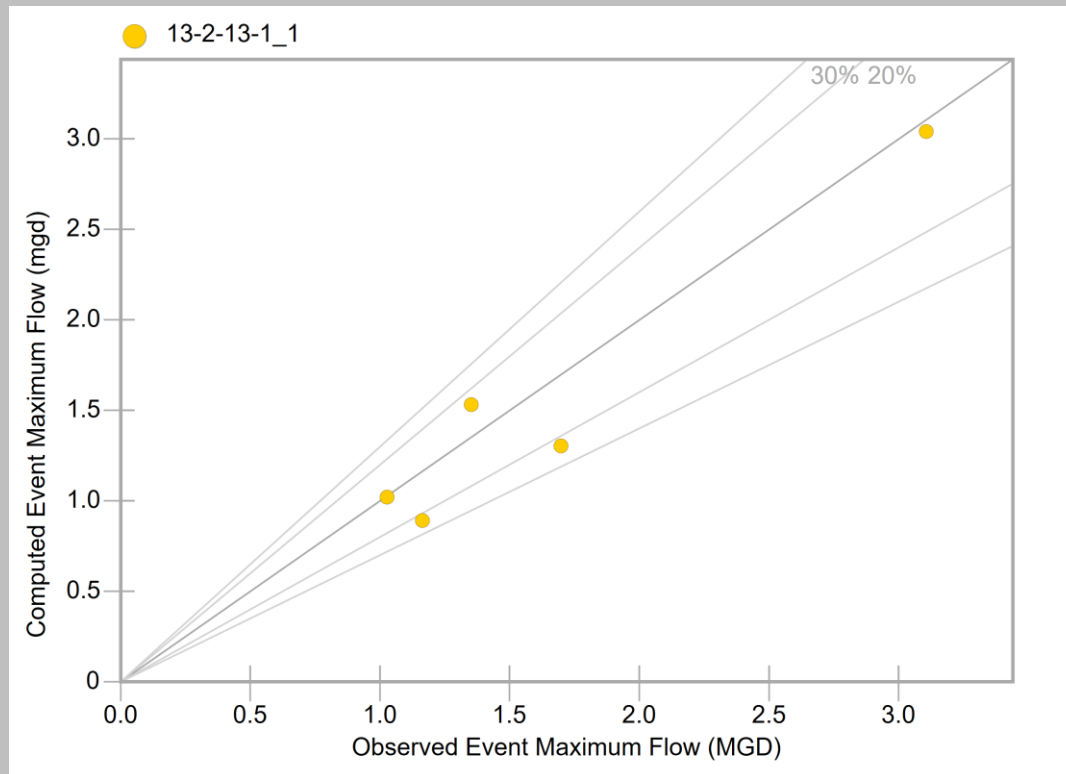


FM_12

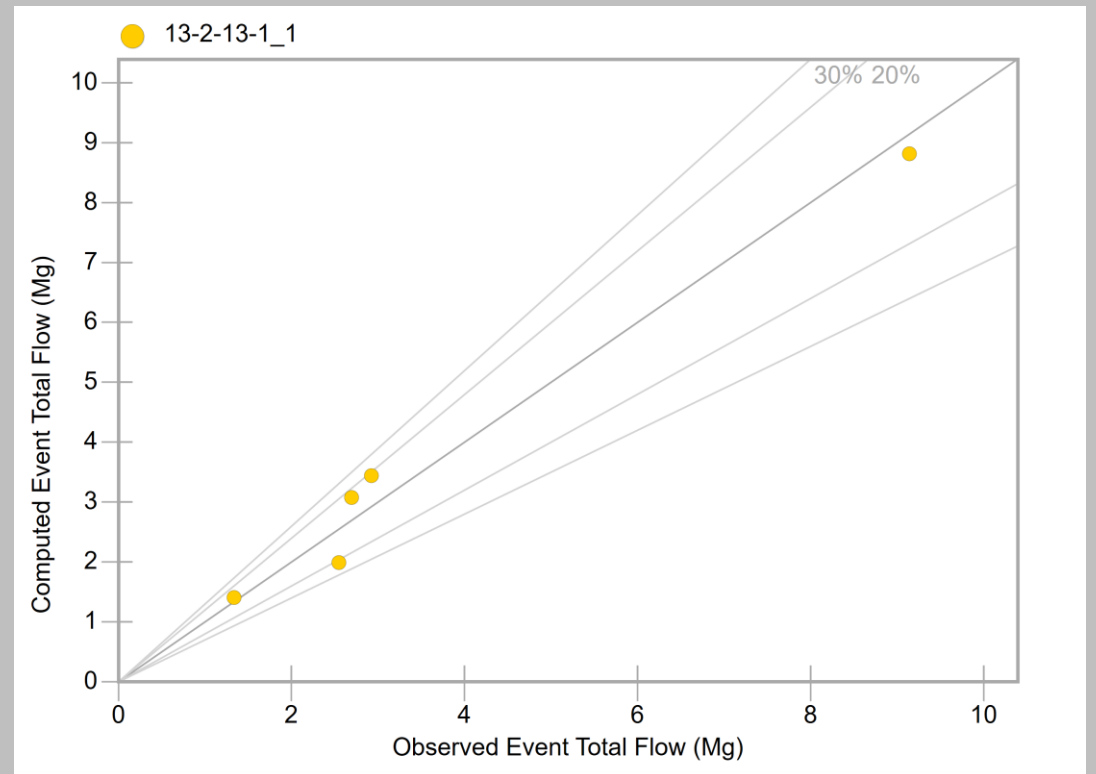


FM_13

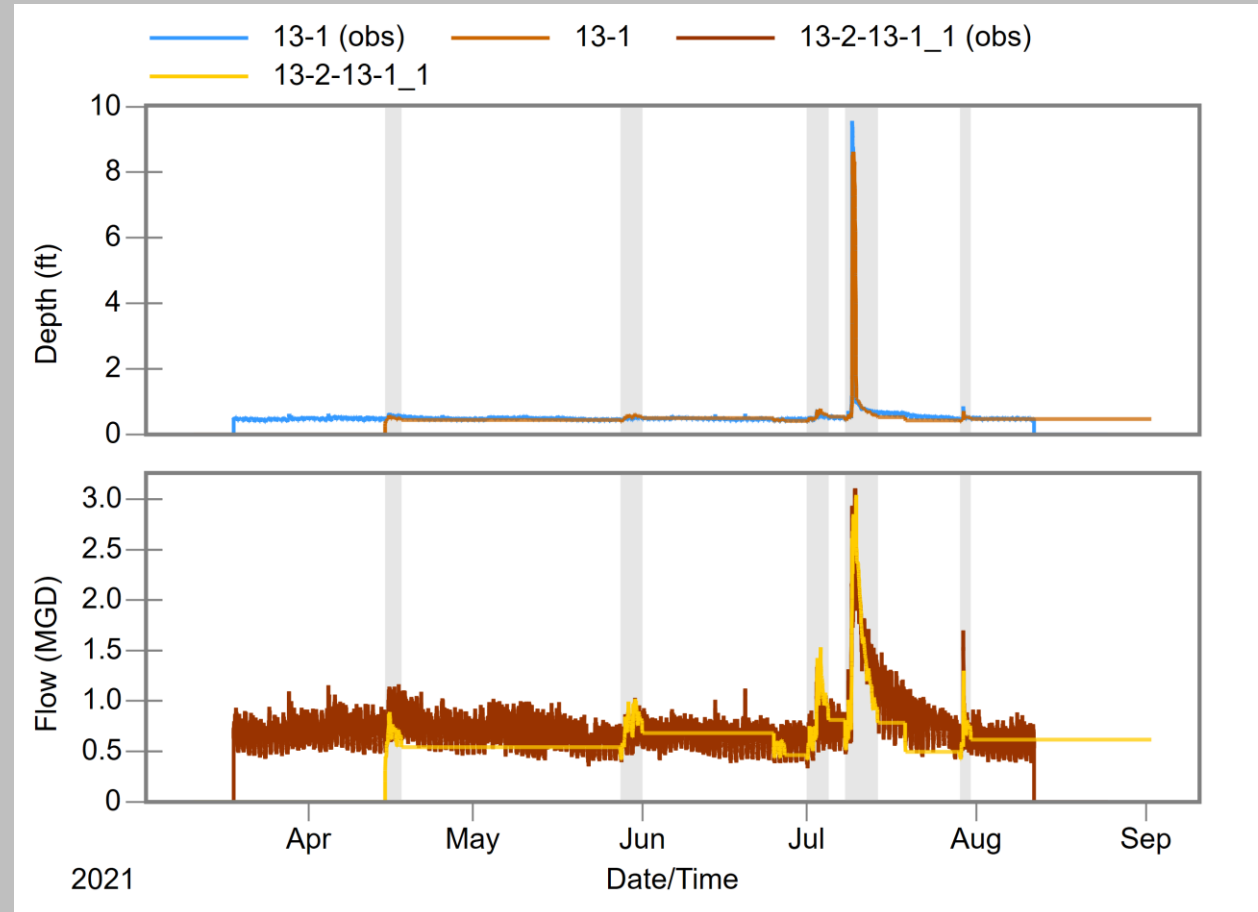
Peaks



Volumes

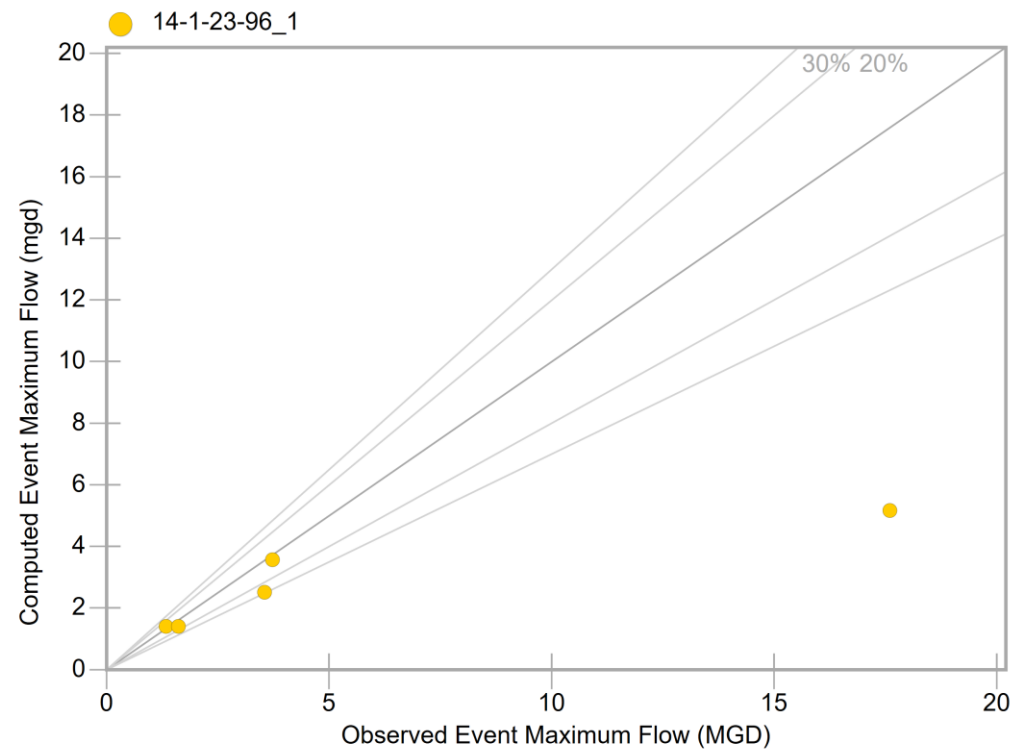


FM_13

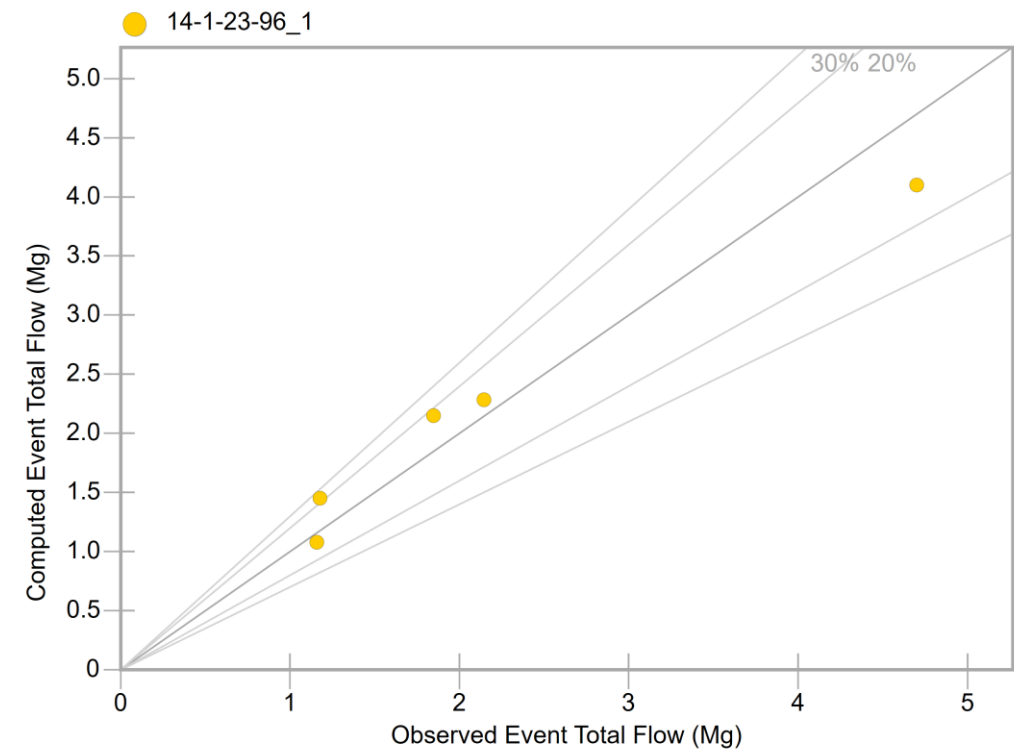


FM_14

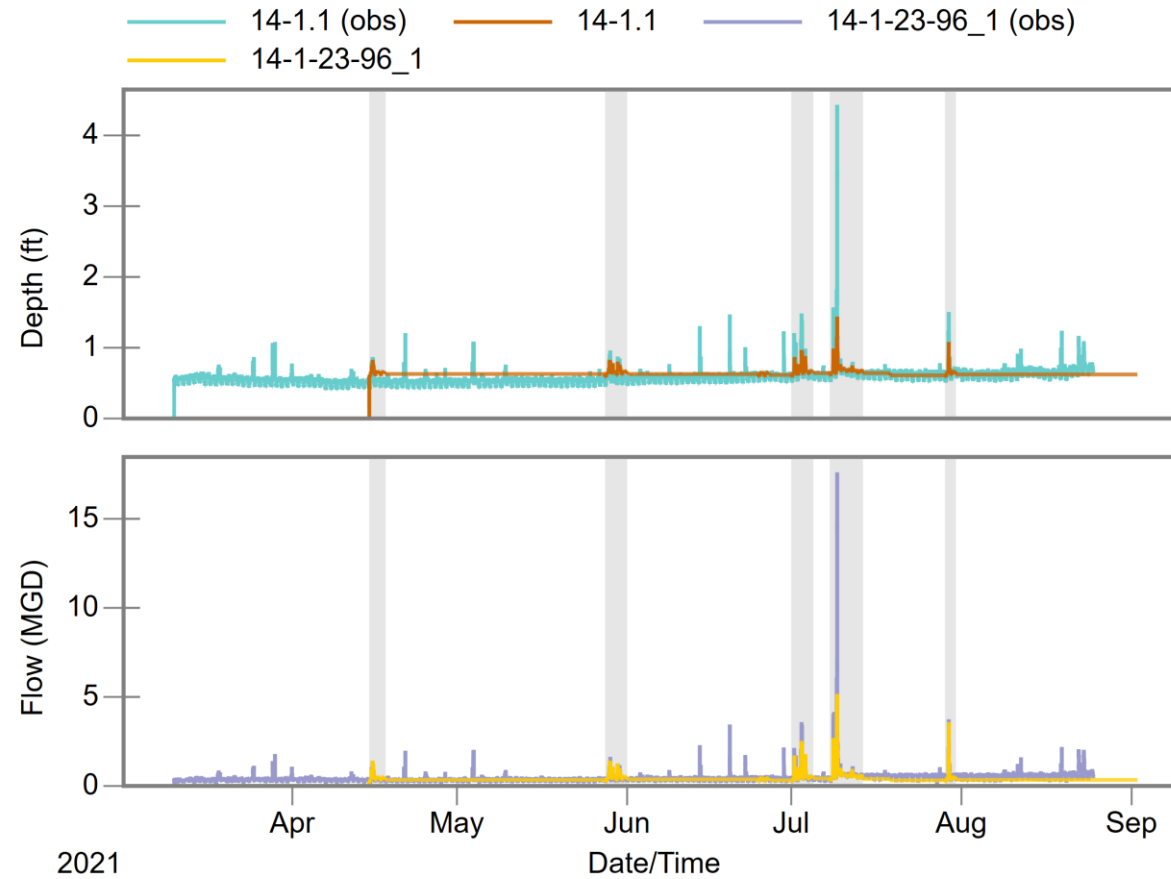
Peaks



Volumes

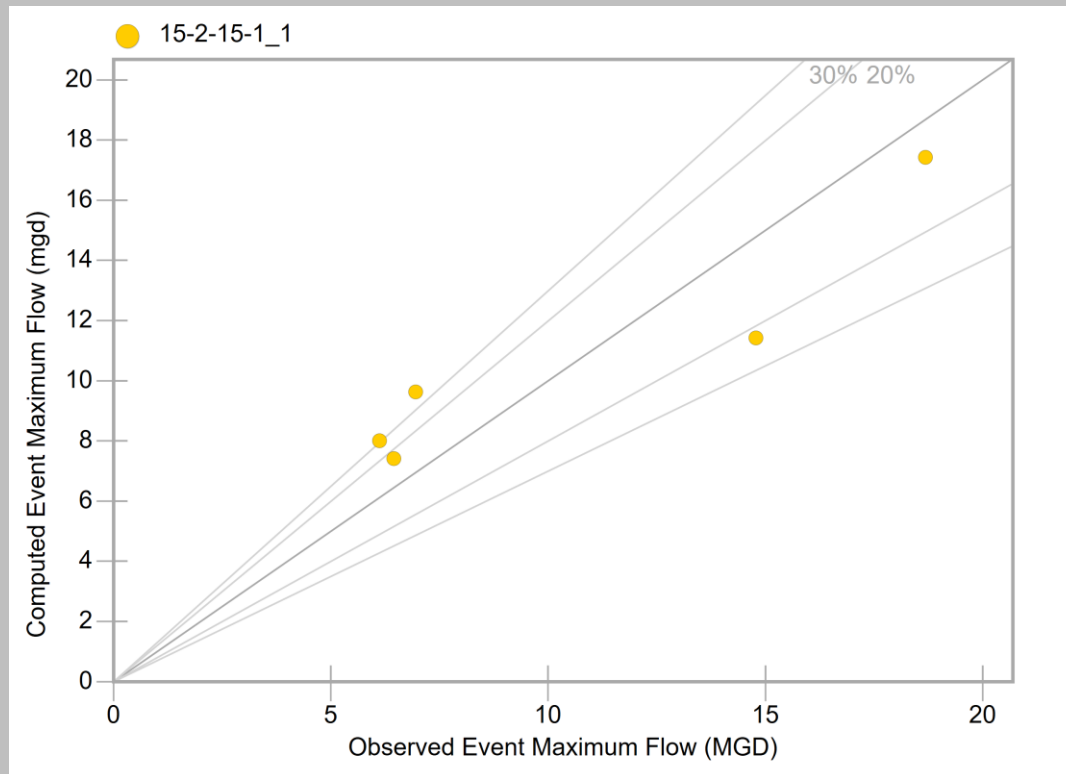


FM_14

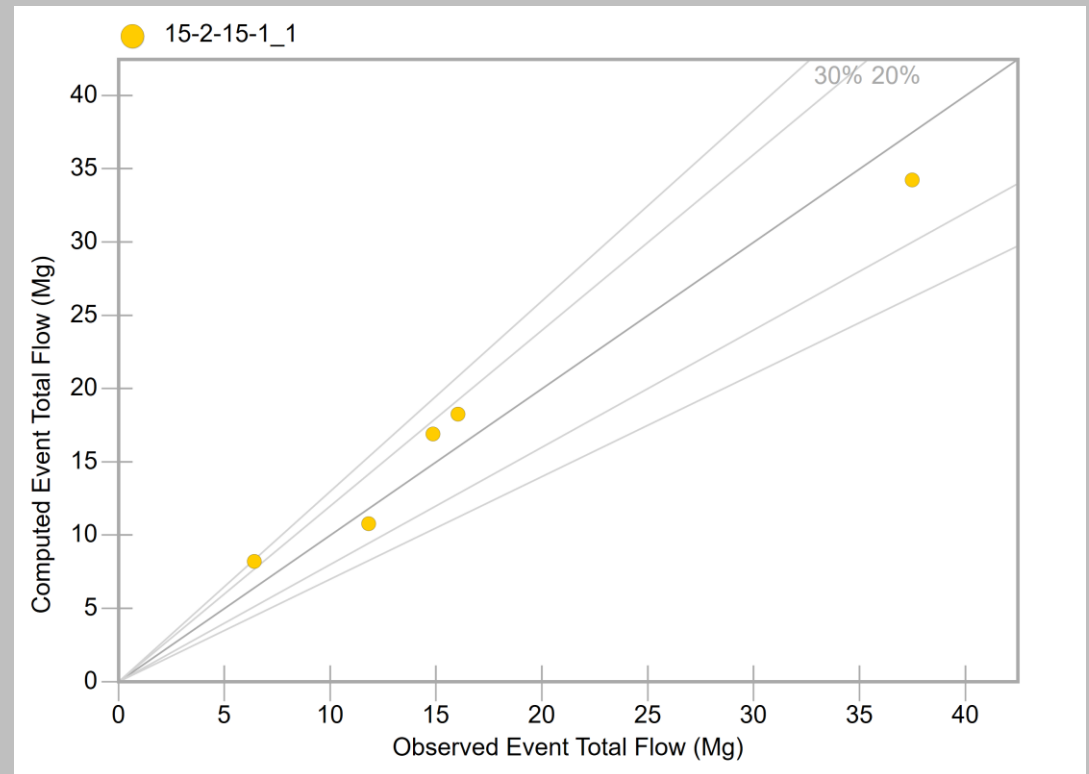


FM_15

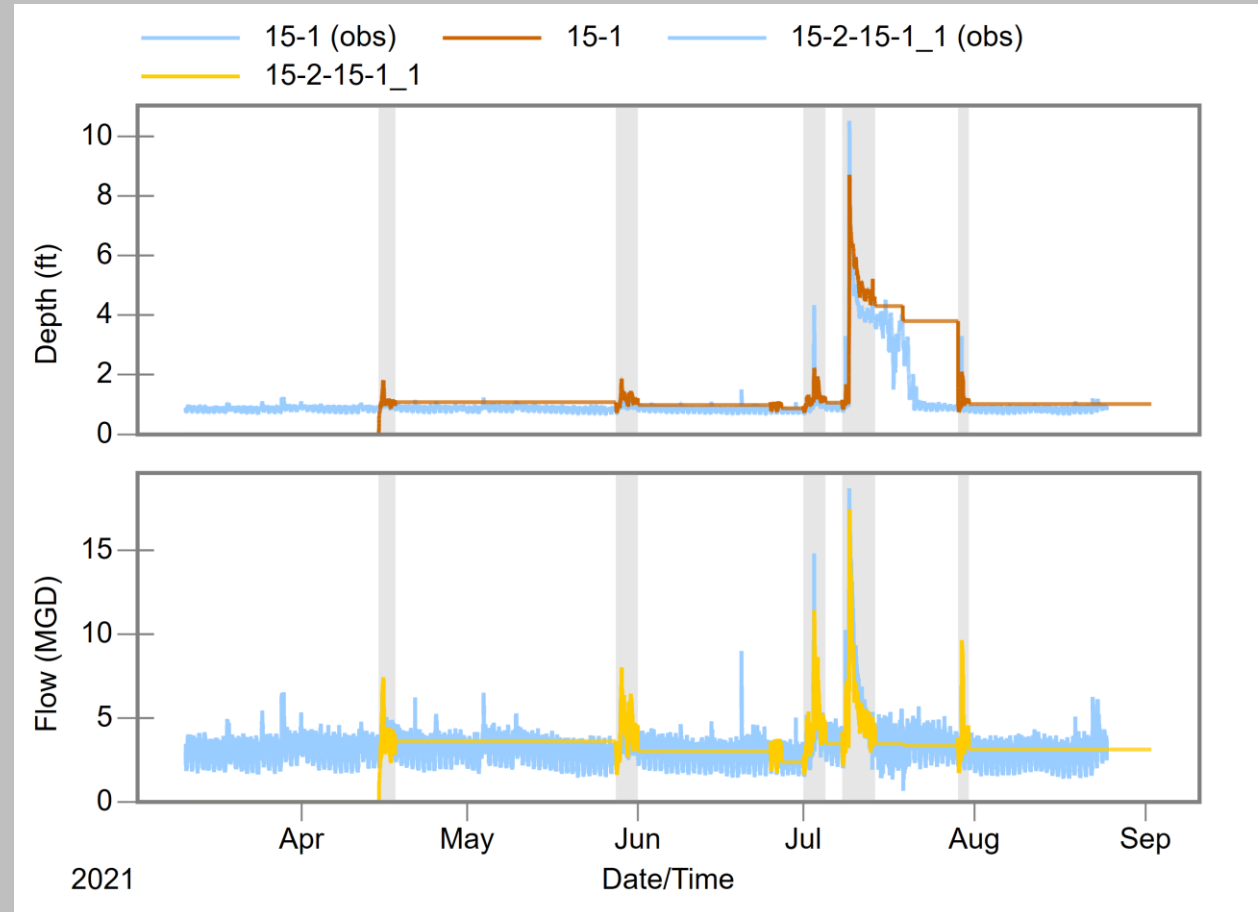
Peaks



Volumes

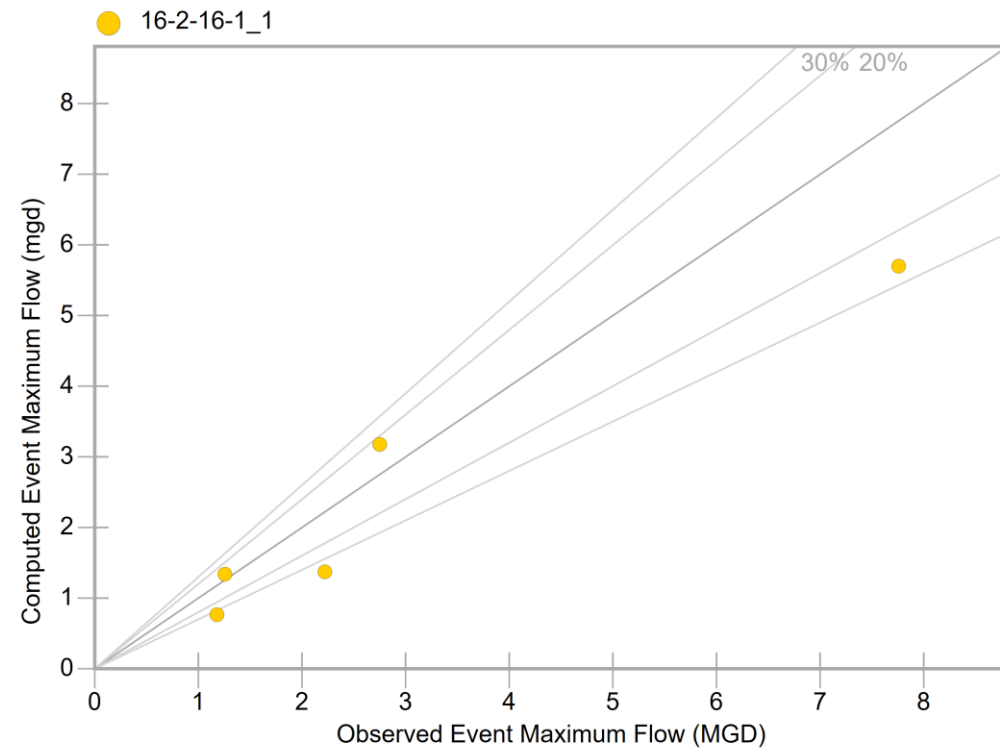


FM_15

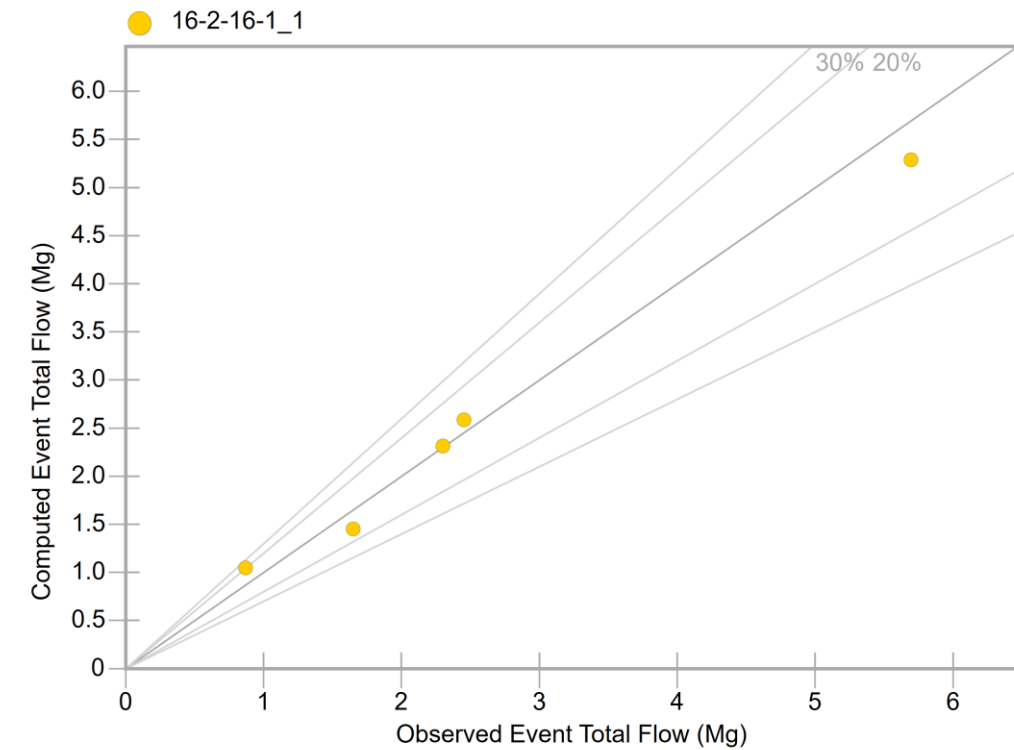


FM_16

