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2020 Racine RWU Facilities Plan

Volume 2

Final

Project number: 60554970

August 2020

Appendix A WPDES Permit

WISCONSIN
DEPT. OF NATURAL RESOURCES

WPDES PERMIT

STATE OF WISCONSIN
DEPARTMENT OF NATURAL RESOURCES

PERMIT TO DISCHARGE UNDER THE WISCONSIN POLLUTANT DISCHARGE ELIMINATION SYSTEM

Racine Wastewater Utility

is permitted, under the authority of Chapter 283, Wisconsin Statutes, to discharge from a facility located at
2101 Wisconsin Avenue, Racine, WI 53403
to
Lake Michigan, via a 500-foot outfall pipe
in Racine County

in accordance with the effluent limitations, monitoring requirements and other conditions set forth in this permit.

The permittee shall not discharge after the date of expiration. If the permittee wishes to continue to discharge after this expiration date an application shall be filed for reissuance of this permit, according to Chapter NR 200, Wis. Adm. Code, at least 180 days prior to the expiration date given below.

State of Wisconsin Department of Natural Resources
For the Secretary

By _____
Bryan Hartsook
Wastewater Field Supervisor

12/30/2019
Date Permit Signed/Issued

PERMIT TERM: EFFECTIVE DATE – January 01, 2020 **EXPIRATION DATE - December 31, 2024**

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1 Influent Requirements

1.1 Sampling Point(s)

Sampling Point Designation	
Sampling Point Number	**Sampling Point Location, WasteType/Sample Contents and Treatment Description (as applicable)**
701	INFLUENT: Samples shall be collected from the headworks influent structure.

1.2 Monitoring Requirements

The permittee shall comply with the following monitoring requirements.

1.2.1 Sampling Point 701 - INFLUENT TO PLANT

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Daily	Continuous	
BOD_5, Total		mg/L	Daily	24-Hr Flow Prop Comp	
Suspended Solids, Total		mg/L	Daily	24-Hr Flow Prop Comp	
Mercury, Total Recoverable		ng/L	Monthly	24-Hr Flow Prop Comp	See 'Mercury Monitoring' section below.
Copper, Total Recoverable		µg/L	Monthly	24-Hr Flow Prop Comp	See 'Total Metals Analyses' and 'Sample Analysis' sections below.
Cadmium, Total Recoverable		µg/L	Monthly	24-Hr Flow Prop Comp	See 'Total Metals Analyses' and 'Sample Analysis' sections below.
Zinc, Total Recoverable		µg/L	Monthly	24-Hr Flow Prop Comp	See 'Total Metals Analyses' and 'Sample Analysis' sections below.
Lead, Total Recoverable		µg/L	Monthly	24-Hr Flow Prop Comp	See 'Total Metals Analyses' and 'Sample Analysis' sections below.
Nickel, Total Recoverable		µg/L	Monthly	24-Hr Flow Prop Comp	See 'Total Metals Analyses' and 'Sample Analysis' sections below.
Chromium, Total Recoverable		µg/L	Monthly	24-Hr Flow Prop Comp	See 'Total Metals Analyses' and 'Sample Analysis' sections below.

1.2.1.1 Total Metals Analyses

Measurements of total metals and total recoverable metals shall be considered as equivalent.

1.2.1.2 Sample Analysis

Samples shall be analyzed using a method which provides adequate sensitivity so that results can be quantified at a level of quantitation below the calculated/potential effluent limit, unless not possible using the most sensitive approved method.

1.2.1.3 Mercury Monitoring

The permittee shall collect and analyze all mercury samples according to the data quality requirements of ss. NR 106.145(9) and (10), Wisconsin Administrative Code. The limit of quantitation (LOQ) used for the effluent and field blank shall be less than 1.3 ng/L, unless the samples are quantified at levels above 1.3 ng/L. The permittee shall collect at least one mercury field blank for each set of mercury samples (a set of samples may include combinations of intake, influent, effluent or other samples all collected on the same day). The permittee shall report results of samples and field blanks to the Department on Discharge Monitoring Reports.

2 In-Plant Requirements

2.1 Sampling Point(s)

Sampling Point Designation	
Sampling Point Number	**Sampling Point Location, WasteType/Sample Contents and Treatment Description (as applicable)**
110	EQ BASIN 1 (EAST): Flow rate shall be monitored only during wet weather blending events. Any blended effluent receives primary settling, disinfection, and is sampled with outfall 001 before discharge. Flow monitoring and reporting is not required during normal operation of EQ basins where blending does not occur.
111	EQ BASIN 2 (WEST): Flow rate shall be monitored only during wet weather blending events. Any blended effluent receives primary settling, disinfection, and is sampled with outfall 001 before discharge. Flow monitoring and reporting is not required during normal operation of EQ basins where blending does not occur.
112	FIELD BLANK: Collect mercury field blank using standard sample handling procedures.
113	Monitor Arsenic in the City Water Intake (Water supply from Lake Michigan)

2.2 Monitoring Requirements and Limitations

The permittee shall comply with the following monitoring requirements and limitations.

2.2.1 Sampling Point 110 - EQ Basin #1

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Per Occurrence	Measure	See 'Operation of Equalization Basins' section below.
Flow Rate		hours	Per Occurrence	Calculated	Total time of blending.

2.2.1.1 Operation of Equalization Basins

During wet weather high flow conditions, when necessary to maintain the proper function of the wastewater treatment facility, the permittee may operate in-plant diversion and blending facilities that have been designed, approved, and constructed for that purpose. The requirements and limitations contained in section 3.2.1 remain in full force and effect during periods where blending occurs. Blending shall only be used by the permittee when there are high wet weather wastewaster flows to the treatment facility and when such alternative operations are necessary to prevent excessive loss of solids from the activated sludge system to the plant effluent.

2.2.2 Sampling Point 111 - EQ Basin #2

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Per Occurrence	Measure	See 'Operation of Equalization Basins' section

					below.
Flow Rate		hours	Per Occurrence	Calculated	Total time of blending.

2.2.2.1 Operation of Equalization Basins

During wet weather high flow conditions, when necessary to maintain the proper function of the wastewater treatment facility, the permittee may operate in-plant diversion and blending facilities that have been designed, approved, and constructed for that purpose. The requirements and limitations contained in section 3.2.1 remain in full force and effect during periods where blending occurs. Blending shall only be used by the permittee when there are high wet weather wastewaster flows to the treatment facility and when such alternative operations are necessary to prevent excessive loss of solids from the activated sludge system to the plant effluent.

2.2.3 Sampling Point 112 - Mercury Field Blanks

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Mercury, Total Recoverable		ng/L	Monthly	Blank	See "Mercury Monitoring' section below.

2.2.3.1 Mercury Monitoring

The permittee shall collect and analyze all mercury samples according to the data quality requirements of ss. NR 106.145(9) and (10), Wisconsin Administrative Code. The limit of quantitation (LOQ) used for the effluent and field blank shall be less than 1.3 ng/L, unless the samples are quantified at levels above 1.3 ng/L. The permittee shall collect at least one mercury field blank for each set of mercury samples (a set of samples may include combinations of intake, influent, effluent or other samples all collected on the same day). The permittee shall report results of samples and field blanks to the Department on Discharge Monitoring Reports.

2.2.4 Sampling Point 113 - City Water Intake

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Arsenic, Total Recoverable		µg/L	Quarterly	Grab	See 'Sample Monitoring and Analysis' section below.

2.2.4.1 Sample Monitoring and Analysis

Arsenic samples shall be analyzed using a highly sensitive but acceptable method unless not possible, using the most sensitive approved method.

3 Surface Water Requirements

3.1 Sampling Point(s)

Sampling Point Designation	
Sampling Point Number	**Sampling Point Location, WasteType/Sample Contents and Treatment Description (as applicable)**
001	EFFLUENT: 24-hour flow proportional composite samples and grab samples shall be collected from the combined outfall structure where effluent mixes with the effluent from the equalization basins before discharge to the lake. Discharge from the equalization basins shall receive primary treatment and disinfection before the combined outfall structure.
010	Safety Site PLANT -21st Street & Roosevelt Avenue - Manhole SS-U0904
011	Safety Site S01 - Augusta Street & Michigan Boulevard - Manhole SS-AC0003
012	Safety Site S02 - Michigan Boulevard & South Street Extd. - Manhole SS-B0305
013	Safety Site S03 - Carlton Drive & La Salle Street - Manhole SS-B0133R
014	Safety Site S04 - 16th Street & College Avenue - Manhole SS-T0005
015	Safety Site S05 - 21st Street & Grove Avenue - Manhole SS-U0040
016	Safety Site S06 - Washington Avenue & Grove Avenue - Manhole SS-Z0010
018	Safety Site S08 - East 6th Street Siphon - Manhole SS-QQ006
019	Safety Site S09 - Ontario Street & 4th Siphon - Manhole SS-EO-462
020	Safety Site S10 - Spruce Street & Brentwood Drive - Manhole SS-U0430
021	Safety Site S11 - Knoll Place & Norwood Drive - Manhole SS-KK005
022	Safety Site S12 - Golf Avenue & Conrad Drive - Manhole SS-A0428
032	Safety Site L02 - Spring Street & Luedke Court - LS #2 – Diversion Structure or East End of Storage Basin
036	Safety Site L06 - Drexel Avenue & Maryland Avenue - LS #6 - Manhole SS-UO352
037	Safety Site L07 - Steeple Chase Drive - Manhole ST-NL02006
038	Safety Site L08 - Rapids Court LS #8 - Manhole SS-BB005
039	Safety Site L09 - Frances Drive & Harrington Drive LS #9 -Station

3.2 Monitoring Requirements and Effluent Limitations

The permittee shall comply with the following monitoring requirements and limitations.

3.2.1 Sampling Point (Outfall) 001 - EFFLUENT

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Daily	Continuous	
BOD_5, Total	Weekly Avg	45 mg/L	Daily	24-Hr Flow Prop Comp	
BOD_5, Total	Monthly Avg	30 mg/L	Daily	24-Hr Flow Prop Comp	
Suspended Solids, Total	Weekly Avg	45 mg/L	Daily	24-Hr Flow Prop Comp	

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Suspended Solids, Total	Monthly Avg	30 mg/L	Daily	24-Hr Flow Prop Comp	
pH Field	Daily Min	6.0 su	Daily	Continuous	
pH Field	Daily Max	9.0 su	Daily	Continuous	
Fecal Coliform	Weekly Avg	970 #/100 ml	Daily	Grab	Limit effective year-round.
Fecal Coliform	Monthly Avg	400 #/100 ml	Daily	Grab	Limit effective year-round.
E. coli		#/100 ml	Daily	Grab	Year-round monitoring.
Chlorine, Total Residual	Daily Max	38 µg/L	Per Occurrence	Grab	Limits apply only when chlorine is added.
Chlorine, Total Residual	Weekly Avg	38 µg/L	Per Occurrence	Grab	Limits apply only when chlorine is added.
Chlorine, Total Residual	Monthly Avg	38 µg/L	Per Occurrence	Grab	Limits apply only when chlorine is added.
Nitrogen, Ammonia Variable Limit		mg/L	Daily	Calculated	Report the calculated variable Ammonia limit on the DMR year-round. See Maximum Ammonia Limits table below.
Nitrogen, Ammonia (NH_3-N) Total	Daily Max - Variable	mg/L	Daily	24-Hr Flow Prop Comp	Report Ammonia effluent value on the DMR. Monitoring year-round. Limit effective November through April.
Nitrogen, Ammonia (NH_3-N) Total	Weekly Avg	62 mg/L	Daily	24-Hr Flow Prop Comp	Monitoring year-round. Limit effective November through April.
Nitrogen, Ammonia (NH_3-N) Total	Monthly Avg	25 mg/L	Daily	24-Hr Flow Prop Comp	Monitoring year-round. Limit effective November through April.
Nitrogen, Total Kjeldahl		mg/L	Quarterly	24-Hr Flow Prop Comp	
Nitrogen, Nitrite + Nitrate Total		mg/L	Quarterly	24-Hr Flow Prop Comp	
Nitrogen, Total		mg/L	Quarterly	Calculated	
Phosphorus, Total	Monthly Avg	0.86 mg/L	Daily	24-Hr Flow Prop Comp	This is an interim limit effective upon permit reissuance. See 'Phosphorus' section below.
Mercury, Total Recoverable	Daily Max	4.0 ng/L	Monthly	Grab	See "Mercury Monitoring' section below.
Hardness, Total as $CaCO_3$		mg/L	Quarterly	24-Hr Flow Prop Comp	See 'Total Metals Analyses' and 'Sample Analysis' sections below.
Arsenic, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	See 'Total Metals Analyses' and 'Sample Analysis' sections below.

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Cadmium, Total Recoverable		µg/L	Monthly	24-Hr Flow Prop Comp	See 'Total Metals Analyses' and 'Sample Analysis' sections below.
Chromium, Total Recoverable		µg/L	Monthly	24-Hr Flow Prop Comp	See 'Total Metals Analyses' and 'Sample Analysis' sections below.
Copper, Total Recoverable		µg/L	Monthly	24-Hr Flow Prop Comp	See 'Total Metals Analyses' and 'Sample Analysis' sections below.
Lead, Total Recoverable		µg/L	Monthly	24-Hr Flow Prop Comp	See 'Total Metals Analyses' and 'Sample Analysis' sections below.
Nickel, Total Recoverable		µg/L	Monthly	24-Hr Flow Prop Comp	See 'Total Metals Analyses' and 'Sample Analysis' sections below.
Zinc, Total Recoverable		µg/L	Monthly	24-Hr Flow Prop Comp	See 'Total Metals Analyses' and 'Sample Analysis' sections below.
Temperature Maximum		deg F	3/Week	Continuous	Year-round monitoring in 2023. See 'Schedules' section.
Temperature Maximum	Weekly Avg	61 deg F	3/Week	Continuous	Limit effective starting October 2023. See 'Schedules' section.
Temperature Maximum	Weekly Avg	62 deg F	3/Week	Continuous	Limit effective starting November 2023. See 'Schedules' section.
Temperature Maximum	Weekly Avg	52 deg F	3/Week	Continuous	Limit effective starting December 2023. See 'Schedules' section.
Chronic WET		TUc	See Listed Qtr(s)	24-Hr Flow Prop Comp	Annual in rotating quarters. See 'WET Testing' section below.
Acute WET		TU_a	See Listed Qtr(s)	24-Hr Flow Prop Comp	Annual in rotating quarters. See 'WET Testing' section below.

3.2.1.1 Annual Average Design Flow

The annual average design flow of the permittee's wastewater treatment facility is 36 MGD.

3.2.1.2 Daily Maximum Ammonia Limits

The daily maximum limits for ammonia correspond to the daily pH value, in accordance with the following table:

Effluent pH s.u.	Limit mg/L	Effluent pH s.u.	Limit mg/L	Effluent pH s.u.	Limit mg/L

6.0 < pH ≤ 6.1	72	7.0 < pH ≤ 7.1	44	8.0 < pH ≤ 8.1	9.3
6.1 < pH ≤ 6.2	71	7.1 < pH ≤ 7.2	39	8.1 < pH ≤ 8.2	7.6
6.2 < pH ≤ 6.3	69	7.2 < pH ≤ 7.3	35	8.2 < pH ≤ 8.3	6.3
6.3 < pH ≤ 6.4	67	7.3 < pH ≤ 7.4	31	8.3 < pH ≤ 8.4	5.2
6.4 < pH ≤ 6.5	65	7.4 < pH ≤ 7.5	27	8.4 < pH ≤ 8.5	4.3
6.5 < pH ≤ 6.6	63	7.5 < pH ≤ 7.6	23	8.5 < pH ≤ 8.6	3.5
6.6 < pH ≤ 6.7	60	7.6 < pH ≤ 7.7	19	8.6 < pH ≤ 8.7	3.0
6.7 < pH ≤ 6.8	56	7.7 < pH ≤ 7.8	16	8.7 < pH ≤ 8.8	2.5
6.8 < pH ≤ 6.9	52	7.8 < pH ≤ 7.9	14	8.8 < pH ≤ 8.9	2.1
6.9 < pH ≤ 7.0	48	7.9 < pH ≤ 8.0	11	8.9 < pH ≤ 9.0	1.8

3.2.1.3 Total Metals Analyses

Measurements of total metals and total recoverable metals shall be considered as equivalent.

3.2.1.4 Metals and Hardness Monitoring

Hardness and metals samples shall be collected concurrently.

3.2.1.5 Sample Analysis

Samples shall be analyzed using a method which provides adequate sensitivity so that results can be quantified at a level of quantification below the calculated/potential effluent limit, unless not possible using the most sensitive approved method.

3.2.1.6 Mercury Monitoring

The permittee shall collect and analyze all mercury samples according to the data quality requirements of ss. NR 106.145(9) and (10), Wisconsin Administrative Code. The limit of quantitation (LOQ) used for the effluent and field blank shall be less than 1.3 ng/L, unless the samples are quantified at levels above 1.3 ng/L. The permittee shall collect at least one mercury field blank for each set of mercury samples (a set of samples may include combinations of intake, influent, effluent or other samples all collected on the same day). The permittee shall report results of samples and field blanks to the Department on Discharge Monitoring Reports.

3.2.1.7 Effluent Temperature Monitoring

For monitoring temperature continuously, collect measurements in accordance with s. NR 218.04(13). This means that discrete measurements shall be recorded at intervals of not more than 15 minutes during the 24-hour period. In either case, report the maximum temperature measured during the day on the DMR.

3.2.1.8 Effluent Temperature Limitations

The effluent limitations for "Temperature, Maximum" become effective on October 1, 2023 as specified in the Schedules section. Monitoring is required 3X/week during calendar year 2023. Daily maximum temperatures shall be reported so that applicable weekly average limits can be compared to the weekly averages of the reported daily maximum temperatures.

Effluent Limitations for 'Temperature Maximum' (Effective per the Schedules section):

Month	Calculated Effluent Limit (°F)
OCT	**61**
NOV	**62**

DEC	52

3.2.1.9 Dissipative Cooling Demonstration – POTW Weekly Average Limits

If weekly average effluent temperature limitations are needed, the permittee may submit all additional necessary information with a request that the Department account for dissipative cooling of the effluent pursuant to s. NR 106.59, Wis. Adm. Code. If the Department determines that weekly average effluent limitations for temperature are not necessary based on dissipative cooling the Department shall modify the permit to remove the weekly average effluent limitations pursuant to s. NR 106.59(4)(e). Monitoring frequency may be reduced and the remainder of the permit schedule for weekly average temperature limits shall be discontinued at that time. If after reviewing the data the Department determines that weekly average effluent limitations for temperature are still necessary because the thermal load from the effluent is not adequately dissipated, the requirement to meet the effluent limitations according to the permit schedule will not be removed and the monitoring frequency specified in the permit shall continue to apply. A re-evaluation of the limits may then be requested pursuant to NR 106 – 'Subchapters V & VI Effluent Limitations for Temperature' or NR 102.26 – Site Specific Ambient Temperature.

3.2.1.10 Phosphorus Water Quality Based Effluent Limitation(s)

The 0.86 mg/L monthly average limit for phosphorus is an interim limit pending the development of a near shore or whole lake model in accordance with s. NR 217.13(4), Wis. Adm. Code. The permittee shall continue to reduce phosphorus as much as practical from their discharge and continue to minimize phosphorus in their discharge. See the Schedules section for optimizing removal of phosphorus. The interim limit for phosphorus is in effect unless:

(A) A near shore or whole lake model is developed to calculate water quality based effluent phosphorus limits for discharges to Lake Michigan. Upon Department approval of the model, the Department may modify, revoke and reissue, or reissue the permit to incorporate revised limitations.

If the Department incorporates revised phosphorus limitations into the permit, the permittee may submit an Adaptive Management Plan and a completed Request Form 3200-139, an application for Water Quality Trading or an application for a variance.

If a variance is approved for the next reissuance, interim limits and conditions will be imposed in the reissued permit in accordance with s. 283.15, Stats., and applicable regulations. A permittee may apply for a variance to the phosphorus WQBEL at the next reissuance even if the permittee did not apply for a phosphorus variance as part of this permit reissuance.

Additional Requirements: If a water quality based effluent limit has taken effect in a permit, any increase in the limit is subject to s. NR 102.05(1) and ch. NR 207, Wis. Adm. Code. When a six-month average effluent limit is specified for Total Phosphorus the applicable averaging periods are May through October and November through April.

*Note: The Department will prioritize reissuances and revocations, modifications, and reissuances of permits to allow permittees the opportunity to implement adaptive management or nutrient trading in a timely and effective manner.

3.2.1.11 Whole Effluent Toxicity (WET) Testing

Primary Control Water: Lake Michigan

Instream Waste Concentration (IWC): 9.1%

Dilution series: At least five effluent concentrations and dual controls must be included in each test.

- **Acute:** 100, 50, 25, 12.5, 6.25% and any additional selected by the permittee.

- **Chronic:** 100, 30, 10, 3, 1% and any additional selected by the permittee.

WET Testing Frequency:

Acute and Chronic tests shall be conducted once each year in rotating quarters in order to collect seasonal information about the discharge. Tests are required during the following quarters.

- **April-June 2020, July-September 2021, October-December 2022, January-March 2023, April - June 2024.**

WET testing shall continue after the permit expiration date (until the permit is reissued) in accordance with the WET requirements specified for the last full calendar year of this permit. For example, the next tests would be required in April- June 2025.

Testing: WET testing shall be performed during normal operating conditions. Permittees are not allowed to turn off or otherwise modify treatment systems, production processes, or change other operating or treatment conditions during WET tests.

Reporting: The permittee shall report test results on the Discharge Monitoring Report form, and also complete the "Whole Effluent Toxicity Test Report Form" (Section 6, "*State of Wisconsin Aquatic Life Toxicity Testing Methods Manual, 2nd Edition*"), for each test. The original, complete, signed version of the Whole Effluent Toxicity Test Report Form shall be sent to the Biomonitoring Coordinator, Bureau of Water Quality, 101 S. Webster St., P.O. Box 7921, Madison, WI 53707-7921, within 45 days of test completion. The Discharge Monitoring Report (DMR) form shall be submitted electronically by the required deadline.

Determination of Positive Results: An acute toxicity test shall be considered positive if the Toxic Unit - Acute (TU_a) is greater than 1.0 for either species. The TU_a shall be calculated as follows: $TU_a = 100 \div LC_{50}$. A chronic toxicity test shall be considered positive if the Toxic Unit - Chronic (TU_c) is greater than 11.0 for either species. The TU_c shall be calculated as follows: $TU_c = 100 \div IC_{25}$.

Additional Testiug Requirements: Within 90 days of a test which showed positive results, the permittee shall submit the results of at least 2 retests to the Biomonitoring Coordinator on "Whole Effluent Toxicity Test Report Forms". The 90-day reporting period shall begin the day after the test which showed a positive result. The retests shall be completed using the same species and test methods specified for the original test (see the Standard Requirements section herein).

3.2.2 Sampling Point (Outfall) 010-SS PLANT; 011-S01; 012-S02; 013-S03; 014-S04; 015-S05; 016-S06; 018-S08; 019-S09; 020-S10; 021-S11; 022-S12; 032-L02; 036-L06; 038-L08; and 039-L09

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Bypass		gal	Per Occurrence	Total Batch Volume	
Flow Bypass		hours	Per Occurrence	Calculated	

3.2.2.1 Safety Site Discharges

Discharges through the safety sites (manholes) listed above are deemed sanitary sewer overflows and are prohibited. In addition to the "Flow Bypass" reporting requirements shown above, the permittee shall report any discharges through safety sites as required by subsection 6.5.6 "Unscheduled Bypassing" and adhere to the notification requirements listed in subsection 5.1 "Drinking Water Intake Notification".

3.2.2.2 Submittal of Annual Reports on Collection System Activities

The Racine Wastewater Utility shall continue to submit annual reports of the work accomplished in the preceding year to reduce the entry of wet weather flows into the collection system. The report shall include information on collection system maintenance improvement efforts of tributary communities including an electronic attachment of the monthly or quarterly wastewater flow rates and water consumption from the tributary communities as provided. In this report, include potential metering sites for any portions of the tributary communities that are not monitored but have flow into the Racine Wastewater Utility collections system. Consider only sites that are directly connected to and are the final connection to the Racine Wastewater Utility collection system. Submittal of the annual reports is required by June 30th of each year.

3.2.2.3 Notification of Drinking Water System Owners

Whenever there is a bypass, a sanitary sewer overflow, a sewage treatment facility overflow or a scheduled bypass, the permittee shall notify the following owner(s) of drinking water intakes located in surface waters as quickly as practicable, but no greater than 8 hours after becoming aware of the bypass or overflow. This notification requirement does not apply to any controlled diversions or blending if specifically allowed in this permit. **Owner(s) of Drinking Water Intakes:** Racine, Caledonia, Elmwood Park, Mount Pleasant, North Bay, Somers (KR Area), Sturtevant, and Wind Point.

4 Land Application Requirements

4.1 Sampling Point(s)

The discharge(s) shall be limited to land application of the waste type(s) designated for the listed sampling point(s) on Department approved land spreading sites or by hauling to another facility.

Sampling Point Designation	
Sampling Point Number	**Sampling Point Location, WasteType/Sample Contents and Treatment Description (as applicable)**
002	Class B, anaerobically digested cake sludge. Representative samples shall be collected prior to land application.

4.2 Monitoring Requirements and Limitations

The permittee shall comply with the following monitoring requirements and limitations.

4.2.1 Sampling Point (Outfall) 002 - ANAEROBIC CAKE SLUDGE

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Solids, Total		Percent	1/ 2 Months	Grab Comp	
Arsenic Dry Wt	Ceiling	75 mg/kg	1/ 2 Months	Grab Comp	
Arsenic Dry Wt	High Quality	41 mg/kg	1/ 2 Months	Grab Comp	
Cadmium Dry Wt	Ceiling	85 mg/kg	1/ 2 Months	Grab Comp	
Cadmium Dry Wt	High Quality	39 mg/kg	1/ 2 Months	Grab Comp	
Copper Dry Wt	Ceiling	4,300 mg/kg	1/ 2 Months	Grab Comp	
Copper Dry Wt	High Quality	1,500 mg/kg	1/ 2 Months	Grab Comp	
Lead Dry Wt	Ceiling	840 mg/kg	1/ 2 Months	Grab Comp	
Lead Dry Wt	High Quality	300 mg/kg	1/ 2 Months	Grab Comp	
Mercury Dry Wt	Ceiling	57 mg/kg	1/ 2 Months	Grab Comp	
Mercury Dry Wt	High Quality	17 mg/kg	1/ 2 Months	Grab Comp	
Molybdenum Dry Wt	Ceiling	75 mg/kg	1/ 2 Months	Grab Comp	
Nickel Dry Wt	Ceiling	420 mg/kg	1/ 2 Months	Grab Comp	
Nickel Dry Wt	High Quality	420 mg/kg	1/ 2 Months	Grab Comp	
Selenium Dry Wt	Ceiling	100 mg/kg	1/ 2 Months	Grab Comp	
Selenium Dry Wt	High Quality	100 mg/kg	1/ 2 Months	Grab Comp	
Zinc Dry Wt	Ceiling	7,500 mg/kg	1/ 2 Months	Grab Comp	
Zinc Dry Wt	High Quality	2,800 mg/kg	1/ 2 Months	Grab Comp	
Nitrogen, Total Kjeldahl		Percent	1/ 2 Months	Grab Comp	
Nitrogen, Ammonium (NH_4-N) Total		Percent	1/ 2 Months	Grab Comp	
Phosphorus, Total		Percent	1/ 2 Months	Grab Comp	
Phosphorus, Water Extractable		% of Tot P	1/ 2 Months	Grab Comp	

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Potassium, Total Recoverable		Percent	1/ 2 Months	Grab Comp	
PCB Total Dry Wt	Ceiling	50 mg/kg	Once	Grab Comp	Once in 2021.
PCB Total Dry Wt	High Quality	10 mg/kg	Once	Grab Comp	Once in 2021.

Other Sludge Requirements	
Sludge Requirements	**Sample Freqnency**
List 3 Requirements – Pathogen Control: The requirements in List 3 shall be met prior to land application of sludge.	**BiMonthly**
List 4 Requirements – Vector Attraction Reduction: The vector attraction reduction shall be satisfied prior to, or at the time of land application as specified in List 4.	**BiMonthly**

4.2.1.1 List 2 Analysis

If the monitoring frequency for List 2 parameters is more frequent than "Annual" then the sludge may be analyzed for the List 2 parameters just prior to each land application season rather than at the more frequent interval specified.

4.2.1.2 Changes in Feed Sludge Characteristics

If a change in feed sludge characteristics, treatment process, or operational procedures occurs which may result in a significant shift in sludge characteristics, the permittee shall reanalyze the sludge for List 1, 2, 3 and 4 parameters each time such change occurs.

4.2.1.3 Multiple Sludge Sample Points (Outfalls)

If there are multiple sludge sample points (outfalls), but the sludges are not subject to different sludge treatment processes, then a separate List 2 analysis shall be conducted for each sludge type which is land applied, just prior to land application, and the application rate shall be calculated for each sludge type. In this case, List 1, 3, and 4 and PCBs need only be analyzed on a single sludge type, at the specified frequency. If there are multiple sludge sample points (outfalls), due to multiple treatment processes, List 1, 2, 3 and 4 and PCBs shall be analyzed for each sludge type at the specified frequency.

4.2.1.4 Sludge Which Exceeds the High-Quality Limit

Cumulative pollutant loading records shall be kept for all bulk land application of sludge which does not meet the high-quality limit for any parameter. This requirement applies for the entire calendar year in which any exceedance of Table 3 of s. NR 204.07(5)(c), is experienced. Such loading records shall be kept for all List 1 parameters for each site land applied in that calendar year. The formula to be used for calculating cumulative loading is as follows:

[(Pollutant concentration (mg/kg) x dry tons applied/ac) ÷ 500] + previous loading (lbs/acre) = cumulative lbs pollutant per acre

When a site reaches 90% of the allowable cumulative loading for any metal established in Table 2 of s. NR 204.07(5)(b), the Department shall be so notified through letter or in the comment section of the annual land application report (3400-55).

4.2.1.5 Sludge Analysis for PCBs

The permittee shall analyze the sludge for Total PCBs one time during **2021**. The results shall be reported as "PCB Total Dry Wt". Either congener-specific analysis or Aroclor analysis shall be used to determine the PCB concentration. The permittee may determine whether Aroclor or congener specific analysis is performed. Analyses shall be performed in accordance with Table EM in s. NR 219.04, Wis. Adm. Code and the conditions specified in Standard Requirements of this permit. PCB results shall be submitted by January 31, following the specified year of analysis.

4.2.1.6 Lists 1, 2, 3, and 4

List 1 **TOTAL SOLIDS AND METALS** See the Monitoring Requirements and Limitations table above for monitoring frequency and limitations for the List 1 parameters
Solids, Total (percent)
Arsenic, mg/kg (dry weight)
Cadmium, mg/kg (dry weight)
Copper, mg/kg (dry weight)
Lead, mg/kg (dry weight)
Mercury, mg/kg (dry weight)
Molybdenum, mg/kg (dry weight)
Nickel, mg/kg (dry weight)
Selenium, mg/kg (dry weight)
Zinc, mg/kg (dry weight)

List 2 **NUTRIENTS** See the Monitoring Requirements and Limitations table above for monitoring frequency for the List 2 parameters
Solids, Total (percent)
Nitrogen Total Kjeldahl (percent)
Nitrogen Ammonium (NH4-N) Total (percent)
Phosphorus Total as P (percent)
Phosphorus, Water Extractable (as percent of Total P)
Potassium Total Recoverable (percent)

List 3
PATHOGEN CONTROL FOR CLASS B SLUDGE

The permittee shall implement pathogen control as listed in List 3. The Department shall be notified of the pathogen control utilized and shall be notified when the permittee decides to utilize alternative pathogen control.

The following requirements shall be met prior to land application of sludge.

Parameter	Unit	Limit
Fecal Coliform*	MPN/gTS or CFU/gTS	2,000,000
OR, ONE OF THE FOLLOWING PROCESS OPTIONS		
Aerobic Digestion	Air Drying	
Anaerobic Digestion	Composting	
Alkaline Stabilization	PSRP Equivalent Process	

* The Fecal Coliform limit shall be reported as the geometric mean of 7 discrete samples on a dry weight basis.

List 4
VECTOR ATTRACTION REDUCTION

The permittee shall implement any one of the vector attraction reduction options specified in List 4. The Department shall be notified of the option utilized and shall be notified when the permittee decides to utilize an alternative option.

One of the following shall be satisfied prior to, or at the time of land application as specified in List 4.

Option	Limit	Where/When it Shall be Met
Volatile Solids Reduction	≥38%	Across the process
Specific Oxygen Uptake Rate	≤1.5 mg O_2/hr/g TS	On aerobic stabilized sludge
Anaerobic bench-scale test	<17 % VS reduction	On anaerobic digested sludge
Aerobic bench-scale test	<15 % VS reduction	On aerobic digested sludge
Aerobic Process	>14 days, Temp >40°C and Avg. Temp > 45°C	On composted sludge
pH adjustment	>12 S.U. (for 2 hours) and >11.5 (for an additional 22 hours)	During the process
Drying without primary solids	>75 % TS	When applied or bagged
Drying with primary solids	>90 % TS	When applied or bagged
Equivalent Process	Approved by the Department	Varies with process
Injection	-	When applied
Incorporation	-	Within 6 hours of application

4.2.1.7 Daily Land Application Log

Daily Land Application Log		
Discharge Monitoring Requirements and Limitations		
The permittee shall maintain a daily land application log for biosolids land applied each day when land application occurs. The following minimum records must be kept, in addition to all analytical results for the biosolids land applied. The log book records shall form the basis for the annual land application report requirements.		
Parameters	**Units**	**Sample Frequency**
DNR Site Number(s)	Number	Daily as used
Outfall number applied	Number	Daily as used
Acres applied	Acres	Daily as used
Amount applied	As appropriate * /day	Daily as used
Application rate per acre	unit */acre	Daily as used
Nitrogen applied per acre	lb/acre	Daily as used
Method of Application	Injection, Incorporation, or surface applied	Daily as used

*gallons, cubic yards, dry US Tons or dry Metric Tons

5 Schedules

5.1 Mercury Pollutant Minimization Program

As a condition of the mixing zone phase out exception for mercury granted in accordance with s. NR 106.06 (2) (br), Wis. Adm. Code, and 40 CFR 132, Appendix F, the permittee shall perform the following actions in accordance with s. NR 106.145, Wis. Adm. Code.

Required Action	Due Date
Submit Annual Status Report: The permittee shall submit to the Department an annual status report to summarize and evaluate mercury monitoring data and other relevant information collected to document background and effluent levels of mercury. The report shall also document any continuing reasonable cost-effective efforts to identify and reduce potential sources of mercury in the effluent. The first annual report shall be due on the date specified and annually thereafter. Note: If the permittee wishes to apply for an alternative mercury effluent limitation in the next permit, that application is dne with the applications for permit reissuance, 6 months prior to permit expiration. The permittee should submit or reference the PMP plan as updated by the Annual Status Report or more recent developments as part of that application.	12/31/2020
Annual Mercury Progress Report #2: Submit a mercury progress report as defined above.	12/31/2021
Annual Mercury Progress Report #3: Submit a mercury progress report as defined above.	12/31/2022
Annual Mercury Progress Report #4: Submit a mercury progress report as defined above.	12/31/2023
Final Mercury Report: Submit a final report documenting the success in reducing or maintaining mercury concentrations in the effluent. The report shall summarize mercury pollutant minimization activities that have been implemented during the current permit term. The report shall include an analysis of trends in monthly and annual total effluent mercury concentrations based on mercury sampling during the current permit term. The report shall also include an analysis of how influent and effluent mercury varies with time and with significant loading of mercury such as loads from industries into the collection system.	06/30/2024
Annual Mercury Reports After Permit Expiration: In the event that this permit is not reissued on time, the permittee shall continue to submit annual mercury status reports.	

5.2 Phosphorus Optimization

No later than 14 days following each compliance date, the permittee shall notify the Department in writing of its compliance or noncompliance with the required action. If a submittal is part of the required action, then a timely submittal fulfills the written notification requirement.

Required Action	Due Date
Optimization Summary Report: The permittee shall continue to implement phosphorus optimization efforts throughout the permit term and identify any new optimization efforts. The permittee shall submit a final report documenting successes in reducing phosphorus concentrations in the effluent. The report shall summarize the actions taken for continued optimization of phosphorus removal. The report shall also include an analysis of trends in monthly and annual total effluent phosphorus concentrations based on sampling during the current permit term and include an evaluation of collected effluent data. The final report shall also identify any possible	06/30/2024

source reduction measures and operational improvements to continue to optimize removal of phosphorus in the future.	

5.3 Temperature Limits Compliance and Dissipative Cooling Evaluation

This compliance schedule requires the permittee to achieve compliance by the specified date

Required Action	Due Date
Preliminary Compliance Report: Submit a preliminary compliance report indicating alternatives to achieve the final temperature limits. Informational Note: Refer to the Surface Water subsection titled 'Dissipative Cooling Demonstration - POTW Weekly Average Limits' regarding requests for Department consideration of dissipative cooling per NR 106.59, Wis. Adm. Code, as well as re-evaluation of the limits pursuant to NR 106 Subchapters V & VI or NR 102.26, Wis. Adm. Code.	12/31/2020
Action Plan: Submit an action plan for complying with all applicable effluent temperature limits.	06/30/2021
Construction Plans: Submit construction plans (if construction is required for complying with effluent termperature limits) and include plans and specifications with the submittal.	12/31/2021
Initiate Actions: Initiate actions identified in the plan.	12/31/2022
Complete Actions: Complete actions necessary to achieve compliance with effluent temperature limits. Limits become effective on October 1, 2023.	09/30/2023

6 Standard Requirements

NR 205, Wisconsin Administrative Code: The conditions in ss. NR 205.07(1) and NR 205.07(2), Wis. Adm. Code, are included by reference in this permit. The permittee shall comply with all of these requirements. Some of these requirements are outlined in the Standard Requirements section of this permit. Requirements not specifically outlined in the Standard Requirement section of this permit can be found in ss. NR 205.07(1) and NR 205.07(2).

6.1 Reporting and Monitoring Requirements

6.1.1 Monitoring Results

Monitoring results obtained during the previous month shall be summarized and reported on a Department Wastewater Discharge Monitoring Report. The report may require reporting of any or all of the information specified below under 'Recording of Results'. This report is to be returned to the Department no later than the date indicated on the form. A copy of the Wastewater Discharge Monitoring Report Form or an electronic file of the report shall be retained by the permittee.

Monitoring results shall be reported on an electronic discharge monitoring report (eDMR). The eDMR shall be certified electronically by a responsible executive or municipal officer, manager, partner or proprietor as specified in s. 283.37(3), Wis. Stats., or a duly authorized representative of the officer, manager, partner or proprietor that has been delegated signature authority pursuant to s. NR 205.07(1)(g)2, Wis. Adm. Code. The 'eReport Certify' page certifies that the electronic report form is true, accurate and complete.

If the permittee monitors any pollutant more frequently than required by this permit, the results of such monitoring shall be included on the Wastewater Discharge Monitoring Report.

The permittee shall comply with all limits for each parameter regardless of monitoring frequency. For example, monthly, weekly, and/or daily limits shall be met even with monthly monitoring. The permittee may monitor more frequently than required for any parameter.

6.1.2 Sampling and Testing Procedures

Sampling and laboratory testing procedures shall be performed in accordance with Chapters NR 218 and NR 219, Wis. Adm. Code and shall be performed by a laboratory certified or registered in accordance with the requirements of ch. NR 149, Wis. Adm. Code. Groundwater sample collection and analysis shall be performed in accordance with ch. NR 140, Wis. Adm. Code. The analytical methodologies used shall enable the laboratory to quantitate all substances for which monitoring is required at levels below the effluent limitation. If the required level cannot be met by any of the methods available in NR 219, Wis. Adm. Code, then the method with the lowest limit of detection shall be selected. Additional test procedures may be specified in this permit.

6.1.3 Pretreatment Sampling Requirements

Sampling for pretreatment parameters (cadmium, chromium, copper, lead, nickel, zinc, and mercury) shall be done during a day each month when industrial discharges are occurring at normal to maximum levels. The sampling of the influent and effluent for these parameters shall be coordinated. All 24 hour composite samples shall be flow proportional.

6.1.4 Recording of Results

The permittee shall maintain records which provide the following information for each effluent measurement or sample taken:

- the date, exact place, method and time of sampling or measurements;
- the individual who performed the sampling or measurements;

- the date the analysis was performed;
- the individual who performed the analysis;
- the analytical techniques or methods used; and
- the results of the analysis.

6.1.5 Reporting of Monitoring Results

The permittee shall use the following conventions when reporting effluent monitoring results:

- Pollutant concentrations less than the limit of detection shall be reported as < (less than) the value of the limit of detection. For example, if a substance is not detected at a detection limit of 0.1 mg/L, report the pollutant concentration as < 0.1 mg/L.

- Pollutant concentrations equal to or greater than the limit of detection, but less than the limit of quantitation, shall be reported and the limit of quantitation shall be specified.

- For purposes of calculating NR 101 fees, the 2 mg/l lower reporting limits for BOD_5 and Total Suspended Solids shall be considered to be limits of quantitation

- For the purposes of reporting a calculated result, average or a mass discharge value, the permittee may substitute a 0 (zero) for any pollutant concentration that is less than the limit of detection. However, if the effluent limitation is less than the limit of detection, the department may substitute a value other than zero for results less than the limit of detection, after considering the number of monitoring results that are greater than the limit of detection and if warranted when applying appropriate statistical techniques.

6.1.6 Compliance Maintenance Annual Reports

Compliance Maintenance Annual Reports (CMAR) shall be completed using information obtained over each calendar year regarding the wastewater conveyance and treatment system. The CMAR shall be submitted and certified by the permittee in accordance with ch. NR 208, Wis. Adm. Code, by June 30, each year on an electronic report form provided by the Department.

In the case of a publicly owned treatment works, a resolution shall be passed by the governing body and submitted as part of the CMAR, verifying its review of the report and providing responses as required. Private owners of wastewater treatment works are not required to pass a resolution; but they must provide an Owner Statement and responses as required, as part of the CMAR submittal.

The CMAR shall be certified electronically by a responsible executive or municipal officer, manager, partner or proprietor as specified in s. 283.37(3), Wis. Stats., or a duly authorized representative of the officer, manager, partner or proprietor that has been delegated signature authority pursuant to s. NR 205.07(1)(g)2, Wis. Adm. Code. The certification verifies that the electronic report is true, accurate and complete.

6.1.7 Records Retention

The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings or electronic data records for continuous monitoring instrumentation, copies of all reports required by the permit, and records of all data used to complete the application for the permit for a period of at least 3 years from the date of the sample, measurement, report or application. All pertinent sludge information, including permit application information and other documents specified in this permit or s. NR 204.06(9), Wis. Adm. Code shall be retained for a minimum of 5 years.

6.1.8 Other Information

Where the permittee becomes aware that it failed to submit any relevant facts in a permit application or submitted incorrect information in a permit application or in any report to the Department, it shall promptly submit such facts or correct information to the Department.

6.1.9 Reporting Requirements – Alterations or Additions

The permittee shall give notice to the Department as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is only required when:

- The alteration or addition to the permitted facility may meet one of the criteria for determining whether a facility is a new source.
- The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification requirement applies to pollutants which are not subject to effluent limitations in the existing permit.
- The alteration or addition results in a significant change in the permittee's sludge use or disposal practices, and such alteration, addition, or change may justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional use of disposal sites not reported during the permit application process nor reported pursuant to an approved land application plan. Additional sites may not be used for the land application of sludge until department approval is received.

6.2 System Operating Requirements

6.2.1 Noncompliance Reporting

Sanitary sewer overflows and sewage treatment facility overflows shall be reported according to the 'Sanitary Sewer Overflows and Sewage Treatment Facility Overflows' section of this permit.

The permittee shall report the following types of noncompliance by a telephone call to the Department's regional office within 24 hours after becoming aware of the noncompliance:

- any noncompliance which may endanger health or the environment;
- any violation of an effluent limitation resulting from a bypass;
- any violation of an effluent limitation resulting from an upset; and
- any violation of a maximum discharge limitation for any of the pollutants listed by the Department in the permit, either for effluent or sludge.

A written report describing the noncompliance shall also be submitted to the Department's regional office within 5 days after the permittee becomes aware of the noncompliance. On a case-by-case basis, the Department may waive the requirement for submittal of a written report within 5 days and instruct the permittee to submit the written report with the next regularly scheduled monitoring report. In either case, the written report shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times; the steps taken or planned to reduce, eliminate and prevent reoccurrence of the noncompliance; and if the noncompliance has not been corrected, the length of time it is expected to continue.

A scheduled bypass approved by the Department under the 'Scheduled Bypass' section of this permit shall not be subject to the reporting required under this section.

NOTE: Section 292.11(2)(a), Wisconsin Statutes, requires any person who possesses or controls a hazardous substance or who causes the discharge of a hazardous substance to notify the Department of Natural Resources **immediately** of any discharge not authorized by the permit. **The discharge of a hazardous substance that is not authorized by this permit or that violates this permit may be a hazardous substance spill. To report a hazardous substance spill, call DNR's 24-hour HOTLINE at 1-800-943-0003.**

6.2.2 Flow Meters

Flow meters shall be calibrated annually, as per s. NR 218.06, Wis. Adm. Code.

6.2.3 Raw Grit and Screenings

All raw grit and screenings shall be disposed of at a properly licensed solid waste facility or picked up by a licensed waste hauler. If the facility or hauler are located in Wisconsin, then they shall be licensed under chs. NR 500-555, Wis. Adm. Code.

6.2.4 Sludge Management

All sludge management activities shall be conducted in compliance with ch. NR 204 "Domestic Sewage Sludge Management", Wis. Adm. Code.

6.2.5 Prohibited Wastes

Under no circumstances may the introduction of wastes prohibited by s. NR 211.10, Wis. Adm. Code, be allowed into the waste treatment system. Prohibited wastes include those:

- which create a fire or explosion hazard in the treatment work;
- which will cause corrosive structural damage to the treatment work;
- solid or viscous substances in amounts which cause obstructions to the flow in sewers or interference with the proper operation of the treatment work;
- wastewaters at a flow rate or pollutant loading which are excessive over relatively short time periods so as to cause a loss of treatment efficiency; and
- changes in discharge volume or composition from contributing industries which overload the treatment works or cause a loss of treatment efficiency.

6.2.6 Bypass

This condition applies only to bypassing at a sewage treatment facility that is not a scheduled bypass, approved blending as a specific condition of this permit, a sewage treatment facility overflow or a controlled diversion as provided in the sections titled 'Scheduled Bypass', 'Blending' (if approved), 'SSO's and Sewage Treatment Facility Overflows' and 'Controlled Diversions' of this permit. Any other bypass at the sewage treatment facility is prohibited and the Department may take enforcement action against a permittee for such occurrences under s. 283.89, Wis. Stats. The Department may approve a bypass if the permittee demonstrates all the following conditions apply:

- The bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;
- There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities or adequate back-up equipment, retention of untreated wastes, reduction of inflow and infiltration, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventative maintenance. When evaluating feasibility of alternatives, the department may consider factors such as technical achievability, costs and affordability of implementation and risks to public health, the environment and, where the permittee is a municipality, the welfare of the community served; and
- The bypass was reported in accordance with the Noncompliance Reporting section of this permit.

6.2.7 Scheduled Bypass

Whenever the permittee anticipates the need to bypass for purposes of efficient operations and maintenance and the permittee may not meet the conditions for controlled diversions in the 'Controlled Diversions' section of this permit,

the permittee shall obtain prior written approval from the Department for the scheduled bypass. A permittee's written request for Department approval of a scheduled bypass shall demonstrate that the conditions for bypassing specified in the above section titled 'Bypass' are met and include the proposed date and reason for the bypass, estimated volume and duration of the bypass, alternatives to bypassing and measures to mitigate environmental harm caused by the bypass. The department may require the permittee to provide public notification for a scheduled bypass if it is determined there is significant public interest in the proposed action and may recommend mitigation measures to minimize the impact of such bypass.

6.2.8 Controlled Diversions

Controlled diversions are allowed only when necessary for essential maintenance to assure efficient operation. Sewage treatment facilities that have multiple treatment units to treat variable or seasonal loading conditions may shut down redundant treatment units when necessary for efficient operation. The following requirements shall be met during controlled diversions:

- Effluent from the sewage treatment facility shall meet the effluent limitations established in the permit. Wastewater that is diverted around a treatment unit or treatment process during a controlled diversion shall be recombined with wastewater that is not diverted prior to the effluent sampling location and prior to effluent discharge;
- A controlled diversion does not include blending as defined in s. NR 210.03(2e), Wis. Adm. Code, and as may only be approved under s. NR 210.12. A controlled diversion may not occur during periods of excessive flow or other abnormal wastewater characteristics;
- A controlled diversion may not result in a wastewater treatment facility overflow; and
- All instances of controlled diversions shall be documented in sewage treatment facility records and such records shall be available to the department on request.

6.2.9 Blending

The Department has determined that blending as defined in s. NR 210.03(2e), Wis. Adm. Code, may occur at this sewage treatment facility. The following requirements shall apply whenever blending operations are in effect:

- Blending may occur temporarily only during wet weather or other high flow conditions when peak wastewater flow to the sewage treatment facility exceeds the maximum design and operating capacity of the biological treatment processes and when necessary to avoid severe property damage to the sewage treatment facility as described in NR 210.12 (2) (a), Wis. Adm. Code.;
- Untreated, or partially treated wastewater that is routed around the biological treatment process, or a portion of a biological treatment process, shall be recombined with the biologically treated wastewater and the combined flow shall be disinfected, if required by this permit, prior to discharge;
- Effluent from the sewage treatment facility shall be monitored to include all wastewater that is discharged from the facility, including those wastewaters that are diverted around the biological treatment process and shall meet the effluent limitations for Outfall 001 included in this permit; and
- Blending under this section and the circumstances that lead to blending shall be reported to the Department by telephone, fax or email no later than 24 hours from the time each blending operation ceases at the sewage treatment facility. Permittees shall also report the time, duration and volume of wastewater routed around the biological treatment process on the wastewater Discharge Monitoring Report (DMR) forms.

6.2.10 Proper Operation and Maintenance

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training as required in ch. NR 114, Wis. Adm. Code, and adequate laboratory and process controls, including appropriate quality assurance

procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems only when necessary to achieve compliance with the conditions of the permit.

6.2.11 Operator Certification

The wastewater treatment facility shall be under the direct supervision of a state certified operator. In accordance with s. NR 114.53, Wis. Adm. Code, every WPDES permitted treatment plant shall have a designated operator-in-charge holding a current and valid certificate. The designated operator-in-charge shall be certified at the level and in all subclasses of the treatment plant, except laboratory. Treatment plant owners shall notify the department of any changes in the operator-in-charge within 30 days. Note that s. NR 114.52(22), Wis. Adm. Code, lists types of facilities that are excluded from operator certification requirements (i.e. private sewage systems, pretreatment facilities discharging to public sewers, industrial wastewater treatment that consists solely of land disposal, agricultural digesters and concentrated aquatic production facilities with no biological treatment).

6.3 Sewage Collection Systems

6.3.1 Sanitary Sewage Overflows and Sewage Treatment Facility Overflows

6.3.1.1 Overflows Prohibited

Any overflow or discharge of wastewater from the sewage collection system or at the sewage treatment facility, other than from permitted outfalls, is prohibited. The permittee shall provide information on whether any of the following conditions existed when an overflow occurred:

- The sanitary sewer overflow or sewage treatment facility overflow was unavoidable to prevent loss of life, personal injury or severe property damage;
- There were no feasible alternatives to the sanitary sewer overflow or sewage treatment facility overflow such as the use of auxiliary treatment facilities or adequate back-up equipment, retention of untreated wastes, reduction of inflow and infiltration, or preventative maintenance activities;
- The sanitary sewer overflow or the sewage treatment facility overflow was caused by unusual or severe weather related conditions such as large or successive precipitation events, snowmelt, saturated soil conditions, or severe weather occurring in the area served by the sewage collection system or sewage treatment facility; and
- The sanitary sewer overflow or the sewage treatment facility overflow was unintentional, temporary, and caused by an accident or other factors beyond the reasonable control of the permittee.

6.3.1.2 Permittee Response to Overflows

Whenever a sanitary sewer overflow or sewage treatment facility overflow occurs, the permittee shall take all feasible steps to control or limit the volume of untreated or partially treated wastewater discharged, and terminate the discharge as soon as practicable. Remedial actions, including those in NR 210.21 (3), Wis. Adm. Code, shall be implemented consistent with an emergency response plan developed under the CMOM program.

6.3.1.3 Permittee Reporting

Permittees shall report all sanitary sewer overflows and sewage treatment overflows as follows:

- The permittee shall notify the department by telephone, fax or email as soon as practicable, but no later than 24 hours from the time the permittee becomes aware of the overflow;
- The permittee shall, no later than five days from the time the permittee becomes aware of the overflow, provide to the department the information identified in this paragraph using department form number 3400-184. If an overflow lasts for more than five days, an initial report shall be submitted within 5 days as required in this paragraph and an updated report submitted following cessation of the overflow. At a minimum, the following information shall be included in the report:

- The date and location of the overflow;
- The surface water to which the discharge occurred, if any;
- The duration of the overflow and an estimate of the volume of the overflow;
- A description of the sewer system or treatment facility component from which the discharge occurred such as manhole, lift station, constructed overflow pipe, or crack or other opening in a pipe;
- The estimated date and time when the overflow began and stopped or will be stopped;
- The cause or suspected cause of the overflow including, if appropriate, precipitation, runoff conditions, areas of flooding, soil moisture and other relevant information;
- Steps taken or planned to reduce, eliminate and prevent reoccurrence of the overflow and a schedule of major milestones for those steps;
- A description of the actual or potential for human exposure and contact with the wastewater from the overflow;
- Steps taken or planned to mitigate the impacts of the overflow and a schedule of major milestones for those steps;
- To the extent known at the time of reporting, the number and location of building backups caused by excessive flow or other hydraulic constraints in the sewage collection system that occurred concurrently with the sanitary sewer overflow and that were within the same area of the sewage collection system as the sanitary sewer overflow; and
- The reason the overflow occurred or explanation of other contributing circumstances that resulted in the overflow event. This includes any information available including whether the overflow was unavoidable to prevent loss of life, personal injury, or severe property damage and whether there were feasible alternatives to the overflow.

NOTE: A copy of form 3400-184 for reporting sanitary sewer overflows and sewage treatment facility overflows may be obtained from the department or accessed on the department's web site at http://dnr.wi.gov/topic/wastewater/SSOreport.html. As indicated on the form, additional information may be submitted to supplement the information required by the form.

- The permittee shall identify each specific location and each day on which a sanitary sewer overflow or sewage treatment facility overflow occurs as a discrete sanitary sewer overflow or sewage treatment facility overflow occurrence. An occurrence may be more than one day if the circumstances causing the sanitary sewer overflow or sewage treatment facility overflow results in a discharge duration of greater than 24 hours. If there is a stop and restart of the overflow at the same location within 24 hours and the overflow is caused by the same circumstance, it may be reported as one occurrence. Sanitary sewer overflow occurrences at a specific location that are separated by more than 24 hours shall be reported as separate occurrences; and
- A permittee that is required to submit wastewater discharge monitoring reports nnder NR 205.07 (1) (r) shall also report all sanitary sewer overflows and sewage treatment facility overflows on that report.

6.3.1.4 Public Notification

The permittee shall notify the public of any sanitary sewer and sewage treatment facility overflows consistent with its emergency response plan required under the CMOM (Capacity, Management, Operation and Maintenance) section of this permit and s. NR 210.23 (4) (f), Wis. Adm. Code. Such public notification shall occur promptly following any overflow event using the most effective and efficient communications available in the community. At minimum, a daily newspaper of general circulation in the county(s) and municipality whose waters may be affected by the overflow shall be notified by written or electronic communication.

6.3.2 Capacity, Management, Operation and Maintenance (CMOM) Program

- The permittee shall have written documentation of the Capacity, Management, Operation and Maintenance (CMOM) program components in accordance with s. NR 210.23(4), Wis. Adm. Code. Such documentation shall be available for Department review upon request. The Department may request that the permittee provide this documentation or prepare a summary of the permittee's CMOM program at the time of application for reissuance of the WPDES permit.
- The permittee shall implement a CMOM program in accordance with s. NR 210.23, Wis. Adm. Code.
- The permittee shall at least annually conduct a self-audit of activities conducted under the permittee's CMOM program to ensure CMOM components are being implemented as necessary to meet the general standards of s. NR 210.23(3), Wis. Adm. Code.

6.3.3 Sewer Cleaning Debris and Materials

All debris and material removed from cleaning sanitary sewers shall be managed to prevent nuisances, run-off, ground infiltration or prohibited discharges.

- Debris and solid waste shall be dewatered, dried and then disposed of at a licensed solid waste facility.
- Liquid waste from the cleaning and dewatering operations shall be collected and disposed of at a permitted wastewater treatment facility.
- Combination waste including liquid waste along with debris and solid waste may be disposed of at a licensed solid waste facility or wastewater treatment facility willing to accept the waste.

6.4 Surface Water Requirements

6.4.1 Permittee-Determined Limit of Quantitation Incorporated into this Permit

For pollutants with water quality-based effluent limits below the Limit of Quantitation (LOQ) in this permit, the LOQ calculated by the permittee and reported on the Discharge Monitoring Reports (DMRs) is incorporated by reference into this permit. The LOQ shall be reported on the DMRs, shall be the lowest quantifiable level practicable, and shall be no greater than the minimum level (ML) specified in or approved under 40 CFR Part 136 for the pollutant at the time this permit was issued, unless this permit specifies a higher LOQ.

6.4.2 Appropriate Formulas for Effluent Calculations

The permittee shall use the following formulas for calculating effluent results to determine compliance with average concentration limits and mass limits and total load limits:

Weekly/Monthly/Six-Month/Anuual Average Concentration = the sum of all daily results for that week/month/six-month/year, divided by the number of results during that time period. [Note: When a six-month average effluent limit is specified for Total Phosphorus the applicable periods are May through October and November through April.]

Weekly Average Mass Discharge (lbs/day): Daily mass = daily concentration (mg/L) x daily flow (MGD) x 8.34, then average the daily mass values for the week.

Monthly Average Mass Discharge (lbs/day): Daily mass = daily concentration (mg/L) x daily flow (MGD) x 8.34, then average the daily mass values for the month.

Six-Month Average Mass Discharge (lbs/day): Daily mass = daily concentration (mg/L) x daily flow (MGD) x 8.34, then average the daily mass values for the six-month period. [Note: When a six-month average effluent limit is specified for Total Phosphorus the applicable periods are May through October and November through April.]

Annual Average Mass Discharge (lbs/day): Daily mass = daily concentration (mg/L) x daily flow (MGD) x 8.34, then average the daily mass values for the entire year.

Total Monthly Discharge: = monthly average concentration (mg/L) x total flow for the month (MG/month) x 8.34.

Total Annual Discharge: = sum of total monthly discharges for the calendar year.

12-Month Rolling Sum of Total Monthly Discharge: = the sum of the most recent 12 consecutive months of Total Monthly Discharges.

6.4.3 Effluent Temperature Requirements

Weekly Average Temperature – The permittee shall use the following formula for calculating effluent results to determine compliance with the weekly average temperature limit (as applicable): Weekly Average Temperature = the sum of all daily maximum results for that week divided by the number of daily maximum results during that time period.

Cold Shock Standard – Water temperatures of the discharge shall be controlled in a manner as to protect fish and aquatic life uses from the deleterious effects of cold shock. 'Cold Shock' means exposure of aquatic organisms to a rapid decrease in temperature and a sustained exposure to low temperature that induces abnormal behavior or physiological performance and may lead to death.

Rate of Temperature Change Standard – Temperature of a water of the state or discharge to a water of the state may not be artificially raised or lowered at such a rate that it causes detrimental health or reproductive effects to fish or aquatic life of the water of the state.

6.4.4 Visible Foam or Floating Solids

There shall be no discharge of floating solids or visible foam in other than trace amounts.

6.4.5 Surface Water Uses and Criteria

In accordance with NR 102.04, Wis. Adm. Code, surface water uses and criteria are established to govern water management decisions. Practices attributable to municipal, industrial, commercial, domestic, agricultural, land development or other activities shall be controlled so that all surface waters including the mixing zone meet the following conditions at all times and under all flow and water level conditions:

a) Substances that will cause objectionable deposits on the shore or in the bed of a body of water, shall not be present in such amounts as to interfere with public rights in waters of the state.

b) Floating or submerged debris, oil, scum or other material shall not be present in such amounts as to interfere with public rights in waters of the state.

c) Materials producing color, odor, taste or unsightliness shall not be present in such amounts as to interfere with public rights in waters of the state.

d) Substances in concentrations or in combinations which are toxic or harmful to humans shall not be present in amounts found to be of public health significance, nor shall substances be present in amounts which are acutely harmful to animal, plant or aquatic life.

6.4.6 Percent Removal

During any 30 consecutive days, the average effluent concentrations of BOD_5 and of total suspended solids shall not exceed 15% of the average influent concentrations, respectively. This requirement does not apply to removal of total suspended solids if the permittee operates a lagoon system and has received a variance for suspended solids granted under NR 210.07(2), Wis. Adm. Code.

6.4.7 Fecal Coliforms

The weekly and monthly limit(s) for fecal coliforms shall be expressed as a geometric mean.

6.4.8 Year Round Disinfection

Disinfection shall be provided year round. Monitoring requirements and the limitation for fecal coliforms apply during the period in which disinfection is required. Whenever chlorine is used for disinfection or other effluent uses, the limitations and monitoring requirements for residual chlorine shall apply. A dechlorination process shall be in operation whenever chlorine is used for disinfection or other effluent uses.

6.4.9 Total Residual Chlorine Requirements (When De-Chlorinating Effluent)

Test methods for total residual chlorine, approved in ch. NR 219 - Table B, Wis. Adm. Code, normally achieve a limit of detection of about 20 to 50 micrograms per liter and a limit of quantitation of about 100 micrograms per liter. Reporting of test results and compliance with effluent limitations for chlorine residual and total residual halogens shall be as follows:

- Sample results which show no detectable levels are in compliance with the limit. These test results shall be reported on Wastewater Discharge Monitoring Report Forms as "< 100 µg/L". (Note: 0.1 mg/L converts to 100 µg/L)

- Samples showing detectable traces of chlorine are in compliance if measured at less than 100 µg/L, unless there is a consistent pattern of detectable values in this range. These values shall also be reported on Wastewater Discharge Monitoring Report Forms as "<100 µg/L." The facility operating staff shall record actual readings on logs maintained at the plant, shall take action to determine the reliability of detected results (such as re-sampling and/or calculating dosages), and shall adjust the chemical feed system if necessary to reduce the chances of detects.

- Samples showing detectable levels greater than 100 µg/L shall be considered as exceedances, and shall be reported as measured.

- To calculate average or mass discharge values, a "0" (zero) may be substituted for any test result less than 100 µg/L. Calculated values shall then be compared directly to the average or mass limitations to determine compliance.

6.4.10 Whole Effluent Toxicity (WET) Monitoring Requirements

In order to determine the potential impact of the discharge on aquatic organisms, static-renewal toxicity tests shall be performed on the effluent in accordance with the procedures specified in the *"State of Wisconsin Aquatic Life Toxicity Testing Methods Manual, 2nd Edition" (PUB-WT-797*, November 2004) as required by NR 219.04, Table A, Wis. Adm. Code). All of the WET tests required in this permit, including any required retests, shall be conducted on the *Ceriodaphnia dubia* and fathead minnow species. Receiving water samples shall not be collected from any point in contact with the permittee's mixing zone and every attempt shall be made to avoid contact with any other discharge's mixing zone.

6.4.11 Whole Effluent Toxicity (WET) Identification and Reduction

Within 60 days of a retest which showed positive results, the permittee shall submit a written report to the Biomonitoring Coordinator, Bureau of Water Quality, 101 S. Webster St., PO Box 7921, Madison, WI 53707-7921, which details the following:

- A description of actions the permittee has taken or will take to remove toxicity and to prevent the recurrence of toxicity;

- A description of toxicity reduction evaluation (TRE) investigations that have been or will be done to identify potential sources of toxicity, including some or all of the following actions:

  (a) Evaluate the performance of the treatment system to identify deficiencies contributing to effluent toxicity (e.g., operational problems, chemical additives, incomplete treatment)
  (b) Identify the compound(s) causing toxicity
  (c) Trace the compound(s) causing toxicity to their sources (e.g., industrial, commercial, domestic)
  (d) Evaluate, select, and implement methods or technologies to control effluent toxicity (e.g., in-plant or pretreatment controls, source reduction or removal)

- Where corrective actions including a TRE have not been completed, an expeditious schedule under which corrective actions will be implemented;

- If no actions have been taken, the reason for not taking action.

The permittee may also request approval from the Department to postpone additional retests in order to investigate the source(s) of toxicity. Postponed retests must be completed after toxicity is believed to have been removed.

6.5 Pretreatment Program Requirements

The permittee is required to operate an industrial pretreatment program as described in the program initially approved by the Department of Natural Resources including any subsequent program modifications approved by the Department, and including commitments to program implementation activities provided in the permittee's annual pretreatment program report, and that complies with the requirements set forth in 40 CFR Part 403 and ch. NR 211, Wis. Adm. Code. To ensure that the program is operated in accordance with these requirements, the following general conditions and requirements are hereby established:

6.5.1 Inventories

The permittee shall implement methods to maintain a current inventory of the general character and volume of wastewater that industrial users discharge to the treatment works and shall provide an updated industrial user listing annually and report any changes in the listing to the Department by March 31 of each year as part of the annual pretreatment program report required herein.

6.5.2 Regulation of Industrial Users

6.5.2.1 Limitations for Industrial Users:

The permittee shall develop, maintain, enforce and revise as necessary local limits to implement the general and specific prohibitions of the state and federal General Pretreatment Regulations.

6.5.2.2 Control Documents for Industrial Users (IUs)

The permittee shall control the discharge from each significant industrial user through individual discharge permits as required by s. NR 211.235, Wis. Adm. Code and in accordance with the approved pretreatment program procedures and the permittee's sewer use ordinance. The discharge permits shall be modified in a timely manner during the stated term of the discharge permits according to the sewer use ordinance as conditions warrant. The discharge permits shall include at a minimum the elements found in s. NR 211.235(1), Wis. Adm. Code and references to the approved pretreatment program procedures and the sewer use ordinance.

6.5.2.3 Review of Industrial User Reports, Inspections and Compliance Monitoring

The permittee shall require the submission of, receive, and review self-monitoring reports and other notices from industrial users in accordance with the approved pretreatment program procedures. The permittee shall randomly sample and analyze industrial user discharges and conduct surveillance activities to determine independent of information supplied by the industrial users, whether the industrial users are in compliance with pretreatment standards and requirements. The inspections and monitoring shall also be conducted to maintain accurate knowledge of local industrial processes, including changes in the discharge, pretreatment equipment operation, spill prevention control plans, slug control plans, and implementation of solvent management plans.

The permittee shall inspect and sample the discharge from each significant industrial user as specified in the permittee's approved pretreatment program or as specified in NR 211.235(3). The permittee shall evaluate whether industrial users identified as significant need a slug control plan according to the requirements of NR 211.235(4). If a slug control plan is needed, the plan shall contain at a minimum the elements specified in s. NR 211.235(4)(b), Wis. Adm. Code.

6.5.2.4 Enforcement and Industrial User Compliance Evaluation & Violation Reports

The permittee shall enforce the industrial pretreatment requirements including the industrial user discharge limitations of the permittee's sewer use ordinance. The permittee shall investigate instances of noncompliance by collecting and analyzing samples and collecting other information with sufficient care to produce evidence admissible in enforcement proceedings or in judicial actions. Investigation and response to instances of noncompliance shall be in accordance with the permittee's sewer use ordinance and approved Enforcement Response Plan.

The permittee shall make a semiannual report on forms provided or approved by the Department. The semiannual report shall include an analysis of industrial user significant noncompliance (i.e. the Industrial User Compliance Evaluation, also known as the SNC Analysis) as outlined in s.NR 211.23(1)(j), Wis. Adm. Code, and a summary of the permittee's response to all industrial noncompliance (i.e. the Industrial User Violation Report). The Industrial User Compliance Evaluation Report shall include monitoring results received from industrial users pursuant to s. NR 211.15(1)-(5), Wis. Adm. Code. The Industrial User Violation Report shall include copies of all notices of noncompliance, notices of violation and other enforcement correspondence sent by the permittee to industrial users, together with the industrial user's response. The Industrial User Compliance Evaluation and Violation Reports for the period January through June shall be provided to the Department by September 30 of each year and for the period July through December shall be provided to the Department by March 31 of the succeeding year, unless alternate submittal dates are approved.

6.5.2.5 Publication of Violations

The permittee shall publish a list of industrial users that have significantly violated the municipal sewer use ordinance during the calendar year, in the largest daily newspaper in the area by March 31 of the following year pursuant to s. NR 211.23(1)(j), Wis. Adm. Code. A copy of the newspaper publication shall be provided as part of the annual pretreatment report specified herein.

6.5.2.6 Multijurisdictional Agreements

The permittee shall establish agreements with all contributing jurisdictions as necessary to ensure compliance with pretreatment standards and requirements by all industrial users discharging to the permittee's wastewater treatment system. Any such agreement shall identify who will be responsible for maintaining the industrial user inventory, issuance of industrial user control mechanisms, inspections and sampling, pretreatment program implementation, and enforcement.

6.5.3 Annual Pretreatment Program Report

The permittee shall evaluate the pretreatment program, and submit the Pretreatment Program Report to the Department on forms provided or approved by the Department by March 31 annually, unless an alternate submittal

date is approved. The report shall include a brief summary of the work performed during the preceding calendar year, including the numbers of discharge permits issued and in effect, pollution prevention activities, number of inspections and monitoring surveys conducted, budget and persomel assigned to the program, a general discussion of program progress in meeting the objectives of the permittee's pretreatment program together with summary comments and recommendations.

6.5.4 Pretreatment Program Modifications

- Future Modifications: The permittee shall within one year of any revisions to federal or state General Pretreatment Regulations submit an application to the Departmnent in duplicate to modify and update its approved pretreatment program to incorporate such regulatory changes as applicable to the permittee. Additionally, the Department or the permittee may request an application for program modification at any time where necessary to improve program effectiveness based on program experience to date.

- Modifications Subject to Department Approval: The permittee shall submit all proposed pretreatment program modifications to the Department for determination of significance and opportunity for comment in accordance with the requirements and conditions of s. NR 211.27, Wis. Adm. Code. Any substantial proposed program modification shall be subject to Department public noticing and formal approval prior to implementation. A substantial program modification includes, bnt is not limited to, changes in enabling legal authority to administer and enforce pretreatment conditions and requirements; significant changes in program administrative or operational procedures; significant reductions in monitoring frequencies; significant reductions in program resources including personnel commitments, equipment, and funding levels; changes (including any relaxation) in the local limitations for substances enforced and applied to users of the sewerage treatment works; changes in treatment works sludge disposal or management practices which impact the pretreatment program; or program modifications which increase pollutant loadings to the treatment works. The Department shall use the procedures outlined in s. NR 211.30, Wis. Adm. Code for review and approval/denial of proposed pretreatment program modifications. The permittee shall comply with local public participation requirements when implementing the pretreatment program.

6.5.5 Program Resources

The permittee shall have sufficient resources and qualified personnel to carry out the pretreatment program responsibilities as listed in ss. NR 211.22 and NR 211.23, Wis. Adm. Code.

6.6 Land Application Requirements

6.6.1 Sludge Management Program Standards And Requirements Based Upon Federally Promulgated Regulations

In the event that new federal sludge standards or regulations are promulgated, the permittee shall comply with the new sludge requirements by the dates established in the regulations, if required by federal law, even if the permit has not yet been modified to incorporate the new federal regulations.

6.6.2 General Sludge Management Information

The General Sludge Management Form 3400-48 shall be completed and submitted prior to any significant sludge management changes.

6.6.3 Sludge Samples

All sludge samples shall be collected at a point and in a manner which will yield sample results which are representative of the sludge being tested, and collected at the time which is appropriate for the specific test.

6.6.4 Land Application Characteristic Report

Each report shall consist of a Characteristic Form 3400-49 and Lab Report. The Characteristic Report Form 3400-49 shall be submitted electronically by January 31 following each year of analysis.

Following submittal of the electronic Characteristic Report Form 3400-49, this form shall be certified electronically via the 'eReport Certify' page by a responsible executive or municipal officer, manager, partner or proprietor as specified in s. 283.37(3), Wis. Stats., or a duly authorized representative of the officer, manager, partner or proprietor that has been delegated signature authority pursuant to s. NR 205.07(1)(g)2, Wis. Adm. Code. The 'eReport Certify' page certifies that the electronic report is true, accurate and complete. The Lab Report must be sent directly to the facility's DNR sludge representative or basin engineer unless approval for not submitting the lab reports has been given.

The permittee shall use the following convention when reporting sludge monitoring results: Pollutant concentrations less than the limit of detection shall be reported as < (less than) the value of the limit of detection. For example, if a substance is not detected at a detection limit of 1.0 mg/kg, report the pollutant concentration as < 1.0 mg/kg .

All results shall be reported on a dry weight basis.

6.6.5 Calculation of Water Extractable Phosphorus

When sludge analysis for Water Extractable Phosphorus is required by this permit, the permittee shall use the following formula to calculate and report Water Extractable Phosphorus:
Water Extractable Phosphorus (% of Total P) =
[Water Extractable Phosphorus (mg/kg, dry wt) ÷ Total Phosphorus (mg/kg, dry wt)] x 100

6.6.6 Monitoring and Calculating PCB Concentrations in Sludge

When sludge analysis for "PCB, Total Dry Wt" is required by this permit, the PCB concentration in the sludge shall be determined as follows.

Either congener-specific analysis or Aroclor analysis shall be used to determine the PCB concentration. The permittee may determine whether Aroclor or congener specific analysis is performed. Analyses shall be performed in accordance with the following provisions and Table EM in s. NR 219.04, Wis. Adm. Code.

- EPA Method 1668 may be used to test for all PCB congeners. If this method is employed, all PCB congeners shall be delineated. Non-detects shall be treated as zero. The values that are between the limit of detection and the limit of quantitation shall be used when calculating the total value of all congeners. All results shall be added together and the total PCB concentration by dry weight reported. **Note**: It is recognized that a number of the congeners will co-elute with others, so there will not be 209 results to sum.
- EPA Method 8082A shall be used for PCB-Aroclor analysis and may be used for congener specific analysis as well. If congener specific analysis is performed using Method 8082A, the list of congeners tested shall include at least congener numbers 5, 18, 31, 44, 52, 66, 87, 101, 110, 138, 141, 151, 153, 170, 180, 183, 187, and 206 plus any other additional congeners which might be reasonably expected to occur in the particular sample. For either type of analysis, the sample shall be extracted using the Soxhlet extraction (EPA Method 3540C) (or the Soxhlet Dean-Stark modification) or the pressurized fluid extraction (EPA Method 3545A). If Aroclor analysis is performed using Method 8082A, clean up steps of the extract shall be performed as necessary to remove interference and to achieve as close to a limit of detection of 0.11 mg/kg as possible. Reporting protocol, consistent with s. NR 106.07(6)(e), should be as follows: If all Aroclors are less than the LOD, then the Total PCB Dry Wt result should be reported as less than the highest LOD. If a single Aroclor is detected then that is what should be reported for the

Total PCB result. If multiple Aroclors are detected, they should be summed and reported as Total PCBs. If congener specific analysis is done using Method 8082A, clean up steps of the extract shall be performed as necessary to remove interference and to achieve as close to a limit of detection of 0.003 mg/kg as possible for each congener. If the aforementioned limits of detection cannot be achieved after using the appropriate clean up techniques, a reporting limit that is achievable for the Aroclors or each congener for the sample shall be determined. This reporting limit shall be reported and qualified indicating the presence of an interference. The lab conducting the analysis shall perform as many of the following methods as necessary to remove interference:

3620C – Florisil	3611B - Alumina
3640A - Gel Permeation	3660B - Sulfur Clean Up (using copper shot instead of powder)
3630C - Silica Gel	3665A - Sulfuric Acid Clean Up

6.6.7 Annual Land Application Report

Land Application Report Form 3400-55 shall be submitted electronically by January 31, each year whether or not non-exceptional quality sludge is land applied. Non-exceptional quality sludge is defined in s. NR 204.07(4), Wis. Adm. Code. Following submittal of the electronic Annual Land Application Report Form 3400-55, this form shall be certified electronically via the 'eReport Certify' page by a responsible executive or municipal officer, manager, partner or proprietor as specified in s. 283.37(3), Wis. Stats., or a duly authorized representative of the officer, manager, partner or proprietor that has been delegated signature authority pursuant to s. NR 205.07(1)(g)2, Wis. Adm. Code. The 'eReport Certify' page certifies that the electronic report form is true, accurate and complete.

6.6.8 Other Methods of Disposal or Distribution Report

The permittee shall submit electronically the Other Methods of Disposal or Distribution Report Form 3400-52 by January 31, each year whether or not sludge is hauled, landfilled, incinerated, or exceptional quality sludge is distributed or land applied. Following submittal of the electronic Report Form 3400-52, this form shall be certified electronically via the 'eReport Certify' page by a responsible executive or municipal officer, manager, partner or proprietor as specified in s. 283.37(3), Wis. Stats., or a duly authorized representative of the officer, manager, partner or proprietor that has been delegated signature authority pursuant to s. NR 205.07(1)(g)2, Wis. Adm. Code. The 'eReport Certify' page certifies that the electronic report form is true, accurate and complete.

6.6.9 Approval to Land Apply

Bulk non-exceptional quality sludge as defined in s. NR 204.07(4), Wis. Adm. Code, may not be applied to land without a written approval letter or Form 3400-122 from the Department unless the Permittee has obtained permission from the Department to self approve sites in accordance with s. NR 204.06 (6), Wis. Adm. Code. Analysis of sludge characteristics is required prior to land application. Application on frozen or snow covered ground is restricted to the extent specified in s. NR 204.07(3) (l), Wis. Adm. Code.

6.6.10 Soil Analysis Requirements

Each site requested for approval for land application must have the soil tested prior to use. Each approved site used for land application must subsequently be soil tested such that there is at least one valid soil test in the four years prior to land application. All soil sampling and submittal of information to the testing laboratory shall be done in accordance with UW Extension Bulletin A-2100. The testing shall be done by the UW Soils Lab in Madison or Marshfield, WI or at a lab approved by UW. The test results including the crop recommendations shall be submitted to the DNR contact listed for this permit, as they are available. Application rates shall be determined based on the crop nitrogen recommendations and with consideration for other sources of nitrogen applied to the site.

6.6.11 Land Application Site Evaluation

For non-exceptional quality sludge, as defined in s. NR 204.07(4), Wis. Adm. Code, a Land Application Site Request Form 3400-053 shall be submitted to the Department for the proposed land application site. The Department will evaluate the proposed site for acceptability and will either approve or deny use of the proposed site. The permittee may obtain permission to approve their own sites in accordance with s. NR 204.06(6), Wis. Adm. Code.

6.6.12 Class B Sludge: Fecal Coliform Limitation

Compliance with the fecal coliform limitation for Class B sludge shall be demonstrated by calculating the geometric mean of at least 7 separate samples. (Note that a Total Solids analysis must be done on each sample). The geometric mean shall be less than 2,000,000 MPN or CFU/g TS. Calculation of the geometric mean can be done using one of the following 2 methods.

Method 1:

Geometric Mean = $(X_1 \times X_2 \times X_3 \ldots \times X_n)^{1/n}$

Where X = Coliform Density value of the sludge sample, and where n = number of samples (at least 7)

Method 2:

Geometric Mean = antilog$[(X_1 + X_2 + X_3 \ldots + X_n) \div n]$

Where X = $\log_{10}$ of Coliform Density value of the sludge sample, and where n = number of samples (at least 7)

Example for Method 2

Sample Number	Coliform Density of Sludge Sample	$\log_{10}$
1	6.0×10^5	5.78
2	4.2×10^6	6.62
3	1.6×10^6	6.20
4	9.0×10^5	5.95
5	4.0×10^5	5.60
6	1.0×10^6	6.00
7	5.1×10^5	5.71

The geometric mean for the seven samples is determined by averaging the $\log_{10}$ values of the coliform density and taking the antilog of that value.

$(5.78 + 6.62 + 6.20 + 5.95 + 5.60 + 6.00 + 5.71) \div 7 = 5.98$

The antilog of $5.98 = 9.5 \times 10^5$

6.6.13 Class B Sludge: Anaerobic Digestion

Treat the sludge in the absence of air for a specific mean cell residence time at a specific temperature. Values for the mean cell residence time and temperature shall be between 15 days at 35° C to 55° C and 60 days at 20° C. Straight-line interpolation to calculate mean cell residence time is allowable when the temperature falls between 35° C and 20° C.

6.6.14 Class B Sludge - Vector Control: Incorporation

Class B sludge shall be incorporated within 6 hours of surface application, or as approved by the Department.

7 Summary of Reports Due

FOR INFORMATIONAL PURPOSES ONLY

Description	Date	Page
Mercury Pollutant Minimization Program -Submit Annual Status Report	December 31, 2020	17
Mercury Pollutant Minimization Program -Annual Mercury Progress Report #2	December 31, 2021	17
Mercury Pollutant Minimization Program -Annual Mercury Progress Report #3	December 31, 2022	17
Mercury Pollutant Minimization Program -Annual Mercury Progress Report #4	December 31, 2023	17
Mercury Pollutant Minimization Program -Final Mercury Report	June 30, 2024	17
Mercury Pollutant Minimization Program -Annual Mercury Reports After Permit Expiration	See Permit	17
Phosphorus Optimization -Optimization Summary Report	June 30, 2024	17
Temperature Limits Compliance and Dissipative Cooling Evaluation - Preliminary Compliance Report	December 31, 2020	18
Temperature Limits Compliance and Dissipative Cooling Evaluation - Action Plan	June 30, 2021	18
Temperature Limits Compliance and Dissipative Cooling Evaluation - Construction Plans	December 31, 2021	18
Temperature Limits Compliance and Dissipative Cooling Evaluation - Initiate Actions	December 31, 2022	18
Temperature Limits Compliance and Dissipative Cooling Evaluation - Complete Actions	September 30, 2023	18
Compliance Maintenance Annual Reports (CMAR)	by June 30, each year	20
Industrial User Compliance Evaluation and Violation Reports	Semiannual	30
Pretreatment Program Report	Annually	30
General Sludge Management Form 3400-48	prior to any significant sludge management changes	31
Characteristic Form 3400-49 and Lab Report	by January 31 following each year of analysis	32
Land Application Report Form 3400-55	by January 31, each year whether or not non-exceptional quality sludge is land applied	33
Other Methods of Disposal or Distribution Report Form 3400-52	by January 31, each	33

	year whether or not sludge is hauled, landfilled, incinerated, or exceptional quality sludge is distributed or land applied	
Wastewater Discharge Monitoring Report	no later than the date indicated on the form	19

Report forms shall be submitted electronically in accordance with the reporting requirements herein. Any facility plans or plans and specifications for municipal, industrial, industrial pretreatment and non-industrial wastewater systems shall be submitted to the Bureau of Water Quality, P.O. Box 7921, Madison, WI 53707-7921. All other submittals required by this permit shall be submitted to:
Southeast Region, 2300 N Dr ML King Drive, Milwaukee, WI 53212

Appendix B WWTP Process Modeling

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List of Acronyms and Abbreviations

A/O	Anaerobic/Oxic
AAC	Annual Average Conditions
ALK	Alkalinity
AOTR	Actual Oxygen Transfer Rate
aSRT	Aerobic Solids Retention Time
AVE	Average
AWTP	Advanced Wastewater Treatment Plant
BNR	Biological Nutrient Removal
BOD	5-day Biochemical Oxygen Demand
BPR	Biological Phosphorus Removal
cBOD	Carbonaceous 5-day Biochemical Oxygen Demand
CFS	Cubic Feet per Second
COD	Chemical Oxygen Demand
CPR	Chemical Phosphorus Removal
DO	Dissolved Oxygen
EPA	Environmental Protection Agency
ft^2	Square feet
ft^3	Cubic feet
gpd	Gallons per Day
gpm	Gallons per Minute
GPS-X	General Purpose Simulator (Process Simulation Software)
HRT	Hydraulic Retention Time
IWA	International Water Association
L/mg	Liter per milligram
lbs/d	Pounds per Day
M&E	Metcalf & Eddy
m^2	Square meters
m^3	Cubic meters
MG	Million Gallons
mg/L	milligrams per Liter
MGD	Million Gallons per Day
MLSS	Mixed Liquor Suspended Solids
MLVSS	Mixed Liquor Volatile Suspended Solids
m	Meter
mm	Millimeter
MMC	Maximum Month Conditions
Mov Avg	Moving Average
NH4-N	Ammonium
NO2-N	Nitrite

NO3-N	Nitrate
NOx-N	Nitrite + Nitrate
O&M	Operations and Maintenance
OP	Orthophosphate
PAOs	Phosphorus Accumulating Organisms
PE	Primary Effluent
QMFD	Quantified Mass Flow Diagram
RAS	Return Activated Sludge
rfloc	Flocculent Zone Settling Parameter
rhin	Hindered Zone Settling Parameter
RWW	Raw Wastewater
SCFM	Standard Cubic Feet per Minute
SLR	Solids Loading Rate
SOR	Surface Overflow Rate
SOTE	Standard Oxygen Transfer Efficiency
SOTR	Standard Oxygen Transfer Rate
SRT	Solids Retention Time
sTP	Soluble Total Phosphorus
TKN	Total Kjeldahl nitrogen
TN	Total Nitrogen
TP	Total Phosphorus
TS	Total Solids
TSS	Total Suspended Solids
TWAS	Thickened Waste Activated Sludge
USEPA	United States Environmental Protection Agency
VFA	Volatile Fatty Acid
VS	Volatile Solids
VSS	Volatile Suspended Solids
WAS	Waste Activated Sludge
WEF	Water Environment Association
WWTP	Wastewater Treatment Plant

1.0 PROCESS MODELING METHODOLOGY

Modeling of the Racine WWTP was a critical step in evaluating existing process performance, oxygen transfer, and potential nutrient removal configurations. This methodology also provided an accurate accounting of primary treatment performance, secondary solids production, nitrification performance, aeration demand, secondary clarifier solids loading, biosolids processing, and sidestream recycle streams; all of which can have a significant influence on performance.

The application of mechanistic modeling in biological wastewater treatment has become a powerful approach to evaluating and designing wastewater treatment processes. Mechanistically based models account for the major individual processes that occur concurrently within a system to predict the overall outcome, and are inherently more powerful, more accurate, and less subjective than most empirical models, which incorporate a statistical approach to mimic results obtained by studies. With the development of the family of International Water Association (IWA) activated sludge models and commercially available modeling software packages, biological wastewater modeling has become a popular evaluatory protocol for optimizing, re-rating, upgrading, and designing wastewater treatment plants. A practical stepwise approach was developed in 2006 that was geared towards the application of process modeling in the engineering consulting industry.[1] Two years later, the IWA task group on Good Modeling Practice developed a unified protocol for broader usage applications.[2] These protocols are appropriately stepwise in nature and generally include the following three phases and sub-steps:

1. **Pre-modeling Activities**
    a. Identification of Modeling Goals
    b. Historical Data Analysis
    c. Historical Data Reconciliation
    d. Intensive Sampling Campaign
    e. Intensive Sampling Data Reconciliation

2. **Model Development**
    a. Influent Characterization
    b. Model Construction and Calibration
    c. Model Validation

3. **Model Application**
    a. Influent Scenario Development
    b. Plant Performance Simulations

This methodology was followed in the development and application of the Racine WWTP process model. **Figure 1.1** illustrates this protocol and **Table 1.1** describes the key steps in further detail.

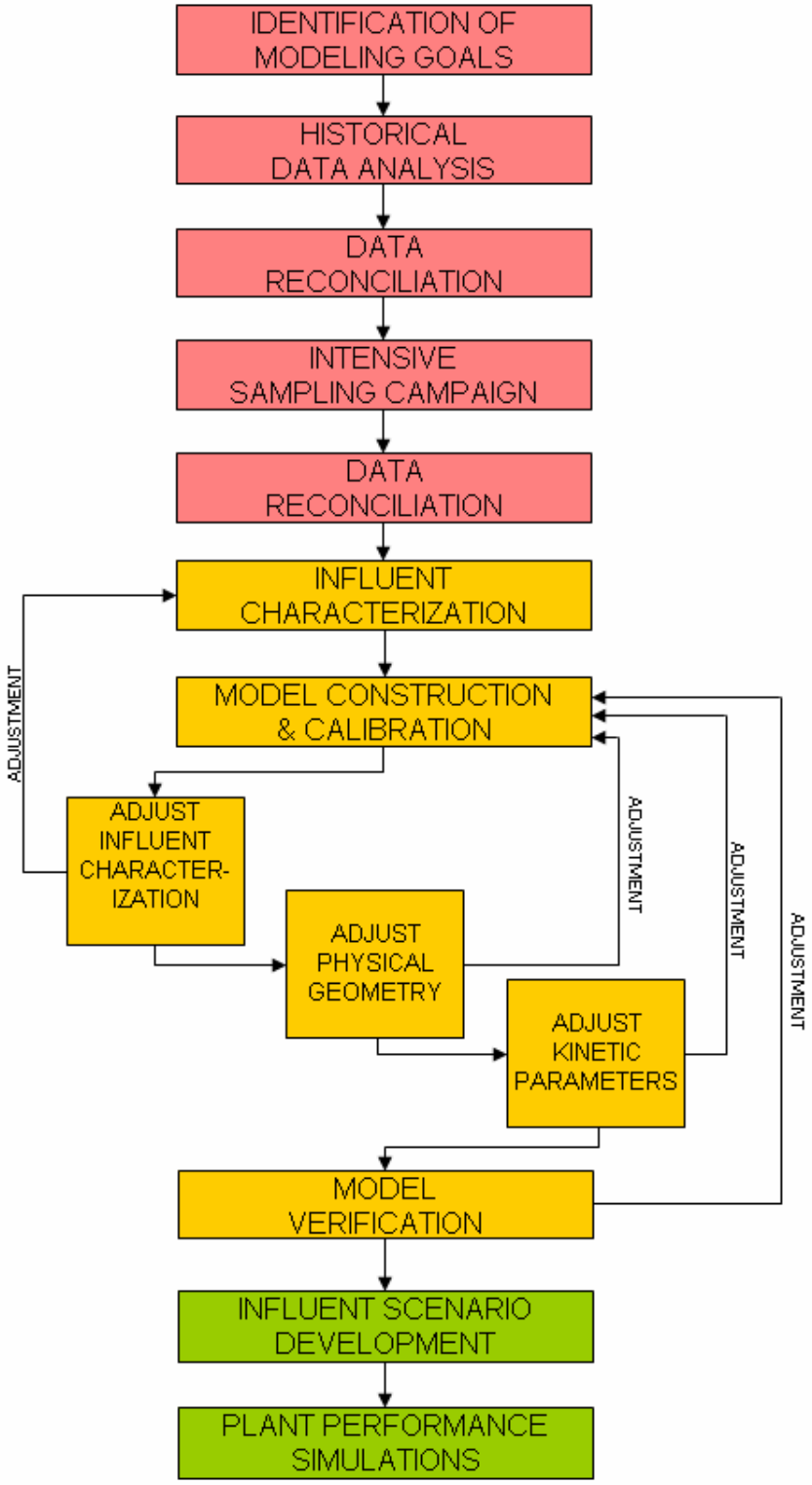


Figure 1.1. Stepwise approach to wastewater process modeling

Table 1.1. Description of wastewater process modeling steps

Step		Description	
1	Define Modeling Goals	The first step is to clearly identify goals to be achieved from the modeling. These goals will dictate the level of model complexity, quantity, and quality of sampling data, and the degree of model calibration. Although a simple step in the process, it can often be neglected causing "scope creep" and an unnecessary expenditure of effort.	Pre-modeling Activities
2	Historical Data Analysis	Mass-balance checks and other data screening techniques help identify errors due to current data collection practices. Since models achieve 100% mass balance closure, identification of these errors is important to understand where model predictions are more valid than measured data.	
3	Historical Data Reconciliation	Correction of the sampling and/or measurement errors identified in the historical data analysis decreases the chances of error generation in the next step.	
4	Intensive Sampling	Obtaining data for model calibration and verification ideally includes a comprehensive sampling program that captures a degree of dynamic variation necessary for the level of calibration identified in the first step.	
5	Intensive Sampling Data Reconciliation	Reconciliation of the intensive sampling data before using it for model calibration helps to avoid incorrect model parameter adjustments. By performing mass-balance checks and other data screening techniques, error in the data is flagged. Since models achieve 100% mass balance closure, identification of these errors is important to understand where model predictions are more valid than measured data.	
6	Influent Characterization	This is considered the most crucial step, as it influences how each inter-unit process will perform. Experience indicates that model calibration is mostly achieved through correctly conducting influent characterization.	Model Development
7	Model Construction and Calibration	Parameters are iteratively adjusted until the model predictions dynamically match inter-unit and effluent parameters. The hierarchy of parameter adjustment is influent characteristics, physical geometry, and lastly kinetic parameters.	
8	Model Validation	A calibrated model is run against a second dataset that is different from the calibration dataset.	
9	Influent Scenario Development	Definition of influent scenarios for evaluation are typically projected influent loading parameters that are extrapolated from a historical database and are characterized by the stoichiometric relationships obtained from the sampling campaign data.	Model Application
10	Plant Performance Simulations	Predicts plant performance for the projected influent scenarios and optimizes performance through sensitivity analyses.	

1.1 Pre-modeling Activities

There are several tasks that should be performed prior to the use of any modeling software. These pre-modeling activities, illustrated in steps 1 through 5 of **Figure 1.1,** aim to enhance the overall modeling project by defining the scope of the modeling, identifying and reconciling areas of poor data quality, and collecting sampling data tailored specifically for model calibration. Much of the effort associated with these steps involved data compilation and reconciliation by performing mass-balance checks of sampling data to evaluate its quality relative to its use as a dataset for process model calibration. As will be discussed in more detail, analysis of the routine historical sampling data rendered an adequate dataset for model calibration and validation so a special sampling program was not carried out.

By identifying the goals of the modeling, there is a better understanding of scope and direction and minimizes the possibility of carrying out modeling investigations not pertinent to the objectives. The goals of modeling the Racine WWTP included an evaluation of the aeration system, and an investigation of chemical phosphorus removal, biological phosphorus removal, and potential nitrification upgrades.

1.2 Model Development Activities

Model development activities involve influent characterization, model construction, calibration, and validation. These activities are normally completed together, as changes to the influent characteristics, geometry parameters, and kinetic coefficients are iteratively made until model outputs match the calibration data. However, it is also important to calibrate a model with a scope that is not limited entirely to the period for which data was available. As such it is advisable to adjust as few model parameters (i.e. biological kinetic coefficients) as possible to avoid criticism of a mathematical curve-fitting exercise.

1.3 Model Application Activities

Model application activities typically involve the establishment of influent scenarios for evaluation (i.e. annual average, maximum month, and/or peak day, etc. conditions that are associated with permitting periods or modeling goals), carrying out sensitivity analyses of various upgrades or operational parameters (i.e. facility sizing and performance optimization), and finally selection and documentation of the most pertinent upgrade alternatives.

2.0 HISTORICAL DATA ANALYSIS

Historical operating data from January 1, 2016 to December 31, 2018 were provided by the Racine Wastewater Utility, compiled, and organized to gain an understanding of existing process performance and to explore the quality of the data for model calibration purposes.

In addition to the 3-year historical dataset, two periods within were selected for dynamic model calibration and validation purposes and were also reviewed in terms of data quality and process performance. These periods reflected February 2018 (28 days) and November – December 2018 (61 days).

To help conduct the analysis, average data was illustrated in a quantified mass-flow diagram (QMFD) to track inter-unit performance. The full-plant QMFD for the long-term average, calibration, and validation datasets have been shown in **Attachment 2.1**, where the average flows, mass loadings, and flow-weighted concentration data have been illustrated. Operating parameters of the process units are also illustrated for evaluation. Much of the data presented is also color-coded to describe the origin of the value shown. Blue values indicate historical average data and red values are calculated values/estimations. This pre-modeling task provided a comprehensive process evaluation of the existing operation of the plant and also provided insight in terms of applicability of upgrade alternatives.

2.1 Raw Wastewater

Section 8.0 of the main facility plan report of which this process modeling report has been included covers the raw wastewater historical data analysis and projections. One of the key findings was that the reported raw wastewater flow, concentrations, and loadings were significantly underestimated due to a combination of two factors: (1) the raw wastewater flow metering data under-represented the true raw wastewater flow and (2) the raw wastewater sampling location and/or methodologies under-represented the pollutant concentrations. The effort associated with estimating the true raw wastewater flows and loadings involved a detailed flow and mass-balance of the whole plant with particular emphasis on estimating the sidestream recycle flows and loadings so as to subtract them from the measured primary influent, which was deemed accurate, to estimate the raw wastewater. Several of the following sections discuss the methods of carrying out these estimations. **Table 2.1** summarizes the estimated existing annual average raw wastewater flow and loadings as per the flow and mass-balance efforts and the projected annual average flow and loadings. **Table 2.2** summarizes the projected maximum month (30-day) flow and loadings.

Table 2.1. Existing and projected annual average flow and loadings

Parameter	Unit		Existing Annual Average Conditions		Additional Annual Average		Design Annual Average Conditions	
Year	(year)		2016 - 2018		Growth to 2040		2040	
Population	(capita)		136,000		14,685		150,685	
Flow	(MGD)		22.0		1.9		23.9	
TSS	(lbs/d)	(mg/L)	26,601	145	2,937	184	29,538	148
BOD	(lbs/d)	(mg/L)	23,544	129	2,643	166	26,188	132
TKN	(lbs/d)	(mg/L)	3,402	18.6	426	27	3,828	19.2
TP	(lbs/d)	(mg/L)	384	2.1	68	4.2	452	2.3

Table 2.2. Projected annual average and maximum month flow and loadings

Parameter	Unit		Annual Average		Maximum Month Average	
Flow	(MGD)		23.9		41.3	
TSS	(lbs/d)	(mg/L)	29,538	148	38,400	112
BOD	(lbs/d)	(mg/L)	26,188	132	32,211	94
TKN	(lbs/d)	(mg/L)	3,828	19.2	4,593	13.3
TP	(lbs/d)	(mg/L)	452	2.3	542	1.6

2.2 Primary Treatment

Primary treatment serves to remove suspended, yet settable material for subsequent removal from the wastewater. Typical primary treatment is mass-conservative, meaning that solids are neither created nor destroyed during the process, therefore, a mass balance across primary treatment can be expected.

Influent wastewater undergoes primary treatment through twelve primary settling tanks with a collective surface area and volume of 51,315 ft and 3.7 MG. The routinely sampled combined primary influent includes raw wastewater, hauled septage, gravity belt thickener filtrate, and belt filter press filtrate. The primary effluent was also routinely sampled in addition to the primary sludge solids concentration. This set of influent, effluent, and sludge data provided a means for checking how well the primary clarifiers solids data mass-balanced. **Table 2.3** illustrates the mass-balance closure analysis, where the long-term historical, calibration, and validation datasets respectively achieved very good closures of about 91%, 93%, and 89%.