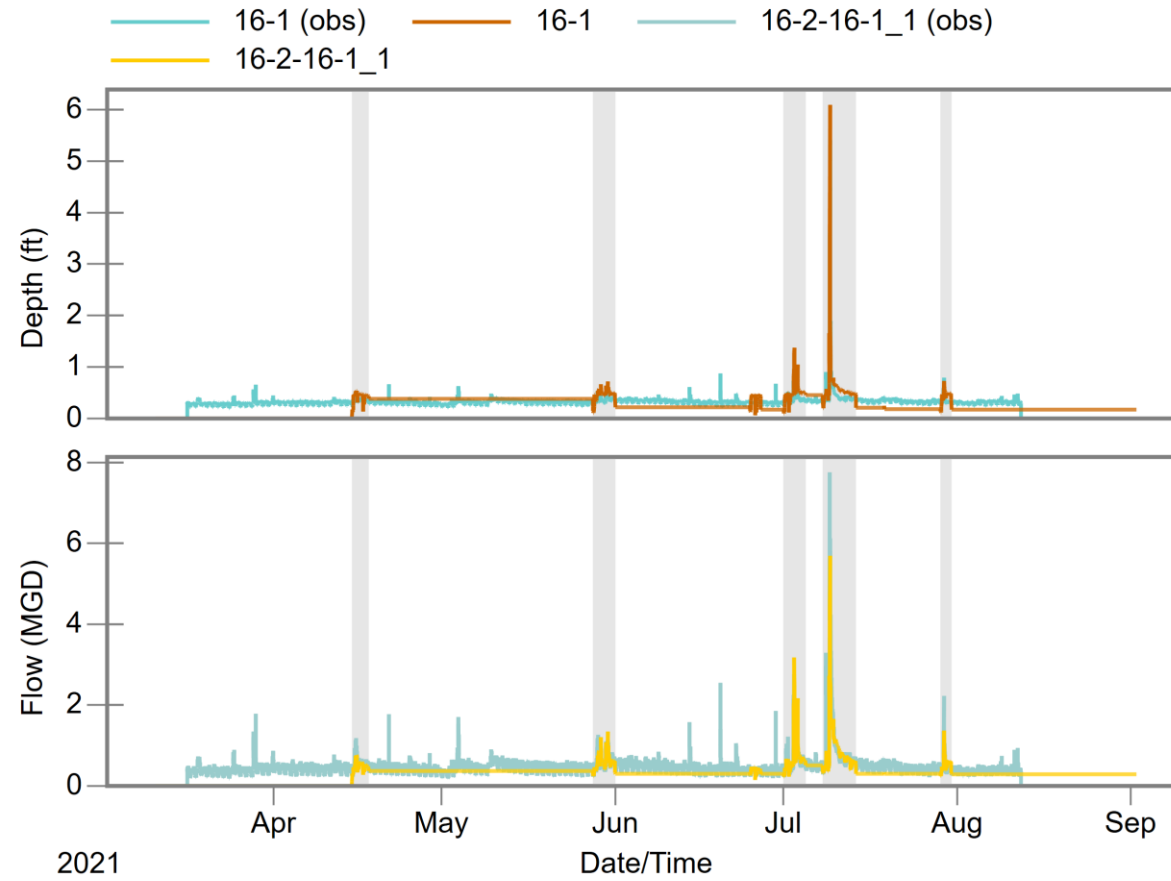
Peaks



Volumes

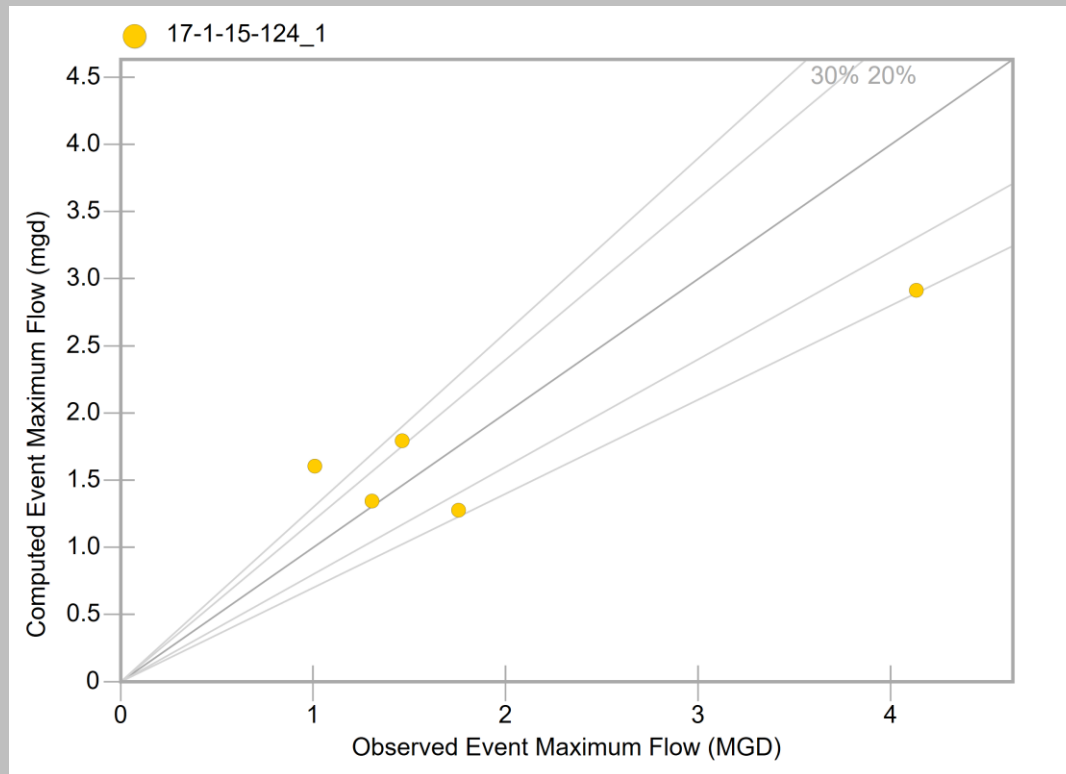


FM_16

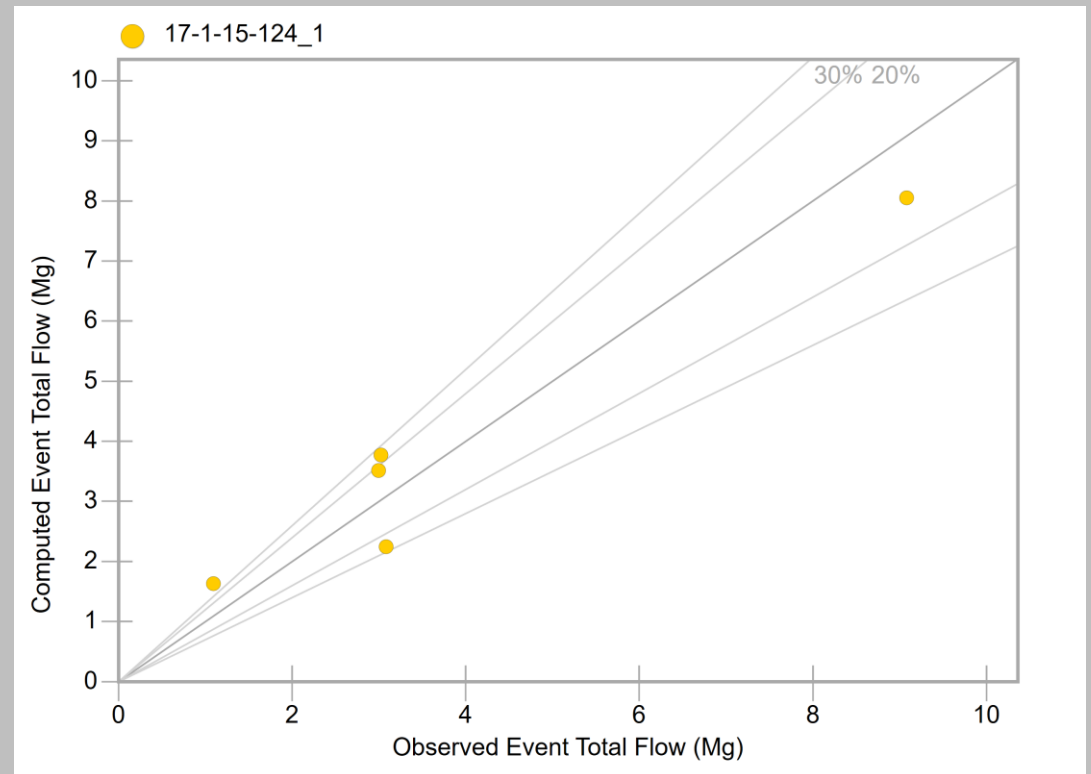


FM_17

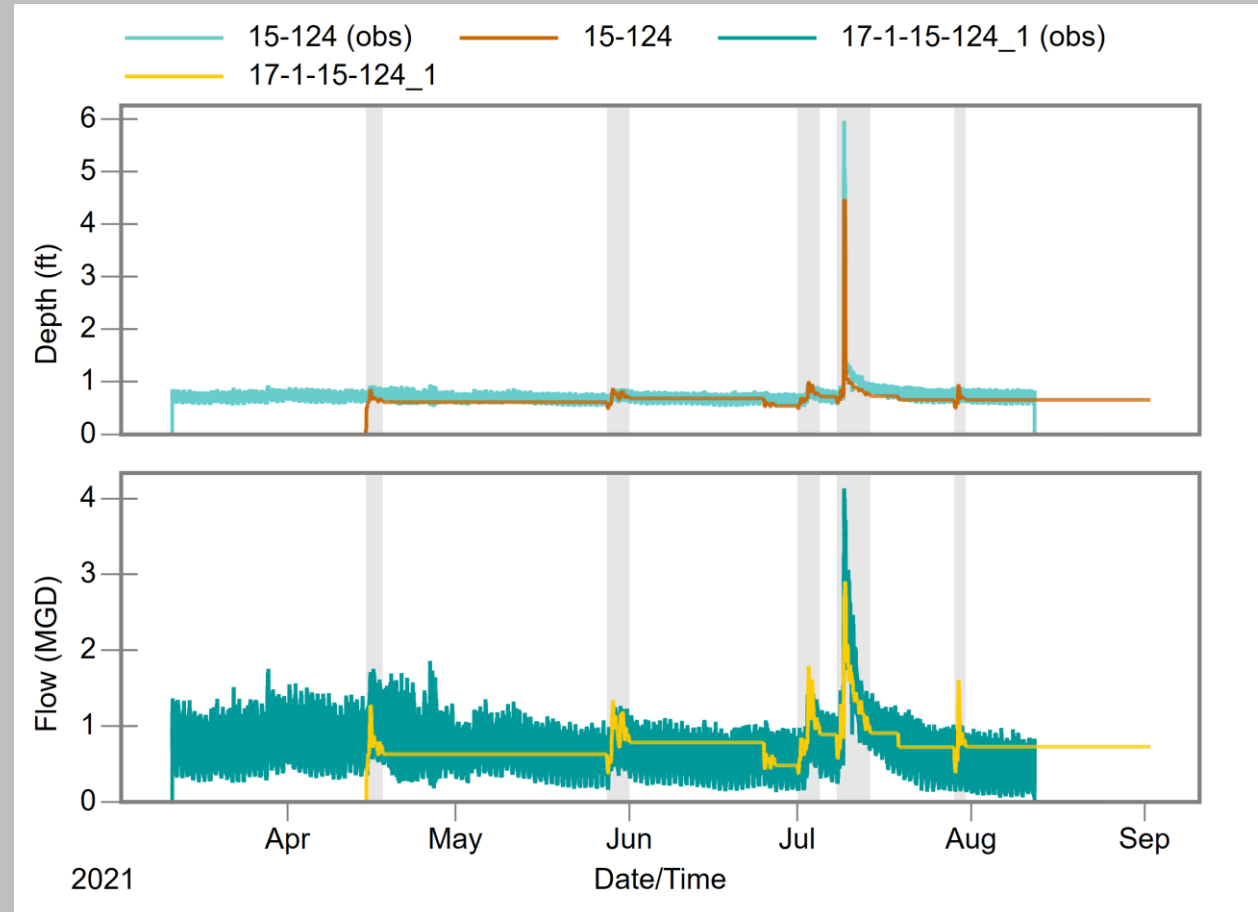
Peaks



Volumes

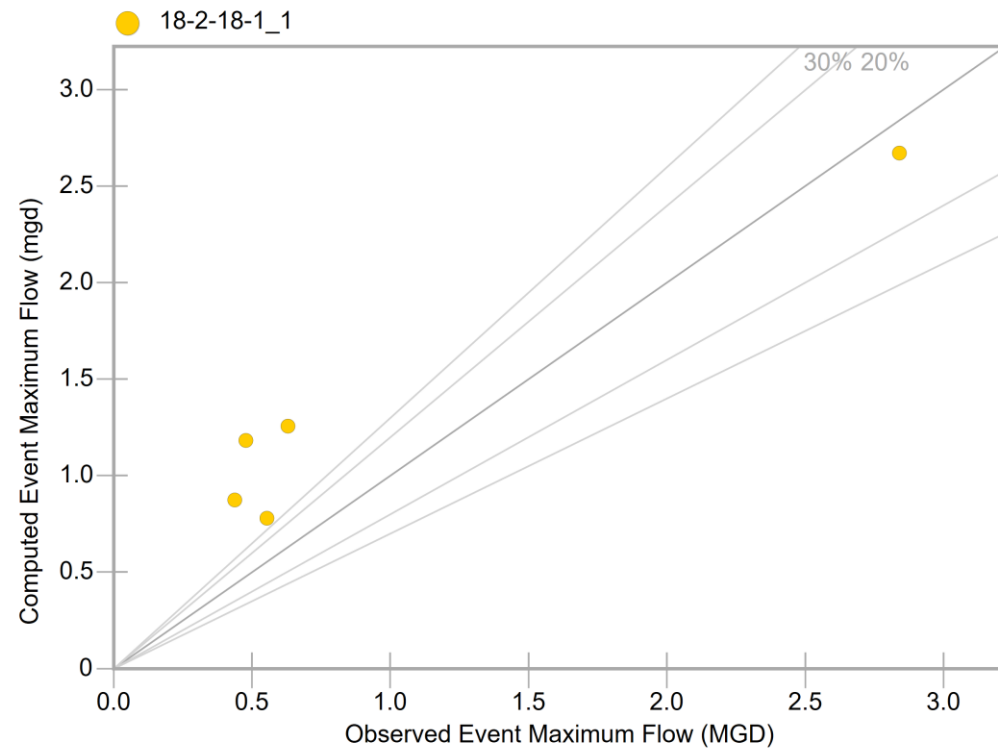


FM_17

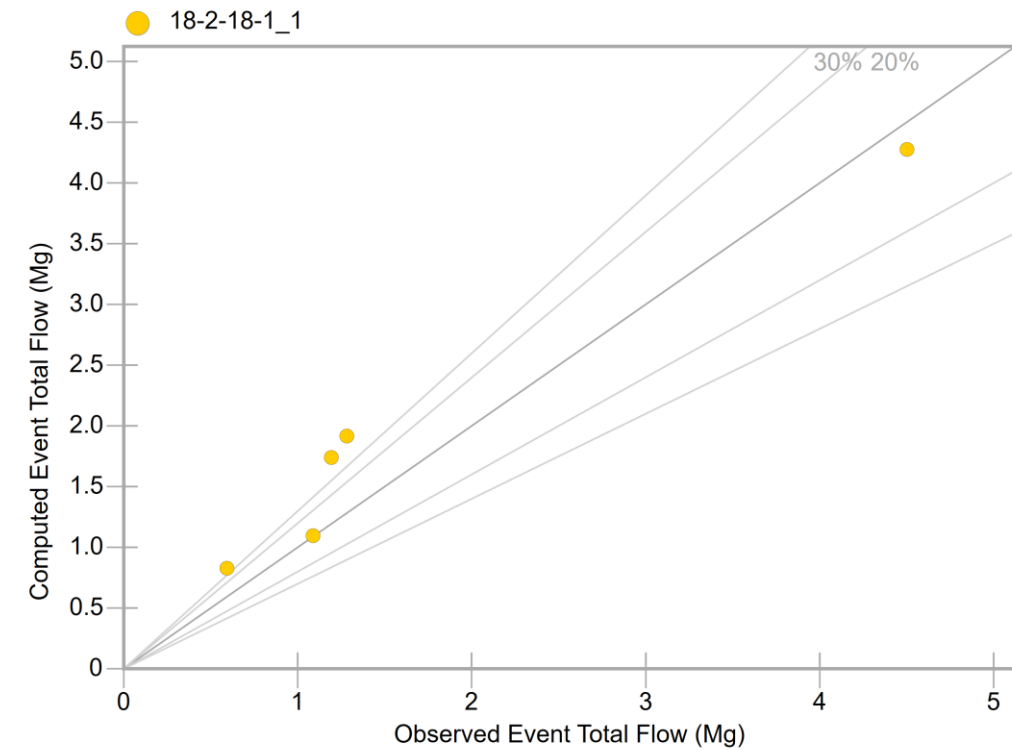


FM_18

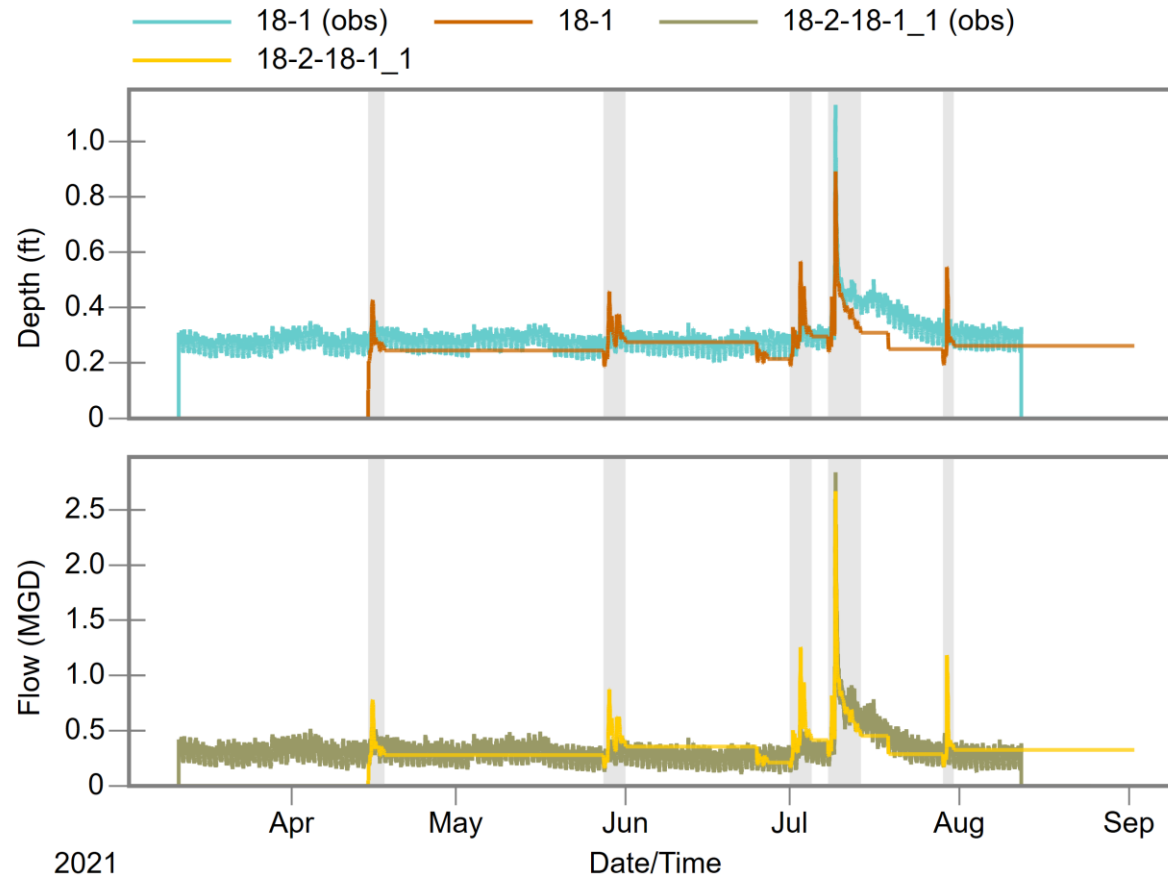
Peaks



Volumes

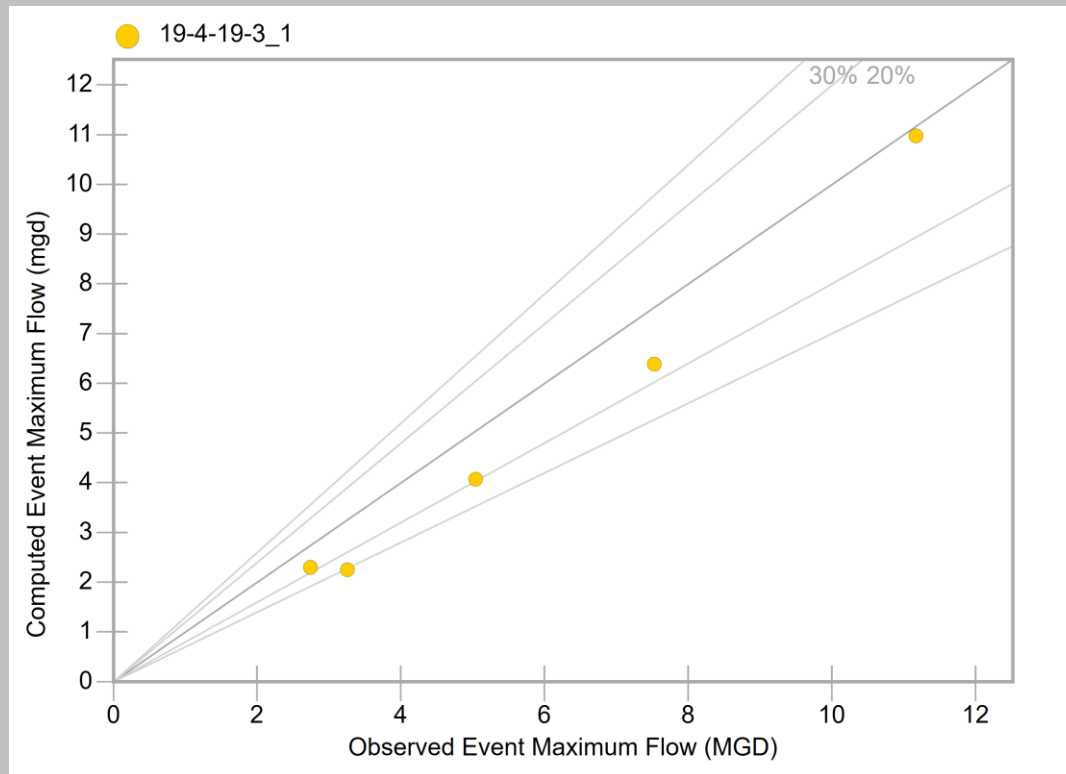


FM_18

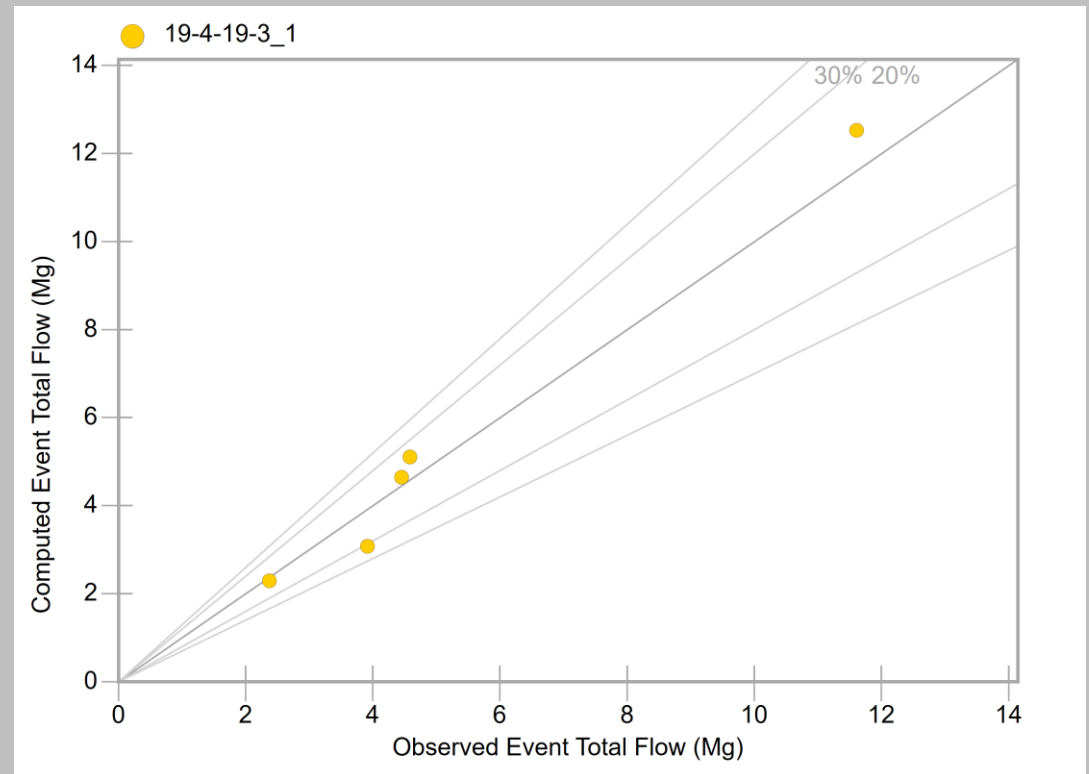


FM_19

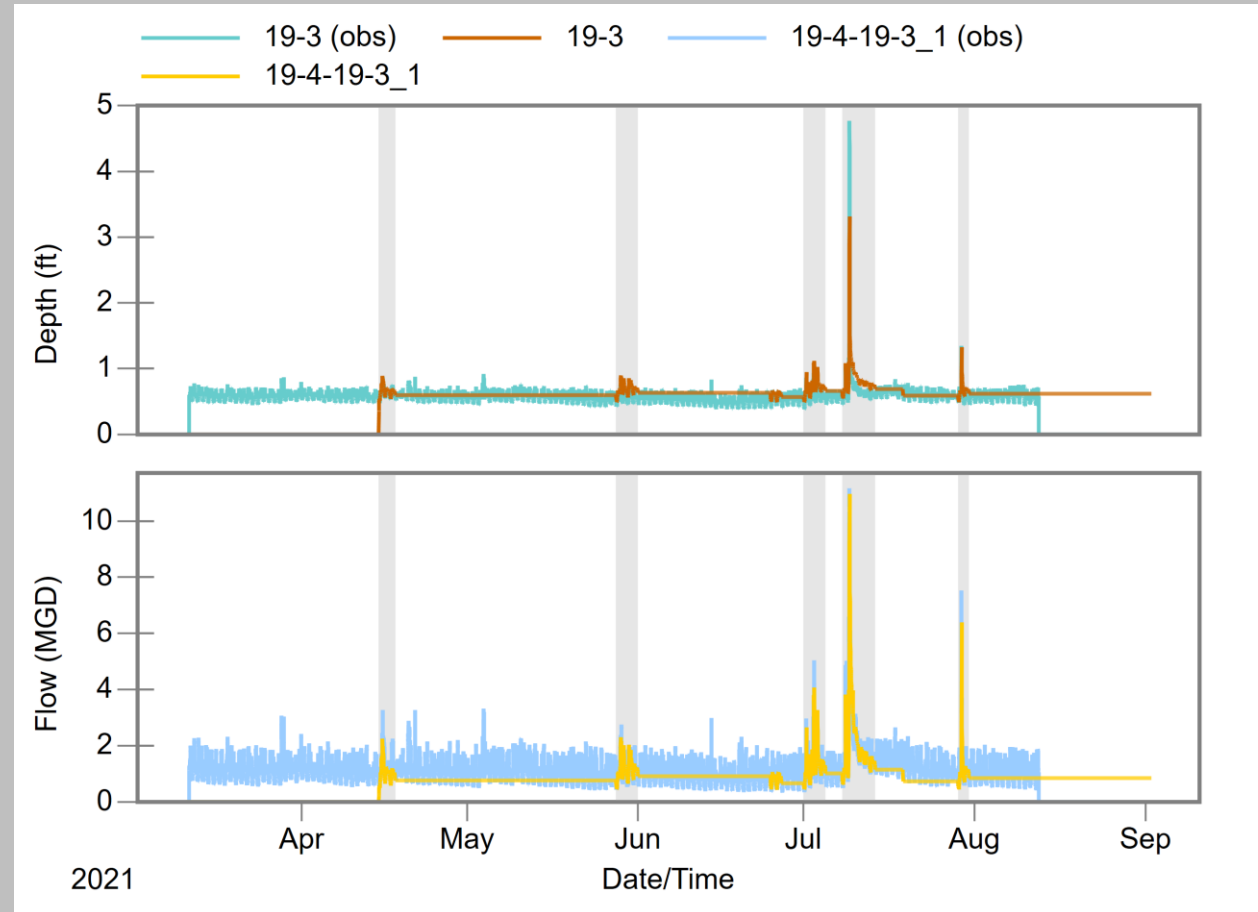
Peaks



Volumes

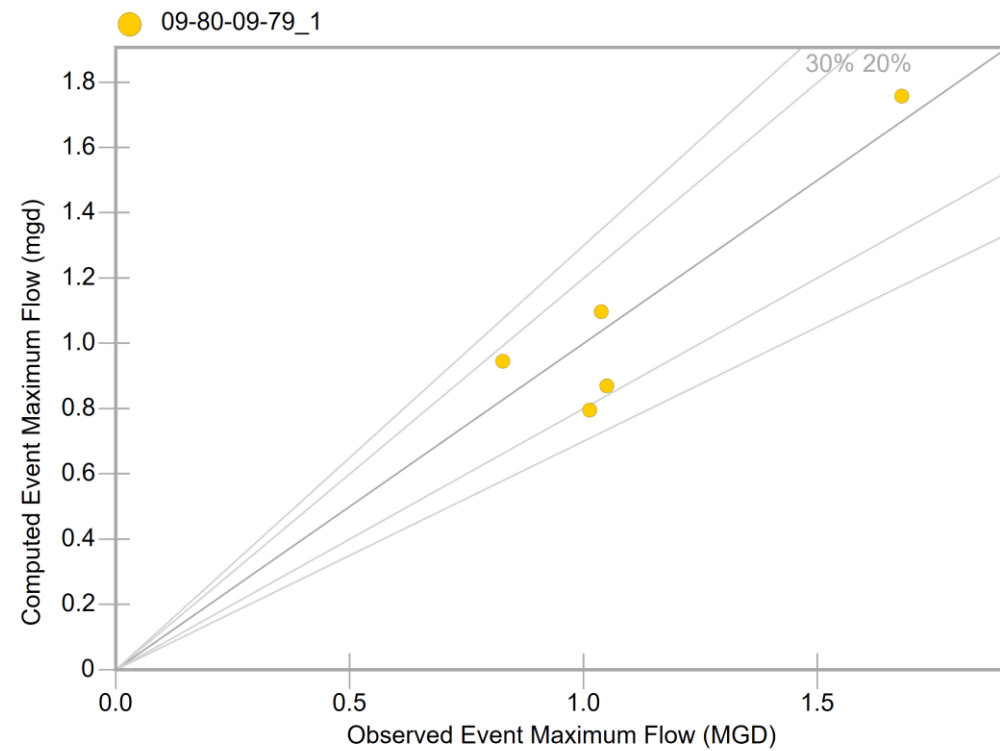


FM_19

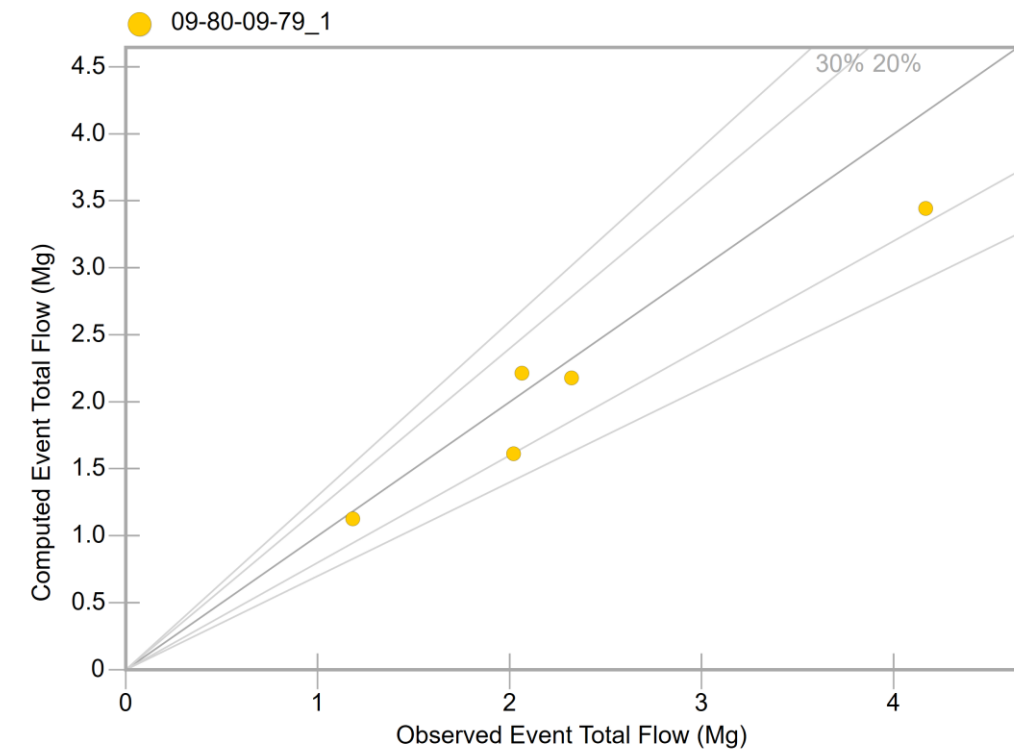


FM_20

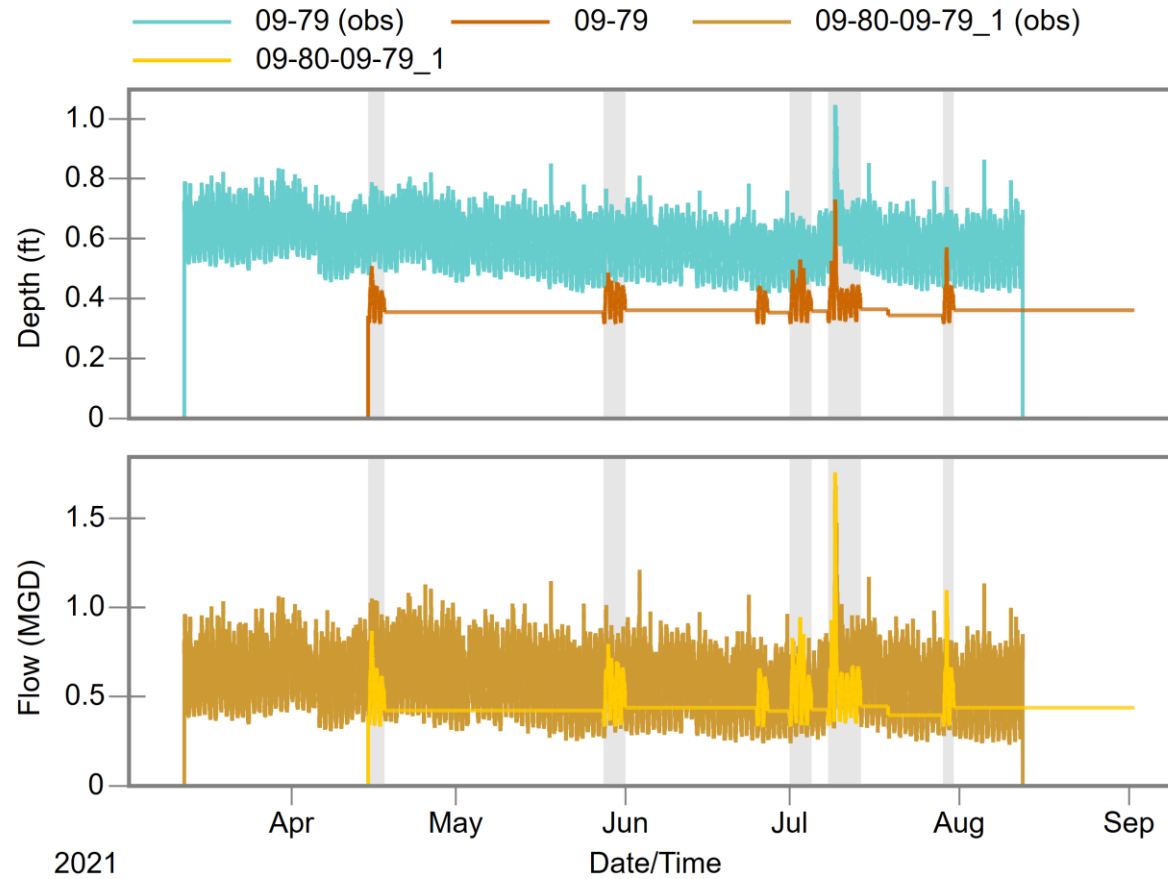
Peaks



Volumes

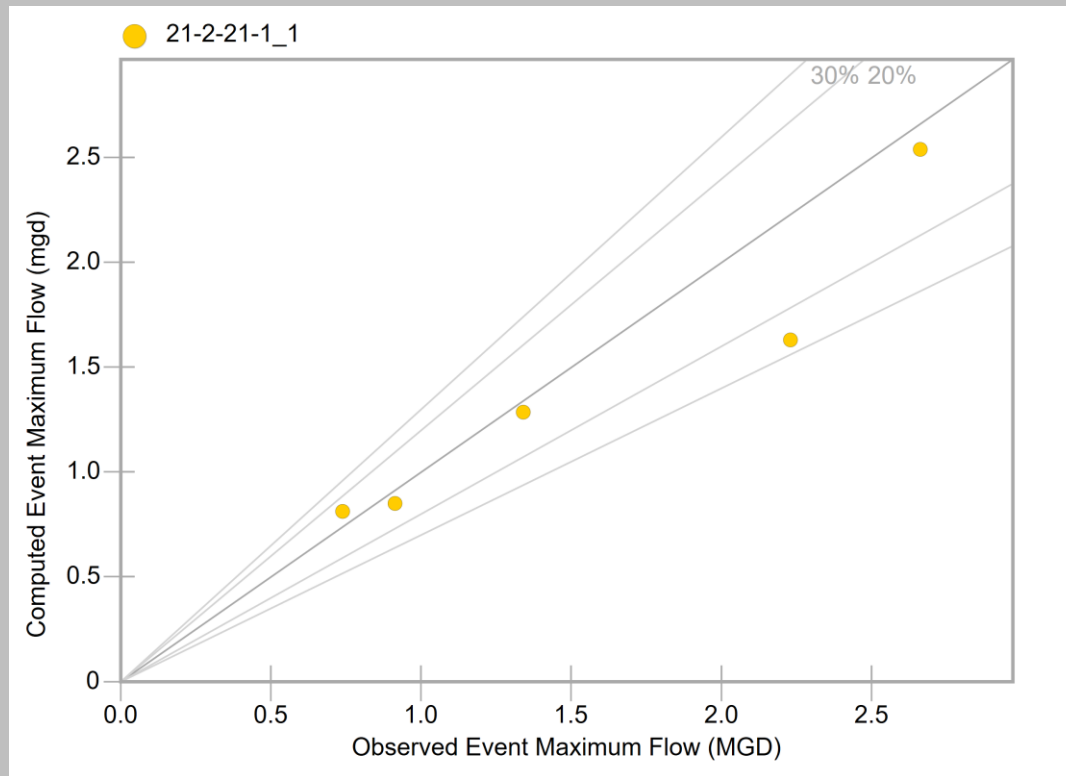


FM_20

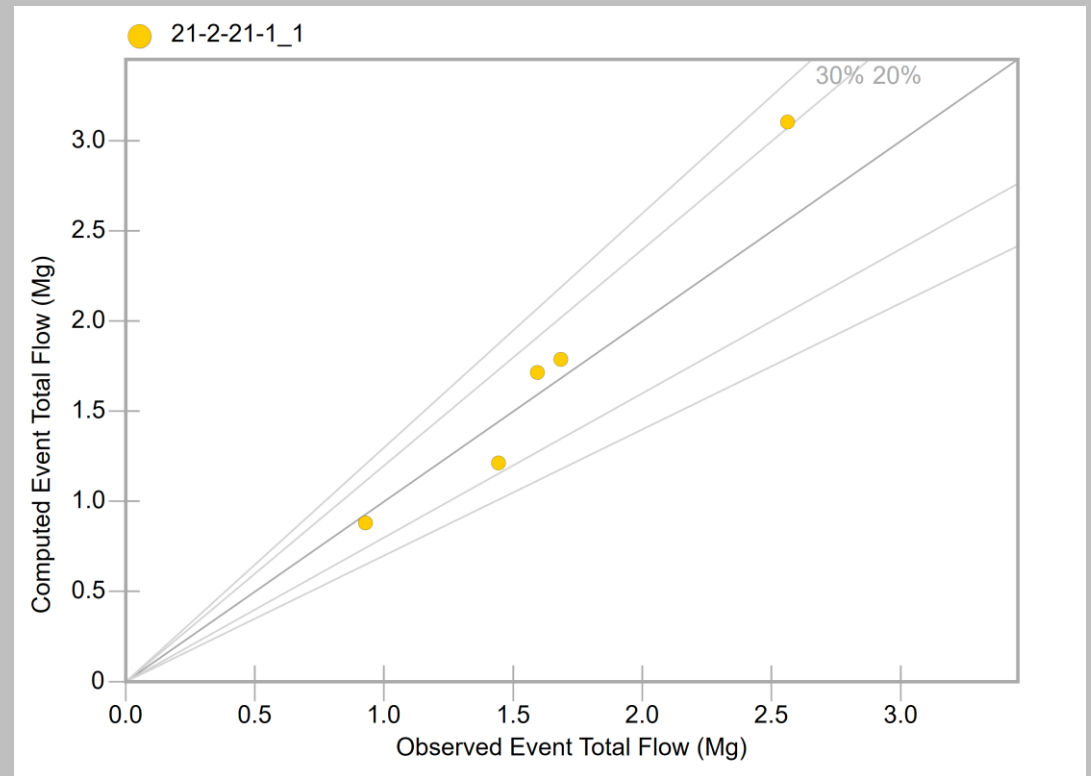


FM_21

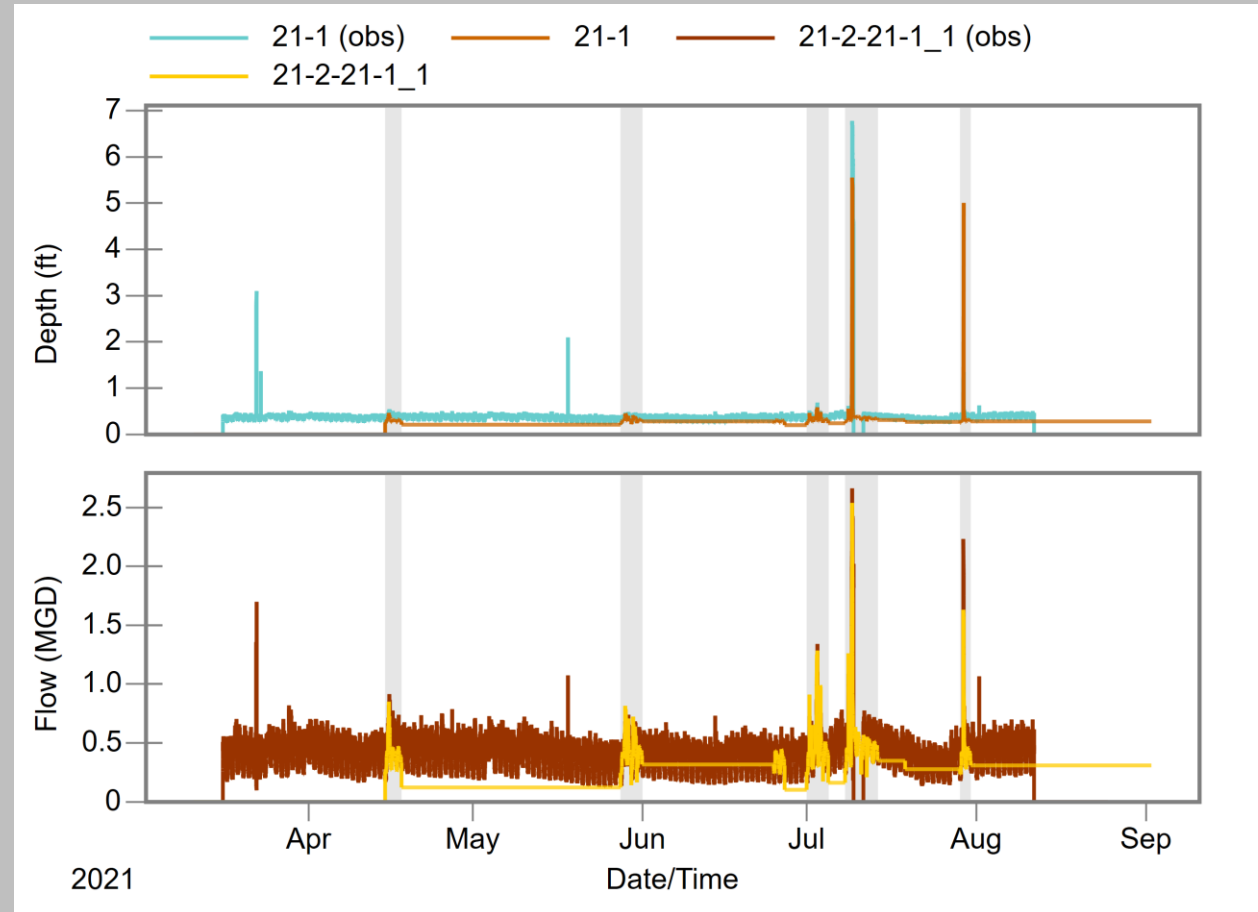
Peaks



Volumes

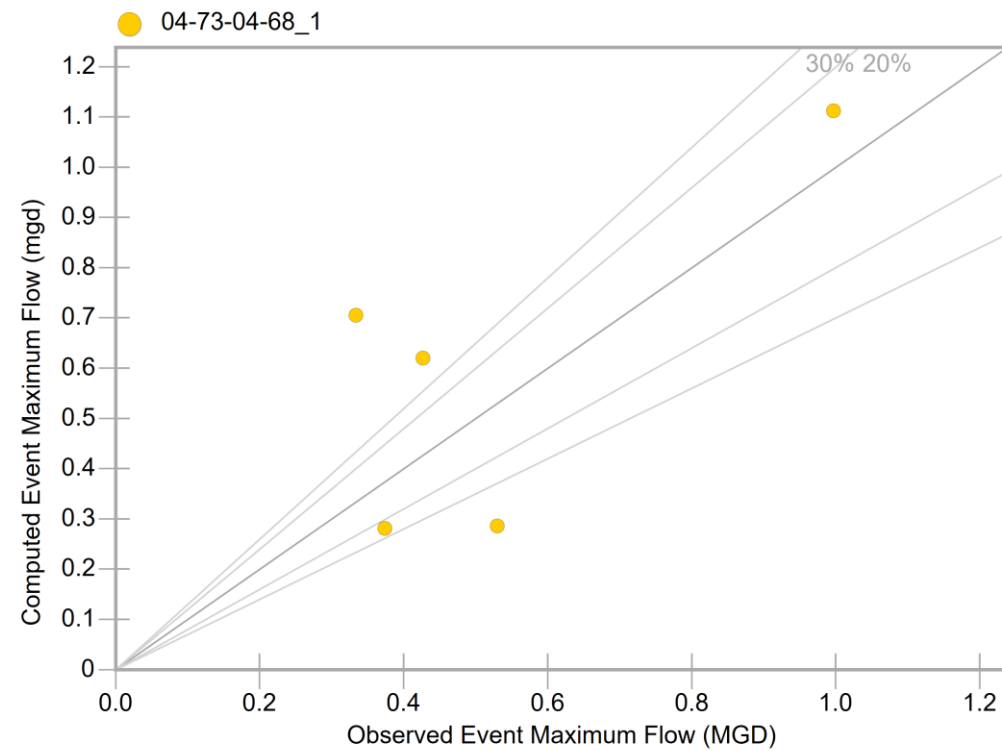


FM_21

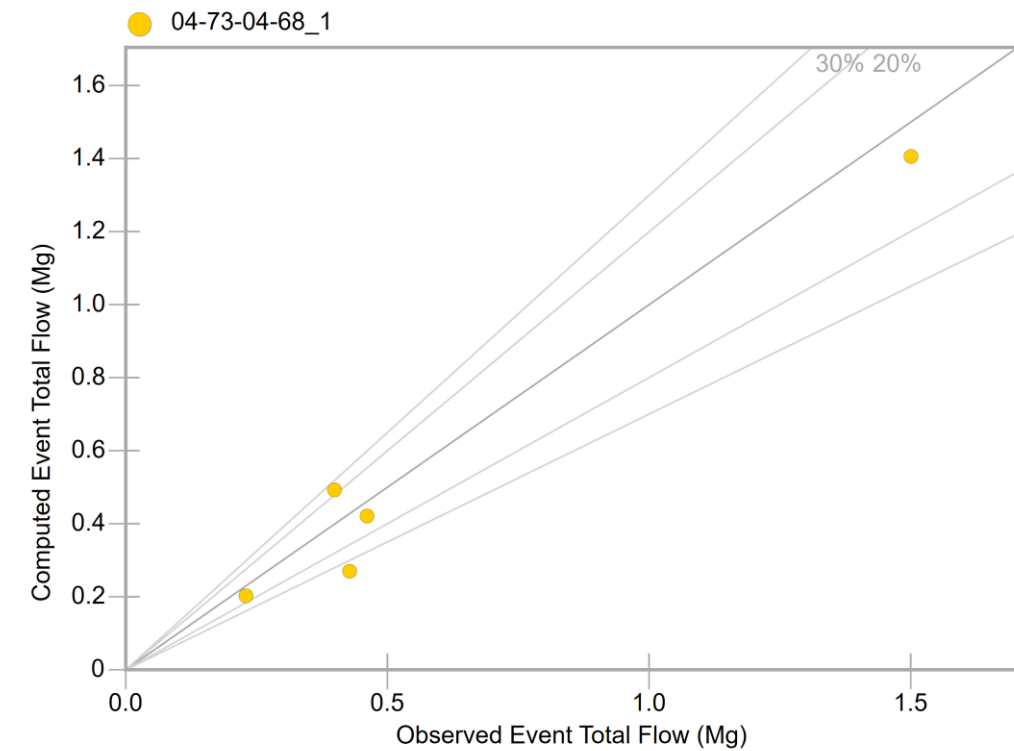


FM_22

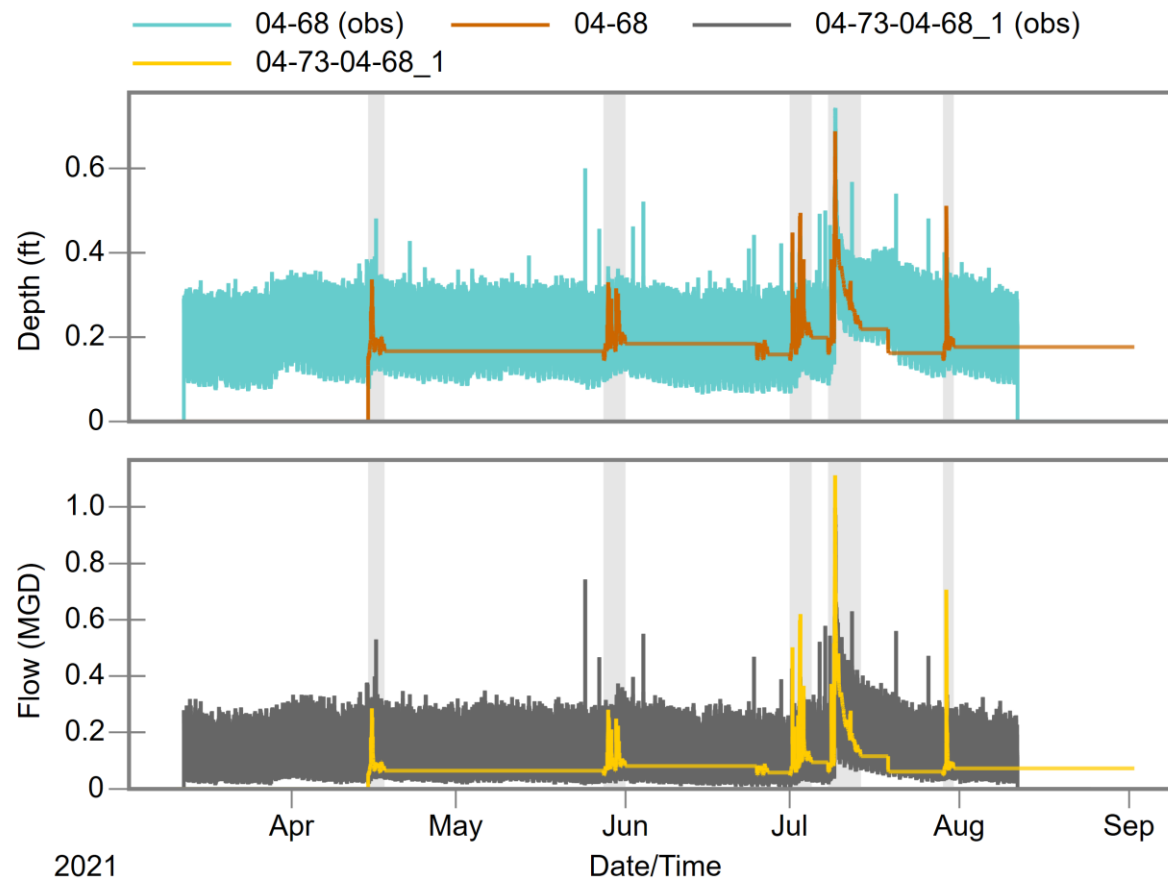
Peaks



Volumes

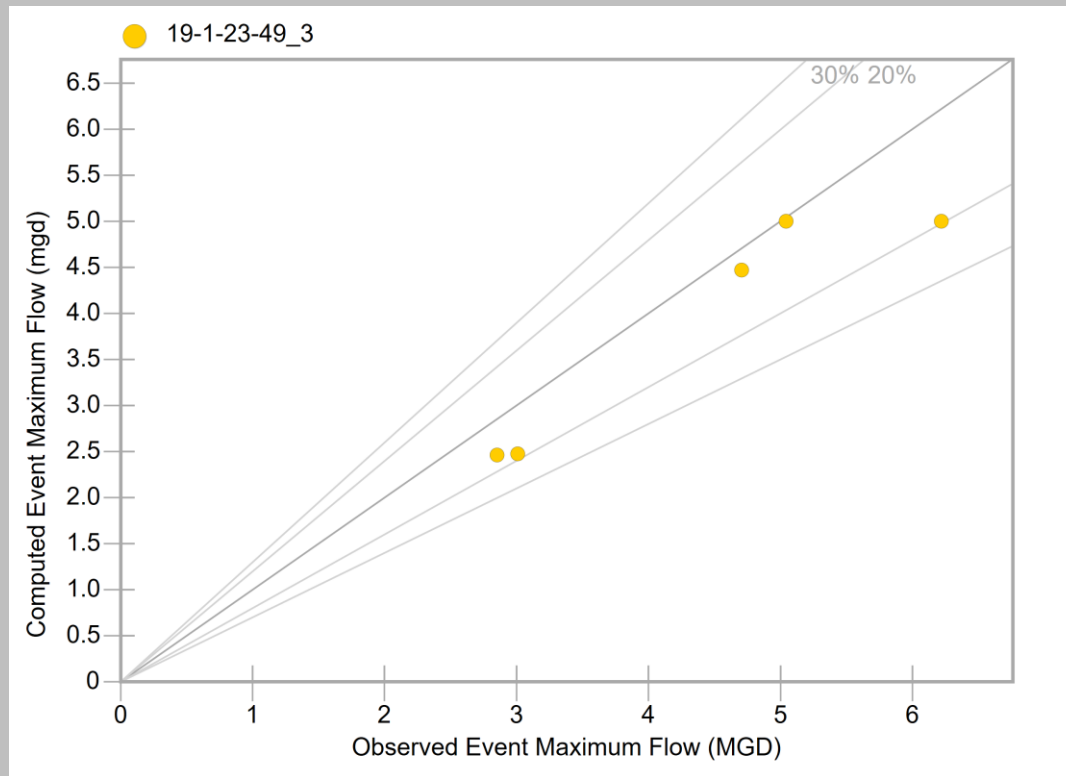


FM_22

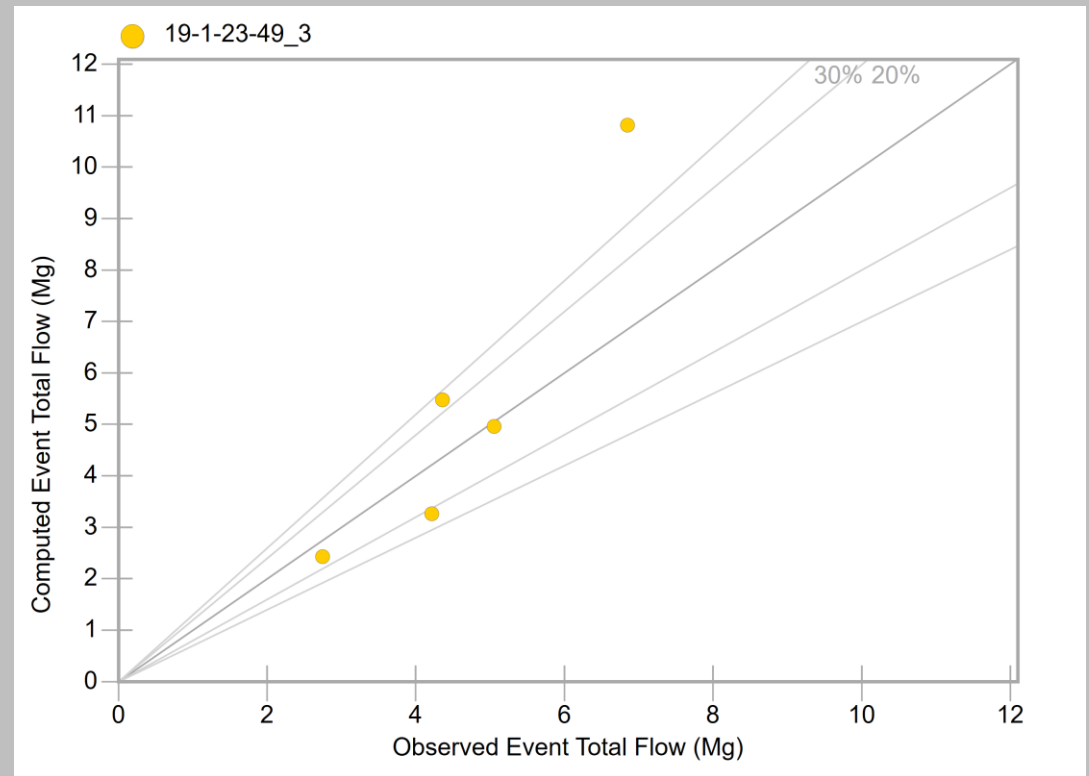


FM_23

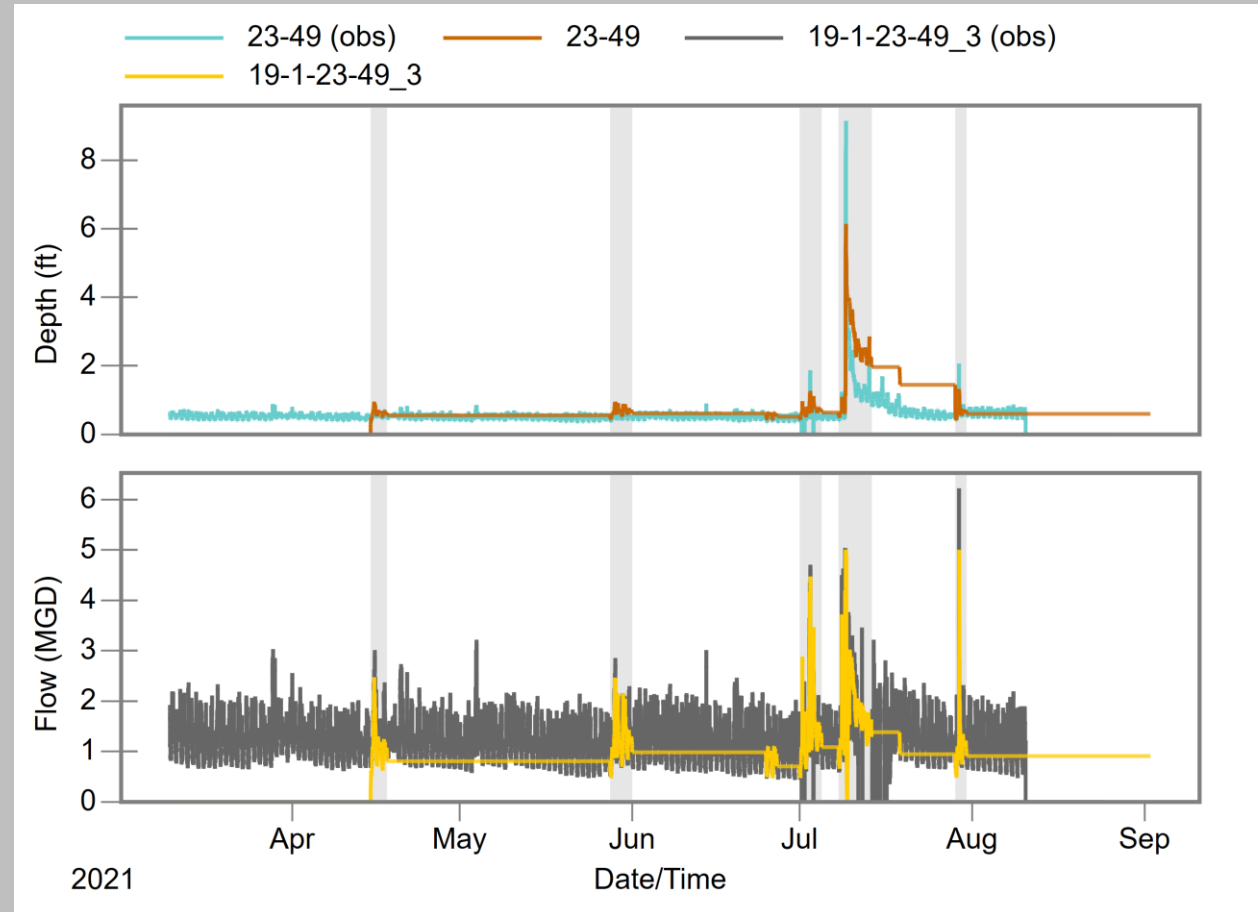