Table 2.3. Primary Settling Tanks Mass Balance Closure Analysis

Parameter			Primary Influent	Primary Effluent	Primary Sludge	Total Out	Mass Balance Closure
Historical Dataset	Flow	(MGD)	22.72	22.69	0.048	---	---
	TSS	(mg/L)	146	41	43,699	---	---
		(lbs/d)	**27,665**	**7,759**	**17,494**	**25,252**	**91%**
Calibration Dataset	Flow	(MGD)	21.53	21.5	0.039	---	---
	TSS	(mg/L)	157	61	46,679	---	---
		(lbs/d)	**28,191**	**10,938**	**15,183**	**26,121**	**93%**
Validation Dataset	Flow	(MGD)	25.9	25.86	0.043	---	---
	TSS	(mg/L)	117	35	41,889	---	---
		(lbs/d)	**25,273**	**7,549**	**15,022**	**22,571**	**89%**

Primary treatment performance is dependent upon the influent characteristics and typically related to the surface overflow rate (SOR)[3] or the clarifier's hydraulic retention time (HRT).[4,5] At the respective long-term historical, calibration, and validation periods the primary setting tanks operated at the SORs and HRTs illustrated in **Table 2.4**. Additionally shown are the observed TSS and BOD removal efficiencies for the three data periods.

Figure 2.1 shows TSS and BOD removal as a function of HRT per the Greeley primary treatment models. The daily TSS and BOD removal points have also been plotted upon the same graph for comparison to the model curves. It was apparent that the observed removal data points generally clustered above the Greeley curves. This observation indicated that the primary treatment performance was generally better than expected.

Table 2.4. Preliminary Settling Tank Performance

Data Period	SOR (gpd/ft^2)	HRT (h)	TSS η (%)	BOD η (%)
Historical Dataset	442	3.9	72	52
Calibration Dataset	419	4.1	61	44
Validation Dataset	504	3.4	70	50

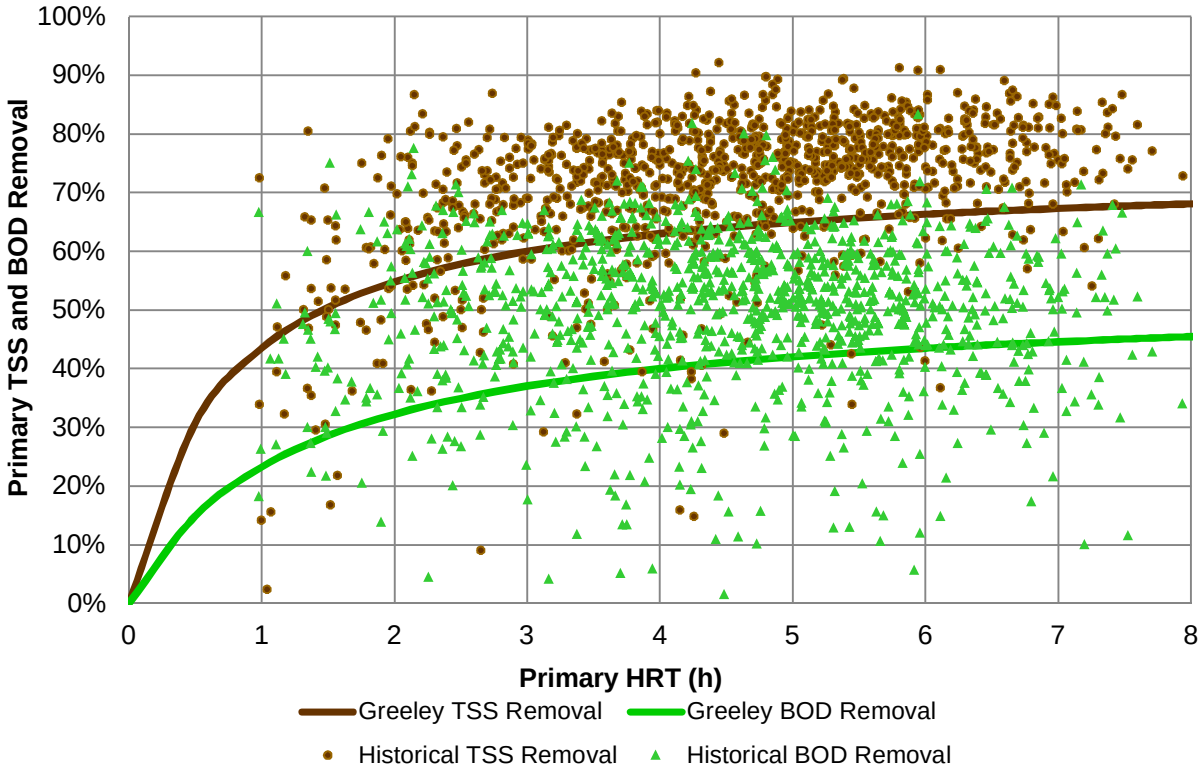


Figure 2.1. Comparison of Greeley removal curves with historical preliminary tank removals

2.3 Secondary Sludge Production

The secondary treatment system operation was investigated in terms of solids retention time (SRT) and waste activated sludge (WAS) production. The SRT is the length of time that solids remain in the secondary system and is a major parameter that influences solids production in an activated sludge process. Other factors include influent characterization, organic loading, and temperature. A simple method for estimating or checking solids production is with the use of an observed yield factor expressed as the mass of VSS produced per mass of BOD oxidized. The observed yield factor is higher for an activated sludge process that receives wastewater without primary treatment because more non-biodegradable VSS is present in the wastewater, and hence, there are two different families of observed yield curves; with and without primary treatment. **Figure 2.2** illustrates how SRT and temperature affect the observed yield factor when preceded by primary treatment.[6]

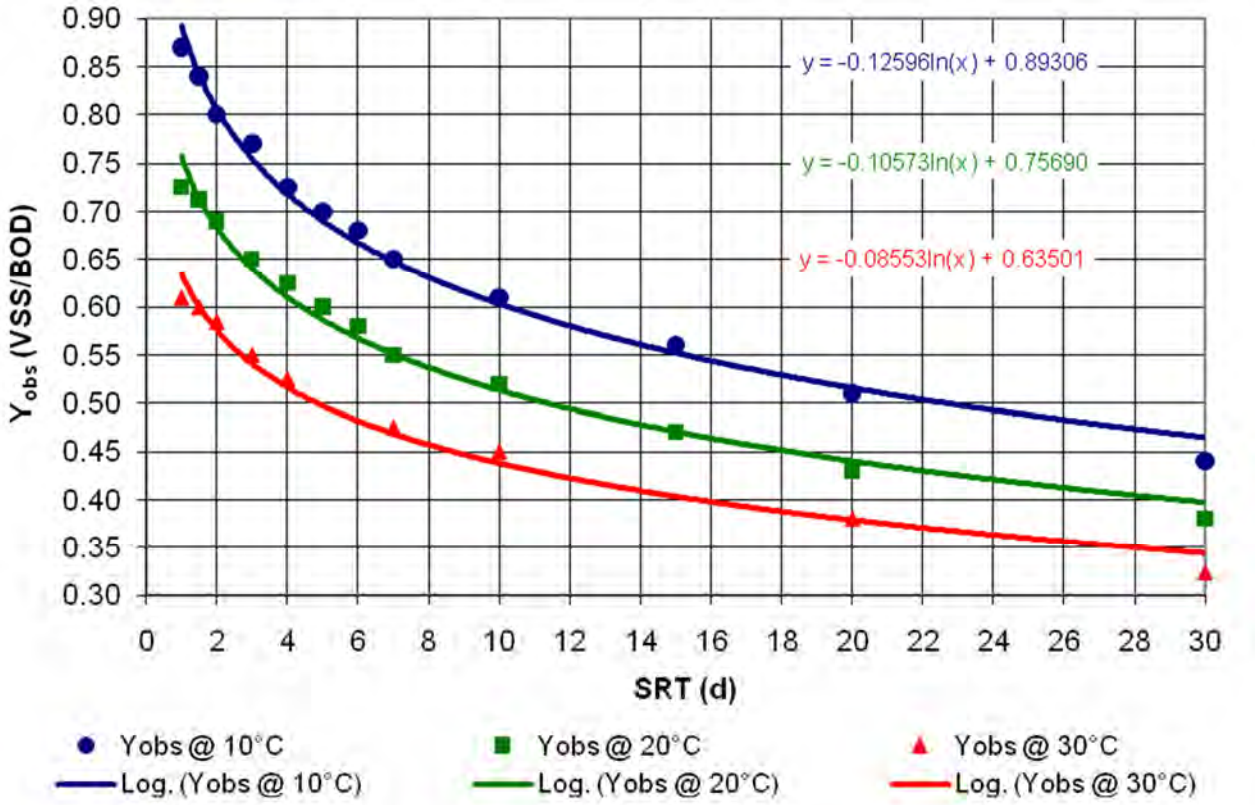


Figure 2.2. Observed yield curves for activated sludge downstream of primary treatment

SRT is defined as the total mass of solids in the secondary system divided by the rate at which solids exits the system and can be computed with **Equation 2.1**. The long-term, calibration, and validation period MLSS respectively averaged 1,781 mg/L, 1,930 mg/L and 1,742 mg/L. The total activated sludge system volume is about 5.65 MG. The WAS solids production respectively averaged 9,775 lbs/d, 10,304 lbs/d, and 9,628 lbs/d and the secondary effluent solids averaged about 1,036 lbs/d, 1,323 lbs/d and 1,111 lbs/d. These values rendered a total SRT of about 7.8 days for all three of the aforementioned datasets.

While **Figure 2.2** provides an approximation of what observed yield (Y_{obs}) factor can be expected based on SRT and temperature, it can be directly computed with **Equation 2.2**. As such, a comparison of what can be expected to the calculated observed yield is illustrated in **Table 2.5**. There was reasonable agreement in the yield factors, although the yields computed with the data were somewhat greater than those suggested by **Figure 2.2**. This comparison indicated that the reported secondary influent BOD and sludge production were in consonance, and suggested fair data quality, however the greater-than-expected yields also suggest that there may have been more non-biodegradable material in the wastewater which increases the sludge production.

$$SRT = \frac{(V)(X_{MLSS})}{(Q_{WAS})(X_{WAS_{TSS}}) + (Q_{eff})(X_{eff_{TSS}})} \quad (2.1)$$

$$Y_{obs} = \frac{(Q_{WAS})(X_{WAS_{VSS}}) + (Q_{eff})(X_{eff_{VSS}})}{(Q_{\inf})(S_{\inf}) - (Q_{eff})(S_{eff})} \quad (2.2)$$

where,

V = reactor volume
X_{MLSS} = mixed liquor suspended solids in reactor
Q_{WAS} = WAS flow
$X_{WAS,TSS}$ = WAS TSS concentration
Q_{eff} = clarifier effluent flow
$X_{eff,TSS}$ = clarifier effluent TSS concentration
$X_{WAS,VSS}$ = WAS VSS concentration
$X_{eff,VSS}$ = effluent VSS concentration
Q_{inf} = reactor influent flow
S_{inf} = reactor influent BOD concentration
S_{eff} = reactor effluent BOD concentration

Table 2.5. Comparison of observed yield factors

Parameter	(unit)	Historical Dataset	Calibration Dataset	Validation Dataset
SRT	(d)	7.8	7.8	7.7
Temperature	(°C)	14.7	10.4	14.5
Observed Yield (from Figure 2.2)	**(VSS/BOD)**	**0.60**	**0.63**	**0.60**
WAS VSS Production	(lbs/d)	7,748	8,331	7,730
Secondary Effluent VSS	(lbs/d)	825	1,078	891
Secondary Influent BOD	(lbs/d)	11,519	14,566	11,878
Secondary Effluent BOD	(lbs/d)	1,779	2,373	1,802
Observed Yield (from data)	**(VSS/BOD)**	**0.74**	**0.65**	**0.73**

2.4 Nitrification Performance

Since the aeration tanks were operated entirely aerobic, the historical SRT of about 7.8 days reflected the time in which biomass was exposed to aerobic conditions and translated to the time available for the growth of heterotrophic and autotrophic organisms, carbonaceous oxidation (BOD removal), and nitrification. Nitrification, however, is much

more sensitive to SRT and temperature than heterotrophs because their growth kinetics are much slower. When the aerobic SRT drops below the minimum time required for nitrifier biomass growth, they cannot be sustained and wash out of the system. The minimum aerobic SRT to completely nitrify varies as a function of nitrifier kinetic coefficients, temperature, and reactor regime (complete-mix vs. plug-flow). For preliminary evaluatory purposes, the minimum aerobic SRT was calculated assuming complete-mix reactor conditions. It is the reciprocal of the specific growth rate and can be computed with **Equation 2.3.** Note that parameters μ_{max}, k_n, and b must be adjusted for temperature using the Arrhenius format shown in **Equation 2.4**.

$$\mu = \mu_{\max}\left(\frac{DO}{DO + k_o}\right)\left(\frac{N}{N + k_n}\right) - b \qquad (2.3)$$

where,

μ = specific nitrifier growth rate (d^{-1})
μ_{max} = Maximum specific nitrifier growth rate (0.9 d^{-1})
DO = reactor dissolved oxygen (2 mg/L)
N = reactor ammonia (1 mg/L)
k_o = Oxygen half saturation coefficient (0.25 mg/L)
k_n = Ammonia half saturation coefficient (0.7 mg/L)
b = decay coefficient (0.17 d^{-1})

$$\mu_{\max_T} = \mu_{\max_{20}}\theta^{(T-20)} \qquad (2.4)$$

where,

$\mu_{max,T}$ = specific nitrifier growth rate (d^{-1}) at T = T
$\mu_{max,20}$ = specific nitrifier growth rate (d^{-1}) at T = 20°C
θ = Arrhenius temperature adjustment factor (1.072 for μ_{max}, 1.053 for k_n, 1.029 for b, unitless)
T = Temperature (°C)

The nitrifier kinetic coefficients shown above are based on accepted research.[7,8]. Based on the aforementioned kinetics, an aerobic zone DO concentration of 2 mg/L, an effluent ammonia of 1 mg/L, and the cold weather design temperature of 9°C, the minimum aerobic SRT was calculated at 7 days. This threshold represents the theoretical minimum aerobic SRT to provide full nitrification during the coldest conditions.

To investigate the effluent ammonia relative to temperature and observed aerobic SRT, **Figure 2.3** illustrates a historical trend of the pertinent parameters. The trends did not illustrate any significant correlations. However, consistent full nitrification was not observed; the 30-day average effluent ammonia was typically between 2 and 7 mg/L while the observed aerobic SRT was typically between 7 and 12 days. This observation was somewhat surprising because the observed aerobic SRT was typically greater than the theoretical minimum 7-day threshold needed to provide full nitrification. Initially it was hypothesized that either the aeration tank DO was low or that the influent alkalinity was deficient. Historical DO data averaged between 2 and 4 mg/L, albeit at the effluent end of the tank. Special alkalinity testing was performed between October 21 – 27, 2019. The raw wastewater, primary influent, primary effluent, and final effluent alkalinity respectively averaged 278, 277, 273 and 197 mg$CaCO_3$/L, indicating excess alkalinity was available. As such, the historical performance analysis suggested a lower rate of nitrification than expected. This was revisited during model development efforts discussed in **Section 3.0**.

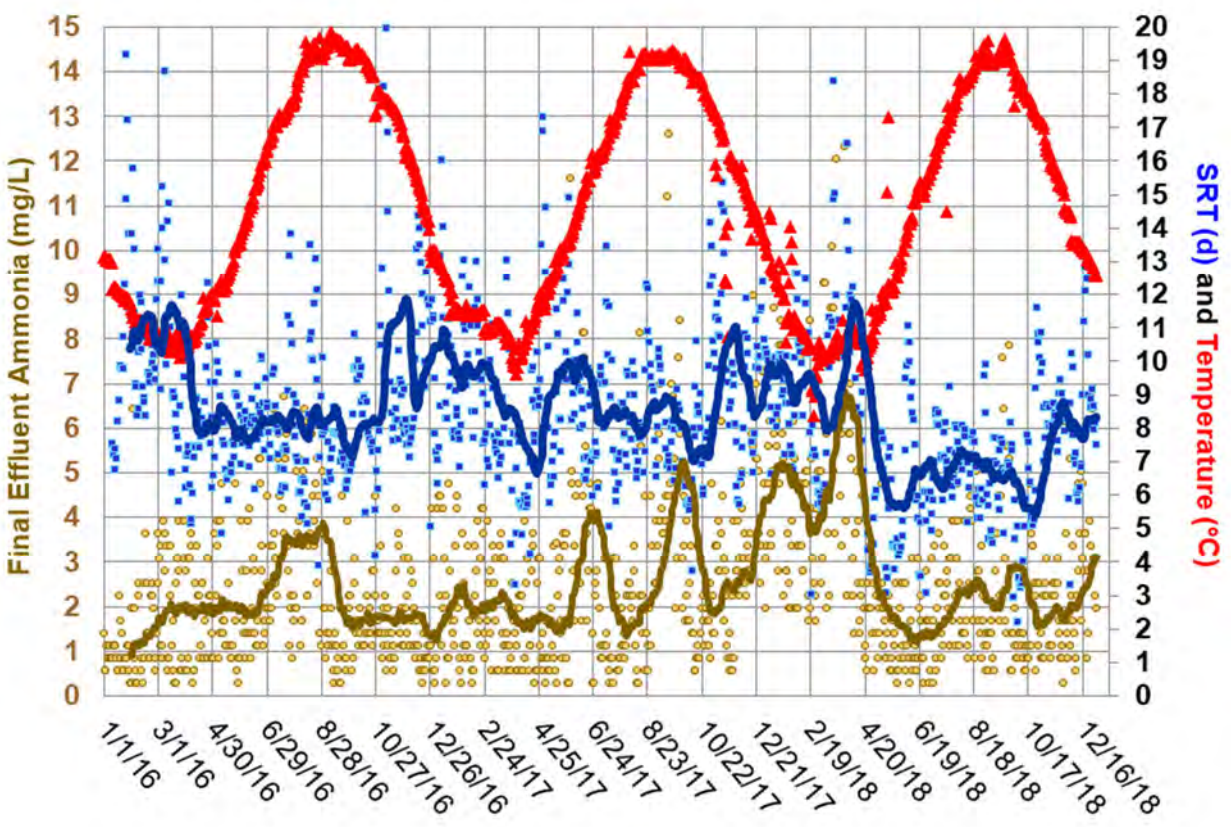


Figure 2.3. Investigation of effluent ammonia, aSRT, and temperature correlation

2.5 Phosphorus Removal Performance

The plant has been practicing chemical phosphorus removal with ferric chloride addition to the primary influent for many years to meet its 1.0 mg/L monthly average TP limit. The long-term ferric chloride addition averaged 507 gpd, or 817 lbs/d of Fe^{3+} based on a 40% solution strength and 11.68 lbs/gal density. This resulted in a primary influent Fe/OP molar ratio of about 1.8 and a primary effluent OP concentration of about 0.6 mg/L. The final effluent 30-day average OP and TP concentrations respectively ranged from about 0.55 – 0.8 mg/L and 0.7 – 0.9 mg/L as illustrated in **Figure 2.4**.

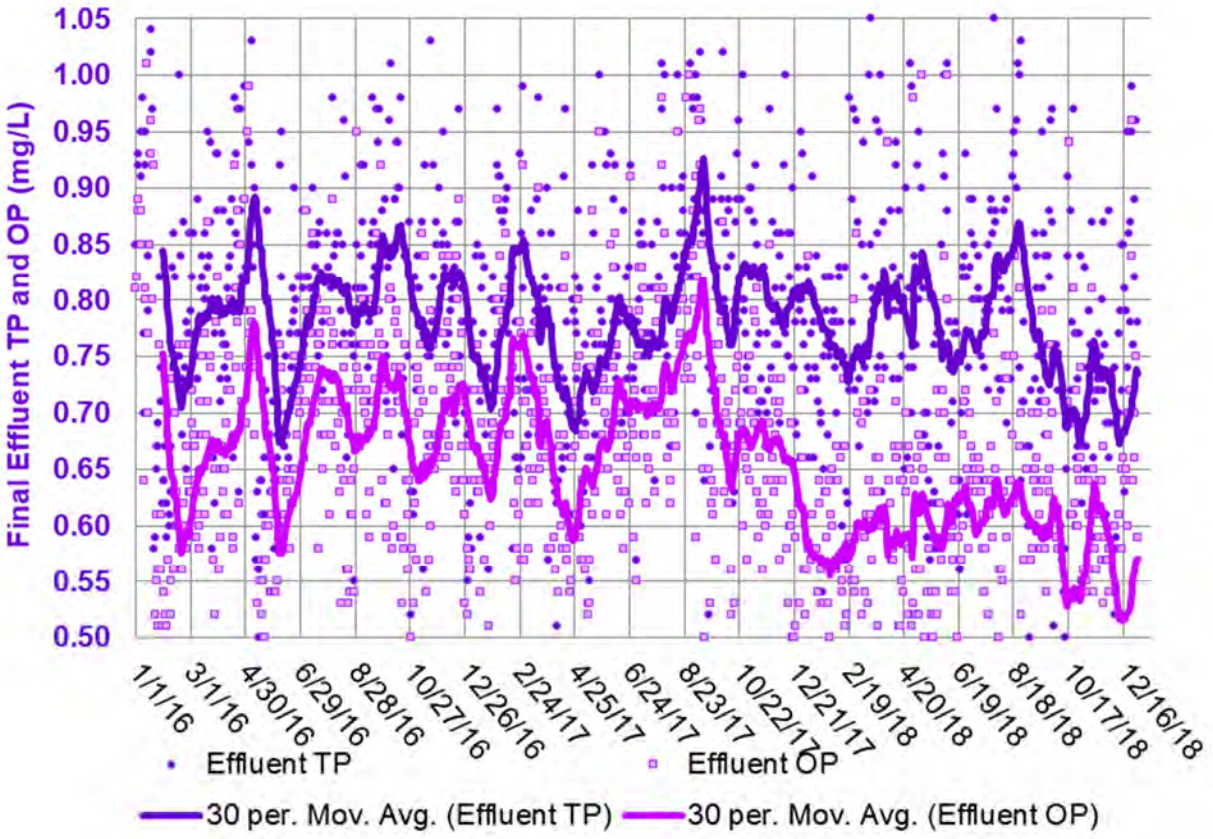


Figure 2.4. Investigation of effluent phosphorus

2.6 Secondary Clarifier Performance

A simple flow and mass balance around the final clarifiers was conducted to check the quality of the pertinent clarifier data using **Equations 2.5** and **2.6**. Mixed liquor flows into the clarifiers and is made up of the primary effluent plus the RAS flow. Solids flow out of the clarifier by means of the RAS, WAS, and clarifier effluent. Since secondary clarification is a mass-conservative process, the total solids in and out should be equal.

As such, a simple mass balance was conducted for each of the datasets analyzed. The results are illustrated in **Table 2.6** where a nearly perfect mass balance was found which indicated that the flow, MLSS, and solids data were likely very good for each dataset.

$$Q_{\text{inf}} + Q_{RAS} = Q_{RAS} + Q_{WAS} + Q_{eff} \quad (2.5)$$

$$(Q_{\text{inf}} + Q_{RAS})X_{MLSS} = (Q_{RAS})(X_{RAS_{TSS}}) + (Q_{WAS})(X_{WAS_{TSS}}) + (Q_{eff})(X_{eff_{TSS}}) \quad (2.6)$$

where,

Q_{inf} = reactor influent flow
Q_{RAS} = RAS flow
Q_{WAS} = WAS flow
Q_{eff} = clarifier effluent flow
X_{MLSS} = mixed liquor suspended solids in reactor
$X_{RAS,TSS}$ = RAS TSS concentration
$X_{WAS,TSS}$ = WAS TSS concentration
$X_{eff,TSS}$ = clarifier effluent TSS concentration

Table 2.6. Final clarifier mass-balance data analysis

Parameter	(unit)	Historical Dataset	Calibration Dataset	Validation Dataset
MLSS	(mg/L)	1,781	1,930	1,742
Primary Effluent Flow	(MGD)	22.69	21.50	25.86
RAS Flow	(MGD)	24.37	23.90	25.11
Clarifier Influent TSS Mass Flow	(lbs/d)	698,769	730,687	740,581
RAS TSS	(mg/L)	3,562	3,626	3,639
RAS TSS Mass Flow	(lbs/d)	723,940	722,817	762,060
WAS TSS Mass Flow	(lbs/d)	9,775	10,304	9,628
Clarifier Effluent TSS Mass Flow	(lbs/d)	1,036	1,323	1,111
Total Out	(lbs/d)	734,751	734,444	772,799
Mass Balance Closure	**(%)**	**105**	**101**	**104**

Secondary clarification is provided by three 85 ft, three 93 ft, and three 90 ft diameter secondary clarifiers. To gauge their operational performance, the historical solids loading rate (SLR) and effluent solids were investigated. The SLR is simply the mixed liquor solids loading rate divided by the clarifier surface area as illustrated in **Equation 2.7**.

$$SLR = \frac{(Q_{\text{inf}} + Q_{RAS})(X_{MLSS})\left(8.34 \frac{lb \cdot L}{mg \cdot MG}\right)}{A_C} \quad (2.7)$$

where,

Q_{inf} = Reactor influent flow (MGD)
Q_{RAS} = Return activated sludge flow (MGD)
X_{MLSS} = Mixed liquor suspended solids (mg/L)
A_C = Clarifier surface area (ft^2)

The secondary clarifiers typically operated at surface overflow rates (SOR) of about 400 gpd/ft^2 and a solids loading rate (SLR) of about 13 $lbs/d/ft^2$. **Figure 2.5** was assembled to investigate if a correlation between the SLR and effluent TSS concentration was present. The data showed a fairly proportional relationship where the effluent TSS increased with the SLR. In terms of performance, the clarifiers typically rendered an effluent TSS concentration of about 6 mg/L, which can be considered very good performance. Performance was also very good at higher SLRs. The data showed repeatedly elevated SLRs on the order of 20 $lbs/d/ft^2$ while the effluent TSS at those moments was typically only around 10 mg/L or less.

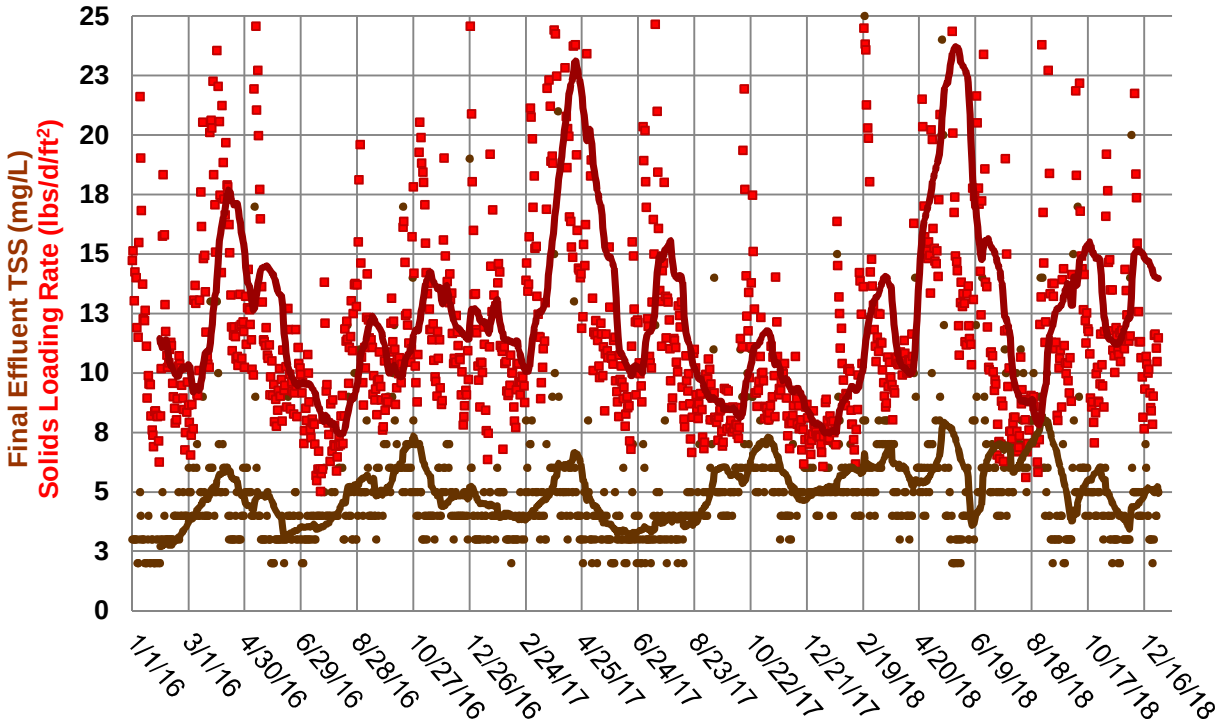


Figure 2.5. Correlation between final clarifier SLR and secondary effluent TSS

2.7 Gravity Belt Thickener Performance

Two gravity belt thickeners thicken WAS to about 5% solids. WAS feed sludge flow, WAS solids concentration, and TWAS concentration data was available. However, to complete the full plant mass balance and to help estimate the true raw wastewater loadings, a mass balance across the thickeners was carried out with the assumption of 95% solids capture and a 1-to-1 ratio of WAS flow to washwater flow. These assumptions provided an estimate of the thickener filtrate TSS and VSS, which also allowed for the estimation of various other parameters with a particulate component (e.g. BOD, TKN, total phosphorus). Soluble filtrate parameters (e.g. ammonia, orthophosphate) were assumed equal to the secondary effluent concentrations. With the filtrate characteristics estimated, they were subtracted from the primary influent to estimate the raw wastewater.

2.8 Anaerobic Digestion Performance

There are four 1 MG anaerobic digesters. The thickened WAS (TWAS) along with raw primary sludge is conveyed to the anaerobic digesters. During anaerobic digestion, volatile solids are broken down and converted to biogas. As such, a mass balance of total solids cannot be performed in the conventional sense of a mass-conservative process. However, the inert solids (TSS – VSS) remain intact and therefore enable an inert solids balance which was conducted to check the quality of the digester data. Examination of the inert loadings around the digesters for the historical, calibration, and validation datasets showed fair mass balance closures; the results of which are shown in **Table 2.7**.

Anaerobic digestion performance has been correlated with the digestion time and temperature that sludge is exposed to. Based on data provided by the USEPA[9], an anaerobic digestion performance curve was developed that shows volatile solids destruction as a function of the time-temperature product exhibited by the digester (time being digester SRT, and temperature being the digester operational temperature). This curve, and the empirical data it is based on, is illustrated in **Figure 2.6**. Applying the operational data from the three datasets, **Figure 2.6** was used to estimate the expected volatile solids (VS) destruction and was compared to the observed destruction. **Table 2.7** shows the results of these comparisons, where it was apparent that the observed and predicted performances reasonably agreed. Also, biogas generation was checked. The observed biogas generated per VSS destroyed ratios for each dataset were within the commonly accepted range of 12 - 18 ft^3/lb VS destroyed.[6]

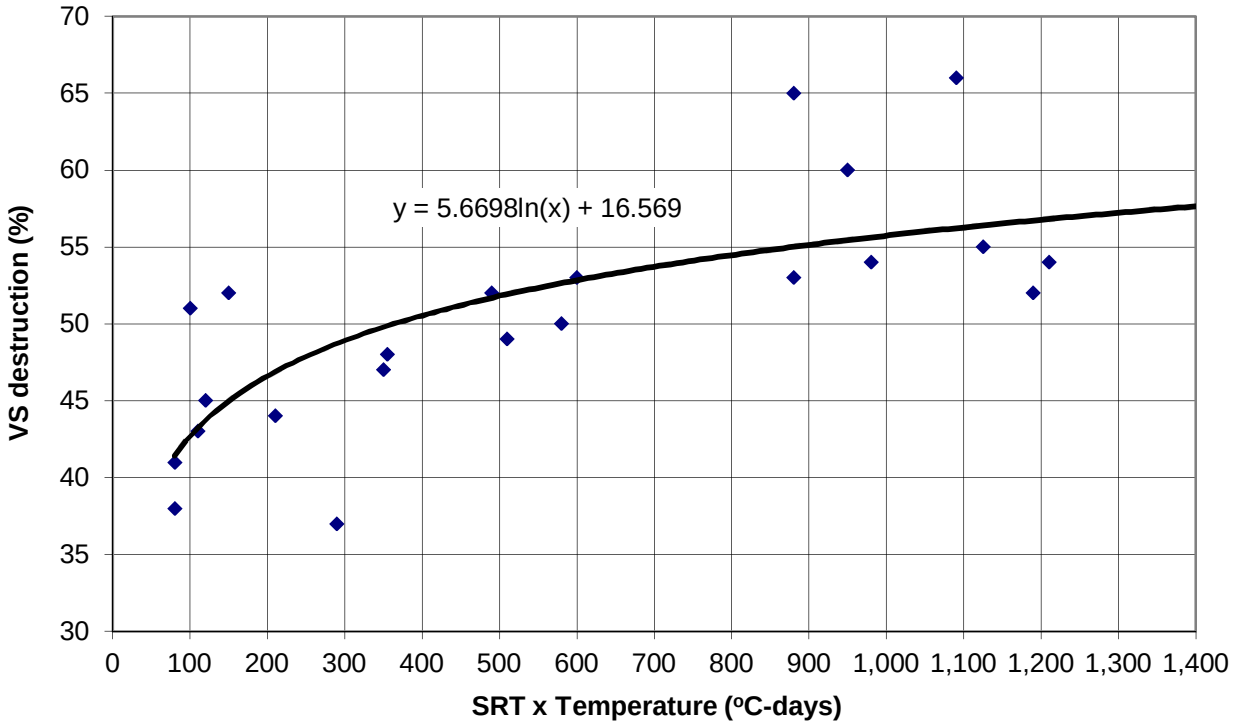


Figure 2.6. Increase in anaerobic digestion performance with increasing time-temperature product

Table 2.7. Anaerobic digestion mass balance and performance analysis results

Parameter	(unit)	Historical Dataset	Calibration Dataset	Validation Dataset
Digester feed inert solids	(lbs/d)	5,847	4,700	4,974
Digested sludge inert solids	(lbs/d)	5,207	4,185	5,283
Mass balance closure	(%)	89	89	94
SRT	(d)	56	66	56
Temperature	(°C)	35	35	35
SRT-Temperature product	(°C-d)	1,960	2,310	1,960
Observed VSS Destruction	(%)	64.1	59.1	61.8
VS Destruction (from **Figure 2.6**)	(%)	59.6	60.5	59.6
Biogas generated per VSS destroyed	(ft^3/lb)	13.7	14.2	14.7

2.9 Dewatering Performance

Sludge withdrawn from the digesters is transferred to a 0.52 MG holding tank. Sludge is then dewatered with belt filter presses. A combination of six 2m presses are typically used on Mondays through Thursday and idled Friday through Sunday. A mass balance was conducted for the three datasets whereby the difference in the feed sludge and dewatered cake solids mass-flow was computed to estimate the filtrate loading and press capture

efficiency. **Table 2.8** illustrates the mass balance results where very good capture efficiency was apparent. It should be noted that the calibration dataset indicated slightly more solids were produced as dewatered cake than withdrawn from the holding tank and therefore showed a negative filtrate loading. This negative result was likely due to sampling error exacerbated by short-term temporal variations; the calibration period was the shortest and therefore had the most potential for mass-balance error as longer averaging periods tend to reduce mass-balance errors. As such, a capture efficiency of 95% was assumed for the calibration period.

Table 2.8. Belt filter press mass balance results

Parameter	(unit)	Historical Dataset	Calibration Dataset	Validation Dataset
Holding Tank Feed Mass Flow	(lbs/d)	12,712	10,445	12,616
Press Feed Mass Flow	(lbs/d)	12,633	11,200	12,075
Dewatered Cake Mass Flow	(lbs/d)	12,091	11,777	11,428
Apparent Filtrate Mass Flow	(lbs/d)	542	-577	647
Belt Press Capture Efficiency	**(%)**	**95.7**	**105**	**94.6**

Integral to estimating the raw wastewater loadings was an estimation of the press filtrate loadings so they could be subtracted from the primary influent. Various parameters, e.g. BOD, TKN, total phosphorus, were estimated by the digester volatile solids destruction and the estimated particulate and soluble fractions of each. Press filtrate ammonia and orthophosphate was estimated by assigning a nitrogen and phosphorus fraction to the VSS that was feed to and destroyed in the digesters. This was carried out by assigning a particulate nitrogen and phosphorus content to the primary sludge and WAS. Primary sludge VSS was assumed at 4% and 0.5% N and P respectively, while WAS was assumed at 7% and 2%. These values were based on various modeling projects and sampling programs carried out by AECOM that included similar sludges. When blended together prior to digestion, this resulted in a respective N and P content of VSS of about 5% and 1%. As such, for every mass of VSS destroyed in the digesters about 0.05 and 0.01 masses of ammonia and orthophosphate was generated in the digested sludge. Undigested VSS would remain at the same particulate N and P content. With the filtrate characteristics established in this way, their loadings were subtracted from the primary influent to help estimate the raw wastewater.

3.0 MODEL DEVELOPMENT

A whole-plant model of the Racine WWTP was developed in GPS-X using the Mantis2 biological model. Each interunit process, including solids processing facilities, was included to reflect the effects of sidestream recycles. The model was dynamically calibrated to a 28-day dataset (February 2018) and then validated to a 61-day dataset (November – December 2018) to provide adequate confidence in the model's ability to predict performance. These periods had some fair dynamic variations in flow and loadings while the process flow diagram and number of treatment units online remained constant. These periods also reflected moderately cold and mild conditions where the wastewater temperature averaged about 10°C and 15°C, respectively.

Individual treatment plant process units (bioreactors, clarifiers, thickeners, etc.) are often referred to as "objects" or "elements" in commercial process modeling software packages. In general, these objects are linked together within a "layout" to create the overall treatment plant process model. The physical parameters (i.e. tank volumes, clarifier surface area, flow splits, etc.) are entered into the respective objects to represent the treatment plant. The layout of the Racine WWTP process model is shown in **Figure 3.1**.

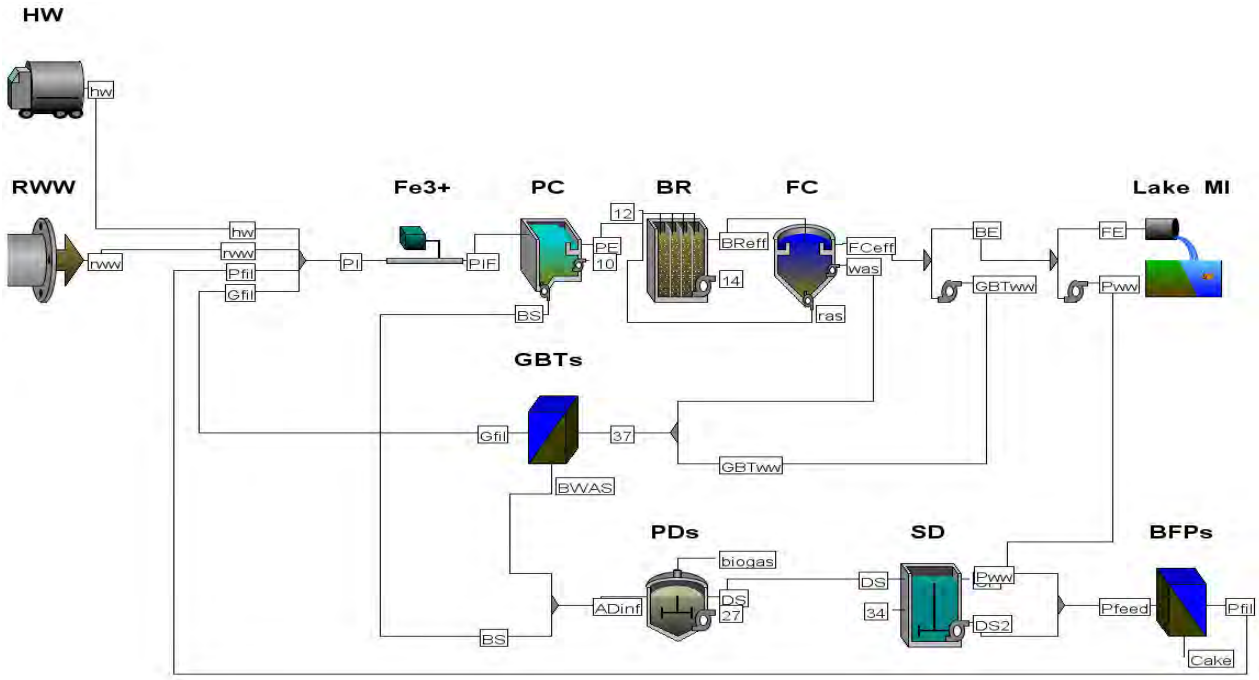


Figure 3.1. Comprehensive modeling layout of the Racine WWTP

3.1 Raw Wastewater Characterization

Influent characterization is the partitioning of raw wastewater organic material, nitrogen, and phosphorus into the various species that make up the wastewater matrix. For the most part, the dynamics of any wastewater treatment plant are driven by the dynamics in the influent. That is, changes in observed oxygen demand, mixed liquor solids, and effluent nutrients are all driven by the incoming wastewater. Therefore, it is normally best to spend the majority of the calibration effort on understanding the influent wastewater dynamics and fractionation. Municipal wastewater treatment models are based on chemical oxygen demand (COD), but the behavior of the model is highly dependent on the fractionation of that COD into its component parts. **Figure 3.2** is an illustrative representation of the IWA-based influent COD fractionation.

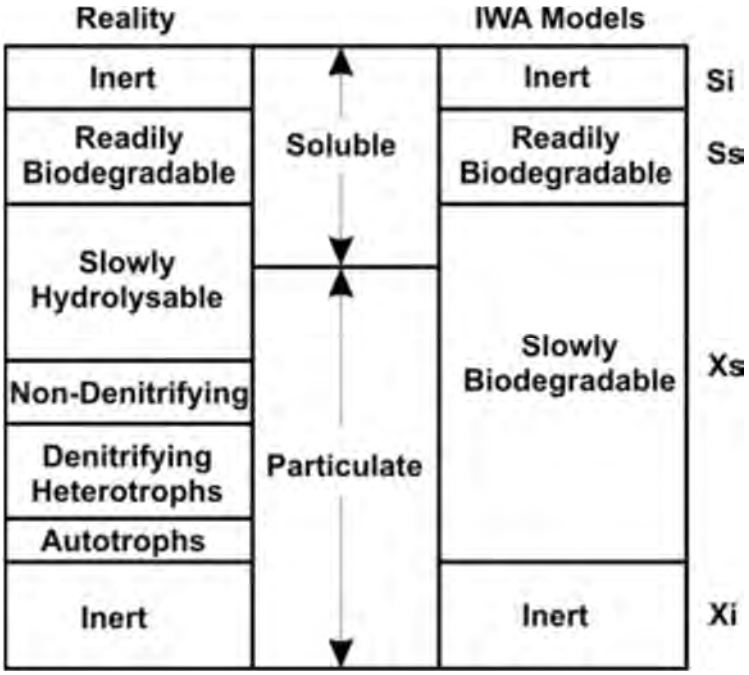


Figure 3.2. Distinction between soluble and particulate components in IWA models compared to the fractions in reality

To describe the fractionation of influent wastewater COD, it is first broken down into its biodegradable and non-biodegradable components. These components are called the composite variables. The composite variables are then broken down into their various constituents known as state variables. In the Mantis2 biological model, the state variables for COD are soluble inert material (si), readily biodegradable soluble fermentable substrate (ss), readily biodegradable volatile fatty acids (sac), slowly biodegradable colloidal substrate (scol), slowly biodegradable substrate (xs), and particulate inert material (xi). The influent nitrogen and phosphorus are also made up of composite and state variables in a similar way.

The daily raw wastewater parameters for the calibration and validation datasets were estimated by mass-balance in a similar manner as discussed in **Section 2.1**. This enabled estimation of the daily raw wastewater BOD, which allowed for conversion to COD and its fractionation for calibration and validation purposes.

The carbonaceous material characterization (fractionation of COD and TSS) was crucial in matching modeled and observed behavior relative to reactor mixed liquor solids concentration (MLSS), RAS solids, and sludge production. The determination of these parameters was mostly achieved through iteratively altering the distribution of COD among the COD state variables until an adequate fit to the data resulted. Typically, the non-biodegradable particulate material (xi) content dominates the effect on MLVSS; too much overestimates the MLVSS, not enough underestimates it.

To provide a starting point, the IWA set forth a standard COD states distribution that reflected a slowly biodegradable substrate and non-biodegradable material content of 66% and 13%, but this was based mostly on European WWTPs. AECOM has found that these percentages reflect too much particulate substrate and not enough particulate inert material for most North American WWTPs. We have found that a slowly biodegradable substrate and non-biodegradable material content of around 50% and 20%, respectively, is more appropriate because North American wastewater seems to have more inert material than European wastewater. At Racine, however, the slowly biodegradable substrate and non-biodegradable material content respectively came out at about 43% and 32% that best achieved calibration. This provided a good dynamic fit of the modeled and measured MLSS. It should be noted that because the particulate inert COD required such a large fraction, the N and P fractions thereof were decreased so as to prevent abnormally large particulate inert N and P values.

Usually hauled waste has a measurable impact on solids production and aeration demand in WWTPs and therefore must be accounted for during model calibration efforts, however the measured septage loadings at Racine were very low. The hauled waste averaged only about 4 lbs/d of TSS and BOD, less than 0.8 lbs/d of TKN, and 0.2 lbs/d of TP for both the calibration and validation datasets and were therefore ignored.

Table 3.1 illustrates the stoichiometric raw wastewater factors that achieved dynamic calibration and validation and also depicts the GPS-X Mantis2 defaults for comparison. **Attachment 3.1** includes the detailed influent characterization breakdown diagrams that illustrate the stoichiometric fractions, composite variables, and state variables for the calibration dataset average values. The dynamic (daily) breakdowns for the calibration and validation datasets have also been included.

Table 3.1. Comparison of Racine and GPS-X default raw wastewater stoichiometry factors

Cryptic Symbol	Fraction Description	Mantis2 Default	Racine
frsi	Non-biodegradable soluble fraction of COD	0.0500	0.0500
frss	Readily biodegradable soluble fermentable fraction of COD	0.2000	0.2000
frsac	Acetate fraction of COD	0.0000	0.0000
frspro	Propionate fraction of COD	0.0000	0.0000
frscol	Slowly biodegradable colloidal COD fraction	0.1500	0.1500
frxi	Non-biodegradable particulate fraction of COD	0.1300	0.3200
fssbodtosscod	Filtered COD to filtered BOD ratio	0.7170	0.7170
fpsbodtopscod	Particulate COD to particulate BOD ratio	0.5800	0.5800
ivsstotss	VSS to TSS ratio	0.7500	0.9200
icodtovssxs	VSS to slowly biodegradable particulate substrate ratio	1.8000	1.8000
icodtovssxi	VSS to non-biodegradable particulate material ratio	1.8000	1.8000
frsnh	Fraction of TKN as ammonia	0.9000	0.9000
insi	Fraction of non-biodegradable soluble material as N	0.0500	0.0500
inxi	Fraction of non-biodegradable particulate material as N	0.0500	0.0100
ipsi	Fraction of non-biodegradable soluble material as P	0.0100	0.0100
ipxi	Fraction of non-biodegradable particulate material as P	0.0100	0.0057

3.2 Primary Clarifiers

The primary clarifiers were modeled as an ideal clarifier object that applies a removal efficiency to all particulate components and passes them to the underflow stream and the balance to the effluent. Soluble parameters are allowed to pass through to the effluent. The solids removal efficiency was varied over time as per the measured removals during the calibration and validation datasets. This method provided very good dynamic agreement between the measured and modeled primary effluent TSS, VSS, BOD, and nutrients. Lastly, the sludge TSS concentration was dynamically varied as per the daily measured values. The resulting modeled primary sludge flows agreed with the measured sludge flows.

3.3 Aeration Tanks

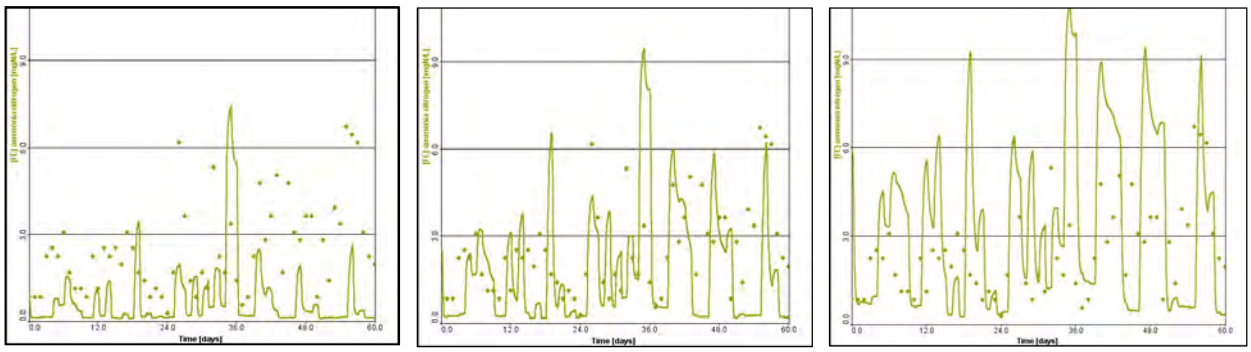
All five aeration tanks were operated in a plug-flow two-pass configuration. Each of the ten passes is 168 ft long, 30 ft wide, and 15 ft deep. These dimensions rendered a total aeration tank volume of about 5.65 MG. The aeration tanks employed a tapered aeration system comprised of 9-inch diameter ceramic fine bubble disk diffusers mounted 1.75 ft above the basin floor and were installed in the early 1990s. The aeration tanks employed four diffuser grids (two per pass), each successively decreasing in diffuser density. For aeration modeling simplicity, the aeration tanks were modeled as four complete-mix zones in series in consonance with the diffuser grids. The diffused aeration system was modeled with fine bubble diffuser characteristics and the aeration alpha factor (ratio of oxygen transfer coefficient in dirty water to clean water) was varied by zone to provide a commonly observed low-to-high alpha gradient where the alpha gradually increases as a function of downstream distance from the point of wastewater entry as the wastewater

becomes cleaner.[10] **Table 3.2** illustrates the aeration tank parameters employed in the process model where the alpha factors reflect typical fine bubble characteristics. The standard oxygen transfer efficiency (SOTE) was estimated with a multivariable regression model in GPS-X that takes into account the diffuser type, depth, density, and fluxrate.[11]

Table 3.2. Reactor zone characteristics (each)

Zone (no.)	Length (ft)	Width (ft)	Area (ft^2)	Diffusers (no.)	Density (%)	Alpha (---)
1	82.7	30	2,480	814	13.4%	0.40
2	84.2	30	2,525	583	9.4%	0.50
3	84.2	30	2,525	408	6.6%	0.55
4	82.7	30	2,480	288	4.7%	0.60

During calibration efforts with the February 2018 dataset, it became clear that the modeled and measured nitrification behavior did not match. The modeled effluent ammonia was consistently less than the measured values. Typically, kinetic parameter adjustments are not required, and extensive effort was expended on getting the aeration system represented adequately so as to provide a good match of measured and modeled dissolved oxygen (DO) data whereby the daily measured airflow data was entered as the model input. In this case, the ammonia oxidizing biomass (AOB) maximum specific growth rate was lowered from the default of 0.9/d to 0.7/d which enabled a fairly good dynamic match of the modeled and measured effluent ammonia. To help confirm this change, a second dataset of about twice the duration of the first was used for validation purposes (November – December 2018). The same kinetic change was confirmed with this dataset. To illustrate the iterative adjustments of the AOB kinetic change, **Figure 3.3** shows the effluent ammonia results with the AOB maximum specific growth rates set at 0.9/d, 0.7/d, and 0.6/d, where 0.7/d provided the best fit for the validation dataset.



(a) **(b)** **(c)**

Figure 3.3. Comparison of modeled and measured effluent ammonia for AOB maximum specific growth rates of (a) default 0.9/d (b) 0.7/d and (c) 0.6/d

Unfortunately, no nitrite or nitrate data was available for calibration and validation purposes so it is unknown if nitrite oxidizing biomass (NOB) kinetic changes were necessary. It is also unknown what the cause for the apparent lower-than-typical AOB growth rate was for the two datasets analyzed. It is suggested that further testing, perhaps direct AOB and NOB maximum specific growth rate measurement, or at least nitrification rate testing, be carried out to further investigate the nitrification kinetics; they will have major repercussions if effluent ammonia limits are implemented at the Racine WWTP and the plant must be upgraded to provide nitrification (a lower AOB maximum specific growth rate will increase the aeration tank volume requirements).

Another major finding from the calibration and validation efforts was associated with the aeration system. In matching up the measured and modeled DO, the daily measured total airflow was dynamically entered as the model input, whereby the airflow per zone was proportioned with the diffuser densities. The available DO data was from the effluent end of the aeration tanks, i.e. Zone 4. As such the measured and modeled Zone 4 DO was compared and an aeration parameter adjustment was iteratively made until a good match was established between them. In this case, the adjusted parameter was the diffuser fouling factor. The value usually ranges from 1 to 0.5; whereby 1 represents clean new diffusers. The factor decreases over time as the diffusers become fouled. Fouling can be due to bacterial growth on the waterside of the diffuser, while at the same time, airside fouling can occur due to the accumulation of dust conveyed by the source air. Chemical fouling can also occur whereby scaling can buildup within the ceramic diffuser element. The modeling found that a fouling factor of 0.6 achieved a good match of the DO data.

It was somewhat surprising that such a low fouling factor was found because the diffusers are annually pressure washed. However, the diffusers are nearly thirty years and it is worth mentioning that a fouling factor of 0.6 was also found at the Baltimore Back River WWTP for the same style diffusers that were installed in the early 1990s. It is important to note, however, that the modeling efforts cannot confirm the fouling factor. In oxygen transfer modeling, the alpha and fouling factor cannot be separated and are therefore lumped together as a combined alphaF factor. It is possible that the assumed alpha factors cited in a **Table 3.2** were too high; the fouling factor could reflect fairly clean diffusers while an industrial component could have caused low alpha factors. As such, additional diffuser and off-gas testing is recommended to measure the fouling factor and/or alpha factor.

3.4 Chemical Phosphorus Removal

The plant adds ferric chloride to the primary influent to meet a monthly effluent TP limit of 1 mg/L. The daily dosage of ferric chloride was computed from the daily volume and solution characteristics during the calibration and validation datasets was dynamically input into the model. The pKsp parameter that governs the solubility of $FePO_4$, was slightly increased from the default of 13.75 to 14.2 to match the measured and modeled

effluent TP. This also helped match the modeled and measured reactor MLSS due to the formation of chemical sludge.

3.5 Secondary Clarifiers

The secondary clarifiers were modeled with a one-dimensional clarifier model as depicted in **Figure 3.4**.[12] The solids flux due to sedimentation was specified by a double exponential settling function, applicable to both hindered sedimentation and flocculent sedimentation conditions.[13] The settling function is given by **Equation 3.1**.

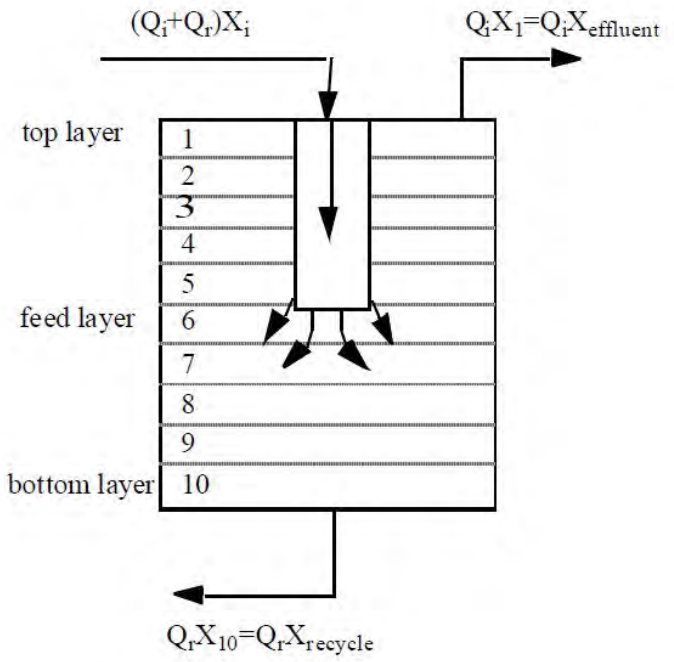


Figure 3.4. One dimensional sedimentation model representation

$$V_{sj} = V_{\max} e^{-rhin \bullet X_j^o} - V_{\max} e^{-rfloc \bullet X_j^o} \quad \textbf{(3.1)}$$

where:

V_{sj} = settling velocity in layer j (m/d)
V_{max} = Maximum Vesilind settling velocity (m/d)
rhin = Hindered zone settling parameter (L/mg)
rfloc = Flocculent zone settling parameter(L/mg)
$X_j^o = X_j - X_{\min}$ where X_{min} is the minimum attainable TSS concentration and X_j is the TSS concentration in layer j (mg/L)

Secondary clarification was modeled with one modeling object with the total surface area set at 56,487 ft^2 and the sidewater depth set at an average depth of 12.7 ft to reflect all clarifiers online as per the calibration and validation datasets. The daily average RAS and WAS flows were dynamically varied. No settling parameter changes were needed to dynamically match the modeled clarifier effluent and RAS TSS.

3.6 Thickening

The gravity belt thickeners were modeled with a simple solids removal object that received WAS. The solids removal was set at 95% and a washwater flow was added with a 1-to-1 ratio of WAS flow to washwater flow. The thickened sludge concentration was dynamically varied as per the values in the calibration and validation datasets. The filtrate was routed to the primary influent.

3.7 Digestion

The digesters were modeled with one anaerobic digester object set at a total volume of 4 MG to reflect all four digesters online during the calibration and validation datasets. A fairly good dynamic match of the modeled and measured digested sludge TSS and VSS was observed. Moreover, the dynamically modeled and measured digester biogas generation matched very well. A 1 MG equalization tank object was employed to model the storage/drainage of digested sludge in the sludge storage tank upstream of the belt filter presses.

3.8 Dewatering

Modeled digested sludge was sent to a simple solids removal object with the removal efficiency set at 95% as observed during the calibration and validation datasets. A washwater flow stream was added with a 1-to-1 ratio of feed flow to washwater flow. The press feed flow and output cake solids were dynamically varied as per the daily data. Digested sludge was allowed to fill/drain the storage tank upstream of the presses as per the datasets. The filtrate was routed to the primary influent. It should be noted that the dynamic modeling revealed that the Monday through Thursday press operation created significant slug loadings of ammonia and phosphorus at times of their operation. These slugs created effluent ammonia spikes during times of press operation. Effluent phosphorus spikes were also present, but less pronounced than ammonia, probably because of the presence of ample ferric chloride. While not of particular importance without effluent ammonia limits, equalization of this filtrate will likely be helpful in attenuating effluent ammonia spikes.

3.9 Dynamic Model Calibration and Validation Documentation

The dynamic model outputs (solid lines) around key processes were graphically compared with the measured daily data points. The calibration and validation graphs are

illustrated in **Figures 3.5** through **3.46** where the model outputs reasonably agreed with the measured data.