Peaks



Volumes

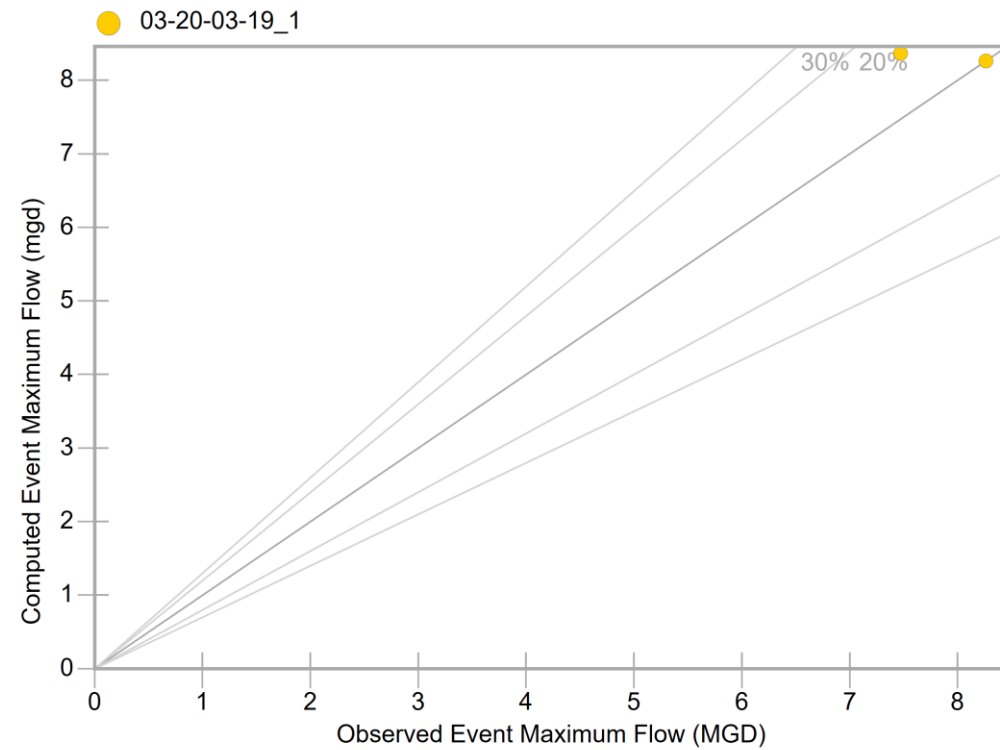


FM_23

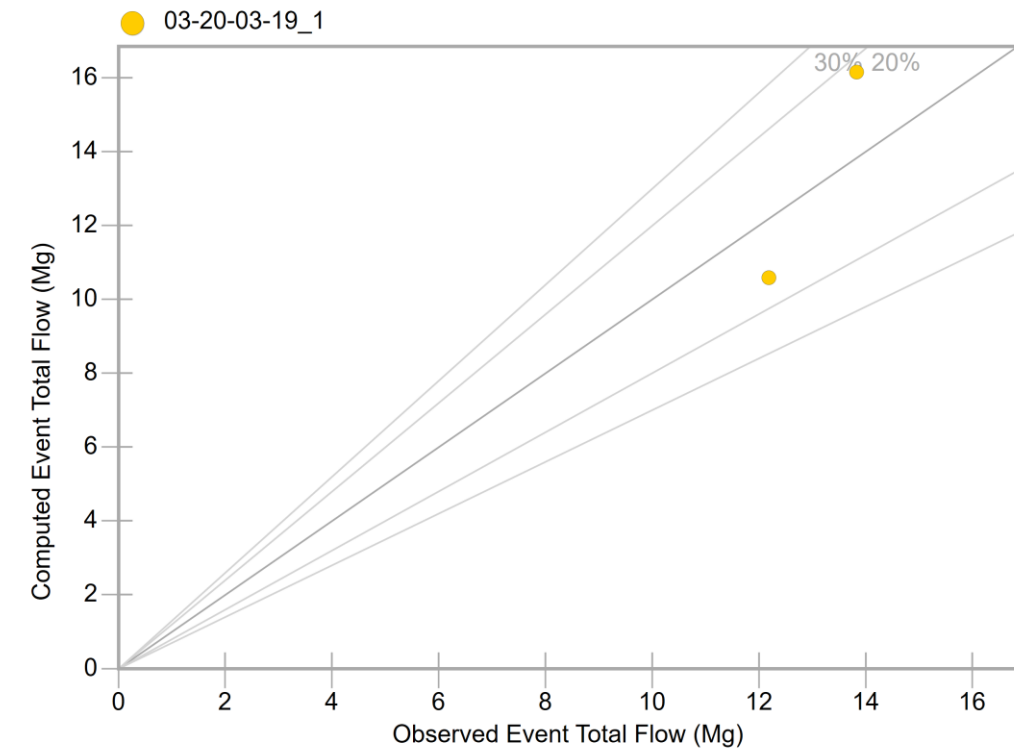


FM_24

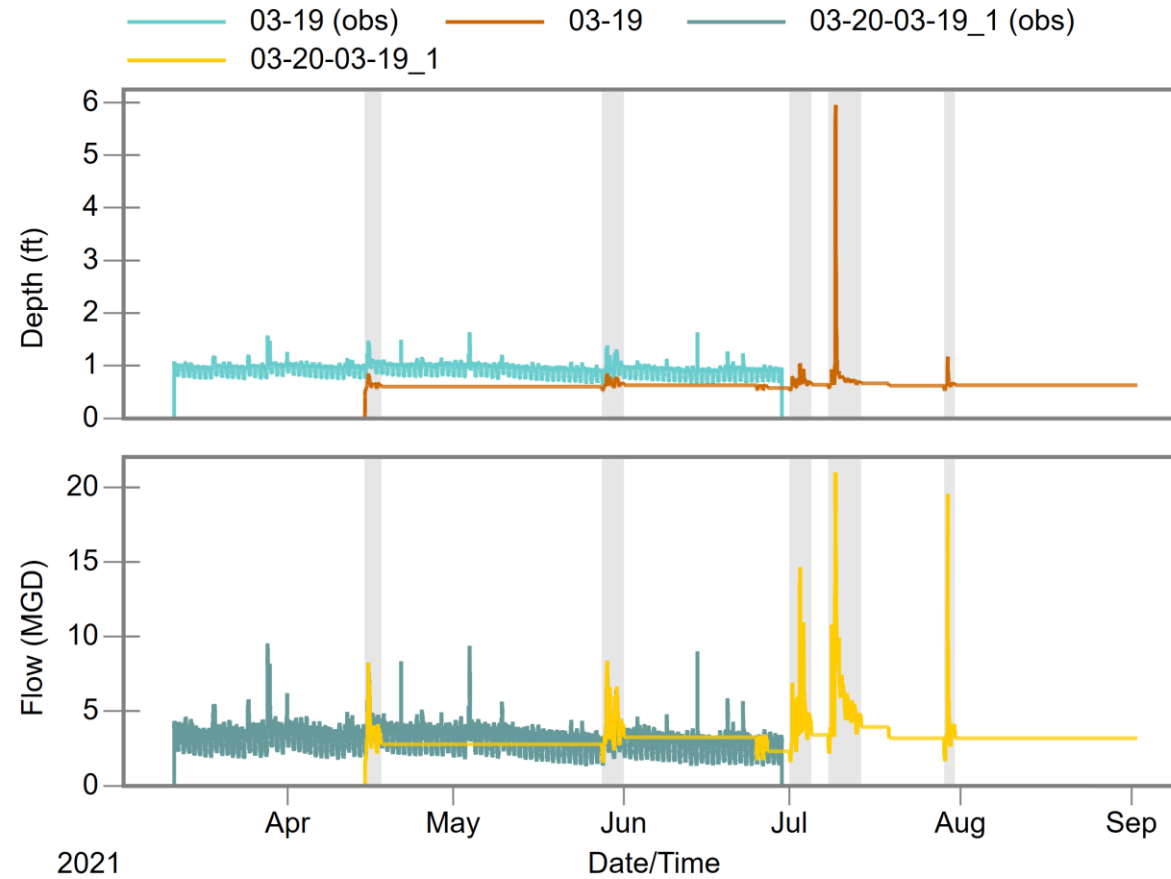
Peaks



Volumes

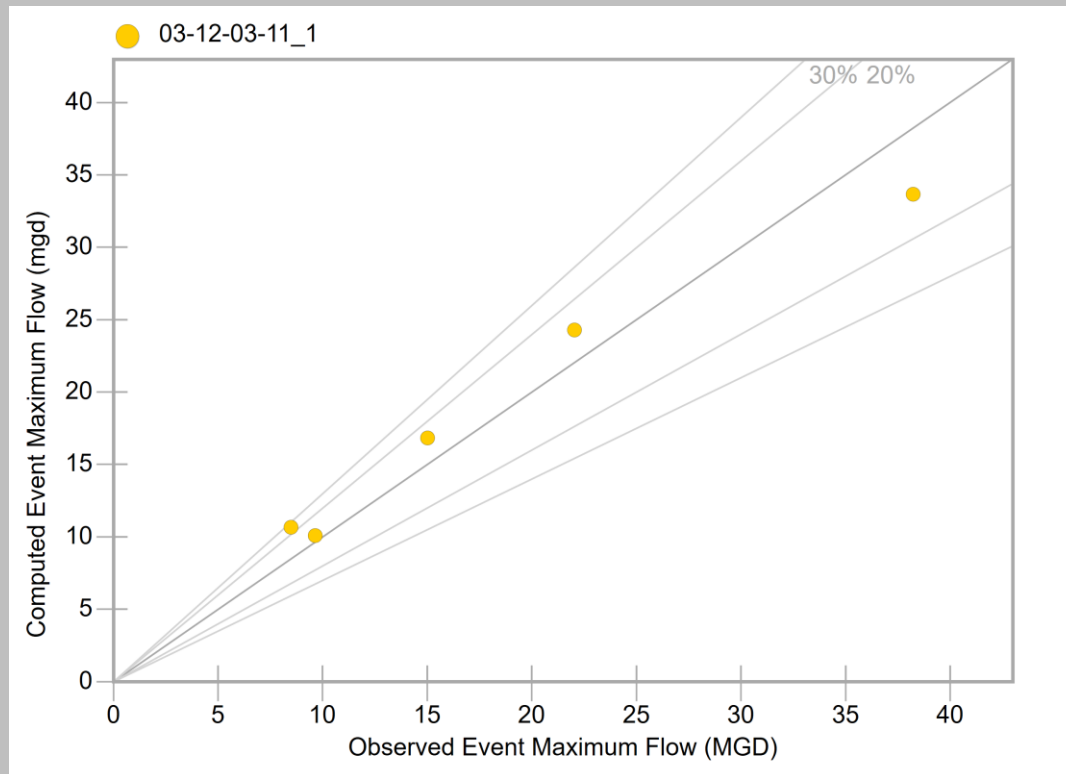


FM_24

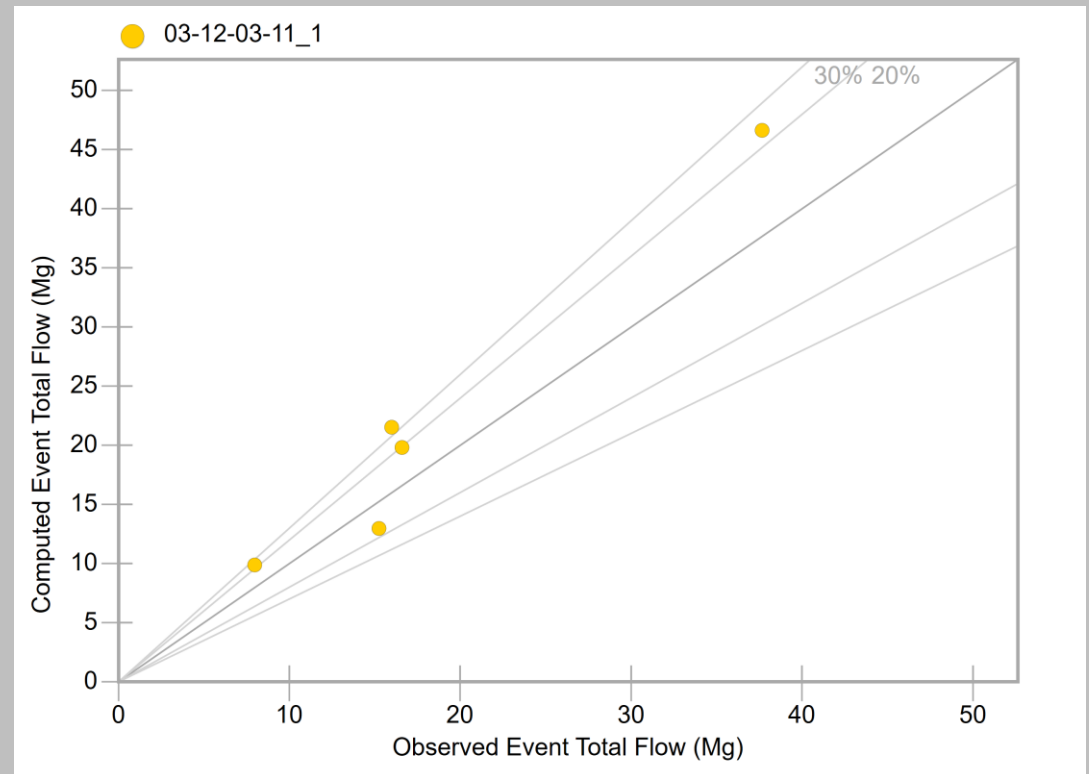


FM_25

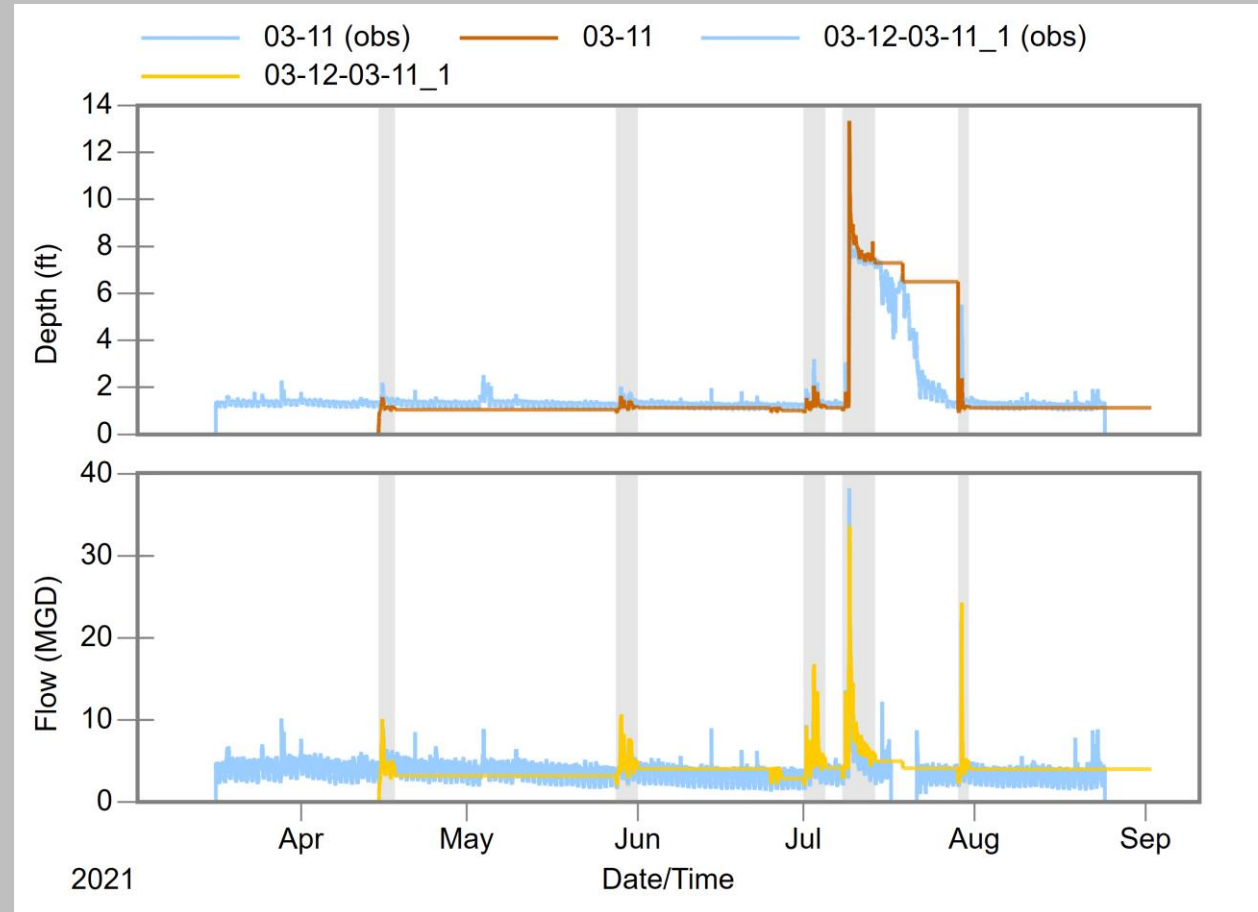
Peaks



Volumes

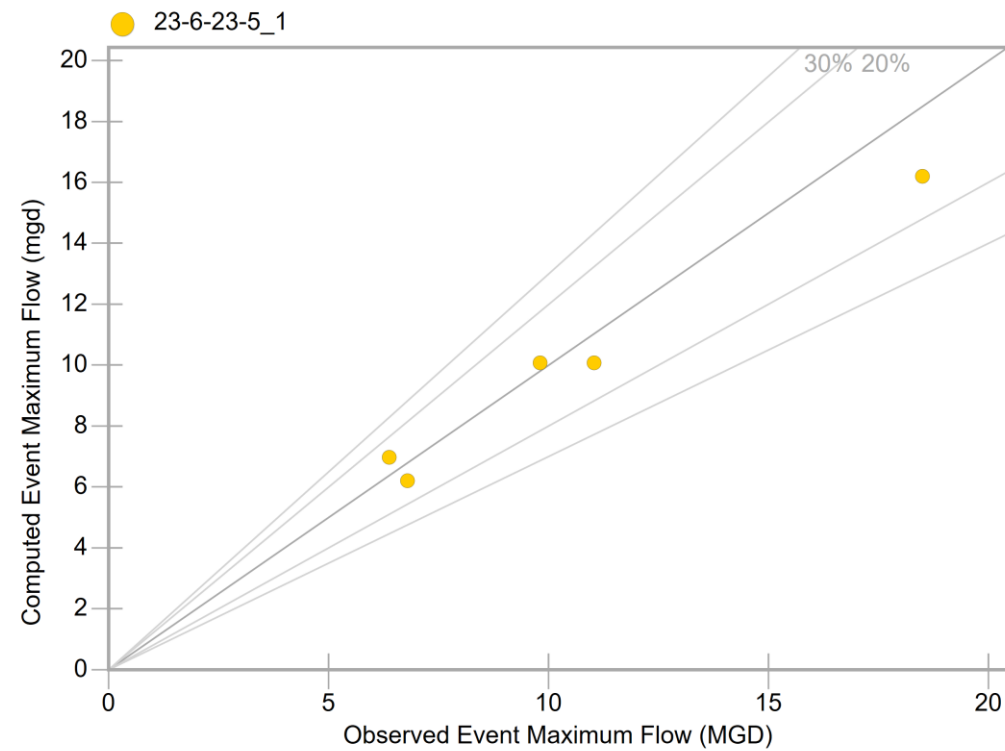


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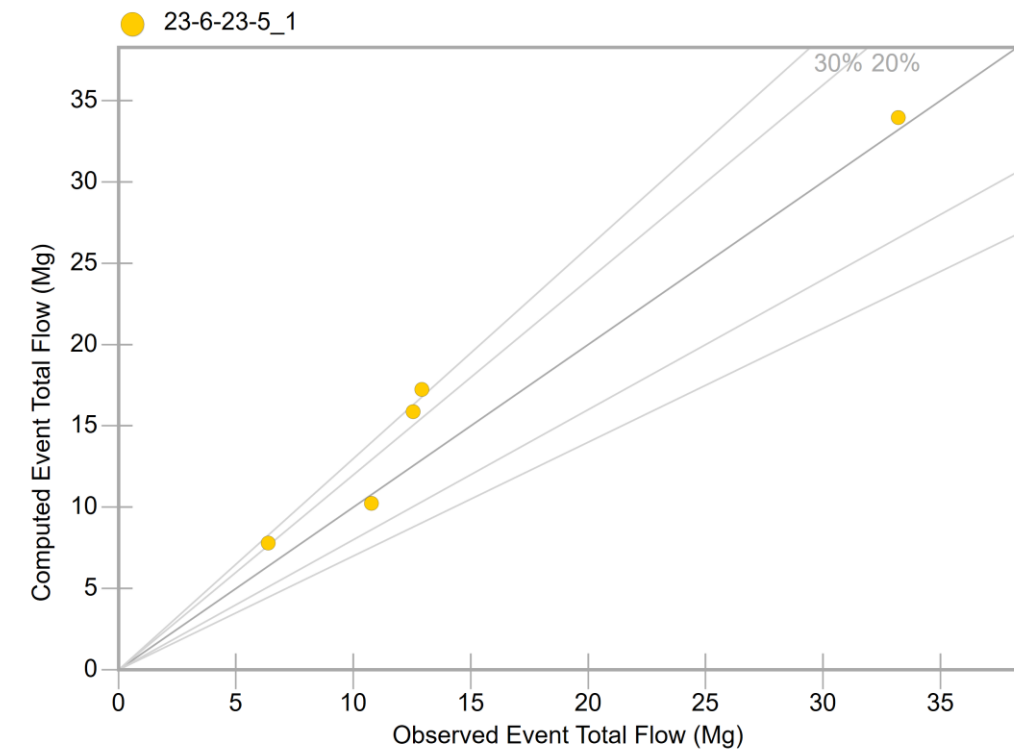


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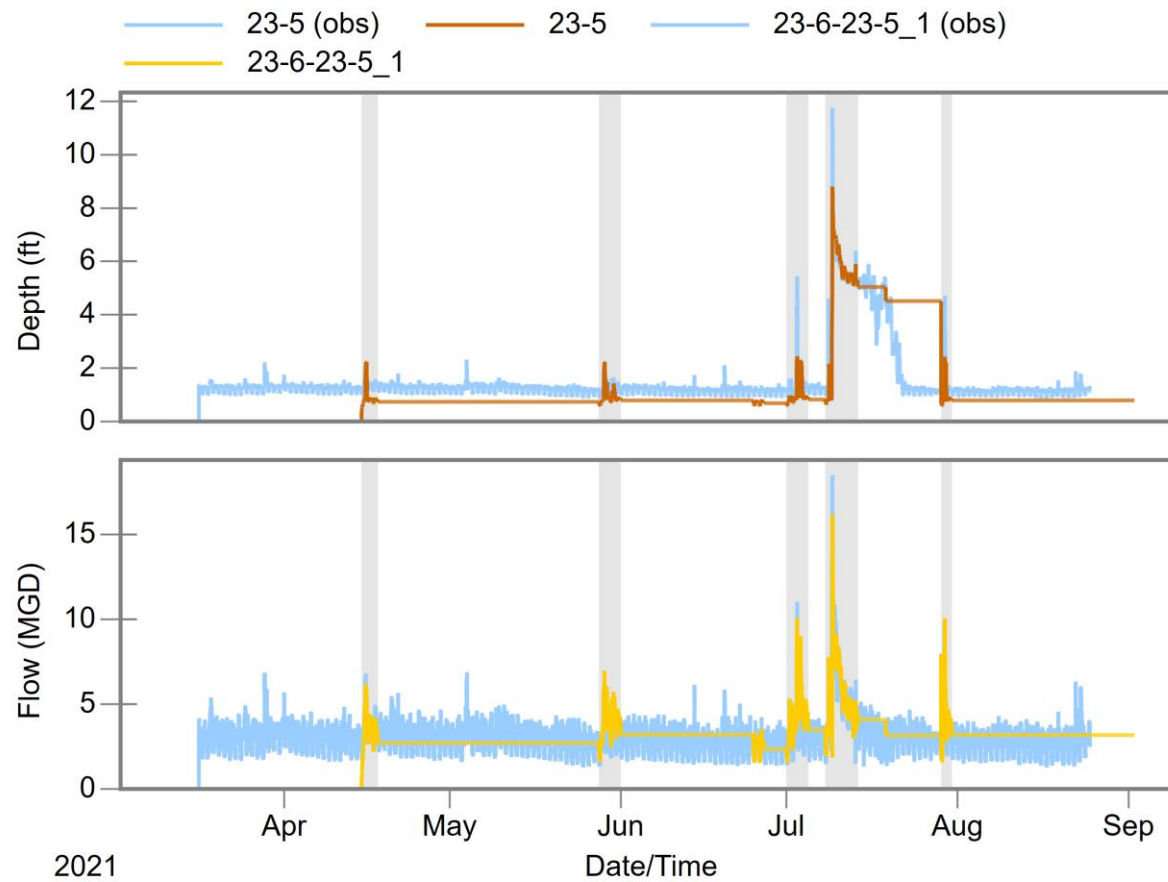
Peaks



Volumes

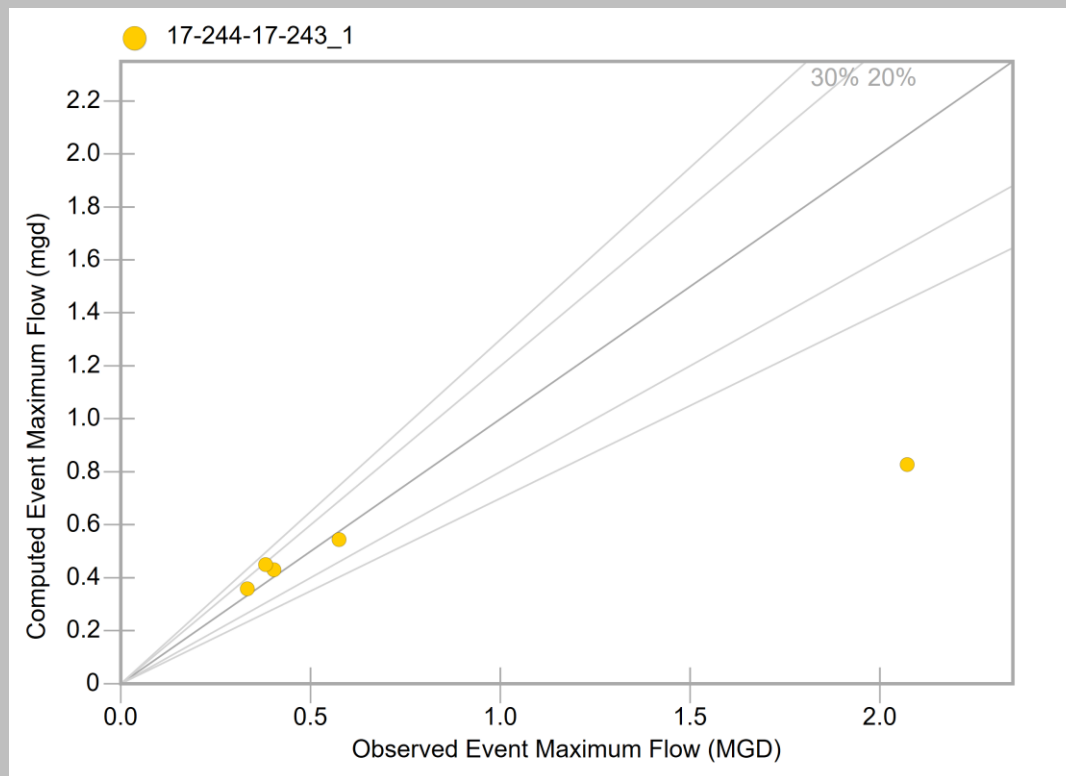


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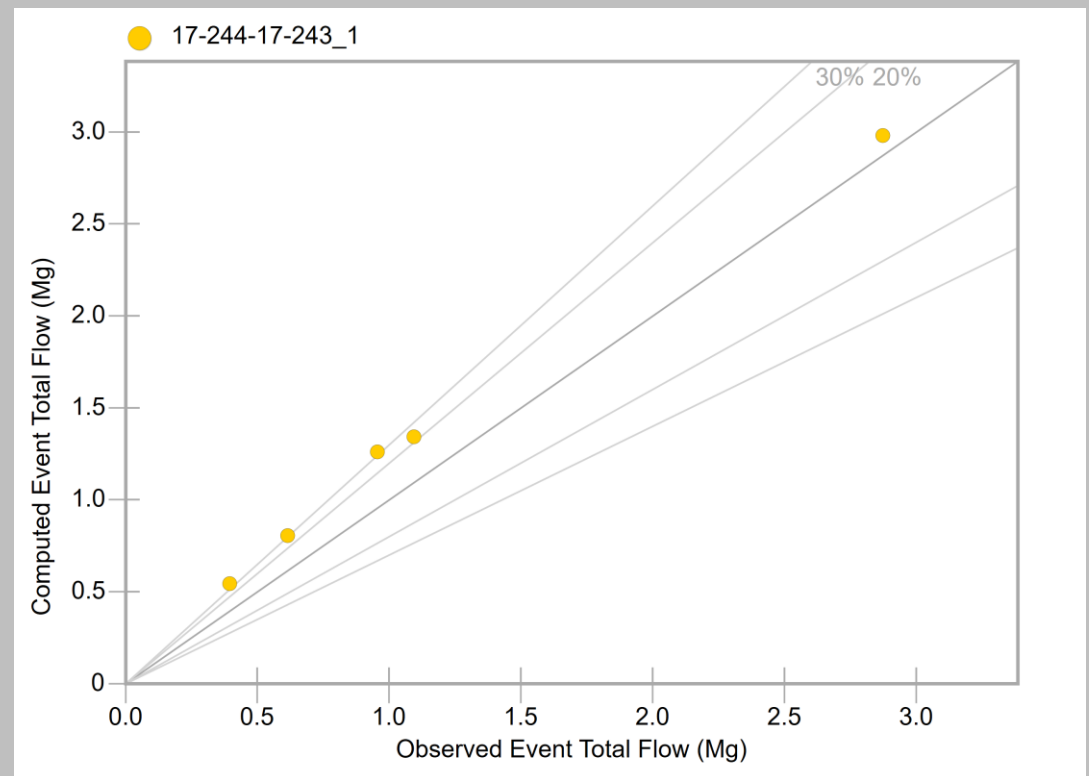


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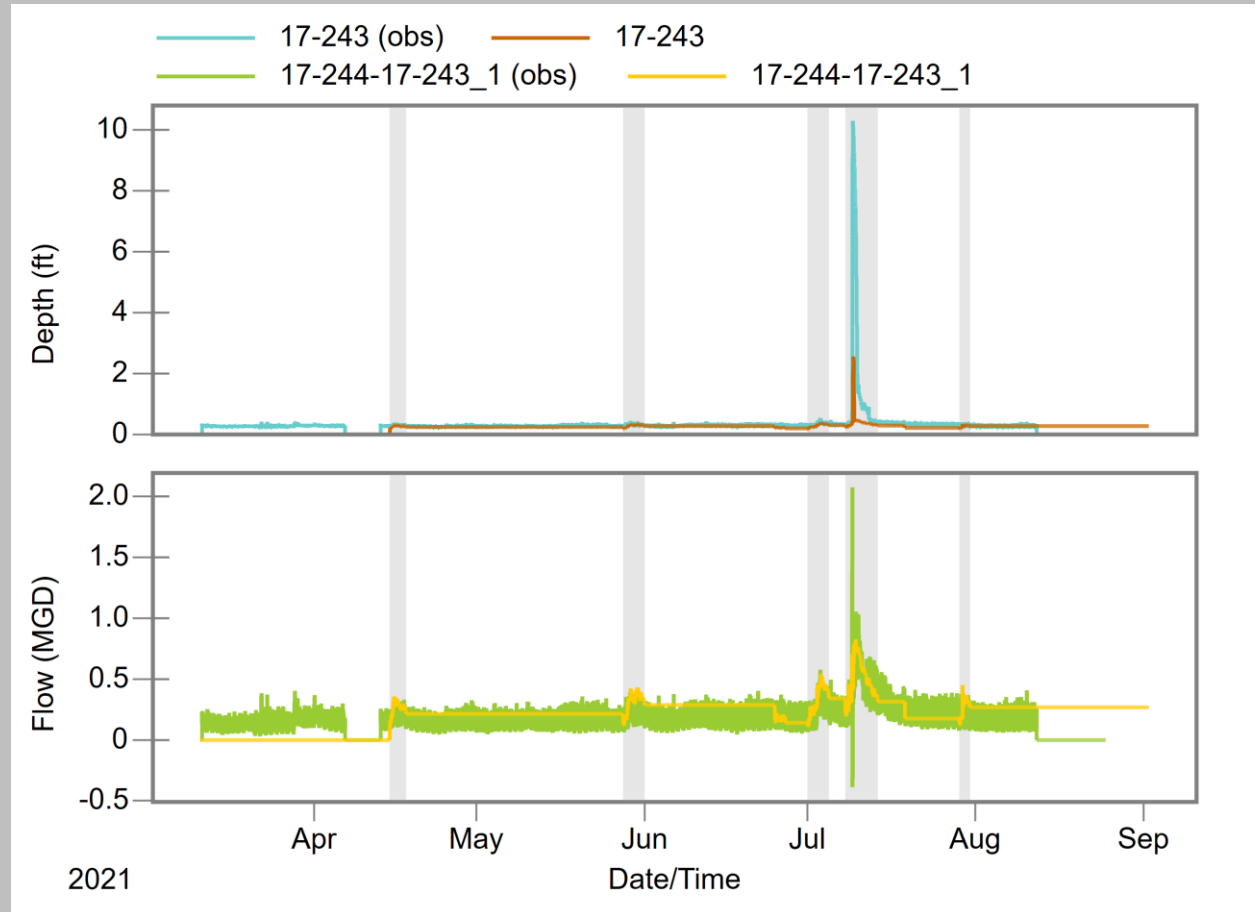
Peaks



Volumes

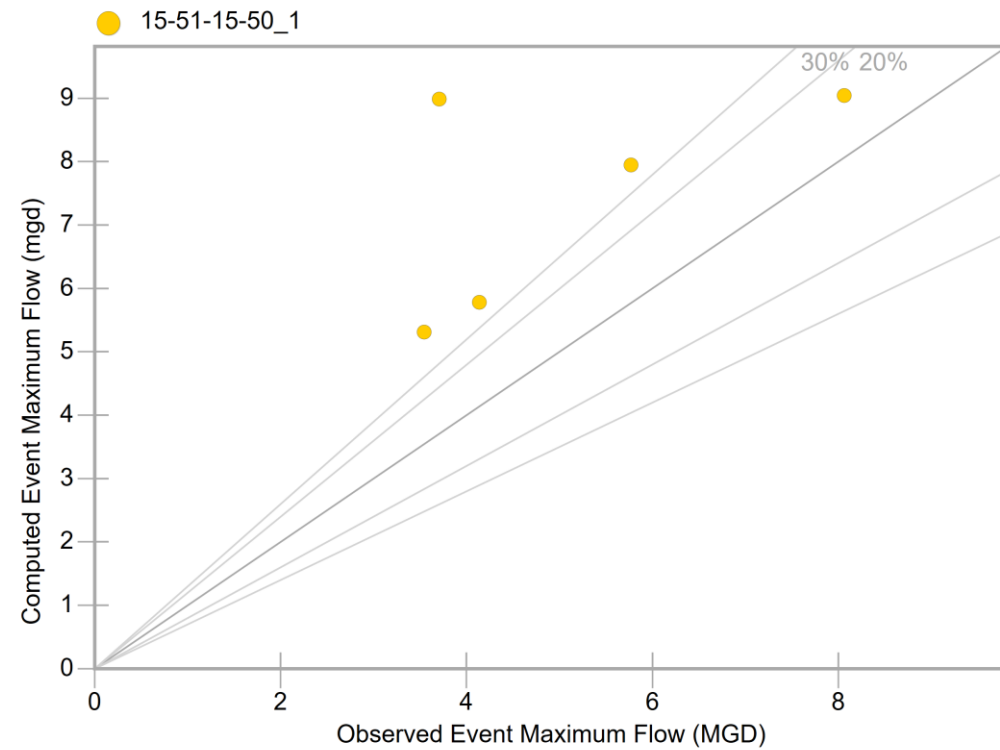


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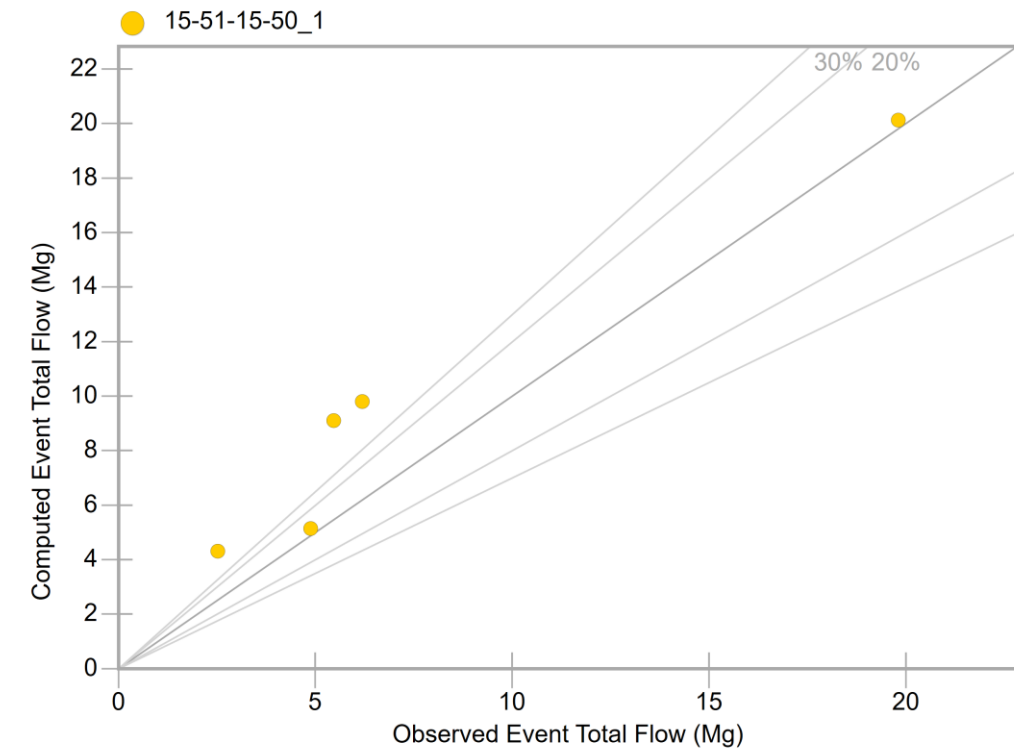


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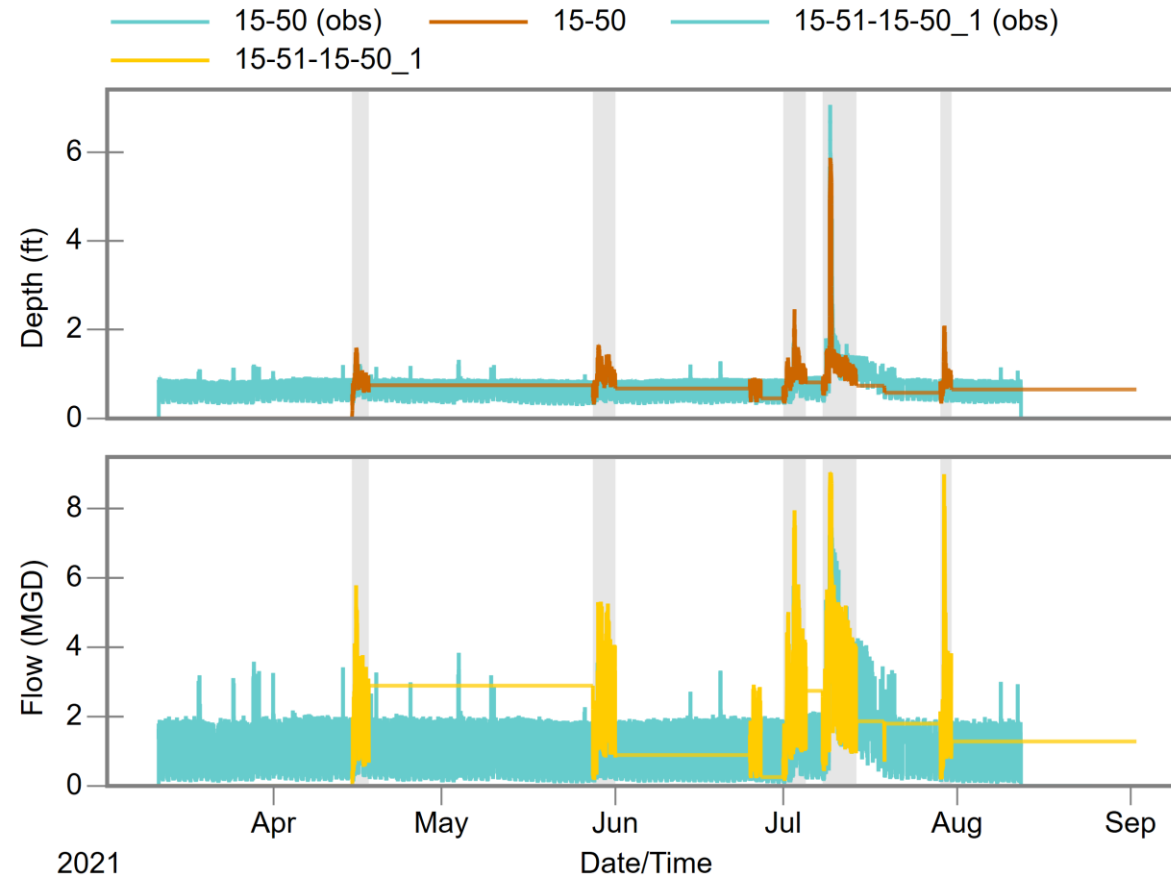
Peaks



Volumes

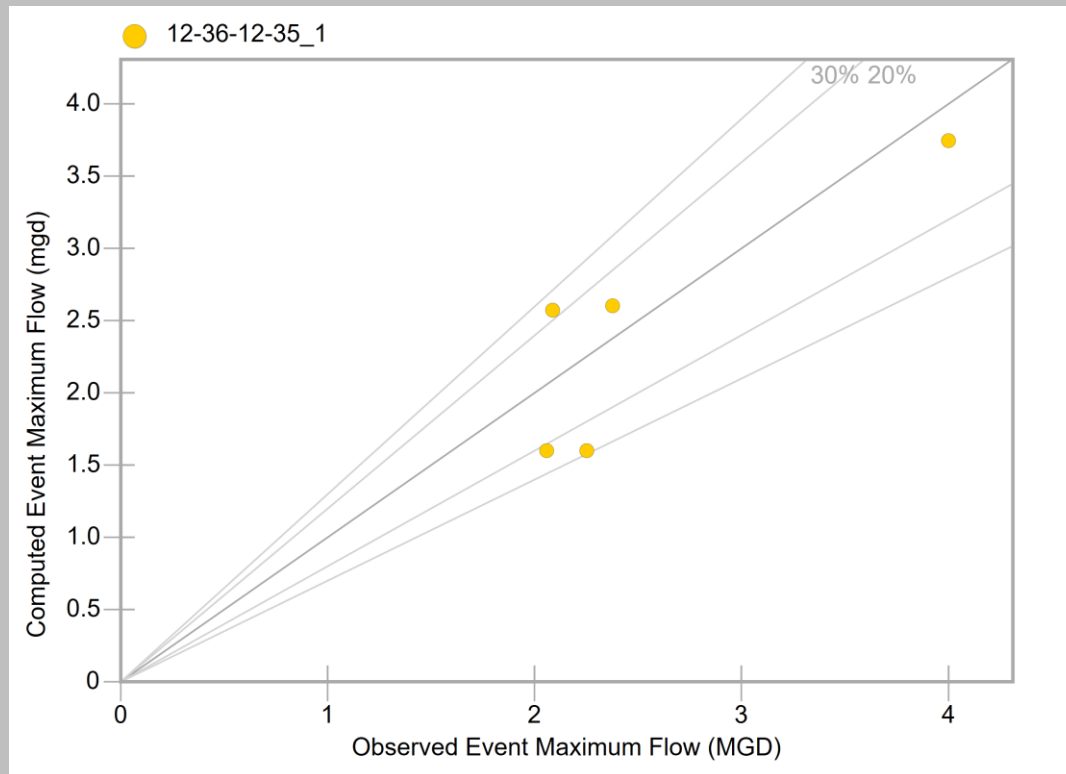


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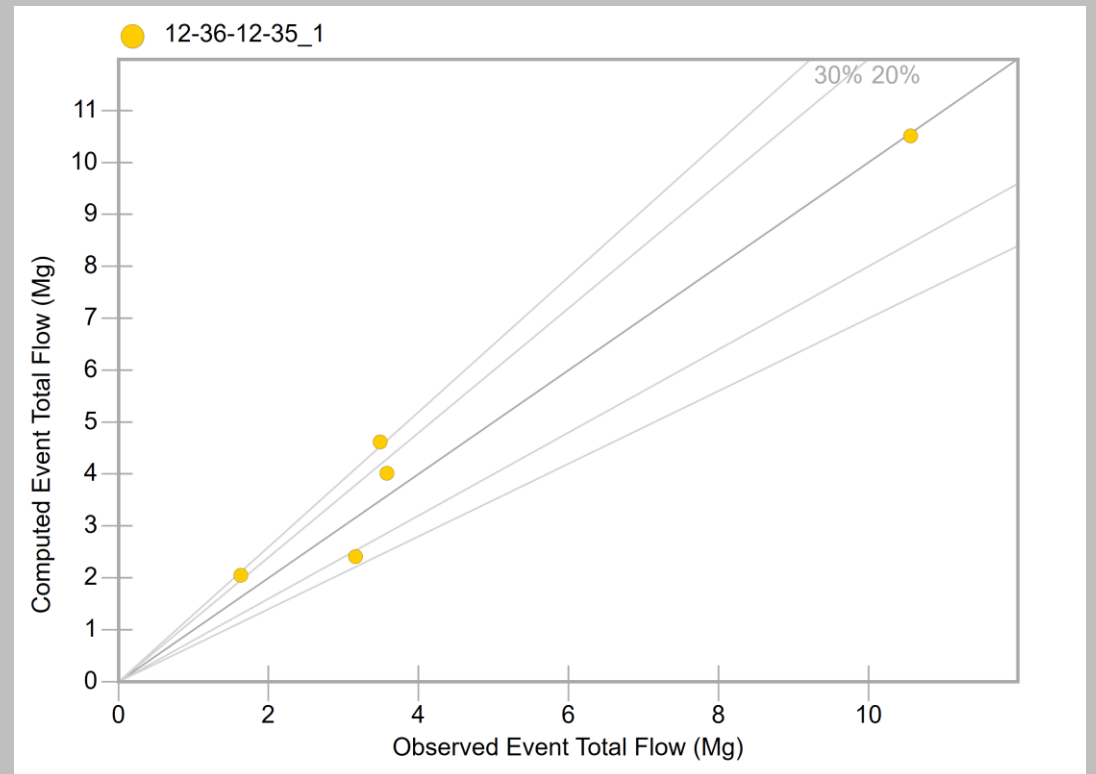


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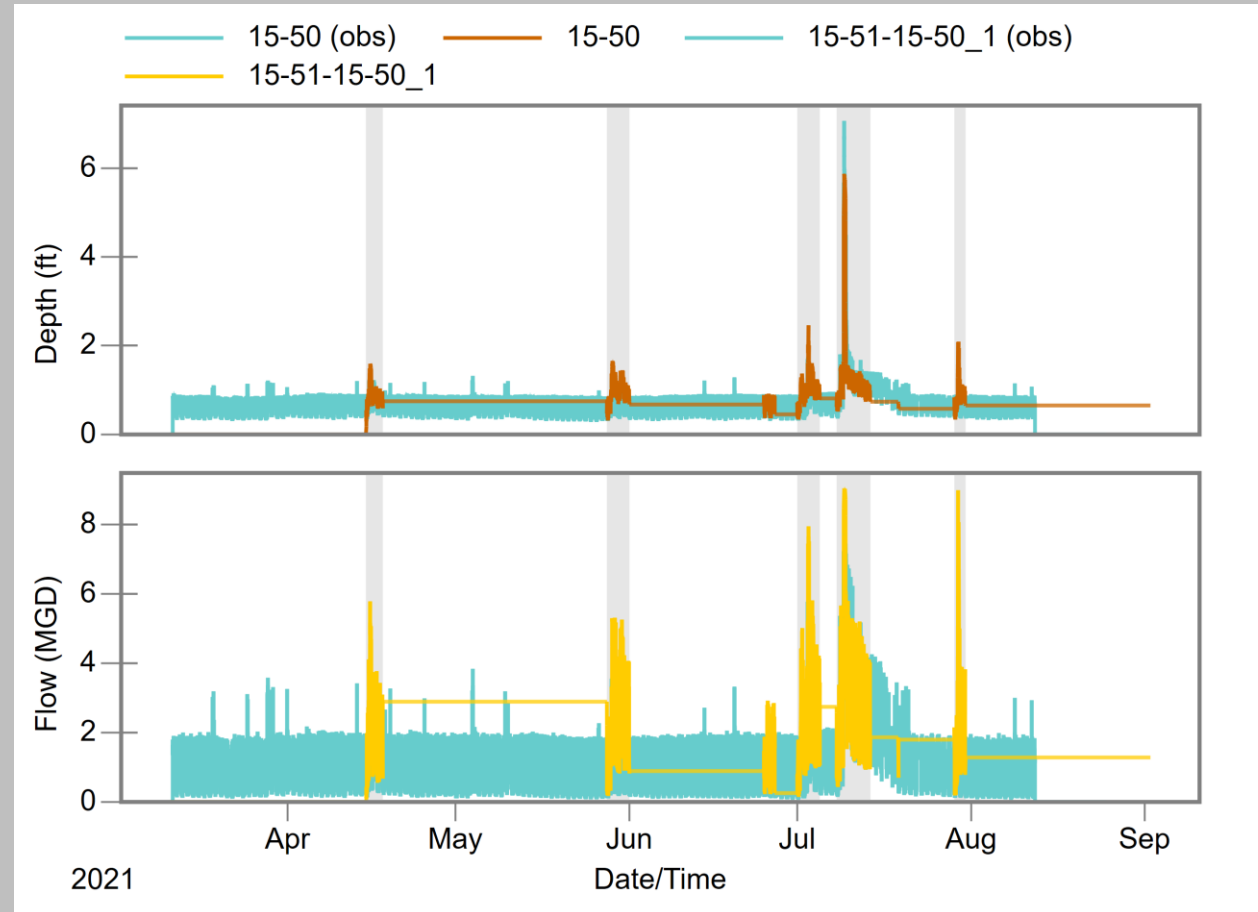
Peaks



Volumes

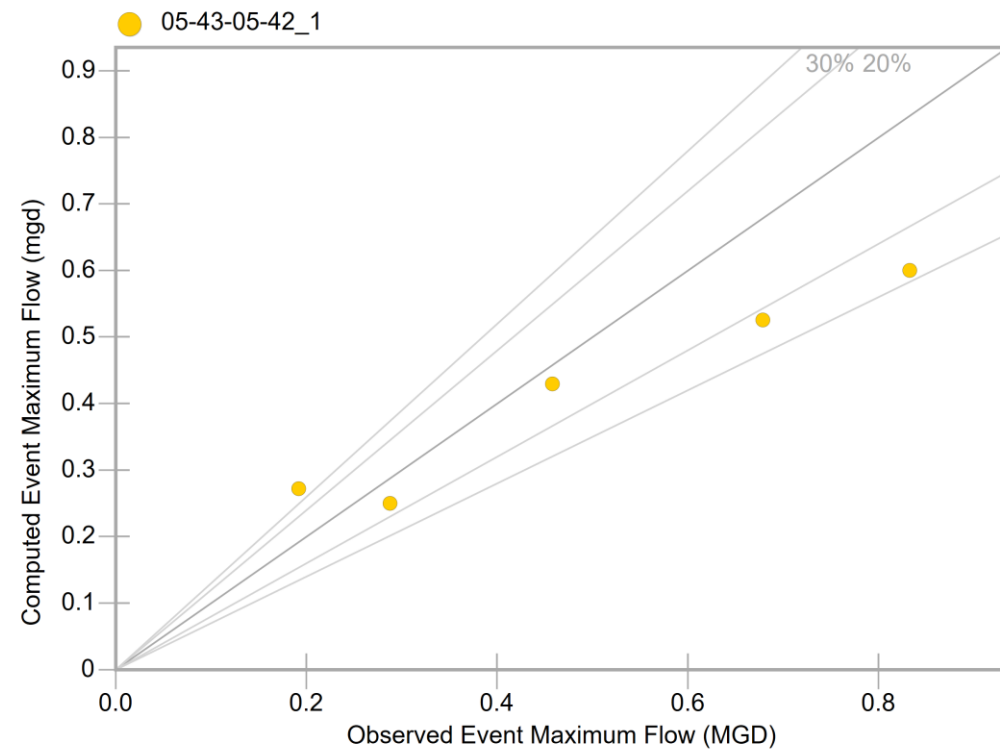


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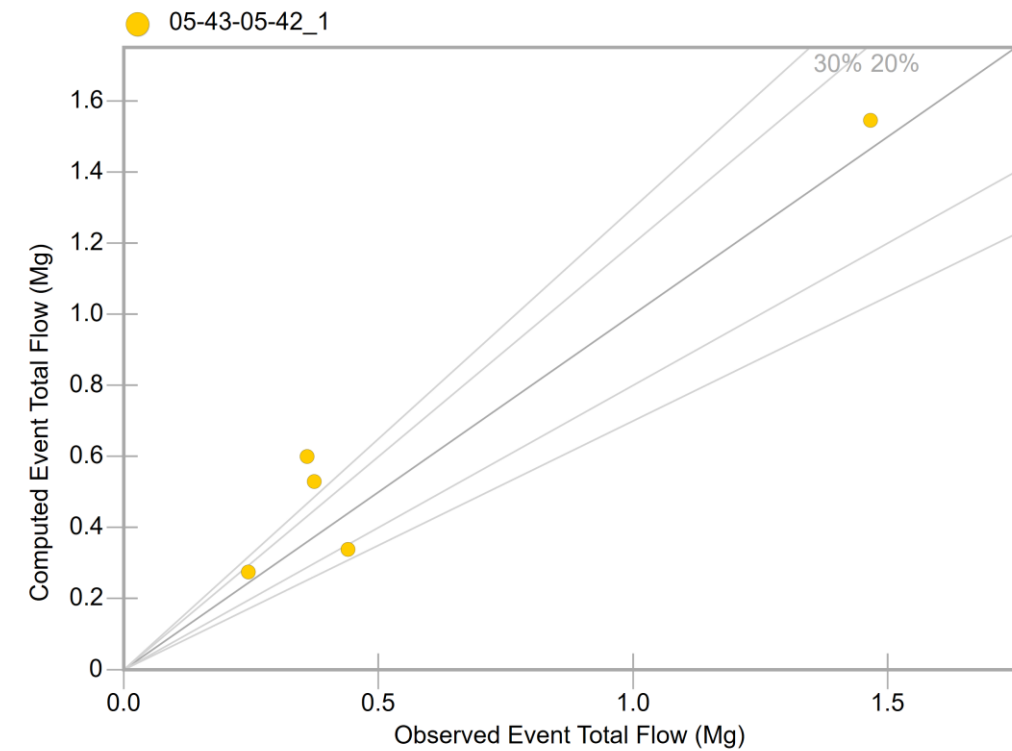