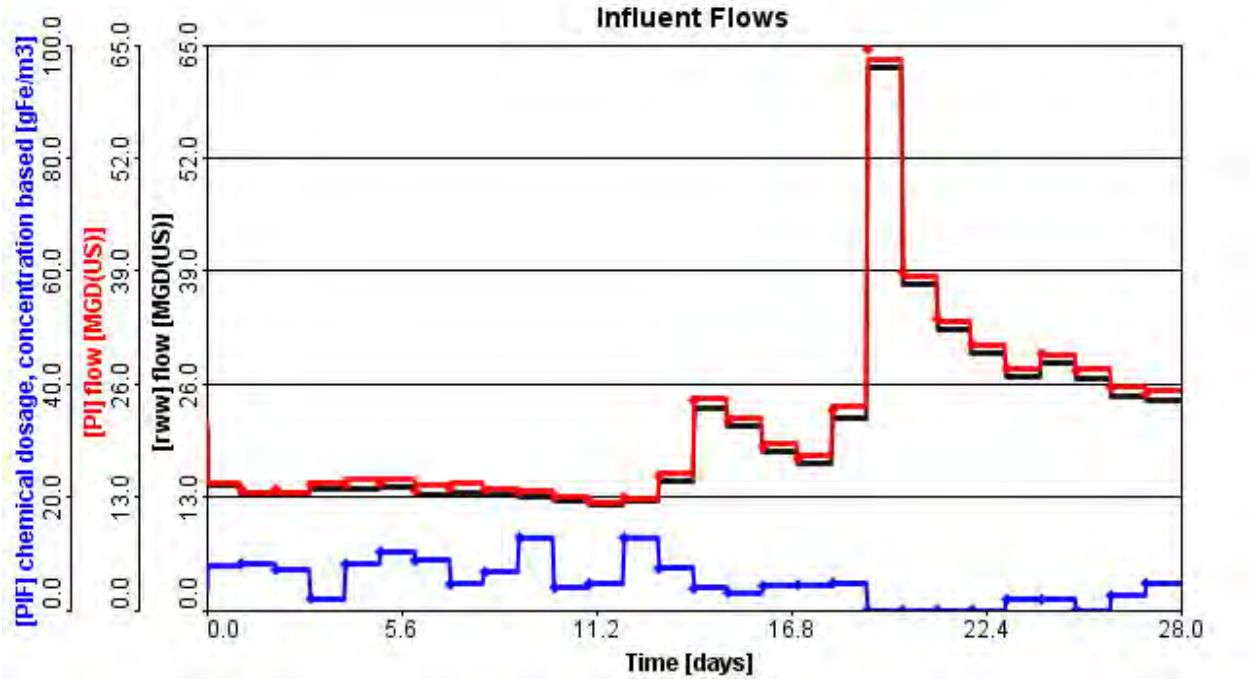


Figure 3.5. Dynamic calibration of wastewater flow and ferric chloride feed

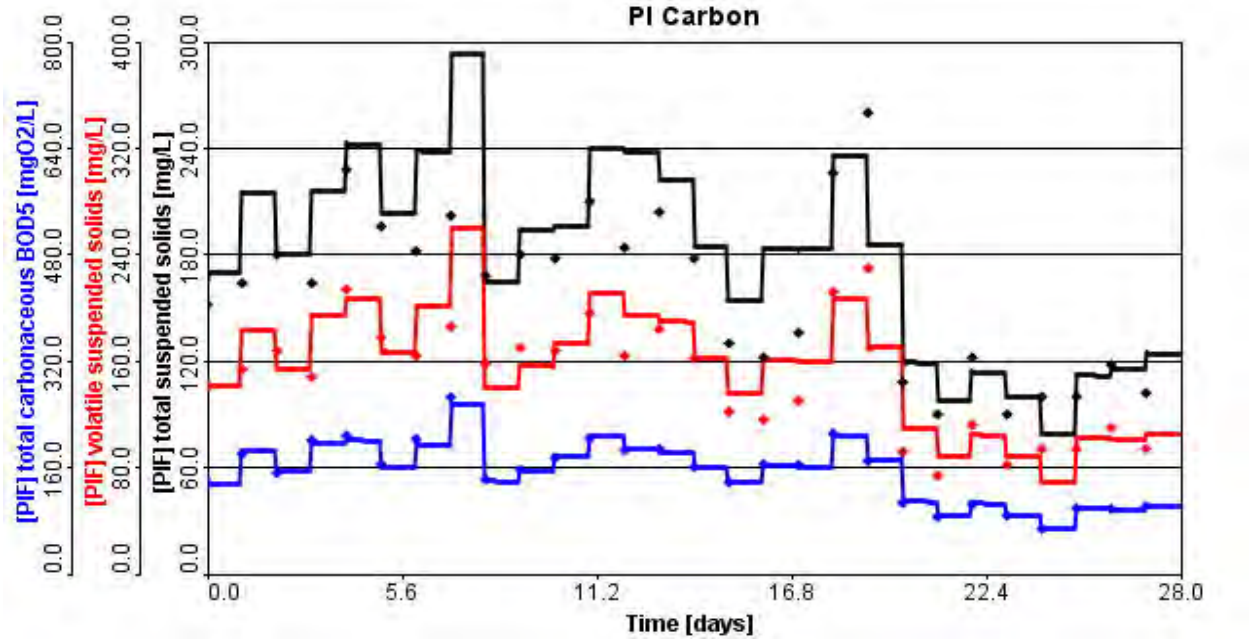


Figure 3.6. Dynamic calibration of primary influent carbonaceous parameters

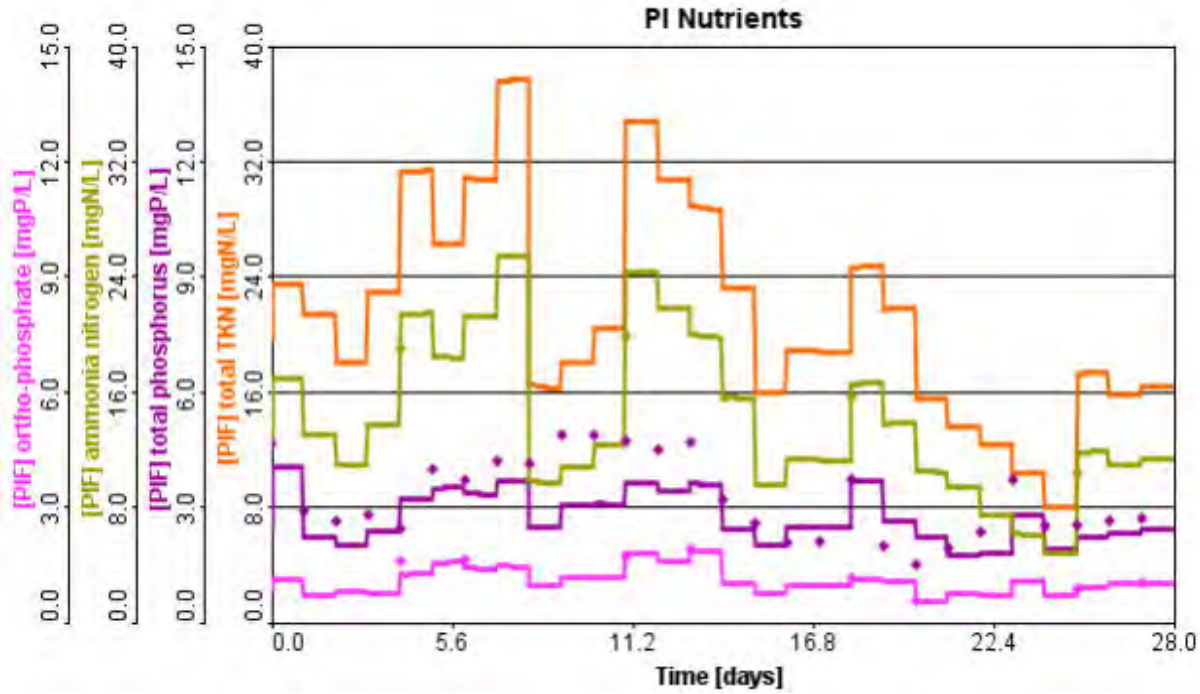


Figure 3.7. Dynamic calibration of primary influent nutrients

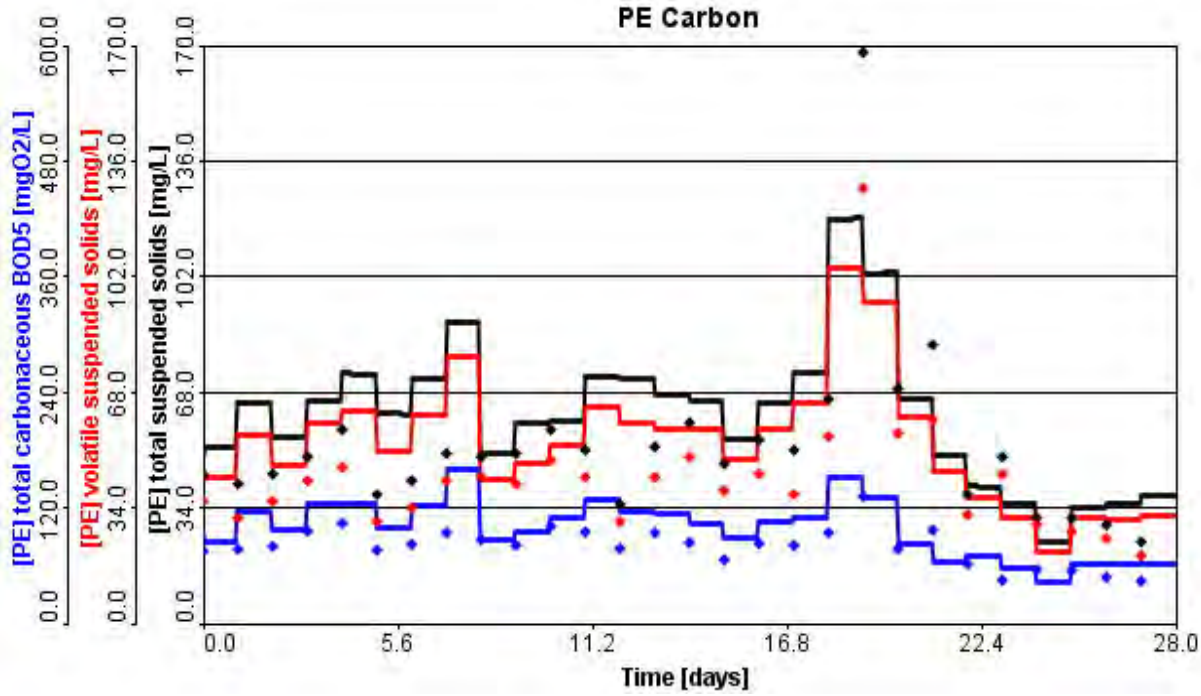


Figure 3.8. Dynamic calibration of primary effluent carbonaceous parameters

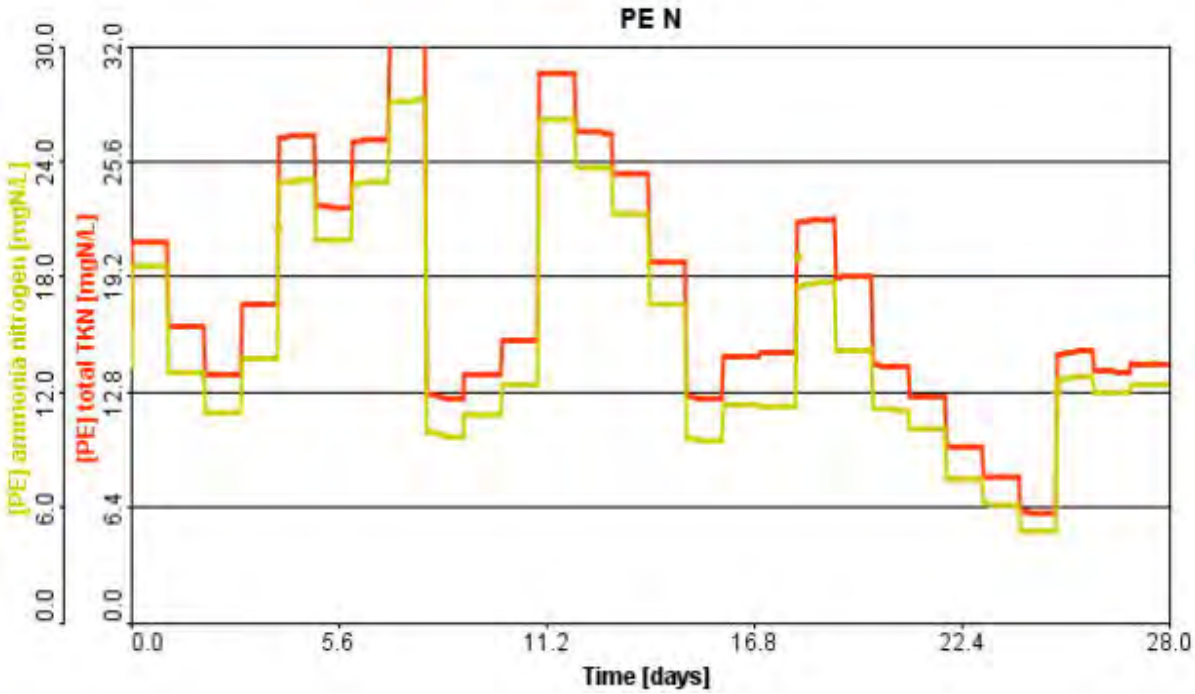


Figure 3.9. Dynamic calibration of primary effluent nitrogen

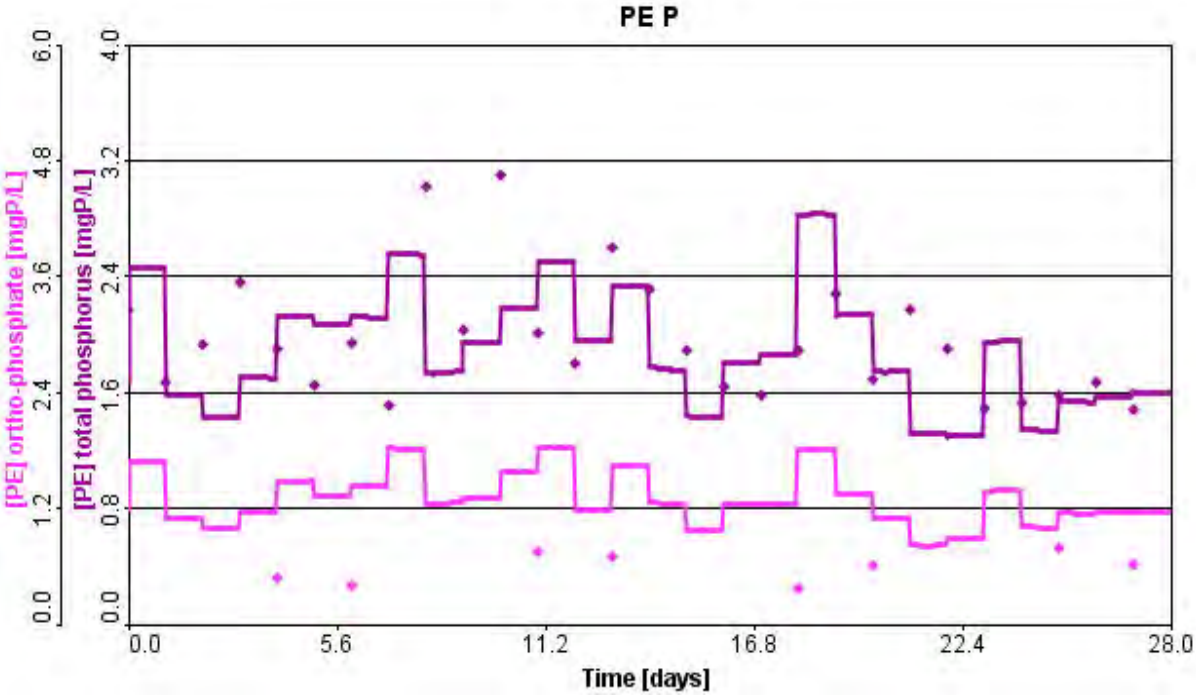


Figure 3.10. Dynamic calibration of primary effluent phosphorus

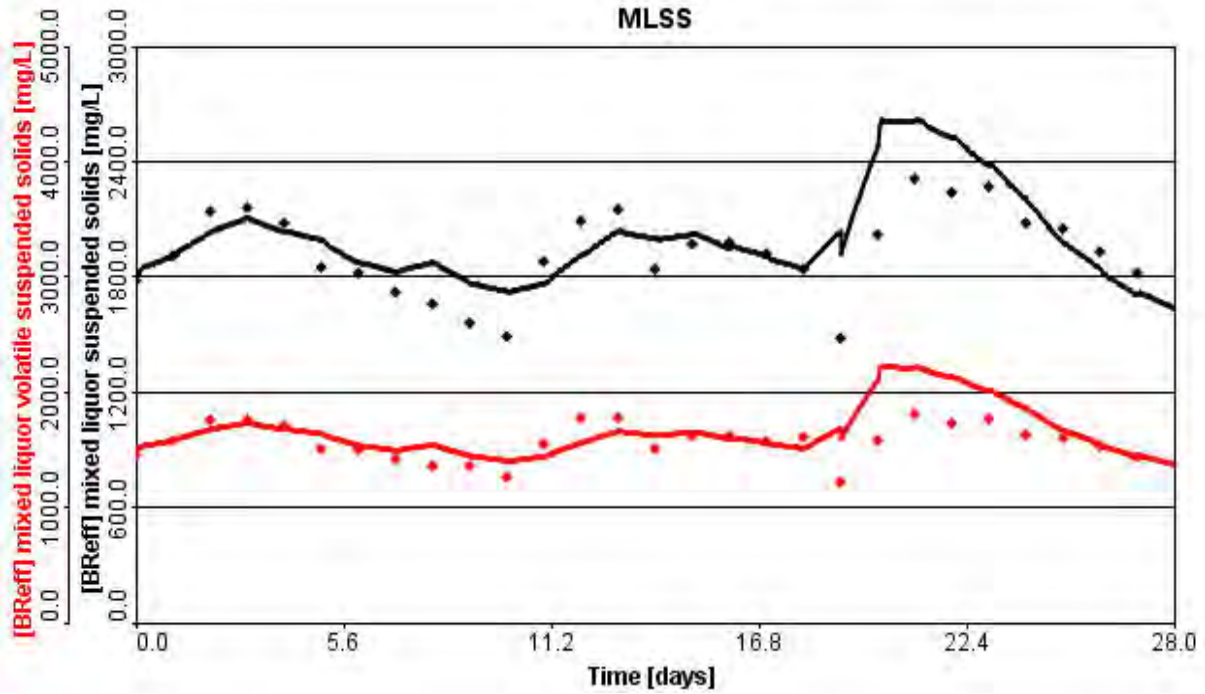


Figure 3.11. Dynamic calibration of MLSS and MLVSS

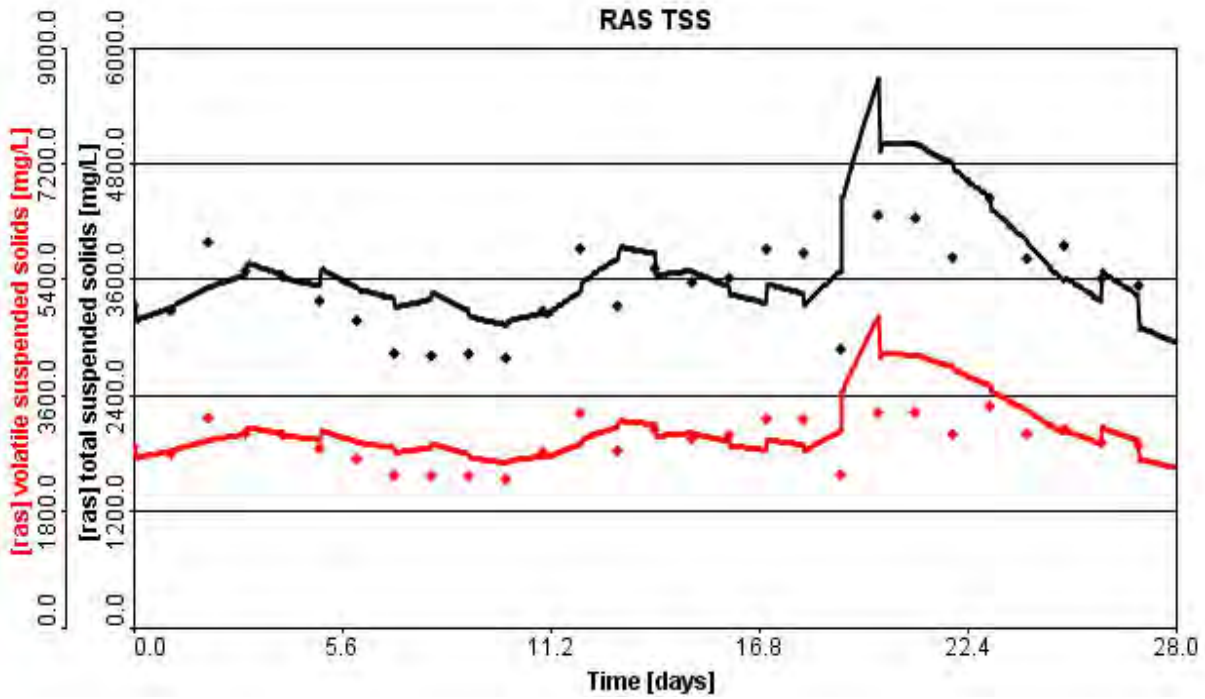


Figure 3.12. Dynamic calibration of RAS TSS and VSS

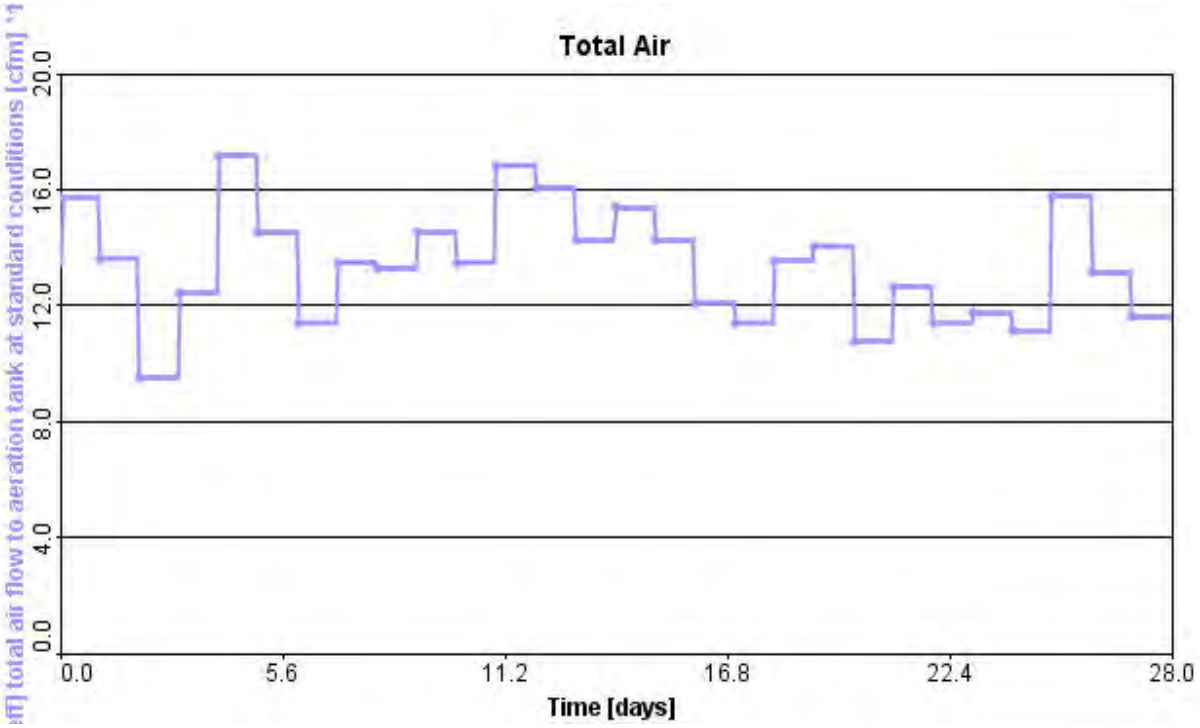


Figure 3.13. Dynamic calibration of total aeration tank airflow

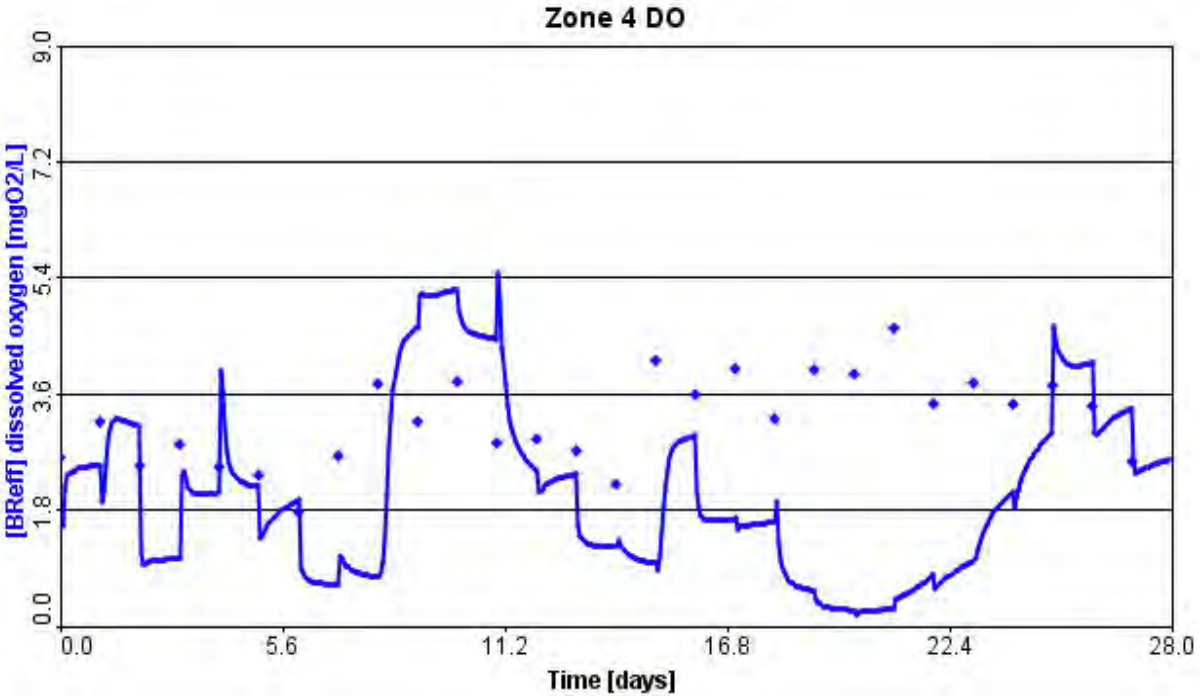


Figure 3.14. Dynamic calibration of zone 4 DO

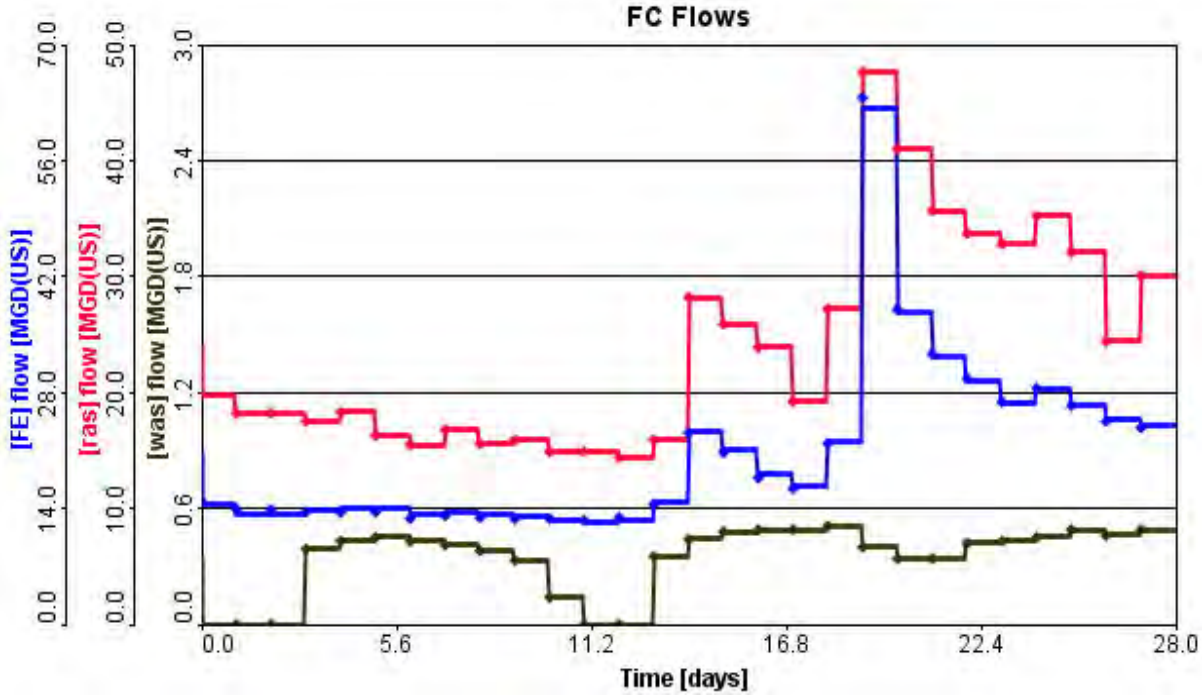


Figure 3.15. Dynamic calibration final effluent, RAS, and WAS flows

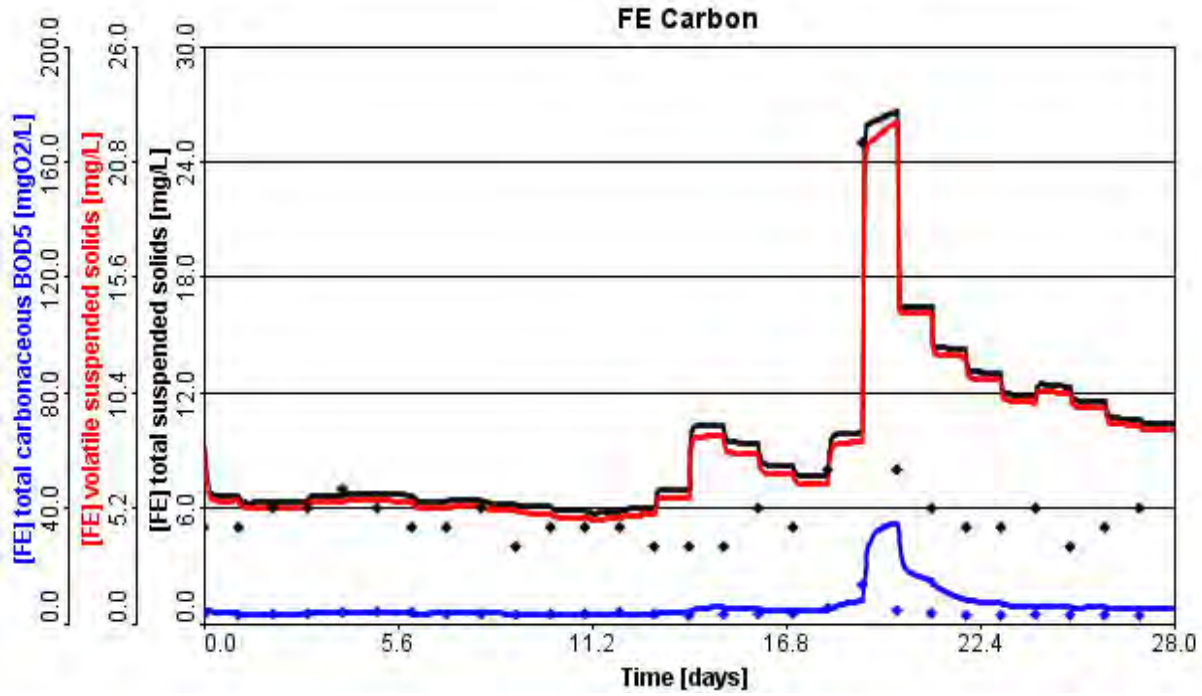


Figure 3.16. Dynamic calibration final effluent carbonaceous parameters

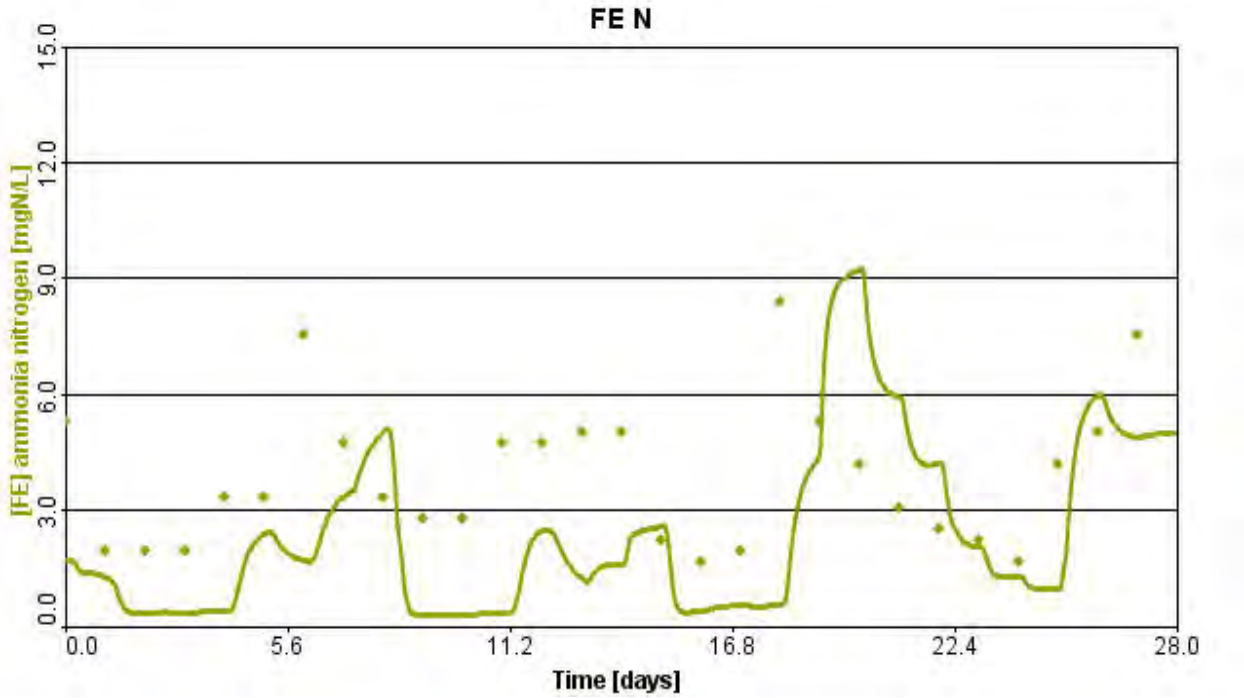


Figure 3.17. Dynamic calibration of final effluent ammonia

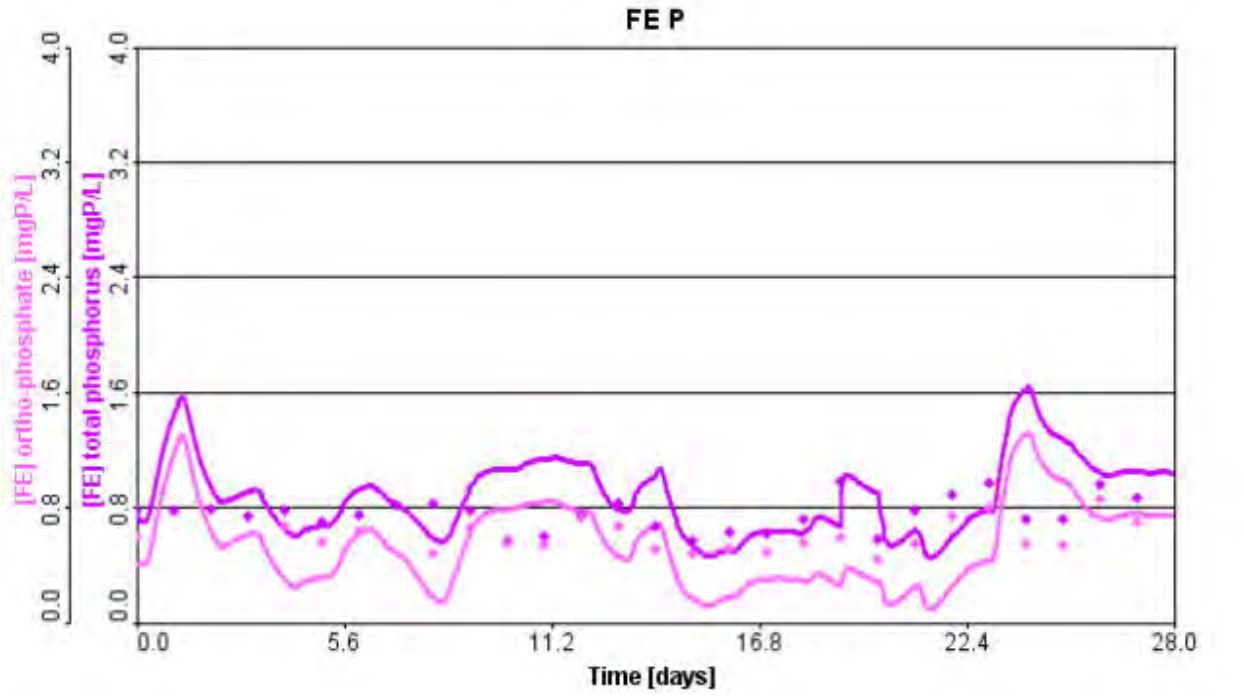


Figure 3.18. Dynamic calibration of final effluent phosphorus

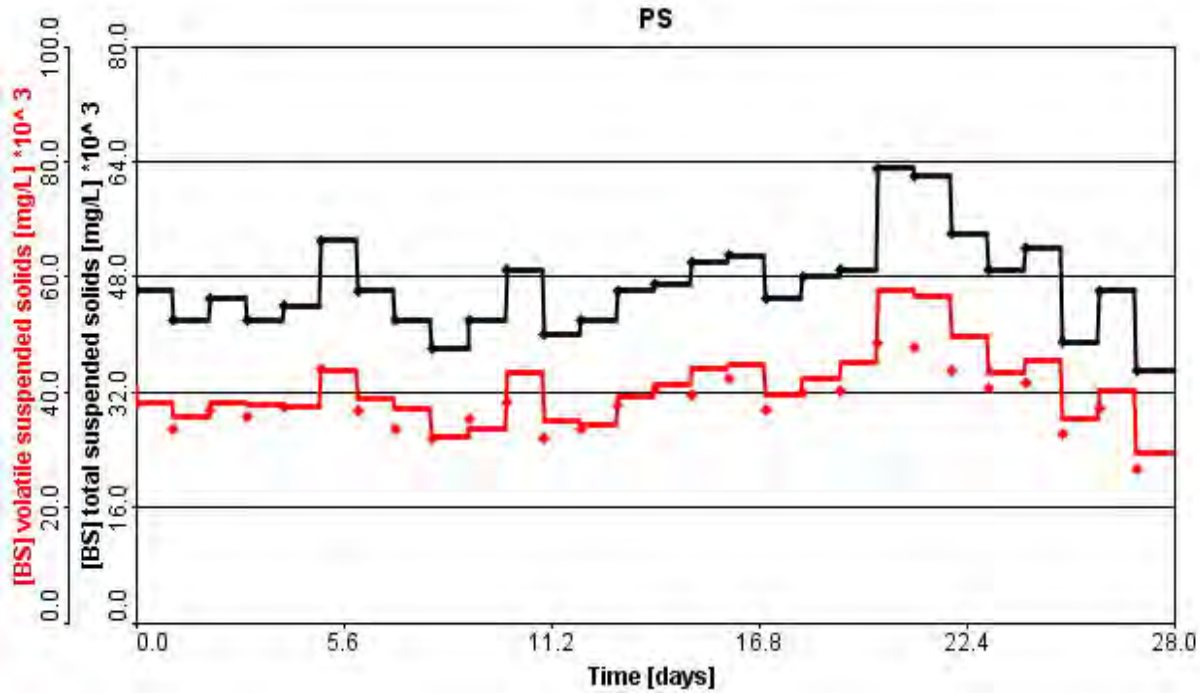


Figure 3.19. Dynamic calibration of primary sludge solids

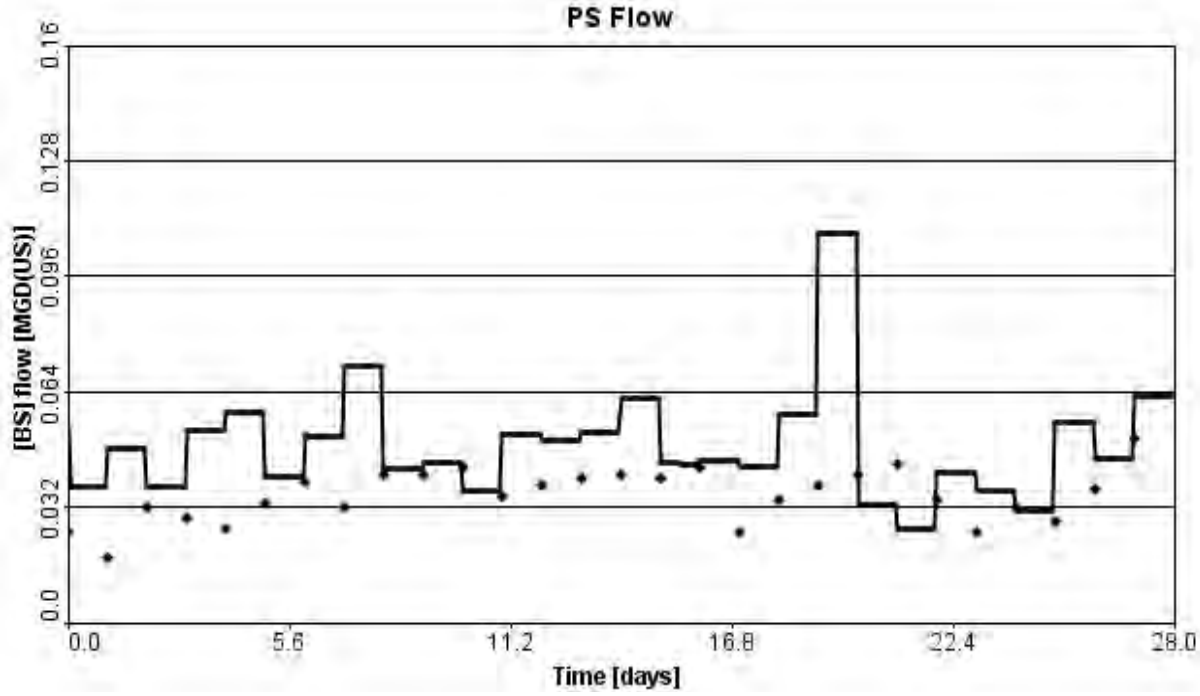


Figure 3.20. Dynamic calibration of primary sludge flow

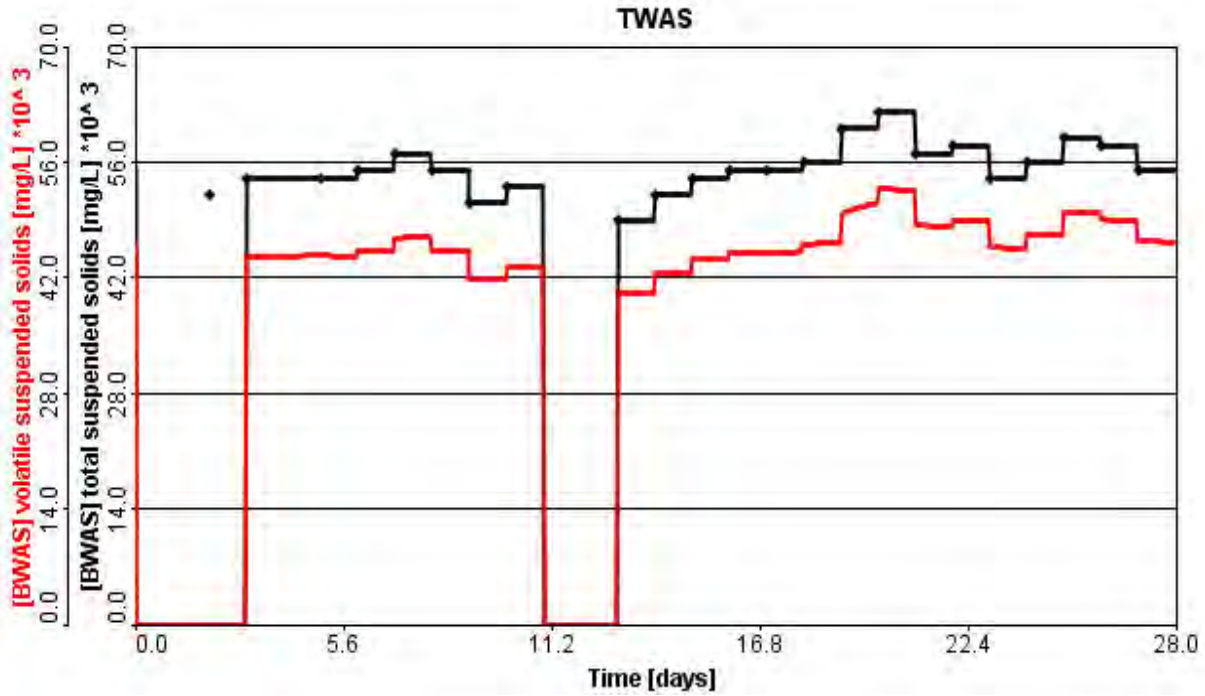


Figure 3.21. Dynamic calibration of thickened WAS solids

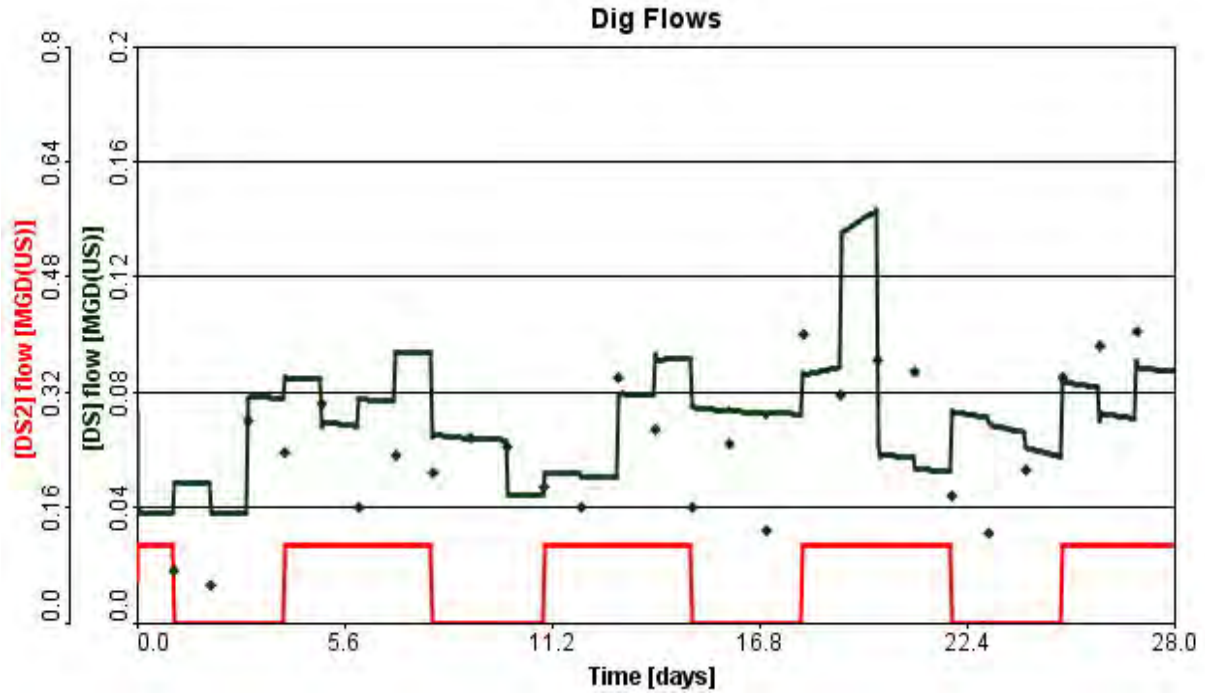


Figure 3.22. Dynamic calibration of digested sludge flows

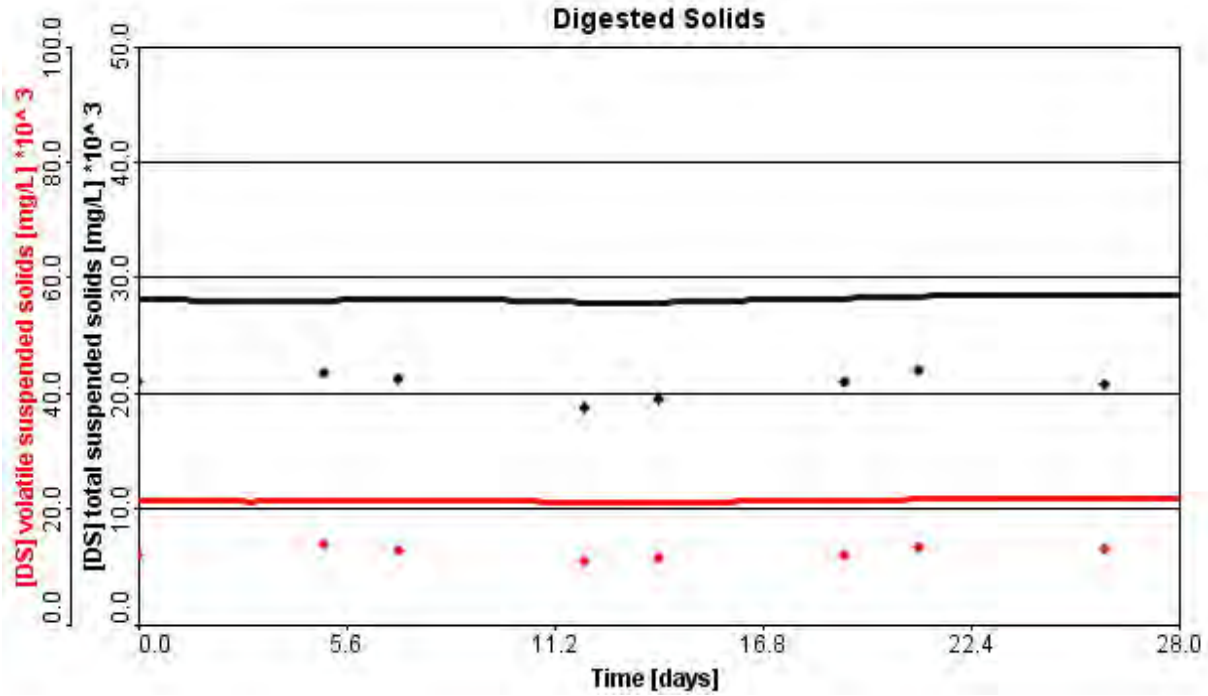


Figure 3.23. Dynamic calibration of digested sludge solids

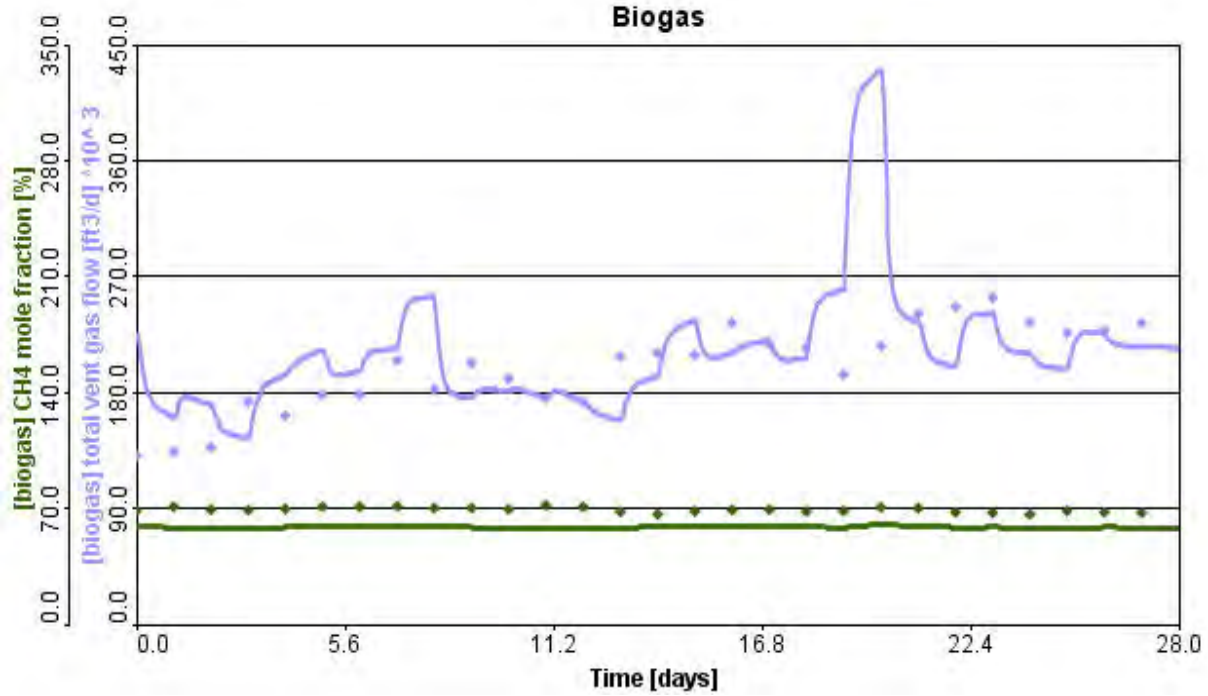


Figure 3.24. Dynamic calibration of biogas parameters

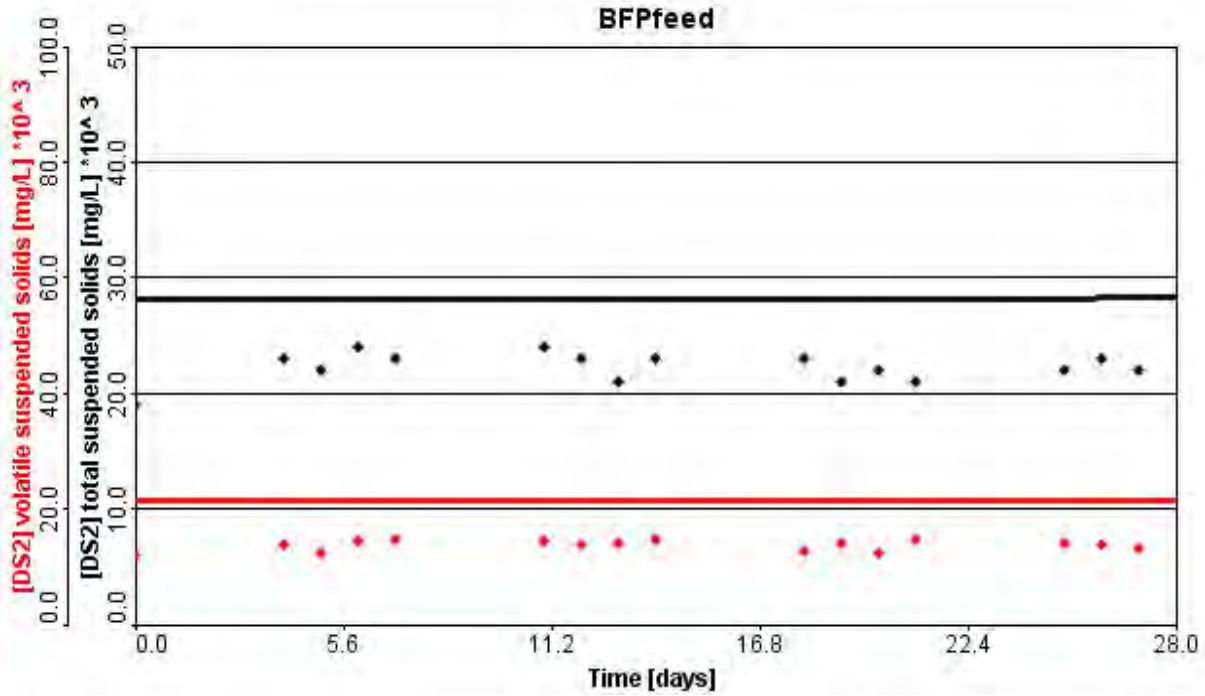


Figure 3.25. Dynamic calibration of dewatering feed solids

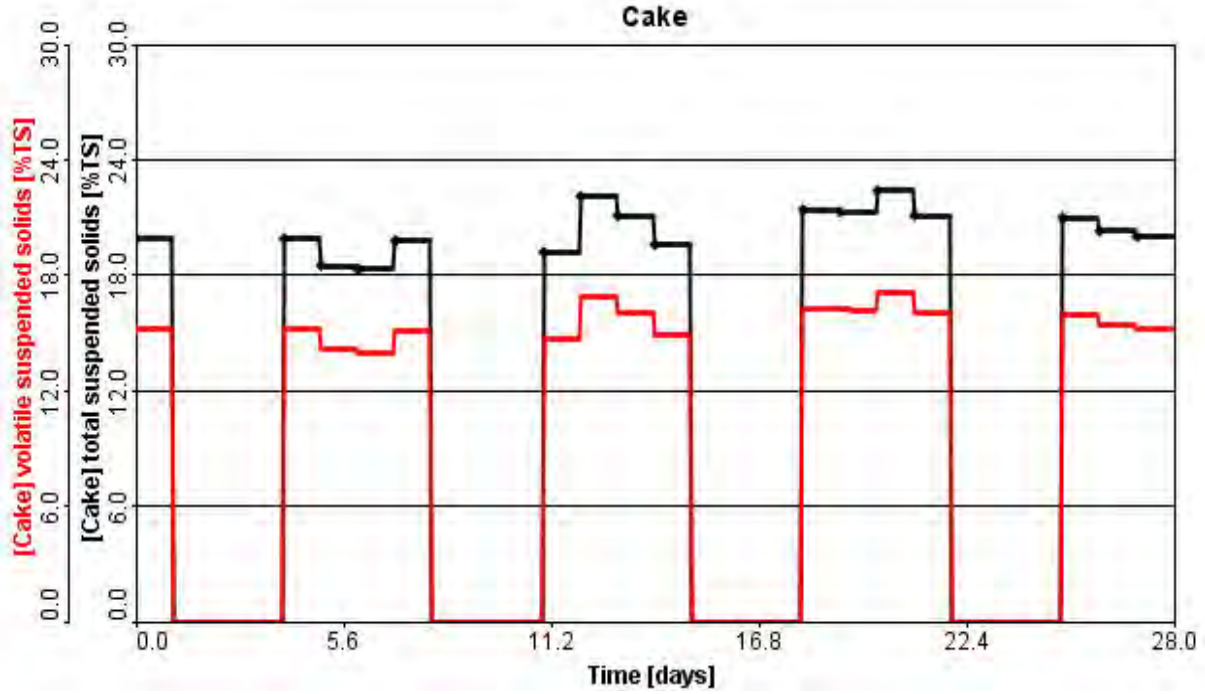


Figure 3.26. Dynamic calibration of dewatered sludge cake solids

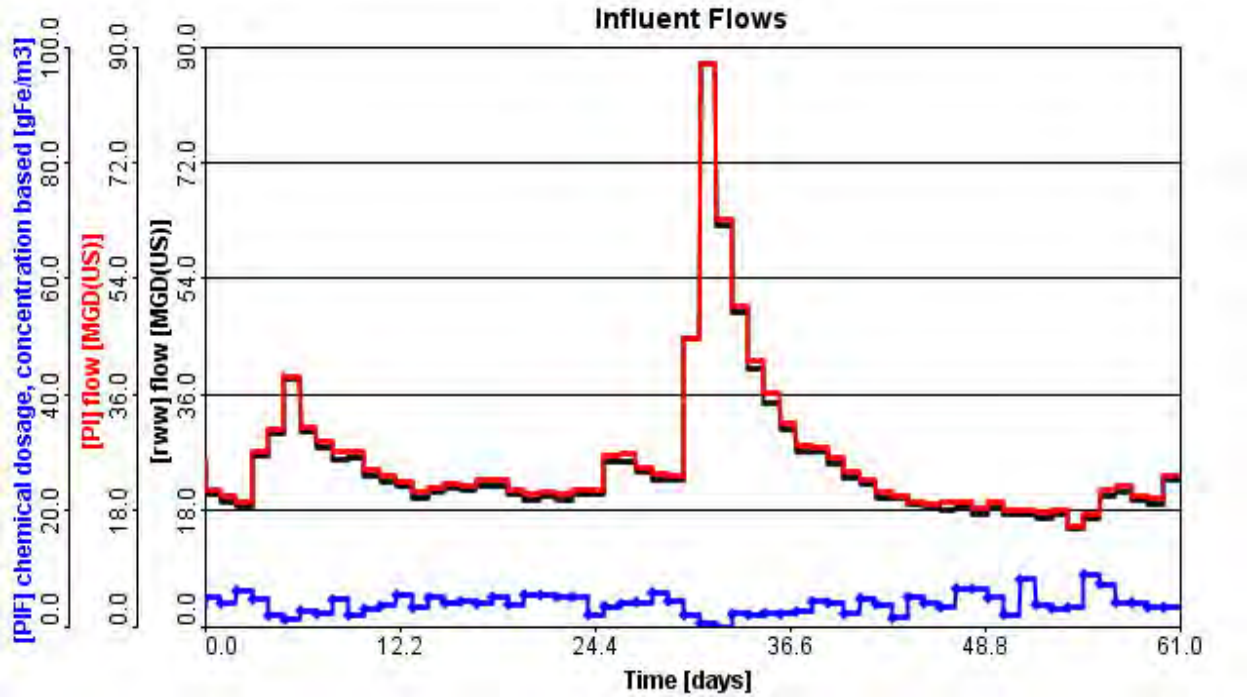


Figure 3.27. Dynamic validation of wastewater flow and ferric chloride feed

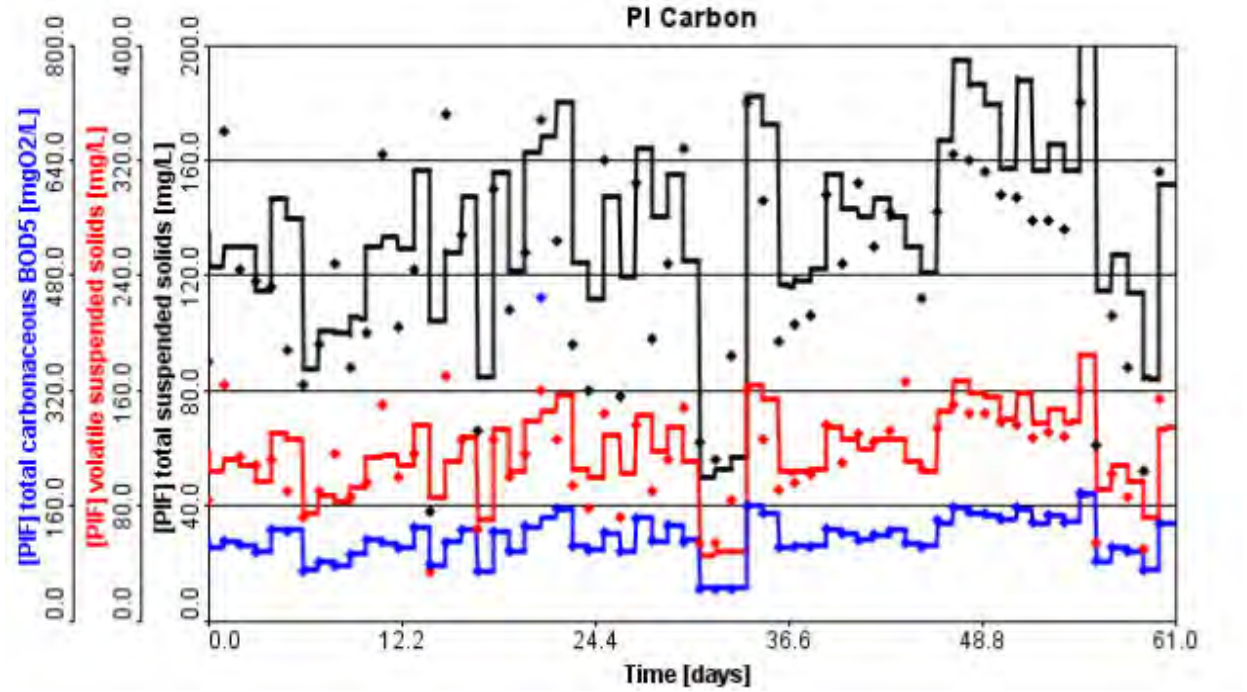


Figure 3.28. Dynamic validation of primary influent carbonaceous parameters

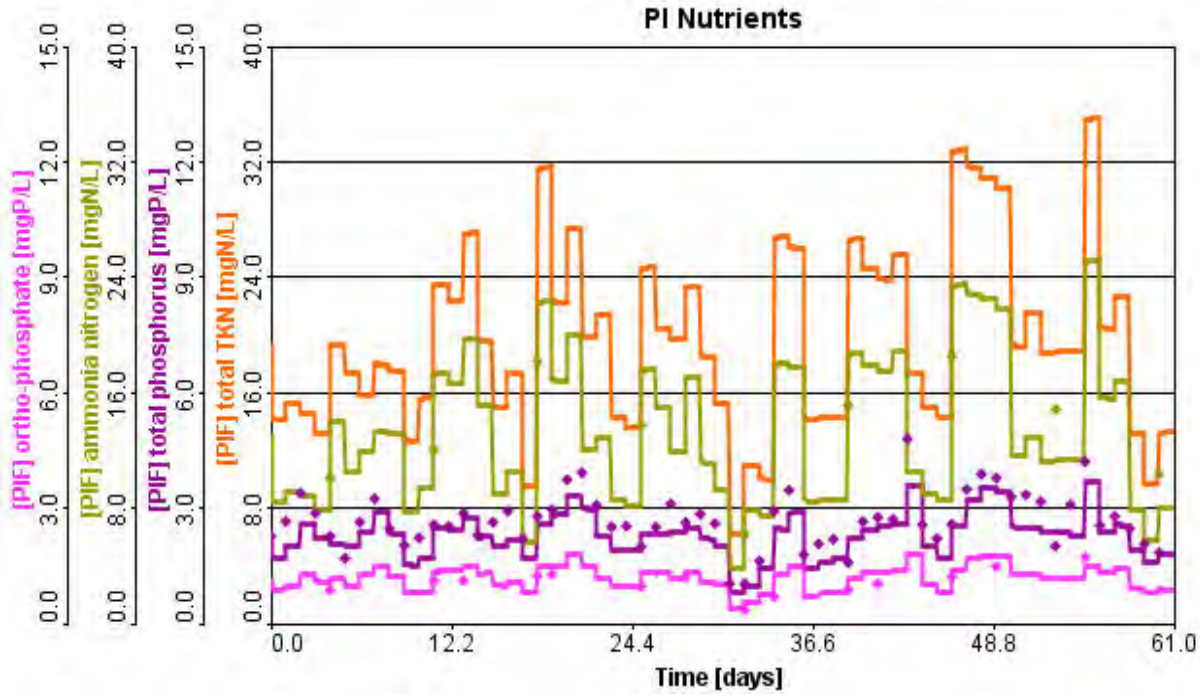


Figure 3.29. Dynamic validation of primary influent nutrients

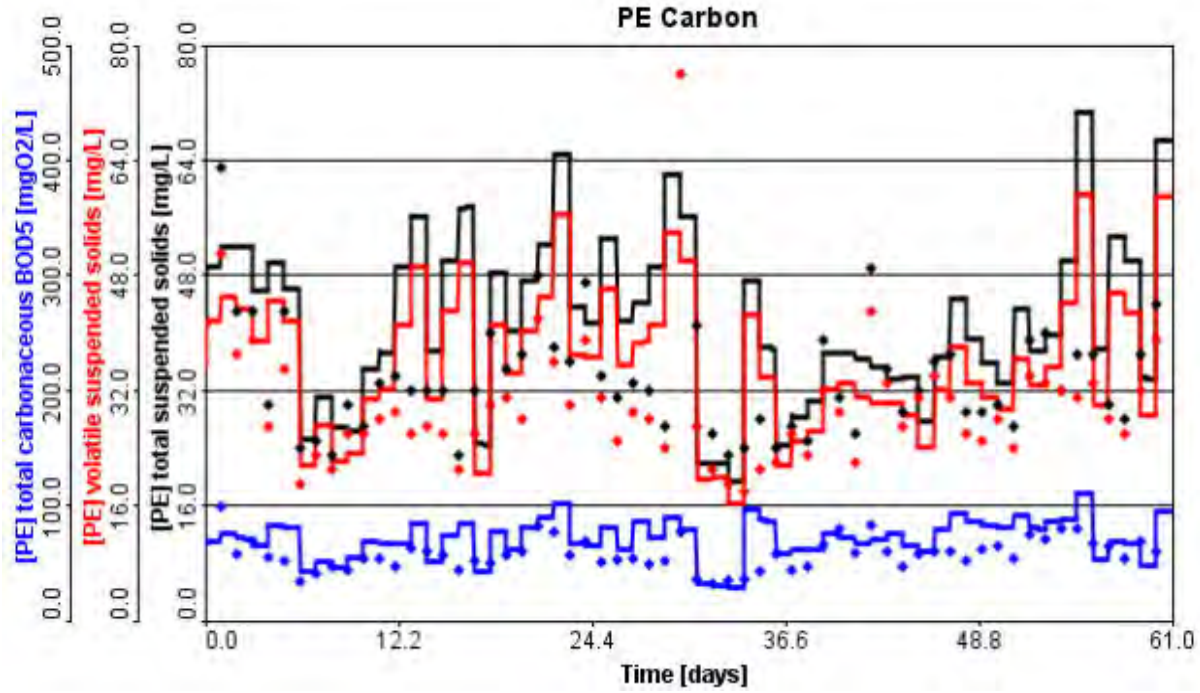


Figure 3.30. Dynamic validation of primary effluent carbonaceous parameters

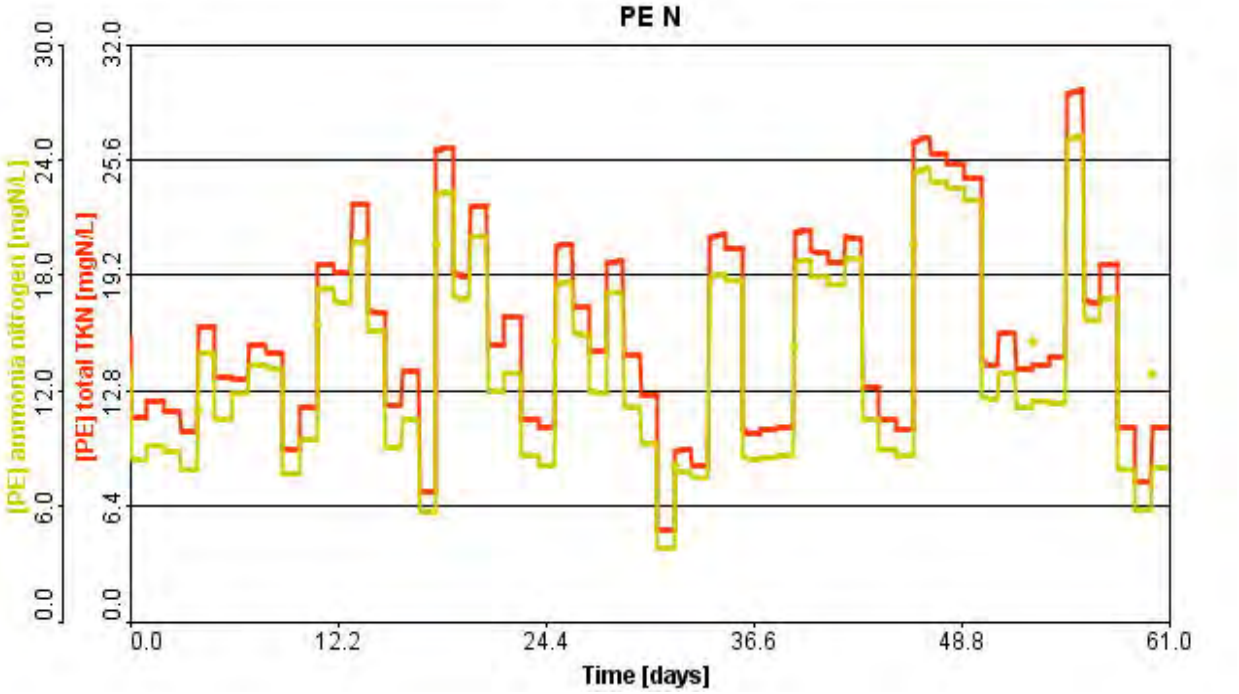


Figure 3.31. Dynamic validation of primary effluent nitrogen

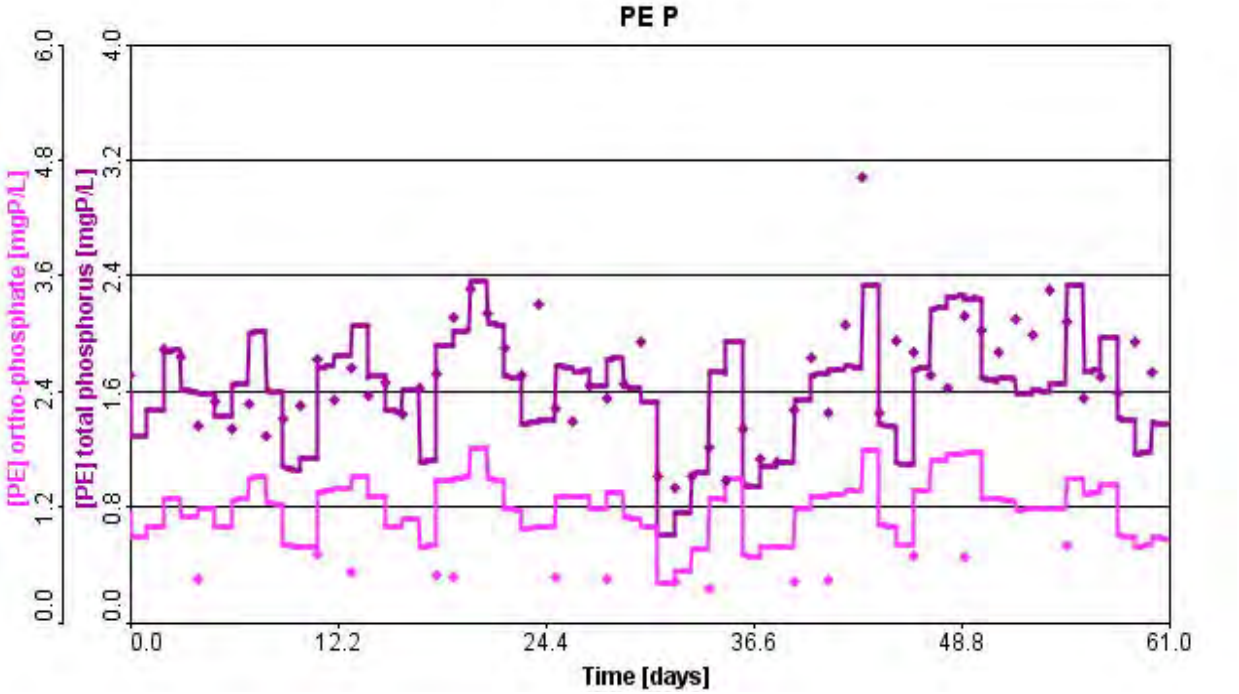


Figure 3.32. Dynamic validation of primary effluent phosphorus

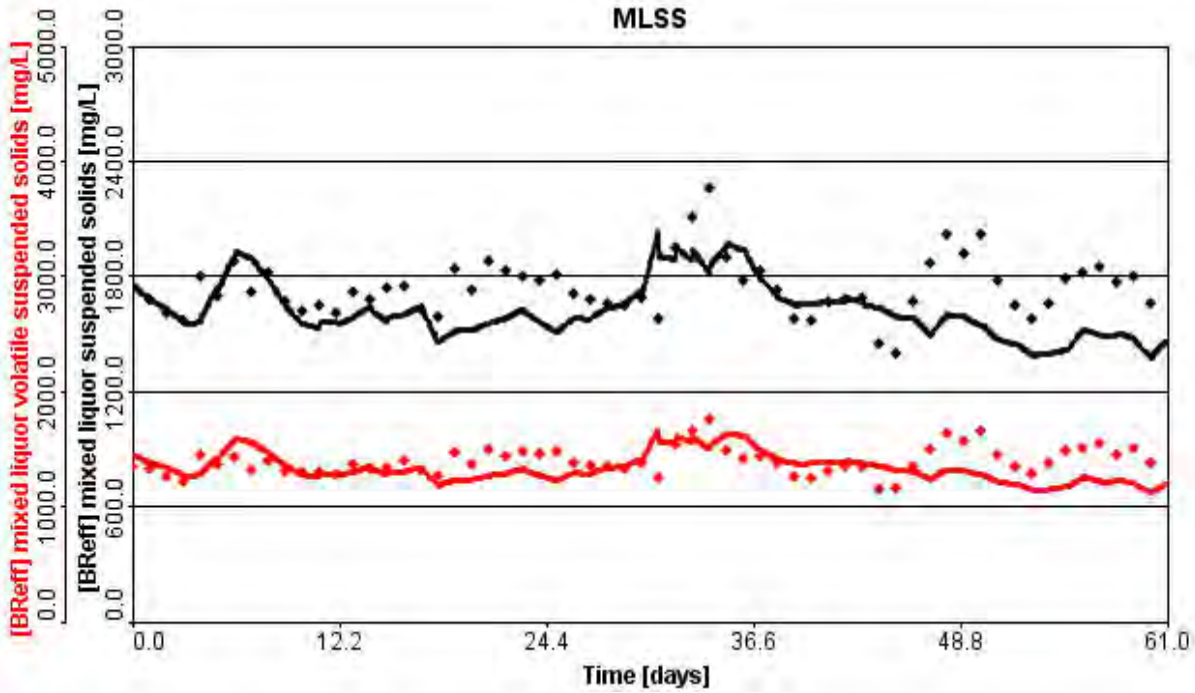


Figure 3.33. Dynamic validation of MLSS and MLVSS

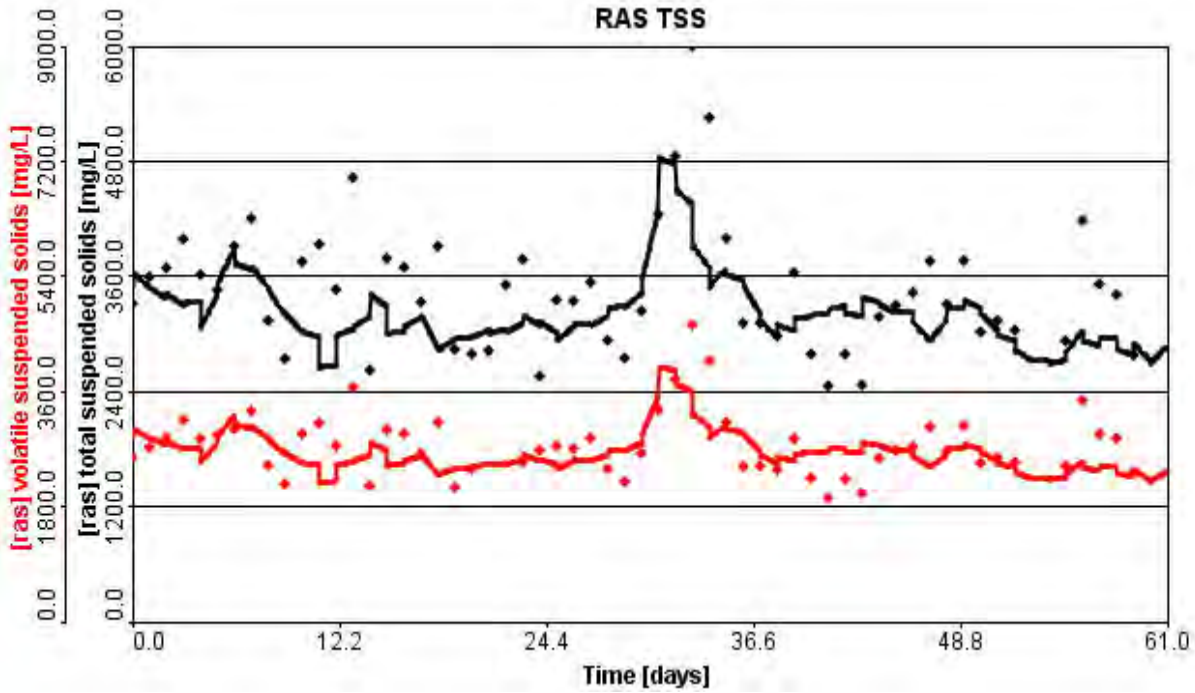


Figure 3.34. Dynamic validation of RAS TSS and VSS

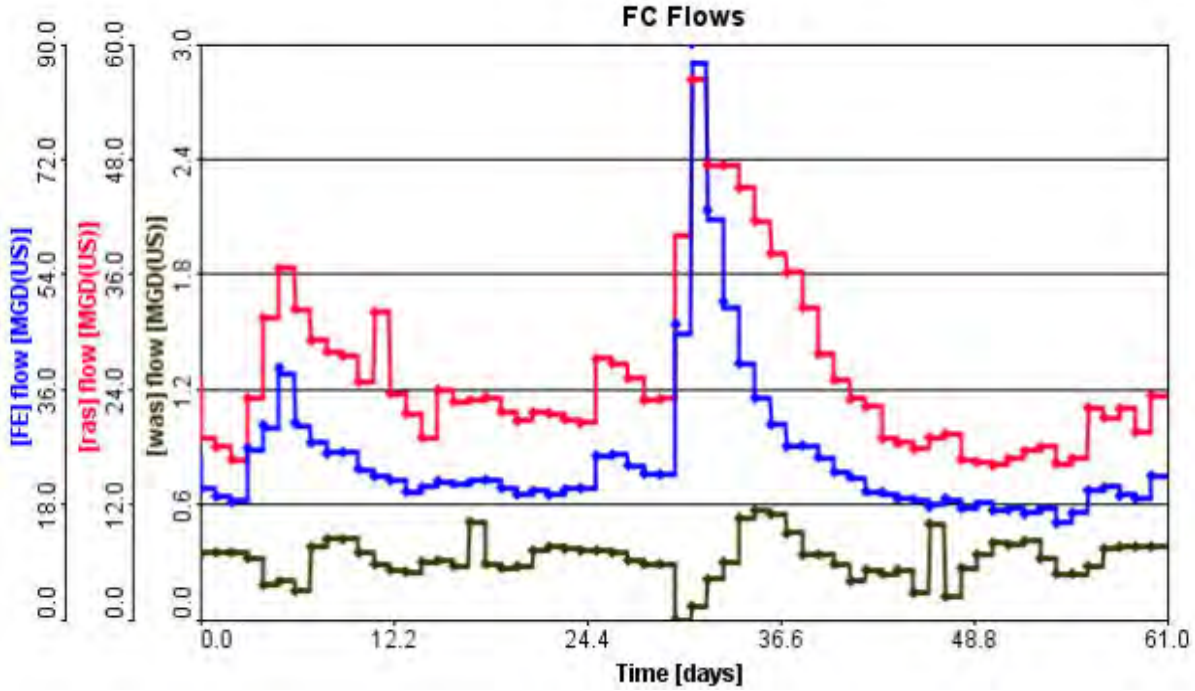


Figure 3.35. Dynamic validation final effluent, RAS, and WAS flows

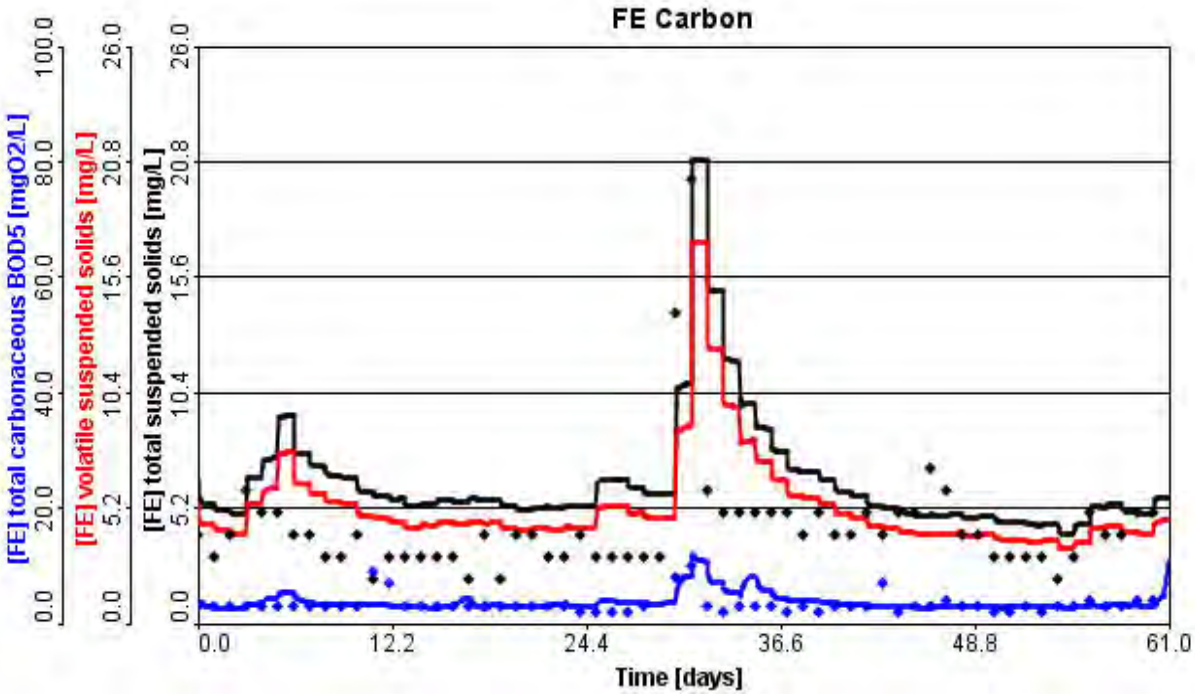


Figure 3.36. Dynamic validation final effluent carbonaceous parameters

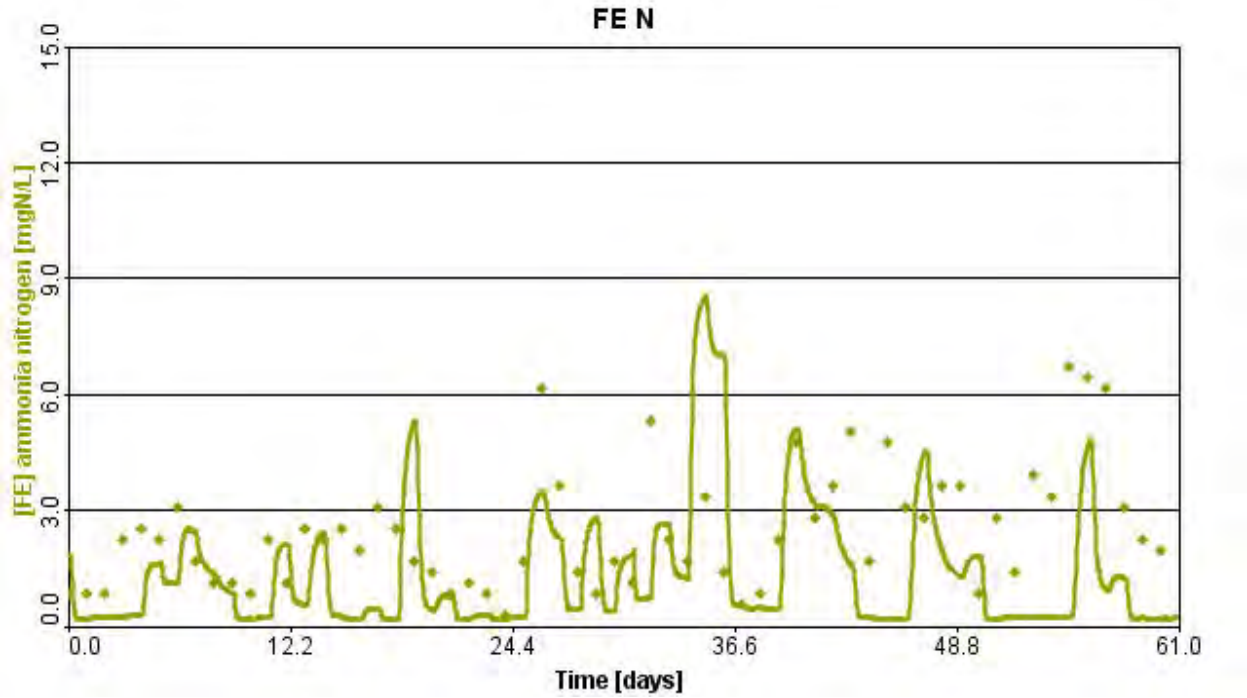


Figure 3.37. Dynamic validation of final effluent ammonia

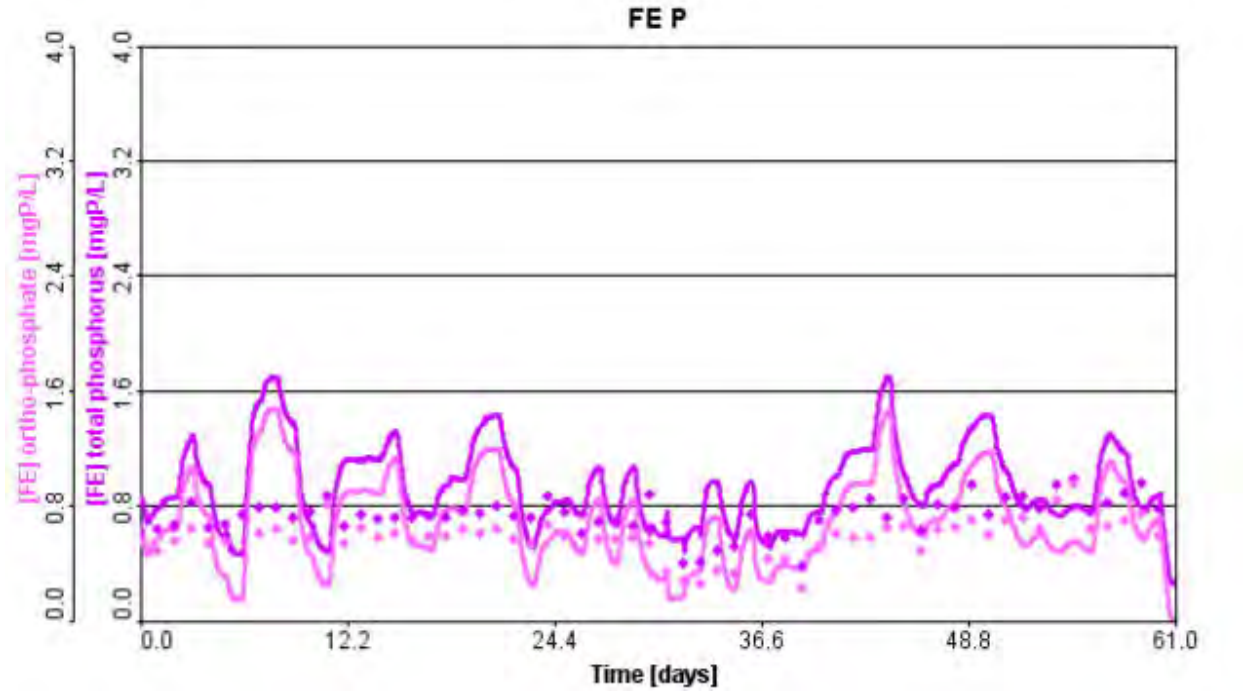


Figure 3.38. Dynamic validation of final effluent phosphorus

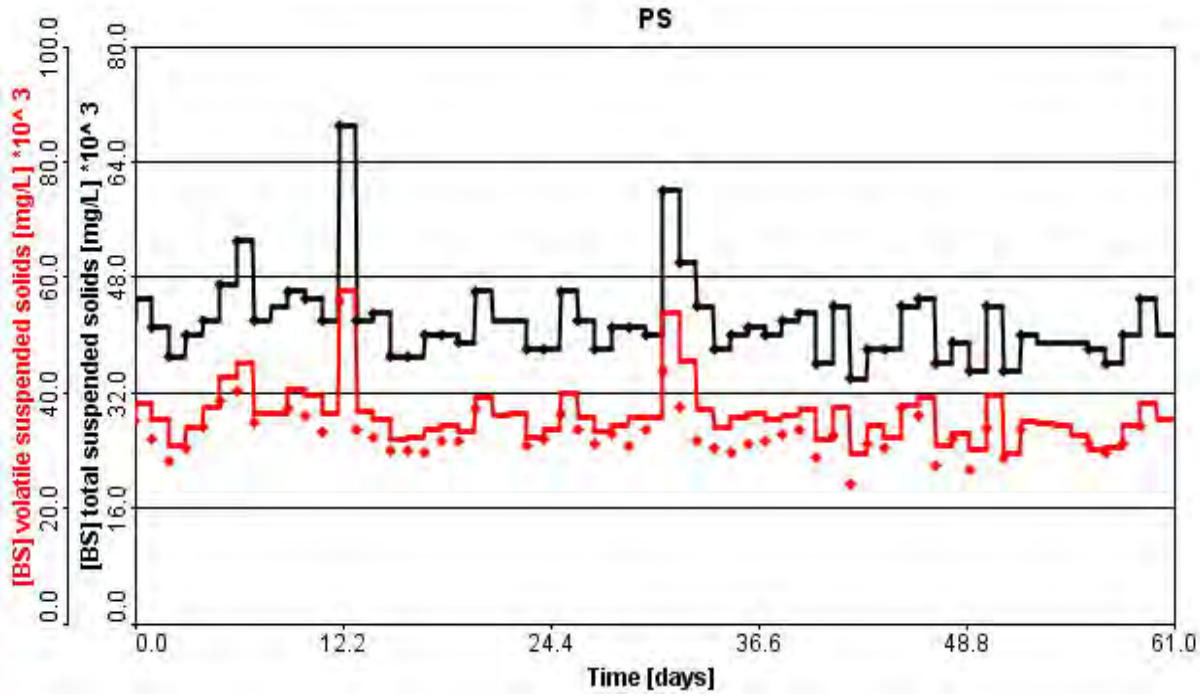


Figure 3.39. Dynamic validation of primary sludge solids

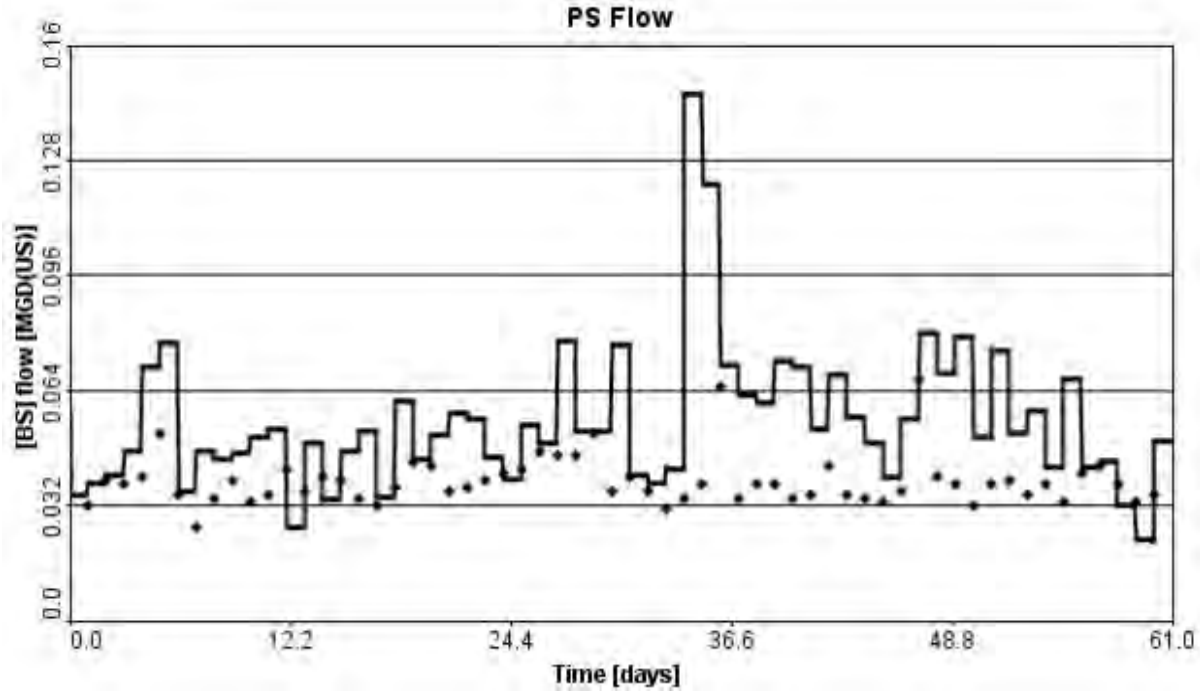


Figure 3.40. Dynamic validation of primary sludge flow

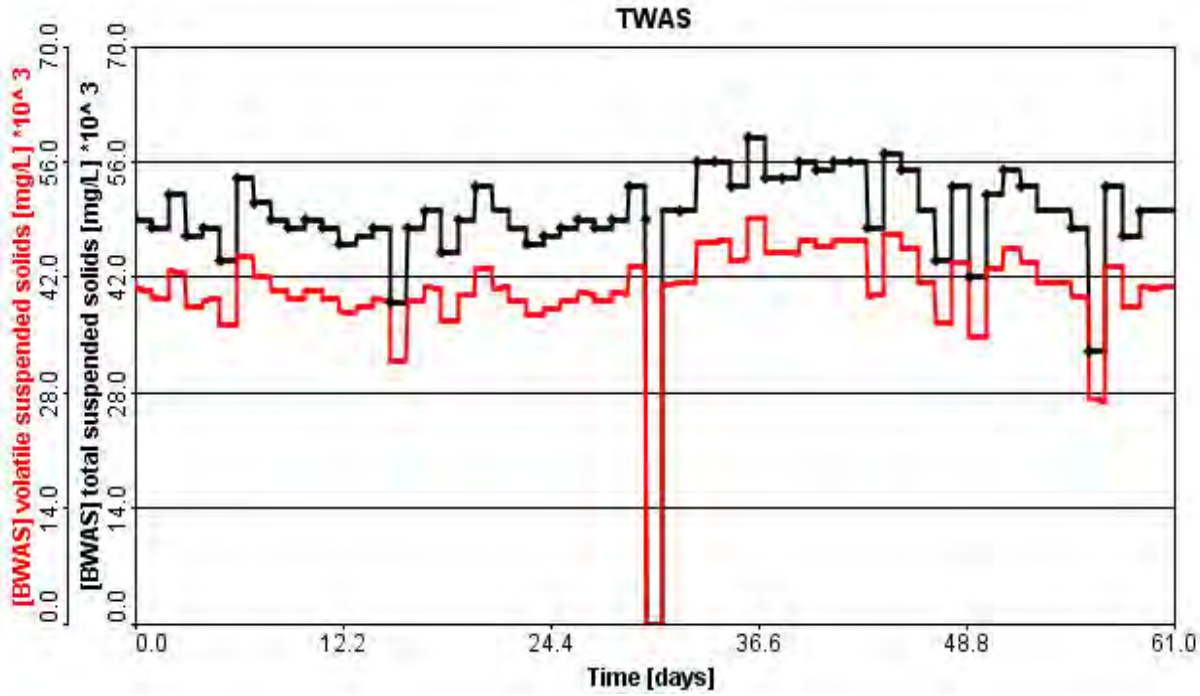


Figure 3.41. Dynamic validation of thickened WAS solids

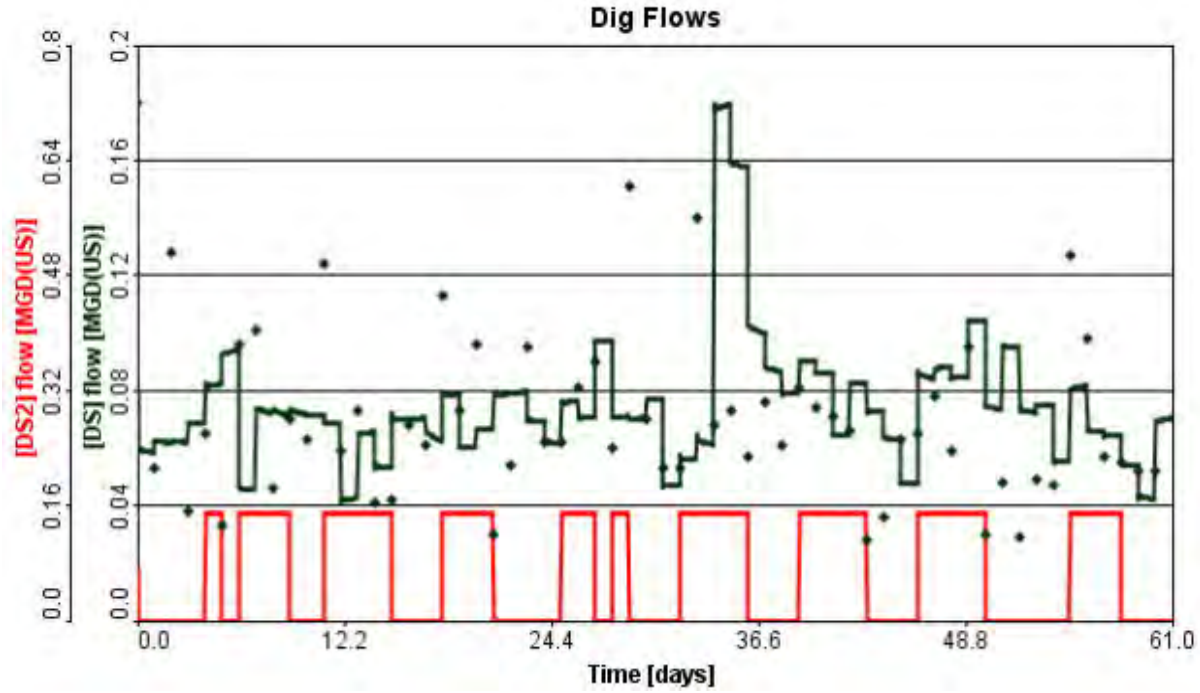


Figure 3.42. Dynamic validation of digested sludge flows

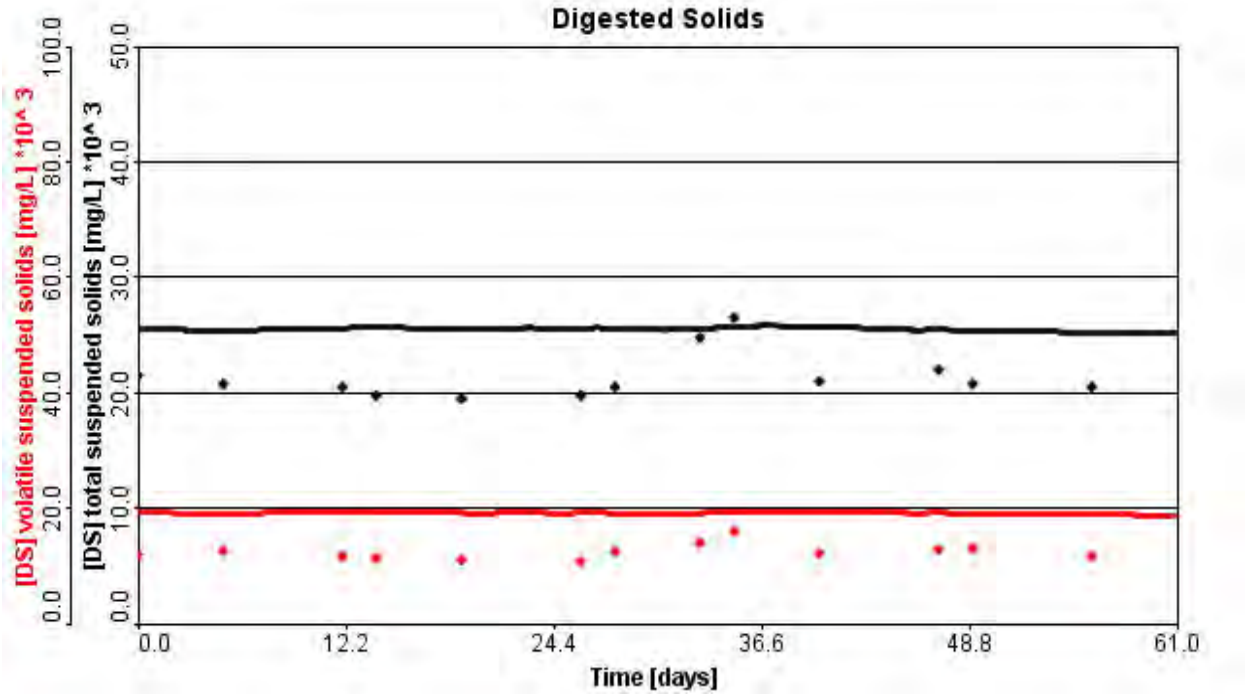


Figure 3.43. Dynamic validation of digested sludge solids

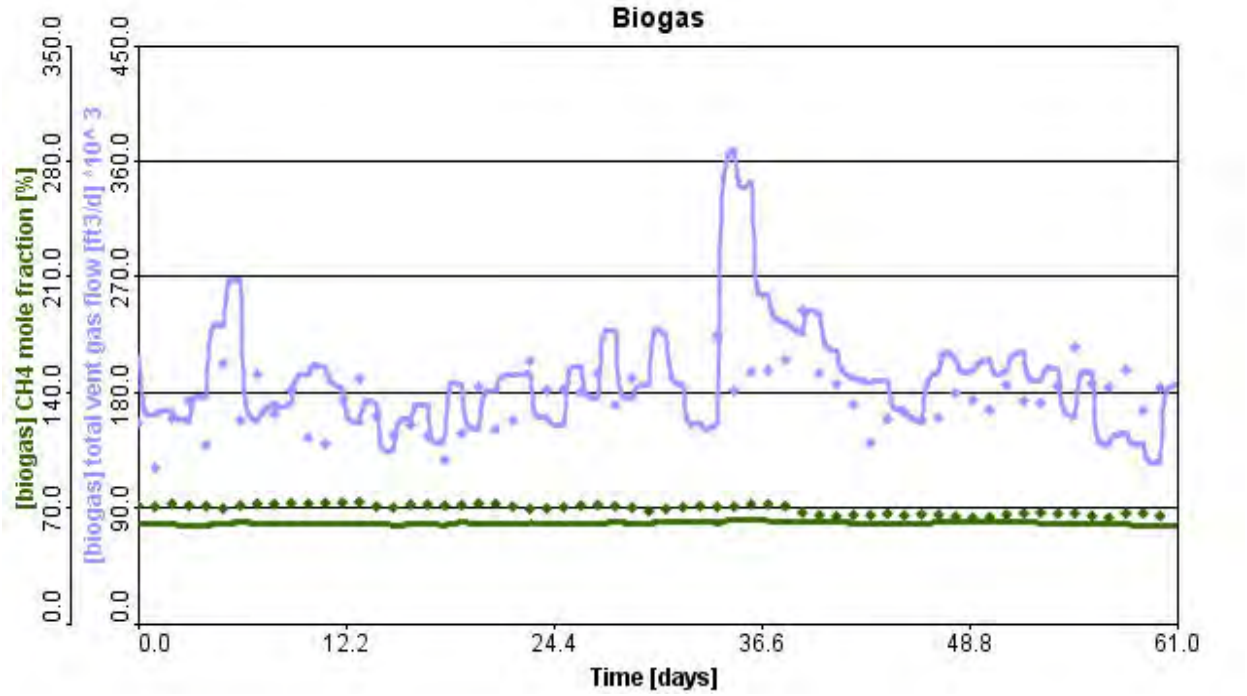


Figure 3.44. Dynamic validation of biogas parameters

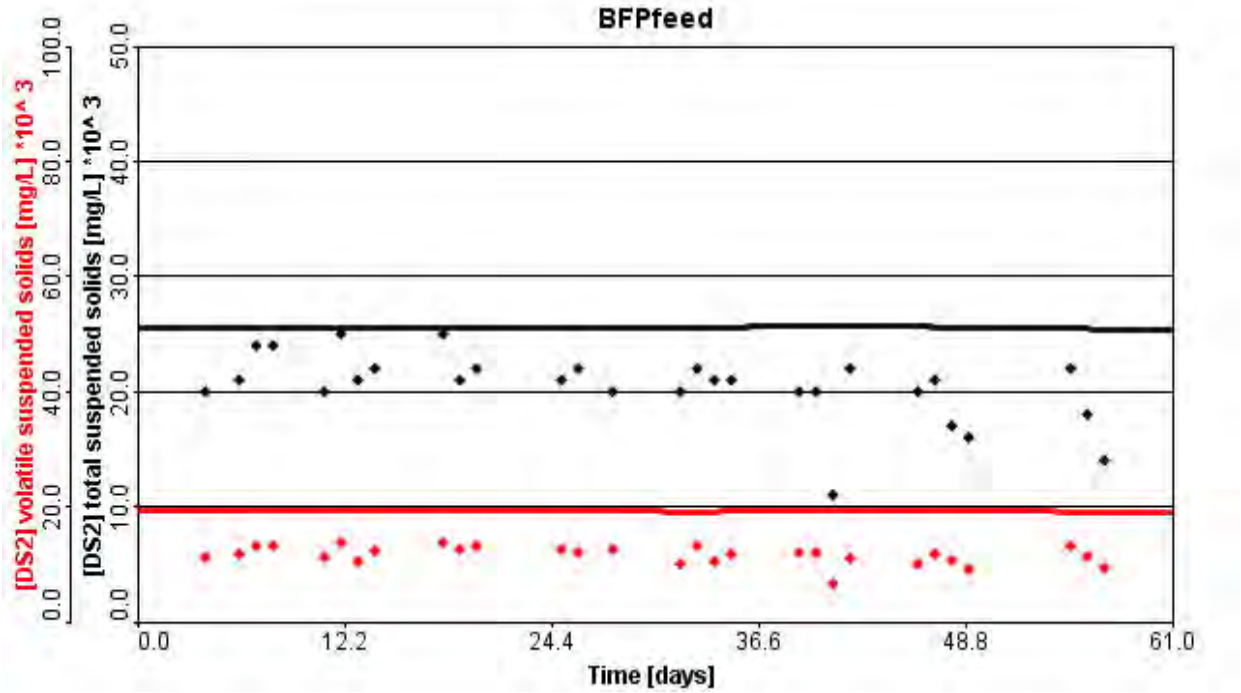


Figure 3.45. Dynamic validation of dewatering feed solids

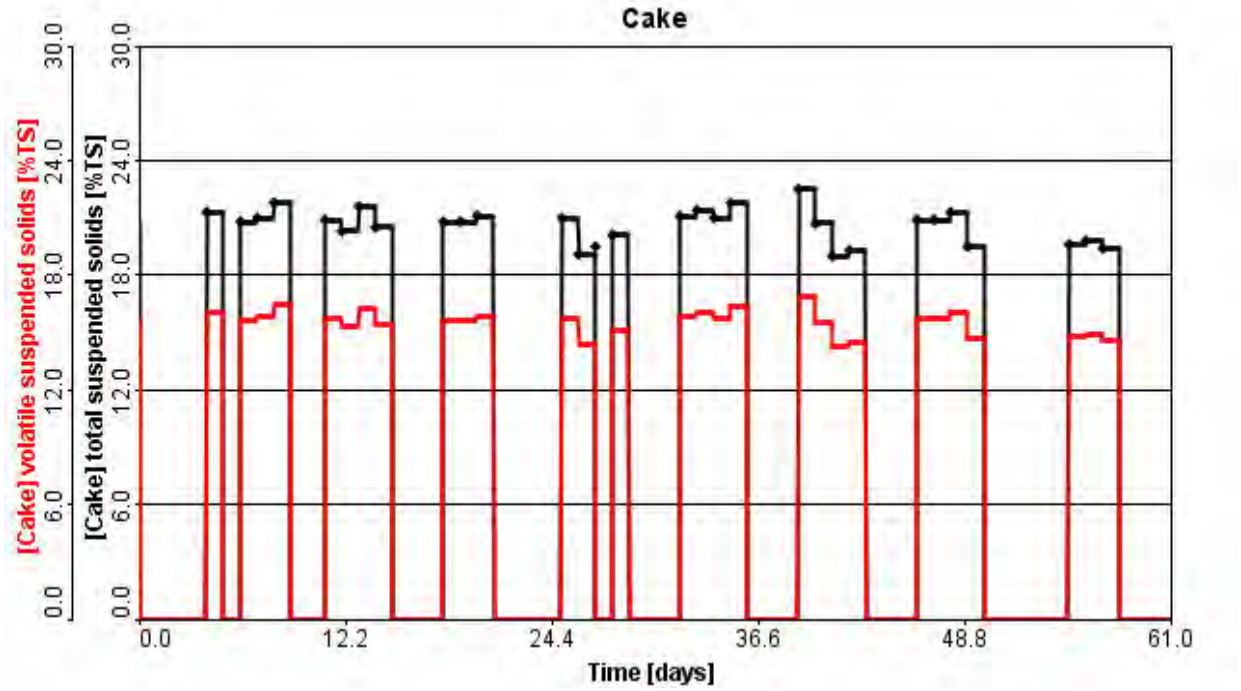


Figure 3.46. Dynamic validation of dewatered sludge cake solids

4.0 MODEL APPLICATION

4.1 Effluent Limits and Simulation Scenarios

In addition to the existing TSS and BOD limits, an update to the plant's effluent permit included a more stringent TP limit of 0.85 mg/L. To evaluate meeting this new limit at the projected flows and loadings, the existing practice of chemical phosphorus removal was simulated. Potential reactor modifications were also investigated and simulated to provide biological phosphorus removal. For most model application simulations, no ammonia or nitrogen limits were assumed, but one set of full nitrification simulations were also carried out with chemical phosphorus removal. The following scenarios were assumed for each set of simulations:

1. Annual average flow and loadings at annual average temperature
2. Annual average flow and loadings during winter
3. Annual average flow and loadings during summer
4. Maximum month average flow and loadings during winter
5. Maximum month average flow and loadings during summer

4.2 Simulation Assumptions

The following assumptions regarding the influent loadings, characterizations, environmental conditions, treatment units online, and operating parameters have been set forth for upgrade scenario simulations; most of which generally reflect the calibration and validation period observations:

1. The raw wastewater stoichiometric fractions that achieved dynamic calibration and validation would remain in effect for the scenario simulations. The future annual average and maximum month influent characterization breakdowns have been included as a part of **Attachment 3.1**.
2. Excess influent alkalinity for full nitrification
3. All primary clarifiers, aeration tanks, secondary clarifiers, and digesters online
4. Primary removal performance governed by a modified Greeley model (discussed later)
5. Aeration tank aerobic zones operated at DO set points of 2 mg/L
6. RAS rate set at 80% of secondary influent flow
7. Secondary clarifier solids loading rate kept under 25 lbs/d/ft^2
8. Primary sludge set to about 4% solids
9. Gravity belt thickener solids capture efficiency set at 95%
10. Gravity belt thickened sludge set to 5% solids
11. Belt filter press capture efficiency set at 95%
12. Belt filter press dewatered sludge cake set to 19.8% solids

4.3 Modified Greeley Primary Treatment Model

In projecting future primary performance, a relationship was generated by means of a modified Greeley removal curve that was fitted to the observed solids removal data. **Figure 4.1** illustrates the modified solids removal curve along with the historical primary solids removal data where the curve generally passed through the observed removal data. This curve was used in predicting the solids removal (and all particulate components, e.g. particulate BOD, particulate COD, particulate TKN, particulate phosphorus, etc.) when the simulations were carried out.

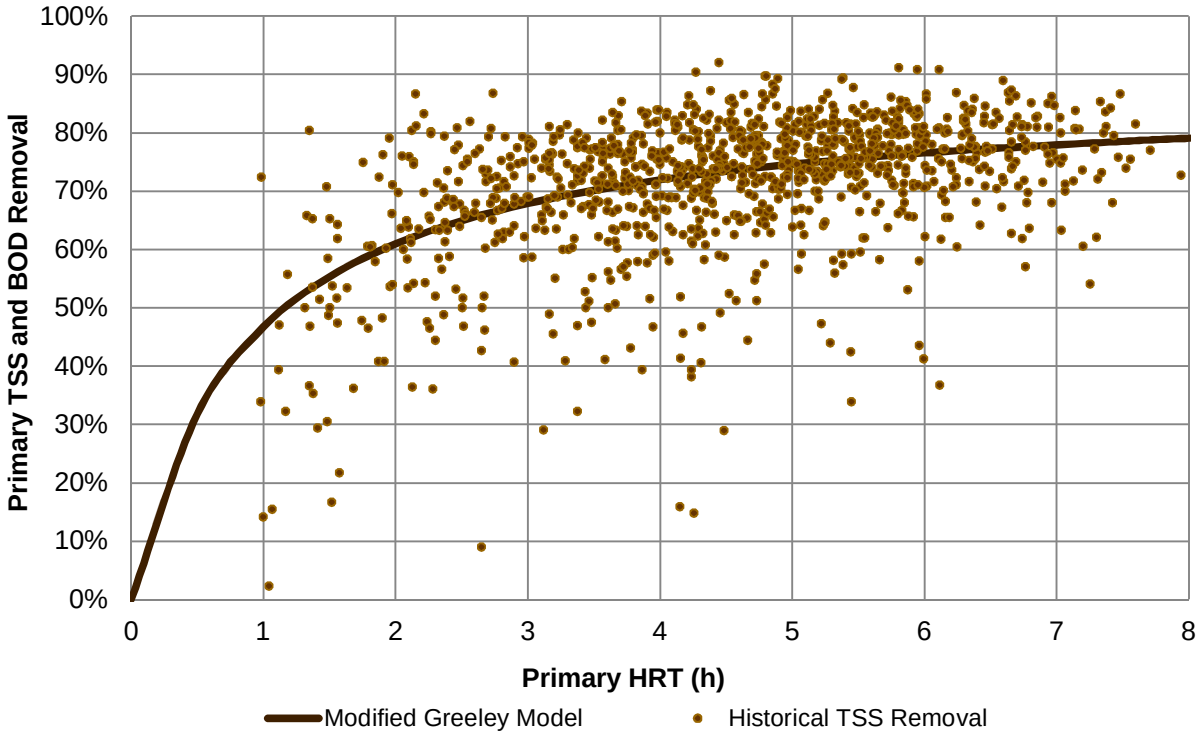


Figure 4.1. Modified Greeley primary treatment removal model

4.4 Chemical Phosphorus Removal

The projected annual average and maximum month average flows and loadings cited in **Table 2.2** were employed in essentially running the existing configuration of the plant for the chemical phosphorus removal simulations. For the annual average conditions, the MLSS concentration was adjusted to typical historical values (~1,500 mg/L) which rendered an SRT of about 6 days. The aeration tanks were kept completely aerobic. Full nitrification was evident for the annual average loadings at the summer and annual average temperatures, but only partial nitrification was found for the winter conditions. For the maximum month loadings, the MLSS was set about 2,000 mg/L, which kept the

secondary clarifier solids loading rate under the 25 lbs/d/ft^2 threshold. The SRT came out around 5.5 days, which enabled full nitrification during summer and only partial nitrification during winter. The ferric chloride addition required to meet the 0.85 mg/L limit was about 500 gpd for annual average loadings and 440 gpd at maximum month loadings. The slightly less ferric chloride requirement for the higher loadings was because the influent TP concentration was less at the higher loadings. The simulation results are shown in **Attachment 4.1**.

4.1 Biological Phosphorus Removal

First off, the applicability of biological phosphorus removal (BPR) at Racine was investigated. BPR removal usually needs a secondary influent BOD/TP ratio of at least 20 to provide adequate carbonaceous material to drive P release. Historically, the primary effluent BOD/TP averaged about 36 (61 mg/L / 1.7 mg/L). Secondly, it was determined that simply converting the first zone of each aeration tank (first half of each first pass) into an unaerated and mixed zone would provide the proper HRT for a typical A/O process. This conversion would provide about 1.4 hours of HRT at annual average conditions and about 0.8 hours at the projected maximum month conditions. This is particularly convenient because P release typically occurs within an HRT range of about 0.5 to 2.0 hours. As such, the applicability of BPR at Racine appeared quite optimistic.

To model BPR at Racine, the zone 1 DO set point in the aeration tanks object was simply set to zero. The simulations indicated very good BPR performance for all the loading and temperature scenarios considered. The modeled effluent TP concentration was about 0.55 mg/L for all the annual average conditions and about 0.60 mg/L for the maximum month conditions. No ferric chloride addition was needed. Another major benefit that was apparent was a significant decrease in the aeration demand. Relative to the chemical phosphorus removal simulations, the aeration demand in the BPR simulations showed a 25 – 54% reduction, depending upon the loading and temperature conditions. **Attachment 4.1** illustrates these results.

While the BPR simulations showed a major reduction in operating cost parameters; e.g. elimination of ferric chloride requirements and a reduction in aeration demand, there is the potential unintended consequences, specifically associated with nuisance struvite formation. Struvite is an insoluble crystalline mineral that can form in anaerobic digesters, sludge piping, and pumps when there is an ample availability of phosphate, ammonia, and magnesium. Due to the storage and removal of phosphate in the WAS and its subsequent conveyance to anaerobic digesters, soluble orthophosphate is typically re-released during digestion making struvite formation possible. There are, however, beneficial struvite harvesting technologies available that can prevent nuisance formation, and at the same time, provide revenue-generating fertilizer production. Such technologies may be appropriate if BPR were implemented at Racine.

4.2 Solids Retention Time Sensitivity

As discussed in **Section 2.4**, nitrification requires a minimum aerobic SRT to provide time for the growth of nitrifying biomass. Model calibration and validation efforts, discussed in **Section 3.3**, identified an apparent AOB maximum specific growth rate of 0.7/d. With this finding, an aerobic SRT sensitivity analysis was carried out to identify the minimum aerobic SRT needed to fully nitrify whereby the effluent nitrogen speciation was plotted as the aerobic SRT was varied.

The aerobic SRT sensitivity analysis investigated the effluent ammonia, nitrite, and nitrate as a function of the aerobic SRT under the projected maximum month conditions and the minimum monthly wastewater temperature of 9.0°C. The effluent nitrogen results indicated that nitrification would be absent at aerobic SRTs of around 7 days or less, partial nitrification would occur between about 7 and 10 days, and full nitrification would occur over 10 days. For design purposes, a slightly greater aerobic SRT of about 12 days or more is recommended to protect against nitrifier washout.

The analysis also investigated the required MLSS concentration and secondary clarifier solids loading rate (SLR) to provide the aerobic SRT in question. **Figure 4.2** showed how the MLSS increased and **Figure 4.3** showed how the SLR increased as the aerobic SRT increased. For example, at a 12 day aerobic SRT, the MLSS and SLR were respectively predicted at about 3,800 mg/L and 42 lbs/d/ft^2 at the existing aeration tank volume and secondary clarifier surface area. These findings are significant because this MLSS and associated SLR values are beyond the capabilities of the existing secondary system components.

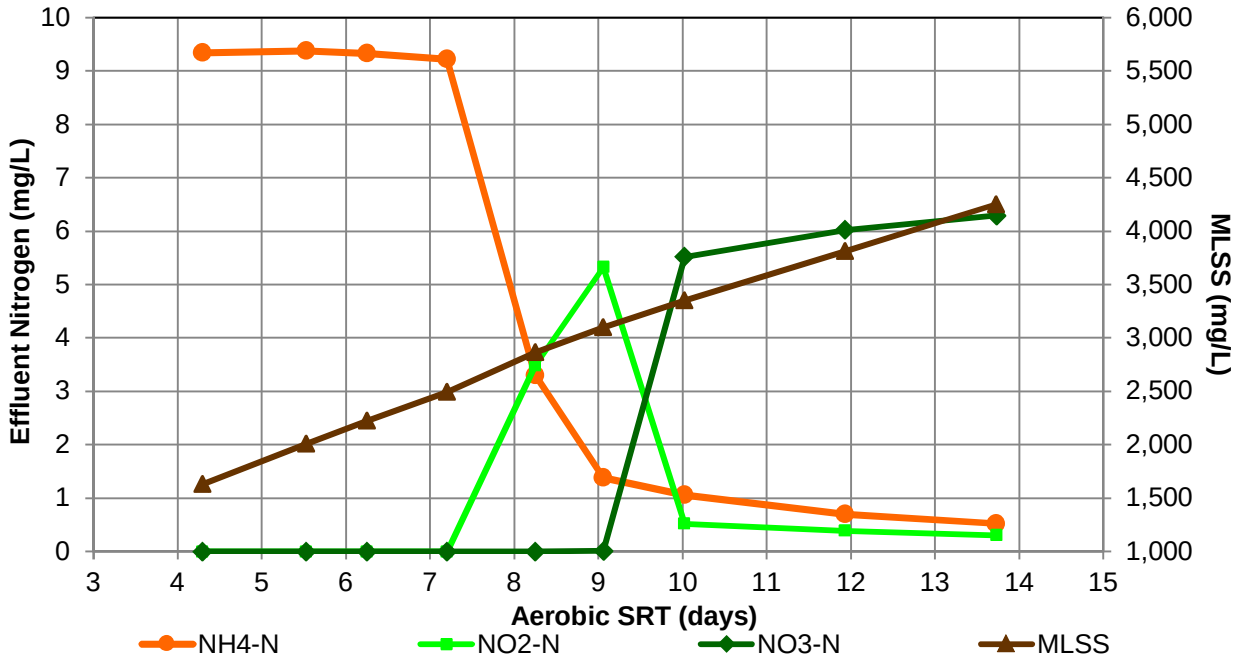


Figure 4.2. Effluent nitrogen and MLSS sensitivity of aerobic SRT at 9.0°C

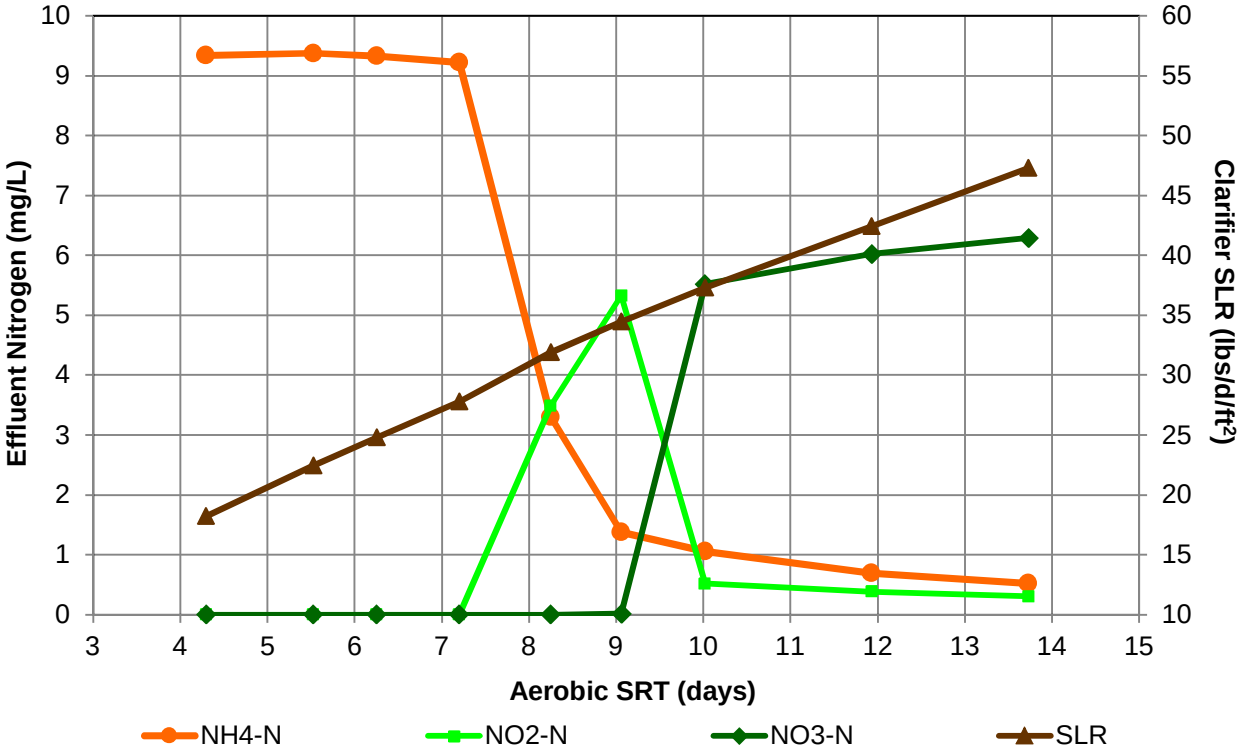


Figure 4.3. Effluent nitrogen and SLR sensitivity of aerobic SRT at 9.0°C

4.3 Nitrification and Chemical Phosphorus Removal

To protect against nitrifier washout, the aerobic SRT was maintained at about 12 days or more. Since the above SRT analysis showed excessive MLSS and SLR parameters for the projected maximum month conditions, the aeration tank volume and clarifier surface area were increased to provide a conventional MLSS concentration and to prevent the SLR from exceeding 25 lbs/d/ft^2. This resulted in a treatment plant expansion inclusive of an additional 2.36 MG of aeration tank volume (four 0.59 MG tanks) and 23,562 ft^2 of clarifier surface area (three 100 ft diameter clarifiers). The simulation results are shown in **Attachment 4.1** and a conceptual layout of the expansion has been shown in **Attachment 4.2**.

4.4 Aeration Demand

The airflow estimations for the model application scenarios assumed the same alpha factors and diffuser densities employed for the model calibration/validation efforts shown in **Table 3.2**. The apparent low fouling factor of 0.6, discussed in **Section 3.3**, however, was increased to 0.9 to reflect mostly clean/new diffusers. **Figure 4.4** illustrates the total and airflow per zone for each simulation. As expected, the chemical phosphorus removal (CPR) simulation results indicated the highest airflow during the maximum month conditions (MMC) during summer when full nitrification was in effect and the lowest airflow during annual average conditions (AAC) during winter that showed only partial nitrification. A similar trend was apparent for the biological phosphorus removal (BPR) simulations, however, a significant reduction in airflow was found due to the removal of organic loading in the unaerated zone. The CPR with nitrification (CPR + Nit) simulations showed the highest airflows.