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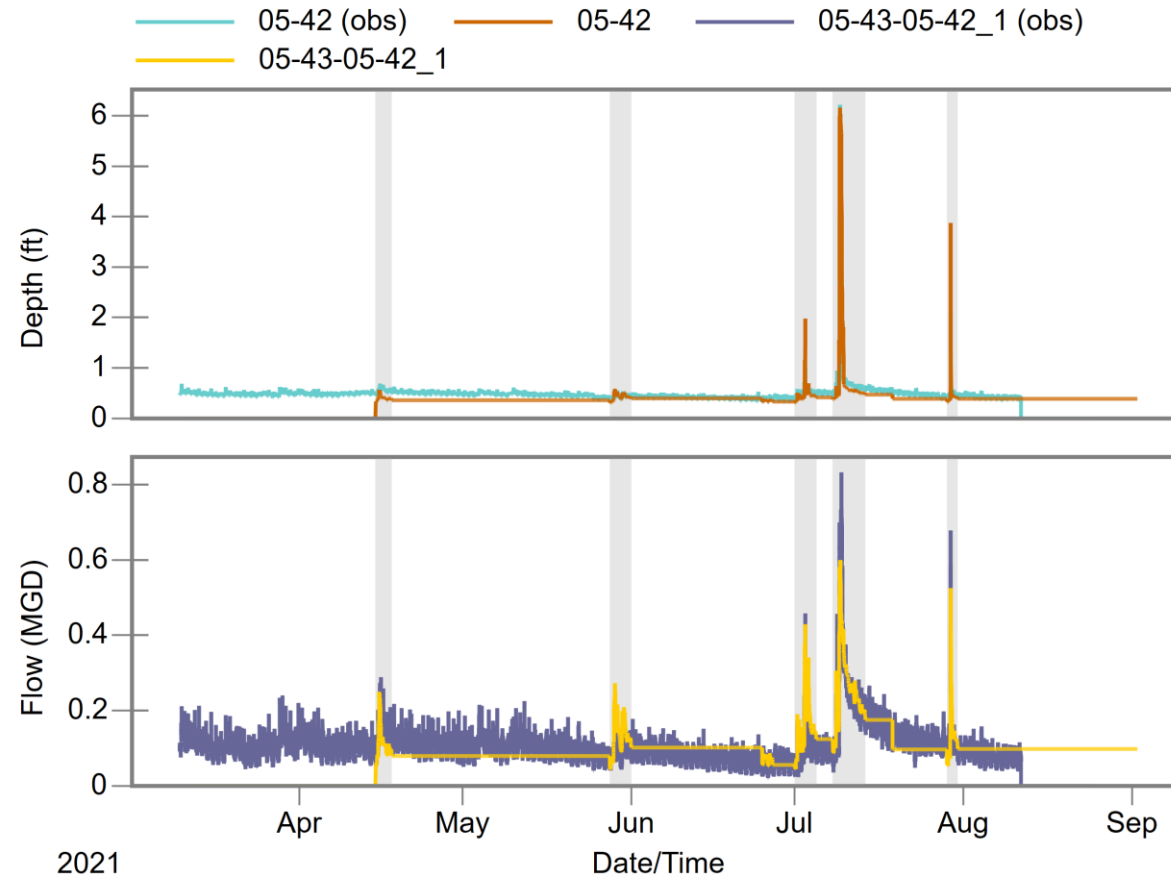
Peaks



Volumes

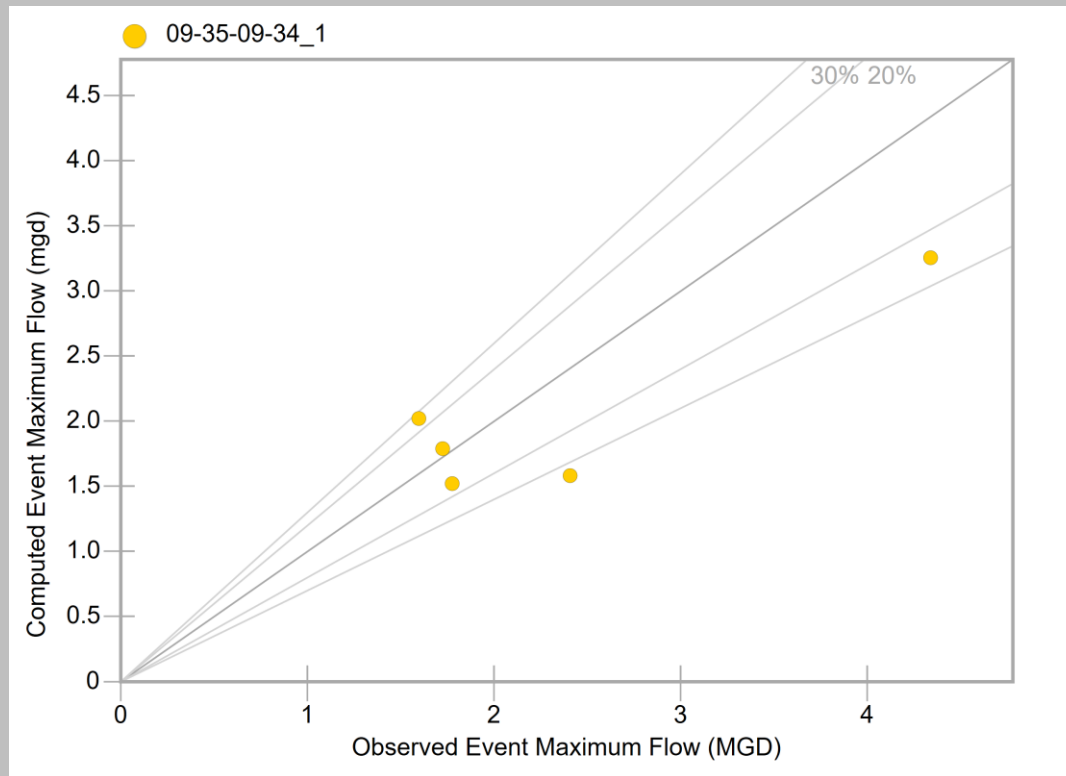


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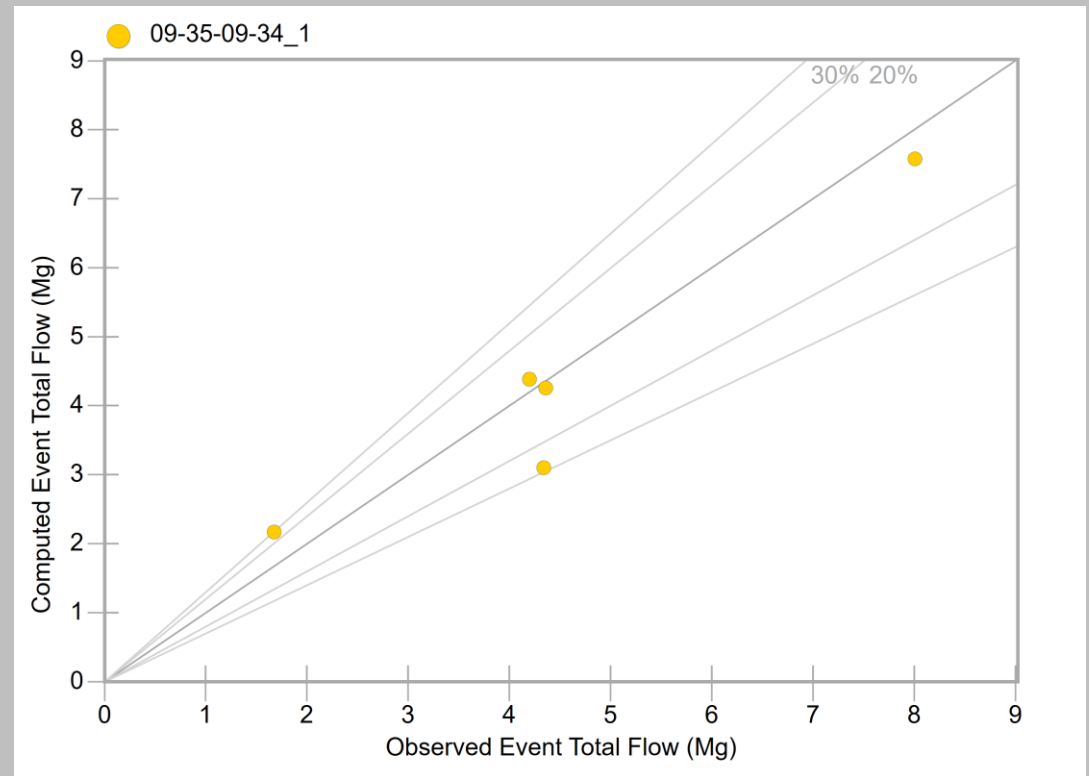


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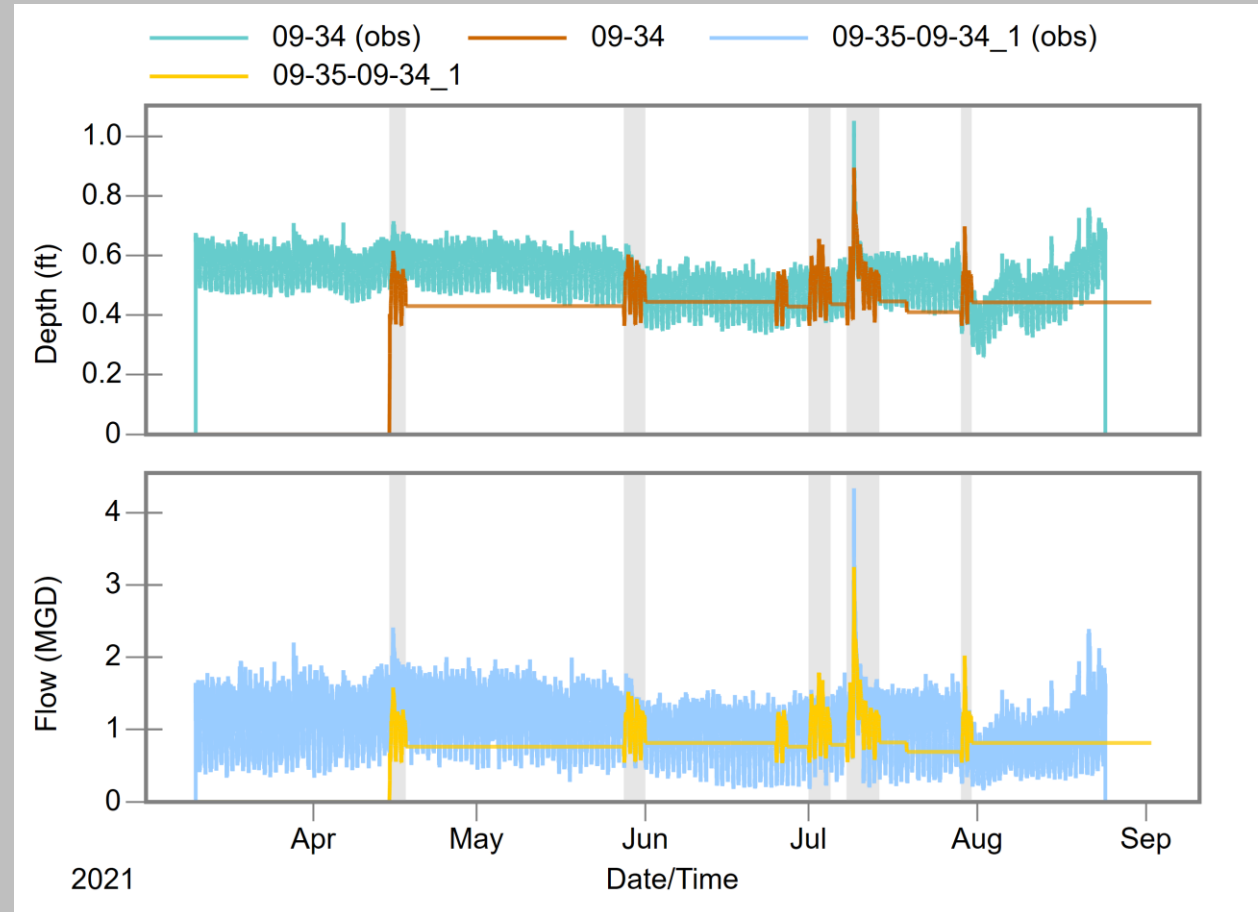
Peaks



Volumes

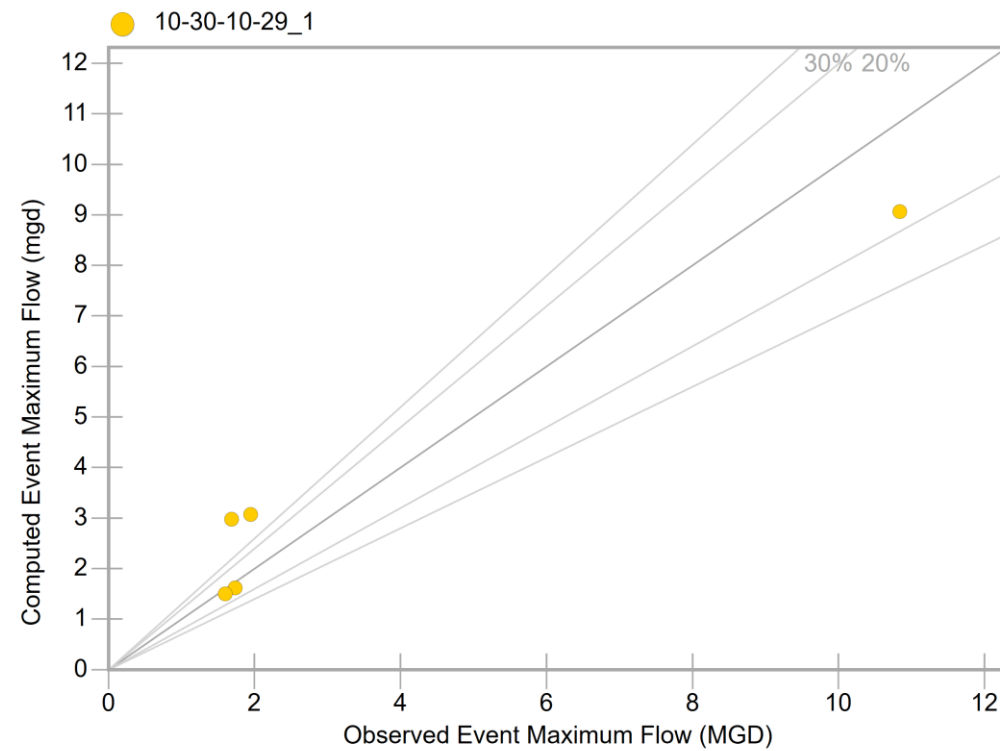


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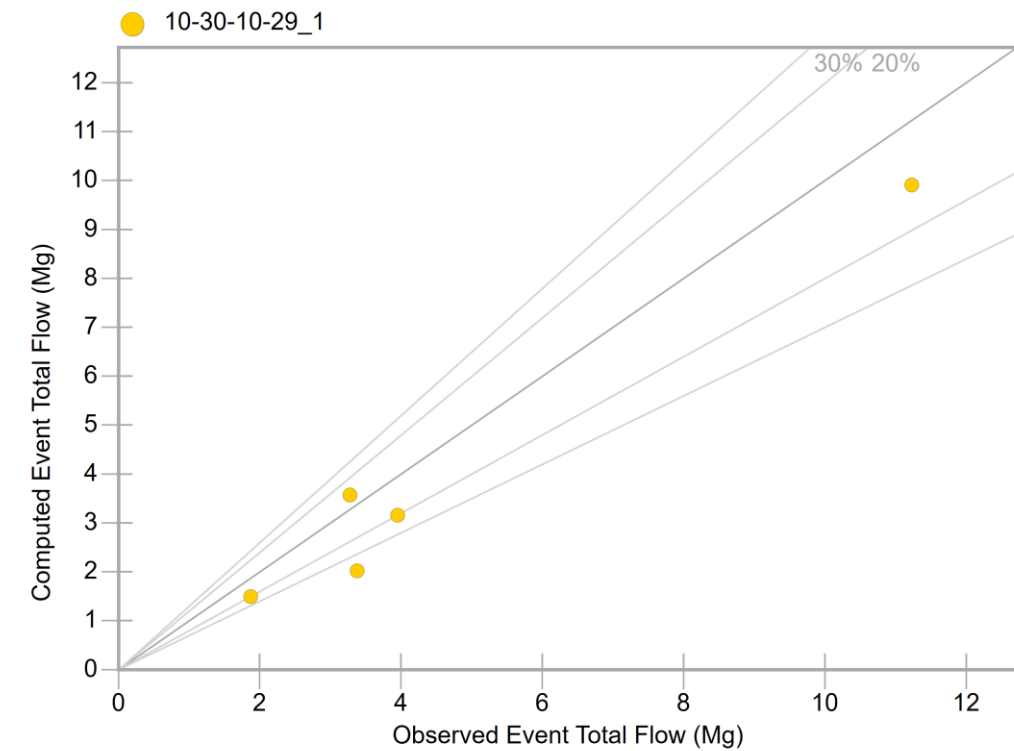


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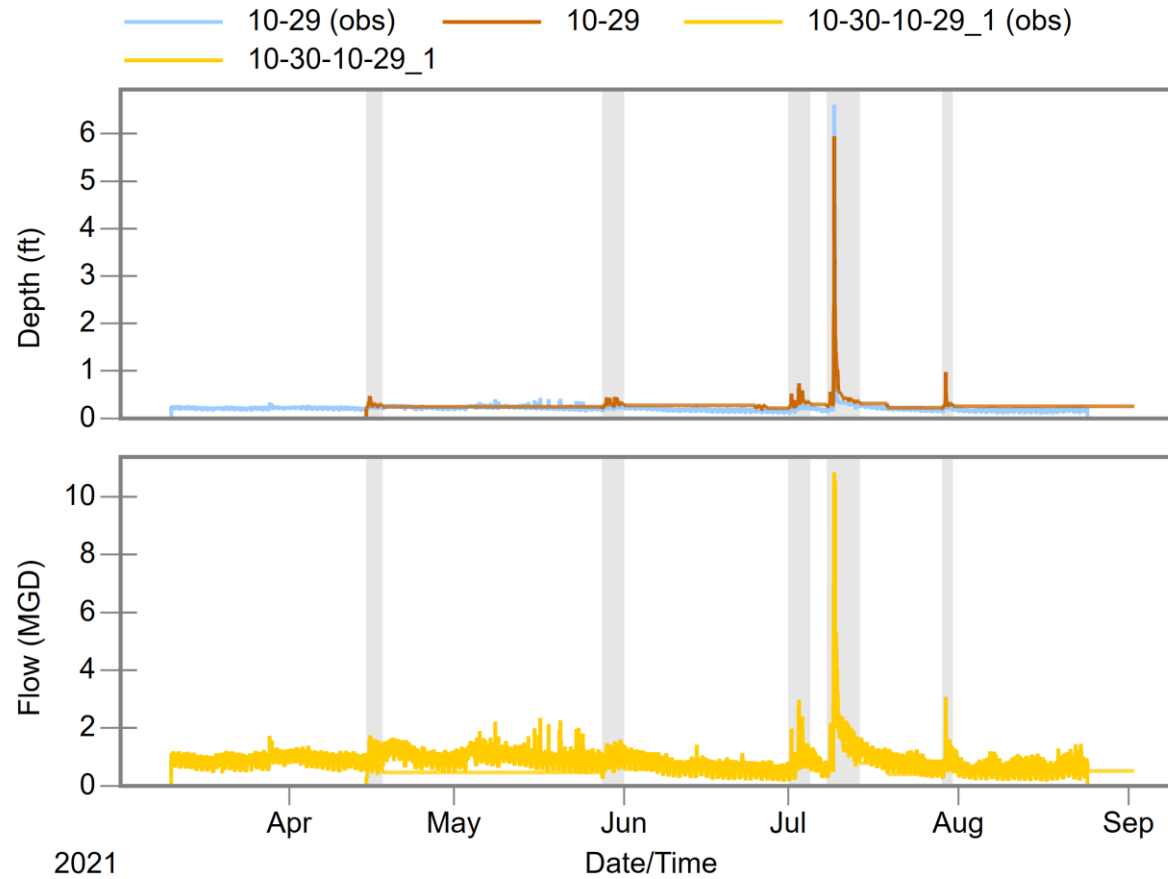
Peaks



Volumes

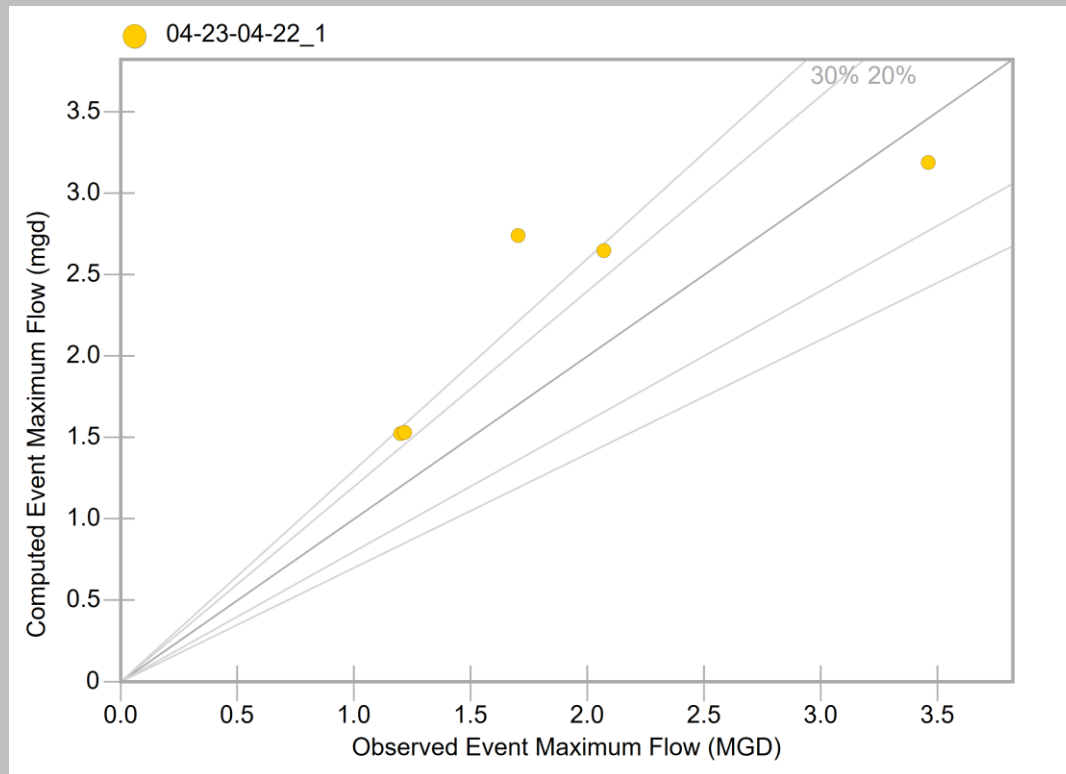


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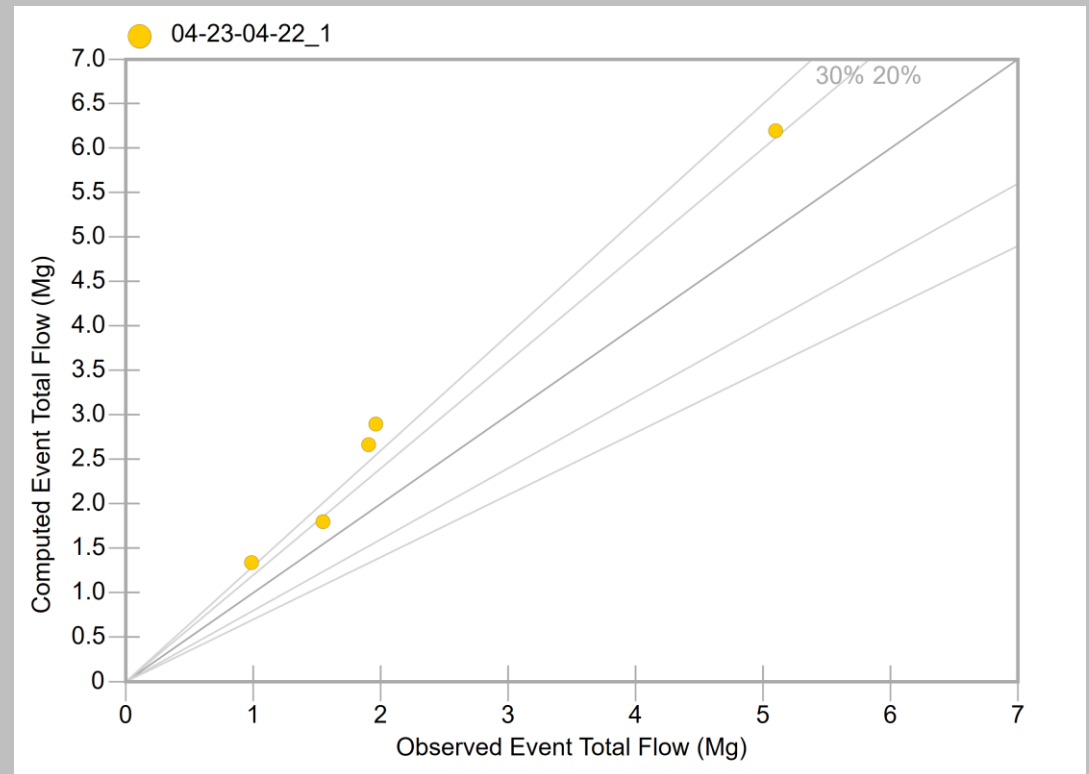


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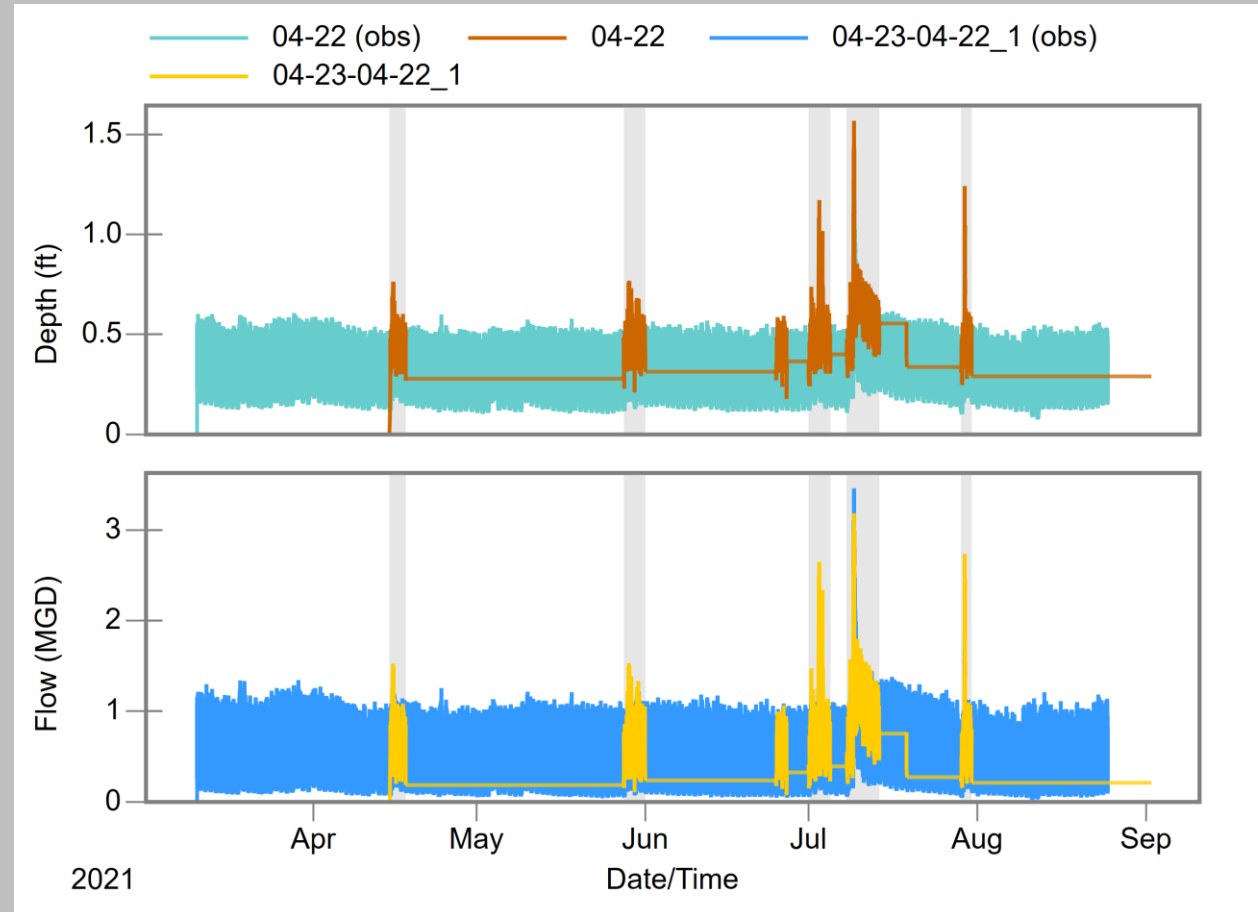
Peaks