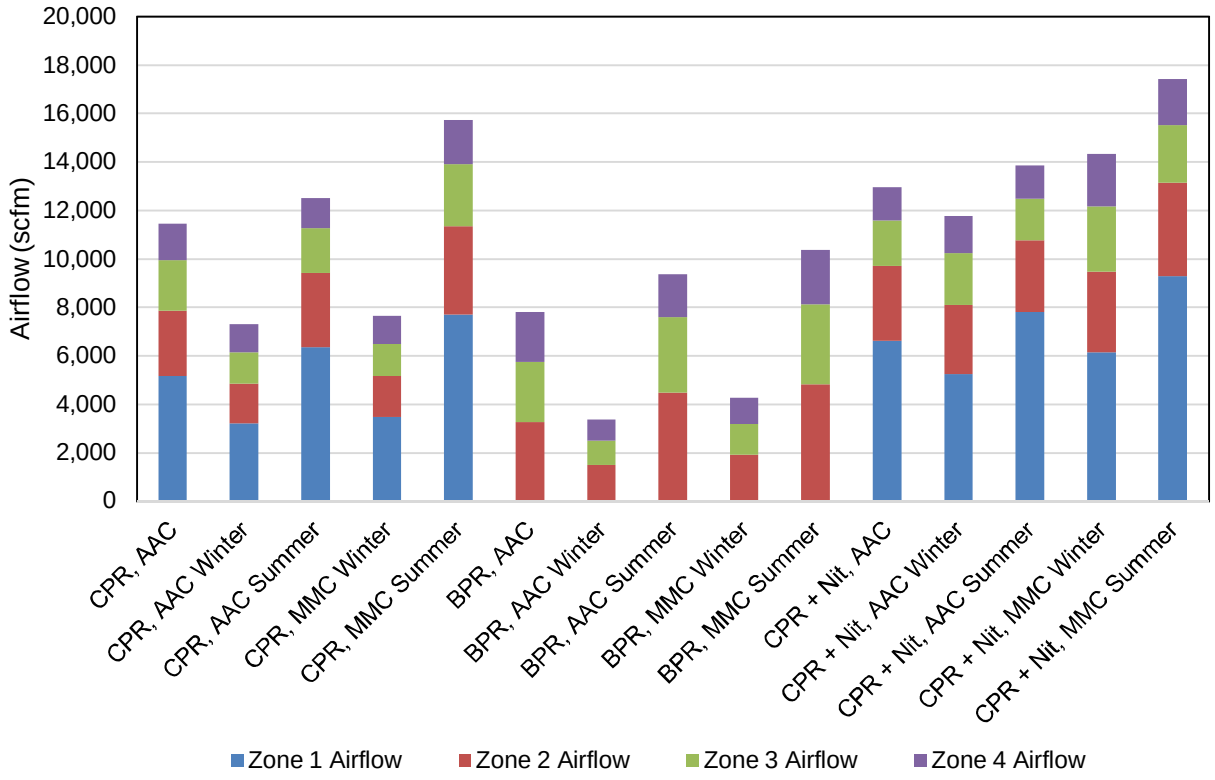


Figure 4.4. Simulated airflow requirements with new diffusers

5.0 REFERENCES

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Attachment 2.1

Quantified Mass Flow Diagrams of Long-term Average, Calibration, and Validation Datasets

PROJECT: **RACINE, WI FACILITY PLAN**
SUBJECT: **QUANTIFIED MASS-FLOW DIAGRAM OF HISTORICAL DATA**
TIME FRAME: **2016 - 2018**
COLOR CODING: **BLUE VALUES INDICATE MEASUREMENTS, RED VALUES ARE CALCULATED/ESTIMATED**

PROJECT NO. : **60554970.5.2**
DATE: **September 17, 2019**
COMPLETED BY: **KEVIN FRANK**

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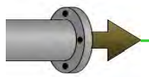
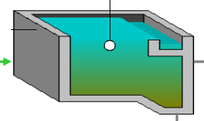
HAULED WASTE		
Q (MGD)	0.0032	
	(mg/L)	(lbs/d)
TSS	242	6.4
VSS	145	3.9
BOD	217	5.8
TKN	47	1.2
NH4-N	1.9	0.1
TP	8.7	0.2
OP	0.4	0.01

FERRIC CHLORIDE		
FLOW	(gpd)	507
Fe^{3+}	(lbs/d)	817
Fe^{3+}	(mgFe/L)	4.3
Fe/P	(mol/mol)	1.75

PRIMARY CLARIFIERS		
AREA	(ft^2)	51,315
VOLUME	(MG)	3.7
SOR	(gpd/ft^2)	442
HRT	(h)	3.9
TSS RE	(%)	72
BOD RE	(%)	52
TP RE	(%)	38





RAW WASTEWATER (Meas.)		
Q (MGD)	16.00	
	(mg/L)	(lbs/d)
TSS	106	14,105
VSS	92	12,268
BOD	108	14,402
TKN	18.9	2,520
NH4-N	11.9	1,591
TP	2.4	319
OP	1.2	160
TEMP (°C)		14.7

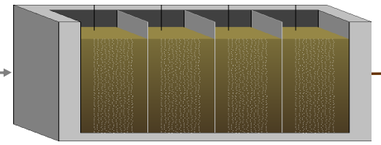
RAW WASTEWATER (Est.)		
Q (MGD)	21.95	
	(mg/L)	(lbs/d)
TSS	145	26,601
VSS	130	23,795
BOD	129	23,544
TKN	18.6	3,402
NH4-N	11.3	2,070
TP	2.1	384
OP	1.3	238

PRIMARY INFLUENT		
Q (MGD)	22.72	
	(mg/L)	(lbs/d)
TSS	146	27,638
VSS	129	24,509
BOD	125	23,775
TKN	21.6	4,085
fTKN	17.2	3,268
NH4-N	14.2	2,696
TP	2.8	523
OP	1.1	208
OP	1.9	366

PRIMARY EFFLUENT		
Q (MGD)	22.69	
	(mg/L)	(lbs/d)
TSS	41	7,777
VSS	34	6,359
BOD	61	11,519
TKN	18.5	3,492
NH4-N	15.5	2,927
TP	1.7	326
OP	0.57	108

BELT THICKENERS		
WIDTH	(m)	1.5
HLR	(gpm/m)	152
SLR	(lbs/h/m)	272
CAPTURE	(%)	95.0

BIOREACTORS		
VOLUME	(MG)	5.65
MLSS	(mg/L)	1,781
MLVSS	(mg/L)	1,418
AIRFLOW	(scfm)	
DO	(mg/L)	
SVI	(mL/g)	87
HRT	(h)	5.98
SRT	(d)	7.77



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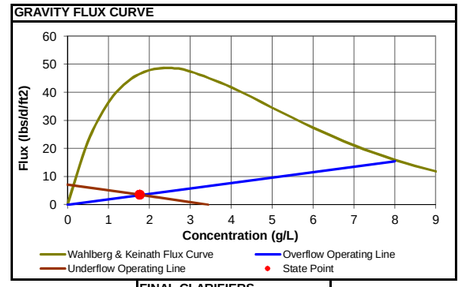
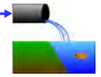
556,578



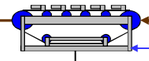
FINAL CLARIFIERS		
AREA	(ft^2)	56,487
VOLUME	(MG)	5.36
SOR	(gpd/ft^2)	389
SLR	($lbs/d/ft^2$)	12.4

RAS		
Q (MGD)	24.37	
	(mg/L)	(lbs/d)
TSS	3,562	723,940
VSS	2,823	573,806

WAS		
Q (MGD)	0.329	
	(mg/L)	(lbs/d)
TSS	3,562	9,775
VSS	2,823	7,748
Yobs (VSS/BOD)		0.74



FINAL EFFLUENT		
Q (MGD)	21.96	
	(mg/L)	(lbs/d)
TSS	5.7	1,036
VSS	4.5	825
BOD	9.7	1,779
TKN	3.6	661
xTKN	0.3	58
fTKN	3.3	604
NH4-N	2.3	420
TP	0.76	139
xTP	0.09	16.5
OP	0.63	116
fOP	0.61	111
TEMP (°C)		15.2

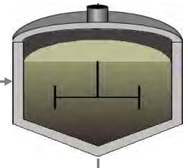


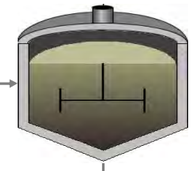
WASHWATER		
Q (MGD)	0.329	

WASHWATER		
Q (MGD)	0.072	

PRIMARY SLUDGE		
Q (MGD)	0.048	0.048
TSS	43,699	17,494
VSS	33,903	13,572
xTKN	1,356	543
fTKN	17.2	6.9
NH4-N	14.2	5.7
TP	171	68
xTP	170	68
OP	1.1	0.44

PRIMARY DIGESTERS		
VOLUME	(MG)	4.00
SRT	(d)	56
TEMP	(°C)	35
VSS DES	(%)	64.1
BIOGAS	(ft^3/d)	184,049
CH4	(%)	70
GAS/VSS	(ft^3/lb)	13.7





BFP FILTRATE		
Q (MGD)	0.136	
	(mg/L)	(lbs/d)
TSS	476	542
VSS	367	323
BOD	83	95
xBOD	73	83
fBOD	10	11
TKN	561	637
xTKN	14.3	16
fTKN	546	621
NH4-N	540	614
TP	112	128
xTP	2.9	3.3
OP	109	124

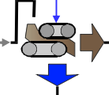
GBT FILTRATE		
Q (MGD)	0.63	
	(mg/L)	(lbs/d)
TSS	92	489
VSS	73	387
BOD	25	130
xBOD	15	77
fBOD	10	53
TKN	8.4	45
xTKN	5.1	27
fTKN	3.3	17
NH4-N	2.3	12
TP	2.1	11
xTP	1.5	7.7
OP	0.6	3.4

THICKENED WAS		
Q (MGD)	0.024	
	(mg/L)	(lbs/d)
TSS	47,338	9,286
VSS	37,521	7,360
xTKN	2,626	515
fTKN	3.3	0.6
NH4-N	2.3	0.5
TP	751	147
xTP	750	147
OP	0.6	0.12

TOTAL SLUDGE		
Q (MGD)	0.072	
	(mg/L)	(lbs/d)
TSS	44,896	26,780
VSS	35,093	20,932
xTKN	1,774	1,058
fTKN	13	7.5
NH4-N	10	6.1
TP	361	216
xTP	361	215
OP	0.9	0.6

PD SLUDGE		
Q (MGD)	0.072	
	(mg/L)	(lbs/d)
TSS	21,210	12,712
VSS	12,522	7,505
xTKN	633	379
fTKN	1,155	692
NH4-N	1,143	685
TP	360	216
xTP	129	77
OP	231	139

BFP FEED SLUDGE		
Q (MGD)	0.072	
	(mg/L)	(lbs/d)
TSS	21,078	12,633
VSS	12,557	7,526
xTKN	633	379
fTKN	1,155	692
NH4-N	1,143	685
TP	360	216
xTP	129	77
OP	231	139



DEWATERED CAKE		
Q (MGD)	0.007	
	(%)	(lbs/d)
TSS	19.5	12,091
VSS	59.6	7,203
CAPTURE	(%)	95.7

PROJECT: **RACINE, WI FACILITY PLAN**
SUBJECT: **QUANTIFIED MASS-FLOW DIAGRAM OF FEBRUARY 2018 CALIBRATION DATA**
TIME FRAME: **FEBRUARY 2018**
COLOR CODING: **BLUE VALUES INDICATE MEASUREMENTS, RED VALUES ARE CALCULATED/ESTIMATED**

PROJECT NO. : **60554970.5.2**
DATE: **September 17, 2019**
COMPLETED BY: **KEVIN FRANK**

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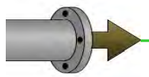
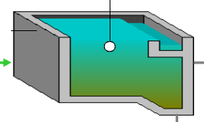
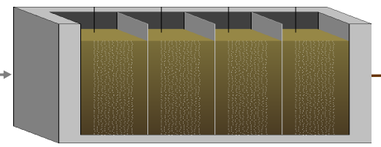
HAULED WASTE		
Q (MGD)	0.0021	
	(mg/L)	(lbs/d)
TSS	231	4.0
VSS	139	2.4
BOD	210	3.7
TKN	45	0.8
NH4-N	2.0	0.0
TP	8.4	0.1
OP	0.4	0.01

FERRIC CHLORIDE		
FLOW	(gpd)	403
Fe^{3+}	(lbs/d)	649
Fe^{3+}	(mgFe/L)	3.62
Fe/P	(mol/mol)	1.37

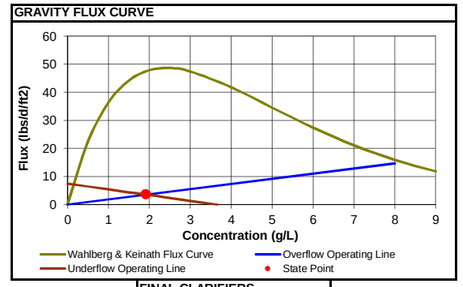
PRIMARY CLARIFIERS		
AREA	(ft^2)	51,315
VOLUME	(MG)	3.7
SOR	(gpd/ft^2)	419
HRT	(h)	4.1
TSS RE	(%)	61
BOD RE	(%)	44
TP RE	(%)	34





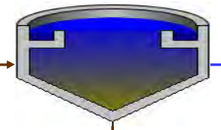


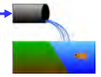
BIOREACTORS		
VOLUME	(MG)	5.65
MLSS	(mg/L)	1,930
MLVSS	(mg/L)	1,572
AIRFLOW	(scfm)	13,399
DO	(mg/L)	3.2
SVI	(mL/g)	87
HRT	(h)	6.31
SRT	(d)	7.83



FINAL CLARIFIERS		
AREA	(ft^2)	56,487
VOLUME	(MG)	5.36
SOR	(gpd/ft^2)	367
SLR	($lbs/d/ft^2$)	12.9

730,687
595,204





RAW WASTEWATER (Meas.)		
Q (MGD)	17.37	
	(mg/L)	(lbs/d)
TSS	103	14,922
VSS	90	13,107
BOD	116	16,809
TKN	20.7	3,006
NH4-N	13.3	1,921
TP	2.3	338
OP	1.2	174
TEMP (°C)		10.4

RAW WASTEWATER (Est.)		
Q (MGD)	20.75	
	(mg/L)	(lbs/d)
TSS	157	27,089
VSS	144	24,943
BOD	148	25,640
TKN	17.1	2,966
NH4-N	10.2	1,768
TP	2.2	375
OP	1.3	229

PRIMARY INFLUENT		
Q (MGD)	21.53	
	(mg/L)	(lbs/d)
TSS	157	28,168
VSS	143	25,707
BOD	144	25,854
TKN	20.6	3,699
fTKN	16.5	2,959
NH4-N	13.6	2,441
TP	2.9	527
OP	1.1	203
OP	2.1	369

PRIMARY EFFLUENT		
Q (MGD)	21.50	
	(mg/L)	(lbs/d)
TSS	61	10,990
VSS	49	8,850
BOD	81	14,566
TKN	18.1	3,243
NH4-N	15.9	2,854
TP	1.9	347
OP	0.59	106

BELT THICKENERS		
WIDTH	(m)	1.5
HLR	(gpm/m)	158
SLR	(lbs/h/m)	286
CAPTURE	(%)	95.0

RAS		
Q (MGD)	23.90	
	(mg/L)	(lbs/d)
TSS	3,626	722,817
VSS	2,932	584,384

WAS		
Q (MGD)	0.341	
	(mg/L)	(lbs/d)
TSS	3,626	10,304
VSS	2,932	8,331
Yobs (VSS/BOD)		0.65

FINAL EFFLUENT		
Q (MGD)	20.75	
	(mg/L)	(lbs/d)
TSS	7.6	1,323
VSS	6.2	1,078
BOD	13.7	2,373
TKN	5.4	940
xTKN	0.4	75
fTKN	5.0	865
NH4-N	4.0	692
TP	0.78	134
xTP	0.12	21.6
OP	0.63	110
fOP	0.54	94
TEMP (°C)		9.8

WASHWATER	
Q (MGD)	0.341

WASHWATER	
Q (MGD)	0.060

PRIMARY SLUDGE		
Q (MGD)	0.039	0.039
TSS	46,679	15,183
VSS	37,993	12,358
xTKN	1,520	494
fTKN	16.5	5.4
NH4-N	13.6	4.4
TP	191	62
xTP	190	62
OP	1.1	0.37

PRIMARY DIGESTERS		
VOLUME	(MG)	4.00
SRT	(d)	66
TEMP	(°C)	35
VSS DES	(%)	69.1
BIOGAS	(ft^3/d)	199,599
CH4	(%)	69
GAS/VSS	(ft^3/lb)	14.2

BFP FILTRATE		
Q (MGD)	0.114	
	(mg/L)	(lbs/d)
TSS	588	560
VSS	329	345
BOD	76	72
xBOD	66	63
fBOD	10	10
TKN	708	675
xTKN	18.7	18
fTKN	690	657
NH4-N	684	652
TP	147	140
xTP	3.9	3.7
OP	143	136

GBT FILTRATE		
Q (MGD)	0.660	
	(mg/L)	(lbs/d)
TSS	94	515
VSS	76	417
BOD	25	138
xBOD	15	83
fBOD	10	55
TKN	10.3	57
xTKN	5.3	29
fTKN	5.0	28
NH4-N	4.0	22
TP	2.1	12
xTP	1.5	8.3
OP	0.6	3.5

THICKENED WAS		
Q (MGD)	0.021	
	(mg/L)	(lbs/d)
TSS	55,261	9,789
VSS	44,677	7,914
xTKN	3,127	554
fTKN	5.0	0.9
NH4-N	4.0	0.7
TP	894	158
xTP	894	158
OP	0.63	0.11

TOTAL SLUDGE		
Q (MGD)	0.060	
	(mg/L)	(lbs/d)
TSS	49,705	24,972
VSS	40,350	20,272
xTKN	2,087	1,048
fTKN	12	6.2
NH4-N	10	5.1
TP	439	221
xTP	438	220
OP	1.0	0.5

PD SLUDGE		
Q (MGD)	0.060	
	(mg/L)	(lbs/d)
TSS	20,750	10,445
VSS	12,437	6,261
xTKN	643	324
fTKN	1,462	736
NH4-N	1,450	730
TP	438	221
xTP	135	68
OP	303	153

BFP FEED SLUDGE		
Q (MGD)	0.060	
	(mg/L)	(lbs/d)
TSS	22,250	11,200
VSS	13,712	6,902
xTKN	643	324
fTKN	1,462	736
NH4-N	1,450	730
TP	438	221
xTP	135	68
OP	303	153

DEWATERED CAKE		
Q (MGD)	0.006	
	(%)	(lbs/d)
TSS	19.8	10,640
VSS	61.6	6,557
CAPTURE	(%)	95.0

PROJECT: **RACINE, WI FACILITY PLAN**
SUBJECT: **QUANTIFIED MASS-FLOW DIAGRAM OF NOVEMBER-DECEMBER 2018 VALIDATION DATA**
TIME FRAME: **NOVEMBER - DECEMBER 2018**
COLOR CODING: **BLUE VALUES INDICATE MEASUREMENTS, RED VALUES ARE CALCULATED/ESTIMATED**

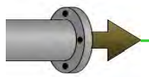
PROJECT NO. : **60554970.5.2**
DATE: **October 31, 2019**
COMPLETED BY: **KEVIN FRANK**

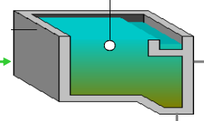
AECOM
Built to deliver a better world

HAULED WASTE		
Q (MGD)	0.0026	
	(mg/L)	(lbs/d)
TSS	191	4.2
VSS	115	2.5
BOD	182	4.0
TKN	38	0.8
NH4-N	2.1	0.0
TP	7.0	0.2
OP	0.4	0.01

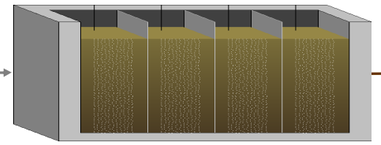
FERRIC CHLORIDE		
FLOW	(gpd)	457
Fe^{3+}	(lbs/d)	736
Fe^{3+}	(mgFe/L)	3.41
Fe/P	(mol/mol)	1.53

PRIMARY CLARIFIERS		
AREA	(ft^2)	51,315
VOLUME	(MG)	3.7
SOR	(gpd/ft^2)	504
HRT	(h)	3.4
TSS RE	(%)	70
BOD RE	(%)	50
TP RE	(%)	37



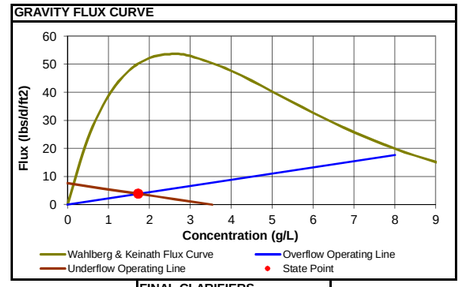


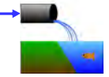
BIOREACTORS		
VOLUME	(MG)	5.65
MLSS	(mg/L)	1,742
MLVSS	(mg/L)	1,397
AIRFLOW	(scfm)	13,421
DO	(mg/L)	3.2
SVI	(mL/g)	75
HRT	(h)	5.25
SRT	(d)	7.65



740,581
593,691

FINAL CLARIFIERS		
AREA	(ft^2)	56,487
VOLUME	(MG)	5.36
SOR	(gpd/ft^2)	445
SLR	($lbs/d/ft^2$)	13.1





FINAL EFFLUENT		
Q (MGD)	25.15	
	(mg/L)	(lbs/d)
TSS	5.3	1,111
VSS	4.2	891
BOD	8.6	1,802
TKN	3.7	781
xTKN	0.3	62
fTKN	3.4	719
NH4-N	2.4	509
TP	0.71	148
xTP	0.08	17.8
OP	0.54	113
fOP	0.52	108
TEMP (°C)		14.3

RAW WASTEWATER (Meas.)		
Q (MGD)	24.91	
	(mg/L)	(lbs/d)
TSS	81	16,859
VSS	73	15,259
BOD	89	18,391
TKN	18.0	3,735
NH4-N	12.0	2,501
TP	1.9	397
OP	1.0	204
TEMP (°C)		14.5

RAW WASTEWATER (Est.)		
Q (MGD)	25.15	
	(mg/L)	(lbs/d)
TSS	115	24,221
VSS	108	22,616
BOD	113	23,747
TKN	17.2	3,607
NH4-N	10.6	2,225
TP	2.0	409
OP	1.2	259

PRIMARY INFLUENT		
Q (MGD)	25.90	
	(mg/L)	(lbs/d)
TSS	117	25,354
VSS	108	23,374
BOD	111	23,985
TKN	19.6	4,236
fTKN	15.7	3,388
NH4-N	12.9	2,795
TP	2.5	540
OP	1.0	217
OP	1.8	378

PRIMARY EFFLUENT		
Q (MGD)	25.86	
	(mg/L)	(lbs/d)
TSS	35	7,579
VSS	30	6,389
BOD	55	11,878
TKN	16.9	3,636
NH4-N	14.4	3,104
TP	1.6	342
OP	0.52	112

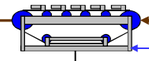
BELT THICKENERS		
WIDTH	(m)	1.5
HLR	(gpm/m)	147
SLR	(lbs/h/m)	267
CAPTURE	(%)	95.0

RAS		
Q (MGD)	25.11	
	(mg/L)	(lbs/d)
TSS	3,639	762,060
VSS	2,922	611,860

WAS		
Q (MGD)	0.317	
	(mg/L)	(lbs/d)
TSS	3,639	9,628
VSS	2,922	7,730
Yobs (VSS/BOD)		0.73

WASHWATER	
Q (MGD)	0.317

WASHWATER	
Q (MGD)	0.071



PRIMARY SLUDGE		
Q (MGD)	0.043	0.049
TSS	41,889	15,022
VSS	33,046	11,851
xTKN	1,322	474
fTKN	15.7	5.6
NH4-N	12.9	4.6
TP	166	60
xTP	165	59
OP	1.0	0.36

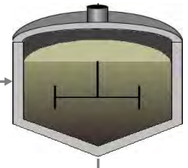
PRIMARY DIGESTERS		
VOLUME	(MG)	4.00
SRT	(d)	56
TEMP	(°C)	35
VSS DES	(%)	61.8
BIOGAS	(ft^3/d)	174,148
CH4	(%)	69
GAS/VSS	(ft^3/lb)	14.7

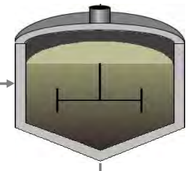
BFP FILTRATE		
Q (MGD)	0.135	
	(mg/L)	(lbs/d)
TSS	575	647
VSS	415	369
BOD	93	105
xBOD	83	94
fBOD	10	11
TKN	518	583
xTKN	16.9	19
fTKN	501	564
NH4-N	496	558
TP	106	120
xTP	3.5	4.0
OP	103	116

GBT FILTRATE		
Q (MGD)	0.612	
	(mg/L)	(lbs/d)
TSS	94	481
VSS	76	387
BOD	25	128
xBOD	15	77
fBOD	10	51
TKN	8.7	45
xTKN	5.3	27
fTKN	3.4	18
NH4-N	2.4	12
TP	2.1	10
xTP	1.5	7.7
OP	0.5	2.8

THICKENED WAS		
Q (MGD)	0.022	
	(mg/L)	(lbs/d)
TSS	49,981	9,146
VSS	40,130	7,344
xTKN	2,809	514
fTKN	3.4	0.6
NH4-N	2.4	0.4
TP	803	147
xTP	803	147
OP	0.54	0.10

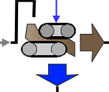
TOTAL SLUDGE		
Q (MGD)	0.065	
	(mg/L)	(lbs/d)
TSS	44,623	24,169
VSS	35,439	19,194
xTKN	1,824	988
fTKN	12	6.3
NH4-N	9	5.1
TP	381	207
xTP	381	206
OP	0.8	0.5





PD SLUDGE		
Q (MGD)	0.071	
	(mg/L)	(lbs/d)
TSS	21,365	12,616
VSS	12,418	7,333
xTKN	639	377
fTKN	1,054	623
NH4-N	1,043	616
TP	350	207
xTP	133	79
OP	216	128

BFP FEED SLUDGE		
Q (MGD)	0.071	
	(mg/L)	(lbs/d)
TSS	20,448	12,075
VSS	11,663	6,887
xTKN	639	377
fTKN	1,054	623
NH4-N	1,043	616
TP	350	207
xTP	133	79
OP	216	128



DEWATERED CAKE		
Q (MGD)	0.007	
	(%)	(lbs/d)
TSS	20.7	11,428
VSS	57.0	6,518
CAPTURE	(%)	94.6

AECOM

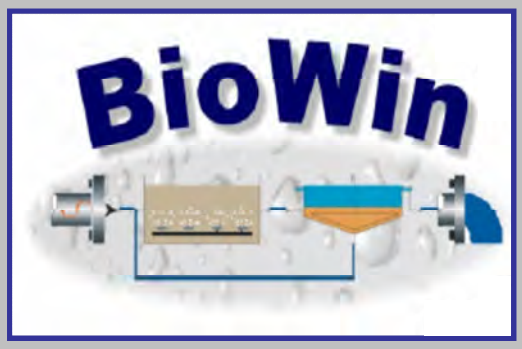
Attachment 3.1

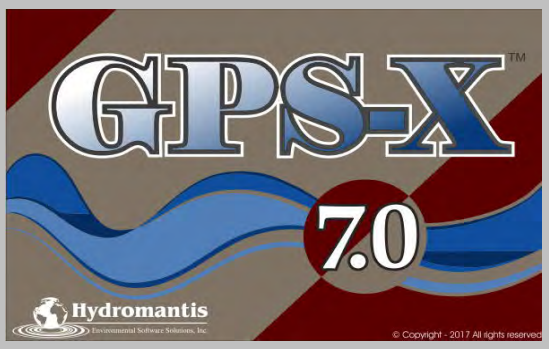
Influent Characterization Breakdowns

INFLUENT CHARACTERIZER VERSION 7.3

CLIENT NAME: *Racine Wastewater Utility*
PROJECT NAME: *Racine WWTP Facility Plan*
JOB NUMBER: *60554970.5.2*
ENGINEER: *K.Frank*
WWTP STREAM: *Raw Wastewater*

FOR USE WITH





AECOM

DIRECTIONS FOR USE:

(1) Fill out the steady-state measurements worksheet with average sampling data
(2) Adjust blue-fonted parameters in the influent characterization diagram worksheets until computed variables match actual measurements
(3) Composite variables, state variables, and stoichiometric fractions are summarized in the variable summery worksheet

Developed by Kevin Frank, Annapolis Junction, MD office, USA

MEASURED RAW WASTEWATER CHARACTERISTICS

CLIENT NAME: *Racine Wastewater Utility*
PROJECT NAME: *Racine WWTP Facility Plan*
JOB NUMBER: *60554970.5.2*
ENGINEER: *K.Frank*
WWTP STREAM: *Raw Wastewater (February 2018)*

Enter available data in the "values" column. Leave unknown variables blank.

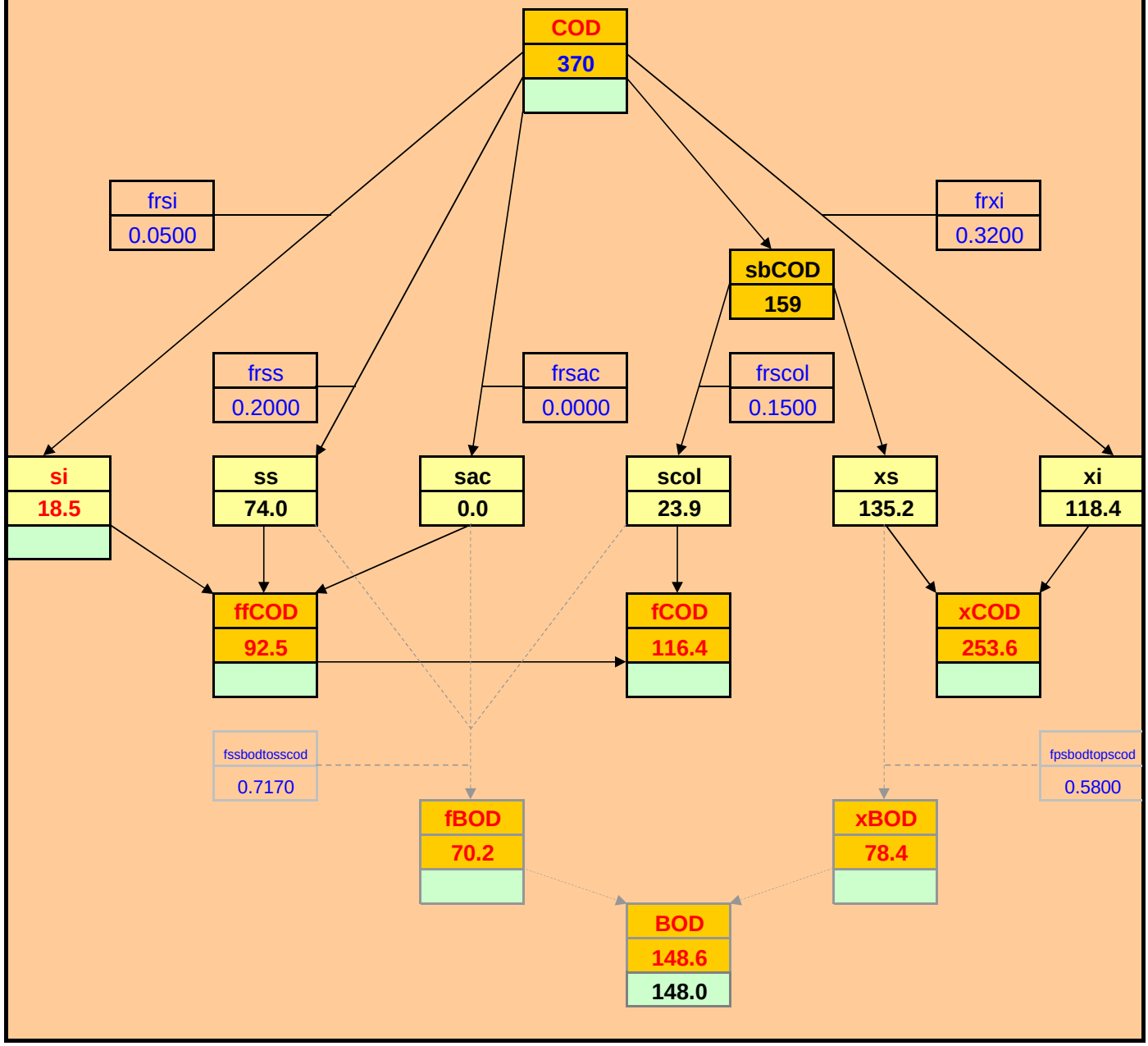
Symbol	Description	Value	BioWin Default	GPS-X Default
COD	Chemical Oxygen Demand		500	430
ffCOD	Flocculated & Filtered COD		105	108
fCOD	Filtered COD		188	148
Effluent fCOD	Effluent Filtered COD		25.0	21.5
BOD	Biochemical Oxygen Demand (5-day)	148	246	250
fBOD	Filtered BOD		115	90
TSS	Total Suspended Solids	157	240	225
VSS	Volatile Suspended Solids	144	195	168
TKN	Total Kjeldahl Nitrogen	17.1	40.0	40.0
fTKN	Filtered TKN		32.5	27.8
NH4-N	Ammonia	10.2	26.4	25.0
TP	Total Phosphorus	2.2	10.0	10.0
sTP	Soluble Total Phosphorus		5.0	8.2
OP	Orthophosphate	0.7	5.0	8.0

GPS-X MANTIS2 BIOLOGICAL MODEL INFLUENT CHARACTERIZATION DIAGRAMS

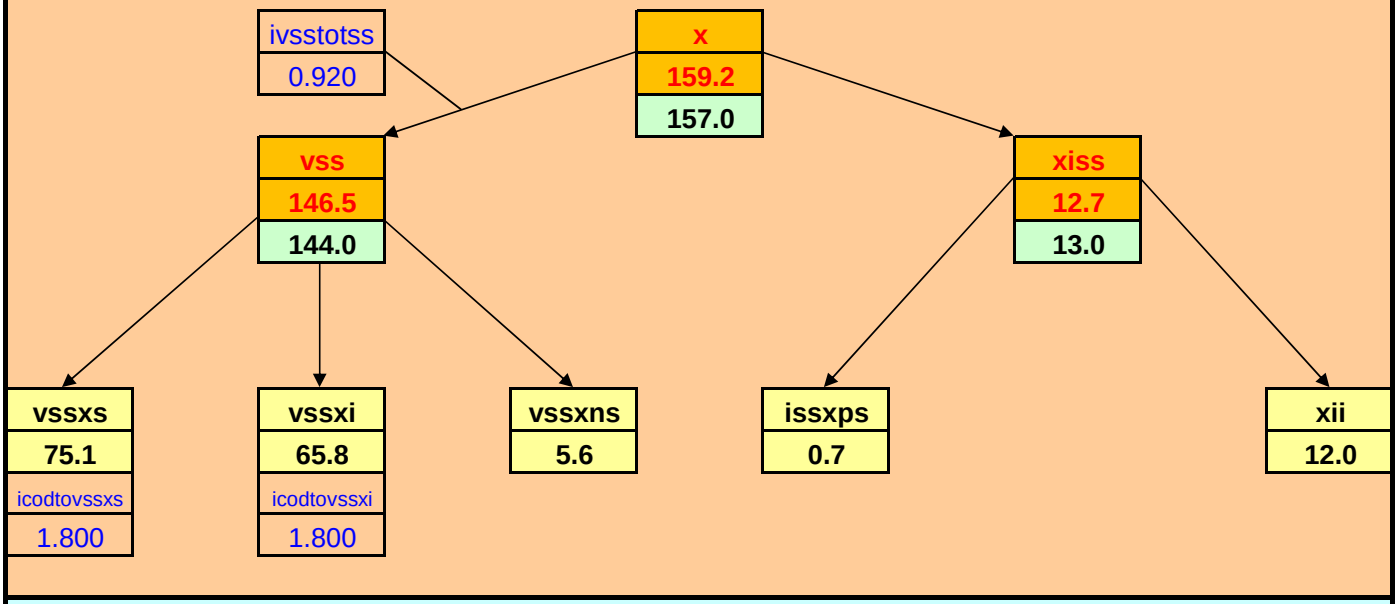
CLIENT NAME:	*Racine Wastewater Utility*
PROJECT NAME:	*Racine WWTP Facility Plan*
JOB NUMBER:	*60554970.5.2*
ENGINEER:	*K.Frank*
WWTP STREAM:	*Raw Wastewater (February 2018)*

Change blue-fonted values until computed variables match actual measurements

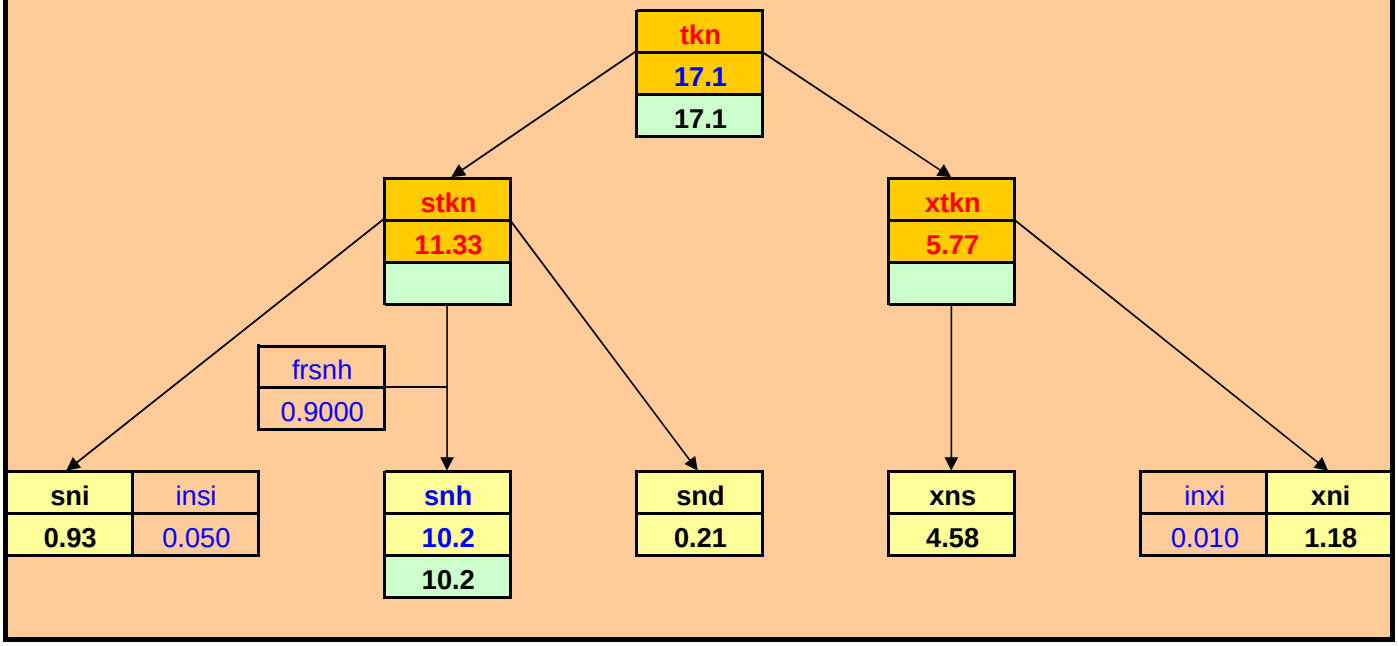
CARBONACEOUS BREAKDOWN

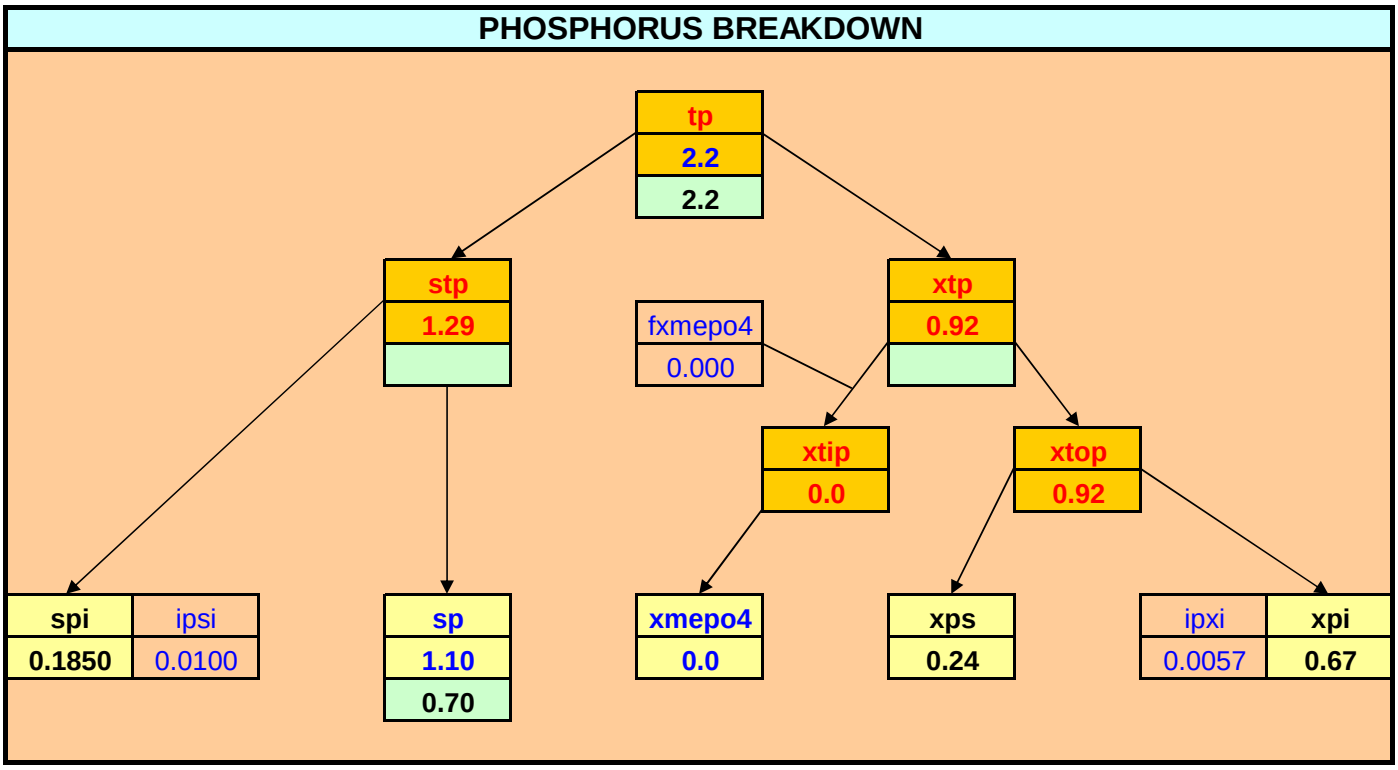


SOLIDS BREAKDOWN



NITROGEN BREAKDOWN




PHOSPHORUS BREAKDOWN
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2.2
stp
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xtp
0.92
xtip
0.0
xtop
0.92
spi
ipsi
0.1850
0.0100
sp
1.10
0.70
xmepo4
0.0
xps
0.24
ipxi
xpi
0.0057
0.67

DYNAMIC GPS-X VARIABLES

CLIENT NAME: *Racine Wastewater Utility*
PROJECT NAME: *Racine WWTP Facility Plan*
JOB NUMBER: *60554970.5.2*
ENGINEER: *K.Frank*
WWTP STREAM: *Raw Wastewater (February 2018)*

Library: Comprehensive
Influent Model: codstates
Biological Model: Mantis2

SAMPLING PROGRAM BASE DATA

t	cod	tkn	snh	tp	sp
SS	370	17.1	10.2	2.2	1.1
0	342	15.8	9.6	3.5	1.8
1	462	21.4	13.0	2.2	1.1
2	388	18.0	10.9	2.0	1.0
3	513	23.8	14.5	2.4	1.2
4	531	24.9	15.1	2.7	1.4
5	421	19.5	11.9	3.0	1.5
6	518	24.0	14.6	2.8	1.4
7	679	31.4	19.1	3.2	1.6
8	362	16.8	10.2	2.5	1.3
9	401	18.6	11.3	3.1	1.6
10	447	20.7	12.6	3.1	1.6
11	521	26.0	15.8	3.0	1.5
12	475	22.0	13.4	2.8	1.4
13	480	22.2	13.5	3.1	1.6
14	411	19.0	11.6	2.1	1.1
15	352	16.3	9.9	2.0	1.0
16	421	19.5	11.9	2.5	1.3
17	419	19.4	11.8	2.5	1.3
18	539	20.5	12.5	3.4	1.7
19	434	20.1	12.2	2.5	1.3
20	273	12.6	7.7	2.0	1.0
21	220	10.2	6.2	1.5	0.7
22	268	12.4	7.6	1.8	0.9
23	225	10.4	6.3	2.8	1.4
24	174	8.0	4.9	1.9	1.0
25	253	13.5	8.2	1.9	1.0
26	250	11.6	7.0	2.0	1.0
27	260	12.1	7.3	2.1	1.0

STEADY STATE STOICH

Fraction	SS Cal	Default
frsi	0.05	0.050
frss	0.200	0.200
frsac	0.000	0.000
frscol	0.15	0.150
frxi	0.32	0.130
fssbodtosscod	0.717	0.717
fpsbodtopscod	0.580	0.703
ivsstotss	0.920	0.750
icodtovssxs	1.800	1.800
icodtovssxi	1.800	1.800
frsnh	0.9	0.900
insi	0.05	0.050
inxi	0.010	0.050
ipsi	0.010	0.010
ipxi	0.0057	0.010
fxmepo4	0.000	0.000

BOD	BOD/TKN	BOD/NH4	NH4/TKN	sp/TP
137			0.61	
186			0.61	
156			0.61	
206			0.61	
213	8.57	14.1	0.61	0.45
169			0.61	
208			0.61	0.44
273			0.61	
146			0.61	
161			0.61	
179			0.61	
209	8.05	13.2	0.61	0.36
191			0.61	
193			0.61	0.41
165			0.61	
141			0.61	
169			0.61	
168			0.61	
216	10.56	17.4	0.61	0.31
174			0.61	
110			0.61	0.35
88			0.61	
108			0.61	
90			0.61	
70			0.61	
101	7.50	12.3	0.61	0.50
100			0.61	
105			0.61	0.50
AVE	**8.67**	**14.25**	**0.61**	**0.42**

COMPOSITE VARIABLES

t	cod	fcod	ffcod	xcod	sbcod	fbod	xbod	bodu	fbodu	xbodu	x	vss	xiss	tkn	stkn	xtkn	tp	stp	xtp	xtip	xtop
SS	370	116	93	254	159	70	78	233	98	135	159	146	12.7	17.1	11.3	5.8	2.2	1.3	0.9	0.0	0.9
0	342	108	86	234	147	65	73	215	90	125	147	135	11.8	15.8	10.7	5.1	3.5	1.9	1.6	0.0	1.6
1	462	145	116	317	199	88	98	291	122	169	198	183	15.9	21.4	14.5	6.9	2.2	1.3	0.9	0.0	0.9
2	388	122	97	266	167	74	82	244	103	142	167	153	13.3	18.0	12.1	5.8	2.0	1.2	0.8	0.0	0.8
3	513	161	128	352	221	97	109	323	136	188	220	203	17.6	23.8	16.1	7.7	2.4	1.5	0.9	0.0	0.9
4	531	167	133	364	228	101	113	334	140	194	228	210	18.3	24.9	16.8	8.1	2.7	1.6	1.1	0.0	1.1
5	421	132	105	289	181	80	89	265	111	154	181	166	14.5	19.5	13.2	6.3	3.0	1.7	1.3	0.0	1.3
6	518	163	130	355	223	98	110	326	137	189	223	205	17.8	24.0	16.2	7.8	2.8	1.7	1.2	0.0	1.2
7	679	214	170	465	292	129	144	428	180	248	292	268	23.3	31.4	21.3	10.2	3.2	1.9	1.3	0.0	1.3
8	362	114	91	248	156	69	77	228	96	132	156	143	12.5	16.8	11.3	5.4	2.5	1.5	1.1	0.0	1.1
9	401	126	100	275	172	76	85	252	106	146	172	158	13.8	18.6	12.5	6.0	3.1	1.8	1.4	0.0	1.4
10	447	140	112	306	192	85	95	281	118	163	192	177	15.3	20.7	14.0	6.7	3.1	1.8	1.3	0.0	1.3
11	521	164	130	357	224	99	110	328	138	190	224	207	18.0	26.0	17.6	8.4	3.0	1.8	1.2	0.0	1.2
12	475	149	119	325	204	90	101	299	126	174	204	188	16.3	22.0	14.9	7.1	2.8	1.6	1.2	0.0	1.2
13	480	151	120	329	206	91	102	302	127	175	206	190	16.5	22.2	15.0	7.2	3.1	1.8	1.3	0.0	1.3
14	411	129	103	282	177	78	87	259	109	150	177	162	14.1	19.0	12.9	6.2	2.1	1.3	0.8	0.0	0.8
15	352	111	88	241	151	67	75	222	93	129	151	139	12.1	16.3	11.0	5.3	2.0	1.2	0.8	0.0	0.8
16	421	132	105	289	181	80	89	265	111	154	181	166	14.5	19.5	13.2	6.3	2.5	1.5	1.0	0.0	1.0
17	419	132	105	287	180	79	89	264	111	153	180	165	14.4	19.4	13.1	6.3	2.5	1.5	1.0	0.0	1.0
18	539	169	135	369	232	102	114	339	142	197	229	211	18.4	20.5	13.8	6.6	3.4	2.0	1.4	0.0	1.4
19	434	136	108	297	187	82	92	273	115	159	186	171	14.9	20.1	13.6	6.5	2.5	1.5	1.0	0.0	1.0
20	273	86	68	187	117	52	58	172	72	100	117	108	9.4	12.6	8.6	4.1	2.0	1.1	0.9	0.0	0.9
21	220	69	55	150	94	42	47	138	58	80	94	87	7.5	10.2	6.9	3.3	1.5	0.8	0.6	0.0	0.6
22	268	84	67	184	115	51	57	169	71	98	115	106	9.2	12.4	8.4	4.0	1.8	1.0	0.8	0.0	0.8
23	225	71	56	154	97	43	48	142	59	82	96	89	7.7	10.4	7.0	3.4	2.8	1.5	1.3	0.0	1.3
24	174	55	43	119	75	33	37	109	46	63	75	69	6.0	8.0	5.4	2.6	1.9	1.0	0.9	0.0	0.9
25	253	79	63	173	109	48	54	159	67	92	109	101	8.7	13.5	9.1	4.4	1.9	1.1	0.8	0.0	0.8
26	250	79	63	171	108	47	53	158	66	91	107	99	8.6	11.6	7.8	3.8	2.0	1.1	0.9	0.0	0.9
27	260	82	65	178	112	49	55	164	69	95	112	103	8.9	12.1	8.2	3.9	2.1	1.2	0.9	0.0	0.9
0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

STATE VARIABLES

t	si	ss	sac	scol	xs	xi	vssxs	vssxi	vssxns	issxps	xii	sni	snh	snd	xns	xni	spi	sp	xmepo4	xps	xpi
SS	19	74	0.0	24	135	118	75	65.8	5.6	0.7	12.0	0.93	10.2	0.21	4.6	1.18	0.19	1.1	0.00	0.2	0.7
0	17	68	0.0	22	125	109	69	60.8	4.9	3.0	8.8	0.86	9.6	0.22	4.0	1.09	0.17	1.8	0.00	1.0	0.6
1	23	92	0.0	30	169	148	94	82.1	6.6	0.1	15.8	1.16	13.0	0.29	5.5	1.48	0.23	1.1	0.00	0.0	0.8
2	19	78	0.0	25	142	124	79	69.0	5.6	0.3	13.0	0.97	10.9	0.24	4.6	1.24	0.19	1.0	0.00	0.1	0.7
3	26	103	0.0	33	188	164	104	91.2	7.4	0.0	17.6	1.28	14.5	0.32	6.1	1.64	0.26	1.2	0.00	0.0	0.9
4	27	106	0.0	34	194	170	108	94.4	7.7	0.4	17.9	1.33	15.1	0.35	6.4	1.70	0.27	1.4	0.00	0.1	1.0
5	21	84	0.0	27	154	135	86	74.9	6.0	1.6	12.8	1.05	11.9	0.27	5.0	1.35	0.21	1.5	0.00	0.5	0.8
6	26	104	0.0	33	189	166	105	92.1	7.4	0.6	17.2	1.30	14.6	0.33	6.1	1.66	0.26	1.4	0.00	0.2	0.9
7	34	136	0.0	44	248	217	138	120.7	9.7	0.1	23.3	1.70	19.1	0.43	8.0	2.17	0.34	1.6	0.00	0.0	1.2
8	18	72	0.0	23	132	116	74	64.4	5.2	1.3	11.1	0.91	10.2	0.23	4.3	1.16	0.18	1.3	0.00	0.4	0.7
9	20	80	0.0	26	146	128	81	71.2	5.7	1.9	11.8	1.00	11.3	0.25	4.7	1.28	0.20	1.6	0.00	0.6	0.7
10	22	89	0.0	29	163	143	91	79.4	6.4	1.6	13.8	1.12	12.6	0.28	5.3	1.43	0.22	1.6	0.00	0.5	0.8
11	26	104	0.0	34	190	167	106	92.6	8.2	0.9	17.1	1.30	15.8	0.45	6.7	1.67	0.26	1.5	0.00	0.3	0.9
12	24	95	0.0	31	174	152	96	84.4	6.8	0.9	15.4	1.19	13.4	0.30	5.6	1.52	0.24	1.4	0.00	0.3	0.9
13	24	96	0.0	31	175	154	97	85.3	6.9	1.3	15.2	1.20	13.5	0.30	5.7	1.54	0.24	1.6	0.00	0.4	0.9
14	21	82	0.0	27	150	132	83	73.1	5.9	0.3	13.8	1.03	11.6	0.26	4.9	1.32	0.21	1.1	0.00	0.1	0.7
15	18	70	0.0	23	129	113	72	62.6	5.0	0.5	11.6	0.88	9.9	0.22	4.2	1.13	0.18	1.0	0.00	0.2	0.6
16	21	84	0.0	27	154	135	86	74.9	6.0	0.8	13.6	1.05	11.9	0.27	5.0	1.35	0.21	1.3	0.00	0.3	0.8
17	21	84	0.0	27	153	134	85	74.4	6.0	0.8	13.5	1.05	11.8	0.26	4.9	1.34	0.21	1.3	0.00	0.3	0.8
18	27	108	0.0	35	197	172	109	95.7	6.0	1.4	17.0	1.35	12.5	0.04	4.9	1.72	0.27	1.7	0.00	0.4	1.0
19	22	87	0.0	28	159	139	88	77.1	6.2	0.7	14.2	1.08	12.2	0.27	5.1	1.39	0.22	1.3	0.00	0.2	0.8
20	14	55	0.0	18	100	87	55	48.6	3.9	1.1	8.3	0.68	7.7	0.17	3.2	0.87	0.14	1.0	0.00	0.4	0.5
21	11	44	0.0	14	80	70	45	39.0	3.1	0.7	6.8	0.55	6.2	0.14	2.6	0.70	0.11	0.7	0.00	0.2	0.4
22	13	54	0.0	17	98	86	54	47.6	3.8	0.8	8.4	0.67	7.6	0.17	3.2	0.86	0.13	0.9	0.00	0.3	0.5
23	11	45	0.0	14	82	72	46	39.9	3.2	2.7	5.0	0.56	6.3	0.14	2.7	0.72	0.11	1.4	0.00	0.9	0.4
24	9	35	0.0	11	63	56	35	30.9	2.5	1.7	4.3	0.43	4.9	0.11	2.0	0.56	0.09	1.0	0.00	0.6	0.3
25	13	51	0.0	16	92	81	51	44.9	4.3	1.2	7.6	0.63	8.2	0.28	3.6	0.81	0.13	1.0	0.00	0.4	0.5
26	13	50	0.0	16	91	80	51	44.5	3.6	1.3	7.3	0.63	7.0	0.16	3.0	0.80	0.13	1.0	0.00	0.4	0.5
27	13	52	0.0	17	95	83	53	46.3	3.7	1.3	7.6	0.65	7.3	0.16	3.1	0.83	0.13	1.0	0.00	0.4	0.5
0	0	0	0.0	0	0	0	0	0.0	0.0	0.0	0.0	0.00	0.0	0.00	0.0	0.00	0.00	0.0	0.00	0.0	0.0
0	0	0	0.0	0	0	0	0	0.0	0.0	0.0	0.0	0.00	0.0	0.00	0.0	0.00	0.00	0.0	0.00	0.0	0.0
0	0	0	0.0	0	0	0	0	0.0	0.0	0.0	0.0	0.00	0.0	0.00	0.0	0.00	0.00	0.0	0.00	0.0	0.0

DYNAMIC GPS-X VARIABLES

CLIENT NAME: *Racine Wastewater Utility*
PROJECT NAME: *Racine WWTP Facility Plan*
JOB NUMBER: *60554970.5.2*
ENGINEER: *K.Frank*
WWTP STREAM: *Raw Wastewater (Nov Dec 2018)*

Library: ***Comprehensive***
Influent Model: ***codstates***
Biological Model: ***Mantis2***

SAMPLING PROGRAM BASE DATA

t	cod	tkn	snh	tp	sp
SS	370	17.1	10.2	2.2	1.1
0	260	14.4	8.7	1.7	0.9
1	283	15.6	9.5	2.0	1.0
2	271	14.9	9.1	2.6	1.3
3	242	13.4	8.1	2.2	1.1
4	324	13.2	8.0	1.7	0.9
5	317	17.4	10.6	2.0	1.0
6	176	9.7	5.9	2.0	1.0
7	209	11.5	7.0	2.5	1.2
8	194	10.7	6.5	1.9	0.9
9	235	12.9	7.9	1.5	0.8
10	288	15.9	9.7	1.7	0.8
11	278	15.7	9.6	2.0	1.0
12	258	14.2	8.6	1.9	1.0
13	332	18.3	11.1	2.2	1.1
14	199	11.0	6.7	1.7	0.9
15	278	15.3	9.3	2.0	1.0
16	322	17.7	10.8	2.2	1.1
17	176	9.7	5.9	1.7	0.8
18	317	23.8	14.5	2.1	1.1
19	248	13.6	8.3	2.3	1.1
20	337	18.6	11.3	2.8	1.4
21	368	20.3	12.4	3.0	1.5
22	398	22.0	13.4	2.3	1.2
23	265	14.6	8.9	1.9	1.0
24	250	13.8	8.4	1.9	1.0
25	314	17.9	10.9	1.9	1.0
26	245	13.5	8.2	1.9	1.0
27	362	20.0	12.2	2.4	1.2
28	283	15.6	9.5	2.0	1.0
29	339	18.7	11.4	2.2	1.1
30	278	15.3	9.3	2.0	1.0
31	112	6.2	3.8	0.8	0.4
32	112	8.0	4.9	0.8	0.4
33	112	6.2	3.8	1.2	0.6
34	408	22.5	13.7	2.2	1.1
35	383	21.1	12.8	2.6	1.3
36	260	14.4	8.7	1.4	0.7

STEADY STATE STOICH

Fraction	SS Cal	Default
frsi	0.05	0.050
frss	0.200	0.200
frsac	0.000	0.000
frscol	0.15	0.150
frxi	0.32	0.130
fssbodtosscod	0.717	0.717
fpsbodtopscod	0.580	0.703
ivsstotss	0.920	0.750
icodtovssxs	1.800	1.800
icodtovssxi	1.800	1.800
frsnh	0.9	0.900
insi	0.05	0.050
inxi	0.010	0.050
ipsi	0.010	0.010
ipxi	0.0057	0.010
fxmepo4	0.000	0.000

BOD	BOD/TKN	BOD/NH4	NH4/TKN	sp/TP
105				
114				
109				
97				
130	9.89	16.3	0.61	0.50
127				
71				
84				
78				
94				
116				
112	7.11	11.7	0.61	0.50
104				
133				0.50
80				
112				
129				
71				
127	5.35	8.8	0.61	0.50
99				0.50
135				
148				
160				
107				
100				
126	7.04	11.6	0.61	0.50
98				
146				
114				0.50
136				
112				
45				
45	5.61	9.2	0.61	0.50
45				
164				0.50
154				
105				

37	263	14.5	8.8	1.6	0.8	106				
38	263	14.5	8.8	1.7	0.8	106				
39	327	19.8	12.0	1.8	0.9	131	6.64	10.9	0.61	0.50
40	309	17.0	10.4	2.0	1.0	124				
41	286	15.8	9.6	2.1	1.0	115				0.50
42	306	16.9	10.3	2.1	1.0	123				
43	319	17.6	10.7	3.6	1.8	128				
44	276	15.2	9.2	2.0	1.0	111				
45	260	14.4	8.7	1.7	0.8	105				
46	357	24.1	14.7	2.0	1.0	144	5.95	9.8	0.61	0.50
47	403	22.2	13.5	2.7	1.3	162				
48	385	21.2	12.9	3.0	1.5	155				
49	380	21.0	12.8	2.9	1.4	153				0.50
50	360	19.8	12.1	2.5	1.3	145				
51	403	22.2	13.5	2.5	1.3	162				
52	350	19.3	11.7	2.4	1.2	140				
53	375	19.4	11.8	2.4	1.2	151	7.77	12.8	0.61	
54	350	19.3	11.7	2.3	1.2	140				
55	454	25.0	15.2	3.2	1.6	182				0.50
56	212	11.7	7.1	1.9	1.0	85				
57	260	14.4	8.7	2.1	1.1	105				
58	245	13.5	8.2	1.9	0.9	98				
59	179	9.8	6.0	1.6	0.8	72				
60	345	13.5	8.2	1.8	0.9	138	10.23	16.8	0.61	
						AVE	**7.29**	**11.98**	**0.61**	**0.50**

COMPOSITE VARIABLES

t	cod	fcod	ffcod	xcod	sbcod	fbod	xbod	bodu	fbodu	xbodu	x	vss	xiss	tkn	stkn	xtkn	tp	stp	xtp	xtip	xtop
SS	370	116	93	254	159	70	78	233	98	135	159	146	12.7	17.1	11.3	5.8	2.2	1.3	0.9	0.0	0.9
0	260	82	65	178	112	49	55	164	69	95	113	104	9.0	14.4	9.7	4.7	1.7	1.0	0.7	0.0	0.7
1	283	89	71	194	122	54	60	179	75	104	123	113	9.8	15.6	10.6	5.1	2.0	1.2	0.9	0.0	0.9
2	271	85	68	185	116	51	57	170	72	99	117	108	9.4	14.9	10.1	4.8	2.6	1.4	1.2	0.0	1.2
3	242	76	61	166	104	46	51	153	64	89	105	97	8.4	13.4	9.0	4.3	2.2	1.2	1.0	0.0	1.0
4	324	102	81	222	139	61	69	204	86	118	138	127	11.1	13.2	8.9	4.3	1.7	1.0	0.7	0.0	0.7
5	317	100	79	217	136	60	67	199	84	116	137	126	11.0	17.4	11.8	5.7	2.0	1.2	0.8	0.0	0.8
6	176	55	44	121	76	33	37	111	47	64	76	70	6.1	9.7	6.6	3.1	2.0	1.1	0.9	0.0	0.9
7	209	66	52	143	90	40	44	132	55	77	91	83	7.3	11.5	7.8	3.7	2.5	1.3	1.1	0.0	1.1
8	194	61	48	133	83	37	41	122	51	71	84	77	6.7	10.7	7.2	3.5	1.9	1.0	0.8	0.0	0.8
9	235	74	59	161	101	45	50	148	62	86	102	94	8.1	12.9	8.8	4.2	1.5	0.9	0.7	0.0	0.7
10	288	91	72	198	124	55	61	182	76	105	125	115	10.0	15.9	10.7	5.2	1.7	1.0	0.7	0.0	0.7
11	278	88	70	191	120	53	59	175	74	102	121	111	9.7	15.7	10.6	5.1	2.0	1.1	0.8	0.0	0.8
12	258	81	64	177	111	49	55	162	68	94	112	103	8.9	14.2	9.6	4.6	1.9	1.1	0.8	0.0	0.8
13	332	104	83	227	143	63	70	209	88	121	144	132	11.5	18.3	12.4	5.9	2.2	1.3	0.9	0.0	0.9
14	199	63	50	136	86	38	42	125	53	73	86	79	6.9	11.0	7.4	3.6	1.7	1.0	0.8	0.0	0.8
15	278	88	70	191	120	53	59	175	74	102	121	111	9.6	15.3	10.4	5.0	2.0	1.1	0.9	0.0	0.9
16	322	101	80	220	138	61	68	203	85	118	139	128	11.1	17.7	12.0	5.7	2.2	1.3	1.0	0.0	1.0
17	176	55	44	121	76	33	37	111	47	64	76	70	6.1	9.7	6.6	3.1	1.7	0.9	0.7	0.0	0.7
18	317	100	79	217	136	60	67	199	84	116	140	129	11.2	23.8	16.1	7.7	2.1	1.2	0.9	0.0	0.9
19	248	78	62	170	106	47	52	156	65	90	107	99	8.6	13.6	9.2	4.4	2.3	1.2	1.0	0.0	1.0
20	337	106	84	231	145	64	71	212	89	123	146	134	11.7	18.6	12.6	6.0	2.8	1.6	1.3	0.0	1.3
21	368	116	92	253	158	70	78	232	97	135	160	147	12.8	20.3	13.7	6.6	3.0	1.7	1.3	0.0	1.3
22	398	125	100	273	171	76	84	251	105	146	173	159	13.8	22.0	14.8	7.1	2.3	1.4	1.0	0.0	1.0
23	265	83	66	182	114	50	56	167	70	97	115	106	9.2	14.6	9.9	4.7	1.9	1.1	0.8	0.0	0.8

24	250	79	63	171	108	47	53	158	66	91	108	100	8.7	13.8	9.3	4.5	1.9	1.1	0.8	0.0	0.8
25	314	99	78	215	135	60	67	198	83	115	136	125	10.9	17.9	12.1	5.8	1.9	1.1	0.8	0.0	0.8
26	245	77	61	168	105	46	52	154	65	90	106	98	8.5	13.5	9.1	4.4	1.9	1.1	0.8	0.0	0.8
27	362	114	91	248	156	69	77	228	96	132	157	144	12.6	20.0	13.5	6.5	2.4	1.4	1.0	0.0	1.0
28	283	89	71	194	122	54	60	179	75	104	123	113	9.8	15.6	10.6	5.1	2.0	1.1	0.9	0.0	0.9
29	339	107	85	233	146	64	72	214	90	124	147	135	11.8	18.7	12.7	6.1	2.2	1.2	0.9	0.0	0.9
30	278	88	70	191	120	53	59	175	74	102	121	111	9.6	15.3	10.4	5.0	2.0	1.1	0.8	0.0	0.8
31	112	35	28	77	48	21	24	71	30	41	49	45	3.9	6.2	4.2	2.0	0.8	0.5	0.3	0.0	0.3
32	112	35	28	77	48	21	24	71	30	41	49	46	4.0	8.0	5.4	2.6	0.8	0.5	0.3	0.0	0.3
33	112	35	28	77	48	21	24	71	30	41	49	45	3.9	6.2	4.2	2.0	1.2	0.7	0.6	0.0	0.6
34	408	128	102	280	176	77	87	257	108	149	177	163	14.2	22.5	15.2	7.3	2.2	1.3	0.9	0.0	0.9
35	383	120	96	262	165	73	81	241	101	140	166	153	13.3	21.1	14.3	6.8	2.6	1.5	1.1	0.0	1.1
36	260	82	65	178	112	49	55	164	69	95	113	104	9.0	14.4	9.7	4.7	1.4	0.8	0.6	0.0	0.6
37	263	83	66	180	113	50	56	166	70	96	114	105	9.1	14.5	9.8	4.7	1.6	0.9	0.7	0.0	0.7
38	263	83	66	180	113	50	56	166	70	96	114	105	9.1	14.5	9.8	4.7	1.7	1.0	0.7	0.0	0.7
39	327	103	82	224	140	62	69	206	86	119	142	131	11.4	19.8	13.4	6.4	1.8	1.1	0.7	0.0	0.7
40	309	97	77	212	133	59	65	195	82	113	134	123	10.7	17.0	11.5	5.5	2.0	1.2	0.9	0.0	0.9
41	286	90	71	196	123	54	61	180	76	104	124	114	9.9	15.8	10.7	5.1	2.1	1.2	0.9	0.0	0.9
42	306	96	77	210	132	58	65	193	81	112	133	122	10.6	16.9	11.4	5.5	2.1	1.2	0.9	0.0	0.9
43	319	100	80	219	137	61	68	201	84	117	138	127	11.1	17.6	11.9	5.7	3.6	2.0	1.7	0.0	1.7
44	276	87	69	189	119	52	58	174	73	101	119	110	9.6	15.2	10.3	4.9	2.0	1.1	0.8	0.0	0.8
45	260	82	65	178	112	49	55	164	69	95	113	104	9.0	14.4	9.7	4.7	1.7	1.0	0.7	0.0	0.7
46	357	112	89	245	154	68	76	225	95	131	157	144	12.5	24.1	16.3	7.8	2.0	1.2	0.8	0.0	0.8
47	403	127	101	276	173	76	85	254	107	147	175	161	14.0	22.2	15.0	7.2	2.7	1.5	1.1	0.0	1.1
48	385	121	96	264	166	73	82	243	102	141	167	154	13.4	21.2	14.4	6.9	3.0	1.7	1.3	0.0	1.3
49	380	120	95	261	164	72	81	240	101	139	165	152	13.2	21.0	14.2	6.8	2.9	1.6	1.2	0.0	1.2
50	360	113	90	247	155	68	76	227	95	132	156	143	12.5	19.8	13.4	6.4	2.5	1.4	1.1	0.0	1.1
51	403	127	101	276	173	76	85	254	107	147	175	161	14.0	22.2	15.0	7.2	2.5	1.5	1.1	0.0	1.1
52	350	110	87	240	150	66	74	220	92	128	152	139	12.1	19.3	13.0	6.2	2.4	1.4	1.0	0.0	1.0
53	375	118	94	257	161	71	80	236	99	137	162	149	13.0	19.4	13.1	6.3	2.4	1.4	1.0	0.0	1.0
54	350	110	87	240	150	66	74	220	92	128	152	139	12.1	19.3	13.0	6.2	2.3	1.3	1.0	0.0	1.0
55	454	143	114	311	195	86	96	286	120	166	197	181	15.7	25.0	16.9	8.1	3.2	1.8	1.4	0.0	1.4
56	212	67	53	145	91	40	45	133	56	77	92	84	7.3	11.7	7.9	3.8	1.9	1.1	0.9	0.0	0.9
57	260	82	65	178	112	49	55	164	69	95	113	104	9.0	14.4	9.7	4.7	2.1	1.2	0.9	0.0	0.9
58	245	77	61	168	105	46	52	154	65	90	106	98	8.5	13.5	9.1	4.4	1.9	1.1	0.8	0.0	0.8
59	179	56	45	122	77	34	38	113	47	65	77	71	6.2	9.8	6.7	3.2	1.6	0.9	0.7	0.0	0.7
60	345	108	86	236	148	65	73	217	91	126	147	135	11.8	13.5	9.1	4.4	1.8	1.1	0.7	0.0	0.7

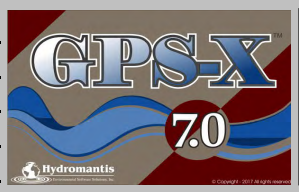
STATE VARIABLES

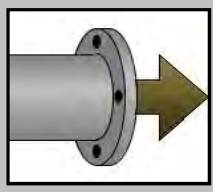
t	si	ss	sac	scol	xs	xi	vssxs	vssxi	vssxns	issxps	xii	sni	snh	snd	xns	xni	spi	sp	xmepo4	xps	xpi
SS	19	74	0.0	24	135	118	75	65.8	5.6	0.7	12.0	0.93	10.2	0.21	4.6	1.18	0.19	1.1	0.00	0.2	0.7
0	13	52	0.0	17	95	83	53	46.3	4.6	0.8	8.2	0.65	8.7	0.32	3.8	0.83	0.13	0.9	0.00	0.3	0.5
1	14	57	0.0	18	104	91	58	50.4	5.0	1.1	8.7	0.71	9.5	0.35	4.2	0.91	0.14	1.0	0.00	0.4	0.5
2	14	54	0.0	17	99	87	55	48.1	4.8	2.0	7.4	0.68	9.1	0.33	4.0	0.87	0.14	1.3	0.00	0.7	0.5
3	12	48	0.0	16	89	78	49	43.1	4.3	1.6	6.8	0.61	8.1	0.30	3.6	0.78	0.12	1.1	0.00	0.5	0.4
4	16	65	0.0	21	118	104	66	57.6	3.9	0.3	10.7	0.81	8.0	0.08	3.2	1.04	0.16	0.9	0.00	0.1	0.6
5	16	63	0.0	20	116	101	64	56.3	5.6	0.8	10.2	0.79	10.6	0.39	4.6	1.01	0.16	1.0	0.00	0.3	0.6
6	9	35	0.0	11	64	56	36	31.3	3.1	1.8	4.3	0.44	5.9	0.22	2.6	0.56	0.09	1.0	0.00	0.6	0.3
7	10	42	0.0	14	77	67	43	37.2	3.7	2.3	5.0	0.52	7.0	0.26	3.1	0.67	0.10	1.2	0.00	0.7	0.4
8	10	39	0.0	13	71	62	39	34.5	3.5	1.5	5.2	0.48	6.5	0.24	2.8	0.62	0.10	0.9	0.00	0.5	0.4
9	12	47	0.0	15	86	75	48	41.7	4.2	0.7	7.4	0.59	7.9	0.29	3.4	0.75	0.12	0.8	0.00	0.2	0.4

10	14	58	0.0	19	105	92	59	51.3	5.1	0.5	9.5	0.72	9.7	0.35	4.2	0.92	0.14	0.8	0.00	0.2	0.5
11	14	56	0.0	18	102	89	56	49.5	5.1	1.0	8.6	0.70	9.6	0.37	4.2	0.89	0.14	1.0	0.00	0.3	0.5
12	13	52	0.0	17	94	82	52	45.8	4.6	1.1	7.8	0.64	8.6	0.32	3.8	0.82	0.13	1.0	0.00	0.4	0.5
13	17	66	0.0	21	121	106	67	59.0	5.9	1.0	10.5	0.83	11.1	0.41	4.9	1.06	0.17	1.1	0.00	0.3	0.6
14	10	40	0.0	13	73	64	40	35.4	3.5	1.3	5.6	0.50	6.7	0.24	2.9	0.64	0.10	0.9	0.00	0.4	0.4
15	14	56	0.0	18	102	89	56	49.5	5.0	1.1	8.6	0.70	9.3	0.34	4.1	0.89	0.14	1.0	0.00	0.4	0.5
16	16	64	0.0	21	118	103	65	57.2	5.7	1.1	10.0	0.80	10.8	0.39	4.7	1.03	0.16	1.1	0.00	0.4	0.6
17	9	35	0.0	11	64	56	36	31.3	3.1	1.3	4.8	0.44	5.9	0.22	2.6	0.56	0.09	0.8	0.00	0.4	0.3
18	16	63	0.0	20	116	101	64	56.3	8.1	1.0	10.2	0.79	14.5	0.82	6.7	1.01	0.16	1.1	0.00	0.3	0.6
19	12	50	0.0	16	90	79	50	44.0	4.4	1.7	6.9	0.62	8.3	0.30	3.6	0.79	0.12	1.1	0.00	0.5	0.5
20	17	67	0.0	22	123	108	68	59.9	6.0	2.0	9.7	0.84	11.3	0.41	4.9	1.08	0.17	1.4	0.00	0.6	0.6
21	18	74	0.0	24	135	118	75	65.5	6.6	1.9	10.8	0.92	12.4	0.45	5.4	1.18	0.18	1.5	0.00	0.6	0.7
22	20	80	0.0	26	146	127	81	70.8	7.1	0.8	13.1	1.00	13.4	0.49	5.8	1.27	0.20	1.2	0.00	0.2	0.7
23	13	53	0.0	17	97	85	54	47.2	4.7	1.0	8.2	0.66	8.9	0.33	3.9	0.85	0.13	1.0	0.00	0.3	0.5
24	13	50	0.0	16	91	80	51	44.5	4.5	1.2	7.5	0.63	8.4	0.31	3.7	0.80	0.13	1.0	0.00	0.4	0.5
25	16	63	0.0	20	115	100	64	55.8	5.8	0.7	10.2	0.78	10.9	0.43	4.8	1.00	0.16	1.0	0.00	0.2	0.6
26	12	49	0.0	16	90	78	50	43.6	4.4	1.2	7.3	0.61	8.2	0.30	3.6	0.78	0.12	1.0	0.00	0.4	0.4
27	18	72	0.0	23	132	116	74	64.4	6.5	1.0	11.5	0.91	12.2	0.44	5.3	1.16	0.18	1.2	0.00	0.3	0.7
28	14	57	0.0	18	104	91	58	50.4	5.0	1.0	8.8	0.71	9.5	0.35	4.2	0.91	0.14	1.0	0.00	0.3	0.5
29	17	68	0.0	22	124	109	69	60.4	6.0	0.9	10.9	0.85	11.4	0.42	5.0	1.09	0.17	1.1	0.00	0.3	0.6
30	14	56	0.0	18	102	89	56	49.5	5.0	1.0	8.6	0.70	9.3	0.34	4.1	0.89	0.14	1.0	0.00	0.3	0.5
31	6	22	0.0	7	41	36	23	20.0	2.0	0.4	3.5	0.28	3.8	0.14	1.6	0.36	0.06	0.4	0.00	0.1	0.2
32	6	22	0.0	7	41	36	23	20.0	2.7	0.4	3.5	0.28	4.9	0.26	2.2	0.36	0.06	0.4	0.00	0.1	0.2
33	6	22	0.0	7	41	36	23	20.0	2.0	1.1	2.8	0.28	3.8	0.14	1.6	0.36	0.06	0.6	0.00	0.4	0.2
34	20	82	0.0	26	149	131	83	72.6	7.3	0.5	13.7	1.02	13.7	0.50	6.0	1.31	0.20	1.1	0.00	0.2	0.7
35	19	77	0.0	25	140	123	78	68.1	6.8	1.3	12.0	0.96	12.8	0.47	5.6	1.23	0.19	1.3	0.00	0.4	0.7
36	13	52	0.0	17	95	83	53	46.3	4.6	0.2	8.8	0.65	8.7	0.32	3.8	0.83	0.13	0.7	0.00	0.1	0.5
37	13	53	0.0	17	96	84	53	46.7	4.7	0.5	8.6	0.66	8.8	0.32	3.9	0.84	0.13	0.8	0.00	0.2	0.5
38	13	53	0.0	17	96	84	53	46.7	4.7	0.7	8.4	0.66	8.8	0.32	3.9	0.84	0.13	0.8	0.00	0.2	0.5
39	16	65	0.0	21	119	105	66	58.1	6.5	0.4	11.0	0.82	12.0	0.52	5.4	1.05	0.16	0.9	0.00	0.1	0.6
40	15	62	0.0	20	113	99	63	54.9	5.5	0.9	9.8	0.77	10.4	0.38	4.5	0.99	0.15	1.0	0.00	0.3	0.6
41	14	57	0.0	18	104	91	58	50.8	5.1	1.2	8.7	0.71	9.6	0.35	4.2	0.91	0.14	1.0	0.00	0.4	0.5
42	15	61	0.0	20	112	98	62	54.5	5.5	1.0	9.6	0.77	10.3	0.38	4.5	0.98	0.15	1.0	0.00	0.3	0.6
43	16	64	0.0	21	117	102	65	56.7	5.7	3.3	7.7	0.80	10.7	0.39	4.7	1.02	0.16	1.8	0.00	1.1	0.6
44	14	55	0.0	18	101	88	56	49.0	4.9	1.0	8.5	0.69	9.2	0.34	4.0	0.88	0.14	1.0	0.00	0.3	0.5
45	13	52	0.0	17	95	83	53	46.3	4.6	0.7	8.3	0.65	8.7	0.32	3.8	0.83	0.13	0.8	0.00	0.2	0.5
46	18	71	0.0	23	131	114	73	63.5	8.1	0.5	12.1	0.89	14.7	0.74	6.7	1.14	0.18	1.0	0.00	0.2	0.7
47	20	81	0.0	26	147	129	82	71.7	7.2	1.2	12.8	1.01	13.5	0.49	5.9	1.29	0.20	1.3	0.00	0.4	0.7
48	19	77	0.0	25	141	123	78	68.5	6.9	1.8	11.6	0.96	12.9	0.47	5.7	1.23	0.19	1.5	0.00	0.6	0.7
49	19	76	0.0	25	139	122	77	67.6	6.8	1.7	11.5	0.95	12.8	0.47	5.6	1.22	0.19	1.4	0.00	0.6	0.7
50	18	72	0.0	23	132	115	73	64.0	6.4	1.3	11.2	0.90	12.1	0.44	5.3	1.15	0.18	1.3	0.00	0.4	0.7
51	20	81	0.0	26	147	129	82	71.7	7.2	1.0	12.9	1.01	13.5	0.49	5.9	1.29	0.20	1.3	0.00	0.3	0.7
52	17	70	0.0	23	128	112	71	62.2	6.2	1.2	10.9	0.87	11.7	0.43	5.1	1.12	0.17	1.2	0.00	0.4	0.6
53	19	75	0.0	24	137	120	76	66.7	6.2	1.0	12.0	0.94	11.8	0.37	5.1	1.20	0.19	1.2	0.00	0.3	0.7
54	17	70	0.0	23	128	112	71	62.2	6.2	1.1	11.0	0.87	11.7	0.43	5.1	1.12	0.17	1.2	0.00	0.4	0.6
55	23	91	0.0	29	166	145	92	80.8	8.1	1.7	14.1	1.14	15.2	0.56	6.7	1.45	0.23	1.6	0.00	0.5	0.8
56	11	42	0.0	14	77	68	43	37.7	3.8	1.5	5.9	0.53	7.1	0.26	3.1	0.68	0.11	1.0	0.00	0.5	0.4
57	13	52	0.0	17	95	83	53	46.3	4.6	1.4	7.6	0.65	8.7	0.32	3.8	0.83	0.13	1.1	0.00	0.5	0.5
58	12	49	0.0	16	90	78	50	43.6	4.4	1.1	7.4	0.61	8.2	0.30	3.6	0.78	0.12	0.9	0.00	0.4	0.4
59	9	36	0.0	12	65	57	36	31.8	3.2	1.1	5.1	0.45	6.0	0.22	2.6	0.57	0.09	0.8	0.00	0.4	0.3
60	17	69	0.0	22	126	110	70	61.3	4.0	0.3	11.5	0.86	8.2	0.05	3.3	1.10	0.17	0.9	0.00	0.1	0.6

GPS-X MANTIS2 BIOLOGICAL MODEL INFLUENT CHARACTERIZATION DIAGRAMS

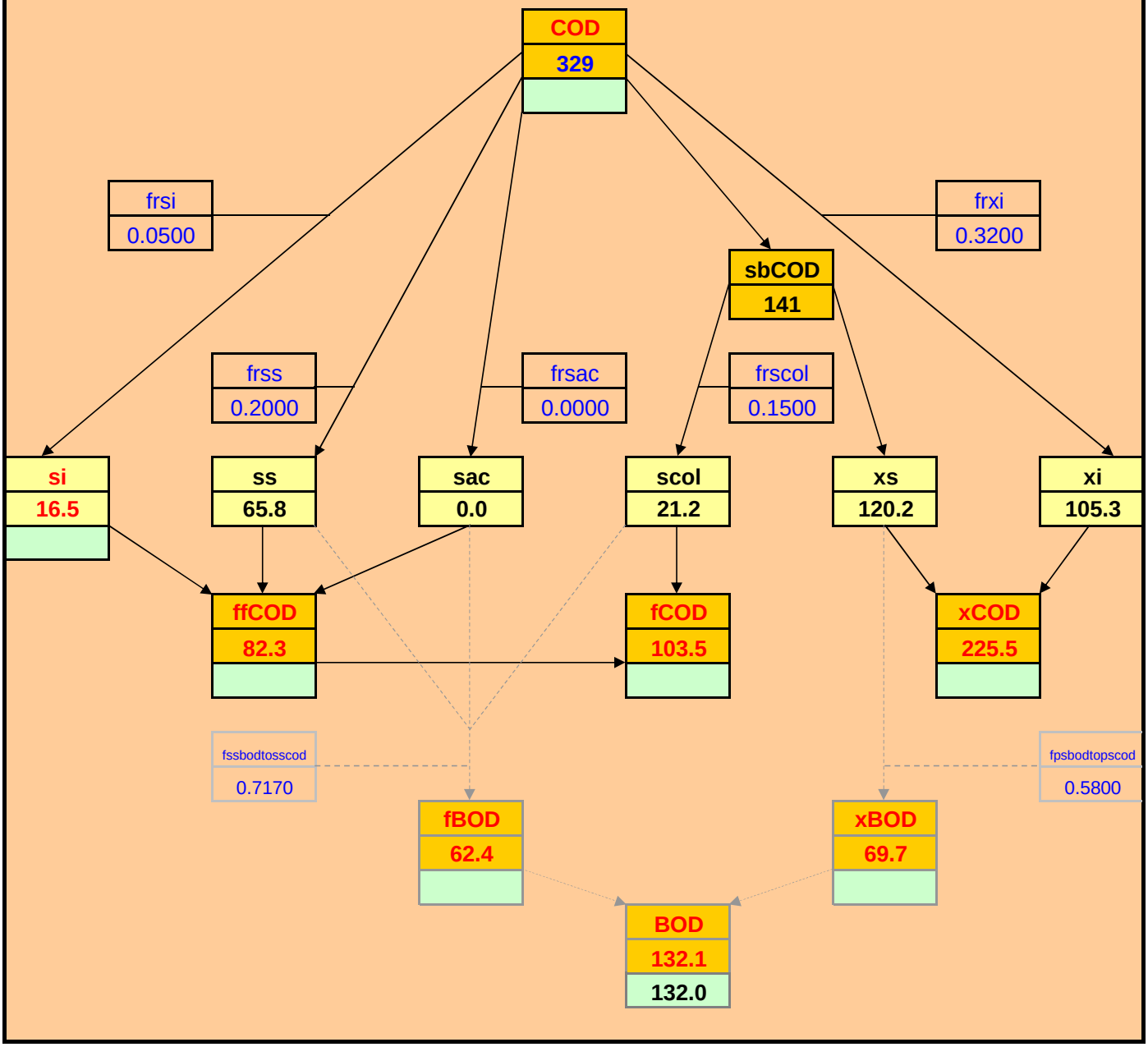
CLIENT NAME:	*Racine Wastewater Utility*
PROJECT NAME:	*Racine WWTP Facility Plan*
JOB NUMBER:	*60554970.5.2*
ENGINEER:	*K.Frank*
WWTP STREAM:	*Raw Wastewater (2040 Annual Average)*



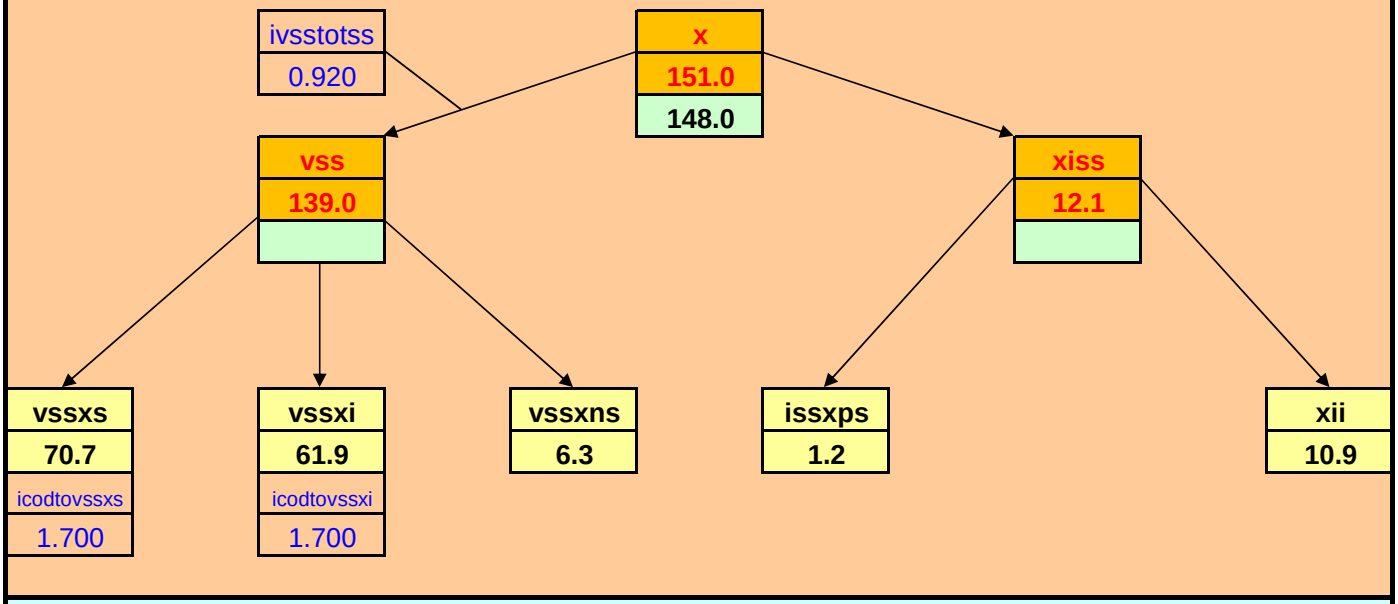


Change blue-fonted values until computed variables match actual measurements

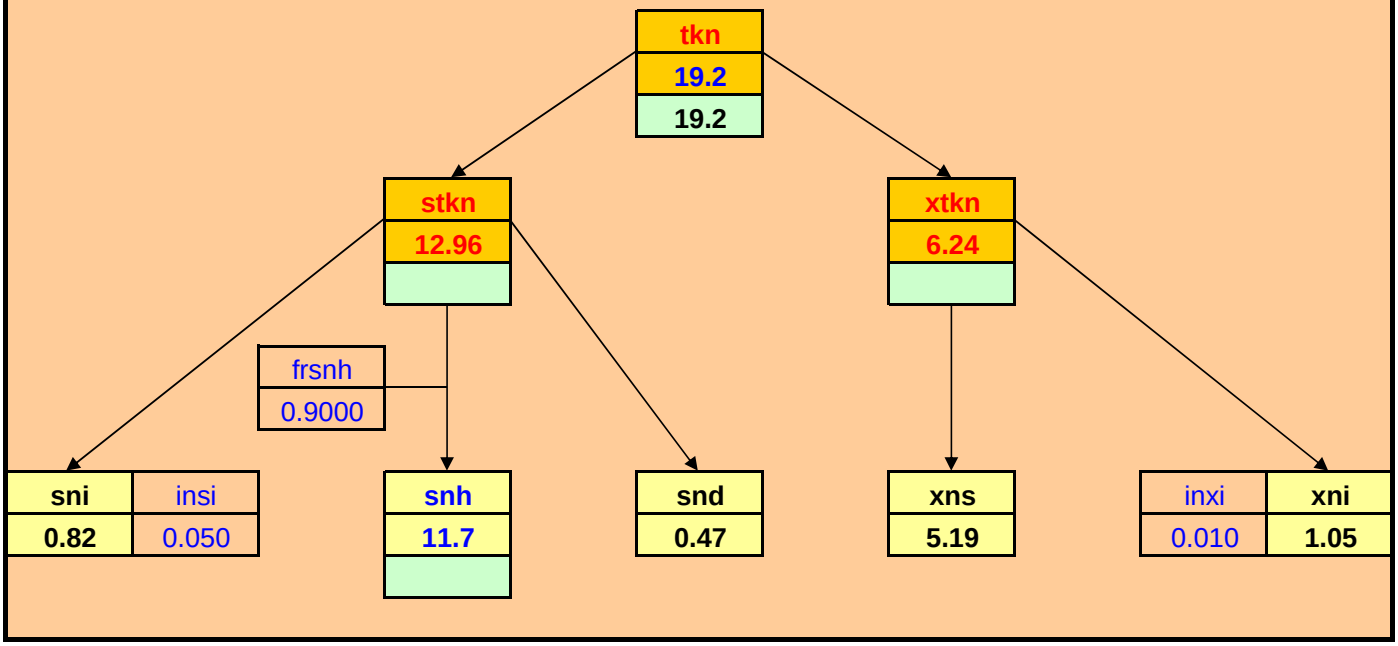
CARBONACEOUS BREAKDOWN

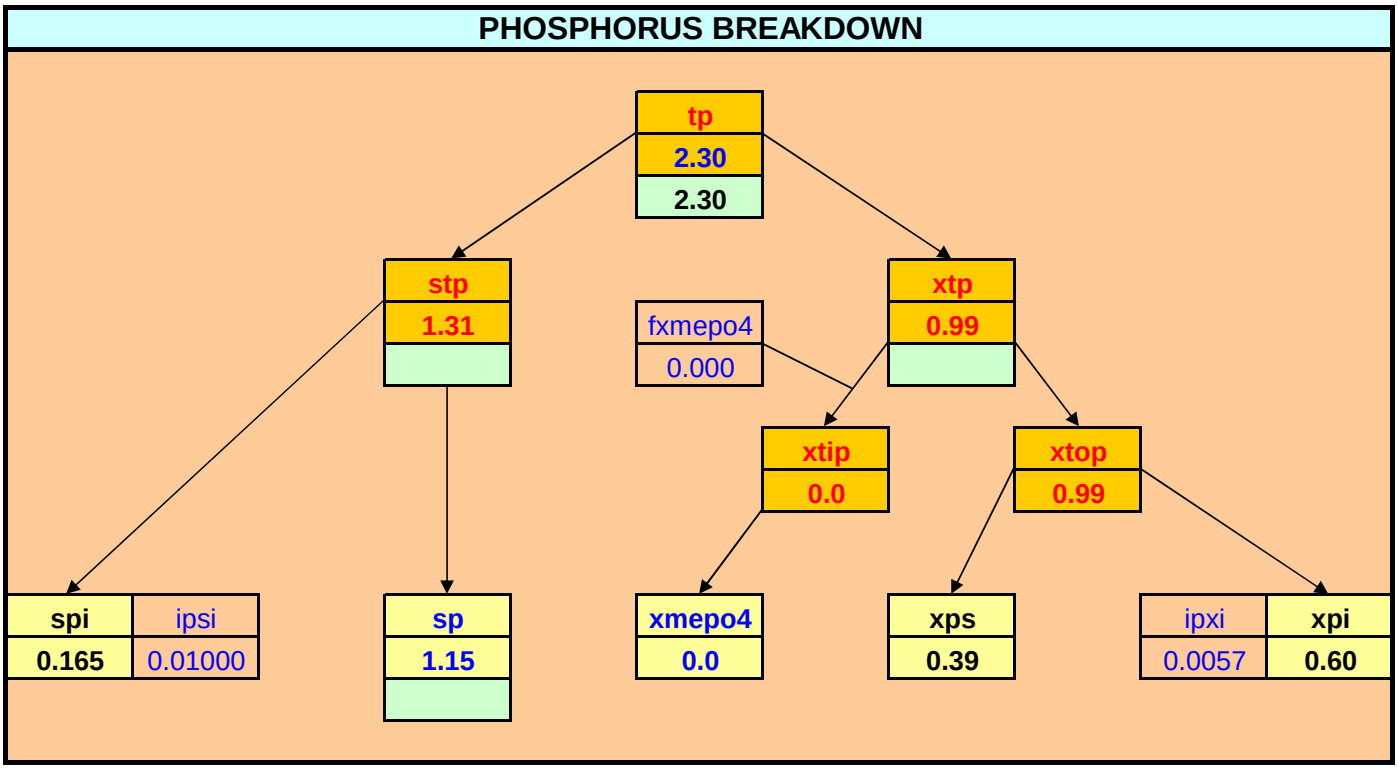


SOLIDS BREAKDOWN



NITROGEN BREAKDOWN

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2.30
stp
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xtp
0.99
xtip
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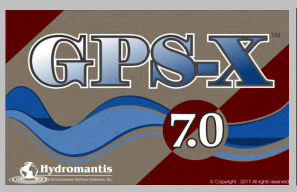
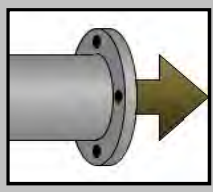
xtop
0.99
spi
0.165
ipsi
0.01000
sp
1.15
xmepo4
0.0
xps
0.39
ipxi
0.0057
xpi
0.60

GPS-X MANTIS2 BIOLOGICAL MODEL INFLUENT CHARACTERIZATION DIAGRAMS

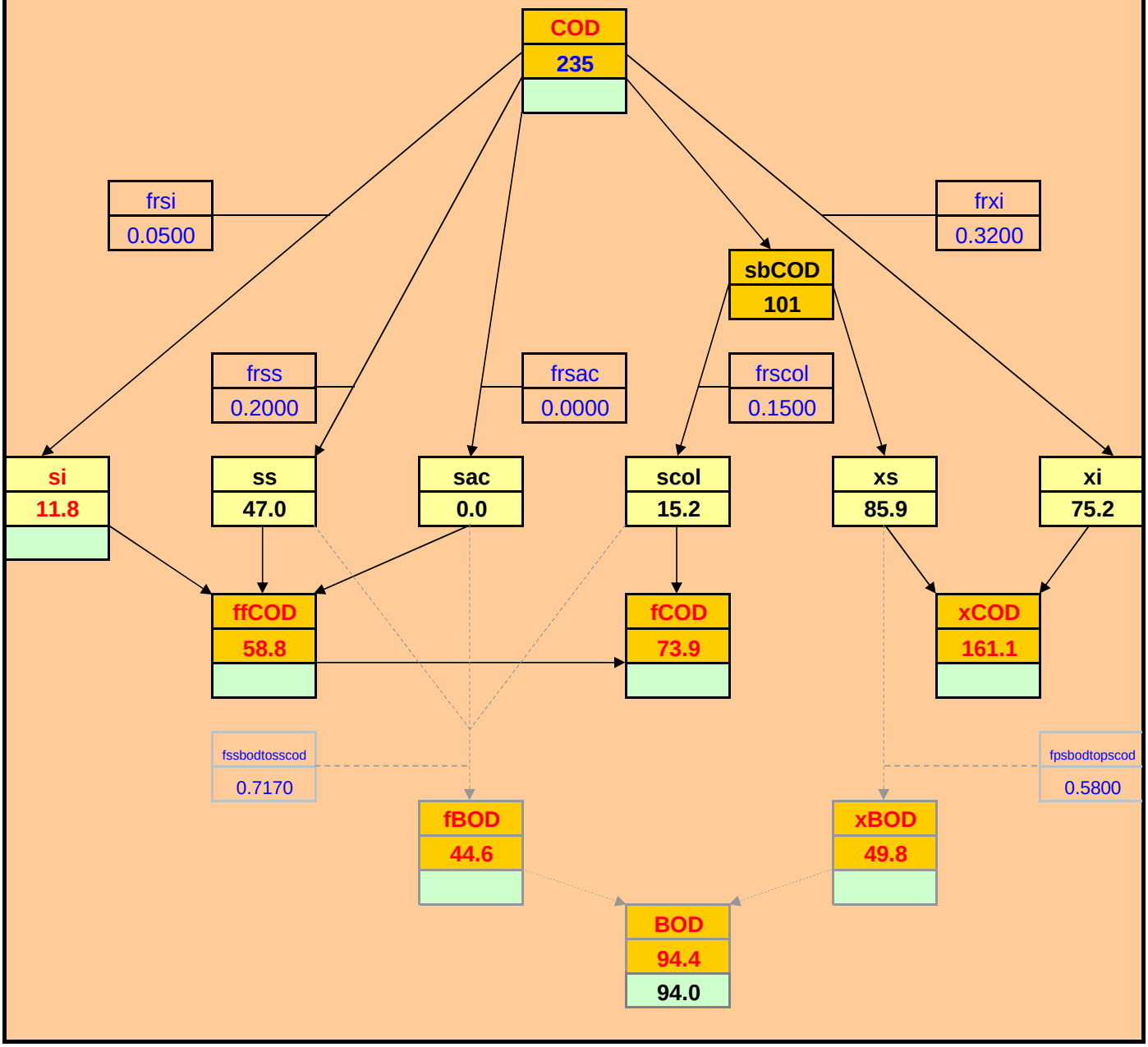
CLIENT NAME:	*Racine Wastewater Utility*
PROJECT NAME:	*Racine WWTP Facility Plan*
JOB NUMBER:	*60554970.5.2*
ENGINEER:	*K.Frank*
WWTP STREAM:	*Raw Wastewater (2040 Max Month)*



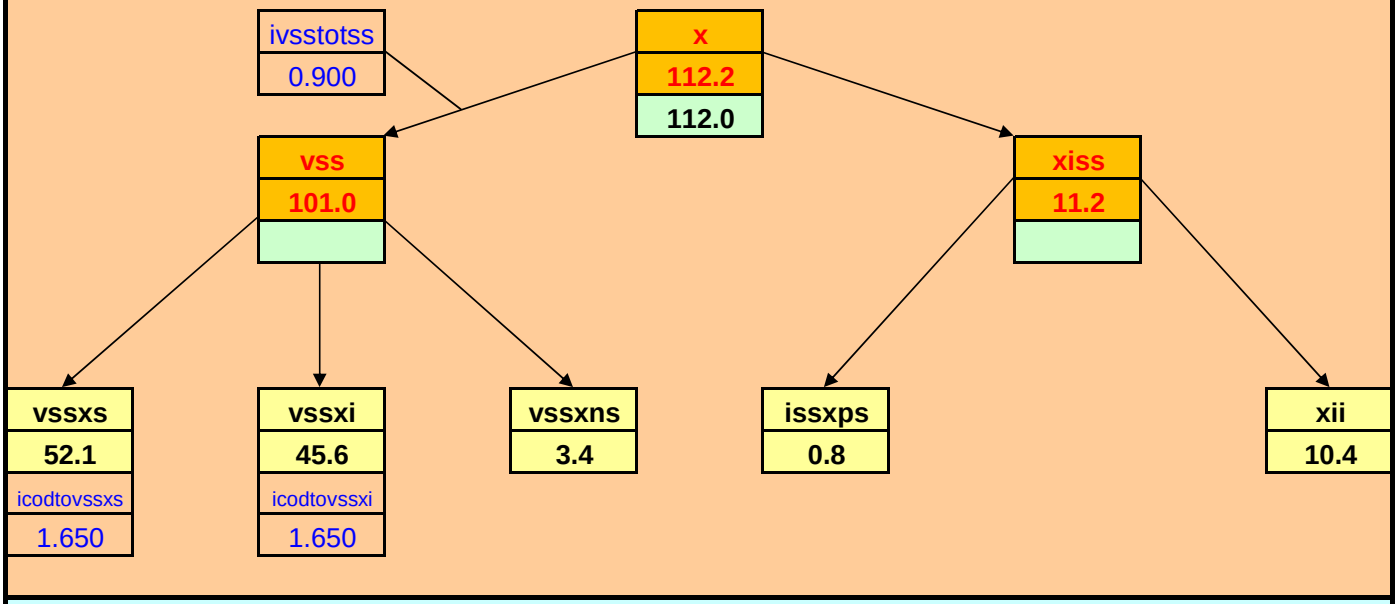


Change blue-fonted values until computed variables match actual measurements

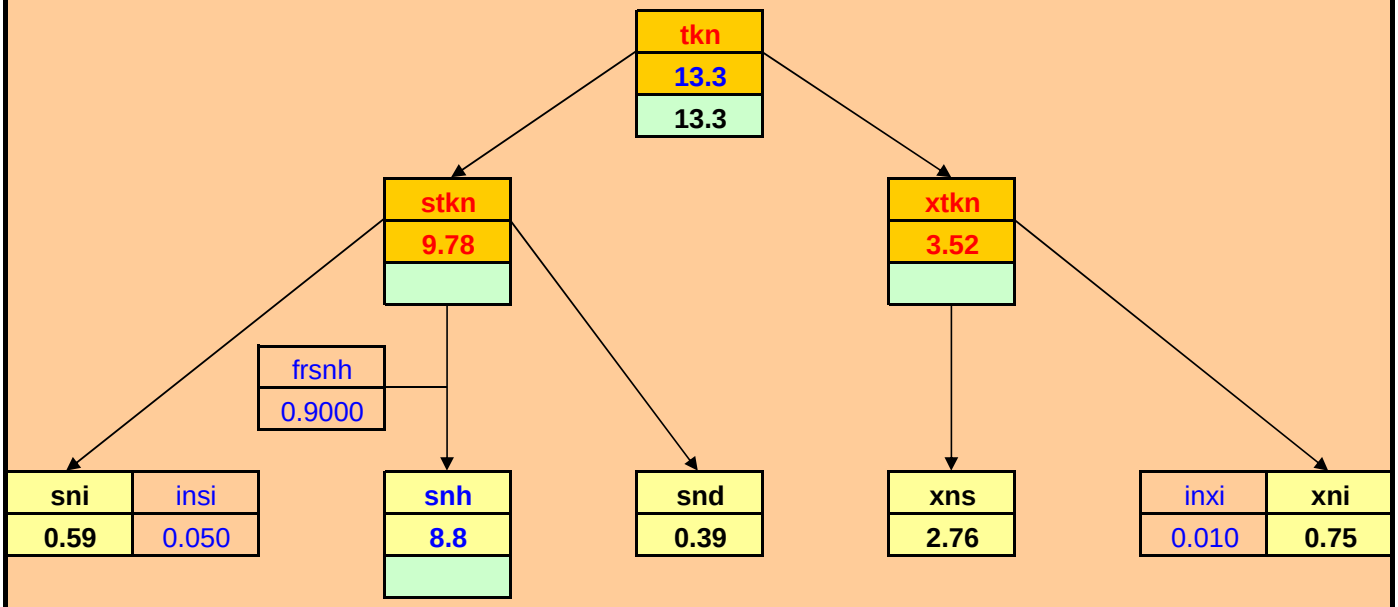
CARBONACEOUS BREAKDOWN

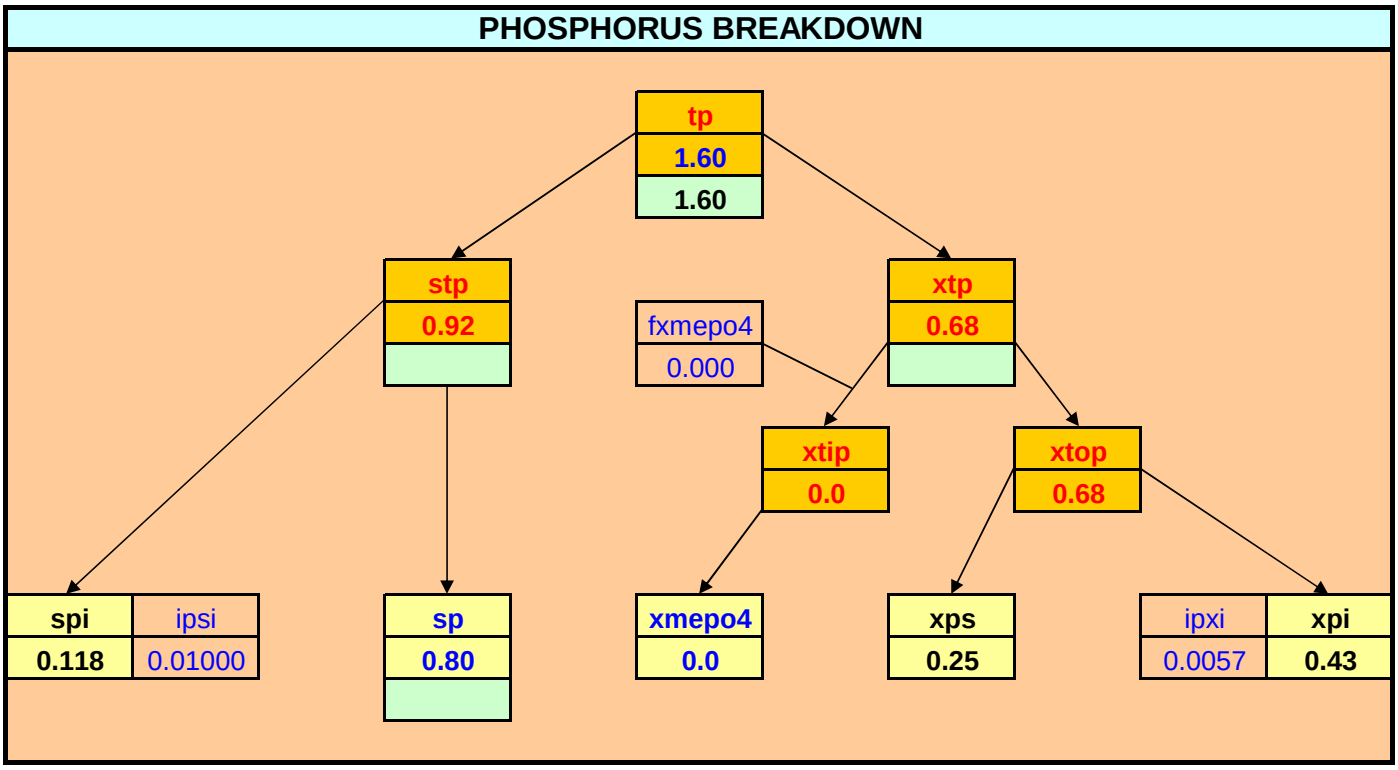


SOLIDS BREAKDOWN



NITROGEN BREAKDOWN

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xtp
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xtip
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xtop
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spi
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ipsi
0.01000
sp
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xmepo4
0.0
xps
0.25
ipxi
0.0057
xpi
0.43