Volumes

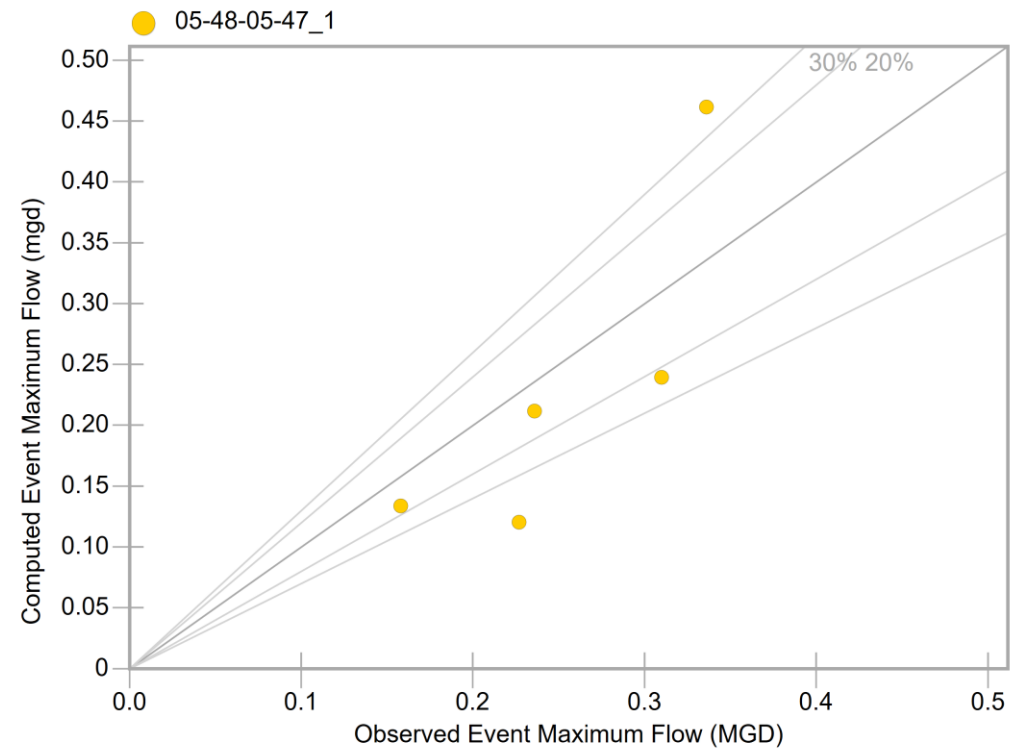


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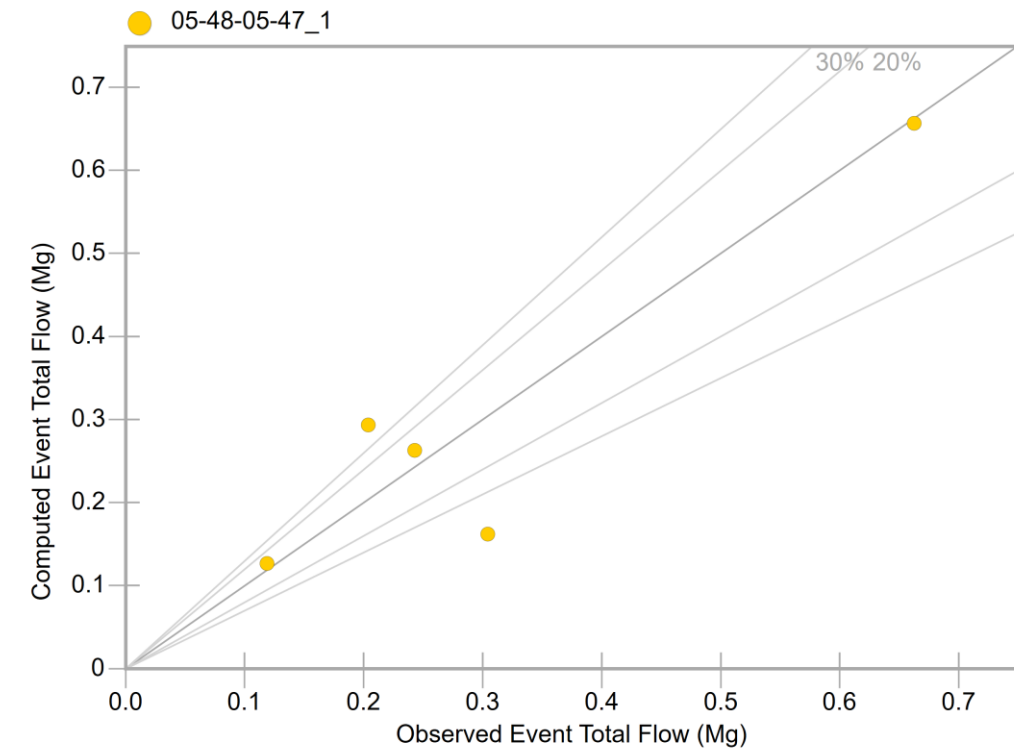


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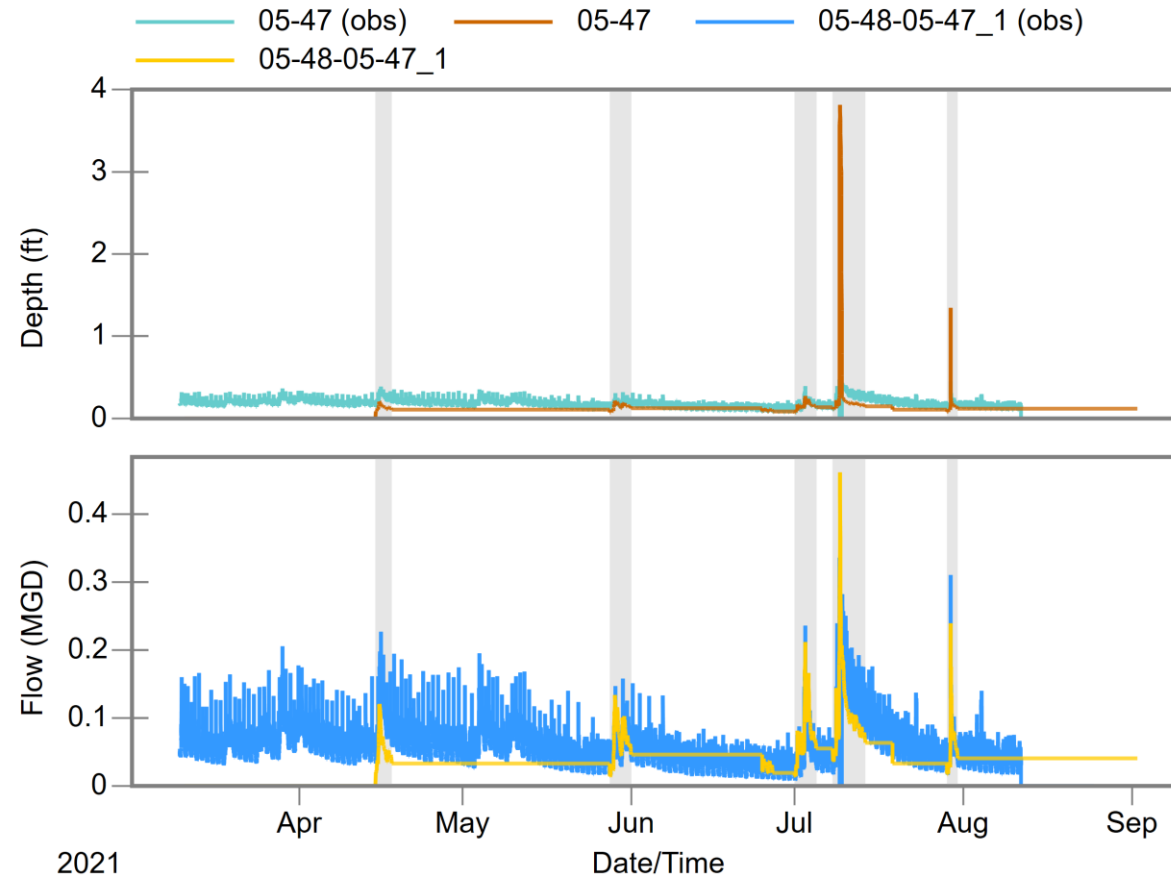
Peaks



Volumes

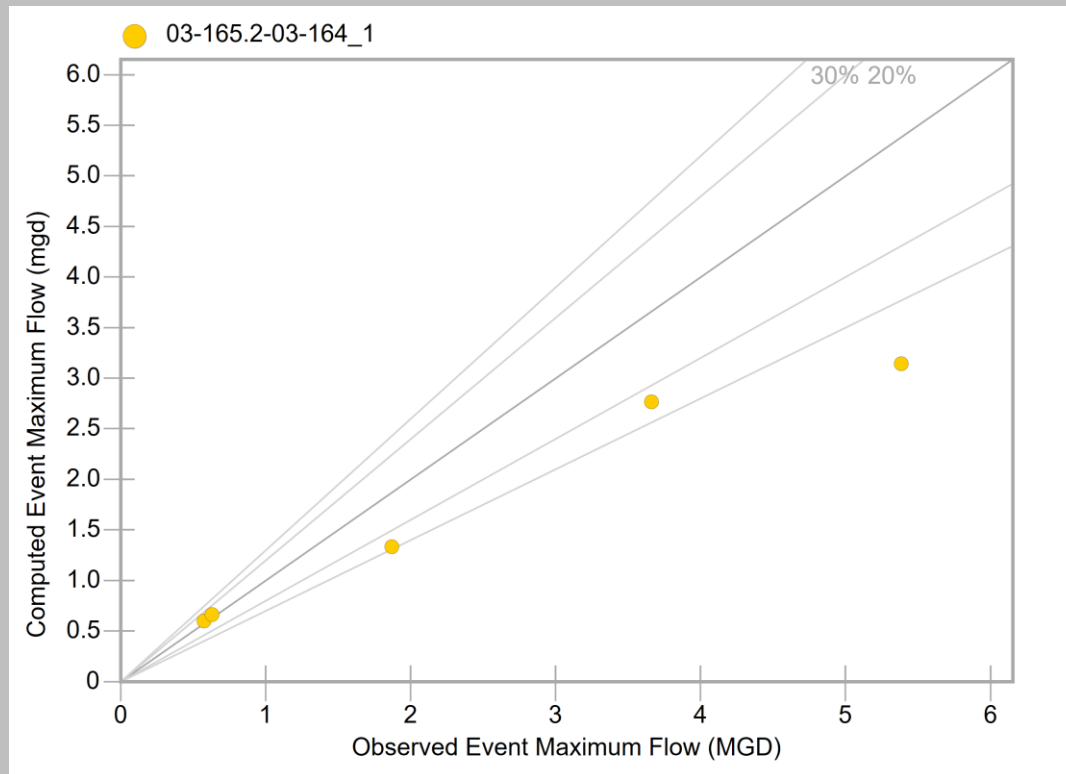


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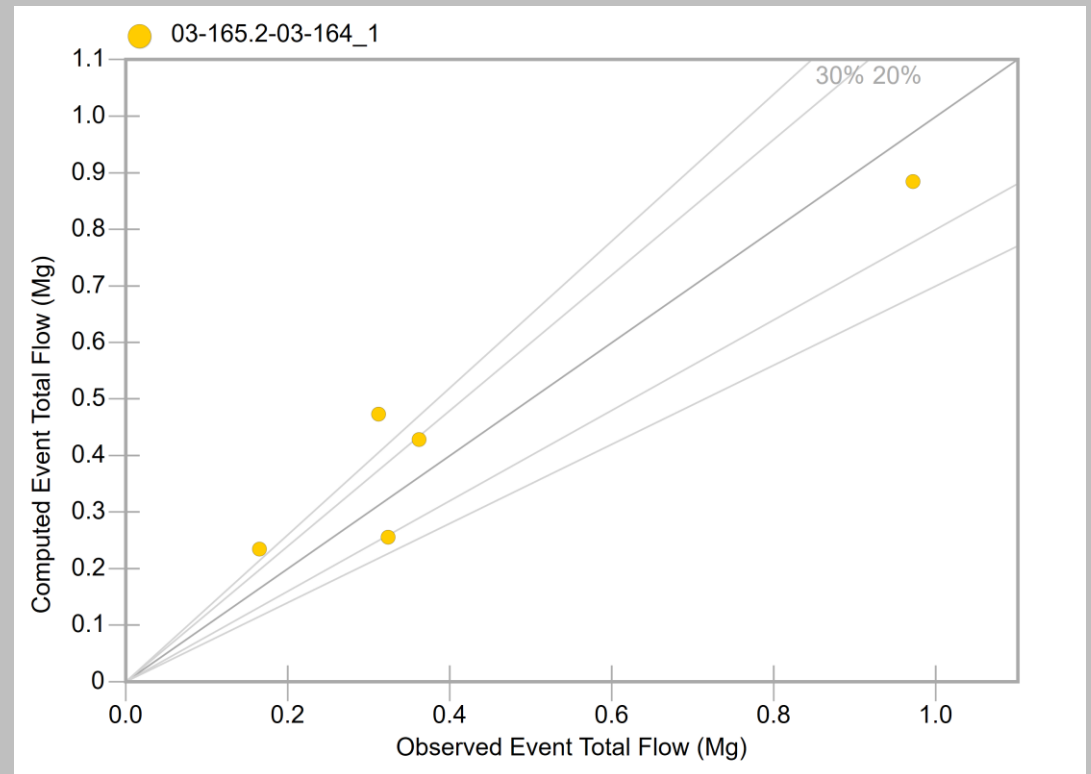


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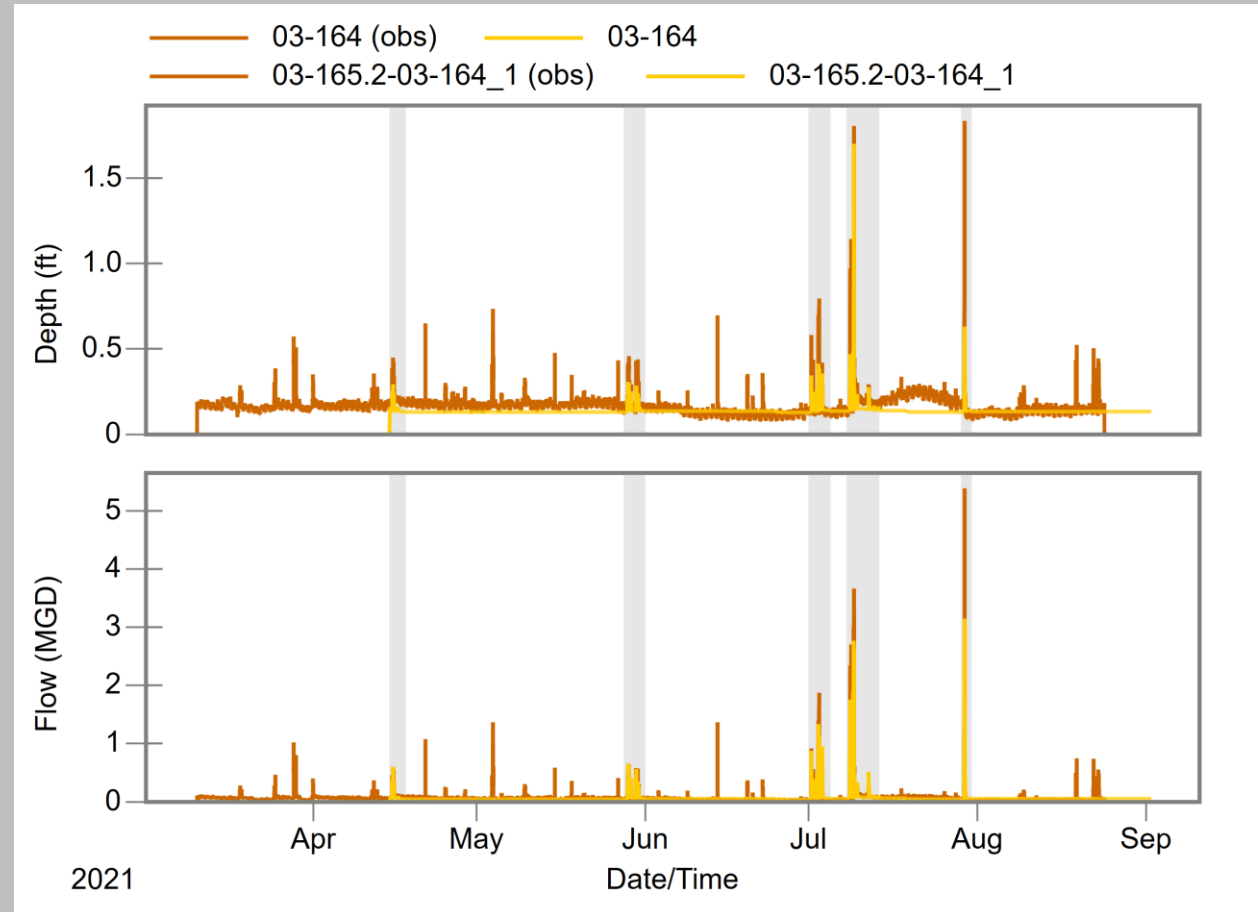
Peaks



Volumes

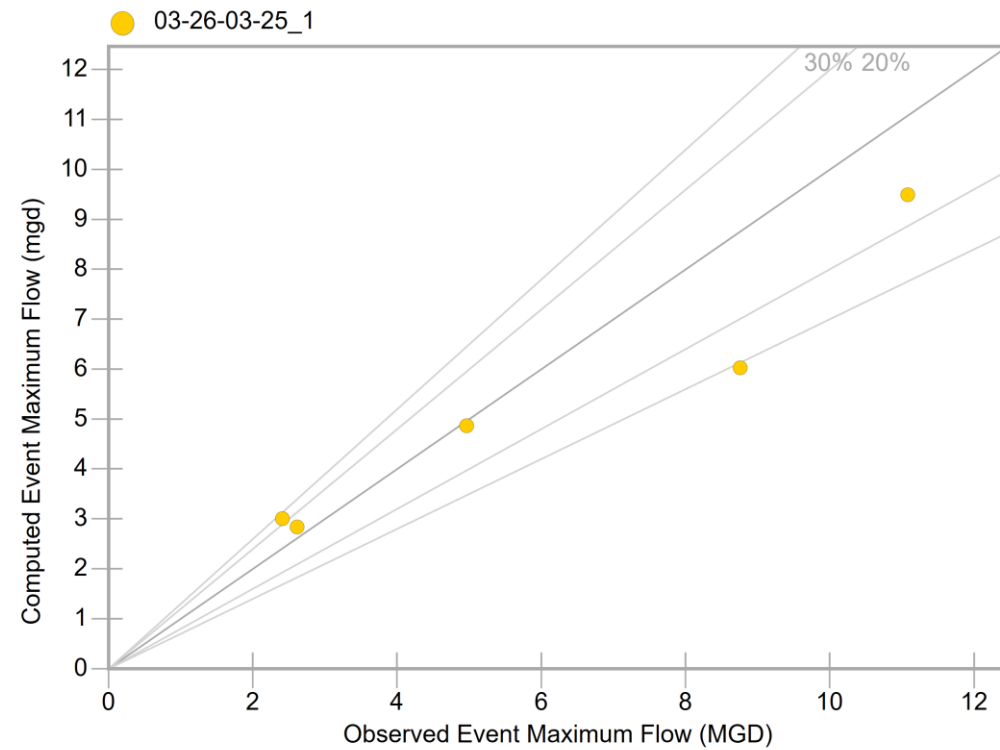


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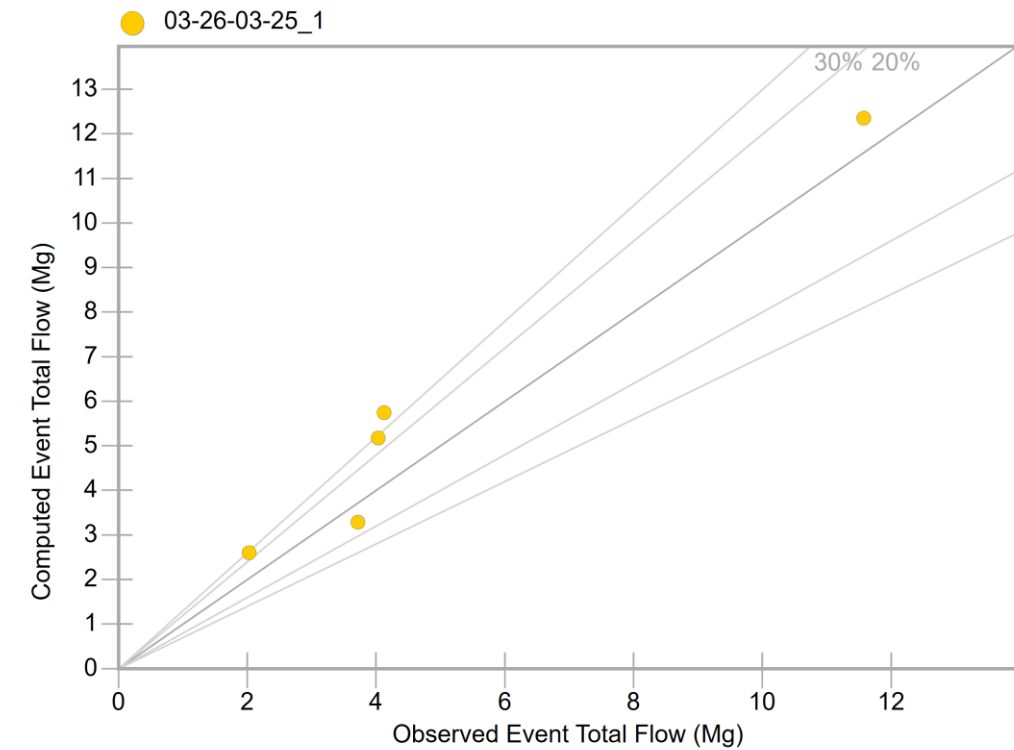


FM_36

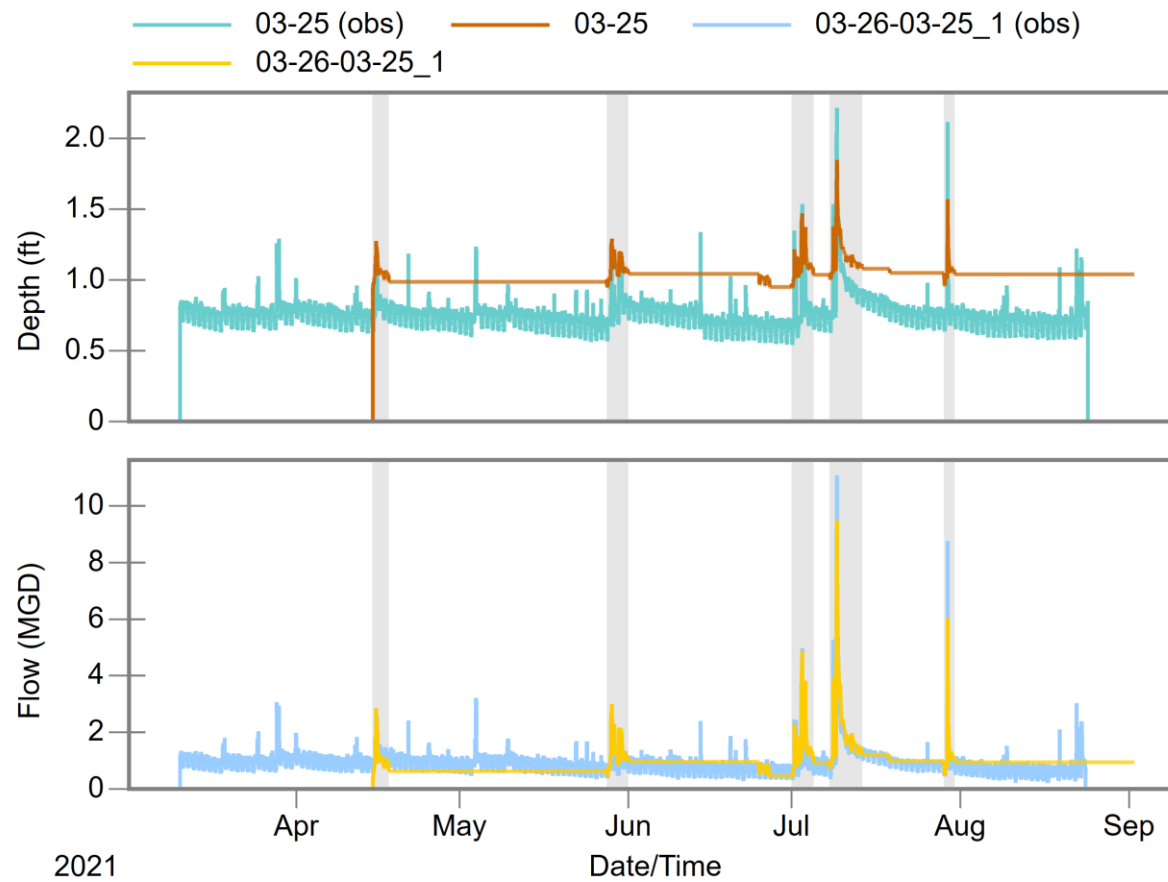
Peaks



Volumes

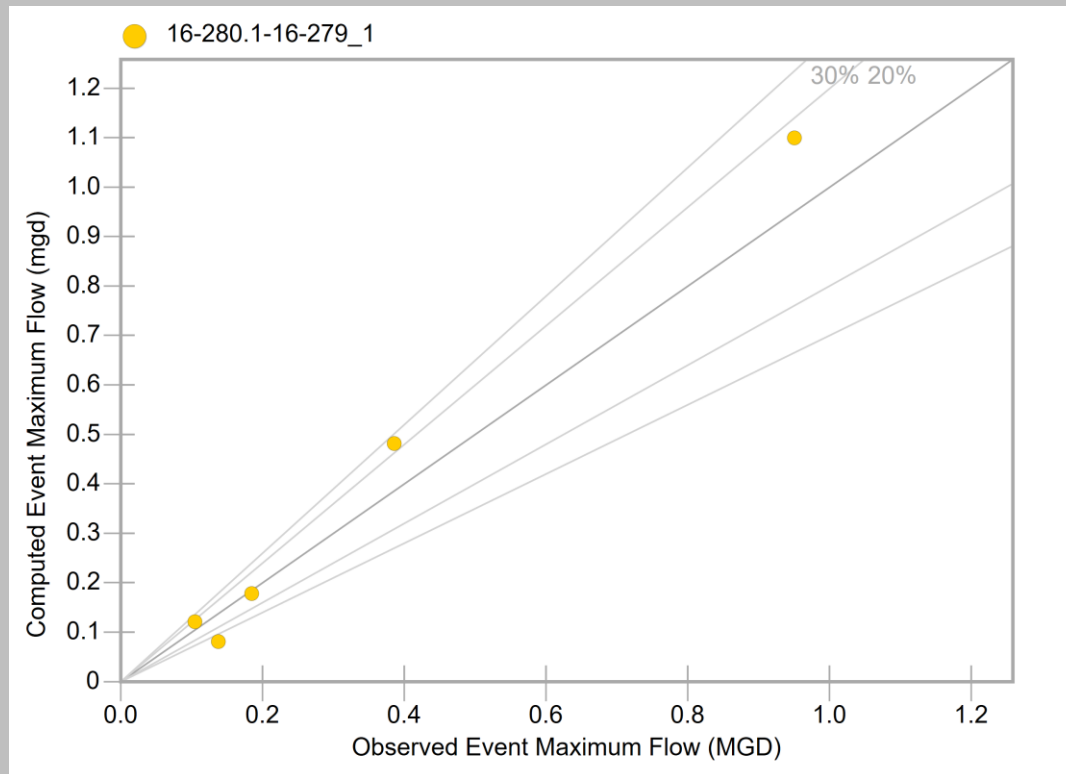


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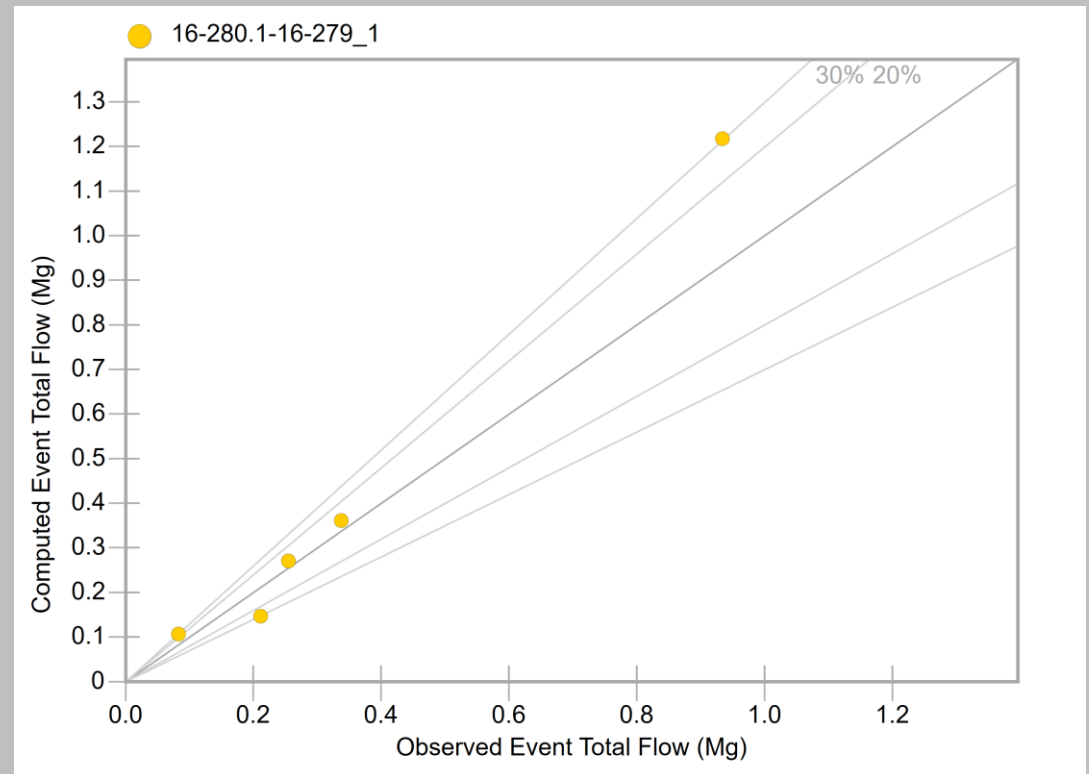