AECOM

Attachment 4.1

Process Modeling Simulation Results

RACINE WWTP PROCESS MODLEING SIMULATION RESULTS

Parameter	*Unit*	*No Ammonia Limits, Chemical Phosphorus Removal*					*No Ammonia Limits, Biological Phosphorus Removal*					*Full Nitrification, Chemical Phosphorus Removal*				
		Annual Average	Annual Average Winter	Annual Average Summer	Maximum Month Winter	Maximum Month Summer	Annual Average	Annual Average Winter	Annual Average Summer	Maximum Month Winter	Maximum Month Summer	Annual Average	Annual Average Winter	Annual Average Summer	Maximum Month Winter	Maximum Month Summer
Raw Wastewater Flow	(MGD)	23.9	23.9	23.9	41.3	41.3	23.9	23.9	23.9	41.3	41.3	23.9	23.9	23.9	41.3	41.3
Wastewater Temperature	(°C)	15.0	9.0	20.0	9.0	20.0	15.0	9.0	20.0	9.0	20.0	15.0	9.0	20.0	9.0	20.0
Primary HRT	(h)	3.6	3.6	3.6	2.1	2.1	3.6	3.6	3.6	2.1	2.1	3.6	3.6	3.6	2.1	2.1
Primary Solids Removal	(%)	70	70	70	62	62	70	70	70	62	62	71	71	71	62	62
Ferric Chloride	**(gpd)**	**511**	**511**	**511**	**435**	**435**	**0**	**0**	**0**	**0**	**0**	**546**	**508**	**597**	**434**	**434**
PE Flow	(MGD)	24.6	24.6	24.6	41.9	41.9	24.6	24.6	24.6	41.9	41.9	24.4	24.4	24.4	41.8	41.8
PE TSS	(mg/L)	48	48	48	45	45	45	45	45	44	44	48	48	48	45	45
PE COD	(mg/L)	166	167	166	135	135	168	168	168	136	135	167	167	167	135	135
PE BOD	(mg/L)	80	80	80	63	63	81	81	81	63	63	80	81	80	63	63
PE TKN	(mg/L)	18.9	19.3	18.8	13.4	13.2	18.8	19.1	18.7	13.2	13.2	18.4	18.5	18.3	13.1	12.9
PE NH4-N	(mg/L)	15.8	16.1	15.7	11.1	10.9	15.7	15.9	15.6	10.9	10.8	15.3	15.4	15.2	10.8	10.6
PE TP	(mg/L)	1.6	1.6	1.6	1.3	1.3	2.3	2.4	2.3	1.5	1.5	1.5	1.6	1.5	1.3	1.3
PE OP	(mg/L)	1.1	1.1	1.1	0.9	0.9	1.8	1.9	1.8	1.1	1.1	1.0	1.0	1.0	0.9	0.9
Zone 1 DO	(mg/L)	2.0	2.0	2.0	2.0	2.0	0	0	0	0	0	2.0	2.0	2.0	2.0	2.0
Zone 2 DO	(mg/L)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Zone 3 DO	(mg/L)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Zone 4 DO	(mg/L)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Zone 1 Diffuser Fluxrate	(scfm/diff)	1.25	0.78	1.54	0.84	1.86	0.00	0.00	0.00	0.00	0.00	1.13	0.90	1.34	1.05	1.59
Zone 2 Diffuser Fluxrate	(scfm/diff)	0.93	0.57	1.05	0.59	1.26	1.12	0.52	1.55	0.67	1.66	0.76	0.70	0.72	0.81	0.94
Zone 3 Diffuser Fluxrate	(scfm/diff)	1.03	0.63	0.92	0.65	1.26	1.22	0.50	1.53	0.61	1.62	0.65	0.74	0.59	0.93	0.83
Zone 4 Diffuser Fluxrate	(scfm/diff)	1.01	0.78	0.84	0.79	1.23	1.41	0.58	1.21	0.73	1.51	0.66	0.73	0.66	1.04	0.91
Zone 1 Airflow	(scfm)	5,170	3,210	6,360	3,460	7,690	0	0	0	0	0	6,600	5,240	7,810	6,150	9,270
Zone 2 Airflow	(scfm)	2,690	1,640	3,040	1,710	3,650	3,250	1,490	4,480	1,920	4,820	3,110	2,850	2,950	3,320	3,860
Zone 3 Airflow	(scfm)	2,090	1,290	1,860	1,320	2,560	2,480	1,010	3,100	1,250	3,300	1,860	2,130	1,700	2,680	2,390
Zone 4 Airflow	(scfm)	1,500	1,150	1,230	1,160	1,820	2,080	853	1,790	1,080	2,230	1,390	1,530	1,380	2,180	1,900
Total Airflow	**(scfm)**	**11,450**	**7,290**	**12,490**	**7,650**	**15,720**	**7,810**	**3,353**	**9,370**	**4,250**	**10,350**	**12,960**	**11,750**	**13,840**	**14,330**	**17,420**
MLSS	(mg/L)	1,560	1,610	1,480	2,150	2,010	1,540	1,590	1,480	2,110	1,990	2,090	2,230	1,970	2,870	2,540
MLVSS	(mg/L)	1,280	1,330	1,210	1,770	1,640	1,240	1,290	1,190	1,730	1,610	1,690	1,820	1,570	2,330	2,030
Aerobic SRT	(d)	6.1	6.1	6.1	5.6	5.5	4.6	4.6	4.5	4.2	4.1	14.5	14.6	14.4	12.2	11.8
Total SRT	(d)	6.1	6.1	6.1	5.6	5.5	6.1	6.1	6.0	5.6	5.5	14.5	14.6	14.4	12.2	11.8
Final Clarifier SLR	(lbs/d/ft^2)	10.2	10.5	9.7	24.0	22.4	10.1	10.4	9.7	23.5	22.1	9.6	10.2	9.0	22.5	19.9
New Bioreactor Volume	**(MG)**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2.36**	**2.36**	**2.36**	**2.36**	**2.36**
New Final Clarifier Area	**(ft^2)**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**23,562**	**23,562**	**23,562**	**23,562**	**23,562**
Effluent TSS	(mg/L)	10.1	10.1	10.0	17.4	17.3	10.0	10.1	10.0	17.4	17.2	7.7	7.8	7.6	13.1	12.8
Effluent BOD	(mg/L)	5.0	5.9	4.4	9.5	6.8	7.3	14.8	5.6	17.2	9.3	3.0	3.7	2.6	5.4	3.9
Effluent TKN	(mg/L)	2.5	10.7	2.1	10.4	2.3	4.9	16.6	2.4	11.7	2.8	2.0	2.4	1.8	2.7	1.9
Effluent NH4-N	**(mg/L)**	**0.5**	**8.5**	**0.2**	**8.1**	**0.2**	**2.7**	**14.0**	**0.4**	**9.2**	**0.6**	**0.2**	**0.4**	**0.1**	**0.6**	**0.1**
Effluent Nitrite	(mg/L)	0.4	1.2	0.2	0.2	0.2	1.4	0.0	0.4	0.0	4.1	0.1	0.2	0.1	0.4	0.1
Effluent Nitrate	(mg/L)	10.8	1.7	11.6	0.0	7.0	4.1	0.0	6.7	0.0	0.0	11.6	10.9	12.0	6.2	7.5
Effluent TN	(mg/L)	13.7	13.7	13.8	10.6	9.5	10.4	16.6	9.5	11.7	6.9	13.7	13.6	13.9	9.3	9.5
Effluent OP	(mg/L)	0.37	0.34	0.42	0.37	0.39	0.02	0.02	0.03	0.03	0.01	0.56	0.55	0.56	0.48	0.54
Effluent TP	**(mg/L)**	**0.71**	**0.68**	**0.76**	**0.76**	**0.78**	**0.55**	**0.55**	**0.56**	**0.61**	**0.62**	**0.85**	**0.84**	**0.84**	**0.80**	**0.85**
Effluent Alkalinity	(mg$CaCO_3$/L)	188	241	189	262	221	229	276	217	270	252	184	180	186	213	219
RAS Flow	(MGD)	19.7	19.7	19.7	33.5	33.5	19.7	19.7	19.7	33.6	33.6	19.6	19.6	19.6	33.5	33.5
WAS Flow	(MGD)	0.35	0.35	0.35	0.30	0.30	0.35	0.35	0.35	0.30	0.30	0.21	0.21	0.21	0.21	0.21
RAS/WAS Solids	(mg/L)	3,426	3,538	3,253	4,779	4,467	3,394	3,510	3,251	4,681	4,407	4,647	4,956	4,375	6,403	5,656
Primary Sludge Flow	(MGD)	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Primary Sludge Total Solids	(% TS)	3.5	3.5	3.5	3.9	3.9	3.3	3.3	3.3	3.7	3.7	3.5	3.5	3.6	3.9	3.9
Primary Sludge Volatile Solids	(% TS)	3.1	3.1	3.1	3.4	3.4	3.0	3.0	3.0	3.3	3.3	3.1	3.1	3.1	3.4	3.4
Thickened WAS Flow	(MGD)	0.023	0.024	0.022	0.027	0.026	0.023	0.023	0.022	0.027	0.025	0.019	0.020	0.018	0.026	0.023
Thickened WAS Total Solids	(% TS)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Thickened WAS Volatile Solids	(% TS)	4.1	4.1	4.1	4.1	4.1	4.0	4.1	4.0	4.1	4.0	4.0	4.1	4.0	4.1	4.0
Digester Feed Flow	(MGD)	0.103	0.104	0.102	0.107	0.106	0.103	0.103	0.102	0.107	0.105	0.099	0.100	0.098	0.106	0.103
Digester Feed Total Solids	(% TS)	3.9	3.9	3.8	4.2	4.2	3.7	3.7	3.7	4.1	4.0	3.8	3.8	3.8	4.2	4.1
Digester Feed Volatile Solids	(% TS)	3.3	3.3	3.3	3.6	3.5	3.3	3.3	3.3	3.5	3.5	3.2	3.3	3.2	3.5	3.5
Digested Sludge Flow	(MGD)	0.103	0.104	0.102	0.107	0.106	0.103	0.103	0.102	0.107	0.105	0.099	0.100	0.098	0.106	0.103
Digested Sludge Total Solids	(% TS)	2.3	2.3	2.3	2.5	2.5	2.1	2.1	2.1	2.4	2.4	2.3	2.3	2.3	2.6	2.6
Digested Sludge Volatile Solids	(% TS)	1.7	1.7	1.7	1.9	1.9	1.7	1.7	1.7	1.9	1.9	1.7	1.7	1.7	1.9	1.9
Biogas Production	**(ft3/d)**	**217,765**	**222,283**	**212,646**	**242,885**	**234,635**	**214,714**	**219,160**	**210,256**	**240,587**	**231,508**	**195,597**	**200,801**	**191,026**	**227,180**	**216,518**
Cake Solids	(% TS)	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80	19.80
Biosolids Cake	**(lbs/d)**	**18,509**	**18,549**	**18,327**	**21,205**	**20,966**	**17,395**	**17,458**	**17,248**	**20,303**	**20,158**	**18,241**	**18,359**	**18,146**	**21,540**	**20,935**

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Attachment 4.2

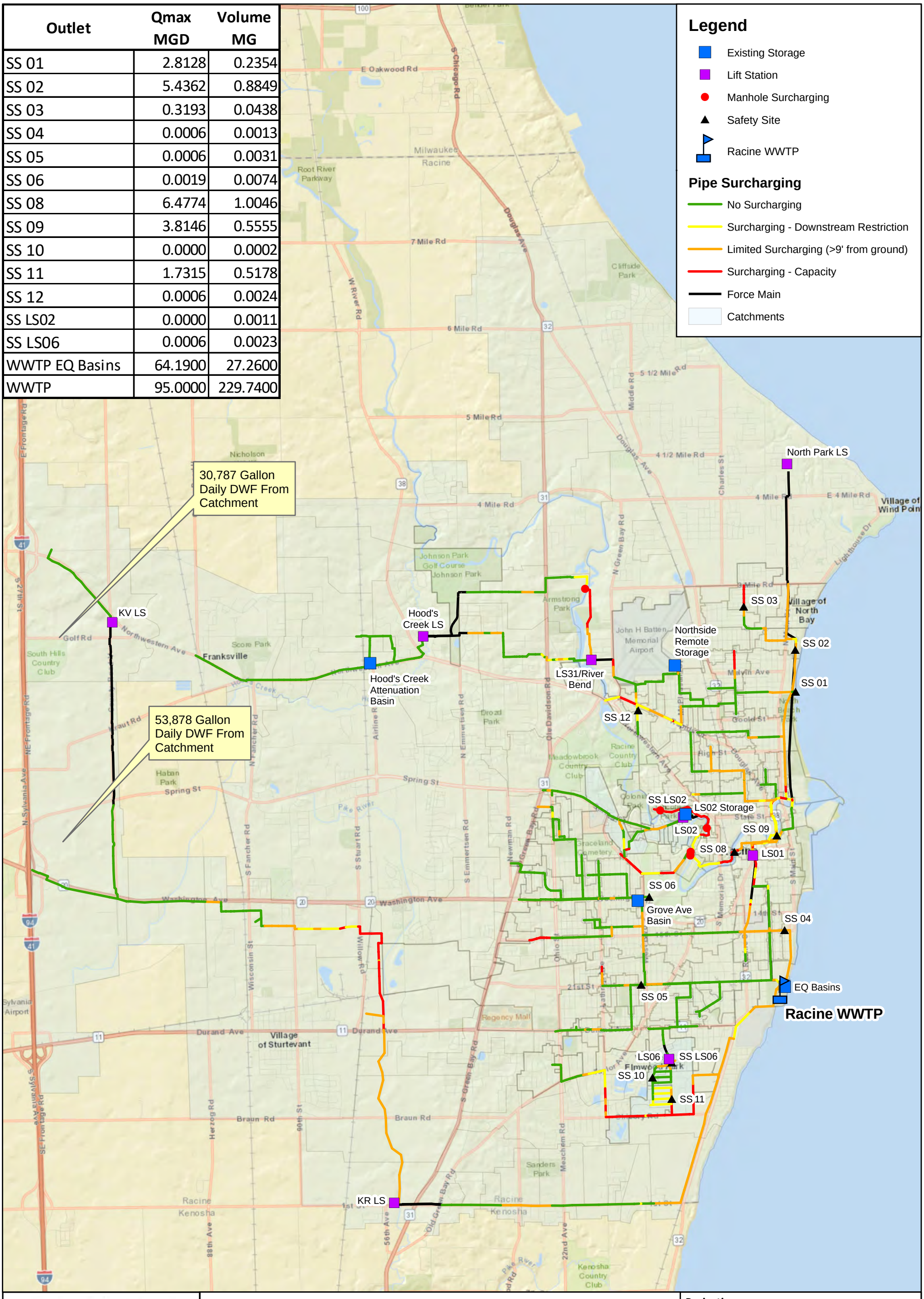
Conceptual Nitrification Expansion Layout

RACINE WWTP NITRIFICATION EXPANSION CONCEPT

Project number: 60554970

Appendix C Conveyance MIKE URBAN Model Output Alternatives Analysis

Outlet	Qmax MGD	Volume MG
SS 01	2.8128	0.2354
SS 02	5.4362	0.8849
SS 03	0.3193	0.0438
SS 04	0.0006	0.0013
SS 05	0.0006	0.0031
SS 06	0.0019	0.0074
SS 08	6.4774	1.0046
SS 09	3.8146	0.5555
SS 10	0.0000	0.0002
SS 11	1.7315	0.5178
SS 12	0.0006	0.0024
SS LS02	0.0000	0.0011
SS LS06	0.0006	0.0023
WWTP EQ Basins	64.1900	27.2600
WWTP	95.0000	229.7400



AECOM

Figure C-1 - 2020 Condition

Projection: NAD_1927_StatePlane_Wisconsin_South_FIPS_4803

Drawn By: JFP

Checked By:

Date:

Project #: 60554970

Racine Facilities Plan
Racine Wastewater Utility

Outlet	Qmax MGD	Volume MG
SS 01	2.4399	0.1876
SS 02	5.3011	0.8316
SS 03	0.3193	0.0438
SS 04	0.0006	0.0013
SS 05	0.0006	0.0031
SS 06	0.0019	0.0074
SS 08	4.4519	0.7243
SS 09	1.3327	0.0882
SS 10	0.0000	0.0002
SS 11	0.0000	0.0004
SS 12	0.0006	0.0024
SS LS02	0.0000	0.0011
SS LS06	0.0006	0.0023
WWTP EQ Basins	66.0400	24.3000
WWTP	95.0000	254.0000

Legend

- Existing Storage
- Proposed Storage
- Lift Station
- Manhole Surcharging
- Racine WWTP
- Safety Site

Pipe Surcharging

- No Surcharging
- Surcharging - Downstream Restriction
- Limited Surcharging (>9' from ground)
- Surcharging - Capacity
- Force Main
- Catchments

+3.5 MG EQ Storage

+1.5 MG EQ Storage

+11.0 MG EQ Storage

+1.0 MG EQ Storage

KV LS

Hood's Creek LS

Hood's Creek Attenuation Basin

LS31/River Bend

Northside Remote Storage

North Park LS

North Park Storage

SS 03

SS 02

SS 01

SS 12

SS LS02

LS02 Storage

LS02

SS 08

SS 09

LS01

SS 06

Grove Ave Basin

SS 04

SS 05

EQ Basins

Racine WWTP

LS06

SS LS06

SS 10

SS 11

Chicory Storage

Pike River Storage

Pike River LS

Figure C-2 - 2030 Condition

Projection: NAD_1927_StatePlane_Wisconsin_South_FIPS_4803

Drawn By: JFP

Checked By:

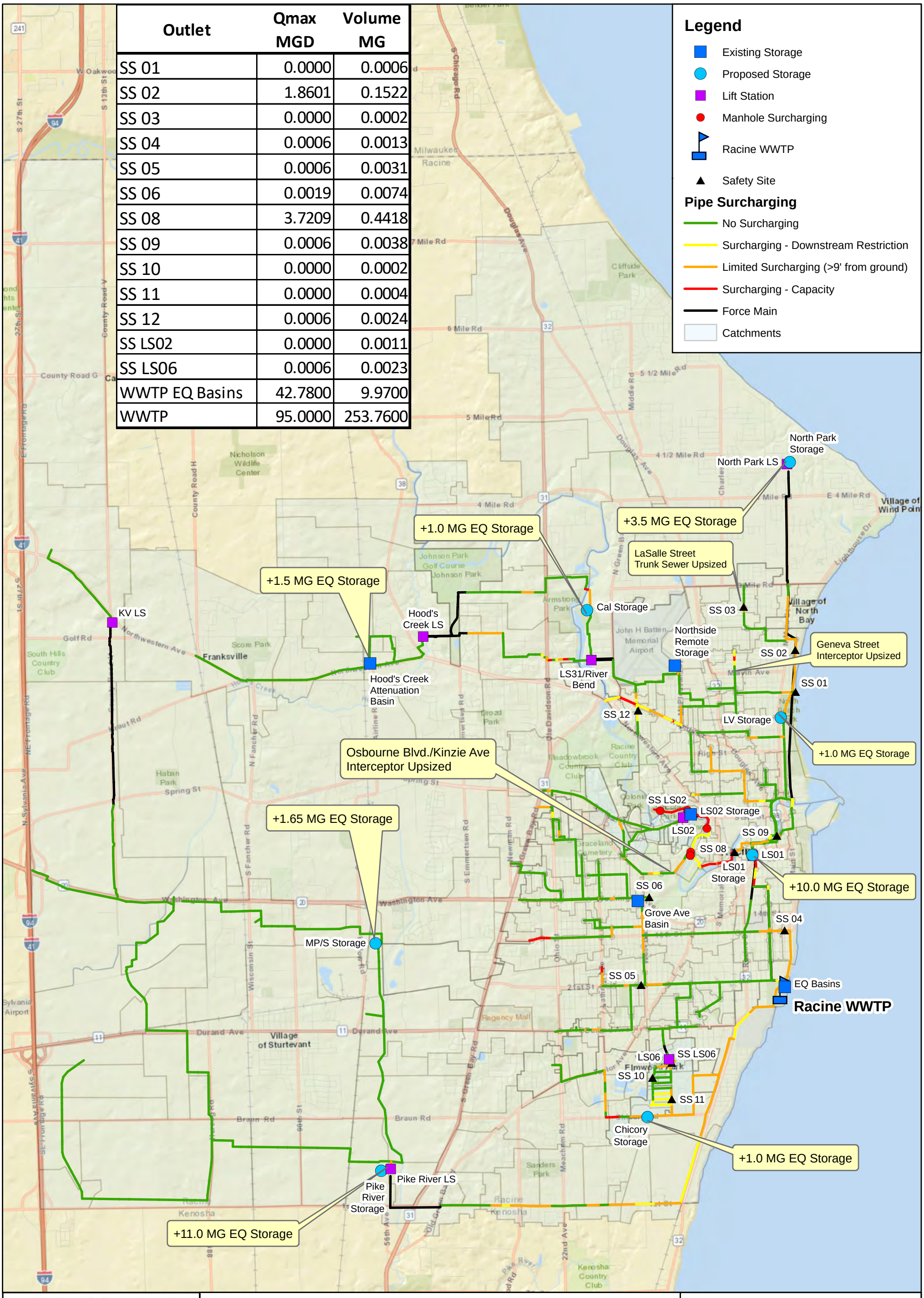
Date:

Project #: 60554970

Racine Facilities Plan
Racine Wastewater Utility

0 0.5 1 2 Miles

Outlet	Qmax MGD	Volume MG
SS 01	0.0000	0.0006
SS 02	1.8601	0.1522
SS 03	0.0000	0.0002
SS 04	0.0006	0.0013
SS 05	0.0006	0.0031
SS 06	0.0019	0.0074
SS 08	3.7209	0.4418
SS 09	0.0006	0.0038
SS 10	0.0000	0.0002
SS 11	0.0000	0.0004
SS 12	0.0006	0.0024
SS LS02	0.0000	0.0011
SS LS06	0.0006	0.0023
WWTP EQ Basins	42.7800	9.9700
WWTP	95.0000	253.7600



AECOM

Figure C-3 - 2040 Baseline Condition

Projection: NAD_1927_StatePlane_Wisconsin_South_FIPS_4803

Drawn By: JFP

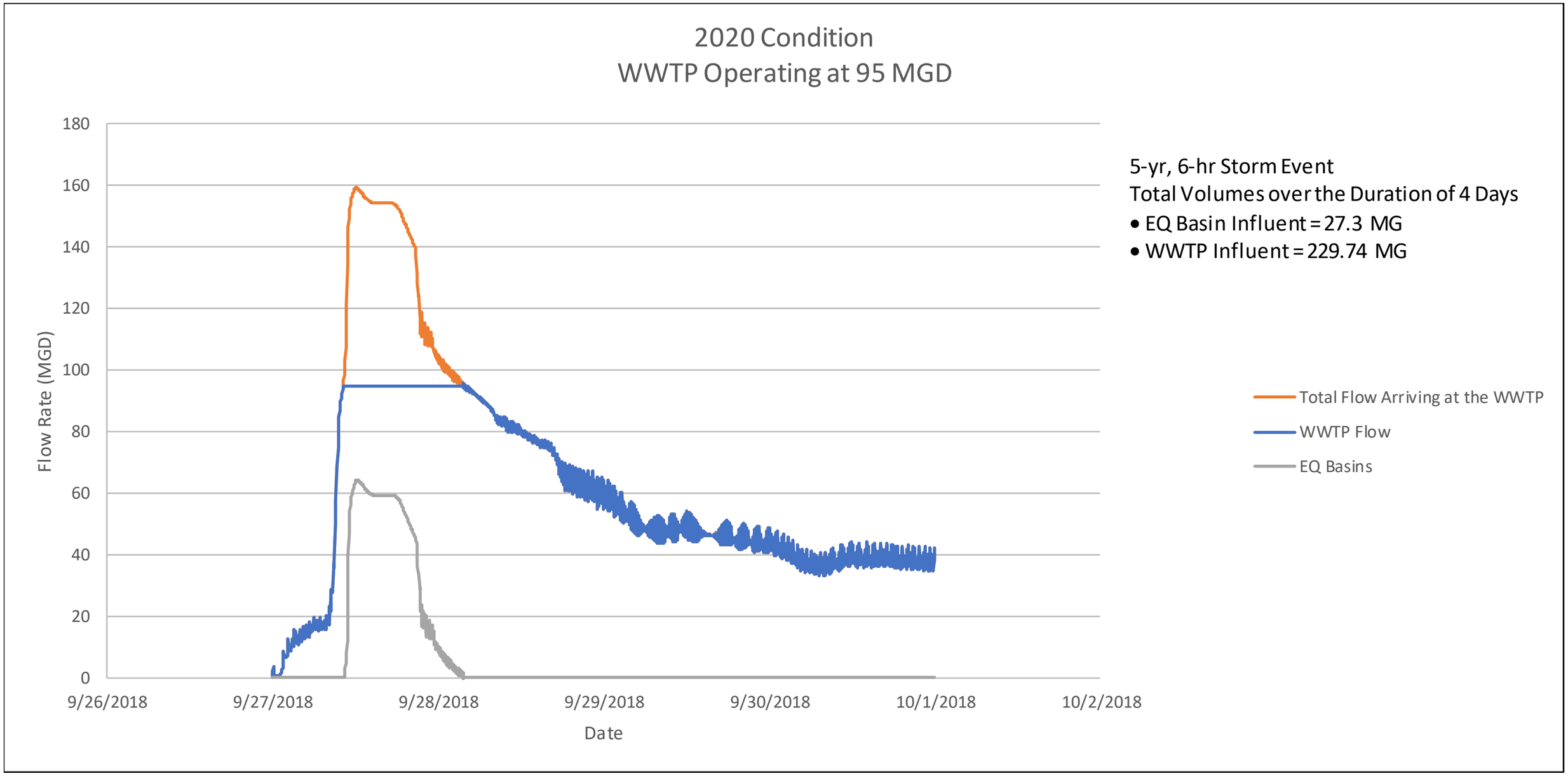
Checked By:

Date:

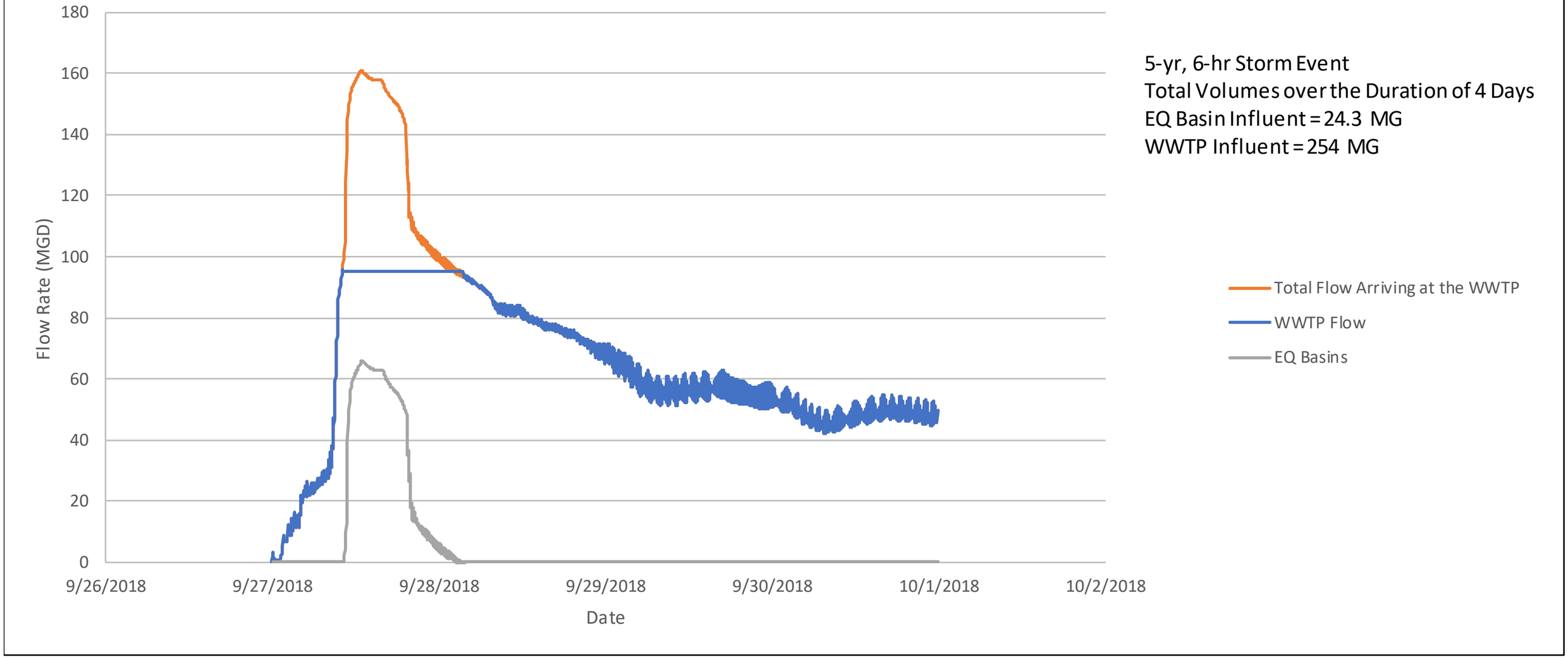
Project #: 60554970

Racine Facilities Plan
Racine Wastewater Utility

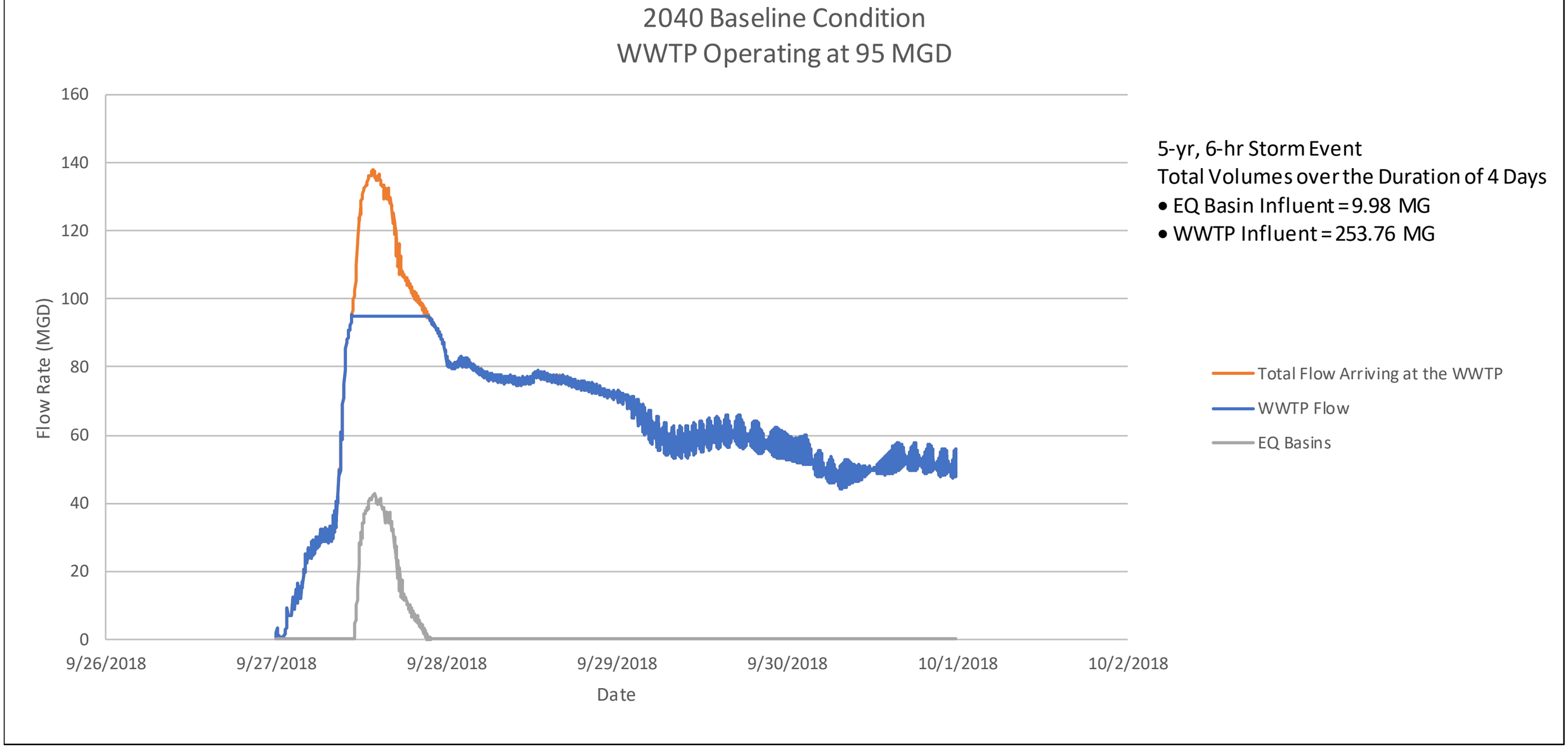
0 0.5 1 2 Miles



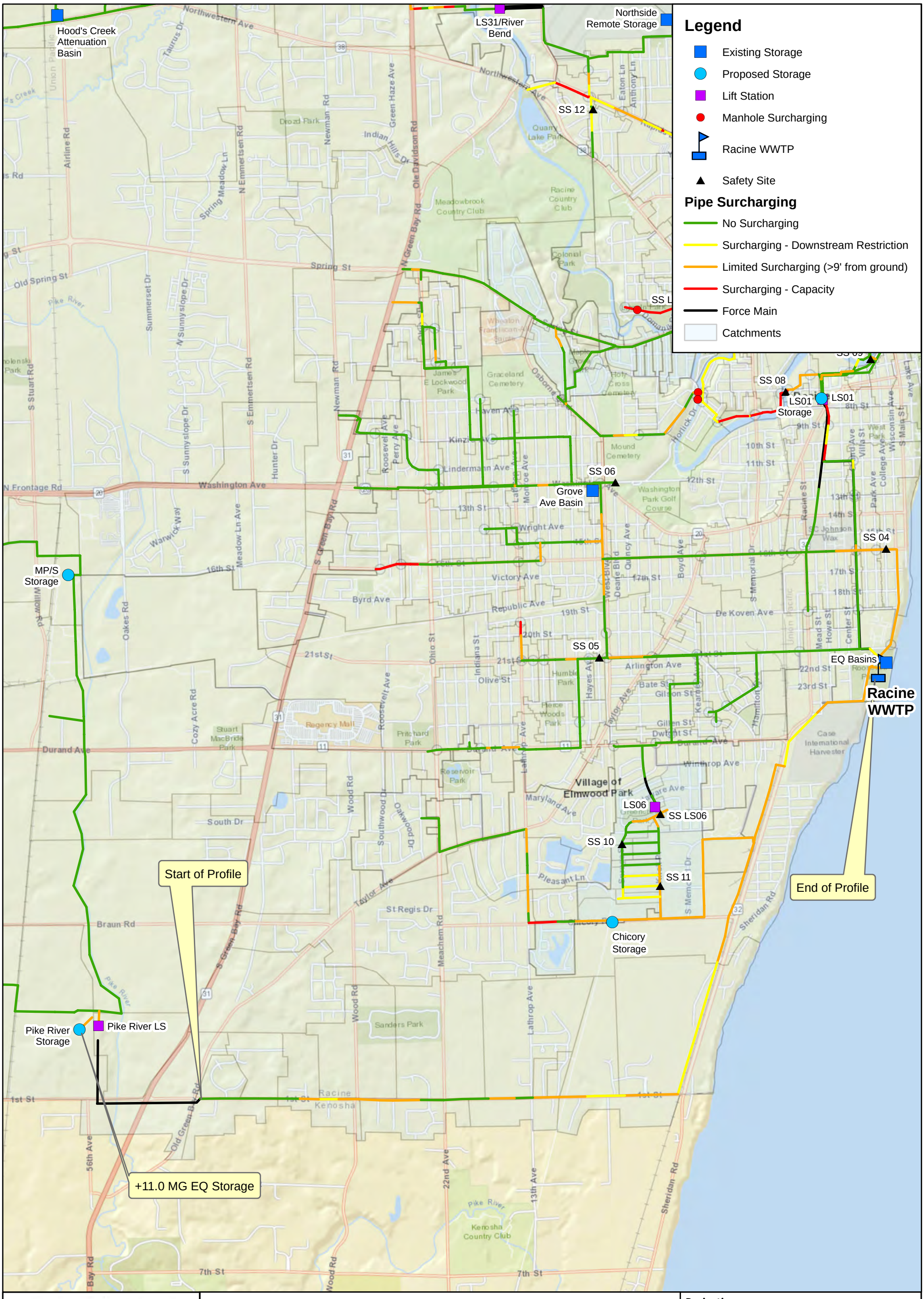
AECOM	**Figure C-4** **2020 WWTP Influent Hydrograph**
Drawn By: JFP	Racine Facilities Plan Racine Wastewater Utility
Checked By:	
Date:	
Project #: 60554970	



AECOM	**Figure C-5** **2030 WWTP Influent Hydrograph**
Drawn By: JFP	Racine Facilities Plan Racine Wastewater Utility
Checked By:	
Date:	
Project #: 60554970	



AECOM	**Figure C-6** **2040 Baseline WWTP Influent Hydrograph**
Drawn By: JFP	Racine Facilities Plan Racine Wastewater Utility
Checked By:	
Date:	
Project #: 60554970	



AECOM

Figure C-7 - Mount Pleasant/Sturtevant Interceptor
2040 Baseline Condition

Projection:
NAD_1983_2011_StatePlane_Wisconsin_South_FIPS_4803_Ft_US

Drawn By: JFP
Checked By:
Date:
Project #: 60554970

Racine Facilities Plan
Racine Wastewater Utility

N
0 0.5 1 Miles

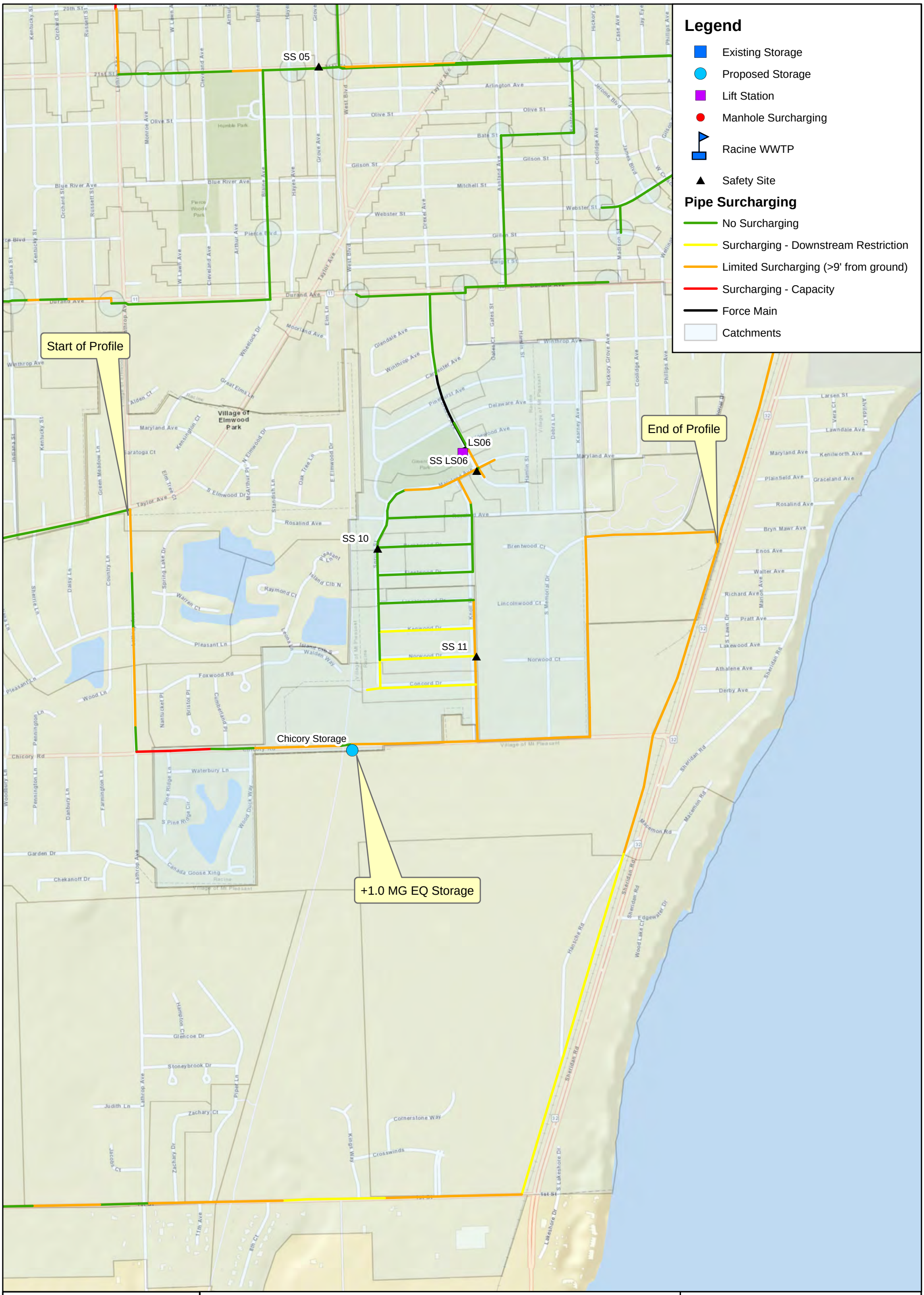
Figure C-8 - 2020 Condition - Mount Pleasant/Surtevant Interceptor

5-year, 6-hour Event

| Discharge | | |

Figure C-9 - 2040 Baseline Condition - Mount Pleasant/Sturtevant Interceptor
5-year, 6-hour Event

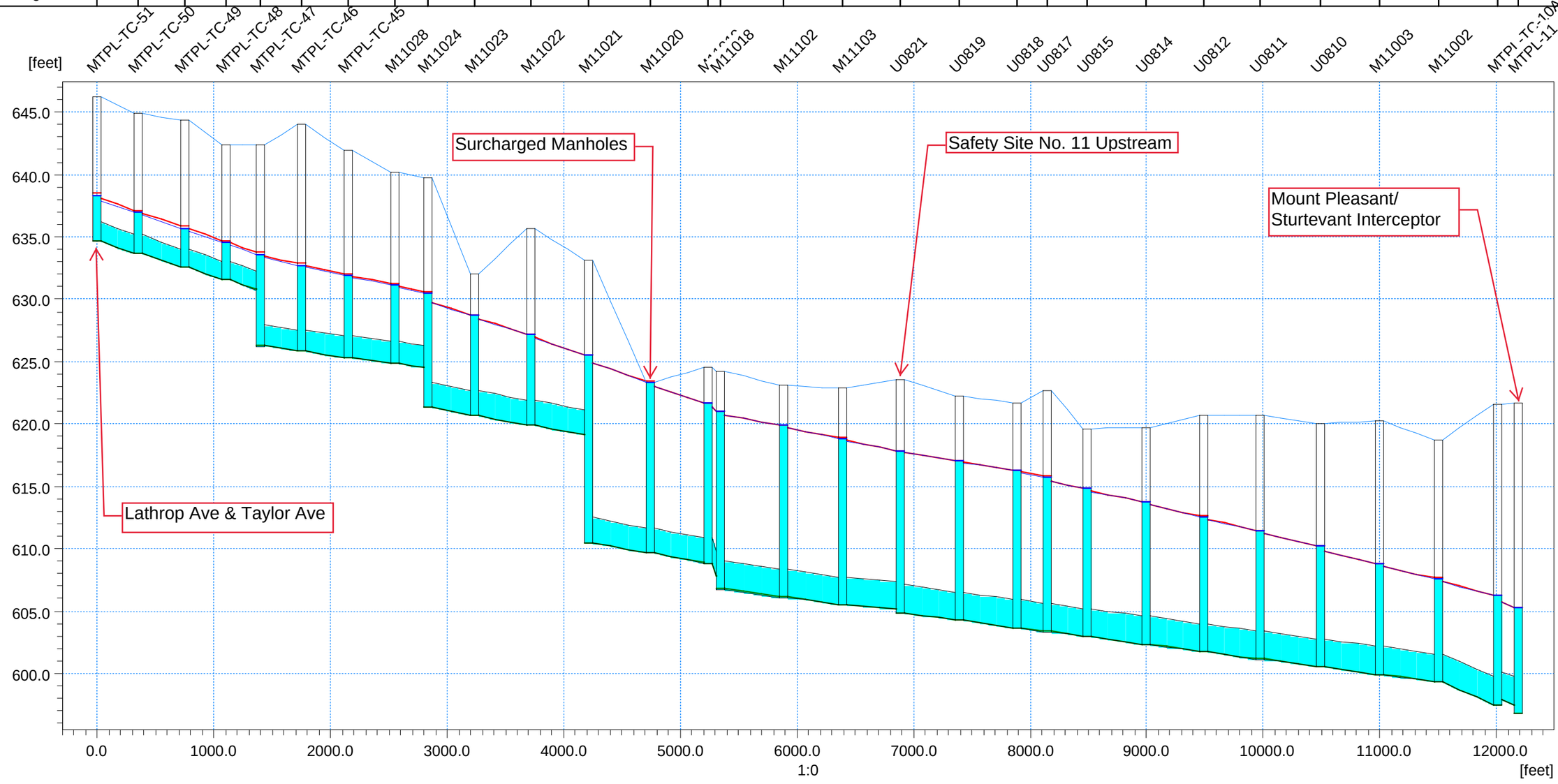
| Discharge | | |



AECOM	**Figure C-10 - Chicory Road Interceptor 2040 Baseline Condition**	**Projection:** NAD_1983_2011_StatePlane_Wisconsin_South_FIPS_4803_Ft_US
Drawn By: JFP	Racine Facilities Plan Racine Wastewater Utility	0 0.25 Miles
Checked By:		
Date:		
Project #: 60554970		

Figure C-11 - 2020 Condition - Chicory Road Interceptor
5-year, 6-hour Event

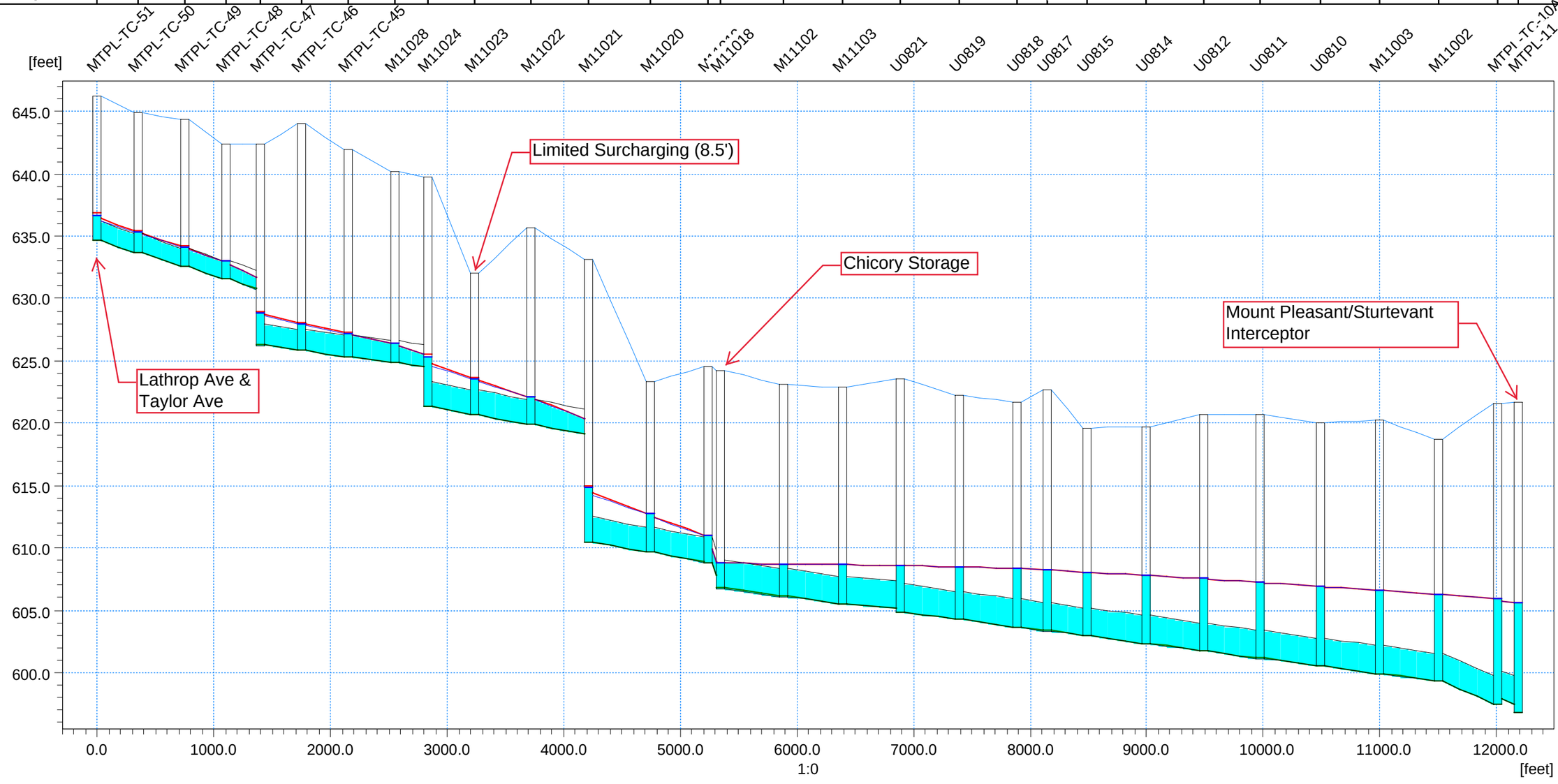
Discharge	5.912	5.910	5.908		7.074	7.072	7.071			12.544	12.887	13.419	13.224		13.586	13.586	13.586	11.998	11.997			13.843	14.692	14.692	14.692	14.691	14.691	16.012			cfs



Ground Lev.	646.26	644.87	644.35	642.37	642.35	644.02	641.94	640.16	639.70	632.06	635.70	633.10	623.35	624.55	623.10	622.86	623.51	622.26	621.66	622.65	619.64	619.74	620.64	620.65	620.03	620.22	618.72	621.60		[ft]
Invert lev.	634.66	633.67	632.55	631.57	626.25	625.82	625.34	624.86	621.30	620.66	619.90	610.50	609.65	608.85	606.10	605.46	604.86	604.26	603.66	603.35	602.94	602.34	601.74	601.15	600.53	599.92	599.32	597.50		[ft]
Length										477.00	499.00	527.00	500.00		541.00	499.00	503.00	498.00	497.00			501.00	500.00	477.00	521.00	510.00	500.00	511.00			[ft]
Diameter	1.50	1.50	1.50		1.75	1.75	1.75		2.00	2.00	2.00	2.00	2.00		2.25	2.25	2.25	2.25	2.25		2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25			[ft]
Slope ft./100ft.	2.82	2.80	2.77		1.22	1.19	1.22		1.61	1.59	1.60	1.61	1.58		1.22	1.20	0.60	1.20	1.21		1.19	1.20	1.20	1.24	1.19	1.20	1.20	3.56			

Figure C-12 - 2040 Baseline Condition - Chicory Road Interceptor
5-year, 6-hour Event

Discharge	5.915	5.914	5.913		7.065	7.065	7.064			12.469	12.808	13.331	13.331		3.492	3.491	3.491	4.576	4.576		6.523	6.522	7.361	7.360	7.359	7.358	7.357	8.665			cfs



Ground Lev.	646.26	644.87	644.35	631.57	642.35	644.02	641.94	640.16	639.70	632.06	635.70	633.10	623.35	624.55	623.10	622.86	623.51	622.26	621.66	622.65	619.64	619.74	620.64	620.65	620.03	620.22	618.72	621.60		[ft]
Invert lev.	634.66	633.67	632.55	631.57	626.25	625.82	625.34	624.86	621.30	620.66	619.90	610.50	609.65	608.85	606.10	605.46	604.86	604.26	603.66	603.35	602.94	602.34	601.74	601.15	600.53	599.92	599.32	597.50		[ft]
Length										477.00	499.00	527.00	500.00		541.00	499.00	503.00	498.00	497.00			501.00	500.00	477.00	521.00	510.00	500.00	511.00			[ft]
Diameter	1.50	1.50	1.50		1.75	1.75	1.75		2.00	2.00	2.00	2.00	2.00		2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25			[ft]
Slope ft./100ft.	2.82	2.80	2.77		1.22	1.19	1.22		1.61	1.59	1.60	1.61	1.58		1.22	1.20	0.60	1.20	1.21		1.19	1.20	1.20	1.24	1.19	1.20	1.20	3.56			

Legend

- Existing Storage
- Proposed Storage
- Lift Station
- Manhole Surcharging
- Racine WWTP
- Safety Site

Pipe Surcharging

- No Surcharging
- Surcharging - Downstream Restriction
- Limited Surcharging (>9' from ground)
- Surcharging - Capacity
- Force Main
- Catchments

+3.5 MG EQ Storage

North Park Storage

North Park LS

SS 03

SS 02

Village of Wind Point

Village of North Bay

Shoop Park Golf Course

Ives

Figure C-13 - North Park Storage 2040 Baseline Condition

Projection: NAD_1983_2011_StatePlane_Wisconsin_South_FIPS_4803_Ft_US

Drawn By: JFP

Checked By:

Date:

Project #: 60554970

Racine Facilities Plan
Racine Wastewater Utility

0 0.25 0.5 Miles

Legend

- Existing Storage
- Proposed Storage
- Lift Station
- Manhole Surcharging
- Racine WWTP
- Safety Site

Pipe Surcharging

- No Surcharging
- Surcharging - Downstream Restriction
- Limited Surcharging (>9' from ground)
- Surcharging - Capacity
- Force Main
- Catchments

Hood's Creek LS

Hood's Creek Attenuation Basin

+1.5 MG EQ Storage

Figure C-14 - Hood's Creek Attenuation Basin 2040 Baseline Condition

Drawn By: JFP

Checked By:

Date:

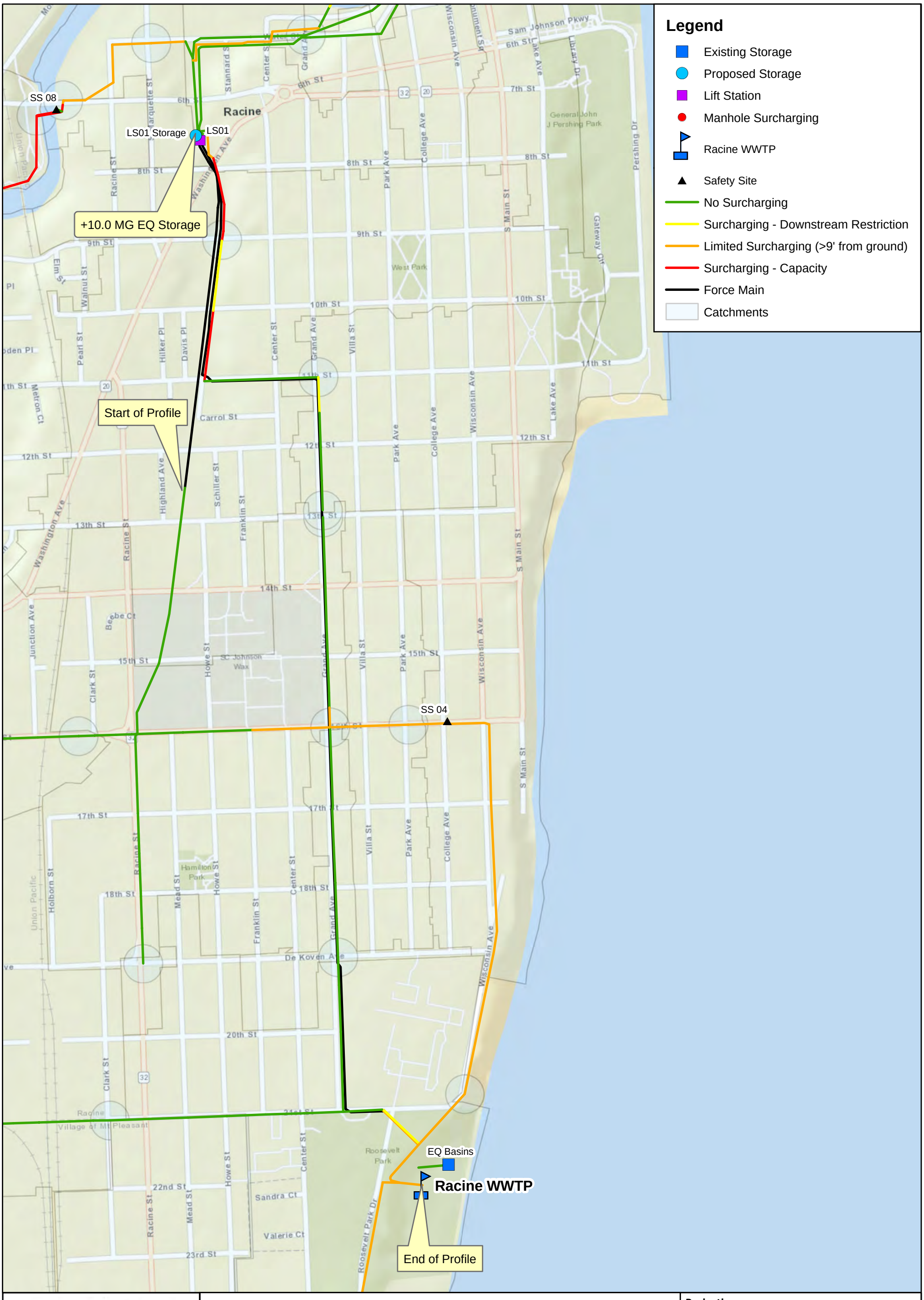
Project #: 60554970

Racine Facilities Plan
Racine Wastewater Utility

Projection:
NAD_1983_2011_StatePlane_Wisconsin_South_FIPS_4803_Ft_US

N

0 0.25 0.5 Miles



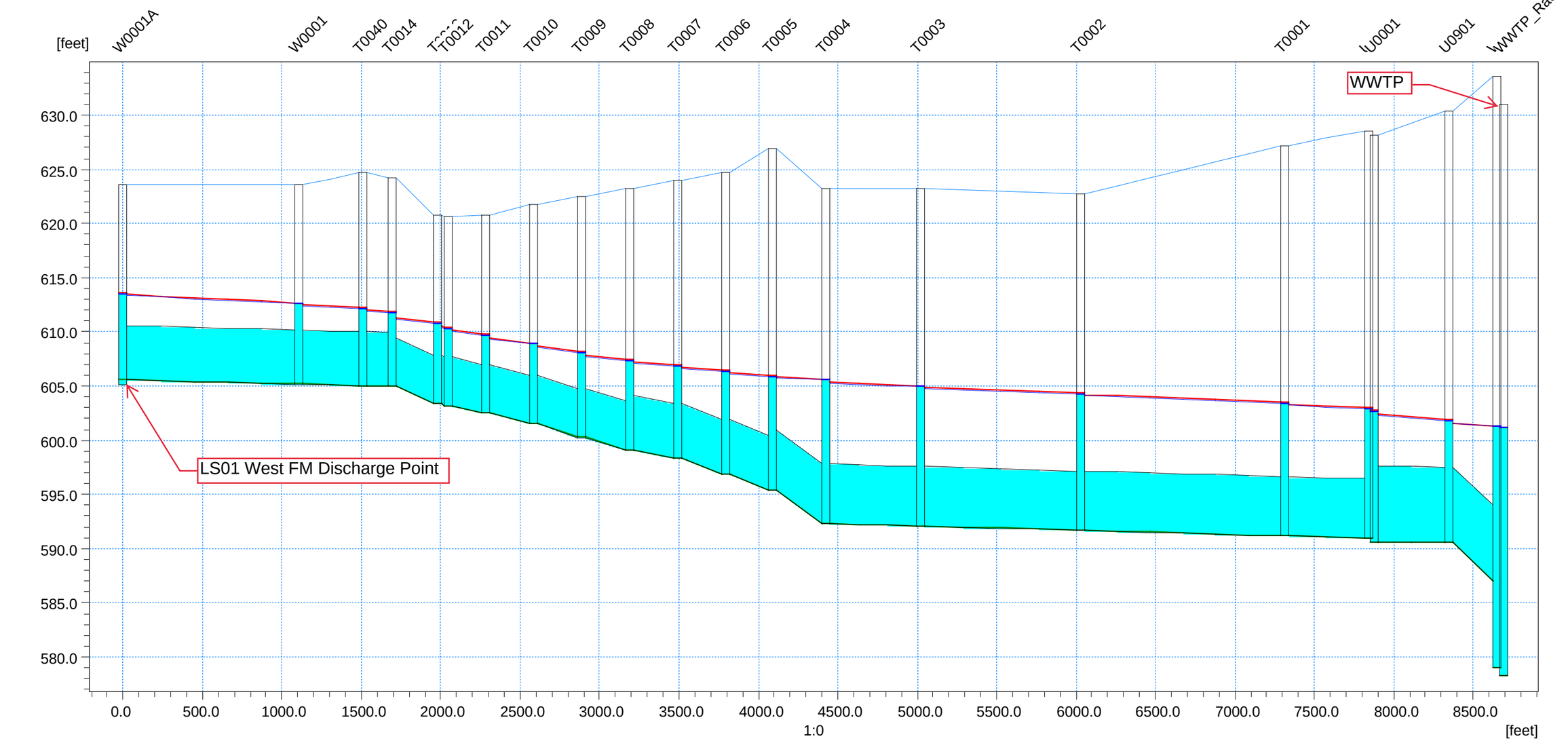
AECOM

Figure C-15 - Lift Station No. 01 EQ Storage
2040 Baseline Condition

Drawn By: JFP	Racine Facilities Plan
Checked By:	Racine Wastewater Utility
Date:	
Project #: 60554970	

Figure C-16 - 2020 Condition - LS01 Downstream Interceptor
5-year, 6-hour Event

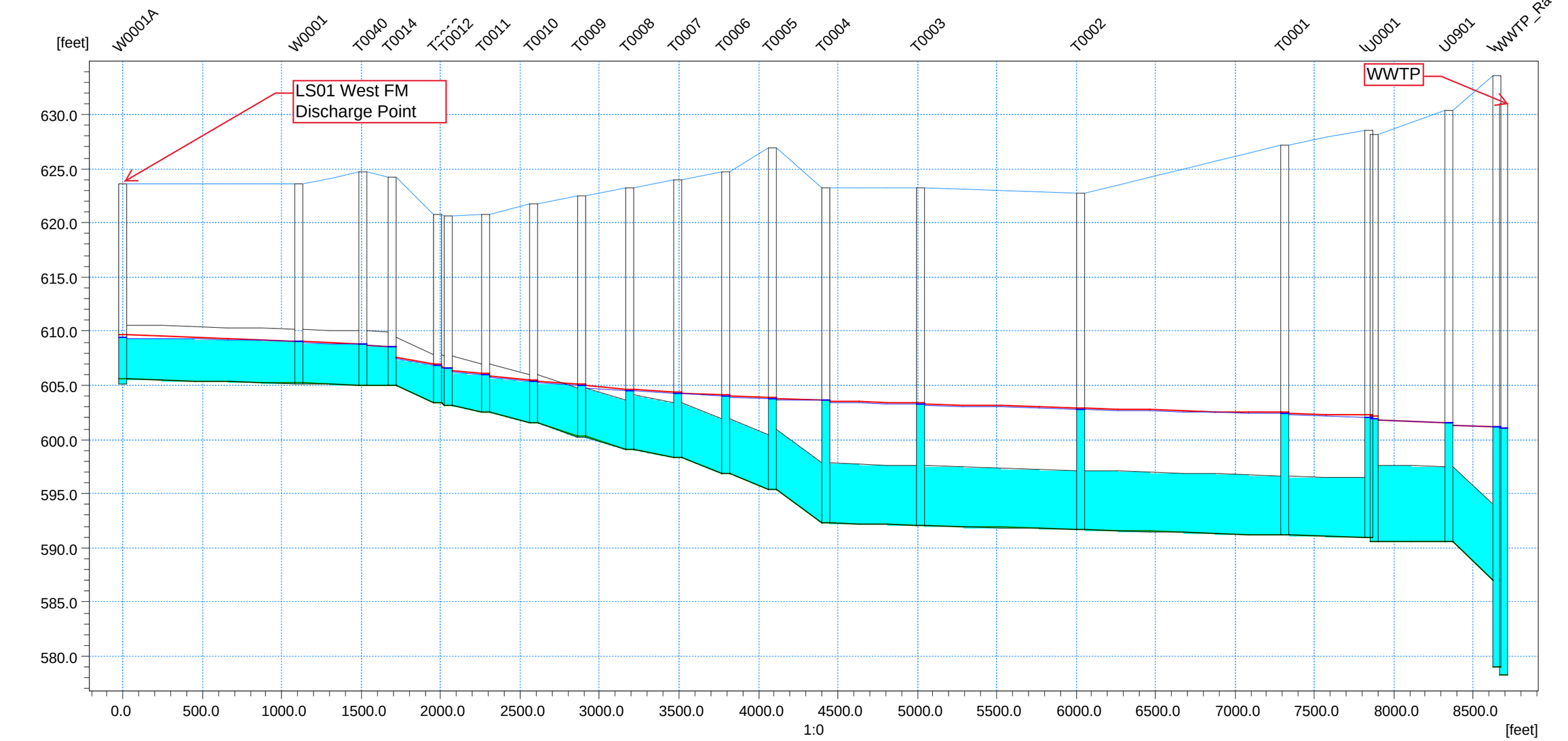
Discharge	67.130	67.139					73.063	73.067	73.071	73.522	73.525	74.778	74.781	74.785	74.793	74.803	75.236	177.397		cfs



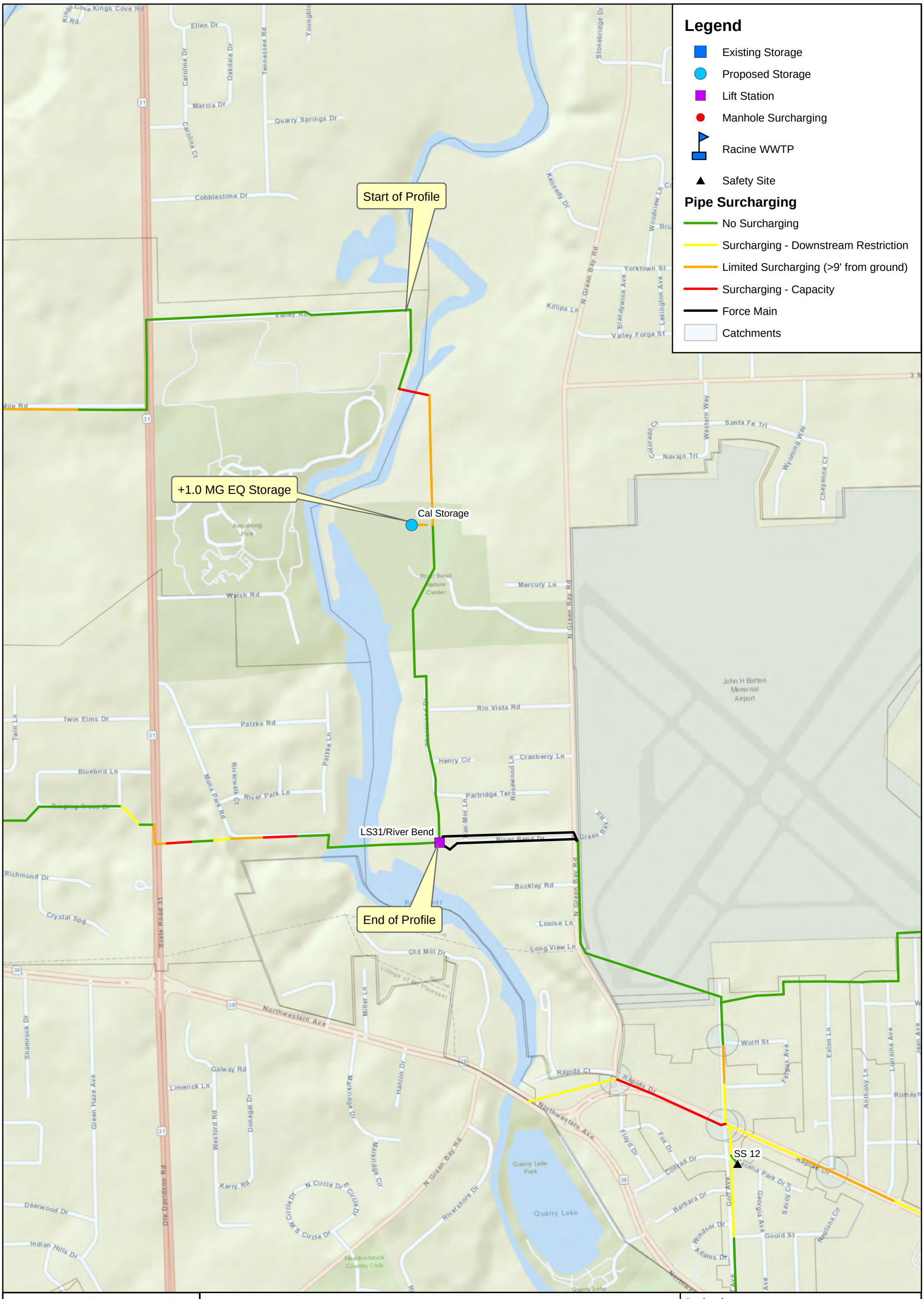
Ground Lev.	623.60		623.60		624.70	624.21	620.71		620.71	621.71	622.51	623.21	624.01	624.71	626.96	623.21	623.20	622.70	627.20	628.58	630.40	633.61	[ft]
Invert lev.	605.19		605.19		605.03	604.96	603.39		602.52	601.55	600.26	599.12	598.36	596.88	595.44	592.31	592.08	591.68	591.16	590.95	590.55	579.00	[ft]
Length		1109.89		400.83		4.50		4.50	4.50	4.50	4.50	5.00	5.00	5.00	333.57	598.74	1005.90	1288.74	523.05	471.00			[ft]
Diameter		5.00		5.00		4.50		4.50	4.50	4.50	4.50	5.00	5.00	5.00	5.50	5.50	5.50	5.50	5.50	7.00	7.00		[ft]
Slope ft./100ft.		0.34		0.40		5.50		2.88	3.21	4.31	3.77	2.51	4.89	4.85	9.38	0.38	0.40	0.40	0.40	0.17	11.75		

Figure C-17 - 2040 Baseline Condition - LS01 Downstream Interceptor
5-year, 6-hour Event

Discharge	43.178	50.590					55.676	55.610	55.594	55.927	55.924	56.912	56.910	56.908	56.905	56.903	57.232	130.733		cfs



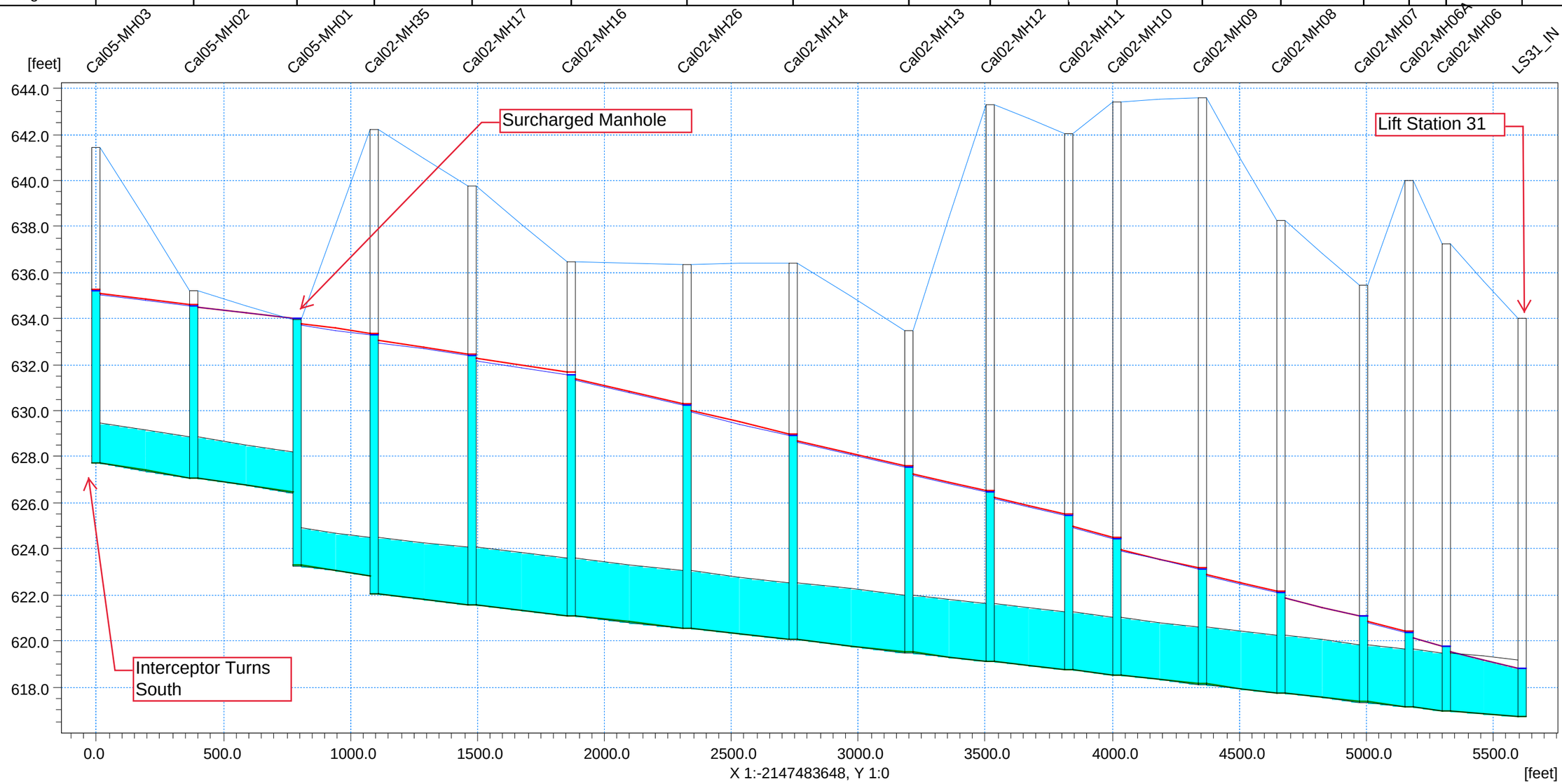
Ground Lev.	623.60		623.60		624.70	624.21	620.71		620.71		621.71	622.51	623.21	624.01	624.71	626.96	623.21		623.20		622.70		627.20	628.58		630.40	633.61	[ft]
Invert lev.	605.19		605.19		605.03	604.96	603.39		602.52		601.55	600.26	599.12	598.36	596.88	595.44	592.31		592.08		591.68		591.16	590.95		590.55	579.00	[ft]
Length		1109.89		400.83				4.50		4.50							333.57	598.74		1005.90		1288.74		523.05		471.00			[ft]
Diameter		5.00		5.00		4.50			4.50		4.50	4.50	5.00	5.00	5.00	5.50	5.50		5.50			5.50		5.50		7.00	7.00		[ft]
Slope ft./100ft.		0.34		0.40		5.50		2.88		3.21		4.31	3.77	2.51	4.89	4.85	9.38	0.38		0.40		0.40		0.40		0.17	11.75		



AECOM	**Figure C-18 - Caledonia Storage** **2040 Baseline Condition**	**Projection:** NAD_1983_2011_StatePlane_Wisconsin_South_FIPS_4803_Ft_US
Drawn By: JFP	Racine Facilities Plan Racine Wastewater Utility	N 0 0.25 Miles
Checked By:		
Date:		
Project #: 60554970		

Figure C-19 - 2020 Condition - LS31 Upstream Interceptor
5-year, 6-hour Event

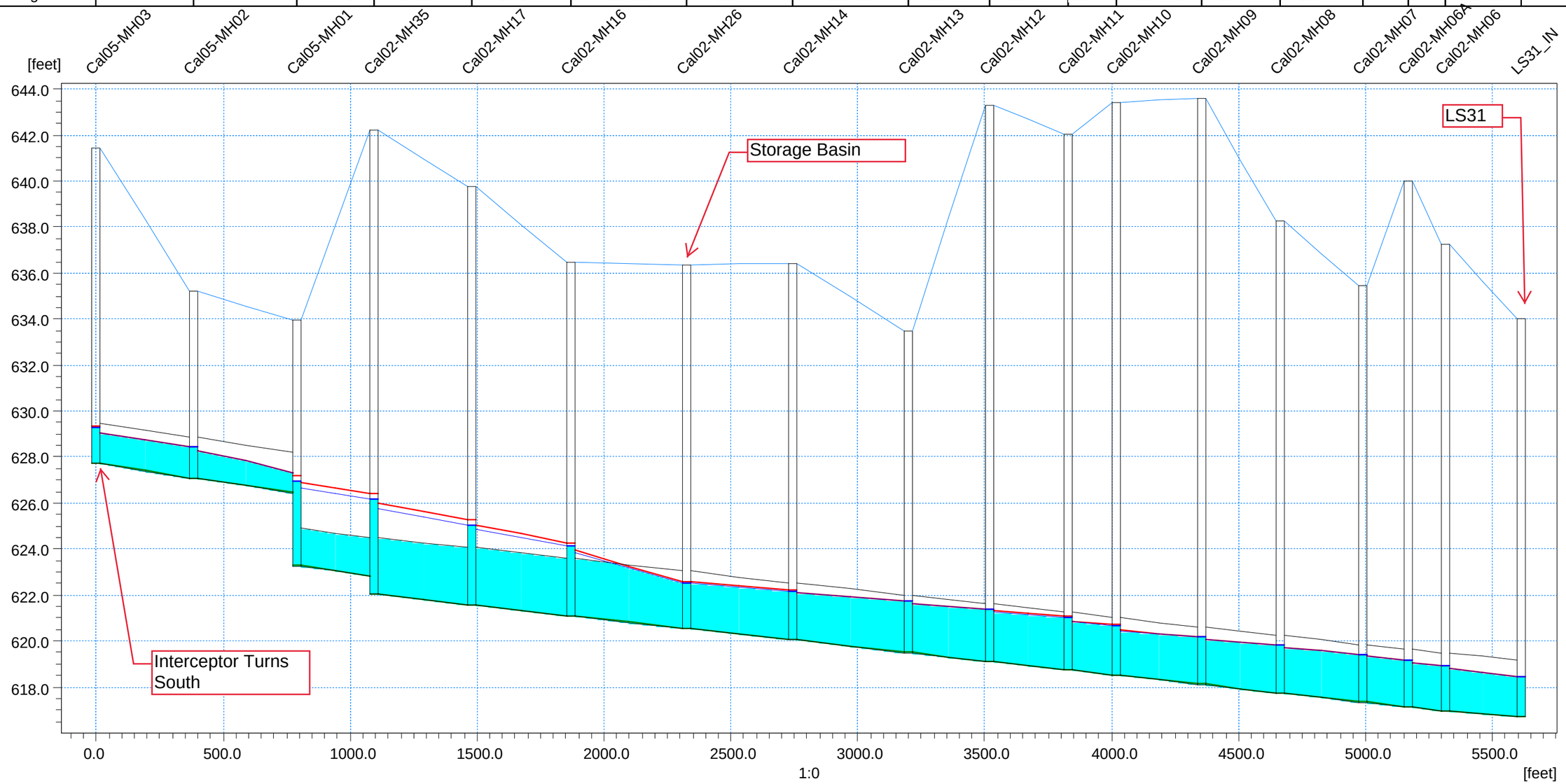
Discharge	5.288	5.288	5.186	15.597	15.597	19.490	19.490	19.489	19.489	19.488	19.488	19.488	19.488	19.487			19.487	cfs



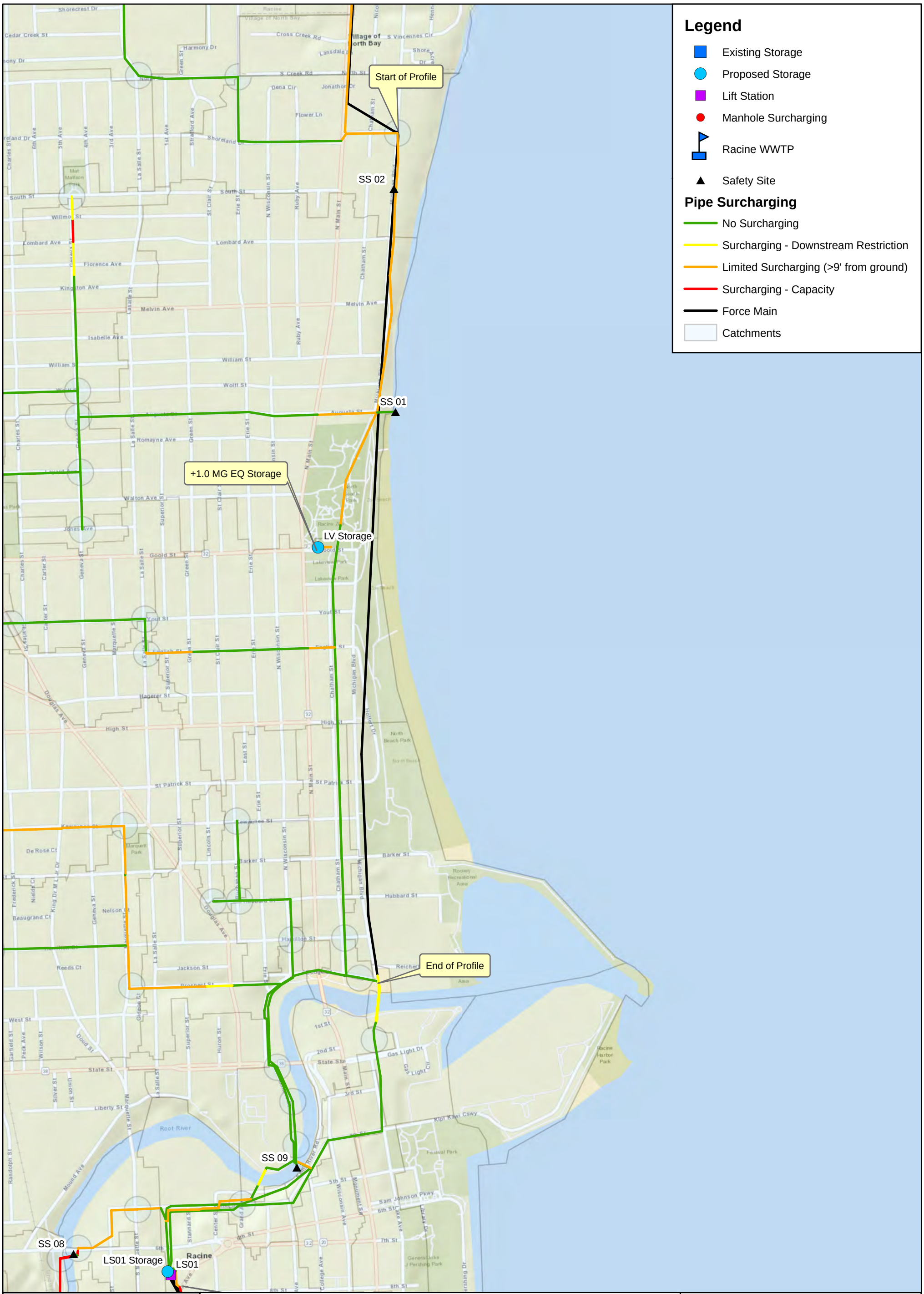
Ground Lev.	641.41	635.19	633.97	642.22	639.75	636.48	636.34	636.44	633.49	643.31	642.04	643.41	643.61	638.25	635.44	640.00	637.25		[ft]
Invert lev.	627.71	627.09	623.27	622.02	621.55	621.08	620.54	620.04	619.49	619.11	618.74	618.51	618.11	617.73	617.34	617.13	616.95		[ft]
Length	383.10	409.70	301.10	387.40	391.00	451.00	420.00	457.80	315.60	311.00		335.40	310.60	327.50			295.30		[ft]
Diameter	1.75	1.75	1.67	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50		[ft]
Slope ft./100ft.	1.62	1.59	1.56	1.21	1.20	1.20	1.19	1.20	1.20	1.19	1.21	1.19	1.22	1.25	1.20	1.20	0.85		

Figure C-20 - 2040 Condition - LS31 Upstream Interceptor
5-year, 6-hour Event

Discharge	5.494	5.497	5.502	17.295	17.299	21.312	11.373	11.411	11.443	11.460	11.474	11.481	11.493	11.504			11.522	cfs



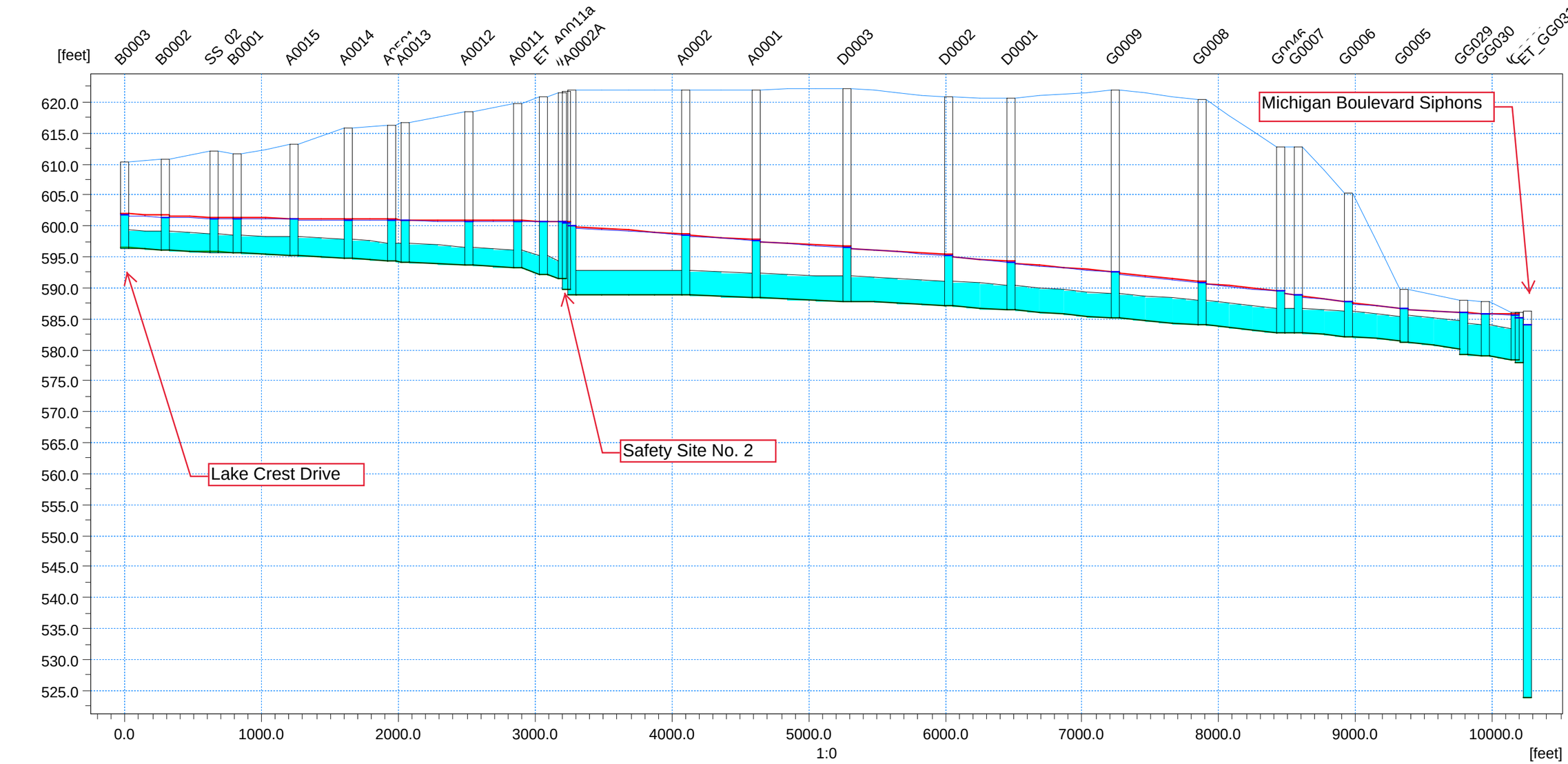
Ground Lev.	641.41	635.19	633.97	642.22	639.75	636.48	636.34	636.44	633.49	643.31	642.04	643.41	643.61	638.25	635.44	640.00	637.25		[ft]
Invert lev.	627.71	627.09	623.27	622.02	621.55	621.08	620.54	620.04	619.49	619.11	618.74	618.51	618.11	617.73	617.34	617.13	616.95		[ft]
Length	383.10	409.70	301.10	387.40	391.00	451.00	420.00	457.80	315.60	311.00		335.40	310.60	327.50			295.30		[ft]
Diameter	1.75	1.75	1.67	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50		[ft]
Slope ft./100ft.	1.62	1.59	1.56	1.21	1.20	1.20	1.19	1.20	1.20	1.19	1.21	1.19	1.22	1.25	1.20	1.20	0.85		



AECOM	**Figure C-21 - Michigan Boulevard Interceptor 2040 Baseline Condition**	**Projection:** NAD_1983_2011_StatePlane_Wisconsin_South_FIPS_4803_Ft_US
Drawn By: JFP	Racine Facilities Plan Racine Wastewater Utility	0 0.25 Miles
Checked By:		
Date:		
Project #: 60554970		

Figure C-22 - 2020 Condition - Michigan Boulevard
5-year, 6-hour Event

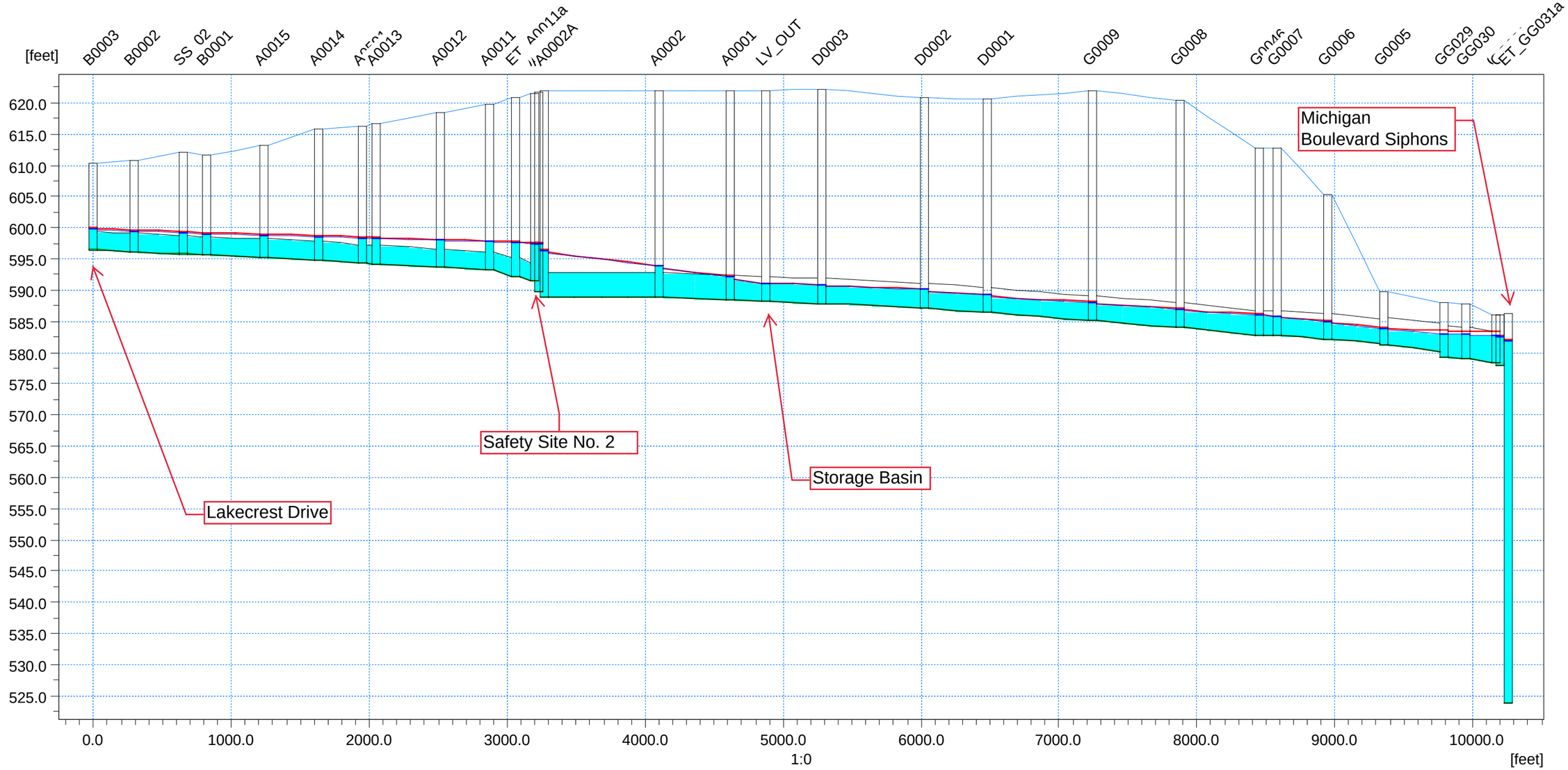
Discharge		15.745		7.975	7.970	7.964		7.955	7.949				50.024	50.014	50.005	49.996	56.808	56.804	56.800	56.797		56.794	56.792	57.865							cfs



Ground Lev.	610.30	610.77	612.00	611.60	613.20	615.70	616.20		618.35	619.70	620.75	621.70		622.00	622.00	622.21	620.81	620.64	621.90	620.47	612.70	605.20	589.70	588.01	586.00						[ft]
Invert lev.	596.42	596.12	595.77	595.60	595.19	594.79	594.29		593.62	593.19	592.20	589.67		588.90	588.44	587.85	587.16	586.36	585.06	583.98	582.78	582.16	581.15	579.19	578.40						[ft]
Length				411.22	403.08		464.00						835.41		519.25	657.08	749.87	452.00	765.94	632.49	571.02			404.29	434.48						[ft]
Diameter	3.00	3.00		3.00	3.00	3.00	3.00		3.00				4.00		4.00	4.00	4.00	4.00	4.00	4.00	4.00		4.00	4.00	4.50						[ft]
Slope ft./100ft.	1.01	0.98		1.00	0.99	1.62	1.21		1.20				0.00		0.89	0.90	0.92	1.77	1.70	1.71	2.10		1.67	1.71	2.16						

Figure C-23 - 2040 Baseline Condition - Michigan Boulevard
5-year, 6-hour Event

Discharge		16.138		13.972	13.962			13.948	13.946				67.705	67.693		33.924	33.899	40.713	40.687	40.642	40.602		40.541	40.466	41.218						cfs



Ground Lev.	610.30	610.77	612.00	611.60	613.20	615.70	616.20		618.35	619.70	620.75	621.70		622.00	622.00	622.00	622.21		620.81	620.64		621.90		620.47	612.70		605.20	589.70	588.01	586.00	[ft]
Invert lev.	596.42	596.12	595.77	595.60	595.19	594.79	594.29		593.62	593.19	592.20	589.67		588.90	588.44	588.22	587.85		587.16	586.36		585.06		583.98	582.78		582.16	581.15	579.19	578.40	[ft]
Length				411.22	403.08			464.00					835.41		519.25		406.51	749.87		452.00	765.94		632.49	571.02			404.29	434.48			[ft]
Diameter	3.00	3.00		3.00	3.00	3.00		3.00	3.00				4.00		4.00	4.00	4.00	4.00		4.00	4.00		4.00	4.00		4.00	4.00	4.50			[ft]
Slope ft./100ft.	1.01	0.98		1.00	0.99	1.62		1.21	1.20				0.00		0.89	0.90	0.90	0.92		1.77	1.70		1.71	2.10		1.67	1.71	2.16			

Legend

- Existing Storage
- Proposed Storage
- Lift Station
- Manhole Surcharging
- Racine WWTP
- Safety Site

Pipe Surcharging

- No Surcharging
- Surcharging - Downstream Restriction
- Limited Surcharging (>9' from ground)
- Surcharging - Capacity
- Force Main
- Catchments

SS LS02

LS02

Start of Profile

Interceptor Upsized

End of Profile

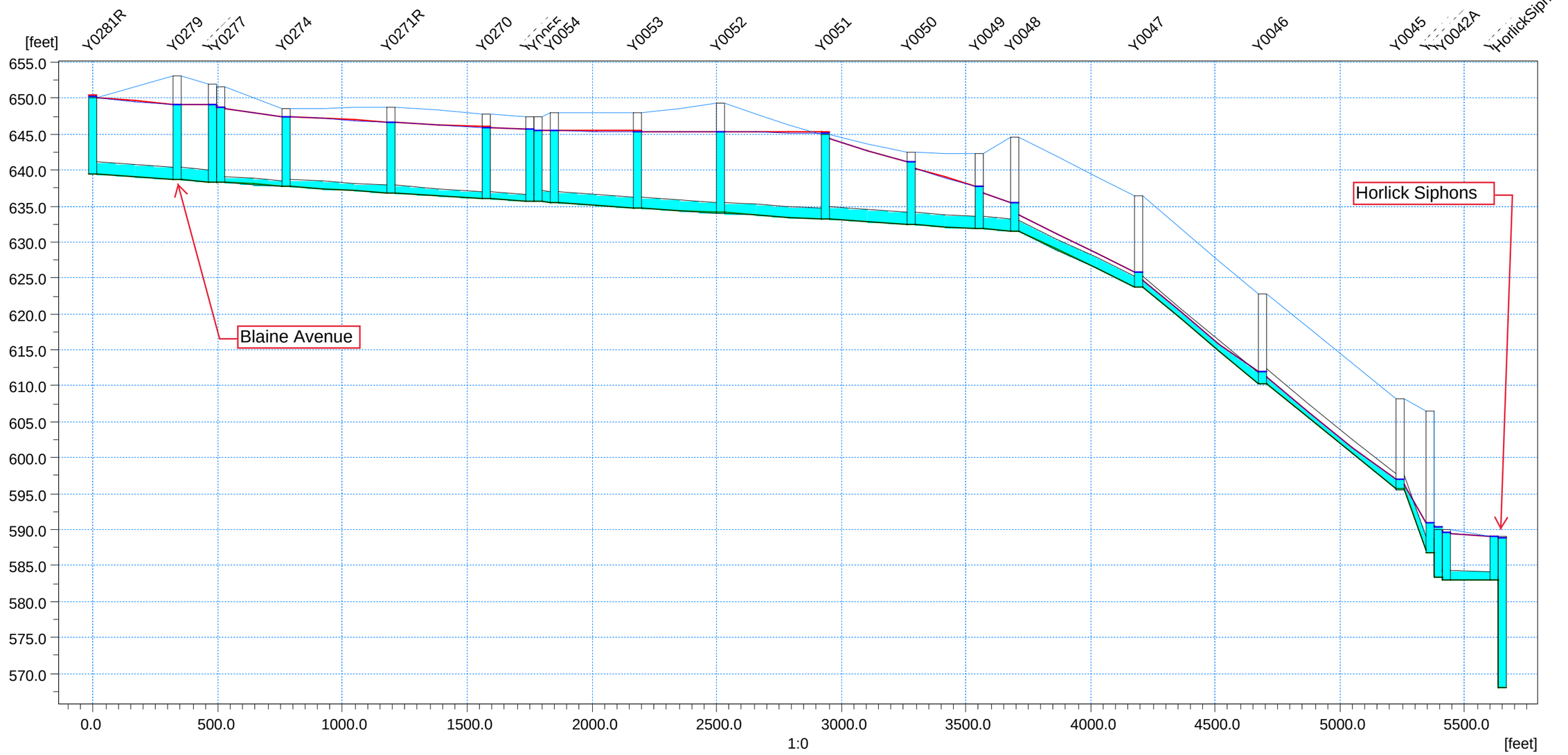
SS 06

Grove Ave Basin

AECOM	**Figure C-24 - Osborne Blvd./Kinzie Avenue Interceptor 2040 Baseline Condition**	**Projection:** NAD_1983_2011_StatePlane_Wisconsin_South_FIPS_4803_Ft_US
Drawn By: JFP	Racine Facilities Plan Racine Wastewater Utility	N 0 0.25 Miles
Checked By:		
Date:		
Project #: 60554970		