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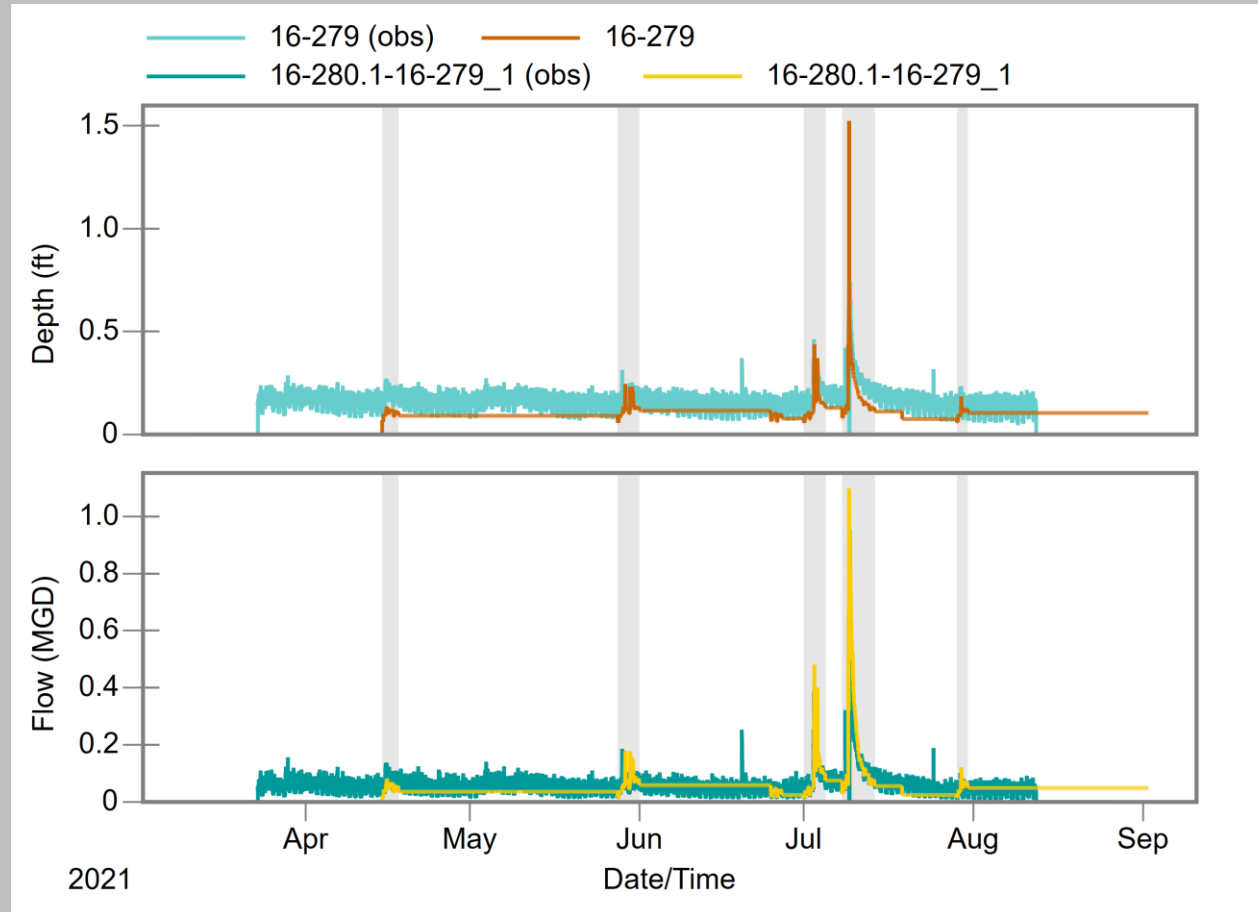
Peaks



Volumes

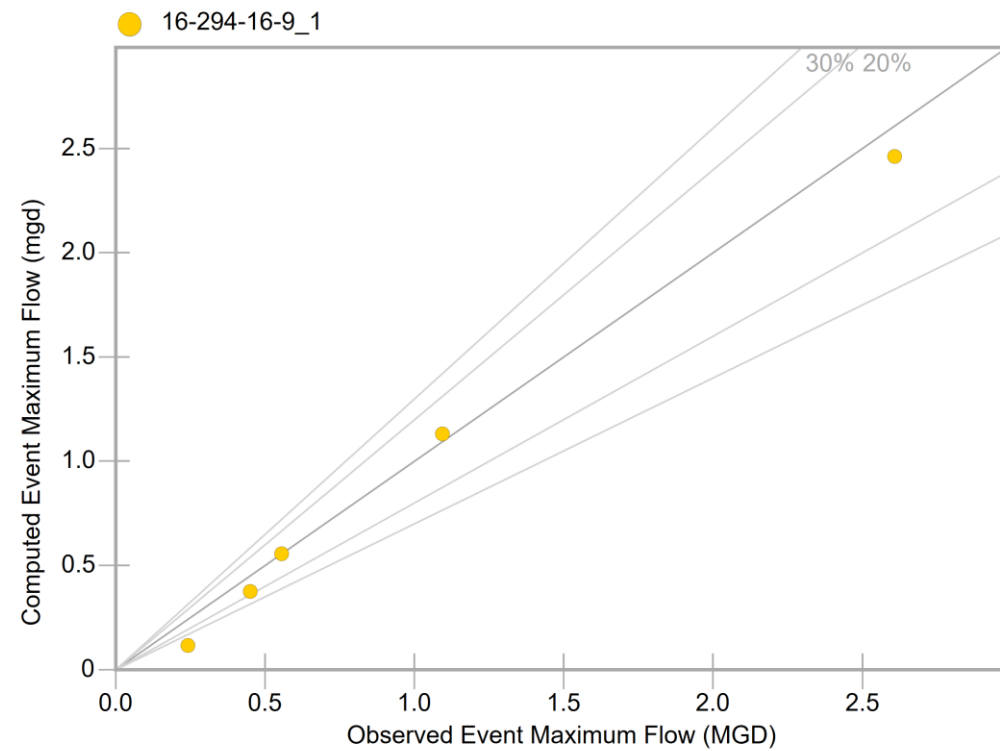


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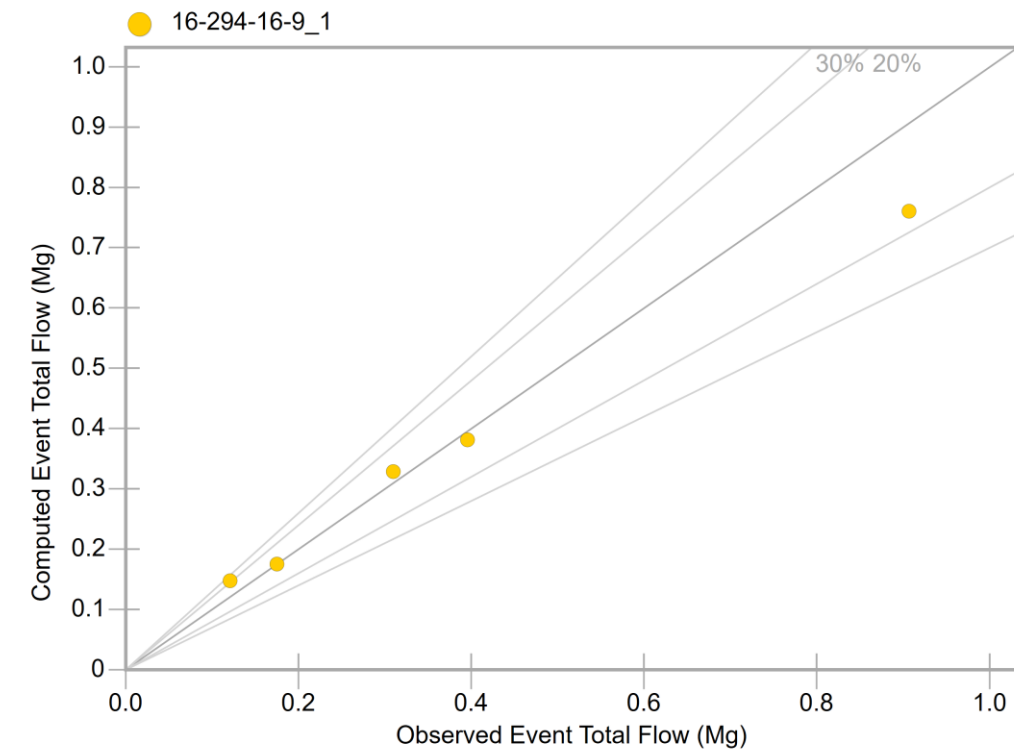


FM_38

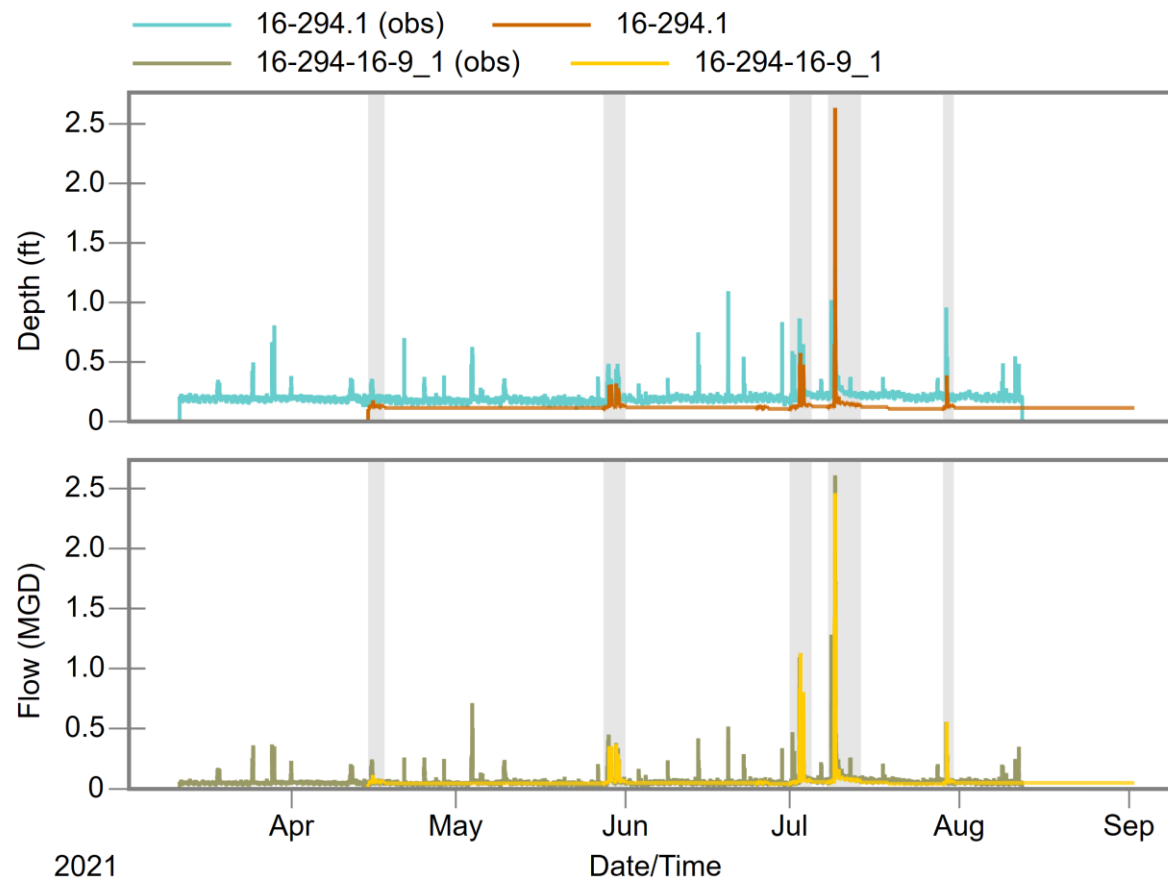
Peaks



Volumes

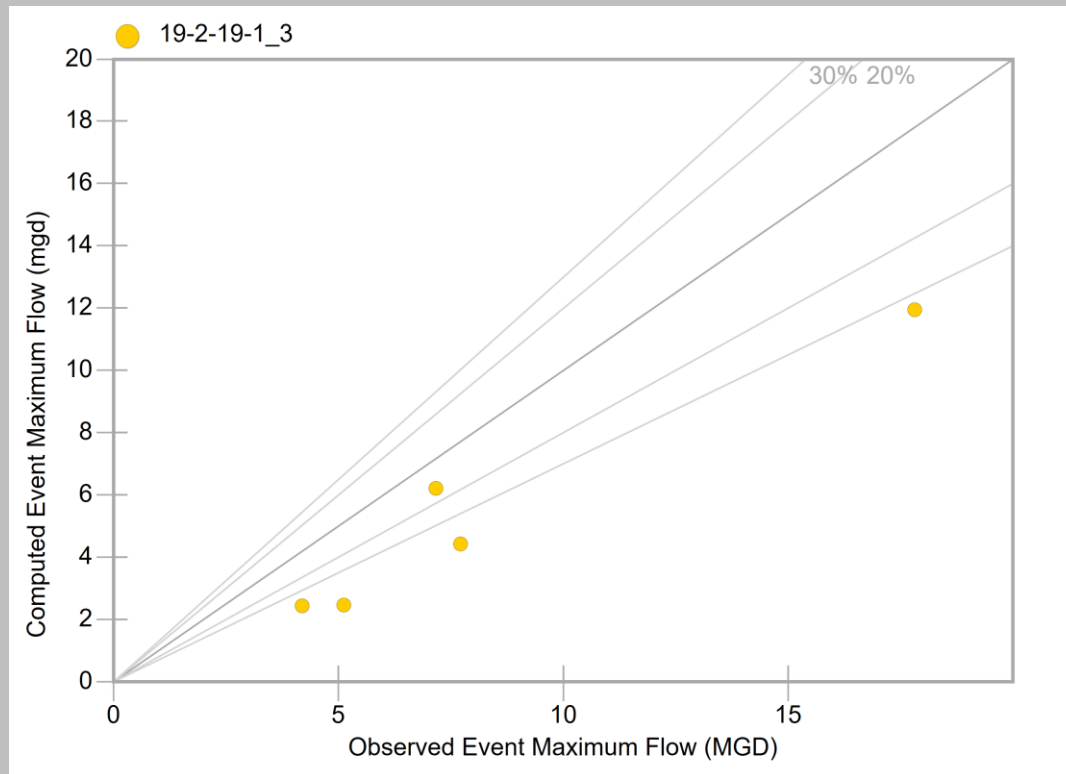


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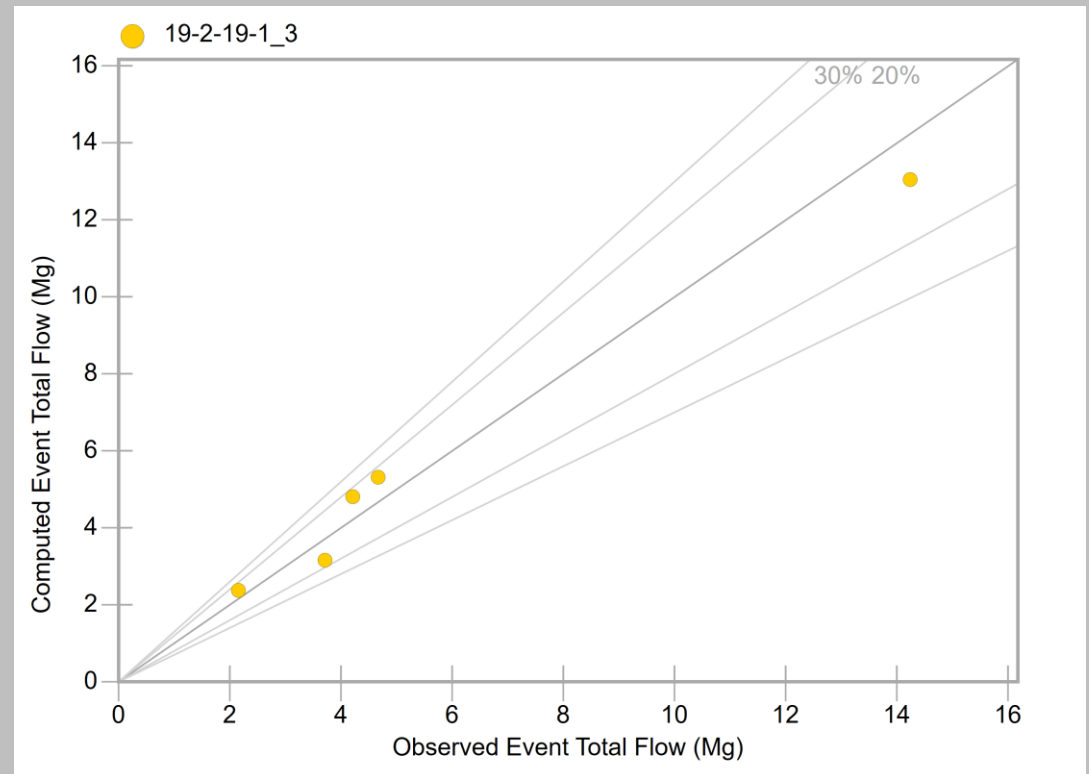


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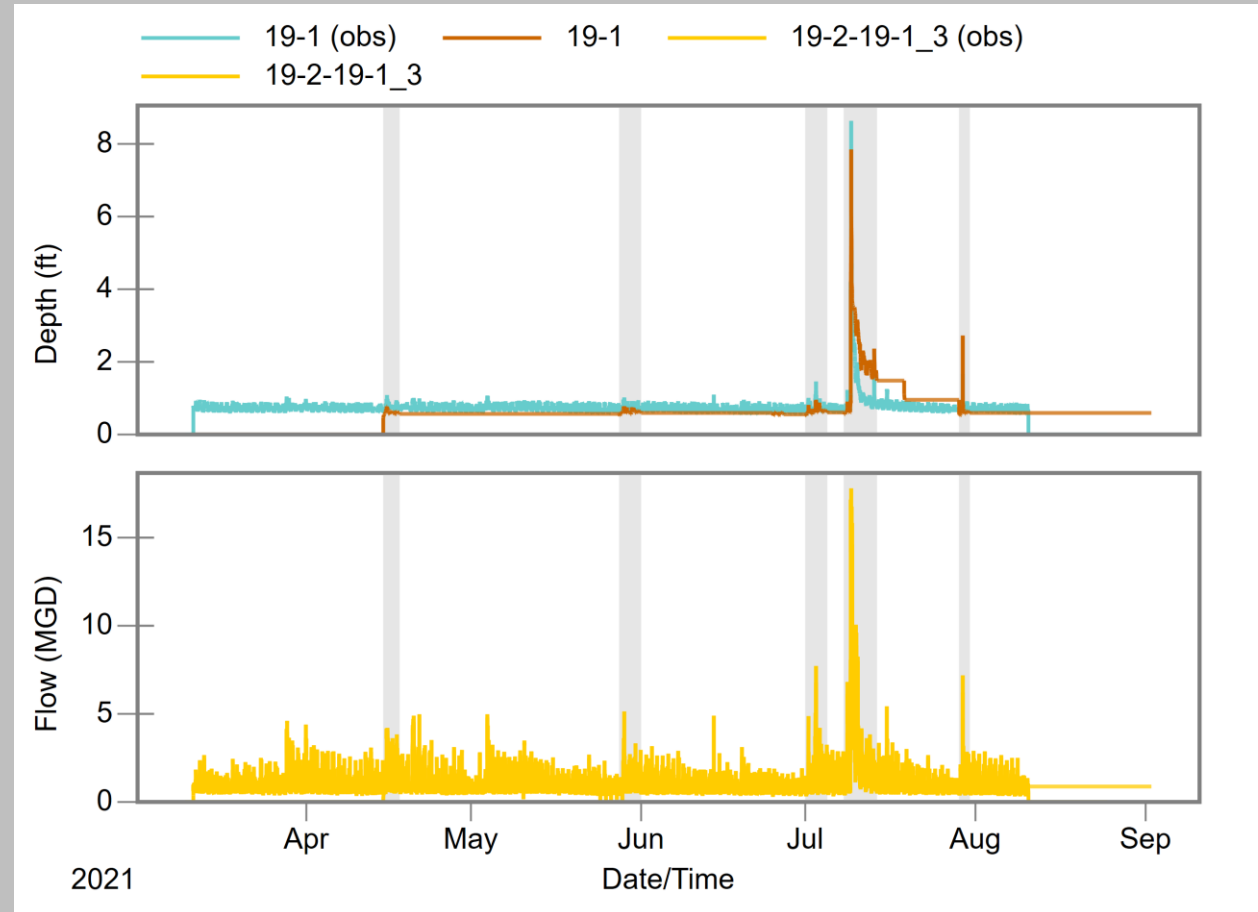
Peaks



Volumes

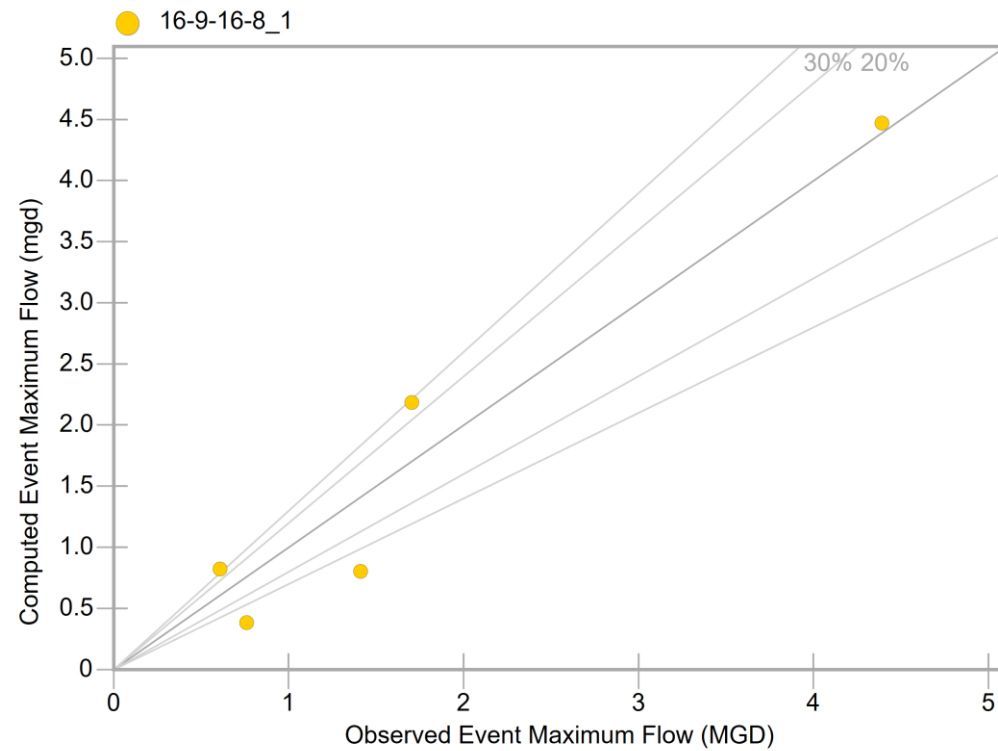


FM_39

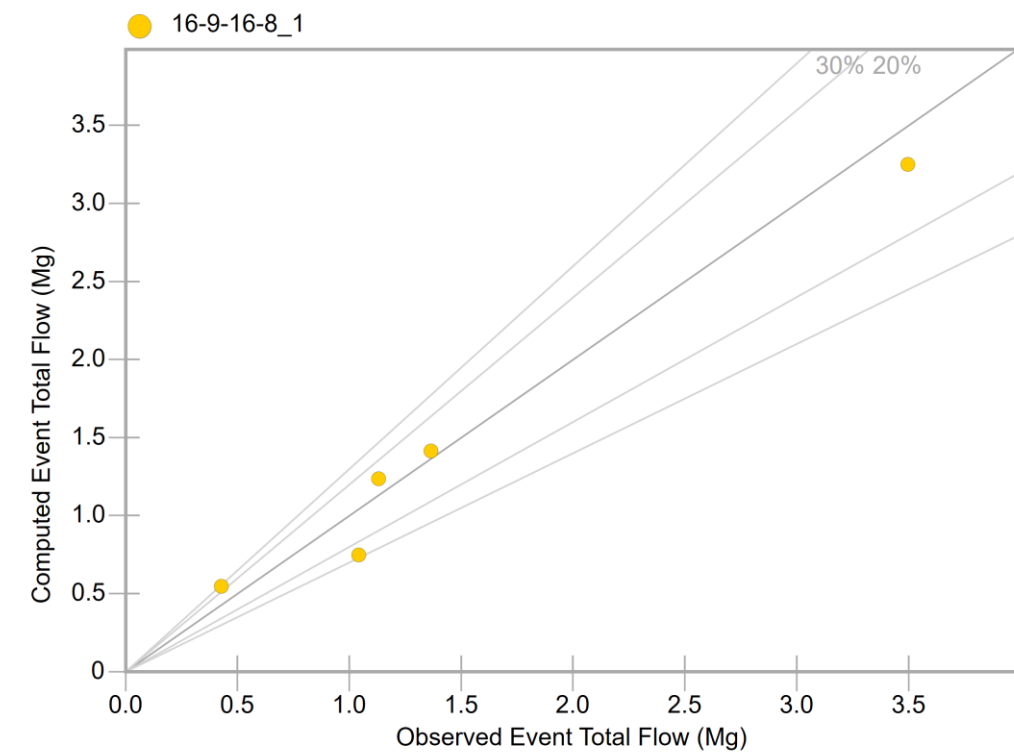


FM_40

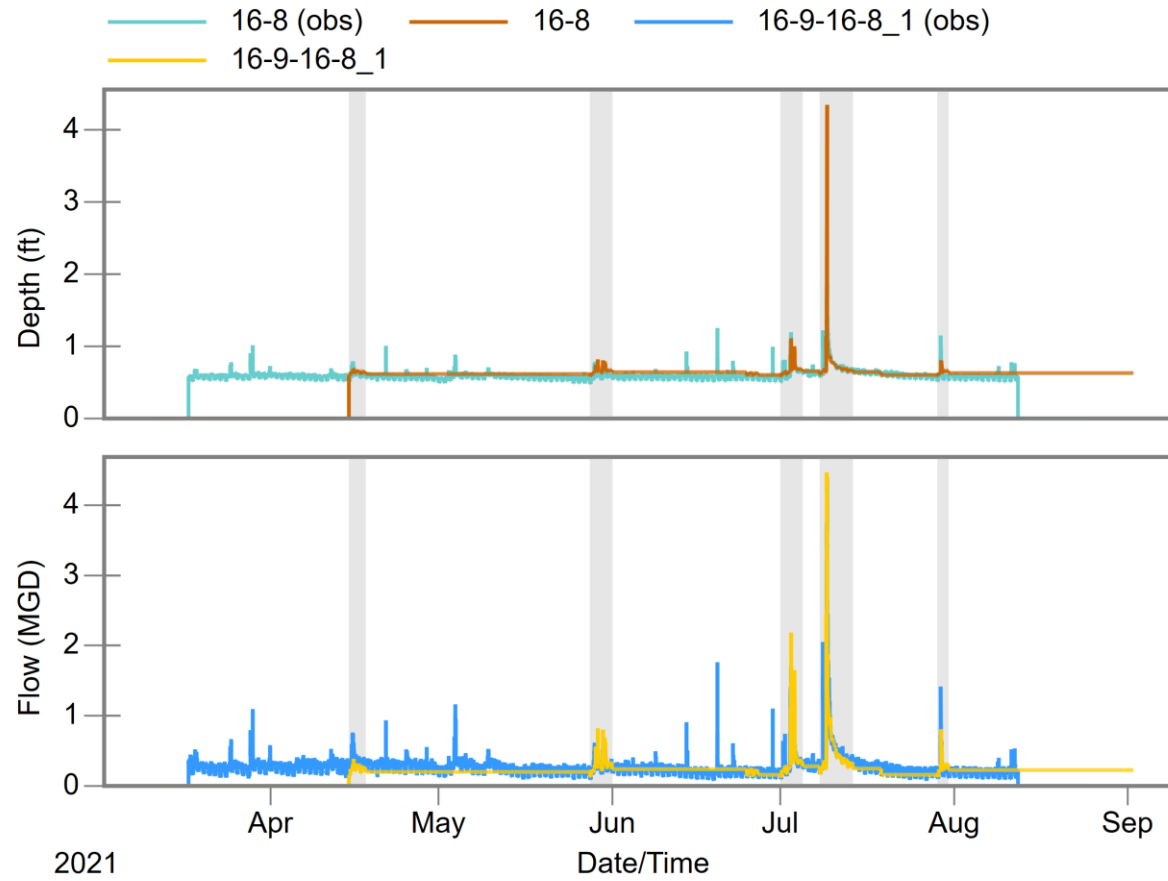
Peaks



Volumes



FM_40



Appendix E: Hubbells Lane Relief Sewer Cost Estimate Summary



Class 5 Cost Estimate			
Hubbells Lane Relief Sewer			
Item	Quantity	Total	Assumptions
Traffic Control	-	\$102,000	One lane traffic control
Demo Asphalt	11,830	\$156,000	13,200 SF
Dewatering	35	\$136,000	35 working days. Assume required for 60" install
36" PVC San	508	\$809,000	508 LF.
Tie-ins	1	\$20,000	1 tie in at siphon junction. New structures elsewhere
72" San Manholes	5	\$230,000	5 structures on 36" pipe (total 67 VF). 2 have 11 VF outside drop
Asphalt Patch	11,830	\$161,000	11830 SF.
Additional Items			
Bypass 36" flows	35	\$675,000	35 working days. 15% of project cost
60" PVC San & Remove ex.	600	\$1,911,000	600 LF.
96" San Manhole	2	\$100,000	2 structures total 24VF
102" San Manhole	1	\$60,000	1 structure 11 VF
15" Storm Sewer	300	\$110,000	300 LF. at \$300/foot plus 2 structures
Misc. Utility Relocation	1	\$100,000	
Total		\$4,570,000	