Figure C-25 - 2020 Condition - Osborne Blvd./Kinzie Avenue Interceptor
5-year, 6-hour Event

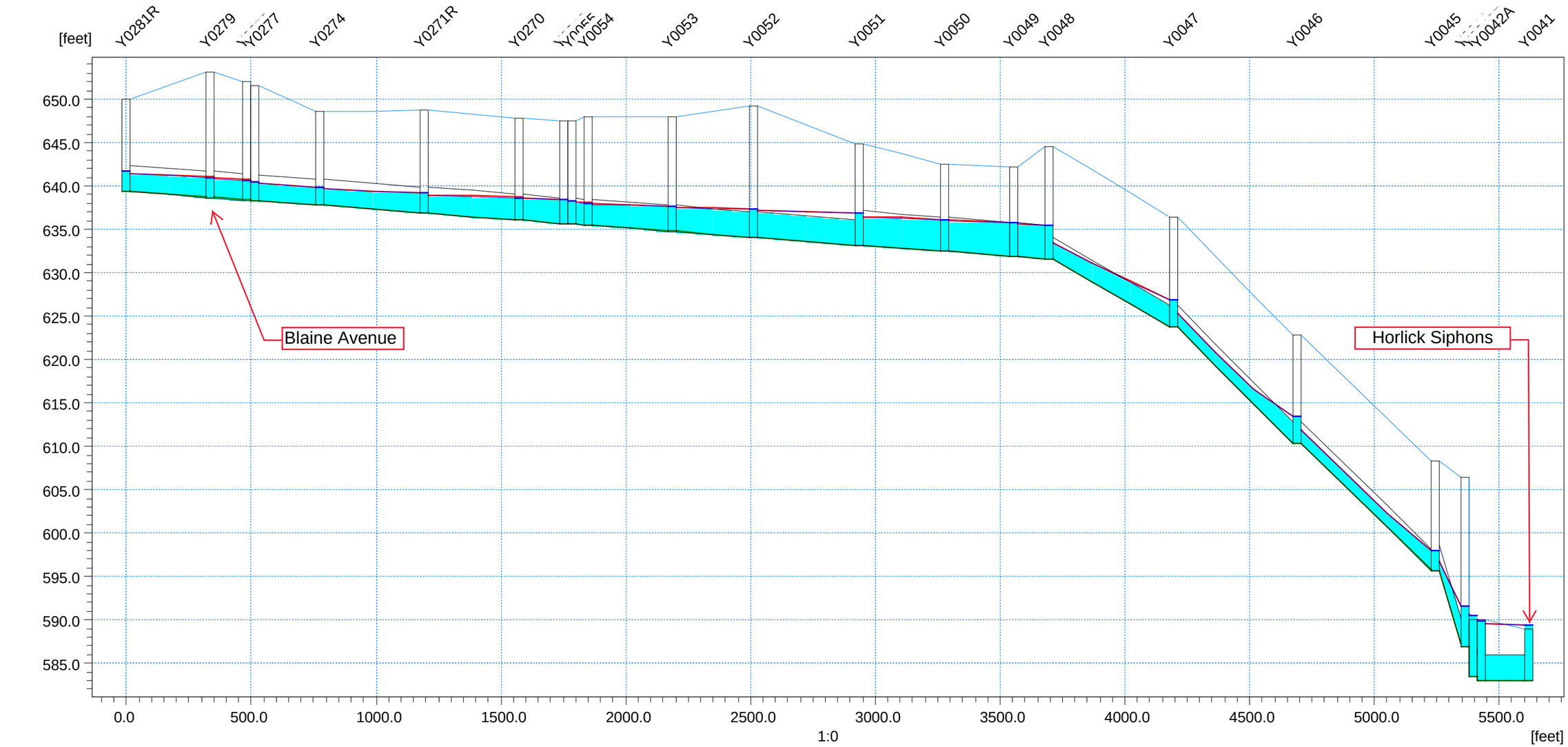
Discharge	9.495		1.588	1.587	1.586	1.585			1.583	1.582	1.581	14.816	14.815		14.814	14.814	14.813			3.299	cfs



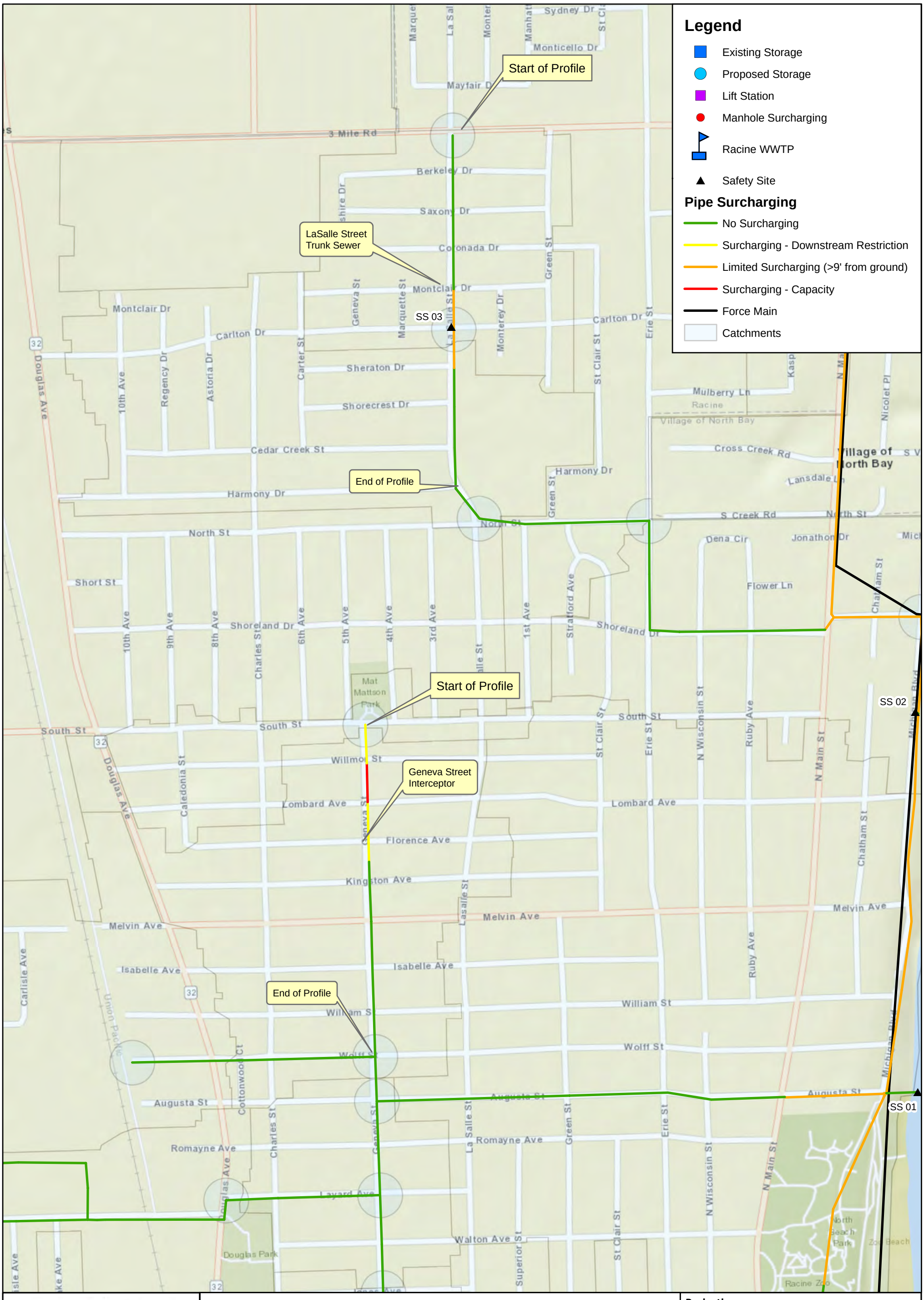
Ground Lev.	650.07		653.16	651.97	648.52		648.81		647.86	647.50	647.92		648.02	649.24		644.87	642.50	642.24	644.53	636.46	622.82		608.24	606.44	588.97	[ft]
Invert lev.	639.38		638.66	638.35	637.76		636.87		636.06	635.67	635.48		634.76	634.06		633.16	632.43	631.84	631.53	623.76	610.32		595.59	586.84	582.96	[ft]
Length		335.50			262.80	416.90		381.20				337.50		329.50	420.00		343.50	276.40		497.00		493.80		555.50			[ft]
Diameter		1.75	1.75		0.83	1.00		1.00	1.00			1.50		1.50	1.50		1.67	1.67	1.67	1.50		1.50		2.00		1.25	[ft]
Slope ft/100ft.		2.15	2.15		2.13	2.13		2.12	2.17			2.13		2.12	2.14		2.13	2.13	2.17	15.63		27.23		26.28		0.43	

Figure C-26 - 2040 Baseline Condition - Osborne Blvd./Kinzie Avenue Interceptor
5-year, 6-hour Event

Discharge	21.187		20.847	20.901	21.017			21.245	21.355	21.387	51.395	51.570		51.659	51.713	51.733			29.621	cfs



Ground Lev.	650.07		653.16	651.97	648.52		648.81		647.86	647.50	647.92		648.02	649.24		644.87	642.50	642.24	644.53		636.46		622.82		608.24	606.44		[ft]
Invert lev.	639.38		638.66	638.35	637.76		636.87		636.06	635.67	635.48		634.76	634.06		633.16	632.43	631.84	631.53		623.76		610.32		595.59	586.84		[ft]
Length		335.50				262.80		416.90		381.20					337.50					329.50		420.00		343.50		276.40		497.00		493.80		555.50		[ft]
Diameter		3.00		3.00		3.00		3.00		3.00					3.00					3.00		3.00		4.00		4.00		4.00		2.50		2.50		2.50		3.00	[ft]
Slope ft./100ft.		2.15		2.15		2.13		2.13		2.12					2.13					2.12		2.14		2.13		2.13		2.17		15.63		27.23		26.28		0.43	



AECOM

Figure C-27 - Geneva Street and Lasalle Street 2040 Baseline Condition

Drawn By: JFP

Checked By:

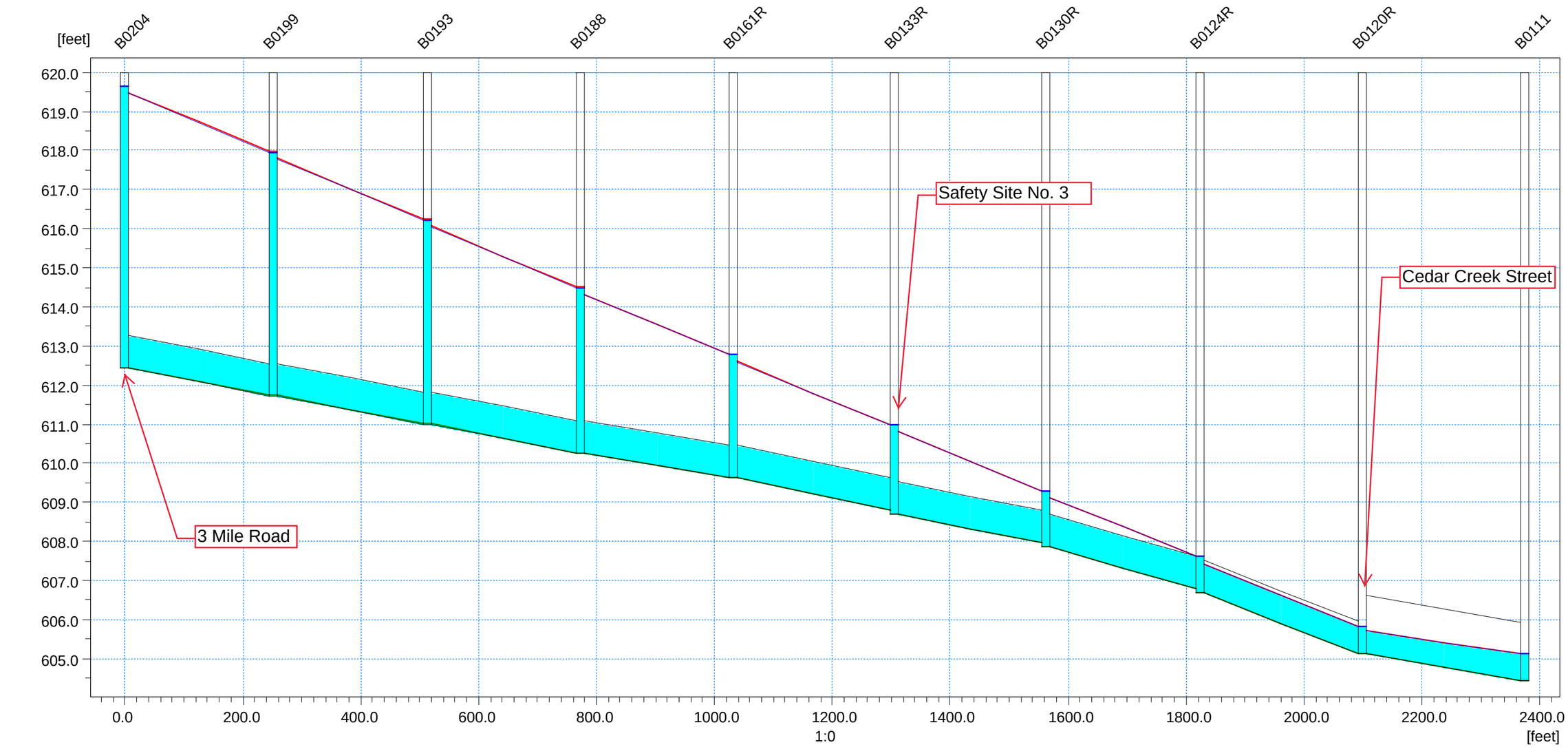
Date:

Project #: 60554970

Racine Facilities Plan
Racine Wastewater Utility

Figure C-28 - 2020 Condition - LaSalle Street Trunk Sewer
5-year, 6-hour Event

Discharge	1.633	1.633	1.634	1.634	1.634	1.610	1.610	1.610	1.610	cfs

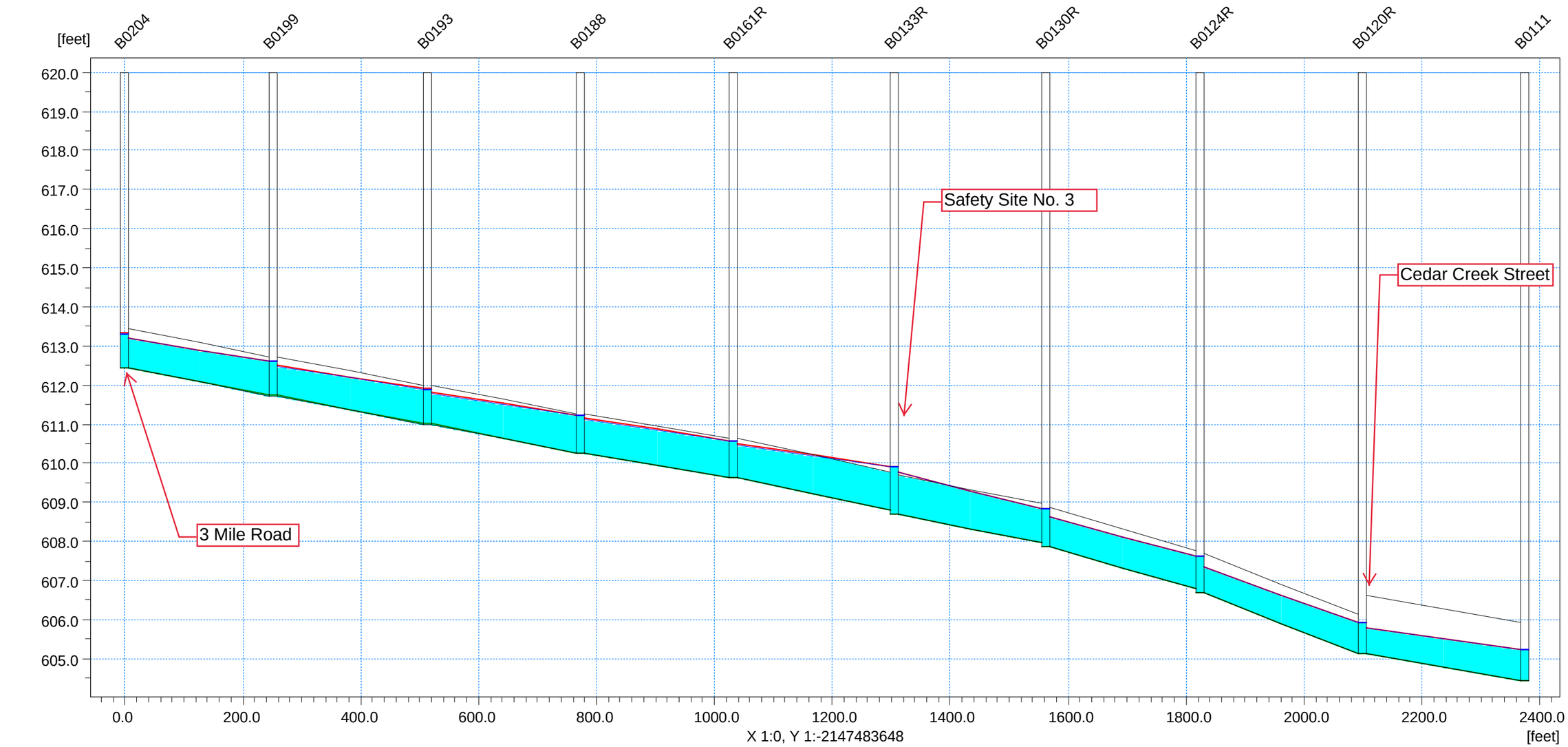


Ground Lev.	620.00		620.00		620.00		620.00		620.00		620.00		[ft]
Invert lev.	612.44		611.73		611.00		610.27		609.63		608.69		[ft]
Length		252.38		260.14		260.47		259.27		271.56		258.97	[ft]
Diameter		0.83		0.83		0.83		0.83		0.83		0.83	[ft]
Slope ft./100ft.		2.81		2.81		2.80		2.47		3.09		2.82	

Ground Lev.	620.00		620.00		620.00		620.00		620.00		620.00		[ft]
Invert lev.	607.86		606.68		605.13								[ft]
Length		260.59		275.60		274.34							[ft]
Diameter		0.83		0.83		1.50							[ft]
Slope ft./100ft.		4.14		5.62		2.55							

Figure C-29 - 2040 Baseline Condition - LaSalle Street Trunk Sewer
5-year, 6-hour Event

Discharge	1.621	1.623	1.627	1.629	1.632	2.097	2.097	2.098	2.098	cfs

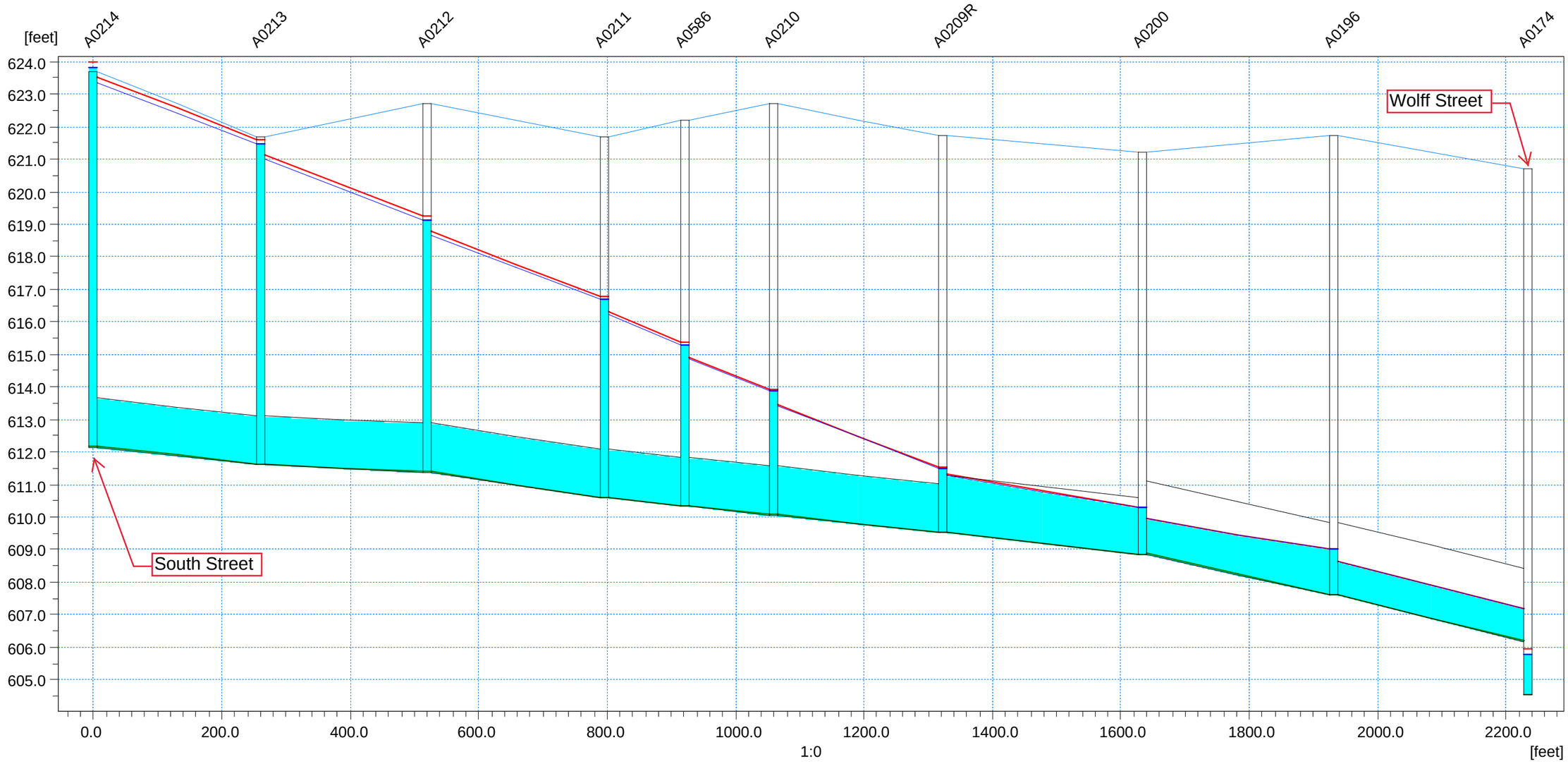


Ground Lev.	620.00		620.00		620.00		620.00		620.00		620.00	[ft]
Invert lev.	612.44		611.73		611.00		610.27		609.63		608.69	[ft]
Length		252.38		260.14		260.47		259.27		271.56		258.97
Diameter		1.00		1.00		1.00		1.00		1.00		1.00
Slope ft./100ft.		2.81		2.81		2.80		2.47		3.09		2.82

Ground Lev.	620.00		620.00		620.00		620.00		620.00	[ft]
Invert lev.	607.86		606.68		605.13					[ft]
Length		260.59		275.60		274.34				[ft]
Diameter		1.00		1.00		1.50				[ft]
Slope ft./100ft.		4.14		5.62		2.55				

Figure C-30 - 2020 Condition - Geneva Street Interceptor
5-year, 6-hour Event

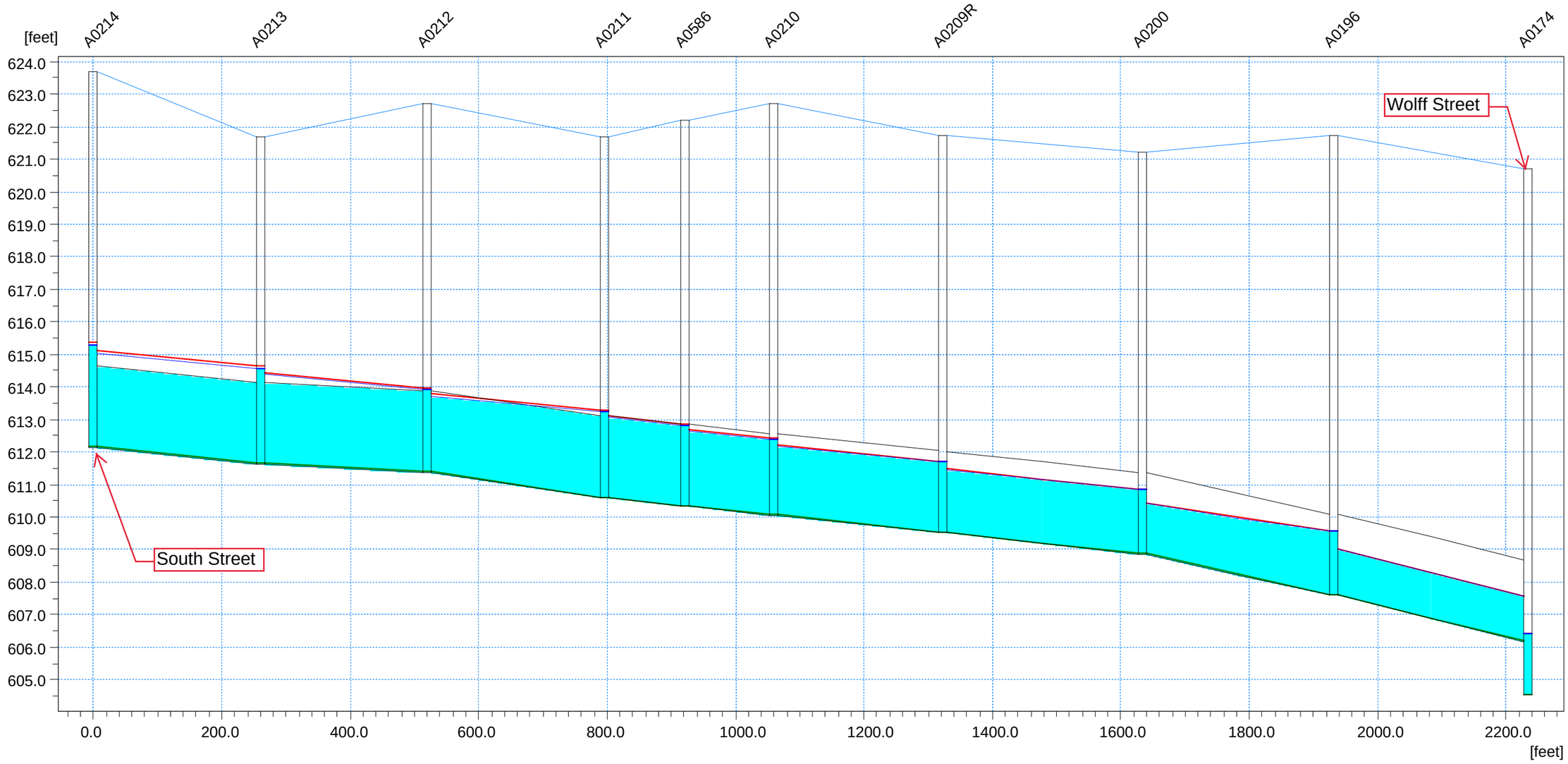
Discharge	8.694	8.692	8.692	8.691	8.691	8.691	8.690	8.689	8.688	cfs



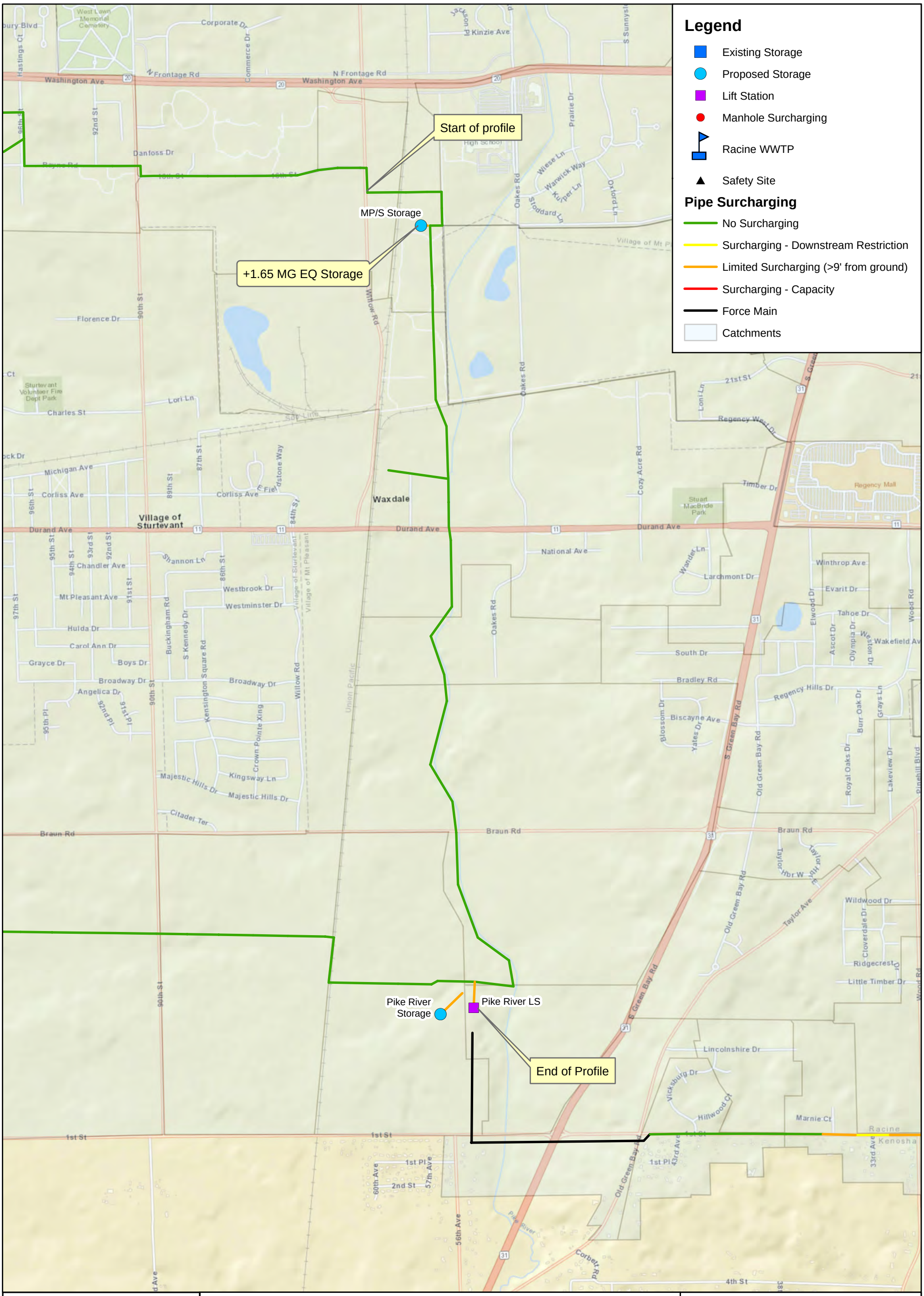
Ground Lev.	623.70		621.70		622.70		621.70	622.19	622.70	621.71	621.21	621.71		[ft]
Invert lev.	612.15		611.63		611.38		610.60	610.34	610.06	609.51	608.86	607.60		[ft]
Length		260.19		260.21		274.97	126.42	136.94	264.40	309.61	299.56		300.65	[ft]
Diameter		1.50		1.50		1.50	1.50	1.50	1.50	1.75	2.25		2.25	[ft]
Slope ft./100ft.		2.00		0.96		2.84	2.06	2.04	2.00	2.10	4.21		4.72	

Figure C-31 - 2040 Baseline Condition - Geneva Street Interceptor
5-year, 6-hour Event

Discharge	17.033	17.037	17.049	17.055	17.062	17.075	17.084	17.096	17.107	cfs



Ground Lev.	623.70		621.70		622.70	621.70	622.19	622.70	621.71	621.21	621.71	[ft]
Invert lev.	612.15		611.63		611.38	610.60	610.34	610.06	609.51	608.86	607.60	[ft]
Length		260.19		260.21	274.97	126.42	136.94	264.40	309.61	299.56	300.65	[ft]
Diameter		2.50		2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	[ft]
Slope ft./100ft.		2.00		0.96	2.84	2.06	2.04	2.00	2.10	4.21	4.72	



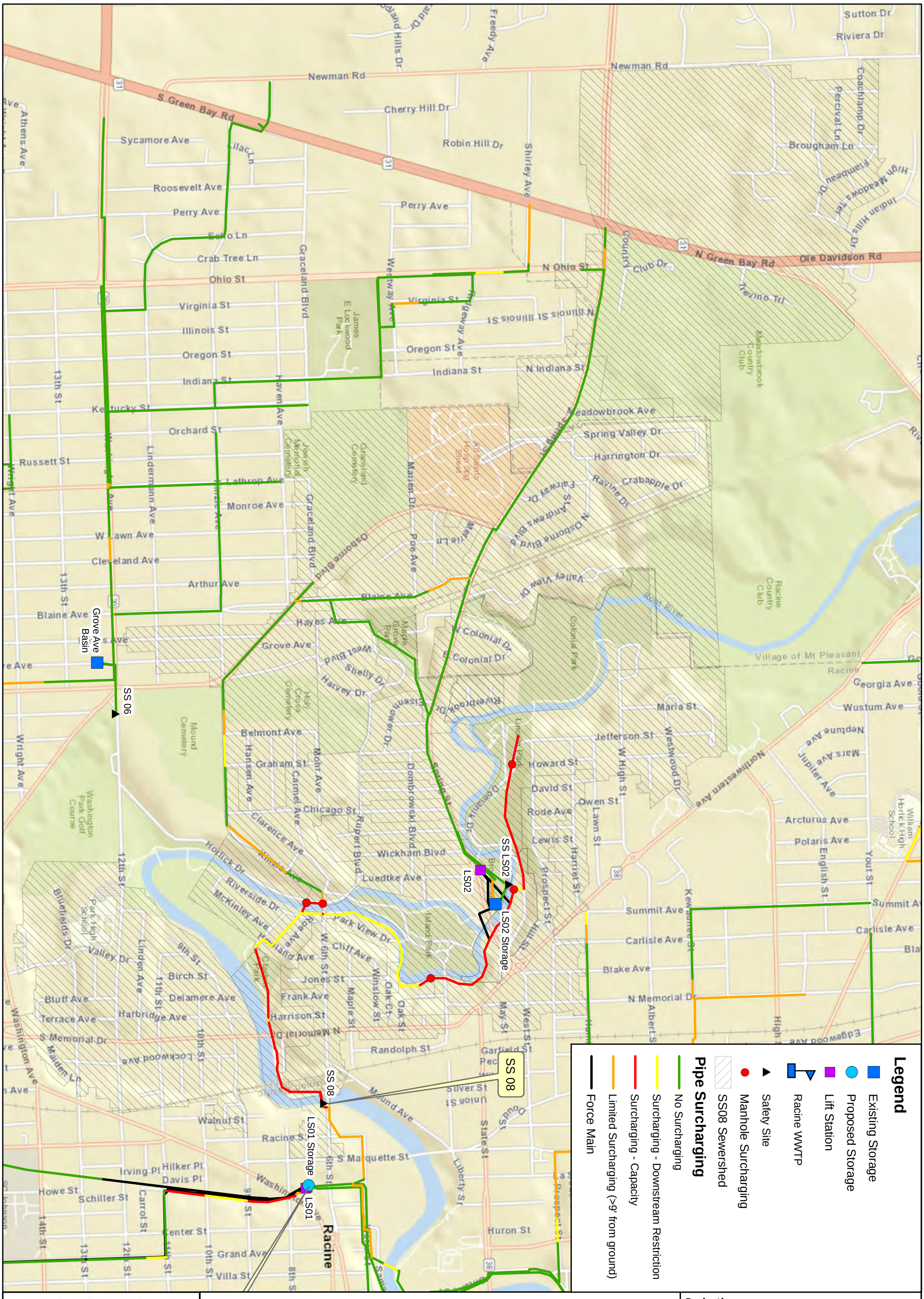
AECOM	**Figure C-32 - Mt. Pleasant/Sturtevant Interceptor 2040 Baseline Condition**	**Projection:** NAD_1927_StatePlane_Wisconsin_South_FIPS_4803
Drawn By: JFP	Racine Facilities Plan Racine Wastewater Utility	0 0.25 0.5 Miles
Checked By:		
Date:		
Project #: 60554970		

Figure C-33 - 2020 Condtion - MP/S Interceptor
5-year, 6-hour Event

| | | |

Figure C-34 - 2040 Baseline Condition - MP/S Storage
5-year, 6-hour Event

| Discharge | | | | | 5.191 | | | | |



AECOM

Figure C-35 - 2040 Alternative No. 01

Projection:
NAD_1983_2011_StatePlane_Wisconsin_South_FIPS_4803_Ft_US

Drawn By: JFP

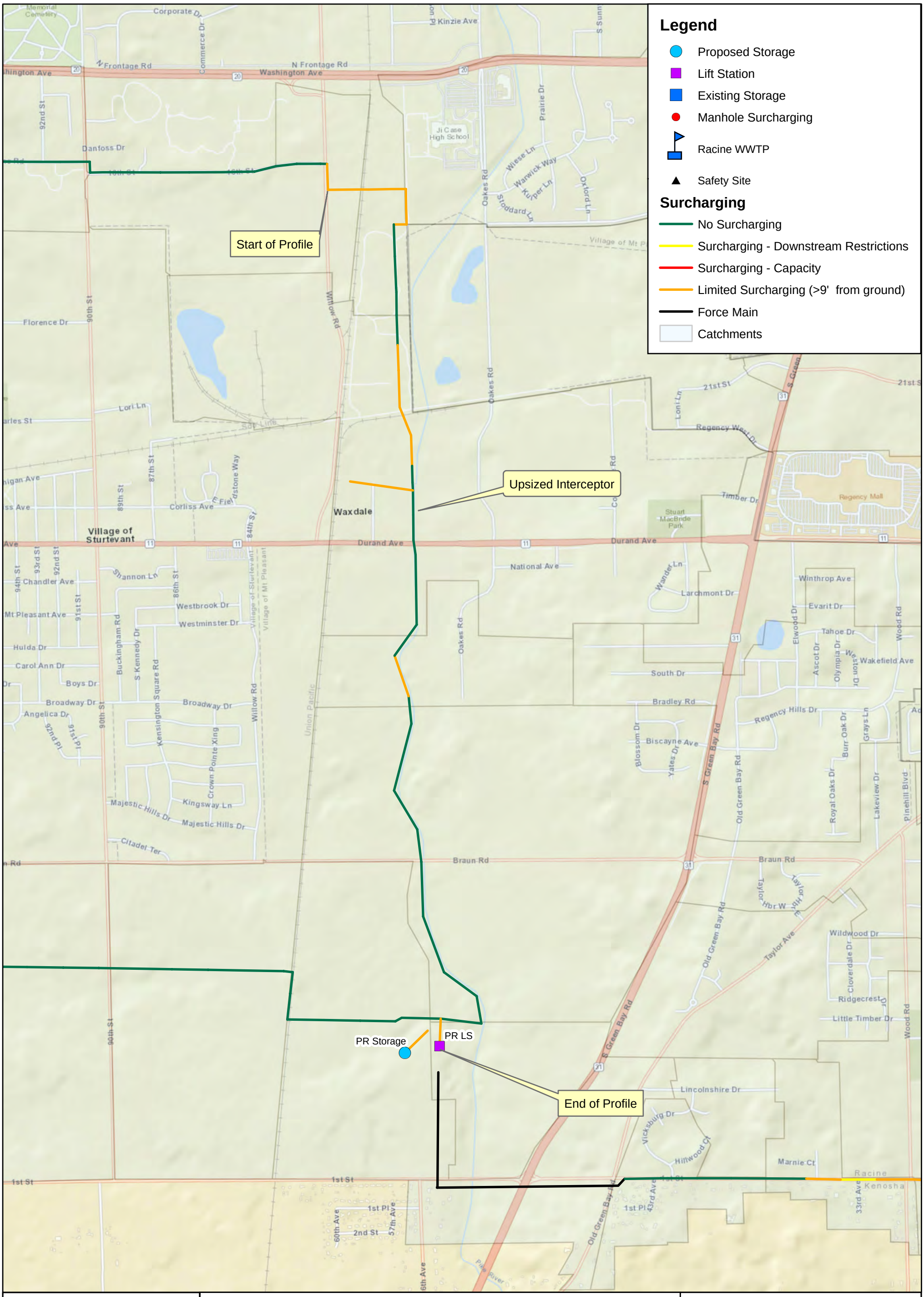
Checked By:

Date:

Project #: 60554970

Racine Facilities Plan
Racine Wastewater Utility

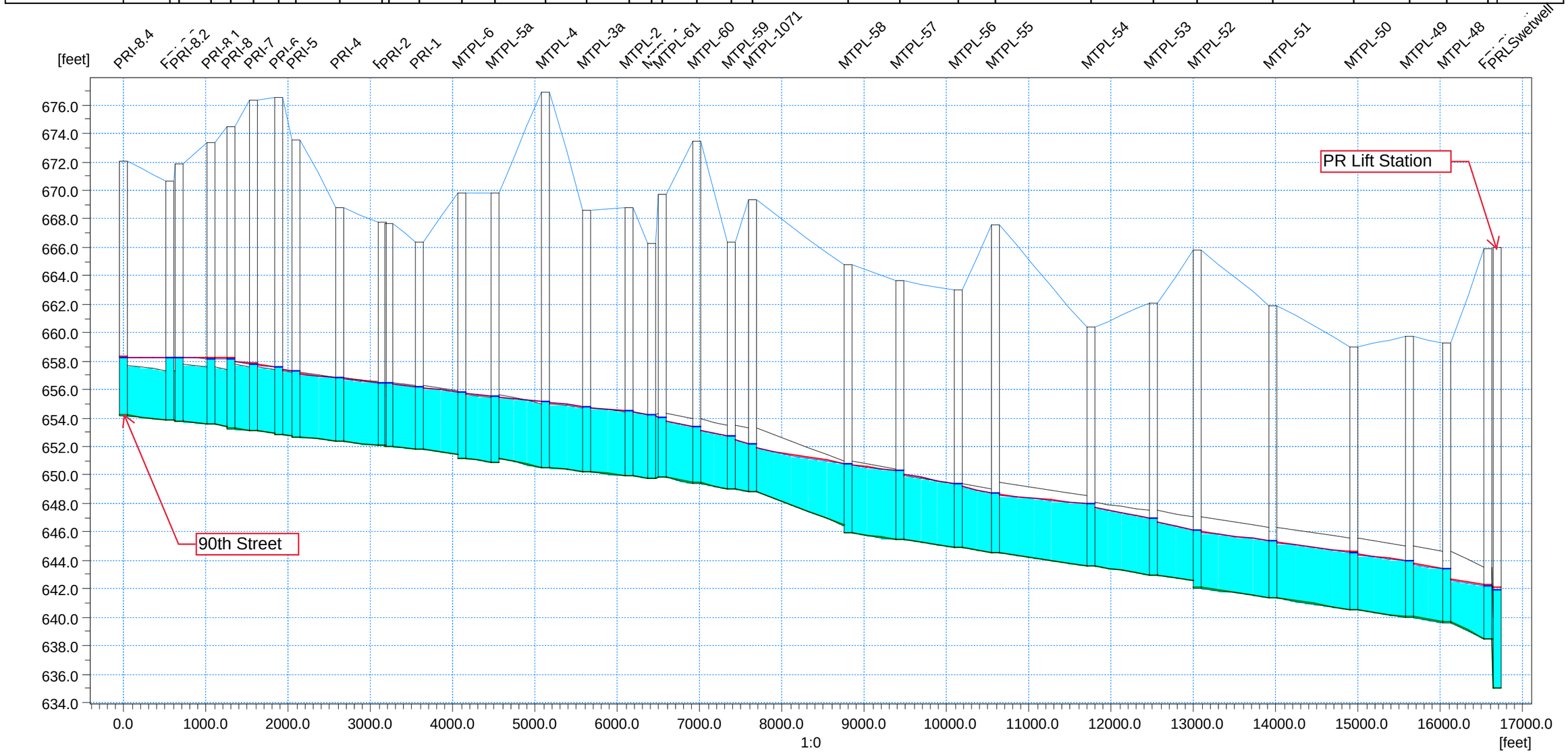
0 0.25 0.5 Miles



AECOM	**Figure C-36 - 2040 Alternative No. 02**	**Projection:** NAD_1983_2011_StatePlane_Wisconsin_South_FIPS_4803_Ft_US
Drawn By: JFP	Racine Facilities Plan Racine Wastewater Utility	
Checked By:		
Date:		
Project #: 60554970		

Figure C-37 - 2040 Alternative No. 2 - Pike River Interceptor Upsizing
5-year, 6-hour Event

Discharge	6.957												42.685								60.411	60.083	59.982		60.814	60.513		63.832	63.654	63.466				cfs



Ground Lev.	672.09	670.66	673.36	676.39	676.56		668.77	667.75	666.38	669.86	669.86	676.93	668.63	668.83	666.28	673.42	666.40		664.75	663.64	662.97	667.60		660.39	662.08	665.76		661.93		659.04	659.70	659.24	665.91		[ft]
Invert lev.	654.19	653.86	653.56	653.09	652.86		652.37	652.05	651.78	651.16	650.91	650.53	650.23	649.93	649.78	649.42	649.00		645.95	645.44	644.87	644.50		643.59	642.98	642.06		641.33		640.54	640.00	639.64	638.50		[ft]
Length											612.00							1168.00	628.00	709.00		1148.00		768.00		920.00		984.00		668.00					[ft]
Diameter		3.50					4.50	4.50		4.50	4.50	4.50	4.50	4.50		4.50	4.50	4.50	5.00	4.50	4.50	5.00		4.50	4.50	5.00		5.00		5.00	5.00	5.00			[ft]
Slope ft./100ft.		0.60					0.59	0.62		0.68	0.61	1.03	0.59	0.58		0.98	0.97	2.02	0.81	0.80	0.80	0.79		0.79	0.78	0.79		0.80		0.81	0.79	2.26			

Legend

- Existing Storage
- Proposed Storage
- Lift Station
- Manhole Surcharging
- Racine WWTP
- Safety Site

Surcharging

- No Surcharging
- Surcharging - Downstream Restriction
- Limited Surcharging (>9' from ground)
- Surcharging - Capacity
- Force Main
- Catchments

SS 12
SS LS02
Kinzie Storage
SS 06
Grove Ave Basin
SS 04
SS 05
EQ Basins
Racine WWTP
End of Profile
LS06
SS LS06
SS 10
SS 11
Chicory Storage
Start of Profile
PR LS
2nd PR Forcemain to WWTP

AECOM	**Figure C-38 - 2040 Alternative No. 03**	**Projection:** NAD_1983_2011_StatePlane_Wisconsin_South_FIPS_4803_Ft_US
Drawn By: JFP	Racine Facilities Plan Racine Wastewater Utility	N 0 0.5 1 Miles
Checked By:		
Date:		
Project #: 60554970		

Figure C-39 - 2040 Alternative No. 3 Condition -Mount Pleasant/Sturtevant Interceptor
5-year, 6-hour Event

| Discharge | | |

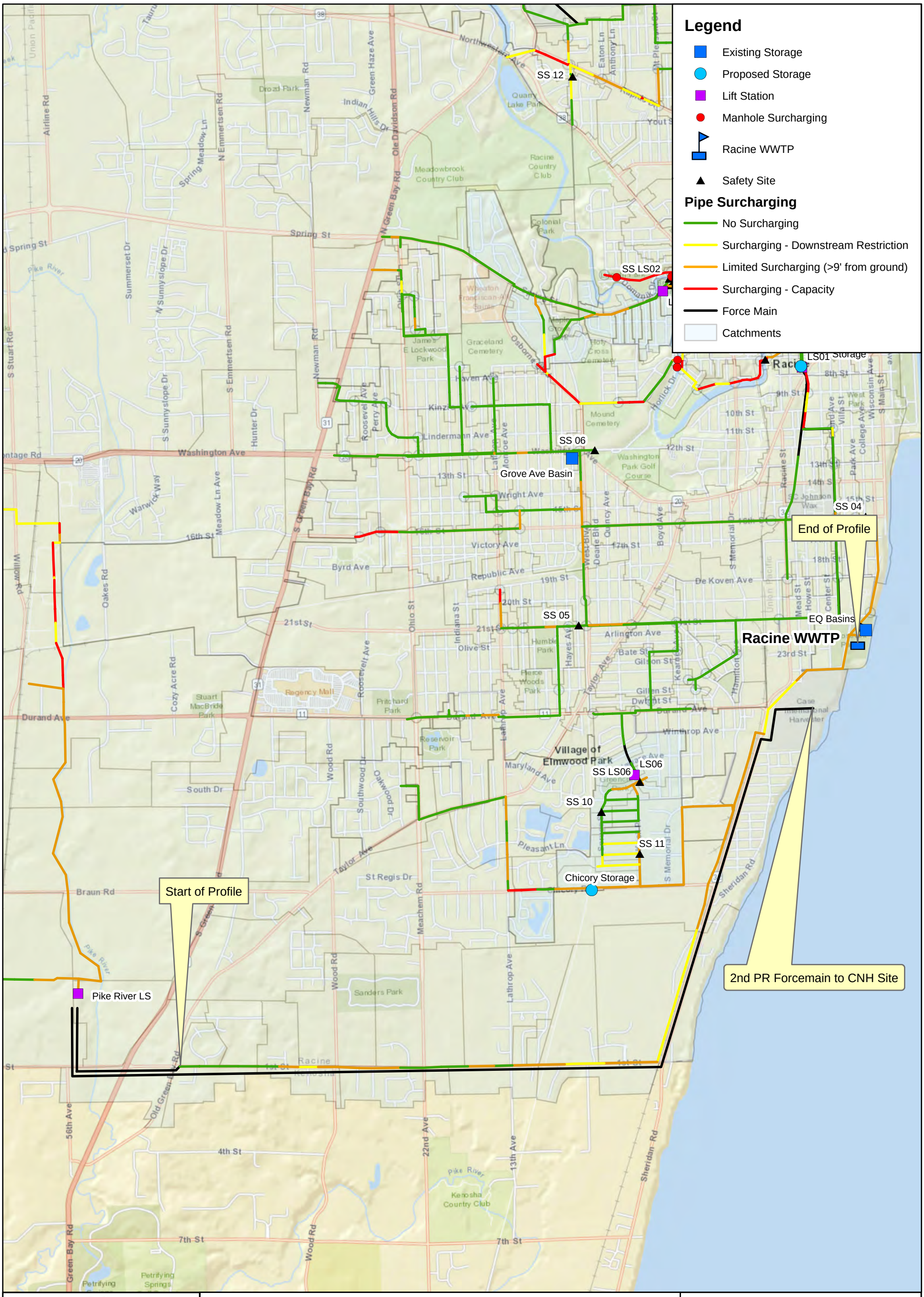

Legend
Existing Storage
Proposed Storage
Lift Station
Manhole Surcharging
Racine WWTP
Safety Site
Pipe Surcharging
No Surcharging
Surcharging - Downstream Restriction
Limited Surcharging (>9' from ground)
Surcharging - Capacity
Force Main
Catchments
SS 12
SS LS02
LS01 Storage
SS 06
Grove Ave Basin
SS 04
End of Profile
SS 05
EQ Basins
Racine WWTP
Village of Elmwood Park
LS06
SS LS06
SS 10
SS 11
Chicory Storage
Start of Profile
Pike River LS
2nd PR Forcemain to CNH Site
Northwestern Ave
Spring St
Washington Ave
Lindermann Ave
Haven Ave
Kinzie Ave
Victory Ave
Republic Ave
Arlington Ave
Durand Ave
Winthrop Ave
Pleasant Ln
St Regis Dr
Braun Rd
South Dr
Maryland Ave
Taylor Ave
Gilson St
Dwight St
Gillen St
Bate St
Olive St
Wright Ave
Byrd Ave
De Koven Ave
Racine
4th St
7th St
Pike River
Kenosha Country Club
Sanders Park
Petrifying Springs
Reservoir Park
Regency Mall
Graceland Cemetery
Mound Cemetery
Holy Cross Cemetery
Washington Park Golf Course
Meadowbrook Country Club
Racine Country Club
Quarry Lake Park
Droad Park
James E Lockwood Park
Colonial Park
Humble Park
Fierce Woods Park
Pritchard Park
Stuart MacBride Park
Wheaton Franciscan-All Saints
Ole Davidson Rd
Green Bay Rd
Newman Rd
Green Haze Ave
Indian Hills Dr
N Emmertsen Rd
Spring Meadow Ln
Airline Rd
Summerset Dr
N Sunnyslope Dr
S Sunnyslope Dr
S Emmertsen Rd
S Stuart Rd
Hunter Dr
Roosevelt Ave
Perry Ave
Lathrop Ave
Monroe Ave
Osborne
Horlick Dr
Eaton Ln
Anthony Ln
Meadow Ln Ave
Warwick Way
Oakes Rd
Cozy Acre Rd
Willow Rd
Wood Rd
Southwood Dr
Oakwood Dr
Meachem Rd
Old Green Bay Rd
56th Ave
22nd Ave
13th Ave
Sheridan Rd
Ohio St
Indiana St
Hayes Ave
Taylor Ave
Keeler Ave
Hamilton
Mead St
Howe St
Center St
Union Pacific
Deane Blvd
Quincy Ave
Boyd Ave
S Memorial Dr
Racine St
Park Ave
College Ave
Wisconsin Ave
S Main St
Villa St
West Park
Case International Harvester
C Johnson Wax
8th St
9th St
10th St
11th St
12th St
13th St
14th St
15th St
16th St
17th St
18th St
19th St
20th St
21st St
23rd St
1st St
Union Pacific
Pike River
Durand Ave
Spring St
Haven Ave
Projection:
NAD_1983_2011_StatePlane_Wisconsin_South_FIPS_4803_Ft_US
0
0.5
1
Miles
Figure C-40 - 2040 Alternative No. 04
Racine Facilities Plan
Racine Wastewater Utility
Drawn By: JFP
Checked By:
Date:
Project #: 60554970

Figure C- 41 - 2040 Alternative No. 4 Condition - Mount Pleasant/Sturtevant Interceptor
5-year, 6-hour Event

| | | |

Legend

- Existing Storage
- Proposed Storage
- Lift Station
- Manhole Surcharging
- Racine WWTP
- Safety Site

Pipe Surcharging

- No Surcharging
- Surcharging - Downstream Restriction
- Limited Surcharging (>9' from ground)
- Surcharging - Capacity
- Force Main
- Catchments

North Park Storage
North Park LS
Cal Storage
16.03 MGD
Hood's Creek LS
Hood's Creek Attenuation Basin
LS31/River Bend
Northside Remote Storage
SS 03
SS 02
SS 01
SS 12
LV Storage
13.02 MGD
SS LS02
LS02 Storage
LS02
SS 09
SS 08
LS01
LS01 Storage
SS 06
Grove Ave Basin
SS 04
MP/S Storage
SS 05
EQ Basins
Racine WWTP
6.86 MGD
51.60 MGD
44.14 MGD
LS06
SS LS06
SS 10
SS 11
Chicory Storage
34.71 MGD
Pike River LS
33.22 MGD
Pike River Storage
32.88 MGD

AECOM	**Figure C-42 - Peak Flows at Key Locations 2040 Baseline Condition (5-yr, 6-hr)**	**Projection:** NAD_1927_StatePlane_Wisconsin_South_FIPS_4803
Drawn By: JFP	Racine Facilities Plan Racine Wastewater Utility	0 0.25 0.5 1 Miles
Checked By:		
Date:		
Project #: 60554970		

Appendix D Conveyance Improvements Cost Opinions

Racine Cost Estimating Criteria

Construction costs were estimated for a Class 4 planning level study with an expected accuracy of +/- 25%. Cost opinions are of this accuracy because alternatives have been prepared with a minimum of detailed design data for the purposes of relative comparison. Construction cost estimates were based primarily on Means Costworks calibrated to Racine. EPA maintains a database for constructed costs for offline wet weather storage basins nationwide at different volumes. The respective volumes and unit costs of the different wet weather storage basins were compared to the EPA cost curve as a reasonableness check.

The interior dimensions were estimated by site constraints and reasonable max water storage elevation relative to nearby residential basement elevations with 2 feet of free board above max water level. Plan view dimension assumed to be rectangular.

Earthwork Quantities

All earthwork quantities assume that all earthwork activities occur on site with no soil material being imported to the site and no soil material being hauled off site. Cost estimating tools factored in excavation, staging, backfilling, compaction, and restoration.

Excavation: Disturbed excavation limits are based on a 1.5:1 ground slope with 5 foot clear space around the structure. Excavation depth extends to 2 feet below base of structure to allow for bedding and unsuitable soil removal. Excavated quantities included an industry standard 30 percent bulking factor.

Trench Excavation: Trench excavation assumed a 5 foot wide braced excavation extending the length of the respective pipe. Trench depth was assumed to be 15 feet deep. Trench excavation quantities included an industry standard 30 percent bulking factor.

Backfill: Backfill assumed that excavated material would be placed and compacted beneath and around the structure. The volume of the basin structure was subtracted from the excavated void with leftover soil material spread on the site.

Concrete Quantities

All structural members will be cast in place concrete with a 6,000 psi structural concrete mix. Cost estimating tools factored in layout, forming, shoring, reinforcing steel, placement, and finishing of structural concrete members.

Base Slab: The base slab dimensions were determined from using inside dimensions plus wall thicknesses. Base slab thickness are 36 inches. Reinforcing steel is assumed to be No. 6 at 12 inch spacings both ways with 2 matts.

Exterior Walls: The exterior wall dimensions were determined from using inside dimensions. Exterior wall thicknesses are 20 inches. Reinforcing steel is assumed to be No. 8 at 12 inch spacings both ways with 2 matts.

Interior Columns: The number of columns was based on 20 foot spacings between columns in both directions. The columns were assumed to be 36 inch x 36 inch with a height that extends from top of base slab to bottom of elevated top slab. Reinforcing steel is assumed to be No. 4 stirrups at 12 inch spacings entire height and No. 7 vertical bars at 6 inch spacings.

Elevated Top Slab: The elevated top slab dimensions were determined by using inside dimensions plus respective wall thicknesses. Elevated top slab thickness is 24 inches. Reinforcing steel is assumed to be No. 6 at 12 inch spacings both ways with 2 matts.

Pumping and Conveyance

Pumping: Pumping infrastructure is based on submersible pumps capable of draining the entire wet weather basin over a 7 day period including flow diversion/control, discharge piping/fittings, electrical, and controls.

Conveyance Piping: Given the proximity to existing conveyance infrastructure, 500 feet of gravity sewer with appropriate capacity was used. For basins that included pumping, 500 feet of force main was used.

11.0 MG Equalization Basin
Pike River Lift Station
Racine, Wisconsin

Paul Herubin / John Lapointe - May 5, 2020
Unit Cost Estimate

Table D-1: 11.0 MG Pike River EQ Basin

Quantity	Description	Crew	Daily Output	Labor Hours	Unit	Material	Labor	Equipment	Total	Ext. Mat.	Ext. Labor	Ext. Equip.	Ext. Total	Mat. O&P	Labor O&P	Equip. O&P	Total O&P	Ext. Mat. O&P	Ext. Labor O&P	Ext. Equip. O&P	Ext. Total O&P	Labor Type	Data Release	CCI Location
2781	Topsoil stripping and stockpiling, topsoil, sandy loam, ideal conditions, 300 HP dozer	B10M	3000	0	C.Y.	$ -	$ 0.21	$ 0.58	$ 0.79	$ -	$ 584.01	$ 1,612.98	$ 2,196.99	$ -	$ 0.32	$ 0.64	$ 0.96	$ -	$ 889.92	$ 1,779.84	$ 2,669.76	STD	Year 2020	WISCONSIN / RACINE (534)
156728	Excavating, bulk bank measure, 2 C.Y. capacity = 165 C.Y./hr, backhoe, hydraulic, crawler mounted, excluding truck loading	B12C	1320	0.01	B.C.Y.	$ -	$ 0.63	$ 0.71	$ 1.34	$ -	$ 98,738.64	$ 111,276.88	$ 210,015.52	$ -	$ 0.94	$ 0.78	$ 1.72	$ -	$ 147,324.32	$ 122,247.84	$ 269,572.16	STD	Year 2020	WISCONSIN / RACINE (534)
78609	Backfill, structural, common earth, 80 HP dozer, 300' haul, from existing stockpile, excludes compaction	B10L	330	0.04	L.C.Y.	$ -	$ 1.94	$ 1.21	$ 3.15	$ -	$ 152,501.46	$ 95,116.89	$ 247,618.35	$ -	$ 2.89	$ 1.33	$ 4.22	$ -	$ 227,180.01	$ 104,549.97	$ 331,729.98	STD	Year 2020	WISCONSIN / RACINE (534)
2000	Synthetic erosion control, silt fence, install and maintain, remove, 3' high	B62	1300	0.02	L.F.	$ 0.41	$ 0.86	$ 0.14	$ 1.41	$ 820.00	$ 1,720.00	$ 280.00	$ 2,820.00	$ 0.45	$ 1.30	$ 0.15	$ 1.90	$ 900.00	$ 2,600.00	$ 300.00	$ 3,800.00	STD	Year 2020	WISCONSIN / RACINE (534)
3611	Excavating, trench or continuous footing, common earth, 2-1/2 C.Y. excavator, 6' to 10' deep, excludes sheeting or dewatering	B12S	1000	0.02	B.C.Y.	$ -	$ 0.83	$ 1.46	$ 2.29	$ -	$ 2,997.13	$ 5,272.06	$ 8,269.19	$ -	$ 1.24	$ 1.59	$ 2.83	$ -	$ 4,477.64	$ 5,741.49	$ 10,219.13	STD	Year 2020	WISCONSIN / RACINE (534)
13431	Structural concrete, ready mix, heavyweight, 5000 psi, includes local aggregate, sand, Portland cement (Type I) and water, delivered, excludes all additives and treatments		0	0	C.Y.	$ 140.13	$ -	$ -	$ 140.13	$ 1,882,086.03	$ -	$ -	$ 1,882,086.03	$ 154.66	$ -	$ -	$ 154.66	$ 2,077,238.46	$ -	$ -	$ 2,077,238.46	STD	Year 2020	WISCONSIN / RACINE (534)
103525	C.I.P. concrete forms, slab on grade, edge, wood, over 12", 4 use, includes erecting, bracing, stripping and cleaning	C1	350	0.09	SFCA	$ 0.97	$ 4.89	$ -	$ 5.86	$ 100,419.25	$ 506,237.25	$ -	$ 606,656.50	$ 1.07	$ 7.32	$ -	$ 8.39	$ 110,771.75	$ 757,803.00	$ -	$ 868,574.75	STD	Year 2020	WISCONSIN / RACINE (534)
15620	C.I.P. concrete forms, retaining wall, battered, job built plywood, over 8' to 16' high, 1 use, includes erecting, bracing, stripping and cleaning	C2	240	0.2	SFCA	$ 2.39	$ 10.98	$ -	$ 13.37	$ 37,331.80	$ 171,507.60	$ -	$ 208,839.40	$ 2.62	$ 16.45	$ -	$ 19.07	$ 40,924.40	$ 256,949.00	$ -	$ 297,873.40	STD	Year 2020	WISCONSIN / RACINE (534)
3672	C.I.P. concrete forms, column, round, steel, heavy duty, rent, 36" diameter, 4 uses per month, includes erecting, bracing, stripping and cleaning	C1	60	0.53	L.F.	$27.53	$28.65	$ -	$ 56.18	$ 101,090.16	$ 105,202.80	$ -	$ 206,292.96	$30.03	$42.97	$ -	$ 73.00	$ 110,270.16	$ 157,785.84	$ -	$ 268,056.00	STD	Year 2020	WISCONSIN / RACINE (534)
621150	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	4 Rodm	4200	0.01	Lb.	$ 0.53	$ 0.48	$ -	$ 1.01	$ 329,209.50	$ 298,152.00	$ -	$ 627,361.50	$ 0.59	$ 0.72	$ -	$ 1.31	$ 366,478.50	$ 447,228.00	$ -	$ 813,706.50	STD	Year 2020	WISCONSIN / RACINE (534)
200	Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	4 Rodm	3	10.67	Ton	$ 1,068.75	$ 663.00	$ -	$ 1,731.75	$ 213,750.00	$ 132,600.00	$ -	$ 346,350.00	$ 1,187.50	$ 1,000.03	$ -	$ 2,187.53	$ 237,500.00	$ 200,006.00	$ -	$ 437,506.00	STD	Year 2020	WISCONSIN / RACINE (534)
56	Reinforcing steel, in place, columns, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	4 Rodm	1.5	21.33	Ton	$ 1,068.75	$ 1,326.00	$ -	$ 2,394.75	$ 59,850.00	$ 74,256.00	$ -	$ 134,106.00	$ 1,187.50	$ 1,989.00	$ -	$ 3,176.50	$ 66,500.00	$ 111,384.00	$ -	$ 177,884.00	STD	Year 2020	WISCONSIN / RACINE (534)
11503	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes leveling (strike off) & consolidation, excludes material	C20	185	0.35	C.Y.	$ -	$ 15.99	$ 2.48	$ 18.47	$ -	$ 183,932.97	$ 28,527.44	$ 212,460.41	$ -	$ 24.09	$ 2.73	$ 26.82	$ -	$ 277,107.27	$ 31,403.19	$ 308,510.46	STD	Year 2020	WISCONSIN / RACINE (534)
7669	Structural concrete, in place, elevated slab (4000 psi), flat slab with drop panels, 125 psf superimposed load, 30' span, includes forms(4 uses), Grade 60 rebar, concrete (Portland cement Type I), placing and finishing	C14B	50.99	4.08	C.Y.	$ 332.16	$ 220.38	$ 8.46	$ 561.00	$ 2,547,335.04	$ 1,690,094.22	$ 64,879.74	$ 4,302,309.00	$ 368.49	$ 333.13	$ 9.31	$ 710.93	$ 2,825,949.81	$ 2,554,773.97	$ 71,398.39	$ 5,452,122.17	STD	Year 2020	WISCONSIN / RACINE (534)
1929	Structural concrete, placing, walls, pumped, 15" thick, includes leveling (strike off) & consolidation, excludes material	C20	120	0.53	C.Y.	$ -	$ 24.60	$ 3.83	$ 28.43	$ -	$ 47,453.40	$ 7,388.07	$ 54,841.47	$ -	$ 36.90	$ 4.22	$ 41.12	$ -	$ 71,180.10	$ 8,140.38	$ 79,320.48	STD	Year 2020	WISCONSIN / RACINE (534)
1224	Structural concrete, placing, column, square or round, pumped, 24" thick, includes leveling (strike off) & consolidation, excludes material	C20	92	0.7	C.Y.	$ -	$ 32.29	$ 5.00	$ 37.29	$ -	$ 39,522.96	$ 6,120.00	$ 45,642.96	$ -	$ 48.18	$ 5.49	$ 53.67	$ -	$ 58,972.32	$ 6,719.76	$ 65,692.08	STD	Year 2020	WISCONSIN / RACINE (534)
1	Packaged pumping station and flow control structure, 500,000 GPD, excludes fencing or external piping	E8	0.15	579	Ea.	$ 265,255.50	$ 26,043.50	$ 14,850.00	$ 306,149.00	$ 265,255.50	$ 26,043.50	$ 14,850.00	$ 306,149.00	$ 291,634.50	$ 44,327.10	$ 16,335.00	$ 352,296.60	$ 291,634.50	$ 44,327.10	$ 16,335.00	$ 352,296.60	OPN	Year 2020	WISCONSIN / RACINE (534)
500	Forcemain piping, ductile iron pipe, cement lined, mechanical joint, no fittings, 18' lengths, 8" diameter, class 50, excludes excavation or backfill	B21A	133.33	0.3	L.F.	$ 52.27	$ 16.69	$ 3.18	$ 72.14	$ 26,135.00	$ 8,345.00	$ 1,590.00	$ 36,070.00	$ 57.64	$ 24.98	$ 3.49	$ 86.11	$ 28,820.00	$ 12,490.00	$ 1,745.00	$ 43,055.00	STD	Year 2020	WISCONSIN / RACINE (534)
500	Gravity sewer piping, reinforced concrete pipe (RCP), 36" diameter, class 5, excludes excavation or backfill, gaskets	B13	72	0.78	L.F.	$ 87.93	$ 38.27	$ 7.97	$ 134.17	$ 43,965.00	$ 19,135.00	$ 3,985.00	$ 67,085.00	$ 96.72	$ 56.87	$ 8.76	$ 162.35	$ 48,360.00	$ 28,435.00	$ 4,380.00	$ 81,175.00	STD	Year 2020	WISCONSIN / RACINE (534)
										$311,353	**$5,607,247**	**$3,559,024**	**$340,899**	**$9,507,170**				**$359,010**	**$6,205,348**	**$5,360,913**	**$374,741**	**$11,941,002**			

Exclusions:
Temporary Utility Bypass
Permits
Pavement Removal or Replacement
Overhead or Underground Utility Conflicts

NOTES:
Elevated concrete slab, 24 inches thick, 20 feet above base slab
2020 YOE

Subtotal, Estimated Construction Cost:	**$ 11,941,002**
Mobilization, Bonds & Insurance, 5% of Construction Cost:	**$ 597,050**
Construction Contingency, 25% of Est. Construction Cost:	**$2,985,250**
Engineering and Administration, 20% of Est. Construction Cost:	**$2,388,200**
TOTAL, ESTIMATED PROJECT COST:	**$ 17,911,503**

3.5 MG Equalization Basin
North Park Lift Station
Racine, Wisconsin

Paul Herubin / John Lapointe - May 5, 2020
Unit Cost Estimate

Table D-2: 3.5 MG North Park EQ Basin

Quantity	Description	Crew	Daily Output	Labor Hours	Unit	Material	Labor	Equipment	Total	Ext. Mat.	Ext. Labor	Ext. Equip.	Ext. Total	Mat. O&P	Labor O&P	Equip. O&P	Total O&P	Ext. Mat. O&P	Ext. Labor O&P	Ext. Equip. O&P	Ext. Total O&P	Labor Type	Data Release	CCI Location
1283	Topsoil stripping and stockpiling, topsoil, sandy loam, ideal conditions, 300 HP dozer	B10M	3000	0	C.Y.	$ -	$ 0.21	$ 0.58	$ 0.79	$ -	$ 269.43	$ 744.14	$ 1,013.57	$ -	$ 0.32	$ 0.64	$ 0.96	$ -	$ 410.56	$ 821.12	$ 1,231.68	STD	Year 2020	WISCONSIN / RACINE (534)
41947	Excavating, bulk bank measure, 2 C.Y. capacity = 165 C.Y./hr, backhoe, hydraulic, crawler mounted, excluding truck loading	B12C	1320	0.01	B.C.Y.	$ -	$ 0.63	$ 0.71	$ 1.34	$ -	$ 26,426.61	$ 29,782.37	$ 56,208.98	$ -	$ 0.94	$ 0.78	$ 1.72	$ -	$ 39,430.18	$ 32,718.66	$ 72,148.84	STD	Year 2020	WISCONSIN / RACINE (534)
12632	Backfill, structural, common earth, 80 HP dozer, 300' haul, from existing stockpile, excludes compaction	B10L	330	0.04	L.C.Y.	$ -	$ 1.94	$ 1.21	$ 3.15	$ -	$ 24,506.08	$ 15,284.72	$ 39,790.80	$ -	$ 2.89	$ 1.33	$ 4.22	$ -	$ 36,506.48	$ 16,800.56	$ 53,307.04	STD	Year 2020	WISCONSIN / RACINE (534)
1200	Synthetic erosion control, silt fence, install and maintain, remove, 3' high	B62	1300	0.02	L.F.	$ 0.41	$ 0.86	$ 0.14	$ 1.41	$ 492.00	$ 1,032.00	$ 168.00	$ 1,692.00	$ 0.45	$ 1.30	$ 0.15	$ 1.90	$ 540.00	$ 1,560.00	$ 180.00	$ 2,280.00	STD	Year 2020	WISCONSIN / RACINE (534)
3611	Excavating, trench or continuous footing, common earth, 2-1/2 C.Y. excavator, 6' to 10' deep, excludes sheeting or dewatering	B12S	1000	0.02	B.C.Y.	$ -	$ 0.83	$ 1.46	$ 2.29	$ -	$ 2,997.13	$ 5,272.06	$ 8,269.19	$ -	$ 1.24	$ 1.59	$ 2.83	$ -	$ 4,477.64	$ 5,741.49	$ 10,219.13	STD	Year 2020	WISCONSIN / RACINE (534)
4763	Structural concrete, ready mix, heavyweight, 5000 psi, includes local aggregate, sand, Portland cement (Type I) and water, delivered, excludes all additives and treatments		0	0	C.Y.	$ 140.13	$ -	$ -	$ 140.13	$ 667,439.19	$ -	$ -	$ 667,439.19	$ 154.66	$ -	$ -	$ 154.66	$ 736,645.58	$ -	$ -	$ 736,645.58	STD	Year 2020	WISCONSIN / RACINE (534)
33825	C.I.P. concrete forms, slab on grade, edge, wood, over 12", 4 use, includes erecting, bracing, stripping and cleaning	C1	350	0.09	SFCA	$ 0.97	$ 4.89	$ -	$ 5.86	$ 32,810.25	$ 165,404.25	$ -	$ 198,214.50	$ 1.07	$ 7.32	$ -	$ 8.39	$ 36,192.75	$ 247,599.00	$ -	$ 283,791.75	STD	Year 2020	WISCONSIN / RACINE (534)
8140	C.I.P. concrete forms, retaining wall, battered, job built plywood, over 8' to 16' high, 1 use, includes erecting, bracing, stripping and cleaning	C2	240	0.2	SFCA	$ 2.39	$ 10.98	$ -	$ 13.37	$ 19,454.60	$ 89,377.20	$ -	$ 108,831.80	$ 2.62	$ 16.45	$ -	$ 19.07	$ 21,326.80	$ 133,903.00	$ -	$ 155,229.80	STD	Year 2020	WISCONSIN / RACINE (534)
1071	C.I.P. concrete forms, column, round, steel, heavy duty, rent, 36" diameter, 4 uses per month, includes erecting, bracing, stripping and cleaning	C1	60	0.53	L.F.	$27.53	$28.65	$ -	$ 56.18	$ 29,484.63	$ 30,684.15	$ -	$ 60,168.78	$30.03	$42.97	$ -	$ 73.00	$ 32,162.13	$ 46,020.87	$ -	$ 78,183.00	STD	Year 2020	WISCONSIN / RACINE (534)
202950	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	4 Rodm	4200	0.01	Lb.	$ 0.53	$ 0.48	$ -	$ 1.01	$ 107,563.50	$ 97,416.00	$ -	$ 204,979.50	$ 0.59	$ 0.72	$ -	$ 1.31	$ 119,740.50	$ 146,124.00	$ -	$ 265,864.50	STD	Year 2020	WISCONSIN / RACINE (534)
94	Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	4 Rodm	3	10.67	Ton	$ 1,068.75	$ 663.00	$ -	$ 1,731.75	$ 100,462.50	$ 62,322.00	$ -	$ 162,784.50	$ 1,187.50	$ 1,000.03	$ -	$ 2,187.53	$ 111,625.00	$ 94,002.82	$ -	$ 205,627.82	STD	Year 2020	WISCONSIN / RACINE (534)
16	Reinforcing steel, in place, columns, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	4 Rodm	1.5	21.33	Ton	$ 1,068.75	$ 1,326.00	$ -	$ 2,394.75	$ 17,100.00	$ 21,216.00	$ -	$ 38,316.00	$ 1,187.50	$ 1,989.00	$ -	$ 3,176.50	$ 19,000.00	$ 31,824.00	$ -	$ 50,824.00	STD	Year 2020	WISCONSIN / RACINE (534)
3758	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes leveling (strike off) & consolidation, excludes material	C20	185	0.35	C.Y.	$ -	$ 15.99	$ 2.48	$ 18.47	$ -	$ 60,090.42	$ 9,319.84	$ 69,410.26	$ -	$ 24.09	$ 2.73	$ 26.82	$ -	$ 90,530.22	$ 10,259.34	$ 100,789.56	STD	Year 2020	WISCONSIN / RACINE (534)
2506	Structural concrete, in place, elevated slab (4000 psi), flat slab with drop panels, 125 psf superimposed load, 30' span, includes forms(4 uses), Grade 60 rebar, concrete (Portland cement Type I), placing and finishing	C14B	50.99	4.08	C.Y.	$ 332.16	$ 220.38	$ 8.46	$ 561.00	$ 832,392.96	$ 552,272.28	$ 21,200.76	$ 1,405,866.00	$ 368.49	$ 333.13	$ 9.31	$ 710.93	$ 923,435.94	$ 834,823.78	$ 23,330.86	$ 1,781,590.58	STD	Year 2020	WISCONSIN / RACINE (534)
1200	Structural concrete, placing, walls, pumped, 15" thick, includes leveling (strike off) & consolidation, excludes material	C20	120	0.53	C.Y.	$ -	$ 24.60	$ 3.83	$ 28.43	$ -	$ 29,520.00	$ 4,596.00	$ 34,116.00	$ -	$ 36.90	$ 4.22	$ 41.12	$ -	$ 44,280.00	$ 5,064.00	$ 49,344.00	STD	Year 2020	WISCONSIN / RACINE (534)
357	Structural concrete, placing, column, square or round, pumped, 24" thick, includes leveling (strike off) & consolidation, excludes material	C20	92	0.7	C.Y.	$ -	$ 32.29	$ 5.00	$ 37.29	$ -	$ 11,527.53	$ 1,785.00	$ 13,312.53	$ -	$ 48.18	$ 5.49	$ 53.67	$ -	$ 17,200.26	$ 1,959.93	$ 19,160.19	STD	Year 2020	WISCONSIN / RACINE (534)
1	Packaged pumping station, 200,000 GPD, excludes fencing or external piping	E8	0.2	440	Ea.	$ 232,526.00	$ 19,771.80	#########	$ 263,583.80	$ 232,526.00	$ 19,771.80	$ 11,286.00	$ 263,583.80	$ 255,974.00	$ 33,697.10	$ 12,474.00	$ 302,145.10	$ 255,974.00	$ 33,697.10	$ 12,474.00	$ 302,145.10	OPN	Year 2020	WISCONSIN / RACINE (534)
500	Forcemain piping, ductile iron pipe, cement lined, mechanical joint, no fittings, 18' lengths, 6" diameter, class 50, excludes excavation or backfill	B21A	160	0.25	L.F.	$ 49.83	$ 13.87	$ 2.65	$ 66.35	$ 24,915.00	$ 6,935.00	$ 1,325.00	$ 33,175.00	$ 54.71	$ 20.83	$ 2.92	$ 78.46	$ 27,355.00	$ 10,415.00	$ 1,460.00	$ 39,230.00	STD	Year 2020	WISCONSIN / RACINE (534)
500	Gravity sewer piping, reinforced concrete pipe (RCP), 36" diameter, class 5, excludes excavation or backfill, gaskets	B13	72	0.78	L.F.	$ 87.93	$ 38.27	$ 7.97	$ 134.17	$ 43,965.00	$ 19,135.00	$ 3,985.00	$ 67,085.00	$ 96.72	$ 56.87	$ 8.76	$ 162.35	$ 48,360.00	$ 28,435.00	$ 4,380.00	$ 81,175.00	STD	Year 2020	WISCONSIN / RACINE (534)
									$268,782	**$2,108,606**	**$1,220,903**	**$104,749**	**$3,434,257**					**$ 308,851**	**$ 2,332,358**	**$ 1,841,240**	**$ 115,190**	**$ 4,288,788**			

Exclusions:
Temporary Utility Bypass
Permits
Pavement Removal or Replacement
Overhead or Underground Utility Conflicts

NOTES:
Elevated concrete slab, 24 inches thick, 20 feet above base slab
2020 YOE

Subtotal, Estimated Construction Cost:	**$4,288,788**
Mobilization, Bonds & Insurance, 5% of Construction Cost:	**$214,439**
Construction Contingency, 25% of Est. Construction Cost:	**$1,072,197**
Engineering and Administration, 20% of Est. Construction Cost:	**$857,758**
TOTAL, ESTIMATED PROJECT COST:	**$6,433,181**

1.5 MG Equalization Basin
Hoods Creek
Racine, Wisconsin

Paul Herubin / John Lapointe - May, 2020
Unit Cost Estimate

Table D-3: 1.5 MG Hood's Creek EQ Basin

Quantity	Description	Crew	Daily Output	Labor Hours	Unit	Material	Labor	Equipment	Total	Ext. Mat.	Ext. Labor	Ext. Equip.	Ext. Total	Mat. O&P	Labor O&P	Equip. O&P	Total O&P	Ext. Mat. O&P	Ext. Labor O&P	Ext. Equip. O&P	Ext. Total O&P	Labor Type	Data Release	CCI Location
891	Topsoil stripping and stockpiling, topsoil, sandy loam, ideal conditions, 300 HP dozer	B10M	3000	0	C.Y.	$ -	$ 0.21	$ 0.58	$ 0.79	$ -	$ 187.11	$ 516.78	$ 703.89	$ -	$ 0.32	$ 0.64	$ 0.96	$ -	$ 285.12	$ 570.24	$ 855.36	STD	Year 2020	WISCONSIN / RACINE (534)
37985	Excavating, bulk bank measure, 2 C.Y. capacity = 165 C.Y./hr, backhoe, hydraulic, crawler mounted, excluding truck loading	B12C	1320	0.01	B.C.Y.	$ -	$ 0.63	$ 0.71	$ 1.34	$ -	$ 23,930.55	$ 26,969.35	$ 50,899.90	$ -	$ 0.94	$ 0.78	$ 1.72	$ -	$ 35,705.90	$ 29,628.30	$ 65,334.20	STD	Year 2020	WISCONSIN / RACINE (534)
22732	Backfill, structural, common earth, 80 HP dozer, 300' haul, from existing stockpile, excludes compaction	B10L	330	0.04	L.C.Y.	$ -	$ 1.94	$ 1.21	$ 3.15	$ -	$ 44,100.08	$ 27,505.72	$ 71,605.80	$ -	$ 2.89	$ 1.33	$ 4.22	$ -	$ 65,695.48	$ 30,233.56	$ 95,929.04	STD	Year 2020	WISCONSIN / RACINE (534)
1200	Synthetic erosion control, silt fence, install and maintain, remove, 3' high	B62	1300	0.02	L.F.	$ 0.41	$ 0.86	$ 0.14	$ 1.41	$ 492.00	$ 1,032.00	$ 168.00	$ 1,692.00	$ 0.45	$ 1.30	$ 0.15	$ 1.90	$ 540.00	$ 1,560.00	$ 180.00	$ 2,280.00	STD	Year 2020	WISCONSIN / RACINE (534)
3611	Excavating, trench or continuous footing, common earth, 2-1/2 C.Y. excavator, 6' to 10' deep, excludes sheeting or dewatering	B12S	1000	0.02	B.C.Y.	$ -	$ 0.83	$ 1.46	$ 2.29	$ -	$ 2,997.13	$ 5,272.06	$ 8,269.19	$ -	$ 1.24	$ 1.59	$ 2.83	$ -	$ 4,477.64	$ 5,741.49	$ 10,219.13	STD	Year 2020	WISCONSIN / RACINE (534)
2252	Structural concrete, ready mix, heavyweight, 5000 psi, includes local aggregate, sand, Portland cement (Type I) and water, delivered, excludes all additives and treatments		0	0	C.Y.	$ 140.13	$ -	$ -	$ 140.13	$ 315,572.76	$ -	$ -	$ 315,572.76	$ 154.66	$ -	$ -	$ 154.66	$ 348,294.32	$ -	$ -	$ 348,294.32	STD	Year 2020	WISCONSIN / RACINE (534)
14400	C.I.P. concrete forms, slab on grade, edge, wood, over 12", 4 use, includes erecting, bracing, stripping and cleaning	C1	350	0.09	SFCA	$ 0.97	$ 4.89	$ -	$ 5.86	$ 13,968.00	$ 70,416.00	$ -	$ 84,384.00	$ 1.07	$ 7.32	$ -	$ 8.39	$ 15,408.00	$ 105,408.00	$ -	$ 120,816.00	STD	Year 2020	WISCONSIN / RACINE (534)
5280	C.I.P. concrete forms, retaining wall, battered, job built plywood, over 8' to 16' high, 1 use, includes erecting, bracing, stripping and cleaning	C2	240	0.2	SFCA	$ 2.39	$ 10.98	$ -	$ 13.37	$ 12,619.20	$ 57,974.40	$ -	$ 70,593.60	$ 2.62	$ 16.45	$ -	$ 19.07	$ 13,833.60	$ 86,856.00	$ -	$ 100,689.60	STD	Year 2020	WISCONSIN / RACINE (534)
425	C.I.P. concrete forms, column, round, steel, heavy duty, rent, 36" diameter, 4 uses per month, includes erecting, bracing, stripping and cleaning	C1	60	0.53	L.F.	$27.53	$28.65	$ -	$ 56.18	$ 11,700.25	$ 12,176.25	$ -	$ 23,876.50	$30.03	$42.97	$ -	$ 73.00	$ 12,762.75	$ 18,262.25	$ -	$ 31,025.00	STD	Year 2020	WISCONSIN / RACINE (534)
86400	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	4 Rodm	4200	0.01	Lb.	$ 0.53	$ 0.48	$ -	$ 1.01	$ 45,792.00	$ 41,472.00	$ -	$ 87,264.00	$ 0.59	$ 0.72	$ -	$ 1.31	$ 50,976.00	$ 62,208.00	$ -	$ 113,184.00	STD	Year 2020	WISCONSIN / RACINE (534)
56	Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	4 Rodm	3	10.67	Ton	$ 1,068.75	$ 663.00	$ -	$ 1,731.75	$ 59,850.00	$ 37,128.00	$ -	$ 96,978.00	$ 1,187.50	$ 1,000.03	$ -	$ 2,187.53	$ 66,500.00	$ 56,001.68	$ -	$ 122,501.68	STD	Year 2020	WISCONSIN / RACINE (534)
7	Reinforcing steel, in place, columns, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	4 Rodm	1.5	21.33	Ton	$ 1,068.75	$ 1,326.00	$ -	$ 2,394.75	$ 7,481.25	$ 9,282.00	$ -	$ 16,763.25	$ 1,187.50	$ 1,989.00	$ -	$ 3,176.50	$ 8,312.50	$ 13,923.00	$ -	$ 22,235.50	STD	Year 2020	WISCONSIN / RACINE (534)
1600	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes leveling (strike off) & consolidation, excludes material	C20	185	0.35	C.Y.	$ -	$ 15.99	$ 2.48	$ 18.47	$ -	$ 25,584.00	$ 3,968.00	$ 29,552.00	$ -	$ 24.09	$ 2.73	$ 26.82	$ -	$ 38,544.00	$ 4,368.00	$ 42,912.00	STD	Year 2020	WISCONSIN / RACINE (534)
1067	Structural concrete, in place, elevated slab (4000 psi), flat slab with drop panels, 125 psf superimposed load, 30' span, includes forms(4 uses), Grade 60 rebar, concrete (Portland cement Type I), placing and finishing	C14B	50.99	4.08	C.Y.	$ 332.16	$ 220.38	$ 8.46	$ 561.00	$ 354,414.72	$ 235,145.46	$ 9,026.82	$ 598,587.00	$ 368.49	$ 333.13	$ 9.31	$ 710.93	$ 393,178.83	$ 355,449.71	$ 9,933.77	$ 758,562.31	STD	Year 2020	WISCONSIN / RACINE (534)
652	Structural concrete, placing, walls, pumped, 15" thick, includes leveling (strike off) & consolidation, excludes material	C20	120	0.53	C.Y.	$ -	$ 24.60	$ 3.83	$ 28.43	$ -	$ 16,039.20	$ 2,497.16	$ 18,536.36	$ -	$ 36.90	$ 4.22	$ 41.12	$ -	$ 24,058.80	$ 2,751.44	$ 26,810.24	STD	Year 2020	WISCONSIN / RACINE (534)
142	Structural concrete, placing, column, square or round, pumped, 24" thick, includes leveling (strike off) & consolidation, excludes material	C20	92	0.7	C.Y.	$ -	$ 32.29	$ 5.00	$ 37.29	$ -	$ 4,585.18	$ 710.00	$ 5,295.18	$ -	$ 48.18	$ 5.49	$ 53.67	$ -	$ 6,841.56	$ 779.58	$ 7,621.14	STD	Year 2020	WISCONSIN / RACINE (534)
1	Packaged pumping station, 200,000 GPD, excludes fencing or external piping	E8	0.2	440	Ea.	$ 232,526.00	$ 19,771.80	$11,286.00	$ 263,583.80	$ 232,526.00	$ 19,771.80	$ 11,286.00	$ 263,583.80	$ 255,974.00	$ 33,697.10	$ 12,474.00	$ 302,145.10	$ 255,974.00	$ 33,697.10	$ 12,474.00	$ 302,145.10	OPN	Year 2020	WISCONSIN / RACINE (534)
500	Forcemain piping, ductile iron pipe, cement lined, mechanical joint, no fittings, 18' lengths, 6" diameter, class 50, excludes excavation or backfill	B21A	160	0.25	L.F.	$ 49.83	$ 13.87	$ 2.65	$ 66.35	$ 24,915.00	$ 6,935.00	$ 1,325.00	$ 33,175.00	$ 54.71	$ 20.83	$ 2.92	$ 78.46	$ 27,355.00	$ 10,415.00	$ 1,460.00	$ 39,230.00	STD	Year 2020	WISCONSIN / RACINE (534)
500	Gravity sewer piping, reinforced concrete pipe (RCP), 36" diameter, class 5, excludes excavation or backfill, gaskets	B13	72	0.78	L.F.	$ 87.93	$ 38.27	$ 7.97	$ 134.17	$ 43,965.00	$ 19,135.00	$ 3,985.00	$ 67,085.00	$ 96.72	$ 56.87	$ 8.76	$ 162.35	$ 48,360.00	$ 28,435.00	$ 4,380.00	$ 81,175.00	STD	Year 2020	WISCONSIN / RACINE (534)
										$268,782	**$1,123,296**	**$627,891**	**$93,230**	**$1,844,417**				**$308,851**	**$1,241,495**	**$947,824**	**$102,500**	**$2,291,820**		

Exclusions:
Temporary Utility Bypass
Permits
Pavement Removal or Replacement
Overhead or Underground Utility Conflicts

NOTES:
Elevated concrete slab, 24 inches thick, 20 feet above base slab
2020 YOE

Subtotal, Estimated Construction Cost:	**$2,291,820**
Mobilization, Bonds & Insurance, 5% of Construction Cost:	**$114,591**
Construction Contingency, 25% of Est. Construction Cost:	**$572,955**
Engineering and Administration, 20% of Est. Construction Cost:	**$458,364**
TOTAL, ESTIMATED PROJECT COST:	**$3,437,729**

1.0 MG Equalization Basin
Chicory Road
Racine, Wisconsin

Paul Herubin / John Lapointe - May 5, 2020
Unit Cost Estimate

Table D-4: 1.0 MG Chicory Road EQ Basin

Quantity	Description	Crew	Daily Output	Labor Hours	Unit	Material	Labor	Equipment	Total	Ext. Mat.	Ext. Labor	Ext. Equip.	Ext. Total	Mat. O&P	Labor O&P	Equip. O&P	Total O&P	Ext. Mat. O&P	Ext. Labor O&P	Ext. Equip. O&P	Ext. Total O&P	Labor Type	Data Release	CCI Location
764	Topsoil stripping and stockpiling, topsoil, sandy loam, ideal conditions, 300 HP dozer	B10M	3000	0	C.Y.	$ -	$ 0.21	$ 0.58	$ 0.79	$ -	$ 160.44	$ 443.12	$ 603.56	$ -	$ 0.32	$ 0.64	$ 0.96	$ -	$ 244.48	$ 488.96	$ 733.44	STD	Year 2020	WISCONSIN / RACINE (534)
31354	Excavating, bulk bank measure, 2 C.Y. capacity = 165 C.Y./hr, backhoe, hydraulic, crawler mounted, excluding truck loading	B12C	1320	0.01	B.C.Y.	$ -	$ 0.63	$ 0.71	$ 1.34	$ -	$ 19,753.02	$ 22,261.34	$ 42,014.36	$ -	$ 0.94	$ 0.78	$ 1.72	$ -	$ 29,472.76	$ 24,456.12	$ 53,928.88	STD	Year 2020	WISCONSIN / RACINE (534)
19676	Backfill, structural, common earth, 80 HP dozer, 300' haul, from existing stockpile, excludes compaction	B10L	330	0.04	L.C.Y.	$ -	$ 1.94	$ 1.21	$ 3.15	$ -	$ 38,171.44	$ 23,807.96	$ 61,979.40	$ -	$ 2.89	$ 1.33	$ 4.22	$ -	$ 56,863.64	$ 26,169.08	$ 83,032.72	STD	Year 2020	WISCONSIN / RACINE (534)
1000	Synthetic erosion control, silt fence, install and maintain, remove, 3' high	B62	1300	0.02	L.F.	$ 0.41	$ 0.86	$ 0.14	$ 1.41	$ 410.00	$ 860.00	$ 140.00	$ 1,410.00	$ 0.45	$ 1.30	$ 0.15	$ 1.90	$ 450.00	$ 1,300.00	$ 150.00	$ 1,900.00	STD	Year 2020	WISCONSIN / RACINE (534)
3611	Excavating, trench or continuous footing, common earth, 2-1/2 C.Y. excavator, 6' to 10' deep, excludes sheeting or dewatering	B12S	1000	0.02	B.C.Y.	$ -	$ 0.83	$ 1.46	$ 2.29	$ -	$ 2,997.13	$ 5,272.06	$ 8,269.19	$ -	$ 1.24	$ 1.59	$ 2.83	$ -	$ 4,477.64	$ 5,741.49	$ 10,219.13	STD	Year 2020	WISCONSIN / RACINE (534)
1795	Structural concrete, ready mix, heavyweight, 5000 psi, includes local aggregate, sand, Portland cement (Type I) and water, delivered, excludes all additives and treatments		0	0	C.Y.	$ 140.13	$ -	$ -	$ 140.13	$ 251,533.35	$ -	$ -	$ 251,533.35	$ 154.66	$ -	$ -	$ 154.66	$ 277,614.70	$ -	$ -	$ 277,614.70	STD	Year 2020	WISCONSIN / RACINE (534)
11025	C.I.P. concrete forms, slab on grade, edge, wood, over 12", 4 use, includes erecting, bracing, stripping and cleaning	C1	350	0.09	SFCA	$ 0.97	$ 4.89	$ -	$ 5.86	$ 10,694.25	$ 53,912.25	$ -	$ 64,606.50	$ 1.07	$ 7.32	$ -	$ 8.39	$ 11,796.75	$ 80,703.00	$ -	$ 92,499.75	STD	Year 2020	WISCONSIN / RACINE (534)
4620	C.I.P. concrete forms, retaining wall, battered, job built plywood, over 8' to 16' high, 1 use, includes erecting, bracing, stripping and cleaning	C2	240	0.2	SFCA	$ 2.39	$ 10.98	$ -	$ 13.37	$ 11,041.80	$ 50,727.60	$ -	$ 61,769.40	$ 2.62	$ 16.45	$ -	$ 19.07	$ 12,104.40	$ 75,999.00	$ -	$ 88,103.40	STD	Year 2020	WISCONSIN / RACINE (534)
272	C.I.P. concrete forms, column, round, steel, heavy duty, rent, 36" diameter, 4 uses per month, includes erecting, bracing, stripping and cleaning	C1	60	0.53	L.F.	$27.53	$28.65	$ -	$ 56.18	$ 7,488.16	$ 7,792.80	$ -	$ 15,280.96	$30.03	$42.97	$ -	$ 73.00	$ 8,168.16	$ 11,687.84	$ -	$ 19,856.00	STD	Year 2020	WISCONSIN / RACINE (534)
66150	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	4 Rodm	4200	0.01	Lb.	$ 0.53	$ 0.48	$ -	$ 1.01	$ 35,059.50	$ 31,752.00	$ -	$ 66,811.50	$ 0.59	$ 0.72	$ -	$ 1.31	$ 39,028.50	$ 47,628.00	$ -	$ 86,656.50	STD	Year 2020	WISCONSIN / RACINE (534)
49	Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	4 Rodm	3	10.67	Ton	$ 1,068.75	$ 663.00	$ -	$ 1,731.75	$ 52,368.75	$ 32,487.00	$ -	$ 84,855.75	$ 1,187.50	$ 1,000.03	$ -	$ 2,187.53	$ 58,187.50	$ 49,001.47	$ -	$ 107,188.97	STD	Year 2020	WISCONSIN / RACINE (534)
4	Reinforcing steel, in place, columns, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	4 Rodm	1.5	21.33	Ton	$ 1,068.75	$ 1,326.00	$ -	$ 2,394.75	$ 4,275.00	$ 5,304.00	$ -	$ 9,579.00	$ 1,187.50	$ 1,989.00	$ -	$ 3,176.50	$ 4,750.00	$ 7,956.00	$ -	$ 12,706.00	STD	Year 2020	WISCONSIN / RACINE (534)
1225	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes leveling (strike off) & consolidation, excludes material	C20	185	0.35	C.Y.	$ -	$ 15.99	$ 2.48	$ 18.47	$ -	$ 19,587.75	$ 3,038.00	$ 22,625.75	$ -	$ 24.09	$ 2.73	$ 26.82	$ -	$ 29,510.25	$ 3,344.25	$ 32,854.50	STD	Year 2020	WISCONSIN / RACINE (534)
817	Structural concrete, in place, elevated slab (4000 psi), flat slab with drop panels, 125 psf superimposed load, 30' span, includes forms(4 uses), Grade 60 rebar, concrete (Portland cement Type I), placing and finishing	C14B	50.99	4.08	C.Y.	$ 332.16	$ 220.38	$ 8.46	$ 561.00	$ 271,374.72	$ 180,050.46	$ 6,911.82	$ 458,337.00	$ 368.49	$ 333.13	$ 9.31	$ 710.93	$ 301,056.33	$ 272,167.21	$ 7,606.27	$ 580,829.81	STD	Year 2020	WISCONSIN / RACINE (534)
570	Structural concrete, placing, walls, pumped, 15" thick, includes leveling (strike off) & consolidation, excludes material	C20	120	0.53	C.Y.	$ -	$ 24.60	$ 3.83	$ 28.43	$ -	$ 14,022.00	$ 2,183.10	$ 16,205.10	$ -	$ 36.90	$ 4.22	$ 41.12	$ -	$ 21,033.00	$ 2,405.40	$ 23,438.40	STD	Year 2020	WISCONSIN / RACINE (534)
91	Structural concrete, placing, column, square or round, pumped, 24" thick, includes leveling (strike off) & consolidation, excludes material	C20	92	0.7	C.Y.	$ -	$ 32.29	$ 5.00	$ 37.29	$ -	$ 2,938.39	$ 455.00	$ 3,393.39	$ -	$ 48.18	$ 5.49	$ 53.67	$ -	$ 4,384.38	$ 499.59	$ 4,883.97	STD	Year 2020	WISCONSIN / RACINE (534)
1	Packaged pumping station, 200,000 GPD, excludes fencing or external piping	E8	0.2	440	Ea.	$ 232,526.00	$ 19,771.80	$11,286.00	$ 263,583.80	$ 232,526.00	$ 19,771.80	$ 11,286.00	$ 263,583.80	$ 255,974.00	$ 33,697.10	$ 12,474.00	$ 302,145.10	$ 255,974.00	$ 33,697.10	$ 12,474.00	$ 302,145.10	OPN	Year 2020	WISCONSIN / RACINE (534)
500	Forcemain piping, ductile iron pipe, cement lined, mechanical joint, no fittings, 18' lengths, 6" diameter, class 50, excludes excavation or backfill	B21A	160	0.25	L.F.	$ 49.83	$ 13.87	$ 2.65	$ 66.35	$ 24,915.00	$ 6,935.00	$ 1,325.00	$ 33,175.00	$ 54.71	$ 20.83	$ 2.92	$ 78.46	$ 27,355.00	$ 10,415.00	$ 1,460.00	$ 39,230.00	STD	Year 2020	WISCONSIN / RACINE (534)
500	Gravity sewer piping, reinforced concrete pipe (RCP), 36" diameter, class 5, excludes excavation or backfill, gaskets	B13	72	0.78	L.F.	$ 87.93	$ 38.27	$ 7.97	$ 134.17	$ 43,965.00	$ 19,135.00	$ 3,985.00	$ 67,085.00	$ 96.72	$ 56.87	$ 8.76	$ 162.35	$ 48,360.00	$ 28,435.00	$ 4,380.00	$ 81,175.00	STD	Year 2020	WISCONSIN / RACINE (534)
										$268,782	**$945,652**	**$506,358**	**$81,108**	**$1,533,118**				**$308,851**	**$1,044,845**	**$764,976**	**$89,175**	**$1,898,996**			

Exclusions:
Temporary Utility Bypass
Permits
Pavement Removal or Replacement
Overhead or Underground Utility Conflicts

NOTES:
Elevated concrete slab, 24 inches thick, 20 feet above base slab
2020 YOE

Subtotal, Estimated Construction Cost:	**$1,898,996**
Mobilization, Bonds & Insurance, 5% of Construction Cost:	**$94,950**
Construction Contingency, 25% of Est. Construction Cost:	**$474,749**
Engineering and Administration, 20% of Est. Construction Cost:	**$379,799**
TOTAL, ESTIMATED PROJECT COST:	**$2,848,494**

10.0 MG Equalization Basin
Lift Station No. 1
Racine, Wisconsin

Paul Herubin / John Lapointe - May 5, 2020
Unit Cost Estimate

Table D-5: 10.0 MG Lift Station No. 01 EQ Basin

Quantity	Description	Crew	Daily Output	Labor Hours	Unit	Material	Labor	Equipment	Total	Ext.Mat.	Ext.Labor	Ext.Equip.	Ext.Total	Mat.O&P	LaborO&P	Equip.O&P	TotalO&P	Ext.Mat. O&P	Ext.Labor O&P	Ext.Equip. O&P	Ext.Total O&P	LaborType	DataRelease	CCI Location
1833	Topsoil stripping and stockpiling, topsoil, sandy loam, ideal conditions, 300 HP dozer	B10M	3000	0	C.Y.	$ -	$ 0.21	$ 0.58	$ 0.79	$ -	$ 384.93	$ 1,063.14	$ 1,448.07	$ -	$ 0.32	$ 0.64	$ 0.96	$ -	$ 586.56	$ 1,173.12	$ 1,759.68	STD	Year 2020	WISCONSIN / RACINE (534)
81166	Excavating, bulk bank measure, 2 C.Y. capacity = 165 C.Y./hr, backhoe, hydraulic, crawler mounted, excluding truck loading	B12C	1320	0.01	B.C.Y.	$ -	$ 0.63	$ 0.71	$ 1.34	$ -	$ 51,134.58	$ 57,627.86	$ 108,762.44	$ -	$ 0.94	$ 0.78	$ 1.72	$ -	$ 76,296.04	$ 63,309.48	$ 139,605.52	STD	Year 2020	WISCONSIN / RACINE (534)
25201	Backfill, structural, common earth, 80 HP dozer, 300' haul, from existing stockpile, excludes compaction	B10L	330	0.04	L.C.Y.	$ -	$ 1.94	$ 1.21	$ 3.15	$ -	$ 48,889.94	$ 30,493.21	$ 79,383.15	$ -	$ 2.89	$ 1.33	$ 4.22	$ -	$ 72,830.89	$ 33,517.33	$ 106,348.22	STD	Year 2020	WISCONSIN / RACINE (534)
2000	Synthetic erosion control, silt fence, install and maintain, remove, 3' high	B62	1300	0.02	L.F.	$ 0.41	$ 0.86	$ 0.14	$ 1.41	$ 820.00	$ 1,720.00	$ 280.00	$ 2,820.00	$ 0.45	$ 1.30	$ 0.15	$ 1.90	$ 900.00	$ 2,600.00	$ 300.00	$ 3,800.00	STD	Year 2020	WISCONSIN / RACINE (534)
3611	Excavating, trench or continuous footing, common earth, 2-1/2 C.Y. excavator, 6' to 10' deep, excludes sheeting or dewatering	B12S	1000	0.02	B.C.Y.	$ -	$ 0.83	$ 1.46	$ 2.29	$ -	$ 2,997.13	$ 5,272.06	$ 8,269.19	$ -	$ 1.24	$ 1.59	$ 2.83	$ -	$ 4,477.64	$ 5,741.49	$ 10,219.13	STD	Year 2020	WISCONSIN / RACINE (534)
11258	Structural concrete, ready mix, heavyweight, 5000 psi, includes local aggregate, sand, Portland cement (Type I) and water, delivered, excludes all additives and treatments		0	0	C.Y.	$ 140.13	$ -	$ -	$ 140.13	$ 1,577,583.54	$ -	$ -	$ 1,577,583.54	$ 154.66	$ -	$ -	$ 154.66	$ 1,741,162.28	$ -	$ -	$ 1,741,162.28	STD	Year 2020	WISCONSIN / RACINE (534)
83025	C.I.P. concrete forms, slab on grade, edge, wood, over 12", 4 use, includes erecting, bracing, stripping and cleaning	C1	350	0.09	SFCA	$ 0.97	$ 4.89	$ -	$ 5.86	$ 80,534.25	$ 405,992.25	$ -	$ 486,526.50	$ 1.07	$ 7.32	$ -	$ 8.39	$ 88,836.75	$ 607,743.00	$ -	$ 696,579.75	STD	Year 2020	WISCONSIN / RACINE (534)
16470	C.I.P. concrete forms, retaining wall, battered, job built plywood, over 8' to 16' high, 1 use, includes erecting, bracing, stripping and cleaning	C2	240	0.2	SFCA	$ 2.39	$ 10.98	$ -	$ 13.37	$ 39,363.30	$ 180,840.60	$ -	$ 220,203.90	$ 2.62	$ 16.45	$ -	$ 19.07	$ 43,151.40	$ 270,931.50	$ -	$ 314,082.90	STD	Year 2020	WISCONSIN / RACINE (534)
3762	C.I.P. concrete forms, column, round, steel, heavy duty, rent, 36" diameter, 4 uses per month, includes erecting, bracing, stripping and cleaning	C1	60	0.53	L.F.	$27.53	$28.65	$ -	$ 56.18	$ 103,567.86	$ 107,781.30	$ -	$ 211,349.16	$30.03	$42.97	$ -	$ 73.00	$ 112,972.86	$ 161,653.14	$ -	$ 274,626.00	STD	Year 2020	WISCONSIN / RACINE (534)
498150	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	4 Rodm	4200	0.01	Lb.	$ 0.53	$ 0.48	$ -	$ 1.01	$ 264,019.50	$ 239,112.00	$ -	$ 503,131.50	$ 0.59	$ 0.72	$ -	$ 1.31	$ 293,908.50	$ 358,668.00	$ -	$ 652,576.50	STD	Year 2020	WISCONSIN / RACINE (534)
264	Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	4 Rodm	3	10.67	Ton	$ 1,068.75	$ 663.00	$ -	$ 1,731.75	$ 282,150.00	$ 175,032.00	$ -	$ 457,182.00	$ 1,187.50	$ 1,000.03	$ -	$ 2,187.53	$ 313,500.00	$ 264,007.92	$ -	$ 577,507.92	STD	Year 2020	WISCONSIN / RACINE (534)
58	Reinforcing steel, in place, columns, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	4 Rodm	1.5	21.33	Ton	$ 1,068.75	$ 1,326.00	$ -	$ 2,394.75	$ 61,987.50	$ 76,908.00	$ -	$ 138,895.50	$ 1,187.50	$ 1,989.00	$ -	$ 3,176.50	$ 68,875.00	$ 115,362.00	$ -	$ 184,237.00	STD	Year 2020	WISCONSIN / RACINE (534)
9225	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes leveling (strike off) & consolidation, excludes material	C20	185	0.35	C.Y.	$ -	$ 15.99	$ 2.48	$ 18.47	$ -	$ 147,507.75	$ 22,878.00	$ 170,385.75	$ -	$ 24.09	$ 2.73	$ 26.82	$ -	$ 222,230.25	$ 25,184.25	$ 247,414.50	STD	Year 2020	WISCONSIN / RACINE (534)
6150	Structural concrete, in place, elevated slab (4000 psi), flat slab with drop panels, 125 psf superimposed load, 30' span, includes forms(4 uses), Grade 60 rebar, concrete (Portland cement Type I), placing and finishing	C14B	50.99	4.08	C.Y.	$ 332.16	$ 220.38	$ 8.46	$ 561.00	$ 2,042,784.00	$ 1,355,337.00	$ 52,029.00	$ 3,450,150.00	$ 368.49	$ 333.13	$ 9.31	$ 710.93	$ 2,266,213.50	$ 2,048,749.50	$ 57,256.50	$ 4,372,219.50	STD	Year 2020	WISCONSIN / RACINE (534)
2033	Structural concrete, placing, walls, pumped, 15" thick, includes leveling (strike off) & consolidation, excludes material	C20	120	0.53	C.Y.	$ -	$ 24.60	$ 3.83	$ 28.43	$ -	$ 50,011.80	$ 7,786.39	$ 57,798.19	$ -	$ 36.90	$ 4.22	$ 41.12	$ -	$ 75,017.70	$ 8,579.26	$ 83,596.96	STD	Year 2020	WISCONSIN / RACINE (534)
1254	Structural concrete, placing, column, square or round, pumped, 24" thick, includes leveling (strike off) & consolidation, excludes material	C20	92	0.7	C.Y.	$ -	$ 32.29	$ 5.00	$ 37.29	$ -	$ 40,491.66	$ 6,270.00	$ 46,761.66	$ -	$ 48.18	$ 5.49	$ 53.67	$ -	$ 60,417.72	$ 6,884.46	$ 67,302.18	STD	Year 2020	WISCONSIN / RACINE (534)
500	Forcemain piping, ductile iron pipe, cement lined, mechanical joint, no fittings, 18' lengths, 24" diameter, class 50, excludes excavation or backfill	B21A	47.06	0.85	L.F.	$ 164.14	$ 47.30	$ 9.01	$ 220.45	$ 82,070.00	$ 23,650.00	$ 4,505.00	$ 110,225.00	$ 180.75	$ 70.69	$ 9.90	$ 261.34	$ 90,375.00	$ 35,345.00	$ 4,950.00	$ 130,670.00	STD	Year 2020	WISCONSIN / RACINE (534)
500	Gravity sewer piping, reinforced concrete pipe (RCP), 36" diameter, class 5, excludes excavation or backfill, gaskets	B13	72	0.78	L.F.	$ 87.93	$ 38.27	$ 7.97	$ 134.17	$ 43,965.00	$ 19,135.00	$ 3,985.00	$ 67,085.00	$ 96.72	$ 56.87	$ 8.76	$ 162.35	$ 48,360.00	$ 28,435.00	$ 4,380.00	$ 81,175.00	STD	Year 2020	WISCONSIN / RACINE (534)
										$5,352	**$4,578,845**	**$2,926,926**	**$192,190**	**$7,697,961**				**$6,888**	**$5,068,255**	**$4,405,352**	**$211,276**	**$9,684,883**		

Exclusions:
Temporary Utility Bypass
Permits
Pavement Removal or Replacement
Overhead or Underground Utility Conflicts

NOTES:
Elevated concrete slab, 24 inches thick, 20 feet above base slab
2020 YOE

Subtotal, Estimated Construction Cost:	**$9,684,883**
Mobilization, Bonds & Insurance, 5% of Construction Cost:	**$484,244**
Construction Contingency, 25% of Est. Construction Cost:	**$2,421,221**
Engineering and Administration, 20% of Est. Construction Cost:	**$1,936,977**
TOTAL, ESTIMATED PROJECT COST:	**$14,527,325**

1.0 MG Equalization Basin
Caledonia
Racine, Wisconsin

Paul Herubin / John Lapointe - May 5, 2020
Unit Cost Estimate

Table D-6: 1.0 MG Caledonia EQ Basin

Quantity	Description	Crew	Daily Output	Labor Hours	Unit	Material	Labor	Equipment	Total	Ext. Mat.	Ext. Labor	Ext. Equip.	Ext. Total	Mat. O&P	Labor O&P	Equip. O&P	Total O&P	Ext. Mat. O&P	Ext. Labor O&P	Ext. Equip. O&P	Ext. Total O&P	Labor Type	Data Release	CCI Location
764	Topsoil stripping and stockpiling, topsoil, sandy loam, ideal conditions, 300 HP dozer	B10M	3000	0	C.Y.	$ -	$ 0.21	$ 0.58	$ 0.79	$ -	$ 160.44	$ 443.12	$ 603.56	$ -	$ 0.32	$ 0.64	$ 0.96	$ -	$ 244.48	$ 488.96	$ 733.44	STD	Year 2020	WISCONSIN / RACINE (534)
31354	Excavating, bulk bank measure, 2 C.Y. capacity = 165 C.Y./hr, backhoe, hydraulic, crawler mounted, excluding truck loading	B12C	1320	0.01	B.C.Y.	$ -	$ 0.63	$ 0.71	$ 1.34	$ -	$ 19,753.02	$ 22,261.34	$ 42,014.36	$ -	$ 0.94	$ 0.78	$ 1.72	$ -	$ 29,472.76	$ 24,456.12	$ 53,928.88	STD	Year 2020	WISCONSIN / RACINE (534)
19676	Backfill, structural, common earth, 80 HP dozer, 300' haul, from existing stockpile, excludes compaction	B10L	330	0.04	L.C.Y.	$ -	$ 1.94	$ 1.21	$ 3.15	$ -	$ 38,171.44	$ 23,807.96	$ 61,979.40	$ -	$ 2.89	$ 1.33	$ 4.22	$ -	$ 56,863.64	$ 26,169.08	$ 83,032.72	STD	Year 2020	WISCONSIN / RACINE (534)
1000	Synthetic erosion control, silt fence, install and maintain, remove, 3' high	B62	1300	0.02	L.F.	$ 0.41	$ 0.86	$ 0.14	$ 1.41	$ 410.00	$ 860.00	$ 140.00	$ 1,410.00	$ 0.45	$ 1.30	$ 0.15	$ 1.90	$ 450.00	$ 1,300.00	$ 150.00	$ 1,900.00	STD	Year 2020	WISCONSIN / RACINE (534)
3611	Excavating, trench or continuous footing, common earth, 2-1/2 C.Y. excavator, 6' to 10' deep, excludes sheeting or dewatering	B12S	1000	0.02	B.C.Y.	$ -	$ 0.83	$ 1.46	$ 2.29	$ -	$ 2,997.13	$ 5,272.06	$ 8,269.19	$ -	$ 1.24	$ 1.59	$ 2.83	$ -	$ 4,477.64	$ 5,741.49	$ 10,219.13	STD	Year 2020	WISCONSIN / RACINE (534)
1795	Structural concrete, ready mix, heavyweight, 5000 psi, includes local aggregate, sand, Portland cement (Type I) and water, delivered, excludes all additives and treatments		0	0	C.Y.	$ 140.13	$ -	$ -	$ 140.13	$ 251,533.35	$ -	$ -	$ 251,533.35	$ 154.66	$ -	$ -	$ 154.66	$ 277,614.70	$ -	$ -	$ 277,614.70	STD	Year 2020	WISCONSIN / RACINE (534)
11025	C.I.P. concrete forms, slab on grade, edge, wood, over 12", 4 use, includes erecting, bracing, stripping and cleaning	C1	350	0.09	SFCA	$ 0.97	$ 4.89	$ -	$ 5.86	$ 10,694.25	$ 53,912.25	$ -	$ 64,606.50	$ 1.07	$ 7.32	$ -	$ 8.39	$ 11,796.75	$ 80,703.00	$ -	$ 92,499.75	STD	Year 2020	WISCONSIN / RACINE (534)
4620	C.I.P. concrete forms, retaining wall, battered, job built plywood, over 8' to 16' high, 1 use, includes erecting, bracing, stripping and cleaning	C2	240	0.2	SFCA	$ 2.39	$ 10.98	$ -	$ 13.37	$ 11,041.80	$ 50,727.60	$ -	$ 61,769.40	$ 2.62	$ 16.45	$ -	$ 19.07	$ 12,104.40	$ 75,999.00	$ -	$ 88,103.40	STD	Year 2020	WISCONSIN / RACINE (534)
272	C.I.P. concrete forms, column, round, steel, heavy duty, rent, 36" diameter, 4 uses per month, includes erecting, bracing, stripping and cleaning	C1	60	0.53	L.F.	$27.53	$28.65	$ -	$ 56.18	$ 7,488.16	$ 7,792.80	$ -	$ 15,280.96	$30.03	$42.97	$ -	$ 73.00	$ 8,168.16	$ 11,687.84	$ -	$ 19,856.00	STD	Year 2020	WISCONSIN / RACINE (534)
66150	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	4 Rodm	4200	0.01	Lb.	$ 0.53	$ 0.48	$ -	$ 1.01	$ 35,059.50	$ 31,752.00	$ -	$ 66,811.50	$ 0.59	$ 0.72	$ -	$ 1.31	$ 39,028.50	$ 47,628.00	$ -	$ 86,656.50	STD	Year 2020	WISCONSIN / RACINE (534)
49	Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	4 Rodm	3	10.67	Ton	$ 1,068.75	$ 663.00	$ -	$ 1,731.75	$ 52,368.75	$ 32,487.00	$ -	$ 84,855.75	$ 1,187.50	$ 1,000.03	$ -	$ 2,187.53	$ 58,187.50	$ 49,001.47	$ -	$ 107,188.97	STD	Year 2020	WISCONSIN / RACINE (534)
4	Reinforcing steel, in place, columns, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	4 Rodm	1.5	21.33	Ton	$ 1,068.75	$ 1,326.00	$ -	$ 2,394.75	$ 4,275.00	$ 5,304.00	$ -	$ 9,579.00	$ 1,187.50	$ 1,989.00	$ -	$ 3,176.50	$ 4,750.00	$ 7,956.00	$ -	$ 12,706.00	STD	Year 2020	WISCONSIN / RACINE (534)
1225	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes leveling (strike off) & consolidation, excludes material	C20	185	0.35	C.Y.	$ -	$ 15.99	$ 2.48	$ 18.47	$ -	$ 19,587.75	$ 3,038.00	$ 22,625.75	$ -	$ 24.09	$ 2.73	$ 26.82	$ -	$ 29,510.25	$ 3,344.25	$ 32,854.50	STD	Year 2020	WISCONSIN / RACINE (534)
817	Structural concrete, in place, elevated slab (4000 psi), flat slab with drop panels, 125 psf superimposed load, 30' span, includes forms(4 uses), Grade 60 rebar, concrete (Portland cement Type I), placing and finishing	C14B	50.99	4.08	C.Y.	$ 332.16	$ 220.38	$ 8.46	$ 561.00	$ 271,374.72	$ 180,050.46	$ 6,911.82	$ 458,337.00	$ 368.49	$ 333.13	$ 9.31	$ 710.93	$ 301,056.33	$ 272,167.21	$ 7,606.27	$ 580,829.81	STD	Year 2020	WISCONSIN / RACINE (534)
570	Structural concrete, placing, walls, pumped, 15" thick, includes leveling (strike off) & consolidation, excludes material	C20	120	0.53	C.Y.	$ -	$ 24.60	$ 3.83	$ 28.43	$ -	$ 14,022.00	$ 2,183.10	$ 16,205.10	$ -	$ 36.90	$ 4.22	$ 41.12	$ -	$ 21,033.00	$ 2,405.40	$ 23,438.40	STD	Year 2020	WISCONSIN / RACINE (534)
91	Structural concrete, placing, column, square or round, pumped, 24" thick, includes leveling (strike off) & consolidation, excludes material	C20	92	0.7	C.Y.	$ -	$ 32.29	$ 5.00	$ 37.29	$ -	$ 2,938.39	$ 455.00	$ 3,393.39	$ -	$ 48.18	$ 5.49	$ 53.67	$ -	$ 4,384.38	$ 499.59	$ 4,883.97	STD	Year 2020	WISCONSIN / RACINE (534)
1	Packaged pumping station, 200,000 GPD, excludes fencing or external piping	E8	0.2	440	Ea.	$ 232,526.00	$ 19,771.80	$11,286.00	$ 263,583.80	$ 232,526.00	$ 19,771.80	$ 11,286.00	$ 263,583.80	$ 255,974.00	$ 33,697.10	$ 12,474.00	$ 302,145.10	$ 255,974.00	$ 33,697.10	$ 12,474.00	$ 302,145.10	OPN	Year 2020	WISCONSIN / RACINE (534)
500	Forcemain piping, ductile iron pipe, cement lined, mechanical joint, no fittings, 18' lengths, 6" diameter, class 50, excludes excavation or backfill	B21A	160	0.25	L.F.	$ 49.83	$ 13.87	$ 2.65	$ 66.35	$ 24,915.00	$ 6,935.00	$ 1,325.00	$ 33,175.00	$ 54.71	$ 20.83	$ 2.92	$ 78.46	$ 27,355.00	$ 10,415.00	$ 1,460.00	$ 39,230.00	STD	Year 2020	WISCONSIN / RACINE (534)
500	Gravity sewer piping, reinforced concrete pipe (RCP), 36" diameter, class 5, excludes excavation or backfill, gaskets	B13	72	0.78	L.F.	$ 87.93	$ 38.27	$ 7.97	$ 134.17	$ 43,965.00	$ 19,135.00	$ 3,985.00	$ 67,085.00	$ 96.72	$ 56.87	$ 8.76	$ 162.35	$ 48,360.00	$ 28,435.00	$ 4,380.00	$ 81,175.00	STD	Year 2020	WISCONSIN / RACINE (534)
									$268,782	**$945,652**	**$506,358**	**$81,108**	**$1,533,118**				**$308,851**	**$1,044,845**	**$764,976**	**$89,175**	**$1,898,996**			

Exclusions:
Temporary Utility Bypass
Permits
Pavement Removal or Replacement
Overhead or Underground Utility Conflicts

NOTES:
Elevated concrete slab, 24 inches thick, 20 feet above base slab
2020 YOE

Subtotal, Estimated Construction Cost:	**$1,898,996**
Mobilization, Bonds & Insurance, 5% of Construction Cost:	**$94,950**
Construction Contingency, 25% of Est. Construction Cost:	**$474,749**
Engineering and Administration, 20% of Est. Construction Cost:	**$379,799**
TOTAL, ESTIMATED PROJECT COST:	**$2,848,494**

1.0 MG Equalization Basin
Lakeview Park
Racine, Wisconsin

Paul Herubin / John Lapointe - May 5, 2020
Unit Cost Estimate

Table D-7: 1.0 MG Lakeview Park EQ Basin

Quantity	Description	Crew	Daily Output	Labor Hours	Unit	Material	Labor	Equipment	Total	Ext. Mat.	Ext. Labor	Ext. Equip.	Ext. Total	Mat. O&P	Labor O&P	Equip. O&P	Total O&P	Ext. Mat. O&P	Ext. Labor O&P	Ext. Equip. O&P	Ext. Total O&P	Labor Type	Data Release	CCI Location
764	Topsoil stripping and stockpiling, topsoil, sandy loam, ideal conditions, 300 HP dozer	B10M	3000	0	C.Y.	$ -	$ 0.21	$ 0.58	$ 0.79	$ -	$ 160.44	$ 443.12	$ 603.56	$ -	$ 0.32	$ 0.64	$ 0.96	$ -	$ 244.48	$ 488.96	$ 733.44	STD	Year 2020	WISCONSIN / RACINE (534)
31354	Excavating, bulk bank measure, 2 C.Y. capacity = 165 C.Y./hr, backhoe, hydraulic, crawler mounted, excluding truck loading	B12C	1320	0.01	B.C.Y.	$ -	$ 0.63	$ 0.71	$ 1.34	$ -	$ 19,753.02	$ 22,261.34	$ 42,014.36	$ -	$ 0.94	$ 0.78	$ 1.72	$ -	$ 29,472.76	$ 24,456.12	$ 53,928.88	STD	Year 2020	WISCONSIN / RACINE (534)
19676	Backfill, structural, common earth, 80 HP dozer, 300' haul, from existing stockpile, excludes compaction	B10L	330	0.04	L.C.Y.	$ -	$ 1.94	$ 1.21	$ 3.15	$ -	$ 38,171.44	$ 23,807.96	$ 61,979.40	$ -	$ 2.89	$ 1.33	$ 4.22	$ -	$ 56,863.64	$ 26,169.08	$ 83,032.72	STD	Year 2020	WISCONSIN / RACINE (534)
1000	Synthetic erosion control, silt fence, install and maintain, remove, 3' high	B62	1300	0.02	L.F.	$ 0.41	$ 0.86	$ 0.14	$ 1.41	$ 410.00	$ 860.00	$ 140.00	$ 1,410.00	$ 0.45	$ 1.30	$ 0.15	$ 1.90	$ 450.00	$ 1,300.00	$ 150.00	$ 1,900.00	STD	Year 2020	WISCONSIN / RACINE (534)
3611	Excavating, trench or continuous footing, common earth, 2-1/2 C.Y. excavator, 6' to 10' deep, excludes sheeting or dewatering	B12S	1000	0.02	B.C.Y.	$ -	$ 0.83	$ 1.46	$ 2.29	$ -	$ 2,997.13	$ 5,272.06	$ 8,269.19	$ -	$ 1.24	$ 1.59	$ 2.83	$ -	$ 4,477.64	$ 5,741.49	$ 10,219.13	STD	Year 2020	WISCONSIN / RACINE (534)
1795	Structural concrete, ready mix, heavyweight, 5000 psi, includes local aggregate, sand, Portland cement (Type I) and water, delivered, excludes all additives and treatments		0	0	C.Y.	$ 140.13	$ -	$ -	$ 140.13	$ 251,533.35	$ -	$ -	$ 251,533.35	$ 154.66	$ -	$ -	$ 154.66	$ 277,614.70	$ -	$ -	$ 277,614.70	STD	Year 2020	WISCONSIN / RACINE (534)
11025	C.I.P. concrete forms, slab on grade, edge, wood, over 12", 4 use, includes erecting, bracing, stripping and cleaning	C1	350	0.09	SFCA	$ 0.97	$ 4.89	$ -	$ 5.86	$ 10,694.25	$ 53,912.25	$ -	$ 64,606.50	$ 1.07	$ 7.32	$ -	$ 8.39	$ 11,796.75	$ 80,703.00	$ -	$ 92,499.75	STD	Year 2020	WISCONSIN / RACINE (534)
4620	C.I.P. concrete forms, retaining wall, battered, job built plywood, over 8' to 16' high, 1 use, includes erecting, bracing, stripping and cleaning	C2	240	0.2	SFCA	$ 2.39	$ 10.98	$ -	$ 13.37	$ 11,041.80	$ 50,727.60	$ -	$ 61,769.40	$ 2.62	$ 16.45	$ -	$ 19.07	$ 12,104.40	$ 75,999.00	$ -	$ 88,103.40	STD	Year 2020	WISCONSIN / RACINE (534)
272	C.I.P. concrete forms, column, round, steel, heavy duty, rent, 36" diameter, 4 uses per month, includes erecting, bracing, stripping and cleaning	C1	60	0.53	L.F.	$27.53	$28.65	$ -	$ 56.18	$ 7,488.16	$ 7,792.80	$ -	$ 15,280.96	$30.03	$42.97	$ -	$ 73.00	$ 8,168.16	$ 11,687.84	$ -	$ 19,856.00	STD	Year 2020	WISCONSIN / RACINE (534)
66150	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	4 Rodm	4200	0.01	Lb.	$ 0.53	$ 0.48	$ -	$ 1.01	$ 35,059.50	$ 31,752.00	$ -	$ 66,811.50	$ 0.59	$ 0.72	$ -	$ 1.31	$ 39,028.50	$ 47,628.00	$ -	$ 86,656.50	STD	Year 2020	WISCONSIN / RACINE (534)
49	Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	4 Rodm	3	10.67	Ton	$ 1,068.75	$ 663.00	$ -	$ 1,731.75	$ 52,368.75	$ 32,487.00	$ -	$ 84,855.75	$ 1,187.50	$ 1,000.03	$ -	$ 2,187.53	$ 58,187.50	$ 49,001.47	$ -	$ 107,188.97	STD	Year 2020	WISCONSIN / RACINE (534)
4	Reinforcing steel, in place, columns, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	4 Rodm	1.5	21.33	Ton	$ 1,068.75	$ 1,326.00	$ -	$ 2,394.75	$ 4,275.00	$ 5,304.00	$ -	$ 9,579.00	$ 1,187.50	$ 1,989.00	$ -	$ 3,176.50	$ 4,750.00	$ 7,956.00	$ -	$ 12,706.00	STD	Year 2020	WISCONSIN / RACINE (534)
1225	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes leveling (strike off) & consolidation, excludes material	C20	185	0.35	C.Y.	$ -	$ 15.99	$ 2.48	$ 18.47	$ -	$ 19,587.75	$ 3,038.00	$ 22,625.75	$ -	$ 24.09	$ 2.73	$ 26.82	$ -	$ 29,510.25	$ 3,344.25	$ 32,854.50	STD	Year 2020	WISCONSIN / RACINE (534)
817	Structural concrete, in place, elevated slab (4000 psi), flat slab with drop panels, 125 psf superimposed load, 30' span, includes forms(4 uses), Grade 60 rebar, concrete (Portland cement Type I), placing and finishing	C14B	50.99	4.08	C.Y.	$ 332.16	$ 220.38	$ 8.46	$ 561.00	$ 271,374.72	$ 180,050.46	$ 6,911.82	$ 458,337.00	$ 368.49	$ 333.13	$ 9.31	$ 710.93	$ 301,056.33	$ 272,167.21	$ 7,606.27	$ 580,829.81	STD	Year 2020	WISCONSIN / RACINE (534)
570	Structural concrete, placing, walls, pumped, 15" thick, includes leveling (strike off) & consolidation, excludes material	C20	120	0.53	C.Y.	$ -	$ 24.60	$ 3.83	$ 28.43	$ -	$ 14,022.00	$ 2,183.10	$ 16,205.10	$ -	$ 36.90	$ 4.22	$ 41.12	$ -	$ 21,033.00	$ 2,405.40	$ 23,438.40	STD	Year 2020	WISCONSIN / RACINE (534)
91	Structural concrete, placing, column, square or round, pumped, 24" thick, includes leveling (strike off) & consolidation, excludes material	C20	92	0.7	C.Y.	$ -	$ 32.29	$ 5.00	$ 37.29	$ -	$ 2,938.39	$ 455.00	$ 3,393.39	$ -	$ 48.18	$ 5.49	$ 53.67	$ -	$ 4,384.38	$ 499.59	$ 4,883.97	STD	Year 2020	WISCONSIN / RACINE (534)
1	Packaged pumping station, 200,000 GPD, excludes fencing or external piping	E8	0.2	440	Ea.	$ 232,526.00	$ 19,771.80	$ 11,286.00	$ 263,583.80	$ 232,526.00	$ 19,771.80	$ 11,286.00	$ 263,583.80	$ 255,974.00	$ 33,697.10	$ 12,474.00	$ 302,145.10	$ 255,974.00	$ 33,697.10	$ 12,474.00	$ 302,145.10	OPN	Year 2020	WISCONSIN / RACINE (534)
500	Forcemain piping, ductile iron pipe, cement lined, mechanical joint, no fittings, 18' lengths, 6" diameter, class 50, excludes excavation or backfill	B21A	160	0.25	L.F.	$ 49.83	$ 13.87	$ 2.65	$ 66.35	$ 24,915.00	$ 6,935.00	$ 1,325.00	$ 33,175.00	$ 54.71	$ 20.83	$ 2.92	$ 78.46	$ 27,355.00	$ 10,415.00	$ 1,460.00	$ 39,230.00	STD	Year 2020	WISCONSIN / RACINE (534)
500	Gravity sewer piping, reinforced concrete pipe (RCP), 36" diameter, class 5, excludes excavation or backfill, gaskets	B13	72	0.78	L.F.	$ 87.93	$ 38.27	$ 7.97	$ 134.17	$ 43,965.00	$ 19,135.00	$ 3,985.00	$ 67,085.00	$ 96.72	$ 56.87	$ 8.76	$ 162.35	$ 48,360.00	$ 28,435.00	$ 4,380.00	$ 81,175.00	STD	Year 2020	WISCONSIN / RACINE (534)
									$268,782	**$945,652**	**$506,358**	**$81,108**	**$1,533,118**					**$308,851**	**$1,044,845**	**$764,976**	**$89,175**	**$1,898,996**			

Exclusions:
Temporary Utility Bypass
Permits
Pavement Removal or Replacement
Overhead or Underground Utility Conflicts

NOTES:
Elevated concrete slab, 24 inches thick, 20 feet above base slab
2020 YOE

Subtotal, Estimated Construction Cost:	**$1,898,996**
Mobilization, Bonds & Insurance, 5% of Construction Cost:	**$94,950**
Construction Contingency, 25% of Est. Construction Cost:	**$474,749**
Engineering and Administration, 20% of Est. Construction Cost:	**$379,799**
TOTAL, ESTIMATED PROJECT COST:	**$2,848,494**

Sanitary Sewer Interceptor Upgrade
Osborne Blvd. / Kinzie Avenue Interceptor Upgrade
Racine, Wisconsin

John Lapointe - May, 2020
Unit Cost Estimate

Table D-8: Sanitary Sewer Interceptor Upgrade

Quantity	Description	Crew	Daily Output	Labor Hours	Unit	Material	Labor	Equipment	Total	Ext. Mat.	Ext. Labor	Ext. Equip.	Ext. Total	Mat. O&P	Labor O&P	Equip. O&P	Total O&P	Ext. Mat. O&P	Ext. Labor O&P	Ext. Equip. O&P	Ext. Total O&P	Labor Type	Data Release	CCI Location	Notes
5,700	Traffic Control Allowance				LF	$ 2.50	$ 2.00	$ 1.50	$ 6.00	$ 14,250.00	$ 11,400.00	$ 8,550.00	$ 34,200.00	$ 2.88	$ 2.30	$ 1.73	$ 6.90	$ 16,387.50	$ 13,110.00	$ 9,832.50	$ 39,330.00				
15	Traffic Control Sign Allowance				Ea.	$ 250.00	$ 200.00	$ 25.00	$ 475.00	$ 3,750.00	$ 3,000.00	$ 375.00	$ 7,125.00	$ 287.50	$ 230.00	$ 28.75	$ 546.25	$ 4,312.50	$ 3,450.00	$ 431.25	$ 8,193.75				
80	Dewatering, pumping 8 hours, attended 2 hours per day, 3" centrifugal pump, includes 20 LF of suction hose and 100 LF of discharge hose	B10J	1	12	Day	$ -	$ 654.01	$ 90.75	$ 744.76	$ -	$ 52,320.80	$ 7,260.00	$ 59,580.80	$ -	$ 983.71	$ 99.88	$ 1,083.59	$ -	$ 78,696.80	$ 7,990.40	$ 86,687.20	STD	Year 2019 Quarter 2	MINNESOTA / MINNEAPOLIS (553-555)	
5,700	Excavating, trench or continuous footing, common earth, 1 C.Y. excavator, 10' to 14' deep, excludes sheeting or dewatering **(Assume 13.5 CY/LF)**	B12A	360	0.04	B.C.Y.	$ -	$ 2.37	$ 2.23	$ 4.60	$ -	$ 13,509.00	$ 12,711.00	$ 26,220.00	$ -	$ 3.57	$ 2.46	$ 6.03	$ -	$ 20,349.00	$ 14,022.00	$ 34,371.00	STD	Year 2019 Quarter 2	MINNESOTA / MINNEAPOLIS (553-555)	
5,700	Furnish & Install reinforced concrete pipe (RCP), 30" to 48" diameter, class 5, **excludes excavation**	B13	72	0.78	L.F.	$ 100.00	$ 42.88	$ 8.70	$ 151.58	$ 570,000.00	$ 244,416.00	$ 49,590.00	$ 864,006.00	$ 107.97	$ 64.31	$ 9.56	$ 181.84	$ 615,429.00	$ 366,567.00	$ 54,492.00	$ 1,036,488.00	STD			
336	Storm drainage manholes, frames and covers, concrete, precast, 4' ID, excludes footing, excavation, backfill, frame and cover, add for depths over 8' **(Assume 16 Ea @ 14VF)**	B22	16	1.88	V.L.F.	$ 127.10	$ 97.92	$ 13.05	$ 238.07	$ 42,705.60	$ 32,901.12	$ 4,384.80	$ 79,991.52	$ 140.01	$ 148.23	$ 14.34	$ 302.58	$ 47,043.36	$ 49,805.28	$ 4,818.24	$ 101,666.88	STD	Year 2019 Quarter 2	MINNESOTA / MINNEAPOLIS (553-555)	
5,700	**Remove** existing sewer interceptor pipe, 10" - 24" diameter, class 5, **excludes excavation**	B21	144	0.19	L.F.		$ 5.67	$ 0.97	$ 6.64	$ -	$ 32,290.50	$ 5,529.00	$ 37,819.50		$ 17.15	$ 1.06	$ 18.21	$ -	$ 97,755.00	$ 6,042.00	$ 103,797.00	STD	Year 2019 Quarter 2	MINNESOTA / MINNEAPOLIS (553-555)	Install Activity modified for removal activity
77,000	Excavating, **trench backfill**, 2-1/4 C.Y. bucket, minimal haul, front end loader, wheel mounted, excludes dewatering **(Assume 13.5 CY/LF)**	B10T	600	0.02	L.C.Y.	$ -	$ 1.09	$ 0.96	$ 2.05	$ -	$ 83,930.00	$ 73,920.00	$ 157,850.00	$ -	$ 1.64	$ 1.04	$ 2.68	$ -	$ 126,280.00	$ 80,080.00	$ 206,360.00	STD	Year 2019 Quarter 2	MINNESOTA / MINNEAPOLIS (553-555)	
10,000	**Remove and Replace 6-inch Pavement (Assume 1.75 SY/LF)**	B14			SY					$ -							$ 100.00	$ -	$ -	$ -	$ 1,000,000.00	STD	Year 2019 Quarter 2	MINNESOTA / MINNEAPOLIS (553-555)	
TOTALS:						$ 1,629	$ 630,706	$ 473,767	$ 162,320	$ 1,266,793					$ 2,248	$ 683,172	$ 756,013	$ 177,708	$ 2,616,894					

Exclusions:
Temporary Utility Bypass
Permits
Pavement Removal or Replacement
Overhead or Underground Utility Conflicts

NOTES:
Assuming Open Cut with no Sheeting or Shoring Requirments
2020 YOE

Subtotal, Estimated Construction Cost:	**$2,616,894**
Mobilization, Bonds & Insurance, 5% of Construction Cost:	**$130,845**
Construction Contingency, 25% of Est. Construction Cost:	**$654,223**
Engineering and Administration, 20% of Est. Construction Cost:	**$523,379**
TOTAL, ESTIMATED PROJECT COST:	**$3,925,341**

Sanitary Sewer Interceptor Upgrade
Geneva Street - Racine, WI
Unit Cost Estimate
J. Lapointe - May 5, 2020

Table D-9: Geneva Street Interceptor Upgrade

						Unit Price				Extended				O&P				O&P Extended					
Quantity	Description	Crew	Daily Output	Labor Hours	Unit	Material	Labor	Equipment	Total	Material	Labor	Equipment	Total	Material	Labor	Equipment	Total	Material	Labor	Equipment	Total	Labor Type	Notes
2,229	Traffic Control Allowance				LF	$ 2.50	$ 2.00	$ 1.50	$ 6.00	$ 5,572.50	$ 4,458.00	$ 3,343.50	$ 13,374.00	$ 2.88	$ 2.30	$ 1.73	$ 6.90	$ 6,408.38	$ 5,126.70	$ 3,845.03	$ 15,380.10		
10	Traffic Control Sign Allowance				Ea.	$ 250.00	$ 200.00	$ 25.00	$ 475.00	$ 2,500.00	$ 2,000.00	$ 250.00	$ 4,750.00	$ 287.50	$ 230.00	$ 28.75	$ 546.25	$ 2,875.00	$ 2,300.00	$ 287.50	$ 5,462.50		
73	Dewatering, pumping 8 hours, attended 2 hours per day, 3" centrifugal pump, includes 20 LF of suction hose and 100 LF of discharge hose	B10J	1	12	Day	$ -	$ 654.01	$ 90.75	$ 744.76	$ -	$ 47,742.73	$ 6,624.75	$ 54,367.48	$ -	$ 983.71	$ 99.88	$ 1,083.59	$ -	$ 71,810.83	$ 7,291.24	$ 79,102.07	STD	
30,092	Excavating, trench or continuous footing, common earth, 1 C.Y. excavator, 10' to 14' deep, excludes sheeting or dewatering **(Assume 13.5 CY/LF)**	B12A	360	0.04	B.C.Y.	$ -	$ 2.37	$ 2.23	$ 4.60	$ -	$ 71,318.04	$ 67,105.16	$ 138,423.20	$ -	$ 3.57	$ 2.46	$ 6.03	$ -	$ 107,428.44	$ 74,026.32	$ 181,454.76	STD	
2,229	**Furnish & Install** smooth interior corrugated PVC pipe (ConTech A2000 or equal), 30" , **excludes excavation**, **includes imported granular bedding under pipe**	B13	72	0.78	L.F.	$ 83.00	$ 42.88	$ 8.70	$ 134.58	$ 185,007.00	$ 95,579.52	$ 19,392.30	$ 299,978.82	$ 91.00	$ 64.31	$ 9.56	$ 164.87	$ 202,839.00	$ 143,346.99	$ 21,309.24	$ 367,495.23	STD	
224	Storm drainage manholes, frames and covers, concrete, precast, 4' ID, excludes footing, excavation, backfill, frame and cover, add for depths over 8' **(Assume 16 Ea @ 14VF)**	B22	16	1.88	V.L.F.	$ 127.10	$ 97.92	$ 13.05	$ 238.07	$ 28,470.40	$ 21,934.08	$ 2,923.20	$ 53,327.68	$ 140.01	$ 148.23	$ 14.34	$ 302.58	$ 31,362.24	$ 33,203.52	$ 3,212.16	$ 67,777.92	STD	
2,229	**Remove** reinforced concrete pipe (RCP), 18" - 27" diameter, class 5, **excludes excavation**	B21	144	0.19	L.F.		$ 5.67	$ 0.97	$ 6.64	$ -	$ 12,627.29	$ 2,162.13	$ 14,789.42		$ 17.15	$ 1.06	$ 18.21	$ -	$ 38,227.35	$ 2,362.74	$ 40,590.09	STD	Install Activity modified for removal activity
30,092	Excavating, **trench backfill**, 2-1/4 C.Y. bucket, minimal haul, front end loader, wheel mounted, excludes dewatering **(Assume 13.5 CY/LF)**	B10T	600	0.02	L.C.Y.	$ -	$ 1.09	$ 0.96	$ 2.05	$ -	$ 32,800.28	$ 28,888.32	$ 61,688.60	$ -	$ 1.64	$ 1.04	$ 2.68	$ -	$ 49,350.88	$ 31,295.68	$ 80,646.56	STD	
3,900	**Remove and Replace 6-inch Pavement (Assume 1.75 SY/LF)**	B14															$ 100.00	$ -	$ -	$ -	$ 390,000.00	STD	
	TOTALS:					$ 1,611.70	$ 221,549.90	$ 288,459.94	$ 130,689.36	$ 640,699.20				$ 2,231.11	$ 243,484.62	$ 450,794.71	$ 143,629.91				$ 1,227,909.23		

Exclusions:

Temporary Utility Bypass

Permits

Pavement Removal or Replacement

Overhead or Underground Utility Conflicts

NOTES:

Assuming Open Cut with no Sheeting or Shoring Requirements

2020 YOE

Subtotal, Estimated Construction Cost:	**$1,227,909.23**
Mobilization, Bonds & Insurance, 5% of Construction Cost:	**$61,395.46**
Construction Contingency, 25% of Est. Construction Cost:	**$306,977.31**
Engineering and Administration, 20% of Est. Construction Cost:	**$245,581.85**
TOTAL, ESTIMATED PROJECT COST:	**$1,841,863.85**

Sanitary Sewer Interceptor Upgrade
LaSalle Street - Racine, WI
Unit Cost Estimate
J. Lapointe - May 5, 2020

Table D-10: LaSalle Street Trunk Sewer Upgrade

						Unit Price				Extended				O&P				O&P Extended					
Quantity	Description	Crew	Daily Output	Labor Hours	Unit	Material	Labor	Equipment	Total	Material	Labor	Equipment	Total	Material	Labor	Equipment	Total	Material	Labor	Equipment	Total	Labor Type	Notes
2,097	Traffic Control Allowance				LF	$ 2.50	$ 2.00	$ 1.50	$ 6.00	$ 5,242.50	$ 4,194.00	$ 3,145.50	$ 12,582.00	$ 2.88	$ 2.30	$ 1.73	$ 6.90	$ 6,028.88	$ 4,823.10	$ 3,617.33	$ 14,469.30		
8	Traffic Control Sign Allowance				Ea.	$ 250.00	$ 200.00	$ 25.00	$ 475.00	$ 2,000.00	$ 1,600.00	$ 200.00	$ 3,800.00	$ 287.50	$ 230.00	$ 28.75	$ 546.25	$ 2,300.00	$ 1,840.00	$ 230.00	$ 4,370.00		
40	Dewatering, pumping 8 hours, attended 2 hours per day, 3" centrifugal pump, includes 20 LF of suction hose and 100 LF of discharge hose	B10J	1	12	Day	$ -	$ 654.01	$ 90.75	$ 744.76	$ -	$ 26,160.40	$ 3,630.00	$ 29,790.40	$ -	$ 983.71	$ 99.88	$ 1,083.59	$ -	$ 39,348.40	$ 3,995.20	$ 43,343.60	STD	
28,310	Excavating, trench or continuous footing, common earth, 1 C.Y. excavator, 10' to 14' deep, excludes sheeting or dewatering **(Assume 13.5 CY/LF)**	B12A	360	0.04	B.C.Y.	$ -	$ 2.37	$ 2.23	$ 4.60	$ -	$ 67,093.52	$ 63,130.19	$ 130,223.70	$ -	$ 3.57	$ 2.46	$ 6.03	$ -	$ 101,064.92	$ 69,641.37	$ 170,706.29	STD	
2,097	**Furnish & Install** smooth interior corrugated PVC pipe (ConTech A2000), 15" , **excludes excavation**, **includes imported granular bedding under pipe**	B13	72	0.78	L.F.	$ 42.00	$ 42.88	$ 8.70	$ 93.58	$ 88,074.00	$ 89,919.36	$ 18,243.90	$ 196,237.26	$ 50.00	$ 64.31	$ 9.56	$ 123.87	$ 104,850.00	$ 134,858.07	$ 20,047.32	$ 259,755.39	STD	
224	Storm drainage manholes, frames and covers, concrete, precast, 4' ID, excludes footing, excavation, backfill, frame and cover, add for depths over 8' **(Assume 16 Ea @ 14VF)**	B22	16	1.88	V.L.F.	$ 127.10	$ 97.92	$ 13.05	$ 238.07	$ 28,470.40	$ 21,934.08	$ 2,923.20	$ 53,327.68	$ 140.01	$ 148.23	$ 14.34	$ 302.58	$ 31,362.24	$ 33,203.52	$ 3,212.16	$ 67,777.92	STD	
2,097	**Remove** reinforced concrete pipe (RCP), **10" diameter**, class 5, **excludes excavation**	B21	144	0.19	L.F.		$ 5.67	$ 0.97	$ 6.64	$ -	$ 11,879.51	$ 2,034.09	$ 13,913.60		$ 17.15	$ 1.06	$ 18.21	$ -	$ 35,963.55	$ 2,222.82	$ 38,186.37	STD	Install Activity modified for removal activity
28,310	Excavating, **trench backfill**, 2-1/4 C.Y. bucket, minimal haul, front end loader, wheel mounted, excludes dewatering **(Assume 13.5 CY/LF)**	B10T	600	0.02	L.C.Y.	$ -	$ 1.09	$ 0.96	$ 2.05	$ -	$ 30,857.36	$ 27,177.12	$ 58,034.48	$ -	$ 1.64	$ 1.04	$ 2.68	$ -	$ 46,427.58	$ 29,441.88	$ 75,869.46	STD	
3,670	Remove and Replace 6-inch Pavement **(Assume 1.75 SY/LF)**	B14															$ 100.00	$ -	$ -	$ -	$ 367,000.00	STD	
	TOTALS:					$ 1,571	$ 123,787	$ 253,638	$ 120,484	$ 497,909				$ 2,190	$ 144,541	$ 397,529	$ 132,408	$ 1,041,478					

Exclusions:

Temporary Utility Bypass

Permits

Pavement Removal or Replacement

Overhead or Underground Utility Conflicts

NOTES:

Assuming Open Cut with no Sheeting or Shoring Requirements

2020 YOE

Subtotal, Estimated Construction Cost:	**$1,041,478**
Mobilization, Bonds & Insurance, 5% of Construction Cost:	**$52,074**
Construction Contingency, 25% of Est. Construction Cost:	**$260,370**
Engineering and Administration, 20% of Est. Construction Cost:	**$208,296**
TOTAL, ESTIMATED PROJECT COST:	**$1,562,217**

1.65 MG Equalization Basin
Mt Pleasant/Sturtevant Interceptor
Racine, Wisconsin

Paul Herubin / John Lapointe - May, 2020
Unit Cost Estimate

Table D-11: 1.65 MG Mt. Pleasant/Sturtevant EQ Basin

Quantity	Description	Crew	Daily Output	Labor Hours	Unit	Material	Labor	Equipment	Total	Ext. Mat.	Ext. Labor	Ext. Equip.	Ext. Total	Mat. O&P	Labor O&P	Equip. O&P	Total O&P	Ext. Mat. O&P	Ext. Labor O&P	Ext. Equip. O&P	Ext. Total O&P	Labor Type	Data Release	CCI Location
958	Topsoil stripping and stockpiling, topsoil, sandy loam, ideal conditions, 300 HP dozer	B10M	3000	0	C.Y.	$ -	$ 0.21	$ 0.58	$ 0.79	$ -	$ 201.18	$ 555.64	$ 756.82	$ -	$ 0.32	$ 0.64	$ 0.96	$ -	$ 306.56	$ 613.12	$ 919.68	STD	Year 2020	WISCONSIN / RACINE (534)
42148	Excavating, bulk bank measure, 2 C.Y. capacity = 165 C.Y./hr, backhoe, hydraulic, crawler mounted, excluding truck loading	B12C	1320	0.01	B.C.Y.	$ -	$ 0.63	$ 0.71	$ 1.34	$ -	$ 26,553.24	$ 29,925.08	$ 56,478.32	$ -	$ 0.94	$ 0.78	$ 1.72	$ -	$ 39,619.12	$ 32,875.44	$ 72,494.56	STD	Year 2020	WISCONSIN / RACINE (534)
24246	Backfill, structural, common earth, 80 HP dozer, 300' haul, from existing stockpile, excludes compaction	B10L	330	0.04	L.C.Y.	$ -	$ 1.94	$ 1.21	$ 3.15	$ -	$ 47,037.24	$ 29,337.66	$ 76,374.90	$ -	$ 2.89	$ 1.33	$ 4.22	$ -	$ 70,070.94	$ 32,247.18	$ 102,318.12	STD	Year 2020	WISCONSIN / RACINE (534)
1500	Synthetic erosion control, silt fence, install and maintain, remove, 3' high	B62	1300	0.02	L.F.	$ 0.41	$ 0.86	$ 0.14	$ 1.41	$ 615.00	$ 1,290.00	$ 210.00	$ 2,115.00	$ 0.45	$ 1.30	$ 0.15	$ 1.90	$ 675.00	$ 1,950.00	$ 225.00	$ 2,850.00	STD	Year 2020	WISCONSIN / RACINE (534)
3611	Excavating, trench or continuous footing, common earth, 2-1/2 C.Y. excavator, 6' to 10' deep, excludes sheeting or dewatering	B12S	1000	0.02	B.C.Y.	$ -	$ 0.83	$ 1.46	$ 2.29	$ -	$ 2,997.13	$ 5,272.06	$ 8,269.19	$ -	$ 1.24	$ 1.59	$ 2.83	$ -	$ 4,477.64	$ 5,741.49	$ 10,219.13	STD	Year 2020	WISCONSIN / RACINE (534)
2584	Structural concrete, ready mix, heavyweight, 5000 psi, includes local aggregate, sand, Portland cement (Type I) and water, delivered, excludes all additives and treatments		0	0	C.Y.	$ 140.13	$ -	$ -	$ 140.13	$ 362,095.92	$ -	$ -	$ 362,095.92	$ 154.66	$ -	$ -	$ 154.66	$ 399,641.44	$ -	$ -	$ 399,641.44	STD	Year 2020	WISCONSIN / RACINE (534)
16900	C.I.P. concrete forms, slab on grade, edge, wood, over 12", 4 use, includes erecting, bracing, stripping and cleaning	C1	350	0.09	SFCA	$ 0.97	$ 4.89	$ -	$ 5.86	$ 16,393.00	$ 82,641.00	$ -	$ 99,034.00	$ 1.07	$ 7.32	$ -	$ 8.39	$ 18,083.00	$ 123,708.00	$ -	$ 141,791.00	STD	Year 2020	WISCONSIN / RACINE (534)
5720	C.I.P. concrete forms, retaining wall, battered, job built plywood, over 8' to 16' high, 1 use, includes erecting, bracing, stripping and cleaning	C2	240	0.2	SFCA	$ 2.39	$ 10.98	$ -	$ 13.37	$ 13,670.80	$ 62,805.60	$ -	$ 76,476.40	$ 2.62	$ 16.45	$ -	$ 19.07	$ 14,986.40	$ 94,094.00	$ -	$ 109,080.40	STD	Year 2020	WISCONSIN / RACINE (534)
612	C.I.P. concrete forms, column, round, steel, heavy duty, rent, 36" diameter, 4 uses per month, includes erecting, bracing, stripping and cleaning	C1	60	0.53	L.F.	$27.53	$28.65	$ -	$ 56.18	$ 16,848.36	$ 17,533.80	$ -	$ 34,382.16	$30.03	$42.97	$ -	$ 73.00	$ 18,378.36	$ 26,297.64	$ -	$ 44,676.00	STD	Year 2020	WISCONSIN / RACINE (534)
101400	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	4 Rodm	4200	0.01	Lb.	$ 0.53	$ 0.48	$ -	$ 1.01	$ 53,742.00	$ 48,672.00	$ -	$ 102,414.00	$ 0.59	$ 0.72	$ -	$ 1.31	$ 59,826.00	$ 73,008.00	$ -	$ 132,834.00	STD	Year 2020	WISCONSIN / RACINE (534)
61	Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	4 Rodm	3	10.67	Ton	$ 1,068.75	$ 663.00	$ -	$ 1,731.75	$ 65,193.75	$ 40,443.00	$ -	$ 105,636.75	$ 1,187.50	$ 1,000.03	$ -	$ 2,187.53	$ 72,437.50	$ 61,001.83	$ -	$ 133,439.33	STD	Year 2020	WISCONSIN / RACINE (534)
9	Reinforcing steel, in place, columns, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	4 Rodm	1.5	21.33	Ton	$ 1,068.75	$ 1,326.00	$ -	$ 2,394.75	$ 9,618.75	$ 11,934.00	$ -	$ 21,552.75	$ 1,187.50	$ 1,989.00	$ -	$ 3,176.50	$ 10,687.50	$ 17,901.00	$ -	$ 28,588.50	STD	Year 2020	WISCONSIN / RACINE (534)
1878	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes leveling (strike off) & consolidation, excludes material	C20	185	0.35	C.Y.	$ -	$ 15.99	$ 2.48	$ 18.47	$ -	$ 30,029.22	$ 4,657.44	$ 34,686.66	$ -	$ 24.09	$ 2.73	$ 26.82	$ -	$ 45,241.02	$ 5,126.94	$ 50,367.96	STD	Year 2020	WISCONSIN / RACINE (534)
1252	Structural concrete, in place, elevated slab (4000 psi), flat slab with drop panels, 125 psf superimposed load, 30' span, includes forms(4 uses), Grade 60 rebar, concrete (Portland cement Type I), placing and finishing	C14B	50.99	4.08	C.Y.	$ 332.16	$ 220.38	$ 8.46	$ 561.00	$ 415,864.32	$ 275,915.76	$ 10,591.92	$ 702,372.00	$ 368.49	$ 333.13	$ 9.31	$ 710.93	$ 461,349.48	$ 417,078.76	$ 11,656.12	$ 890,084.36	STD	Year 2020	WISCONSIN / RACINE (534)
706	Structural concrete, placing, walls, pumped, 15" thick, includes leveling (strike off) & consolidation, excludes material	C20	120	0.53	C.Y.	$ -	$ 24.60	$ 3.83	$ 28.43	$ -	$ 17,367.60	$ 2,703.98	$ 20,071.58	$ -	$ 36.90	$ 4.22	$ 41.12	$ -	$ 26,051.40	$ 2,979.32	$ 29,030.72	STD	Year 2020	WISCONSIN / RACINE (534)
204	Structural concrete, placing, column, square or round, pumped, 24" thick, includes leveling (strike off) & consolidation, excludes material	C20	92	0.7	C.Y.	$ -	$ 32.29	$ 5.00	$ 37.29	$ -	$ 6,587.16	$ 1,020.00	$ 7,607.16	$ -	$ 48.18	$ 5.49	$ 53.67	$ -	$ 9,828.72	$ 1,119.96	$ 10,948.68	STD	Year 2020	WISCONSIN / RACINE (534)
1	Packaged pumping station, 200,000 GPD, excludes fencing or external piping	E8	0.2	440	Ea.	$ 232,526.00	$ 19,771.80	$11,286.00	$ 263,583.80	$ 232,526.00	$ 19,771.80	$ 11,286.00	$ 263,583.80	$ 255,974.00	$ 33,697.10	$ 12,474.00	$ 302,145.10	$ 255,974.00	$ 33,697.10	$ 12,474.00	$ 302,145.10	OPN	Year 2020	WISCONSIN / RACINE (534)
500	Forcemain piping, ductile iron pipe, cement lined, mechanical joint, no fittings, 18' lengths, 6" diameter, class 50, excludes excavation or backfill	B21A	160	0.25	L.F.	$ 49.83	$ 13.87	$ 2.65	$ 66.35	$ 24,915.00	$ 6,935.00	$ 1,325.00	$ 33,175.00	$ 54.71	$ 20.83	$ 2.92	$ 78.46	$ 27,355.00	$ 10,415.00	$ 1,460.00	$ 39,230.00	STD	Year 2020	WISCONSIN / RACINE (534)
500	Gravity sewer piping, reinforced concrete pipe (RCP), 36" diameter, class 5, excludes excavation or backfill, gaskets	B13	72	0.78	L.F.	$ 87.93	$ 38.27	$ 7.97	$ 134.17	$ 43,965.00	$ 19,135.00	$ 3,985.00	$ 67,085.00	$ 96.72	$ 56.87	$ 8.76	$ 162.35	$ 48,360.00	$ 28,435.00	$ 4,380.00	$ 81,175.00	STD	Year 2020	WISCONSIN / RACINE (534)
										$268,782	**$1,255,448**	**$717,850**	**$100,870**	**$2,074,167**				**$308,851**	**$1,387,754**	**$1,083,182**	**$110,899**	**$2,581,834**		

Exclusions:
Temporary Utility Bypass
Permits
Pavement Removal or Replacement
Overhead or Underground Utility Conflicts

NOTES:
Elevated concrete slab, 24 inches thick, 20 feet above base slab
2020 YOE

Subtotal, Estimated Construction Cost:	**$2,581,834**
Mobilization, Bonds & Insurance, 5% of Construction Cost:	**$129,092**
Construction Contingency, 25% of Est. Construction Cost:	**$645,458**
Engineering and Administration, 20% of Est. Construction Cost:	**$516,367**
TOTAL, ESTIMATED PROJECT COST:	**$3,872,751**

Appendix E WWTP Alternative Cost Opinions

1-30-1 Improve Flow Equalization Facilities
Facility Plan Opinion of Cost

Item		Initial Cost
EQ Channel and Building 30		
New Bar Screens (two automated 4'-6" w x 6 ft deep channel)	$	400,000
Add Flushing Equipment- Water Cannon	$	25,000
Upgrade Metering	$	100,000
Subtotal Equipment	$	525,000
Installation		
Demo existing screens	$	10,000
Install new screens	$	40,000
Install New Piping & Valves (A.G.)	$	50,000
Relocate Discharge Valve to Influent	$	25,000
Subtotal Installation	$	125,000
Subtotal Equipment and Installation	$	650,000
Contingency (30%)	$	195,000
Subtotal Equipment & Installation w/ Contingency	$	845,000
Contractor GC OH & P (20%)	$	169,000
TOTAL Construction Cost	$	1,014,000
Engineering (Design and CRS ~10%)	$	86,000
Total Capital Cost	**$**	**1,100,000**

1-30-2 EQ Building and Channel Upgrades
Facility Plan Opinion of Cost

Item		Initial Cost
EQ Channel and Building 30		
New Bar Screens (two automated 4'-6" w x 15 ft deep channel)	$	700,000
Subtotal Equipment	$	700,000
Installation		
Construct New EQ Sludge P.S. Bldg 15'x15'	$	60,000
Demo Existing Pumps and Piping and Bar Screens	$	10,000
Relocate Existing Pumps to New Sludge P.S.	$	10,000
Install New Piping & Valves (A.G.)	$	75,000
Underground Piping Modifications	$	50,000
Demo Existing Channel Walls	$	15,000
Construct New Channel Walls	$	25,000
Install New Bar Screens	$	60,000
Electrical - I&C	$	75,000
HVAC and Plumbing	$	20,000
Subtotal Installation	$	400,000
Subtotal Equipment and Installation	$	1,100,000
Contingency (30%)	$	300,000
Subtotal Equipment & Installation w/ Contingency	$	1,400,000
Contractor GC OH & P (~20%)	$	280,000
TOTAL Construction Cost	$	1,680,000
Engineering (Design and CRS ~15%)	$	200,000
Total Capital Cost	**$**	**1,900,000**

2-130-1 Replace Grit Conveyors
Facility Plan Opinion of Cost

Item	Initial Cost
Grit Conveyors	
Grit Conveyors (Qty-2) (See Smith & Loveless Budget Estimate)	$ 260,000
Shipping	$ 2,500
Commissioning	$ 2,500
Subtotal Equipment	$ 265,000
Installation	
Demo. of Existing Equip. & Support Systems	$ 5,000
Mechanical Installation (20%)	$ 52,000
Piping (5%)	$ 13,000
Electrical (5%)	$ 13,000
Subtotal Installation	$ 83,000
Subtotal Equipment and Installation	$ 348,000
Contingency (15%)	$ 50,000
Subtotal Equipment & Installation w/ Contingency	$ 398,000
Contractor GC OH & P (20%)	$ 80,000
TOTAL Construction Cost	$ 478,000
Engineering (Design and CRS @5%)	$ 20,000
Total Capital Cost	**$ 498,000**

3-125-1 Maintain Existing Diffused Air Mixing System
Facility Plan Opinion of Cost

Item		Initial Cost
Replace Existing Hoffman PD Blowers		
New Rotary Screw Blowers (Qty-2)	$	232,000
(Kaeser Model FB 660S-M-SFC; $116,535 each per LAI Ltd estimate)		
New Piping	$	20,000
Shipping	$	5,000
Commissioning	$	5,000
Subtotal Equipment	$	262,000
Installation		
Demolition Existing PD Blowers	$	10,000
Mechanical Install (20%)	$	50,000
Electrical and I&C (20%)	$	46,000
Subtotal Installation	$	106,000
Subtotal Equipment and Installation	$	368,000
Contingency (10%)	$	37,000
Subtotal Equipment & Installation w/ Contingency	$	405,000
Contractor GC_OH &P (20%)	$	81,000
TOTAL Construction Cost	$	486,000
Engineering (Design and CRS @10%)	$	49,000
Total Capital Cost	**$**	**535,000**
Estimated Annual Operating Power Cost	$	50,000
Present Worth of O&M	**$**	**719,000**
Total Present Worth Cost		$1,254,000

$$PV = A \times \frac{(1+i)^n - 1}{i(1+i)^n}$$

Discount Rate (*i*)	3.375%
Discount Period (*n*)	20.0
PV	**$718,725**

Annual Cost of Diffused Air Mixing at $0.09/kW-Hr

Kaeser Model FB660S-M-SFC Screw Blower $116,535.00 list price each net plus shipping (Complete with all controls including vfd wired ready to go)

3-135 & 136-1 Primary Clarifier Drive Replacement
5-Year Replacement
Facility Plan Opinion of Cost

Item		Initial Cost
Primary Clarifier Mechanisms		
Tanks #1, #2, #3, #4	$	-
Tanks #5, #6	$	-
Tanks #7, #8, #9, #10	$	406,000
See Budget Information Detail from EVOQUA dated 9/25/2019)		
Subtotal Equipment	$	406,000
Installation		
Removal of Existing Equipment	$	20,000
Mechanical Installation (25%)	$	100,000
Electrical (5%)	$	20,000
Subtotal Installation	$	140,000
Subtotal Equipment and Installation	$	546,000
Contingency (30%)	$	164,000
Subtotal Equipment & Installation w/ Contingency	$	710,000
Contractor GC OH & P (20%)	$	140,000
TOTAL Construction Cost	$	850,000
Engineering (Design and CRS @0%)	$	-
Total Capital Cost	**$**	**850,000**

3-135 & 136-1 Primary Clarifier Mechanism Replacement
10-Year Replacement
Facility Plan Opinion of Cost

Item		Initial Cost
Primary Clarifier Mechanisms		
Tanks #1, #2, #3, #4	$	446,000
See Budget Information Detail from EVOQUA dated 9/25/2019)		
Tanks #5, #6	$	-
Tanks #7, #8, #9, #10, #11, #12	$	-
Subtotal Equipment	$	446,000
Installation		
Removal of Existing Equipment	$	22,000
Mechanical Installation (25%)	$	112,000
Electrical (5%)	$	22,000
Subtotal Installation	$	156,000
Subtotal Equipment and Installation	$	602,000
Contingency (30%)	$	180,000
Subtotal Equipment & Installation w/ Contingency	$	780,000
Contractor GC OH & P (20%)	$	160,000
TOTAL Construction Cost	$	940,000
Engineering (Design and CRS @ 0%)	$	-
Total Capital Cost	**$**	**940,000**

3-135 & 136-1 Primary Clarifier Mechanism Replacement
15-Year Replacement
Facility Plan Opinion of Cost

Item		Initial Cost
Primary Clarifier Mechanisms		
Tanks #1, #2, #3, #4	$	-
Tanks #5, #6	$	216,000
Tanks #7, #8, #9, #10, #11, #12	$	203,000
See Budget Information Detail from EVOQUA dated 9/25/2019)		
Subtotal Equipment	$	419,000
Installation		
Removal of Existing Equipment	$	21,000
Mechanical Installation (25%)	$	100,000
Electrical (5%)	$	21,000
Subtotal Installation	$	142,000
Subtotal Equipment and Installation	$	561,000
Contingency (30%)	$	168,000
Subtotal Equipment & Installation w/ Contingency	$	729,000
Contractor GC OH & P (20%)	$	146,000
TOTAL Construction Cost	$	875,000
Engineering (Design and CRS @ 0%)	$	-
Total Capital Cost	**$**	**875,000**

3-135/136-3 New Primary Influent Channel Mixing System
Facility Plan Opinion of Cost

Item		Initial Cost
New BIOMIX Channel Aeration Equipment		
Biomix Channel Equipment	$	291,000
(See Enviromix Proposal #OM-20-124800 dated 01-15-2020)		
Shipping (included)	$	-
Commissioning (included)	$	-
Subtotal Equipment	$	291,000
Installation		
Demolition of PD Blower & Piping Systems	$	10,000
Mechanical (exclusions from Enviromix) (10%)	$	29,000
Electrical and I&C (10%)	$	29,000
Subtotal Installation	$	68,000
Subtotal Equipment and Installation	$	359,000
Contingency (30%)	$	108,000
Subtotal Equipment & Installation w/ Contingency	$	467,000
Contractor GC_OH &P (~20%)	$	93,000
TOTAL Construction Cost	$	560,000
Engineering (Design and CRS @ 7.5%)	$	40,000
Total Capital Cost	$	600,000
Estimated Annual Operating Power Cost	$	10,000
Present Worth of O&M	$	144,000
Total Present Worth Cost		$744,000

$$PV = A \times \frac{(1+i)^n - 1}{i(1+i)^n}$$

Discount Rate (*i*)	3.375%
Discount Period (*n*)	20.0
PV	**$143,745**

3-135/136-4A- Replace Scum Pumps
Facility Plan Opinion of Cost

Item		Initial Cost
Scum Pumping System		
Progressing Cavity Pumps (2)	$	30,000
Shipping	$	1,000
Commissioning	$	2,000
Subtotal Equipment	$	33,000
Installation		
Removal of Existing Equipment	$	1,500
Installation (25%)	$	7,500
Piping (25%)	$	7,500
Electrical (10%)	$	3,000
I&C (5%)	$	1,500
Subtotal Installation	$	21,000
Subtotal Equipment and Installation	$	54,000
Contingency (30%)	$	16,000
Subtotal Equipment & Installation w/ Contingency	$	70,000
Contractor GC OH & P (20%)	$	14,000
TOTAL Construction Cost	$	84,000
Engineering (Design and CRS @20%)	$	16,000
Total Capital Cost	**$**	**100,000**
Estimated Annual Power Cost	$	1,100
Estimated Annual Maintenance Cost	$	4,160
Estimated Annual Total Operating Cost	**$**	**5,260**
Present Worth of O&M	**$**	**75,600**
Total Present Worth Cost	**$**	**175,600**

$$PV = A \times \frac{(1+i)^n - 1}{i(1+i)^n}$$

Discount Rate (*i*)		3.375%
Discount Period (*n*)		20
PV	**$**	**75,610**

3-135/136-4B Upgrade Scum Pumping System
Facility Plan Opinion of Cost

Item		Initial Cost
Scum Pumping System		
Maintain Existing Scum Pots	$	-
Revise Piping on Scum Pots	$	25,000
Modify piping for distribution to Digester B&E	$	50,000
	$	-
Subtotal	$	75,000
Subtotal Equipment and Installation	$	75,000
Contingency (30%)	$	22,500
Subtotal Equipment & Installation w/ Contingency	$	97,500
Contractor GC OH & P (20%)	$	19,500
TOTAL Construction Cost	$	117,000
Engineering (Design and CRS ~10%)	$	13,000
Total Capital Cost	**$**	**130,000**
Estimated Annual Power Cost		
Estimated Annual Maintenance Cost		
Estimated Annual Total Operating Cost		
Present Worth of O&M		
Total Present Worth Cost	**$**	**130,000**

3-136-2 Primary Clarifier Walkway
Facility Plan Opinion of Cost

Item	Initial Cost
Walkway Between Clarifiers #10 and #11	
Walkway (including installation)	$ 60,000
Subtotal Equipment	$ 60,000
Subtotal Equipment and Installation	$ 60,000
Contingency (30%)	$ 20,000
Subtotal Equipment & Installation w/ Contingency	$ 80,000
Contractor GC OH & P (20%)	$ 16,000
TOTAL Construction Cost	$ 96,000
Engineering (Design and CRS @15%)	$ 14,000
Total Capital Cost	**$ 110,000**

3-136-5 Provide Redundancy for Primary Effluent Channel
Facility Plan Opinion of Cost

Item		Initial Cost
Isolation Gate		
Bulkhead Gates (2)	$	40,000
Commissioning	$	1,000
Subtotal Equipment	$	41,000
Installation		
Mechanical Installation	$	20,000
Subtotal Installation	$	20,000
Subtotal Equipment and Installation	$	61,000
Contingency (30%)	$	18,000
Subtotal Equipment & Installation w/ Contingency	$	79,000
Contractor GC OH & P (20%)	$	16,000
TOTAL Construction Cost	$	95,000
Engineering (Design and CRS @15%)	$	15,000
Total Capital Cost	**$**	**110,000**
Estimated Annual Power Cost	$	-
Estimated Annual Maintenance Cost	$	-
Estimated Annual Total Operating Cost	**$**	**-**

4-139-1 Maintain Existing Diffusers- Upgrade Aeration Control
Facility Plan Opinion of Cost

Item		Initial Cost
Maintain Diffusers- Upgrade Aeration Control		
Diffuser Off Gas Testing	$	20,000
Assume 10% Diffuser Replacement	$	60,000
New Aeration Flow Meters	$	75,000
New Aeration Control System	$	50,000
Commissioning	$	15,000
Subtotal Equipment	$	220,000
Installation		
Mechanical Install	$	30,000
Electrical and I&C	$	20,000
Subtotal Installation	$	50,000
Subtotal Equipment and Installation	$	270,000
Contingency (0%)	$	-
Subtotal Equipment & Installation w/ Contingency	$	270,000
Contractor GC_OH &P (20%)	$	50,000
TOTAL Construction Cost	$	320,000
Engineering (Design and CRS @15%)	$	50,000
Total Capital Cost	**$**	**370,000**

4-139-2 New Ceramic Diffuser System
Facility Plan Opinion of Cost

Item		Initial Cost
New Ceramic Diffusers (EDI Proposal)	**ASSUME ALL NEW**	
New Ceramic Diffusers and PVC Piping	$	600,000
New Aeration Control Valves	$	100,000
New Aeration Control System	$	50,000
Shipping	$	10,000
Commissioning	$	15,000
Subtotal Equipment	$	775,000
Installation		
Demolition of Existing Diffusers	$	20,000
Mechanical Install (20%)	$	150,000
Electrical and I&C (20%)	$	30,000
Subtotal Installation	$	200,000
Subtotal Equipment and Installation	$	975,000
Contingency (30%)	$	293,000
Subtotal Equipment & Installation w/ Contingency	$	1,268,000
Contractor GC_OH &P (20%)	$	254,000
TOTAL Construction Cost	$	1,522,000
Engineering (Design and CRS @15%)	$	228,000
Total Capital Cost	**$**	**1,750,000**
Annual Energy Savings	$	(16,604)
Present Worth of O&M	**$**	**(239,000)**
TOTAL PRESENT WORTH		$1,511,000

$$PV = A \times \frac{(1+i)^n - 1}{i(1+i)^n}$$

Discount Rate (*i*)	3.375%
Discount Period (*n*)	20.0
PV	**-$238,670**

4-139-3 New Membrane Diffuser System
Facility Plan Opinion of Cost

Item		Initial Cost
New Membrane Diffusers (EDI Proposal)		
Membrane Diffusers and PVC Piping	$	650,000
New Aeration Control Valves	$	100,000
New Aeration Control System	$	50,000
Shipping	$	5,000
Commissioning	$	15,000
Subtotal Equipment	$	820,000
Installation		
Demolition of Existing Diffusers	$	20,000
Mechanical Install (20%)	$	160,000
Electrical and I&C (20%)	$	30,000
Subtotal Installation	$	210,000
Subtotal Equipment and Installation	$	1,030,000
Contingency (30%)	$	300,000
Subtotal Equipment & Installation w/ Contingency	$	1,330,000
Contractor GC_OH &P (20%)	$	270,000
TOTAL Construction Cost	$	1,600,000
Engineering (Design and CRS @15%)	$	240,000
Total Capital Cost	**$**	**1,840,000**
Focus on Energy Grants (TBD)	$	(200,000)
Annual O&M Energy Savings	$	(75,056)
Replacement Cost in YR 10	$	650,000
Present Worth of O&M	**$**	**(429,000)**
TOTAL PRESENT WORTH		$1,211,000

$$PV = A \times \frac{(1+i)^n - 1}{i(1+i)^n}$$

Discount Rate (*i*)	3.375%
Discount Period (*n*)	20.0
PV	**-$1,078,888**

4-139-5 Replace RAS Flow Distribution Meters
Facility Plan Opinion of Cost

Item		Initial Cost
RAS Flow Distribution Meters		
16" Magmeters- (Qty 5 @ 20,000 ea)	$	100,000
Subtotal Equipment	$	100,000
Installation		
Mechanical Installation (10%)	$	10,000
Electrical and I&C (20%)	$	25,000
Subtotal Installation	$	35,000
Subtotal Equipment and Installation	$	135,000
Contingency (30%)	$	41,000
Subtotal Equipment & Installation w/ Contingency	$	176,000
Contractor GC OH & P (20%)	$	35,000
TOTAL Construction Cost	$	211,000
Engineering (Design and CRS @5%)	$	11,000
Total Capital Cost	**$**	**222,000**

4-139-6 Add ML Channel Isolation Gates
Facility Plan Opinion of Cost

Item		Initial Cost
Primary Effluent Channel Gates		
72" x 96" Gates (2)	$	60,000
Shipping	$	2,000
Subtotal Equipment	$	62,000
Installation		
Installation (25%)	$	15,000
Subtotal Installation	$	15,000
Subtotal Equipment and Installation	$	77,000
Contingency (30%)	$	23,000
Subtotal Equipment & Installation w/ Contingency	$	100,000
Contractor GC OH & P (20%)	$	20,000
TOTAL Construction Cost	$	120,000
Engineering (Design and CRS @5%)	$	5,000
Total Capital Cost	**$**	**125,000**

4-139-7 Replace ML Valves- Aeration Tanks
Facility Plan Opinion of Cost

Item		Initial Cost
Mixed Liquor Valves		
36" Dia. BF Valves (10)	$	300,000
Subtotal Equipment	$	300,000
Installation		
Removal of Existing Valves	$	15,000
Mechanical Installation (15%)	$	45,000
Connection to Pneumatic System (10%)	$	30,000
Subtotal Installation	$	90,000
Subtotal Equipment and Installation	$	390,000
Contingency (10%)	$	39,000
Subtotal Equipment & Installation w/ Contingency	$	429,000
Contractor GC OH & P (20%)	$	86,000
TOTAL Construction Cost	$	515,000
Engineering (Design and CRS)	$	25,000
Total Capital Cost	**$**	**540,000**

4-139-8 Replace Aeration Tank Inlet Gates
Facility Plan Opinion of Cost

Item		Initial Cost
Aeration Tank Inlet Gates		
48" x 60" Gates (5)	$	50,000
Shipping	$	1,000
Commissioning	$	3,000
Subtotal Equipment	$	54,000
Installation		
Installation (25%)	$	13,000
Subtotal Installation	$	13,000
Subtotal Equipment and Installation	$	67,000
Contingency (30%)	$	20,000
Subtotal Equipment & Installation w/ Contingency	$	87,000
Contractor GC OH & P (20%)	$	17,000
TOTAL Construction Cost	$	104,000
Engineering (Design and CRS @15%)	$	16,000
Total Capital Cost	**$**	**120,000**

5-139-9 Replace RAS Flow Meters
Facility Plan Opinion of Cost

Item		Initial Cost
RAS Flow Meters 3-7		
14" Magmeters- (Qty 5 @ 15,000 ea)	$	75,000
Subtotal Equipment	$	75,000
Installation		
Mechanical Installation (10%)	$	7,500
Electrical and I&C (20%)	$	15,000
Subtotal Installation	$	23,000
Subtotal Equipment and Installation	$	98,000
Contingency (30%)	$	29,000
Subtotal Equipment & Installation w/ Contingency	$	127,000
Contractor GC OH & P (20%)	$	25,000
TOTAL Construction Cost	$	152,000
Engineering (Design and CRS @5%)	$	8,000
Total Capital Cost	**$**	**160,000**

5-139-10 Upgrade RAS Pumps
Facility Plan Opinion of Cost

Item		Initial Cost
Overhaul RAS Pumps		
RAS Pump Overhaul (7 Pumps)	$	70,000
Air-Driven Actuators (3)	$	6,000
Commissioning	$	2,000
Subtotal Equipment	$	78,000
Installation		
Connection RAS Valves Actuator to Air System	$	19,500
Disconnection/Reconnection	$	7,000
Subtotal Installation	$	26,500
Subtotal Equipment and Installation	$	104,500
Contingency (30%)	$	30,000
Subtotal Equipment & Installation w/ Contingency	$	135,000
Contractor GC OH & P (20%)	$	25,000
TOTAL Construction Cost	$	160,000
Engineering Design and CRS	$	20,000
Total Capital Cost	**$**	**180,000**

5-140-2A Fiberglass Covers Over Weir Launders
Facility Plan Opinion of Cost

Item		Initial Cost
Fiberglass Weir Launder Covers		
Covers - Tanks #7 - #9	$	123,000
Shipping	$	3,000
Commissioning	$	3,000
Subtotal Equipment	$	129,000
Installation		
Installation (25%)	$	31,000
Subtotal Installation	$	31,000
Subtotal Equipment and Installation	$	160,000
Contingency (30%)	$	48,000
Subtotal Equipment & Installation w/ Contingency	$	208,000
Contractor GC OH & P (20%)	$	42,000
TOTAL Construction Cost	$	250,000
Engineering (Design and CRS @10%)	$	25,000
Total Capital Cost	**$**	**275,000**

ENDURO COMPOSITES -FRP launder covers.
316 SST hardware/ fasteners included.
3 ea – 90 ft. FRP effluent channel covers – with scum baffle = $122,896

5-141-1 Fiberglass Covers Over Weir Launders
Facility Plan Opinion of Cost

Item		Initial Cost
Fiberglass Weir Launder Covers		
Covers - Tanks #1 - #6	$	246,000
Shipping	$	6,000
Commissioning	$	6,000
Subtotal Equipment	$	258,000
Installation		
Installation (25%)	$	62,000
Subtotal Installation	$	62,000
Subtotal Equipment and Installation	$	320,000
Contingency (30%)	$	96,000
Subtotal Equipment & Installation w/ Contingency	$	416,000
Contractor GC OH & P (20%)	$	83,000
TOTAL Construction Cost	$	499,000
Engineering (Design and CRS @10%)	$	25,000
Total Capital Cost	**$**	**524,000**

ENDURO COMPOSITES -FRP launder covers
9 tanks total – 3 at 85ft OD, 3 at 90ft OD, and 3 at 93ft OD.
316 SST hardware and fasteners are included.

3 ea – 85 ft FC effluent channel covers – with no scum baffle = $118,666
3 ea – 93 ft. FC effluent channel covers – with no scum baffle = $126,936
3 ea – 90 ft. FC effluent channel covers – with scum baffle = $122,896

5-140-1A Aluminum Covers Over Weir Launders
Facility Plan Opinion of Cost

Item		Initial Cost
Aluminum Weir Launder Covers		
Covers - Tanks #7 - #9	$	416,000
Shipping	$	10,000
Commissioning	$	10,000
Subtotal Equipment	$	436,000
Installation		
Installation (25%)	$	104,000
Subtotal Installation	$	104,000
Subtotal Equipment and Installation	$	540,000
Contingency (30%)	$	162,000
Subtotal Equipment & Installation w/ Contingency	$	702,000
Contractor GC OH & P (20%)	$	140,000
TOTAL Construction Cost	$	842,000
Engineering (Design and CRS @10%)	$	84,000
Total Capital Cost	**$**	**926,000**

Subject: Ultraflote Aluminum Launder cover
Budget pricing 2/20/2020
for this application is as follows:
One Launder cover
(Materials Only) - $ 130,250 FOB Jobsite
Ultraflote LLC
3640 W. 12th St.
Houston, TX 77008

5-141-2 Improve WAS Pumping from Final Clar #2, #4, and #6
Facility Plan Opinion of Cost

Item		Initial Cost
WAS Pumping Improvements		
8" dia Piping and Fittings (75 LF)	$	11,300
Fittings	$	2,800
8" dia Plug Valves (6)	$	12,000
Shipping	$	500
Subtotal Equipment	$	26,600
Installation		
Piping Removal	$	1,300
Piping Installation	$	13,100
Connection to Air System	$	6,500
Subtotal Installation	$	20,900
Subtotal Equipment and Installation	$	47,500
Contingency (30%)	$	14,300
Subtotal Equipment & Installation w/ Contingency	$	61,800
Contractor GC OH & P (20%)	$	12,400
TOTAL Construction Cost	$	74,000
Engineering (Design and CRS @15%)	$	11,000
Total Capital Cost	**$**	**85,000**

5-141-3 Modify ML Inlet Channel at Final Clarifiers #1 – #6
Facility Plan Opinion of Cost

Item		Initial Cost
Clarifiers #1 - #6 Mixed Liquor Channel Walls		
Concrete for Raising Channel Walls	$	4,400
Subtotal Equipment	$	4,400
Installation		
Concrete/Wall Preparation	$	4,400
Subtotal Installation	$	4,400
Subtotal Equipment and Installation	$	8,800
Contingency (30%)	$	2,600
Subtotal Equipment & Installation w/ Contingency	$	11,400
Contractor GC OH & P (20%)	$	2,300
TOTAL Construction Cost	$	13,700
Engineering (Design and CRS @15%)	$	2,100
Total Capital Cost	**$**	**16,000**

5-145-4 Upgrade Secondary Scum Pumping System
Facility Plan Opinion of Cost

Item		Initial Cost
Scum Pumping System		
Maintain Existing Scum Pots	$	-
Revise Piping on Scum Pots	$	25,000
Modify piping for distribution to Digester B&E	$	50,000
	$	-
Subtotal	$	75,000
Subtotal Equipment and Installation	$	75,000
Contingency (30%)	$	22,500
Subtotal Equipment & Installation w/ Contingency	$	97,500
Contractor GC OH & P (20%)	$	19,500
TOTAL Construction Cost	$	117,000
Engineering (Design and CRS ~10%)	$	13,000
Total Capital Cost	**$**	**130,000**

5-145-5 Final Effluent Engine Cooling Pumps
Facility Plan Opinion of Cost

Item		Initial Cost
Engine Cooling Pump System		
Centrifugal Pumps (2)	$	20,000
Shipping	$	500
Commissioning	$	1,000
Subtotal Equipment	$	21,500
Installation		
Removal of Existing Equipment	$	1,000
Mechanical Installation (25%)	$	5,000
Piping (25%)	$	5,000
Electrical (10%)	$	2,000
I&C (5%)	$	1,000
Subtotal Installation	$	14,000
Subtotal Equipment and Installation	$	36,000
Contingency (30%)	$	10,800
Subtotal Equipment & Installation w/ Contingency	$	46,800
Contractor GC OH & P (20%)	$	9,400
TOTAL Construction Cost	$	56,000
Engineering (Design and CRS @10%)	$	6,000
Total Capital Cost	**$**	**62,000**

6-91-1 Expand EQ Sampler Bldg
Facility Plan Opinion of Cost

Item		Initial Cost
Expand EQ Sampler Building		
	$	-
Subtotal Equipment	$	-
Installation		
8x8 Custom Masonry Building to Match Existing	$	20,000
HVAC/Plumbing	$	4,000
Electrical	$	4,000
Subtotal Installation	$	28,000
Contractor GC OH & P (20%)	$	6,000
Subtotal Installation	$	34,000
Contingency (30%)	$	10,000
TOTAL Construction Cost	$	44,000
Engineering (Design and CRS)	$	16,000
Total Capital Cost	**$**	**60,000**

6-160-1 No Upgrade of UV Disinfection System #1 & #2
Facility Plan Opinion of Cost

Item		Initial Cost
UV Disinfection System		
UV Equipment		
Commissioning	$	-
Subtotal Equipment	$	-
Installation		
Removal of Existing Equipment	$	-
Channel Alterations (1%)	$	-
Mechanical Installation (10%)	$	-
Electrical (4%)	$	-
I&C (2%)	$	-
Subtotal Installation	$	-
Subtotal Equipment and Installation	$	-
Contingency (30%)	$	-
Subtotal Equipment & Installation w/ Contingency	$	-
Contractor GC OH & P (20%)	$	-
TOTAL Construction Cost	$	-
Engineering (Design and CRS @15%)	$	-
Total Capital Cost	**$**	**-**
Estimated Annual Power Cost	$	395,080
Bulb/Equipment Replacement	$	82,500
Estimated Annual Maintenance Cost	$	8,320
Estimated Annual Total Operating Cost	**$**	**485,900**
Present Worth of O&M	**$**	**6,985,000**
Total Present Worth Cost	**$**	**6,985,000**

$$PV = A \times \frac{(1+i)^n - 1}{i(1+i)^n}$$

Discount Rate (*i*)		3.375%
Discount Period (*n*)		20
PV	**$**	**6,984,572**

6-160-3 Upgrade UV Disinfection System #1, #2 & #3 (3 Channels)
Facility Plan Opinion of Cost

Item		Initial Cost
UV Disinfection System		
UV Equipmen-3 Channel System	$	1,700,000
Gates (2)	$	40,000
Concrete Channel	$	198,000
Commissioning	$	17,000
Subtotal Equipment	$	1,955,000
Installation		
Removal of Existing Equipment	$	17,000
Excavation & Backfill	$	18,000
Mechanical Installation (10%)	$	174,000
UV Building	$	100,000
Channel Modifications	$	99,000
Electrical (5%)	$	85,000
I&C (2.5%)	$	43,000
Subtotal Installation	$	536,000
Subtotal Equipment and Installation	$	2,491,000
Contingency (30%)	$	747,000
Subtotal Equipment & Installation w/ Contingency	$	3,238,000
Contractor GC OH & P (20%)	$	648,000
TOTAL Construction Cost	$	3,886,000
Engineering (Design and CRS @15%)	$	583,000
Total Capital Cost	**$**	**4,469,000**
Estimated Annual Power Cost	$	122,580
Estimated Annual Maintenance Cost	$	4,160
Estimated Annual Total Operating Cost	**$**	**126,740**
Present Worth of O&M	**$**	**1,822,000**
Total Present Worth Cost	**$**	**6,291,000**

$$PV = A \times \frac{(1+i)^n - 1}{i(1+i)^n}$$

Discount Rate (*i*)		3.375%
Discount Period (*n*)		20
PV	**$**	**1,821,825**

6-160-4 Replace Effluent Flow Meters
Facility Plan Opinion of Cost

Item		Initial Cost
Effluent Flow Meters 6-4-1 and 6-4-2		
60" Magmeters- (Qty 2 @ 100,000 ea)	$	200,000
Subtotal Equipment	$	200,000
Installation		
Mechanical Installation (25%)	$	50,000
Electrical and I&C (10%)	$	20,000
Subtotal Installation	$	70,000
Subtotal Equipment and Installation	$	270,000
Contingency (30%)	$	80,000
Subtotal Equipment & Installation w/ Contingency	$	350,000
Contractor GC OH & P (20%)	$	70,000
TOTAL Construction Cost	$	420,000
Engineering (Design and CRS @5%)	$	20,000
Total Capital Cost	**$**	**440,000**

6-162-1 – Cover for Effluent Junction Chamber
Facility Plan Opinion of Cost

Item		Initial Cost
Effluent Junction Chamber Cover		
Cover	$	51,000
Commissioning	$	2,600
Subtotal Equipment	$	53,600
Installation		
Mechanical Installation (25%)	$	12,800
Subtotal Installation	$	12,800
Subtotal Equipment and Installation	$	66,400
Contingency (30%)	$	19,900
Subtotal Equipment & Installation w/ Contingency	$	86,300
Contractor GC OH & P (20%)	$	17,300
TOTAL Construction Cost	$	103,600
Engineering (Design and CRS @15%)	$	15,500
Total Capital Cost	**$**	**119,000**

ENGINEERS ESTIMATE from VENDOR COMPARISON ESTIMATE:
For covers to fit the 12x 90 ft area
for this application is as follows: $
51,000.00
(Peterson & Matz)

6-162-2 Final Effluent Junction Chamber Solar Panels
Facility Plan Opinion of Cost

Item		Initial Cost
Solar Panel Array (12' x 90')		
Solar Panels	$	10,000
Shipping	$	300
Commissioning	$	500
Subtotal Equipment	$	10,800
Installation		
Mechanical Installation (25%)	$	3,000
Electrical (20%)	$	2,000
I&C (5%)	$	1,000
Subtotal Installation	$	6,000
Subtotal Equipment and Installation	$	16,800
Contingency (30%)	$	5,000
Subtotal Equipment & Installation w/ Contingency	$	21,800
Contractor GC OH & P (20%)	$	4,000
TOTAL Construction Cost	$	25,800
Engineering (Design and CRS @15%)	$	4,000
Total Capital Cost	**$**	**30,000**
Estimated Annual Power Cost	$	(4,730)
Estimated Annual Maintenance Cost	$	4,360
Estimated Annual Total Operating Cost	**$**	**(370)**
Present Worth of O&M	**$**	**(5,000)**
Total Present Worth Cost	**$**	**25,000**

$$PV = A \times \frac{(1+i)^n - 1}{i(1+i)^n}$$

Discount Rate (i)		3.375%
Discount Period (n)		20
PV	**$**	**(5,319)**

7-185-1 Aeration Blower Alternative
New Single Stage Gearless Centrifugal Blowers
Facility Plan Opinion of Cost

Item		Initial Cost
New Aeration Blowers		
Blower Package 1 (1)	$	200,000
Blower Package 2 (1)	$	200,000
Blower Package 3 (1)	$	200,000
Blower Package 4 (1)	$	200,000
Shipping	$	15,000
Commissioning	$	25,000
Subtotal Equipment	$	840,000
Installation		
Demolition of PD Blower & Engine Systems	$	50,000
Mechanical Install (25%)	$	200,000
Electrical and I&C (10%)	$	80,000
HVAC & Plumbing (5%)	$	40,000
Subtotal Installation	$	370,000
Subtotal Equipment and Installation	$	1,210,000
Contingency (30%)	$	363,000
Subtotal Equipment & Installation w/ Contingency	$	1,600,000
Contractor GC_OH &P (20%)	$	300,000
TOTAL Construction Cost	$	1,900,000
Engineering (Design and CRS @15%)	$	300,000
Total Capital Cost	**$**	**2,200,000**
Focus on Energy CREDIT ($0.04/kWh saved)	**$**	**(33,000)**
Estimated Average Annual Blowers Maintenance Cost	$	15,000
Estimated Average Annual Blowers Energy Savings	$	(75,056)
Total Estimated Average Annual O&M Cost	$	(60,056)
Present Worth of O&M	**$**	**(863,000)**
TOTAL PRESENT WORTH		$1,337,000

NOTE: (1)480 V VFD Drive included in 480V Blower Cost

$$PV = A \times \frac{(1+i)^n - 1}{i(1+i)^n}$$

Discount Rate (*i*)	3.375%
Discount Period (*n*)	20.0
PV	**-$863,271**

8-165-1 Upgrade TWAS Piping to Digesters
Facility Plan Opinion of Cost

Item		Initial Cost
TWAS Piping Reconfiguration		
Piping and Valves		$ 100,000
	Subtotal Equipment	$ 100,000
Installation		
Mechanical Installation (25%)		$ 100,000
	Subtotal Installation	$ 100,000
	Subtotal Equipment and Installation	$ 200,000
	Contingency (30%)	$ 60,000
	Subtotal Equipment & Installation w/ Contingency	$ 260,000
	Contractor GC OH & P (20%)	$ 50,000
TOTAL Construction Cost		$ 310,000
Engineering (Design and CRS)		$ 40,000
Total Capital Cost		**$ 350,000**

9-170-1 Inspect, Evaluate and Rehabilitate Digester B Cover
Facility Plan Opinion of Cost

Item		Initial Cost
Digester B Floating Cover		
Inspect/Evaluate Cover	$	36,000
Inspect/Evaluate Mixing System	$	48,000
Rehabilitate Cover (10% of new cover)	$	56,000
Subtotal Equipment	$	140,000
Installation		
Mechanical Installation (25%)	$	14,000
Subtotal Installation	$	14,000
Subtotal Equipment and Installation	$	154,000
Contingency (30%)	$	46,000
Subtotal Equipment & Installation w/ Contingency	$	200,000
Contractor GC OH & P (20%)	$	40,000
TOTAL Construction Cost	$	240,000
Engineering (Design and CRS @15%)	$	36,000
Total Capital Cost	**$**	**276,000**

9-177-1 Replace Digester D Floating Cover
Facility Plan Opinion of Cost

Item		Initial Cost
Digester D Floating Cover		
Radial Beam Gasholder Cover	$	555,000
Commissioning	$	28,000
Subtotal Equipment	$	583,000
Installation		
Removal of Existing Cover (30%)	$	167,000
Installation (40%)	$	222,000
Piping (10%)	$	56,000
Subtotal Installation	$	445,000
Subtotal Equipment and Installation	$	1,028,000
Contingency (30%)	$	308,000
Subtotal Equipment & Installation w/ Contingency	$	1,336,000
Contractor GC OH & P (20%)	$	267,000
TOTAL Construction Cost	$	1,603,000
Engineering (Design and CRS @15%)	$	240,000
Total Capital Cost	**$**	**1,843,000**

9-184-1A Biogas Conditioning
Hydrogen Sulfide Removal System
Facility Plan Opinion of Cost

Item		Initial Cost
New New Hydrogen Sulfide H2S System		
Unison H2S Removal Media Vessel	$	105,000
Shipping	$	15,000
Commissioning	$	25,000
Subtotal Equipment	$	145,000
Installation		
Mechanical Install (15%)	$	16,000
Electrical and I&C (15%)	$	16,000
Subtotal Installation	$	32,000
Subtotal Equipment and Installation	$	177,000
Contingency (30%)	$	53,000
Subtotal Equipment & Installation w/ Contingency	$	230,000
Contractor GC_OH &P (20%)	$	46,000
TOTAL Construction Cost	$	276,000
Engineering (Design and CRS @15%)	$	41,000
Total Capital Cost	**$**	**317,000**
Estimated H2S Media Replacement	$	7,333
Total Estimated Average Annual O&M Cost	$	7,333
Present Worth of O&M	**$**	**105,000**
TOTAL PRESENT WORTH	$	422,000

$$PV = A \times \frac{(1+i)^n - 1}{i(1+i)^n}$$

Discount Rate (*i*)	3.375%
Discount Period (*n*)	20.0
PV	**$105,413**

9-184-1B Biogas Conditioning
Compression Moisture and Siloxane Removal
Facility Plan Opinion of Cost

Item		Initial Cost
New New Hydrogen Sulfide H2S System		
Unison Biogas Compression Moisture Removal Ski	$	355,000
Unison Siloxane/VOC Removal System	$	115,000
Shipping	$	15,000
Commissioning	$	15,000
Subtotal Equipment	$	500,000
Installation		
Building or Temp Controlled Enclosure	$	180,000
Mechanical Install (15%)	$	75,000
Electrical and I&C (15%)	$	75,000
Subtotal Installation	$	330,000
Subtotal Equipment and Installation	$	830,000
Contingency (10%)	$	83,000
Subtotal Equipment & Installation w/ Contingency	$	913,000
Contractor GC_OH &P (20%)	$	183,000
TOTAL Construction Cost	$	1,096,000
Engineering (Design and CRS @15%)	$	164,000
Total Capital Cost	**$**	**1,260,000**
Estimated Silicone Media Replacement	$	10,000
Total Estimated Average Annual O&M Cost	$	10,000
Present Worth of O&M	**$**	**144,000**
TOTAL PRESENT WORTH	$	1,404,000
Discount Rate (*i*)		3.375%
Discount Period (*n*)		20.0
PV		**$143,745**

9-185-2A Biogas Utilization
IC Engine-Generator CHP
Facility Plan Opinion of Cost
Biogas Conditioning 9-184-1B REQUIRED

Item		Initial Cost
New 600kW IC Engine Generator		
Jenbacher IC Engine_ Primary	$	607,000
Jenbacher IC Engine- Redundant	$	607,000
Exhaust Stacks - Assumed will be Required	$	100,000
Hot Water System Heat Exchangers	$	100,000
New Flare	$	75,000
Shipping	$	25,000
Commissioning	$	25,000
Subtotal Equipment	$	1,540,000
Installation		
Demolition of PD Blower & Engine Systems	$	50,000
Mechanical Install (30%)	$	447,000
Electrical and I&C (30%)	$	387,000
HVAC & Plumbing (10%)	$	61,000
Subtotal Installation	$	945,000
Subtotal Equipment and Installation	$	2,480,000
Contingency (30%)	$	740,000
Subtotal Equipment & Installation w/ Contingency	$	3,220,000
Contractor GC_OH &P (20%)	$	640,000
TOTAL Construction Cost	$	3,900,000
Engineering (Design and CRS @15%)	$	600,000
Total Capital Cost	**$**	**4,500,000**
Focus on Energy Grants (Est)	**$**	**(50,000)**
Annual O&M Maintenance Cost for CHP	$	105,000
Net Electrical Utility Cost Savings	**$**	**(176,000)**
Net Thermal BTU Savings	**$**	**(132,000)**
Net Annual Operating Cost	$	(203,000)
Present Worth of O&M	**$**	**(2,918,000)**
TOTAL PRESENT WORTH		$1,532,000

$$PV = A \times \frac{(1+i)^n - 1}{i(1+i)^n}$$

Discount Rate (*i*)	3.375%
Discount Period (*n*)	20.0
PV	**-$2,918,024**

Racine, WI WWTP

*Standard ratings of the engines in the specification is valid for full load operation for an installation at **≤ 670 ft (204m)** and air intake temperature **T1<91.4°F (33°C)**. For **91.4°F <T1<104°F**, an output derate of **0.83%/°F (1.5%/°C)** derate will occur. Above **104°F (40°C)**, an output derate of **1.11%/°F (2.0%/°C)** derate will occur. Natural gas performance based on **MN=90**.*

SRT WF XXXXXX: TC

NEW AIR PERMIT MAY NECESSITATE STACKS (PENDING DISPERSION MODELING)

	kW	Hrs/yr	kWH	$/kWh	Annual Cost	Annual Savings
Engine O&M	600	8760	5,256,000	0.02	$ 105,120	
Blower Elec	420	8760	3,679,200	0.09	$ 331,128	
Recover Flared Gas			**(379,531)**	**0.09**		**$ (34,158)**
Generator Power	**(600)**	**8760**	**(5,256,000)**	**0.09**		**$ (473,040)**
NET Electrical Savings			**(1,956,331)**	**0.09**		**$ (176,070)**
	BTU/hr	Hrs/yr	kWH	$/kWh		
New Thermal	**(2,500,000)**	**8760**	**(6,351,000)**	**0.09**		**$ (571,590)**
CURRENT Annual Thermal Savings via Heat Recovery						$ 439,752
NET THERMAL SAVINGS with additional heat recovery						**$ (131,838)**

Discount Rate (*i*)	3.375%
Discount Period (*n*)	20.0
PV	**-$2,916,700**

$$PV = A \times \frac{(1+i)^n - 1}{i(1+i)^n}$$

9-185-2B Biogas Utilization
Microturbine Generators - CHP
Facility Plan Opinion of Cost
Biogas Conditioning 9-184-1B REQUIRED

Item		Initial Cost
New Microturbine Generator Equipment		
Capstone CR65 (Qty-9 @$105K each)	$	945,000
Cain Heat Exchanger - Exhaust Gas	$	150,000
Exhaust Ducting	$	35,000
New Flare	$	75,000
Shipping	$	15,000
Commissioning	$	25,000
Subtotal Equipment	$	1,245,000
Installation		
Demolition of PD Blower & Engine Systems	$	50,000
Mechanical Install (30%)	$	362,000
Electrical and I&C (50%)	$	510,000
HVAC & Plumbing (15%)	$	170,000
Subtotal Installation	$	1,092,000
Subtotal Equipment and Installation	$	2,337,000
Contingency (30%)	$	701,000
Subtotal Equipment & Installation w/ Contingency	$	3,038,000
Contractor GC_OH &P (20%)	$	608,000
TOTAL Construction Cost	$	3,650,000
Engineering (Design and CRS @15%)	$	548,000
Total Capital Cost	**$**	**4,200,000**
Focus on Energy Grants (Est)	**$**	**(50,000)**
Estimated Annualized Maintenance Cost	$	77,000
Net Electrical Utility Cost Savings	**$**	**(176,000)**
Net Thermal BTU Savings	**$**	**-**
Net Annual Operating Cost	$	(99,000)
Present Worth of O&M	**$**	**(1,423,000)**
TOTAL PRESENT WORTH		$2,727,000

$$PV = A \times \frac{(1+i)^n - 1}{i(1+i)^n}$$

Discount Rate (i)		3.375%
Discount Period (n)	$	20
PV	$	(1,423,076)

9-185-2C Maintain Existing Biogas Utilization
Facility Plan Opinion of Cost

Item		Initial Cost
Maintain Existing Biogas for Aeration Blowers		
Upgrade Engine Controls & Instrumentation	$	100,000
Add 2nd Biogas Flare (8 " Waste Gas Burner)	$	75,000
Gas Handling Equipment	$	50,000
Subtotal Equipment	$	225,000
Installation		
Concrete Foundation and Footings	$	30,000
Mechanical Install (15%)	$	3,000
Electrical and I&C (50% of I&C equipment)	$	50,000
Subtotal Installation	$	83,000
Subtotal Equipment and Installation	$	308,000
Contingency (30%)	$	92,000
Subtotal Equipment & Installation w/ Contingency	$	400,000
Contractor GC_OH &P (20%)	$	80,000
TOTAL Construction Cost	$	480,000
Engineering (Design and CRS @15%)	$	70,000
Total Capital Cost	**$**	**550,000**
Estimated Annualized Maintenance Cost	$	105,000
Present Worth of O&M	**$**	**1,500,000**
TOTAL PRESENT WORTH		$2,050,000

$$PV = A \times \frac{(1+i)^n - 1}{i(1+i)^n}$$

Discount Rate (*i*)	3.375%
Discount Period (*n*)	20.0
PV	**$1,509,323**

9-190-1 Add Biogas Storage
Facility Plan Opinion of Cost

Item		Initial Cost
BIOGAS MEMBRANE STORAGE		
Membrane Storage- Slab on Grade Remote 100,000 CF @ $6/CF	$	600,000
Subtotal Equipment	$	600,000
Installation		
Site Work	$	10,000
Concrete	$	10,000
Biogas Piping	$	40,000
Electrical and I&C	$	40,000
Subtotal Installation	$	100,000
Subtotal Equipment and Installation	$	700,000
Contingency (30%)	$	210,000
Subtotal Equipment & Installation w/ Contingency	$	910,000
Contractor GC_OH &P (20%)	$	182,000
TOTAL Construction Cost	$	1,092,000
Engineering (Design and CRS @15%)	$	164,000
Total Capital Cost	**$**	**1,256,000**

10-165-3 – BFP Filtrate Equalization Tank
Facility Plan Opinion of Cost

Item		Initial Cost
BFP Filtrate Equalization Tank		
Storage Tank, incl. Accessories①	$	730,000
47ft dia x 30ft SWD - 390,000 gallons		
Valve Vault w/Meter & Control Valve	$	15,000
Shipping	$	15,000
Commissioning	$	19,000
Subtotal Equipment	$	779,000
Installation		
Installation (Tank & Vault - 25%)	$	186,000
Excavation (Tank)	$	24,000
Backfill (Tank)	$	4,000
Piping (10-in)	$	27,200
Piping (6-in)	$	13,000
Electrical (5%)	$	37,000
I&C (3%)	$	22,000
Subtotal Installation	$	313,200
Subtotal Equipment and Installation	$	1,092,200
Contingency (30%)	$	328,000
Subtotal Equipment & Installation w/ Contingency	$	1,420,200
Contractor GC OH & P (20%)	$	284,000
TOTAL Construction Cost	$	1,704,200
Engineering (Design and CRS @15%)	$	256,000
Total Capital Cost	**$**	**1,960,000**

13-47-1 Permanent Sodium Bisulfite Pumps and Piping
Facility Plan Opinion of Cost

Item		Initial Cost
Sodium Bisulfite Pumps		
New Pump w/controls (add to existing duplex)	$	15,000
Commissioning	$	1,500
Subtotal Equipment	$	16,500
Installation		
Mechanical Installation (30%)	$	4,500
Piping (865 LF of 1" PVC)	$	25,950
Electrical (25%)	$	3,800
I&C (10%)	$	1,500
Subtotal Installation	$	36,000
Subtotal Equipment and Installation	$	52,500
Contingency (30%)	$	15,800
Subtotal Equipment & Installation w/ Contingency	$	68,300
Contractor GC OH & P (20%)	$	14,000
TOTAL Construction Cost	$	82,300
Engineering (Design and CRS @15%)	$	12,300
Total Capital Cost	**$**	**95,000**

14-185-3 New Air Compressors
New Rotary Screw Air Compressor Systems
Facility Plan Opinion of Cost

Item		Initial Cost
New Plant Air Compressors		
Rotary Screw Air Compressor Package[1]	$	26,000
Rotary Screw Air Compressor Package[1]	$	26,000
Shipping	$	1,500
Commissioning	$	1,500
Subtotal Equipment	$	55,000
Installation		
Demolition of Existing Air Compressors	$	5,000
Mechanical Install (20%)	$	10,000
Electrical and I&C (10%)	$	5,000
HVAC & Plumbing (5%)	$	3,000
Subtotal Installation	$	23,000
Subtotal Equipment and Installation	$	78,000
Contingency (30%)	$	23,000
Subtotal Equipment & Installation w/ Contingency	$	101,000
Contractor GC_OH &P (20%)	$	20,000
TOTAL Construction Cost	$	121,000
Engineering (Design and CRS @15%)	$	18,000
Total Capital Cost	**$**	**139,000**

① ATLAS COPCO G22-175 FF 208-230/460, 132 Gallon (P/N 8153335837) 30HP oil-injected rotary screw compressors, w/ integrated refrigerant dryers, mounted on 132 gallon receiver tank. (LAI Ltd. Budget estimate)

NOTE: **LOW VIBRATION- SMOOTH PULSE FREE OUTPUT**

G-1 Upgrade Stormwater and Road Paving
Facility Plan Opinion of Cost

Item	Initial Cost
SF Pavement	$ 75,000
New 72" MH	$ 25,000
Subtotal Equipment and Installation	$ 100,000
Contingency (30%)	$ 30,000
Subtotal Equipment & Installation w/ Contingency	$ 130,000
Contractor GC OH & P (20%)	$ 26,000
TOTAL Construction Cost	$ 156,000
Engineering (Design and CRS @15%)	$ 23,000
Total Capital Cost	**$ 179,000**

G-2 Stormwater at Digester B
Facility Plan Opinion of Cost

Item	Initial Cost
Stormwater Piping	$ 30,000
Grading	$ 30,000
Landcaping	$ 15,000
Subtotal Equipment and Installation	$ 75,000
Contingency (30%)	$ 23,000
Subtotal Equipment & Installation w/ Contingency	$ 98,000
Contractor GC OH & P (20%)	$ 20,000
TOTAL Construction Cost	$ 118,000
Engineering (Design and CRS @15%)	$ 18,000
Total Capital Cost	**$ 136,000**

G-3 Metal Manstards on Buildings
Facility Plan Opinion of Cost

Item	Initial Cost
Field Inspection/Testing	
Predesign inspection & testing	$ 4,000
New panels & supports (matls)	$ 52,000
New panels & Supports (labor)	$ 36,000
Subtotal Equipment and Installation	$ 92,000
Contingency (30%)	$ 28,000
Subtotal Equipment & Installation w/ Contingency	$ 120,000
Contractor GC OH & P (20%)	$ 24,000
TOTAL Construction Cost	$ 144,000
Engineering (Design and CRS @15%)	$ 22,000
Total Capital Cost	**$ 166,000**

G-4 Upgrade Obsolete Fire Alarm Panels
Facility Plan Opinion of Cost

Item		Initial Cost
New Fire Alarm Panels		
Simplex Equivalent Panels (6 @ $2000 ea)	$	12,000
Shipping	$	1,000
Commissioning	$	6,000
Subtotal Equipment	$	19,000
Installation		
Installation	$	12,000
Electrical	$	12,000
I&C (5%)	$	6,000
Subtotal Installation	$	30,000
Subtotal Equipment and Installation	$	49,000
Contingency (30%)	$	15,000
Subtotal Equipment & Installation w/ Contingency	$	64,000
Contractor GC OH & P (20%)	$	13,000
TOTAL Construction Cost	$	77,000
Engineering (Design and CRS @15%)	$	12,000
Total Capital Cost	**$**	**89,000**

G-6 Upgrade Back up Engines
Facility Plan Opinion of Cost

Item		Initial Cost
3 New Engine Systems	$	45,000
Subtotal Equipment	$	45,000
Installation		
Mech Installation	$	9,000
Electrical	$	22,500
I&C (5%)	$	2,250
Subtotal Installation	$	33,750
Subtotal Equipment and Installation	$	78,750
Contingency (30%)	$	24,000
Subtotal Equipment & Installation w/ Contingency	$	103,000
Contractor GC OH & P (20%)	$	21,000
TOTAL Construction Cost	$	124,000
Engineering (Design and CRS @15%)	$	19,000
Total Capital Cost	**$**	**143,000**

G-7 Upgrade Women's Locker Room
Facility Plan Opinion of Cost

Item		Initial Cost
Materials		
Wall & Flooring	$	9,500
Tlt Partitions & Accessories	$	5,000
Subtotal Equipment	$	14,500
Installation		
Demolition	$	2,500
Wall & Flooring	$	7,500
Partitions & Accessories	$	3,500
Subtotal Installation	$	13,500
Subtotal Equipment and Installation	$	28,000
Contingency (30%)	$	8,000
Subtotal Equipment & Installation w/ Contingency	$	36,000
Contractor GC OH & P (20%)	$	7,000
TOTAL Construction Cost	$	43,000
Engineering (Design and CRS @15%)	$	6,000
Total Capital Cost	**$**	**49,000**

G-110-1 Admin Bldg Roofs
Facility Plan Opinion of Cost

See IRS Roofing quote 11/2019 for additional info

Item	Initial Cost
IRS quote Clay Tile Replacement ($325K)	**$ 325,000**
IRS quote Adj Flat Roofs ($240K)	**$ 240,000**
Subtotal Equipment and Installation	$ 565,000
Contingency (10%)	$ 57,000
Subtotal Equipment & Installation w/ Contingency	$ 622,000
Contractor GC OH & P (5%)	$ 30,000
TOTAL Construction Cost	$ 652,000
Architect (Spec and CRS Shop Drawing Reviews @ 5%)	$ 33,000
Total Capital Cost	**$ 685,000**

G-110-2 Admin Bldg Furniture and Furnishes
Facility Plan Opinion of Cost

Item	Initial Cost
Finishes include ceilings, walls and floors) Admin Bldg 1st & 2nd fl @ 7400 sf Estimate used conceptual level costs	
Demo	$ 10,000
Flooring, Walls & Clg @ 8% of new bldg	$ 104,000
Furniture @ 2% of new bldg 7400 sf x $180/sf = $1,300,000	$ 26,000
Subtotal Equipment and Installation	$ 140,000
Contingency (30%)	$ 42,000
Subtotal Equipment & Installation w/ Contingency	$ 182,000
Contractor GC OH & P (20%)	$ 36,000
TOTAL Construction Cost	$ 218,000
Engineering (Design and CRS @15%)	$ 33,000
Total Capital Cost	**$ 251,000**

G-110-3 Admin Bldg Communications/Technology
Facility Plan Opinion of Cost

Item		Initial Cost
	Staff inout reqd	
	Admin Bldg @ 7400 sf @ $1/sf	$ 7,400
	Lab @ 9000 sf @ $1/sf	$ 9,000
	Other Bldgs @ 10K sf @ $2/sf	$ 20,000
	Subtotal Equipment and Installation	$ 36,400
	Contingency (30%)	$ 11,000
	Subtotal Equipment & Installation w/ Contingency	$ 47,400
	Contractor GC OH & P (20%)	$ 9,000
TOTAL Construction Cost		$ 60,000
Engineering (Design and CRS @15%)		$ 9,000
Total Capital Cost		**$ 69,000**

G-110-4 Adm Bldg Men's Restroom Upgrade - in Lobby
Facility Plan Opinion of Cost

Item		Initial Cost
Materials		
Wall & Flooring	$	9,500
Tlt Partitions & Accessories	$	5,000
Subtotal Equipment	$	14,500
Installation		
Demolition	$	2,500
Wall & Flooring	$	7,500
Partitions & Accessories	$	3,500
Subtotal Installation	$	13,500
Subtotal Equipment and Installation	$	28,000
Contingency (30%)	$	8,000
Subtotal Equipment & Installation w/ Contingency	$	36,000
Contractor GC OH & P (20%)	$	7,000
TOTAL Construction Cost	$	43,000
Engineering (Design and CRS @15%)	$	6,000
Total Capital Cost	**$**	**49,000**

G-110-5 Adm Bldg HVAC Air Handling Unit
Facility Plan Opinion of Cost

Item	Initial Cost
Materials	
HVAC engineering TBD	
Installation	
Subtotal Installation	$ 100,000
Subtotal Equipment and Installation	$ 100,000
Contingency (30%)	$ 30,000
Subtotal Equipment & Installation w/ Contingency	$ 130,000
Contractor GC OH & P (20%)	$ 26,000
TOTAL Construction Cost	$ 156,000
Engineering (Design and CRS @15%)	$ 23,000
Total Capital Cost	**$ 179,000**

G-120-1 Ferric Chloride Unloading Spill Containment Facility Plan Opinion of Cost

Item		Initial Cost
	Enclose current unloading area for safety (chem spills, unloading hazards, etc.) Assuming new floor, roof and north wall New 10T hydrallic lift for chemical, etc. in Loading Dock space Remodel space.	$ 18,000
	Approx 3000 sf @ $50	$ 150,000
	Eliminates existing lake spill potential	
	Subtotal Equipment and Installation	$ 168,000
	Contingency (30%)	$ 50,000
	Subtotal Equipment & Installation w/ Contingency	$ 218,000
	Contractor GC OH & P (20%)	$ 44,000
TOTAL Construction Cost		$ 262,000
Engineering (Design and CRS @15%)		$ 39,000
Total Capital Cost		**$ 300,000**

120-3 Upgrade Ferric Chloride Tank Fill Piping
Facility Plan Opinion of Cost

Item			Initial Cost
Materials			
	2" OH dual containment piping system		
LF	FRP or HDPE	144	$ 10,080
	Valves & Fittings		$ 20,000
Installation			
	Labor and Pipe supports		$ 60,160
	Subtotal Equipment and Installation		$ 90,240
	Contingency (30%)		$ 27,000
	Subtotal Equipment & Installation w/ Contingency		$ 117,240
	Contractor GC OH & P (20%)		$ 23,000
TOTAL Construction Cost			$ 140,000
Engineering (Design and CRS @15%)			$ 20,000
Total Capital Cost			**$ 160,000**

G-125-2 Lab Hoods - Metal Free
Facility Plan Opinion of Cost

Item		Initial Cost
Material		
Demo	$	2,000
New metal free lab hood	$	20,000
New exhaust ductwork	$	3,000
Installation	$	10,000
Subtotal Equipment and Installation	$	35,000
Contingency (20%)	$	7,000
Subtotal Equipment & Installation w/ Contingency	$	42,000
Contractor GC OH & P (20%)	$	8,000
TOTAL Construction Cost	$	50,000
Engineering (Design and CRS @20%)	$	10,000
Total Capital Cost	**$**	**60,000**

G-125-3 Replace Lab Floor
Facility Plan Opinion of Cost

Item		Initial Cost
Chem resistant floor @ $10/SF (subcontractor install price)	$	56,000
Subtotal Equipment and Installation	$	56,000
Contingency (20%)	$	11,000
Subtotal Equipment & Installation w/ Contingency	$	67,000
Contractor GC OH & P (5%)	$	3,000
TOTAL Construction Cost	$	70,000
Engineering (Design and CRS @5%)	$	5,000
Total Capital Cost	**$**	**75,000**

G-125-4 Eval Lab Gas Piping
Facility Plan Opinion of Cost

Item		Initial Cost
Materials	$	25,000
Labor	$	25,000
Subtotal Equipment and Installation	$	50,000
Contingency (30%)	$	15,000
Subtotal Equipment & Installation w/ Contingency	$	65,000
Contractor GC OH & P (20%)	$	13,000
TOTAL Construction Cost	$	78,000
Engineering (Design and CRS @15%)	$	12,000
Total Capital Cost	**$**	**90,000**

G-125-6 Lab Air Handlers
Facility Plan Opinion of Cost

Item	Initial Cost
Equipment Estimate by Mech Engineer	$ 75,000
Installation est. by Mech Engineer	$ 75,000
Subtotal Equipment and Installation	$ 150,000
Contingency (30%)	$ 45,000
Subtotal Equipment & Installation w/ Contingency	$ 195,000
Contractor GC OH & P (20%)	$ 39,000
TOTAL Construction Cost	$ 234,000
Engineering (Design and CRS @15%)	$ 35,000
Total Capital Cost	**$ 269,000**

G-125-7 Upgrade Lab Fixtures
Facility Plan Opinion of Cost

Item		Initial Cost
Equipment Est by Mech Engineer	$	15,000
Installation Est by Mech Engineer	$	15,000
Subtotal Equipment and Installation	$	30,000
Contingency (30%)	$	9,000
Subtotal Equipment & Installation w/ Contingency	$	39,000
Contractor GC OH & P (20%)	$	8,000
TOTAL Construction Cost	$	47,000
Engineering (Design and CRS @15%)	$	7,000
Total Capital Cost	**$**	**54,000**

G-130-2 Solar Panels on Preliminary Treatment Bldg.
Facility Plan Opinion of Cost

Item		Initial Cost
Solar Panel Array (50' x 65')		
Solar Panels	$	30,000
Shipping	$	1,000
Commissioning	$	2,000
Subtotal Equipment	$	33,000
Installation		
Mechanical Installation (25%)	$	8,000
Electrical (20%)	$	6,000
I&C (5%)	$	2,000
Subtotal Installation	$	16,000
Subtotal Equipment and Installation	$	49,000
Contingency (30%)	$	15,000
Subtotal Equipment & Installation w/ Contingency	$	64,000
Contractor GC OH & P (20%)	$	13,000
TOTAL Construction Cost	$	77,000
Engineering (Design and CRS @15%)	$	12,000
Total Capital Cost	**$**	**89,000**
Estimated Annual Power Cost	$	(17,340)
Estimated Annual Maintenance Cost	$	4,760
Estimated Annual Total Operating Cost	**$**	**(12,580)**
Present Worth of O&M	**$**	**(181,000)**
Total Present Worth Cost	**$**	**(92,000)**

$$PV = A \times \frac{(1+i)^n - 1}{i(1+i)^n}$$

Discount Rate (*i*)		3.375%
Discount Period (*n*)		20
PV	**$**	**(180,831)**

G-139 Structural Tunnel Leak Repair/ Upgrades
Facility Plan Opinion of Cost

Item		Initial Cost
Allowance pending results of future survey	$	20,000
Subtotal Equipment and Installation	$	20,000
Contingency (30%)	$	6,000
Subtotal Equipment & Installation w/ Contingency	$	26,000
Contractor GC OH & P (20%)	$	5,000
TOTAL Construction Cost	$	31,000
Engineering (Design and CRS @15%)	$	5,000
Total Capital Cost	**$**	**36,000**

G-CNH-Lakefront Stabilization/Erosion Protection
Facility Plan Opinion of Cost

Item		Initial Cost
Allowance	$	50,000
Subtotal Equipment	$	50,000
Installation		
Allowance	$	150,000
Subtotal Installation	$	150,000
Subtotal Equipment and Installation	$	200,000
Contingency (30%)	$	60,000
Subtotal Equipment & Installation w/ Contingency	$	260,000
Contractor GC OH & P (20%)	$	50,000
TOTAL Construction Cost	$	310,000
Engineering (Design and CRS @15%)	$	50,000
Total Capital Cost	**$**	**360,000**

G-CNH-2 Consider Solar Panels on CNH Site.
Facility Plan Opinion of Cost

Item		Initial Cost
New Solar Panels		
Solar Panels (270' x 540')	$	1,322,000
Shipping	$	33,000
Commissioning	$	33,000
Subtotal Equipment	$	1,388,000
Installation		
Installation (25%)	$	331,000
Site Work (5%)	$	66,000
Electrical (25%)	$	331,000
I&C (5%)	$	66,000
Subtotal Installation	$	794,000
Subtotal Equipment and Installation	$	2,182,000
Contingency (30%)	$	655,000
Subtotal Equipment & Installation w/ Contingency	$	2,837,000
Contractor GC OH & P (20%)	$	567,000
TOTAL Construction Cost	$	3,404,000
Engineering (Design and CRS @15%)	$	511,000
Total Capital Cost	**$**	**3,915,000**
Estimated Annual Power Cost	$	(659,900)
Estimated Annual Maintenance Cost	$	43,080
Estimated Annual Total Operating Cost	**$**	**(616,820)**
Present Worth of O&M	**$**	**(8,866,000)**
Total Present Worth Cost	**$**	**(4,951,000)**

$$PV = A \times \frac{(1+i)^n - 1}{i(1+i)^n}$$

Discount Rate (*i*)		3.375%
Discount Period (*n*)		20
PV	**$**	**(8,866,482)**

Smith & Loveless, Inc.
14040 Santa Fe Trail Drive
Lenexa, KS 66215
USA
913-888-5201

PROPOSAL CM-30112

2-130-1
REPLACE GRIT SCREW CONVEYORS
RACINE WWTP

SMITH & LOVELESS®, INC. having an office at 14040 Santa Fe Trail Drive, Lenexa, Kansas 66215 (hereinafter referred to as "Seller"), hereby agrees to sell to the buyer designated below (hereinafter referred to as "Buyer"), the following equipment is subject to all provisions set forth in this Sales Agreement. ***The Sales Representative is not an agent or employee of Seller and is not authorized to enter into any agreement on Seller's behalf or bind Seller in any way.***

SMITH & LOVELESS®, INC. is pleased to offer our quotation for the following:

TWO **SMITH & LOVELESS® Model 250 PISTA® TURBO™ Grit Washers** with parallel plate separator, including two (2) 250 GPM, 2-piece Ni-Hard grit concentrators.

- Constructed of 316 stainless steel, including the screw and concentrator mounting bracket.
- ~~Includes two (2) control panels, each with MicroLogix PLC to control the Grit Washer.~~
- Drive motor to be 3 HP, 3/60/460 V, explosion proof.
- Grit Washer utilizes 3 wash levels: 1) High air scour, 2) Intense flushing with water, and 3) Thorough agitation.

CORROSION PROTECTION:

All fabricated steel components shall be commercial blasted and prime coated by the manufacturer with one 3-mil DFT coat of red oxide primer prior to shipment. All motors and gearboxes shall be furnished with the original manufacturer's coating. Final touch-up and finish coating shall be the responsibility of the purchasing contractor. Stainless steel, aluminum, and other corrosion-resistant surfaces shall not be coated.

Seller will provide Buyer with four hard copies of the O&M Manual, also on CD (.pdf format). Additional copies can be provided for $50 per copy.

Reduce to delete price of Control Panels NOT REQUIRED (estimated at $25K ea)

BUDGET PRICE, SUBMITTAL DATA AND DELIVERY:

$ ~~**310,000**~~ $260,0000

F.O.B. factory plus any taxes, which may apply. Truck/Rail freight allowed to the job site, rail siding or nearest unloading area-unloading to be by Buyer. Due to the spike in gas prices, which is beyond the control of Seller at the time of our quotation/bid, a fuel surcharge may need to be assessed at time of shipment.

A two-day supervision of initial operation over one trip is included. If additional days are required, Seller will furnish a factory-trained supervisor for $975 per day including travel time plus actual travel expenses.

With continuing approval of the **SMITH & LOVELESS®** Credit Department, payment terms are:

- 10% with the order,
- 25% upon release to manufacturing, and
- 65% net 30 days from date of shipment.

Seller to send Submittal Data for approval 4 to 6 weeks after receipt of complete details at Seller's factory.

Manufacturing completion is estimated at 16 to 18 weeks after receipt in Seller's office of approved Submittal Data and/or after all notations or comments have been clarified, approved and inserted into the manufacturing documents by the Seller. Variations in the time Submittal Data is returned to Seller and/or Submittal Data marked approved but which contain contingencies or variations may impact the completion time of the equipment.

If the equipment **SMITH & LOVELESS®** is providing is associated with the retrofit or modification of existing equipment, then field adjustments to the existing and/or new equipment may be required for correct installation. Such adjustments may include but are not limited to, piping modifications, grouting, shimming, control panel or electrical changes, etc. **SMITH & LOVELESS®** is relying on information provided by the customer, the installing contractor, or others regarding the measurement, model or part numbers, drawings, and descriptions of existing equipment in the design and manufacturing of the new equipment for this project. As a result, **SMITH & LOVELESS®** shall not be responsible for any problems or difficulties encountered when fitting-up new equipment with existing equipment.

ADDITIONAL TERMS AND CONDITIONS:

1. GENERAL A. Buyer's execution of this Agreement constitutes Buyer's offer to purchase, on the terms and conditions set forth herein, the equipment described in this agreement, and such offer is irrevocable for thirty (30) days after Buyer executes and delivers to Seller this Agreement together with all necessary engineering data and information. Prices are firm for sixty (60) days after the bid date provided a firm order is received at the factory within that time period and provided approved Submittal Data is received at the factory within forty-five (45) days from the date submittals are forwarded from the factory. In the event firm orders and Submittal Data are not received by Seller within the times set forth above, then price and delivery estimates may change due to changes in the costs of material and labor and/or factory capacity at the time when the firm orders or approved Submittal Data is received by Seller.

Seller reserves the right to amend this Sales Agreement if not signed and returned within sixty (60) days from the quotation date. In the event we are unable to ship within estimated period for reasons beyond our control, including a request by the Buyer to defer shipment, the prices are subject to adjustment to those prevailing at the time of shipment, but will not exceed 1½% per month.

B. THIS AGREEMENT IS NOT BINDING ON SELLER UNLESS SIGNED ON SELLER'S BEHALF BY AN OFFICER OR MANAGER OF SELLER.

C. This Agreement constitutes the entire contract between the parties with respect to said equipment (any prior agreement, representation, covenant or warranty, written or oral, being superseded hereby) and may not be amended or modified except by a written instrument duly executed by both parties, the provisions of any purchase order or other document submitted by or on behalf of Buyer to the contrary notwithstanding.

D. All notices hereunder are to be in writing and mailed postage prepaid to the party being notified at the address indicated in this agreement or at such other address as may be designated in writing.

E. Remedies provided for herein are cumulative and are in addition to all other remedies as may be available at law or in equity.

F. This Agreement is governed by and subject to the laws of the State of Kansas and the Buyer by executing this agreement agrees to submit to the Jurisdiction of the State of Kansas and the venue for any disputes between the parties will be in the District Court of Johnson County, Kansas, or the Federal District Court of Kansas.

2. NOTICE TO PROCEED- Return to Seller of approved Submittal Data or notification to Seller that the submission of submittals will be waived, constitutes notice to Seller to proceed with manufacture. In the event Seller does not receive approved Submittal Data within forty-five (45) days after Seller's submission of submittal data for approval, then Seller reserves the right to amend price and delivery of the equipment being sold. Final approved Submittal Data means approval by Buyer (or Buyer's representative) of Seller's Submittal Data and/or after all notations or comments have been clarified, approved and inserted into Seller's manufacturing documents at which point Sellers estimated completion schedule commences. Variations in the time Submittal Data is returned to Seller and/or Submittal Data marked approved but which contain contingencies or variations may impact the completion time of the equipment. Seller agrees to furnish only the equipment included in Seller's quotation and/or as described and modified in the Submittal Data. Approval of the Submittal Data constitutes acceptance of the equipment in the configuration described therein. If Seller is directed to change the scope of the equipment after notice to proceed to manufacture, then Seller reserves the right to amend the price and delivery of the equipment.

3. EXCUSED PERFORMANCE- Seller is not liable for any failure or delay in performance hereof, with respect to delivery or otherwise, if such failure or delay is due to any cause beyond Seller's control including, but not limited to, any Act of God, war, civil disturbance, riot, labor difficulty, factory capacity, fire, other casualty, accident or supplier's failure or inability to perform.

4. CREDIT APPROVAL- The credit terms specified herein are subject to Seller's continuing approval of Buyer's credit and if, in Seller's sole judgment, Buyer's credit or financial standing is impaired as to cause Seller to deem itself insecure, Seller may withdraw the extension of credit and require other payment terms.

5. PAYMENT- Subject only to any credit terms, which Seller may extend, the total purchase price hereunder is due at such time, within or after the estimated shipment period specified herein, as said equipment is ready to be shipped. Buyer shall pay in full all invoices within the time for payment specified therein and Buyer's payment obligation is in no way dependent or contingent upon Buyer's receipt of payment from any other party. Any balance owed by Buyer for thirty (30) days or more after the same becomes due is subject to a 2% per month delinquency charge until paid. In addition to all other amounts due hereunder, Buyer shall reimburse Seller in full for all damages, costs and expenses, including reasonable attorneys' fees, which Seller may incur with respect to Buyer's breach of this Sales Agreement or the collection of past due amounts from Buyer. If Buyer is in default under this or any other agreement with Seller, Seller may, at its option, defer performance hereunder until such default is cured.

6. SECURITY INTEREST- Until all amounts due hereunder have been paid in full, Seller has a security interest in said equipment and has all rights of a secured party under the Uniform Commercial Code including, without limitation, the right to take possession of said equipment without legal process and the right to require Buyer to assemble said equipment and make it available to Seller at a place reasonably convenient to both parties. At Seller's request, Buyer shall execute any financing statement or statements submitted by Seller in order that Seller's security interest in said equipment may be perfected.

7. WARRANTY & LIABILITY- Seller warrants only that said equipment is free from defects in materials and workmanship as set forth in Seller's standard Certificate of Warranty furnished to Buyer at the time of final shipment. THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ALL IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE OR DESIGN AND WHICH ARE EXPRESSLY DISCLAIMED BY SELLER. Seller's sole responsibility with respect to any equipment which proves to be defective as to materials or workmanship is either to replace or to repair the same as is set forth in said Certificate of Warranty. Unless authorized in writing by Seller, Seller is not responsible for any charge or expense incurred for the modification, servicing or adjusting of said equipment after the same has been delivered to Buyer. Seller is not liable in association with its warranty or in any other capacity for any consequential, incidental or liquidated damages, late fees/damages or penalties.

8. CLAIM PERIOD- Buyer shall immediately inspect said equipment upon receipt thereof and immediately notify the carrier of any damage, shortage or other nonconformance. Seller is not obligated to consider any claim for damages, shortages or non-conformance unless notified by Buyer within ten (10) days after Buyer's receipt of said equipment.

9. CANCELLATION- Should Buyer cancel this agreement without Seller's prior written consent, Seller may, at its option, recover from Buyer a cancellation charge of not less than 20% of the purchase price hereunder. This cancellation charge is intended to compensate Seller for difficult-to-calculate economic losses, including but not limited to, material and labor costs, as well as loss of anticipated profits suffered due to cancellation.

10. SEVERABILITY – If any provision or provisions of this Agreement shall be held to be invalid, illegal, unenforceable or in conflict with the law of any jurisdiction, the validity, legality and enforceability of the remaining provisions shall not in any way be affected or impaired thereby.

11. STORAGE- If at such time, within or after the estimated shipment period specified herein, as Seller notifies Buyer that said equipment is ready to be shipped Buyer requests a delay in shipment, Seller may, at its option, agree to store said equipment for a period of time determined by Seller, provided that such agreement will not affect Buyer's obligation to pay in full all invoices as they become due, and provided further that for each month, or portion thereof, said equipment is so stored by Seller, Buyer shall pay to Seller as a storage fee an amount equal to 2% of the purchase price.

12. DRAWINGS, ILLUSTRATIONS AND MANUALS- Catalog and proposal drawings, bulletins, and other accompanying literature are solely for purpose of general style, arrangement and approximate dimensions. Seller may make any changes Seller deems necessary or desirable. Submittal for approval, if required, will be made after receipt of complete information from Buyer. Unless otherwise specified at the time of quotation, six sets will be furnished. Additional sets are at $25.00 per set. Installation, maintenance and operation manuals will be furnished in the number of copies specified at the time of quotation. If none specified, four will be provided at no added cost, with additional copies at $50.00 each.

13. PERMITS, LICENSES- Buyer at its sole cost and expense shall obtain all building or other permits or licenses with respect to the installation and operation of said equipment required by any federal, state or local governmental body.

14. PATENT INDEMNIFICATION- Seller shall, at its own expense, defend any suit instituted against Buyer, based on any claim that equipment furnished hereunder infringes any Letters Patent of the United States, and Seller shall pay any damages assessed against Buyer in any such suit, provided that Buyer, upon service of process upon Buyer, gives to Seller notice in writing of the institution of such suit, and permits Seller, through counsel chosen by Seller, to defend the same, and gives Seller all information in Buyer's possession and reasonable assistance and authority to enable Seller so to do. Seller shall have no liability or obligation to Buyer for patent infringement resulting from compliance by Seller with written instructions or specifications of Buyer concerning the structure, operation, material, or method of making equipment furnished hereunder.

SIGNATURES:

Agreed to this _____ **day of** _____, _____

_____
Buyer

_____
By *(Print Name)*

_____
By *(Authorized Signature)*

_____
Address

Is this purchase tax exempt? YES ____ **NO** ____
If YES, attach Sales Tax Exemption Certificate. Failure to provide tax exempt certificate prior to shipment will result in Buyer being responsible for all applicable taxes.

Agreed to this _____ **day of** _____, _____
At Lenexa, KS.

SMITH & LOVELESS®, INC.
Seller

_____
By *(Authorized Signature)*

_____
Prepared by *(Sales Representative)*

NOTE: The Sales Representative is not an agent or employee of Seller and is not authorized to enter into any agreement on Seller's behalf or to bind Seller in any way.

3-125-1 Maintain Existing Diffused Air Mixing System
Facility Plan Opinion of Cost

Item		Initial Cost	
Replace Existing Hoffman PD Blowers			
New Rotary Screw Kaeser	$	232,000	Kaeser Model FB660S-M-SFC Screw Blower $116,535.00 list price each net plus shipping (Complete with all controls including vfd wired ready to go)
New Piping	$	20,000	
Shipping	$	5,000	
Commissioning	$	5,000	
Subtotal Equipment	$	262,000	
Installation			
Demolition Existing PD Blowers	$	10,000	
Mechanical Install (20%)	$	50,000	
Electrical and I&C (20%)	$	46,000	
Subtotal Installation	$	106,000	
Subtotal Equipment and Installation	$	368,000	
Contingency (10%)	$	37,000	
Subtotal Equipment & Installation w/ Contingency	$	405,000	
Contractor GC_OH &P (20%)	$	81,000	
TOTAL Construction Cost	$	486,000	
Engineering (Design and CRS @10%)	$	49,000	
Total Capital Cost	**$**	**535,000**	
Estimated Annual Operating Power Cost	$	50,000	
Present Worth of O&M	**$**	**719,000**	
Total Present Worth Cost		$1,254,000	

$$PV = A \times \frac{(1+i)^n - 1}{i(1+i)^n}$$

Discount Rate (*i*)	3.375%	Wisconsin Fiscal Impact Cost Analysis
Discount Period (*n*)	20.0	
PV	**$718,725**	

ECONOMIC ANALYSIS

The following economic analysis between BioMix and the existing coarse bubble mixing systems uses a $0.08, $0.0.09, and $0.10/kW-hr rate, for comparative purposes for mixing the Primary Influent Channels.

O&M Analysis

DIFFUSED AIR MIXING
Electrical

Application		Blower Power (HP)	Estimated Operating BHP	Operating Kilowatts	Annual Cost @ $0.08/kW-Hr	Annual Cost @ $0.09/kW-Hr	Annual Cost @ $0.1/kW-Hr
PI Channel		100	85	63.41	$44,437.73	$49,992.44	$55,547.16
			TOTAL ANNUAL COST		$44,437.73	$49,992.44	$55,547.16

*$2000/yr maintenance/repair + 100% replacement every 20 years

BIOMIX with (1) 25 HP Compressor
Electrical

	Application	Compressor Power (HP)	Estimated Operating HP	Operating Kilowatts	Annual Cost @ $0.08/kW-Hr	Annual Cost @ $0.09/kW-Hr	Annual Cost @ $0.1/kW-Hr
	PI Channel	25	17.30	12.91	$9,044.38	$10,174.93	$11,305.48
			TOTAL ANNUAL COST		$9,044.38	$10,174.93	$11,305.48

	Current Rate:	$0.08/kW-Hr	$0.09/kW-Hr	$0.1/kW-Hr
	BIOMIX YEARLY O&M SAVINGS	$35,393.34	$39,817.51	$44,241.68

Annual Cost of Diffused Air Mixing at $0.09/kW-Hr $(49,992)

EVOQUA WATER TECHNOLOGIES CONFIDENTIAL ALL RIGHTS RESERVED	**3-135-1 PRIMARY TANK COLLECTOR MECHANISMS**	**Installation:** Racine, WI WWTP **Engineer:** AECOM Tank 1,2,3,4 **Date:** September 25, 2019 **By:** SDI

A. CHARACTERISTICS

Manufacturer	Evoqua Water Technologies LLC (Evoqua) - Waukesha, Wisconsin USA					
Equipment Description	Envirex® Sludge Collecting Equipment for Primary Sedimentation Basin - Wastewater Plant					
Basin Quantity	4					
Each Basin Contains	1	Tank				
Each Tank Contains	2	Long Collector Mechanisms and	one (1)	Cross Collector		
Total Longitudinal Collectors	8					
Total Cross Collectors	4					
Width - Longitudinal (Scraped Width)	16.50 ft	**Overall Channel Width**	16.50 ft	**Dividing Wall Type**	Columns	**Dividing Wall(s') Thickness** 12.0 inch
Width - Cross Collector (Scraped Width)	4.00 ft					
Tank Length - Longitudinal (Includes cross collector channel)	137.5 ft					
Cross Collector Channel Length (Including Hopper)	34.0 ft					
Max. WATER Depth (Measured at point nearest edge of hopper)	10.50 ft					
New or Existing Tanks	Existing					

Budget Information

(8) ea Longitudinal Sludge Collectors

(4) ea Cross Collectors

Drives, return track brackets, shafts and stub shafts, and scum pipes are to be reused.

Minimum Recommended Field Service

Field Service Quantity
Trips: **4**
8 Hr Days at Site: **8**

FOB Shipping Point, Freight Allowed

$445,700 Total USD

Budget Information
Preliminary budget is based on limited information, Evoqua standard equipment selection, and standard terms of sale and warranty terms. Any variations from these standards may affect this budget. Additionally, please note that this budget is for review and informational purposes only and does not constitute an offer for acceptance. A copy of our standard Terms & Conditions are available upon request. Budget quoted based on delivery within one (1) year from date of this submittal.

Est (4) Truck loads

Pairs of Sprockets per Longitudinal Collector	4
Pairs of Sprockets per Cross Collector	3
Flight Speed - Longitudinal	2.0 ft/min
Flight Speed - Cross Collector	4.0 ft/min

Flight Spacing - Longitudinal	10.0 ft	
Flight Spacing - Cross Collector	5.0 ft	
Sludge Load (Average) - Longitudinal	4.0 lb/ft	Primary at 4% sludge concentration with 8 inch (200mm) tall flights = 4 lb/ft
Sludge Load (Average) - Cross Collectors	8.0 lb/ft	of flight length
Friction Factors	0.20 to 0.30 (UHMW-PE on UHMW-PE - water lubricated) 0.05 to 0.10 (UHMW-PE on Stn. Stl. - water lubricated)	
Bearing Friction Factors	0.05 per shaft assembly	

B. MATERIALS

CHAIN		
Flight Carry Chain - Long	NCS720S-NX - Non-metallic, unfilled acetal resin chain and reinforced nylon resin pins, 3/8 inch (10mm) flight fasteners, working load 3100 lbf (13.8 kN), minimum ultimate 6,000 lbf (27 kN), weight 1.3 lb/ft (1.9 kg/m)	
Flight Carry Chain - Cross	Same as Longitudinals	
Drive Chain	NH78 - Unfilled acetal links, SS pin, working load 1750 lb (7.78 kN), min. ultimate 4,000 lb (17.79 kN), weight 1.4 lb/ft (2.1 kg/m)	
FLIGHTS		
Flights - Long	Sigma Plus FRP 3 x 8 inch (75 x 200 mm) - Modulus of elasticity (E, psi) x moment of inertia (I, in^4) >= 6.83 x 10^6 lb-in^2 (19.5 kN-m^2) about its minor axis, 50 to 60% glass content	
Flights - Cross	Same as Longitudinals	
WEAR SHOES		
Wear Shoes - Return Track	UHMW-PE with lug every flight Wear shoe (track) - Virgin Black UHMW-PE, ASTM D-4020, w/ lug 4.5 x 3 x 0.5 inch (114 x 76 x 12.7mm), min. 62 Shore "D" ASTM D-2240, 6,000 psi (41,400 KPA) ultimate tensile	
Wear Shoes - Floor	Wear shoe (floor) - Virgin Black UHMW-PE, ASTM D-4020 5.5 wide x 3 x 0.5 inch (140 x 76 x 12.7mm), min. 62 Shore "D" ASTM D-4020, 6,000 psi (41,400 KPA) ultimate tensile	
WEAR STRIPS		
Floor	UHMW-PE 5/8 X 2 5/8 inch (16 x 67mm) - 2 lines per tank	
Attachment	316SS convex washer, #14 x 1-1/2 inch (6 x 38mm) 316SS pan head self tapping screw and vinyl anchor	
Return Tracks	UHMW-PE 5/8 X 2 5/8 inch (16 x 67mm)	
Attachment	316SS convex washer, 1/4 inch (6mm) 410SS, zinc plated self-drilling & tapping pan head screw	
RETURN TRACKS	3 x 3 x 3/8 inch (76 x 76 x 9.5mm)	**Track Mat'l:** FRP
Supports	REUSED	**Support Mat'l:** Non-metallic
Support Spacing	10.0 ft (3.0m)	
DEFLECTOR ANGLES	3 x 3 x 3/8 inch (76 x 76 x 10mm) with UHMW-PE wear strips and 316SS fasteners	**Track Mat'l:** Carbon Steel
Supports	A500 Sch. 40 steel pipe with 1/4 inch (6mm) steel end plates	**Support Mat'l:** Carbon Steel
	Note: Deflector angles will be furnished only if it is determined by Evoqua at time of drawing submittal that	
COLLECTOR BEARINGS - LONGITUDINALS		
Head Shaft	Cast steel split housing, polyurethane, self-aligning bearing, water lubricated with provisions for greasing when unsubmerged	Solid Hub Ball
Upper Effl & Lower Effl Idler Shafts	Sprocket bore rotates on Virgin UHMW-PE sprocket sleeve bearing, sprocket position retained by UHMW-PE set collar	
Upper Effluent	Same as Lower Influent Idler Shaft	
COLLECTOR BEARINGS - CROSS COLLECTORS		
Head Shaft	Cast steel split housing, polyurethane, self-aligning bearing, water lubricated with provisions for greasing when unsubmerged	Solid Hub Ball
Idler Shaft	Sprocket sleeve bearings, Virgin Black UHMW-PE with 316SS band clamps	
COLLECTOR SPROCKETS - LONGITUDINALS		
Head Shaft	NCS720S, 23T-22.24 inch (565mm) PD w/ chain saver rim, split cast nylon, bolted hub with 316SS hdw. and set screws	
Idler Shaft	NCS720S, 17T-16.61 inch (422mm) PD w/ chain saver rim, solid cast nylon	

SPROCKETS - CROSS COLLECTORS		
Head Shaft	NCS720S, 23T-22.24 inch (565mm) PD w/ chain saver rim, split cast nylon, bolted hub with 316SS hdw. and set screws	
Idler Shaft	720 / 730, 17T-16.61 inch (422mm) PD, split polyurethane, 316 SS band clamps	
DRIVE SPROCKET and TORQUE LIMITER	11T tooth segments and ball detent torque limiter	
DRIVEN SPROCKET	N78-40T-33.25 inch (845mm) PD, split polyurethane hub, deep dished and replaceable polyurethane tooth segments, 316 SS hdw.	
DRIVE UNIT	not furnished	
SPEED REDUCER		
MOTOR		
Torque Overload Protection Device	Ball detent torque limiter with combination NEMA 4X (IP67) / NEMA 7 (IEC Zone 0 and 1) lever-arm limit switch	
Drive Base	REUSED	
Chain Guard	REUSED	
Drive Chain Tightener	316SS bracket, self-aligning, self-lubricated with N78-7T Polyurethane Sprocket	
HARDWARE		
Flights	316SS HHCS's, flat washers, and locknuts	
Miscellaneous connections	316SS	
Thread Standard	Unified American Standard	
Anchors	Stud anchors at all locations	
Anchor material	316SS	
PAINT		
Surface prep (Non-Subm)	Shop blast to SSPC-SP10	
Surface prep (Submerged)	Shop blast to SSPC-SP10	
Shop prime - Non-submerged	Sherwin-Williams Dura-Plate 235NSF red oxide epoxy 4-8 mil DFT	or Equal
Shop prime - Submerged	Sherwin-Williams Dura-Plate 235NSF red oxide epoxy 4-8 mil DFT	or Equal
Finish paint - Non-submerged	Field applied coating by others	
Finish paint - Submerged	Field applied coating by others	
SKIMMING EQUIPMENT	Existing skimmers to be reused	
SPARE PARTS	Spare parts are Not included.	

evoqua WATER TECHNOLOGIES CONFIDENTIAL ALL RIGHTS RESERVED	**3-135-1 PRIMARY TANK COLLECTOR MECHANISMS**	**Installation:** Racine, WI WWTP **Engineer:** AECOM Tank 5&6 West Bank **Date:** September 25, 2019 **By:** SDI

A. CHARACTERISTICS

Manufacturer	Evoqua Water Technologies LLC (Evoqua) - Waukesha, Wisconsin USA	
Equipment Description	Envirex® Sludge Collecting Equipment for Primary Sedimentation Basin - Wastewater Plant Envirex 40383 U5	
Basin Quantity	2	
Each Basin Contains	1 Tank	
Each Tank Contains	2 Long Collector Mechanisms and	one (1) Cross Collector
Total Longitudinal Collectors	4	
Total Cross Collectors	2	
Width - Longitudinal (Scraped Width)	14.00 ft	**Overall Channel Width** 14.00 ft; **Dividing Wall Type** Columns; **Dividing Wall(s') Thickness** 12.0 inch
Width - Cross Collector (Scraped Width)	3.00 ft	
Tank Length - Longitudinal (Includes cross collector channel)	115.0 ft	
Cross Collector Channel Length (Including Hopper)	29.0 ft	
Max. WATER Depth (Measured at point nearest edge of hopper)	7.35 ft	
New or Existing Tanks	Existing	

Budget Information

(4) ea Longitudinal Sludge Collectors

(2) ea Cross Collectors

Drives, return track brackets, shafts and stub shafts, and scum pipes are to be reused.

Minimum Recommended Field Service

Field Service Quantity
Trips: **2**
8 Hr Days at Site: **4**

FOB Shipping Point, Freight Allowed

$215,900 Total USD

Budget Information
Preliminary budget is based on limited information, Evoqua standard equipment selection, and standard terms of sale and warranty terms. Any variations from these standards may affect this budget. Additionally, please note that this budget is for review and informational purposes only and does not constitute an offer for acceptance. A copy of our standard Terms & Conditions are available upon request. Budget quoted based on delivery within one (1) year from date of this submittal.

Est (2) Truck loads

Pairs of Sprockets per Longitudinal Collector	4
Pairs of Sprockets per Cross Collector	3
Flight Speed - Longitudinal	2.0 ft/min
Flight Speed - Cross Collector	4.0 ft/min

Flight Spacing - Longitudinal	10.0 ft	
Flight Spacing - Cross Collector	5.0 ft	
Sludge Load (Average) - Longitudinal	4.0 lb/ft	Primary at 4% sludge concentration with 8 inch (200mm) tall flights = 4 lb/ft
Sludge Load (Average) - Cross Collectors	8.0 lb/ft	of flight length
Friction Factors	0.20 to 0.30 (UHMW-PE on UHMW-PE - water lubricated) 0.05 to 0.10 (UHMW-PE on Stn. Stl. - water lubricated)	
Bearing Friction Factors	0.05 per shaft assembly	

B. MATERIALS

CHAIN		
Flight Carry Chain - Long	NCS720S-NX - Non-metallic, unfilled acetal resin chain and reinforced nylon resin pins, 3/8 inch (10mm) flight fasteners, working load 3100 lbf (13.8 kN), minimum ultimate 6,000 lbf (27 kN), weight 1.3 lb/ft (1.9 kg/m)	
Flight Carry Chain - Cross	Same as Longitudinals	
Drive Chain	NH78 - Unfilled acetal links, SS pin, working load 1750 lb (7.78 kN), min. ultimate 4,000 lb (17.79 kN), weight 1.4 lb/ft (2.1 kg/m)	
FLIGHTS		
Flights - Long	Sigma Plus FRP 3 x 8 inch (75 x 200 mm) - Modulus of elasticity (E, psi) x moment of inertia (I, in^4) >/= 6.83 x 10^6 lb-in^2 (19.5 kN-m^2) about its minor axis, 50 to 60% glass content	
Flights - Cross	Same as Longitudinals	
WEAR SHOES		
Wear Shoes - Return Track	UHMW-PE with lug every flight Wear shoe (track) - Virgin Black UHMW-PE, ASTM D-4020, w/ lug 4.5 x 3 x 0.5 inch (114 x 76 x 12.7mm), min. 62 Shore "D" ASTM D-2240, 6,000 psi (41,400 KPA) ultimate tensile	
Wear Shoes - Floor	Wear shoe (floor) - Virgin Black UHMW-PE, ASTM D-4020 5.5 wide x 3 x 0.5 inch (140 x 76 x 12.7mm), min. 62 Shore "D" ASTM D-4020, 6,000 psi (41,400 KPA) ultimate tensile	
WEAR STRIPS		
Floor	UHMW-PE 5/8 X 2 5/8 inch (16 x 67mm) - 2 lines per tank	
Attachment	316SS convex washer, #14 x 1-1/2 inch (6 x 38mm) 316SS pan head self tapping screw and vinyl anchor	
Return Tracks	UHMW-PE 5/8 X 2 5/8 inch (16 x 67mm)	
Attachment	316SS convex washer, 1/4 inch (6mm) 410SS, zinc plated self-drilling & tapping pan head screw	
RETURN TRACKS	3 x 3 x 3/8 inch (76 x 76 x 9.5mm)	**Track Mat'l:** FRP
Supports	REUSED	**Support Mat'l:** Non-metallic
Support Spacing	10.0 ft (3.0m)	
DEFLECTOR ANGLES	3 x 3 x 3/8 inch (76 x 76 x 10mm) with UHMW-PE wear strips and 316SS fasteners	**Track Mat'l:** Carbon Steel
Supports	A500 Sch. 40 steel pipe with 1/4 inch (6mm) steel end plates	**Support Mat'l:** Carbon Steel
	Note: Deflector angles will be furnished only if it is determined by Evoqua at time of drawing submittal that	
COLLECTOR BEARINGS - LONGITUDINALS		
Head Shaft	Cast steel split housing, polyurethane, self-aligning bearing, water lubricated with provisions for greasing when unsubmerged	Solid Hub Ball
Upper Effl & Lower Effl Idler Shafts	Sprocket bore rotates on Virgin UHMW-PE sprocket sleeve bearing, sprocket position retained by UHMW-PE set collar	
Upper Effluent	Same as Lower Influent Idler Shaft	
COLLECTOR BEARINGS - CROSS COLLECTORS		
Head Shaft	Cast steel split housing, polyurethane, self-aligning bearing, water lubricated with provisions for greasing when unsubmerged	Solid Hub Ball
Idler Shaft	Sprocket sleeve bearings, Virgin Black UHMW-PE with 316SS band clamps	
COLLECTOR SPROCKETS - LONGITUDINALS		
Head Shaft	NCS720S, 23T-22.24 inch (565mm) PD w/ chain saver rim, split cast nylon, bolted hub with 316SS hdw. and set screws	
Idler Shaft	NCS720S, 17T-16.61 inch (422mm) PD w/ chain saver rim, solid cast nylon	

SPROCKETS - CROSS COLLECTORS		
Head Shaft	NCS720S, 23T-22.24 inch (565mm) PD w/ chain saver rim, split cast nylon, bolted hub with 316SS hdw. and set screws	
Idler Shaft	720 / 730, 17T-16.61 inch (422mm) PD, split polyurethane, 316 SS band clamps	
DRIVE SPROCKET and TORQUE LIMITER	11T tooth segments and ball detent torque limiter	
DRIVEN SPROCKET	N78-40T-33.25 inch (845mm) PD, split polyurethane hub, deep dished and replaceable polyurethane tooth segments, 316 SS hdw.	
DRIVE UNIT	not furnished	
SPEED REDUCER		
MOTOR		
Torque Overload Protection Device	Ball detent torque limiter with combination NEMA 4X (IP67) / NEMA 7 (IEC Zone 0 and 1) lever-arm limit switch	
Drive Base	REUSED	
Chain Guard	REUSED	
Drive Chain Tightener	316SS bracket, self-aligning, self-lubricated with N78-7T Polyurethane Sprocket	
HARDWARE		
Flights	316SS HHCS's, flat washers, and locknuts	
Miscellaneous connections	316SS	
Thread Standard	Unified American Standard	
Anchors	Stud anchors at all locations	
Anchor material	316SS	
PAINT		
Surface prep (Non-Subm)	Shop blast to SSPC-SP10	
Surface prep (Submerged)	Shop blast to SSPC-SP10	
Shop prime - Non-submerged	Sherwin-Williams Dura-Plate 235NSF red oxide epoxy 4-8 mil DFT	or Equal
Shop prime - Submerged	Sherwin-Williams Dura-Plate 235NSF red oxide epoxy 4-8 mil DFT	or Equal
Finish paint - Non-submerged	Field applied coating by others	
Finish paint - Submerged	Field applied coating by others	
SKIMMING EQUIPMENT	Existing skimmers to be reused	
SPARE PARTS	Spare parts are Not included.	

EVOQUA WATER TECHNOLOGIES CONFIDENTIAL ALL RIGHTS RESERVED	**3-136-1 PRIMARY TANK COLLECTOR MECHANISMS**	**Installation:** Racine, WI WWTP **Engineer:** AECOM Tank 7,8,9,10,11,12 **Date:** September 25, 2019 **By:** SDI

A. CHARACTERISTICS

Manufacturer	Evoqua Water Technologies LLC (Evoqua) - Waukesha, Wisconsin USA					
Equipment Description	Envirex® Sludge Collecting Equipment for Primary Sedimentation Basin - Wastewater Plant					
Basin Quantity	6					
Each Basin Contains	1	Tank				
Each Tank Contains	2	Long Collector Mechanisms and	one (1)	Cross Collector		
Total Longitudinal Collectors	12					
Total Cross Collectors	6					
Width - Longitudinal (Scraped Width)	18.50 ft	**Overall Channel Width**	18.50 ft	**Dividing Wall Type**	Columns	**Dividing Wall(s') Thickness** 12.0 inch
Width - Cross Collector (Scraped Width)	3.00 ft					
Tank Length - Longitudinal (Includes cross collector channel)	120.0 ft					
Cross Collector Channel Length (Including Hopper)	38.0 ft					
Max. WATER Depth (Measured at point nearest edge of hopper)	8.20 ft					
New or Existing Tanks	Existing					

Budget Information

(12) ea Longitudinal Sludge Collectors

(6) ea Cross Collectors

Drives, return track brackets, shafts and stub shafts, and scum pipes are to be reused.

Minimum Recommended Field Service

Field Service Quantity
Trips: **4**
8 Hr Days at Site: **8**

FOB Shipping Point, Freight Allowed

$608,600 Total USD

Budget Information
Preliminary budget is based on limited information, Evoqua standard equipment selection, and standard terms of sale and warranty terms. Any variations from these standards may affect this budget. Additionally, please note that this budget is for review and informational purposes only and does not constitute an offer for acceptance. A copy of our standard Terms & Conditions are available upon request. Budget quoted based on delivery within one (1) year from date of this submittal.

Est (5) Truck loads

Pairs of Sprockets per Longitudinal Collector	4
Pairs of Sprockets per Cross Collector	3
Flight Speed - Longitudinal	2.0 ft/min
Flight Speed - Cross Collector	4.0 ft/min

Flight Spacing - Longitudinal	10.0 ft	
Flight Spacing - Cross Collector	5.0 ft	
Sludge Load (Average) - Longitudinal	4.0 lb/ft	Primary at 4% sludge concentration with 8 inch (200mm) tall flights = 4 lb/ft
Sludge Load (Average) - Cross Collectors	8.0 lb/ft	of flight length
Friction Factors	0.20 to 0.30 (UHMW-PE on UHMW-PE - water lubricated) 0.05 to 0.10 (UHMW-PE on Stn. Stl. - water lubricated)	
Bearing Friction Factors	0.05 per shaft assembly	

B. MATERIALS

CHAIN		
Flight Carry Chain - Long	NCS720S-NX - Non-metallic, unfilled acetal resin chain and reinforced nylon resin pins, 3/8 inch (10mm) flight fasteners, working load 3100 lbf (13.8 kN), minimum ultimate 6,000 lbf (27 kN), weight 1.3 lb/ft (1.9 kg/m)	
Flight Carry Chain - Cross	Same as Longitudinals	
Drive Chain	NH78 - Unfilled acetal links, SS pin, working load 1750 lb (7.78 kN), min. ultimate 4,000 lb (17.79 kN), weight 1.4 lb/ft (2.1 kg/m)	
FLIGHTS		
Flights - Long	Sigma Plus FRP 3 x 8 inch (75 x 200 mm) - Modulus of elasticity (E, psi) x moment of inertia (I, in^4) >= 6.83 x 10^6 lb-in^2 (19.5 kN-m^2) about its minor axis, 50 to 60% glass content	
Flights - Cross	Same as Longitudinals	
WEAR SHOES		
Wear Shoes - Return Track	UHMW-PE with lug every flight Wear shoe (track) - Virgin Black UHMW-PE, ASTM D-4020, w/ lug 4.5 x 3 x 0.5 inch (114 x 76 x 12.7mm), min. 62 Shore "D" ASTM D-2240, 6,000 psi (41,400 KPA) ultimate tensile	
Wear Shoes - Floor	Wear shoe (floor) - Virgin Black UHMW-PE, ASTM D-4020 5.5 wide x 3 x 0.5 inch (140 x 76 x 12.7mm), min. 62 Shore "D" ASTM D-4020, 6,000 psi (41,400 KPA) ultimate tensile	
WEAR STRIPS		
Floor	UHMW-PE 5/8 X 2 5/8 inch (16 x 67mm) - 2 lines per tank	
Attachment	316SS convex washer, #14 x 1-1/2 inch (6 x 38mm) 316SS pan head self tapping screw and vinyl anchor	
Return Tracks	UHMW-PE 5/8 X 2 5/8 inch (16 x 67mm)	
Attachment	316SS convex washer, 1/4 inch (6mm) 410SS, zinc plated self-drilling & tapping pan head screw	
RETURN TRACKS	3 x 3 x 3/8 inch (76 x 76 x 9.5mm)	**Track Mat'l:** FRP
Supports	REUSED	**Support Mat'l:** Non-metallic
Support Spacing	10.0 ft (3.0m)	
DEFLECTOR ANGLES	3 x 3 x 3/8 inch (76 x 76 x 10mm) with UHMW-PE wear strips and 316SS fasteners	**Track Mat'l:** Carbon Steel
Supports	A500 Sch. 40 steel pipe with 1/4 inch (6mm) steel end plates	**Support Mat'l:** Carbon Steel
	Note: Deflector angles will be furnished only if it is determined by Evoqua at time of drawing submittal that	
COLLECTOR BEARINGS - LONGITUDINALS		
Head Shaft	Cast steel split housing, polyurethane, self-aligning bearing, water lubricated with provisions for greasing when unsubmerged	Solid Hub Ball
Upper Effl & Lower Effl Idler Shafts	Sprocket bore rotates on Virgin UHMW-PE sprocket sleeve bearing, sprocket position retained by UHMW-PE set collar	
Upper Effluent	Same as Lower Influent Idler Shaft	
COLLECTOR BEARINGS - CROSS COLLECTORS		
Head Shaft	Cast steel split housing, polyurethane, self-aligning bearing, water lubricated with provisions for greasing when unsubmerged	Solid Hub Ball
Idler Shaft	Sprocket sleeve bearings, Virgin Black UHMW-PE with 316SS band clamps	
COLLECTOR SPROCKETS - LONGITUDINALS		
Head Shaft	NCS720S, 23T-22.24 inch (565mm) PD w/ chain saver rim, split cast nylon, bolted hub with 316SS hdw. and set screws	
Idler Shaft	NCS720S, 17T-16.61 inch (422mm) PD w/ chain saver rim, solid cast nylon	

SPROCKETS - CROSS COLLECTORS		
Head Shaft	NCS720S, 23T-22.24 inch (565mm) PD w/ chain saver rim, split cast nylon, bolted hub with 316SS hdw. and set screws	
Idler Shaft	720 / 730, 17T-16.61 inch (422mm) PD, split polyurethane, 316 SS band clamps	
DRIVE SPROCKET and TORQUE LIMITER	11T tooth segments and ball detent torque limiter	
DRIVEN SPROCKET	N78-40T-33.25 inch (845mm) PD, split polyurethane hub, deep dished and replaceable polyurethane tooth segments, 316 SS hdw.	
DRIVE UNIT	not furnished	
SPEED REDUCER		
MOTOR		
Torque Overload Protection Device	Ball detent torque limiter with combination NEMA 4X (IP67) / NEMA 7 (IEC Zone 0 and 1) lever-arm limit switch	
Drive Base	REUSED	
Chain Guard	REUSED	
Drive Chain Tightener	316SS bracket, self-aligning, self-lubricated with N78-7T Polyurethane Sprocket	
HARDWARE		
Flights	316SS HHCS's, flat washers, and locknuts	
Miscellaneous connections	316SS	
Thread Standard	Unified American Standard	
Anchors	Stud anchors at all locations	
Anchor material	316SS	
PAINT		
Surface prep (Non-Subm)	Shop blast to SSPC-SP10	
Surface prep (Submerged)	Shop blast to SSPC-SP10	
Shop prime - Non-submerged	Sherwin-Williams Dura-Plate 235NSF red oxide epoxy 4-8 mil DFT	or Equal
Shop prime - Submerged	Sherwin-Williams Dura-Plate 235NSF red oxide epoxy 4-8 mil DFT	or Equal
Finish paint - Non-submerged	Field applied coating by others	
Finish paint - Submerged	Field applied coating by others	
SKIMMING EQUIPMENT	Existing skimmers to be reused	
SPARE PARTS	Spare parts are Not included.	

3-135/136-3
Primary Influent Channel Mixing Alternative

BUDGETARY PROPOSAL

PROJECT DEFINITION

Proposed Process – BioMix™ compressed gas mixing system to provide mixing for the Primary Influent Channels. Each nozzle can be isolated via the ball valve at the top of each nozzle. Below is a depiction of the valve control panel, nozzle header and nozzles arranged within the Channel.

Tank	Primary Influent Channel
# of Channels	1
Length (ft.)	~ 500’
Width (ft.)	6’
Depth (ft.)	7’
Size of Pipe (Ø)	2.0 – Inch
# of Nozzle Headers	7
Nozzles / Header	Varies

- Typical Channel Arrangement with Nozzle Headers on One Side of Channel and Valve Module –

PRELIMINARY BIOMIX CONFIGURATION

RETRIEVABLE CHANNEL MIXING - GENERAL ARRANGEMENT

DESCRIPTION OF SYSTEM PROPOSED

BioMix systems provide mixing in liquids by firing short bursts of compressed air through engineered nozzle(s) affixed to the floor of a tank. This compressed air is intermittently fired in fractional second durations to mix the tank. The relatively small surface area of the large gas volumes and their rapid upward velocity enable BioMix to provide energy-efficient, effective mixing. A Zombie™ Valve Module (ZVM) with 304SS enclosure, mounted near the basin, will control the firing of the compressed air through Sch 5 304SS press-technology tank piping and the 304SS BioMix nozzles. Potentiometers for firing Frequency and Duration allow user input to optimally control the mixing intensity in the tank. Electrical power requirements are limited to the power to operate the compressed air source and the 120V VCP.

The proposed BioMix™ system for the Primary Influent Channels is designed for a "wet installation" with a live channel. The header supply piping will be installed above the liquid surface by affixing the piping to the tank wall using the supplied supports and hardware. The vertical nozzle header will be lowered into the channel which will have a concrete block affixed to the nozzle. The block will rest on the floor of the tank and counter act fluid velocity forces and buoyant forces to restrain the nozzle header. A sway brace support will be affixed to the nozzle header above the liquid surface for added structural rigidity.

All BioMix™ installations share the following characteristics:

- Significantly reduced power consumption compared to mechanical mixing
- Reduced numbers of operating equipment to be maintained
- No mechanical or electrical components in the wastewater
- Non-clogging, self-cleaning in-tank components
- Minimal scheduled maintenance of other components (compressor, air control valves) in controlled environments

SCOPE OF SUPPLY SUMMARY

EnviroMix proposes the following BioMix™ System:

- (1) – BioMix Zombie™ Valve Module (ZVM) with timer controller and firing-valves.
- (86)— BioMix 90-degree nozzles affixed to raised headers (see above configuration details)
- BioMix Sch5 press-technology in-tank air piping from ZVM to tank headers and nozzles, respective fittings and BioMix wall/pipe supports and anchors
- (1) 25 HP Rotary Screw Compressor with filter and refrigerated dryer.
    - *Anticipated operating power is 17.3 BHP*
- (1) 240 Gallon Receiver Tank w/ Auto-Drain Valve.
- (3) – days of on-site time for a qualified representative are included for equipment installation, testing, startup, and operations and maintenance training
- Submittals and Operations & Maintenance manuals
- Freight to jobsite

- *Exclusions/Clarifications:*
    - *Electrical connection to compressor (460/3/60) and Valve Module and receiver drain valve (120/1/60) by others*
    - *Interconnecting 2.0" diameter compressed air piping and fittings to tank side located Valve Module from compressors by others*
    - *Compressor and Receiver to be installed in a building*

ECONOMIC ANALYSIS

The following economic analysis between BioMix and the existing coarse bubble mixing systems uses a $0.08, $0.0.09, and $0.10/kW-hr rate, for comparative purposes for mixing the Primary Influent Channels.

O&M Analysis

DIFFUSED AIR MIXING
Electrical

Application		Blower Power (HP)	Estimated Operating BHP	Operating Kilowatts	Annual Cost @ $0.08/kW-Hr	Annual Cost @ $0.09/kW-Hr	Annual Cost @ $0.1/kW-Hr
PI Channel		100	85	63.41	$44,437.73	$49,992.44	$55,547.16
			TOTAL ANNUAL COST		**$44,437.73**	**$49,992.44**	**$55,547.16**

**$2000/yr maintenance/repair + 100% replacement every 20 years*

BIOMIX with (1) 25 HP Compressor
Electrical

	Application	Compressor Power (HP)	Estimated Operating HP	Operating Kilowatts	Annual Cost @ $0.08/kW-Hr	Annual Cost @ $0.09/kW-Hr	Annual Cost @ $0.1/kW-Hr
	PI Channel	25	17.30	12.91	$9,044.38	$10,174.93	$11,305.48
			TOTAL ANNUAL COST		**$9,044.38**	**$10,174.93**	**$11,305.48**

Current Rate:	**$0.08/kW-Hr**	**$0.09/kW-Hr**	**$0.1/kW-Hr**
BIOMIX YEARLY O&M SAVINGS	**$35,393.34**	**$39,817.51**	**$44,241.68**

20-Year Present Worth Analysis

Current Rate:	**$0.08/kW-Hr**	**$0.09/kW-Hr**	**$0.1/kW-Hr**
DIFFUSED AIR MIXING			
Initial Purchase - None (Existing)	$0	$0	$0
Installation (by others)	$0	$0	$0
Electrical (Power) *	$947,121	$1,065,511	$1,183,901
TOTAL	$947,121	$1,065,511	$1,183,901

BIOMIX			
Initial Purchase Incl. Nozzles, Nozzle Headers, Compressors, Controls	$291,000	$291,000	$291,000
Installation (by others)	$58,200	$58,200	$58,200
Electrical (Power) *	$192,767	$216,863	$240,959
TOTAL	$541,967	$566,063	$590,159

**Present Worth Cost: 20 years, 3% loan rate, 4% energy cost increase/year, 2% maintenance cost increase/year*

	$0.08/kW-Hr	**$0.09/kW-Hr**	**$0.1/kW-Hr**
BIOMIX PRESENT WORTH SAVINGS	**$405,154**	**$499,448**	**$593,743**
PAYBACK PERIOD† (YEARS)	**9.87**	**8.77**	**7.89**

† Difference of respective initial purchase plus installation, divided by yearly O&M savings.

PRICING

It is our intent that this budgetary proposal for the Primary Influent Channels mixing system serves as the basis for a more detailed proposal. **Pricing for the above Scope of Supply is $291,000.**

We trust that you will find this proposal responsive to your needs. Please contact me with any questions.

Respectfully,

Tyler Kunz, P.E.
Vice President of Sales
701 East Bay Street, Suite 502, Charleston SC 29403
tkunz@enviro-mix.com C 262 720 0316; T 843 573 7510

3-136-4
UPGRADE SCUM PUMPING
PROGRESSIVE CAVITY PUMP OPTION

Subject: RE: Scum Pumping
Attachments: FSiP.PDF; NM063--01L Pump Curve.pdf; NM 063 FSIP Drawing.pdf

Option for Netzsch model NM063B-01L07 FSIP progressive cavity pump.

The pump will deliver 100 GPM @ 21 psi(50' TDH) while operating at 200 RPM with a 7.5 hp motor.

Budgetary Price is $13-15K each.

Regards,
Pat Carney

3-136-4
UPGRADE SCUM PUMPING
ROTARY LOBE PUMP OPTION

Subject: RE: Scum Pumping
Attachments: Technical Quote HKZ-B000372878.pdf; T2 08_45_BG_E_CHANNEL_ASSEMBLY_00518ET3ER184TC-W22.pdf

Barry,

I have sent additional information from Netzsch regarding our offering for the Scum Pumps for the Racine Project.

Budgetary price is $20-22K per unit.

Should you have any questions or need additional information do not hesitate to contact me.

Regards,
Pat Carney

Flow-Technics, Inc.

3-136-4
UPGRADE SCUM PUMPING
ROTARY LOBE PUMP OPTION TECHNICAL

Option for Netzsch Rotary Lobe Pump model T2 08/45. Pump will be operating at approximately 350 RPM delivering 100 GPM at 50' (21 psi) TDH with 3" suction & discharge.

I have included the following:

1. Pump curve
2. Drawing
3. Specification

I have requested pricing from factory and as soon as I receive will forward.

Regards,
Pat Carney

Flow-Technics, Inc.
181 Ontario Street
Frankfort, Illinois 60423
Phone (815) 277-2600
Cell (708) 932-5470
Fax (815) 534-5311
www.flowtechnics.com

Energenecs

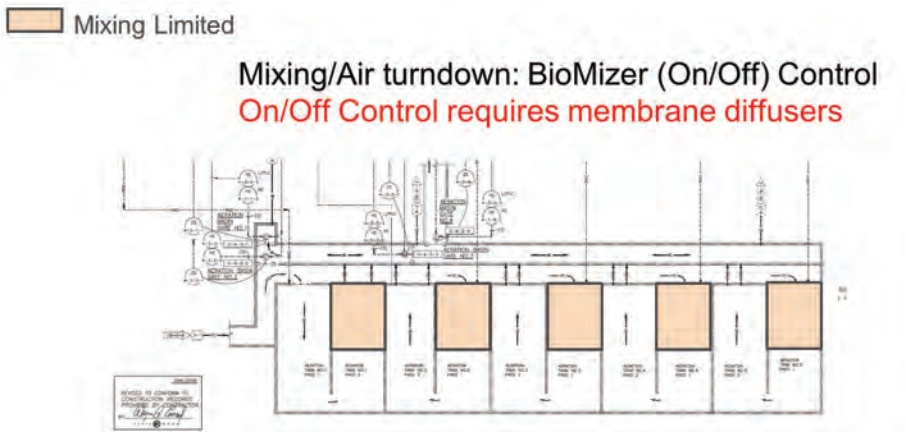
Proposal

ALTERNATIVES 4-139-1,-2,3
AERATION SYSTEM DIFFUSERS

Key Points & Benefits of the proposed solution:

-**Aging Equipment** – The existing aeration system is 30 years old and far exceeds the 20 year expected life. The PVC piping and diffuser supports degrade over time resulting in weakness. The frequency of pipe leaks and breaks may increase over time as this material continues to degrade.

-**Reduced Energy Bills/Energy Efficiency** – A new membrane aeration system with automated feed-forward control is expected to reduce aeration energy consumption as much as 50%, or about $150,000/year of electricity @ $0.09/kw-hr. One of the key benefits of membrane diffusers is the ability to turn off air. When the air is turned off, the membrane acts as a check valve, preventing backflow of liquid into the air system. In contrast, air cannot be turned off to the existing ceramic diffuser system. If air is turned off to a ceramic diffuser, the activated sludge backflows into the diffuser causing plugging and fouling. The ability to turn air off allows for on/off control. This ability is especially important in mixing limited zones such as the final 25% of the aeration basin at the Racine WWTP (see figure below).



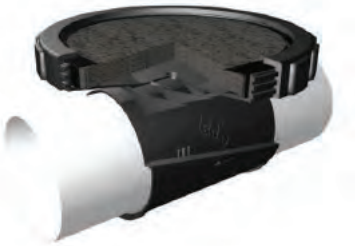
-**Ability for on/off and Biological Nutrient Removal (Phosphorus and Nitrogen)**

-**Focus on Energy Incentive Grants** – This project should qualify for incentive grants to offset some of the capital expense. We project as much as $200,000 in grant funding for this project.

Option 1 Proposal Specifically includes:
Replace in kind. EDI will provide a brand new ceramic system to match the existing.

Aeration System

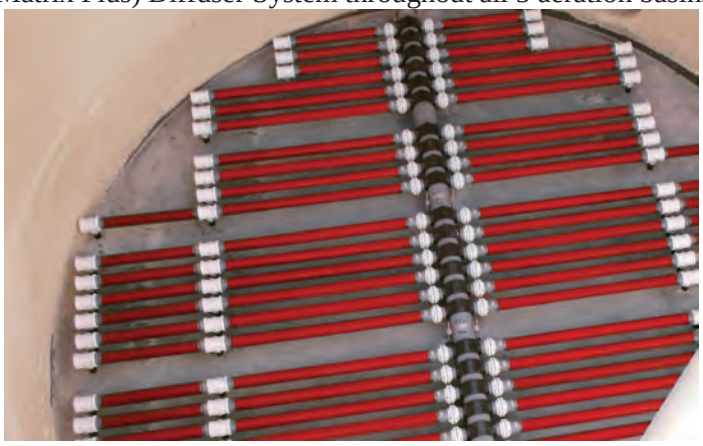
- EDI Ceramic Disc Diffuser System



Budgetary Price: $600,000
Deduct $150,000 if existing diffusers are retained

Option 2 Proposal Specifically includes:
Brand new mini-panel membrane diffuser (Matrix plus) system throughout all 5 aeration basins (10 passes total). The MiniPanel Matrix Plus aeration system will offer improved performance and efficiency compared to the existing ceramic disc system. EDI can adjust this performance to be more efficient or less efficient (if desired for the last zone which is mixing limited) by adding or removing diffusers. Budget price includes all new equipment downstream of the existing drop pipes. Please note that this includes equipment for all 4 zones which may not be necessary if 1 zone will be converted to anaerobic.

Aeration System
EDI Minipanel Membrane (Matrix Plus) Diffuser System throughout all 5 aeration basins (10 passes total)

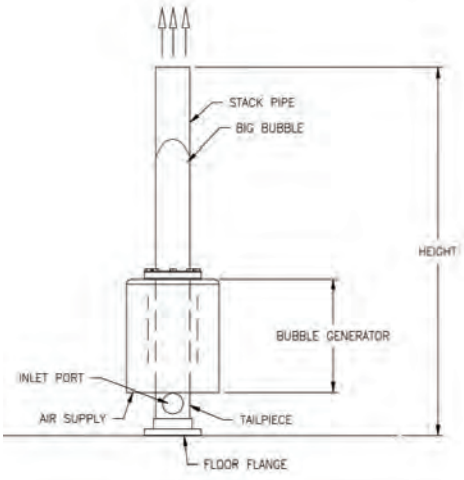


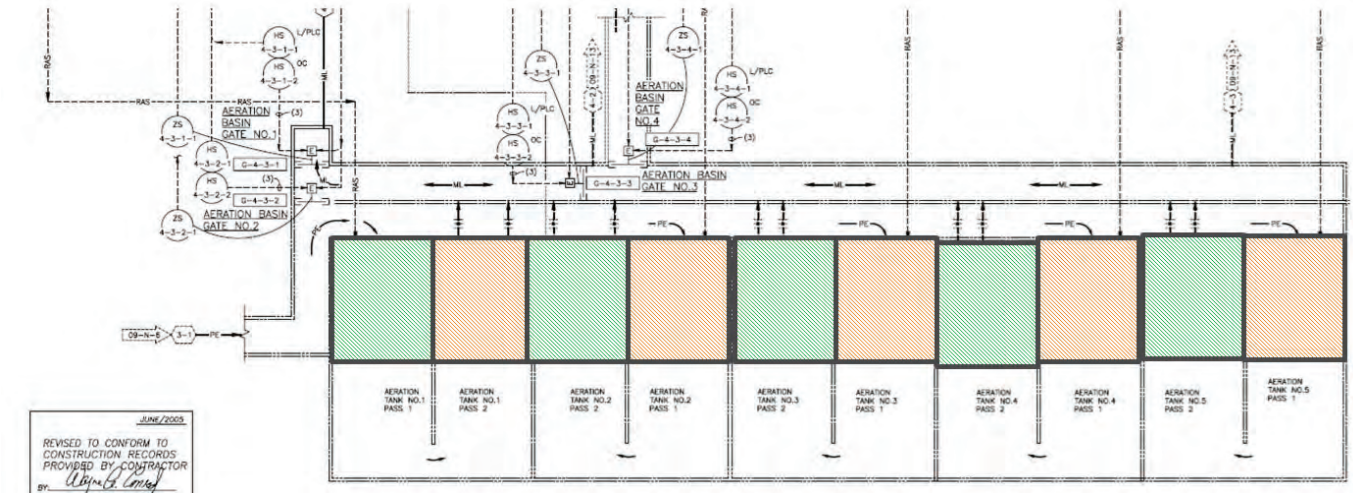
Budgetary Price: $650,000

Aeration Control
Symphony Feed-forward Ammonia or COD-based control
Budgetary Price: $50,000

Mixing

BAB mixers in first 25% (green-swing/anaerobic zone) and last 25% (yellow-mixing limited) zone of each of 5 basins (see below). This includes the BAB mixers only and does not include the airline into the tank to feed the units, anchor bolts, or any valves/controls.





Budgetary Price: $120,000

Pricing Summary

Option 1

New ceramic diffuser system similar to existing: $600,000

Option 2 with Control System

New membrane diffuser system: $650,000
New Control system: $50,000
Total: $700,000
Potential Grants available: $200,000
Net cost after Grants: $500,000
Expected annual electricity savings (Option 2 vs. Option 1): $150,000
Payback period of Option 2 with control system: **3.33 years**
Annual return on investment: 30%

Optional Mixing System for swing zone and mixing limited zones: $120,000
Enables ability for biological nutrient removal (phosphorus and/or nitrogen) and additional energy savings.

PROPOSAL EXCLUSIONS

- Sales tax
- Any system components found to be defective

Notes:

Delivery of Equipment: 12-16 weeks after approval

If you have any technical questions, please give me a call.

Sincerely,

Trevor Ghylin
Energenecs
Mobile: 262-685-6201
Trevor.ghylin@energenecs.com

cc:

Terms & Conditions

PURCHASE ORDER FORMS

Orders submitted on BUYER'S purchase order forms will be accepted only with the express understanding that no statements, clauses or conditions contained in said order form will be binding on the SELLER if they in any way modify the SELLERS Terms & Conditions of sale.

PRICES

Pricing is valid for 30 days from issuance. All prices are F.O.B. factory unless expressly stated otherwise. Prices DO NOT include sales, excise, municipal, state or other government taxes.

ACCEPTANCE

Acceptance of a quotation, whether by a separate purchase order or by other means, shall constitute an acknowledgment of the quotation as written and an acceptance of the Terms & Conditions hereof.

CREDIT APPROVAL

The credit terms specified on the face hereof are subject to SELLERS continuing approval of BUYERS credit and if, in SELLERS sole judgment, BUYERS credit or financial standing is so impaired as to cause SELLER in good faith to deem itself insecure, SELLER may withdraw the extension of credit and require other payment terms.

FORCE MAJEURE

Seller will not be liable for failure to deliver or perform, for any delay in the performance of orders or contracts, or in the delivery or shipment of goods, or for any damages suffered by the BUYER by reason of such delay or failure, when such delay or failure is, directly or indirectly, caused by, or in any manner arises from delays of suppliers or carriers or any other cause or causes beyond SELLER'S control.

PAYMENT

95% payment due on shipment of equipment to job site. 5% due on acceptance of the system. Net 30 days on all invoices. 95% payment must be received before start up can be authorized. Any balance owed by BUYER is subject to a 1.5% per month delinquency charge until paid. FIELD STARTUP SERVICE CANNOT BE AUTHORIZED WITHOUT 95% PAYMENT BEING REMITTED TO SELLER IN ADVANCE OF PERFORMING START UP SERVICES. If no startup is required, 100% payment is due net 30 days from invoice date. BUYERS PAYMENT OBLIGATION IS IN NO WAY CONTINGENT UPON BUYERS RECEIPT OF PAYMENT FROM ANY OTHER PARTY. In addition to all other amounts due hereunder, BUYER shall reimburse SELLER in full for all collection costs or charges, including reasonable attorney fees, which SELLER may incur with respect to the collection of past due amounts from BUYER, including interest on overdue accounts. If BUYER is in default under this or any other agreement with SELLER, SELLER may, at their option, defer performance hereunder until such default is cured. SELLER shall have no obligation to provide factory startup assistance and/or factory training until all invoices (including retentions) for equipment have been paid in full.

WARRANTY

SELLER is a system integrator/manufacturer's representative and, as such, our product guaranty(s) and warranty(s) is set forth in the manufacturer's instruction book or operation and maintenance manual that accompanies each product. SELLER does not offer its customers any warranty or guarantee that would impose upon SELLER greater obligations than those imposed by the manufacturers we represent.

SELLER shall not be liable for any incidental or consequential loss, damage or expense arising directly or indirectly from the use of the product. SELLER shall not be liable for any damages or charges for labor or expense in making repairs or adjustments to the product within the warranty period without prior written approval of SELLER. SELLER shall not be liable for any damages or charges sustained in the adaptation or use of its engineering data or services.

SELLER makes no warranties, expressed or implied, except as set forth in such standard Terms & Conditions of sale in this agreement. No claims of any kind shall be greater in amount than the purchase price of the SELLER'S products in respect of which such claims are made. SELLER is not liable in any event hereunder for any consequential, incidental or liquidated damages or penalties. IN ANY CASE SELLER SHALL NOT BE LIABLE FOR FIELD WORK BY STAFF OTHER THAN

THE SELLER UNLESS EXPRESSLY AUTHORIZED IN WRITING, IN ADVANCE, BY THE SELLER. THIS IS IN SPECIFIC REGARD TO BACK CHARGES.

BUYER agrees to reimburse SELLER for ALL expenses incurred in servicing a warranty request if the cause of the warranty request is determined to be other than a manufacturer's defect or failure of a SELLER supplied component.

CLAIM PERIODS

All goods are shipped at the risk of the buyer after they have been delivered by SELLER to the carrier. BUYER shall immediately inspect said equipment upon receipt of equipment and any damage must be noted on the freight carriers bill of lading at time of receipt. SELLER is not liable for any shortages or non-conformance unless notified thereof by BUYER within 10 days after BUYERS receipt of said equipment.

CHANGES, CANCELLATIONS, RETURNS

All requests for changes, cancellations and/or returns must have prior written approval and are conditional on manufacturers cancellation/return policies and subject to a restocking and/or service charge for order handling, inspection, reconditioning and repackaging, as required. Authorized returned goods must be packaged and shipped prepaid to manufacturer. Products more than six (6) months old cannot be returned for credit. Terms and conditions stated herein shall also govern and be binding to all BUYER requested/approved change orders.

SELLER shall retain a security interest in the equipment until the full purchase price has been paid. BUYER'S failure to pay any amounts when due shall give SELLER the right to possession and removal of the equipment at any time upon giving at least ten (10) days prior written notice. SELLER'S taking of such possession shall be without prejudice to any other remedies SELLER may have. Title to the equipment shall transfer to the BUYER upon shipment from SELLER.

SUBMITTAL DRAWINGS & OPERATION/MAINTENANCE MANUALS

Submittal drawings and operation & maintenance documentation is provided in accordance with plan documents.

THE SELLER RESERVES THE RIGHT TO REVIEW AND REVISE THIS PROPOSAL AFTER THIRTY DAYS FROM ISSUANCE.

By: Energenecs, Inc. Trevor Ghylin

I accept this proposal and all terms thereof:

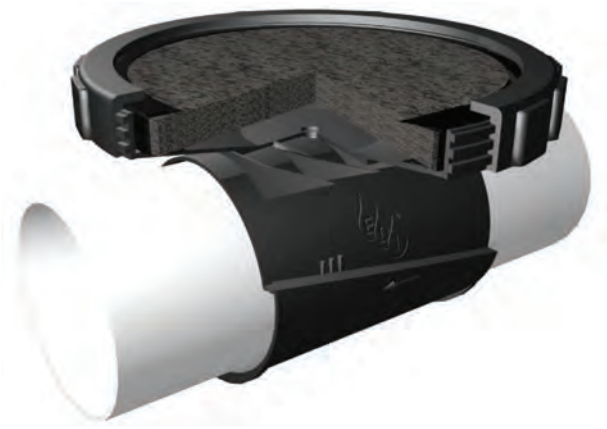
Accepted: _____

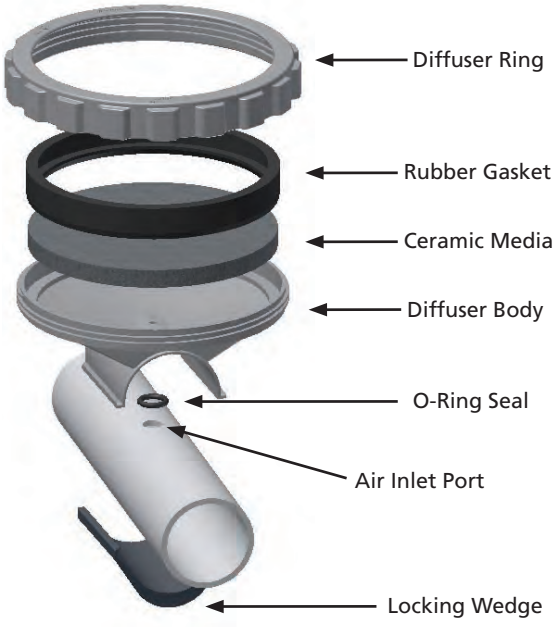
Title: _____

Date: _____ PO #: _____

PRODUCT
SPECIFICATIONS

Ceramic Disc Diffuser
Fine Pore Rigid Media Technology





- Glass-fiber-reinforced polypropylene diffuser body for maximum chemical, temperature, and UV resistance
- Saddle mount diffuser provides ease of installation/maintenance along with maximum strength
- Aluminum oxide ceramic media
- Compatibility with in-situ acid (liquid and gas) cleaning systems
- Fits 3", 4", 90 mm, and 110 mm pipe sizes for design/install flexibility
- Mounts on any pipe material (PVC, ABS, CPVC, SS, etc.)
- Non-blowout gasket with Chevron EZ-Seal™

METRIC				
Diffuser Type	Design Airflow	Overall Diameter	Active Surface Area	Dry Weight
	m^3_N/h	mm	m^2	kg
9" Ceramic	0–16	277	0.038	2.6

ENGLISH				
Diffuser Type	Design Airflow	Overall Diameter	Active Surface Area	Dry Weight
	scfm	in	ft^2	lb
9" Ceramic	0–10	10.9	0.41	5.6

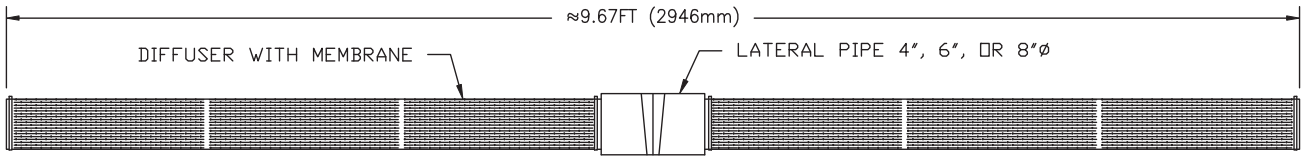
- Optimum oxygen transfer efficiency is achieved when operating in the middle to low end of the airflow range. The approximate operating pressure of the diffuser at the mid-range is 13 to 16 inches (3.2–4.0 kPa).
- Operating the unit at the high end of the range will result in reduced SOTE performance and increased operating pressure. Use the maximum airflow value for short-term operations such as peak loads or system maintenance.
- Short-term operation (peak conditions) up to 2x design flow.

PRODUCT
SPECIFICATIONS

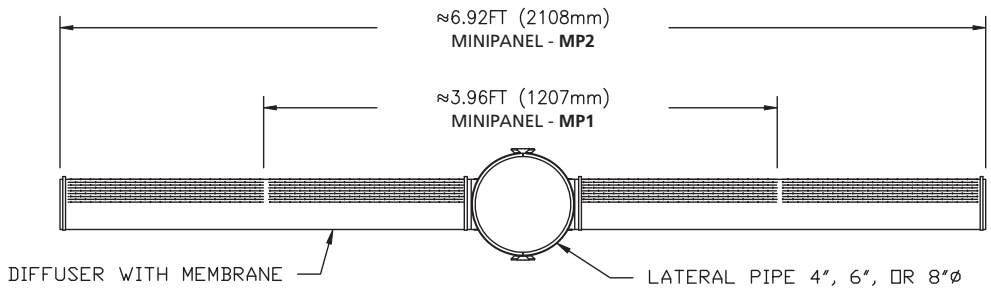
FlexAir™ MiniPanel
MP1, MP2, & MP3

- Fits 4", 6", 8", 110 mm and 160 mm air piping—plastic or stainless steel
- PVC construction for maximum chemical & UV resistance, and optional CPVC for maximum temperature resistance
- NanoPore™ and MicroPore™ perforation options available to match oxygen transfer, airflow and operating pressure requirements
- Simplex (single-arm) and Duplex (two-arm) configurations possible
- Horizontal projected diffuser area for maximum OTE performance. System geometry supports high-density installations of over 65% floor coverage
- Non-buoyant & cantilever design for reduced stress on mounting connections and for water cooling
- Advanced technology premium-quality membranes available in EPDM, polyurethane, PTFE Matrix™ and others

PLAN VIEW OF MINIPANEL - **MP3 DIFFUSER UNIT**



SIDE VIEW OF MINIPANEL - **MP1 & MP2 DIFFUSER UNIT**



METRIC						ENGLISH					
Diffuser Type	Perforation Type	Design Airflow m^3_N/h	Active Surface Area m^2	Operating Buoyancy kg	Dry Weight kg	Diffuser Type	Perforation Type	Design Airflow scfm	Active Surface Area ft^2	Operating Buoyancy lb	Dry Weight lb
MP1	Nano	0–4	.082	1.18	2.13	MP1	Nano	0–2.5	.88	2.6	4.7
	Micro	0–10	.082	1.18	2.13		Micro	0–6.5	.88	2.6	4.7
MP2	Nano	0–8	.164	1.74	3.42	MP2	Nano	0–5	1.76	3.85	7.55
	Micro	0–20	.164	1.74	3.42		Micro	0–13	1.76	3.85	7.55
MP3	Nano	0–13	.246	2.29	4.71	MP3	Nano	0–8	2.64	5.05	10.4
	Micro	0–32	.246	2.29	4.71		Micro	0–20	2.64	5.05	10.4

- * Values listed are per tube unless noted
- * For high-capacity units, active area & air capacity doubled.
- Optimum oxygen transfer efficiency is achieved when operating in the middle to low end of the airflow range.
- The approximate operating pressure of the diffuser at the mid-range is 13 to 16 inches (3.2–4.0 kPa).
- Operating the unit at the high end of the range will result in reduced performance and increased operating pressure.
- Use the maximum airflow value for short-term operations such as peak loads or system maintenance.
- Short-term operation (peak conditions) up to 2x design airflow.

MATRIX PLUS™

Project Number: 60554970

advancements in
aeration membrane technology

High–efficiency
PTFE-embedded
membranes

Extensive testing along with 20 years of polyurethane (PU) application history

- PTFE MATRIX™ technology for added mechanical, chemical and thermal performance
- Highest temperature rating of any polyurethane panel membrane on the market
- Proven performance in aggressive chemical applications
- Reduced organic and inorganic fouling, leading to reduced energy consumption

Environmental Dynamics International

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visit www.EnvironmentalDynamics.com for more information

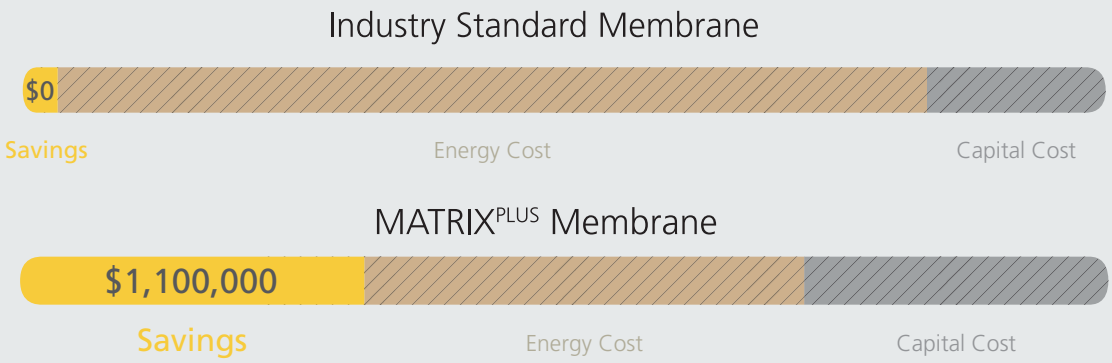
MATRIX PLUS™

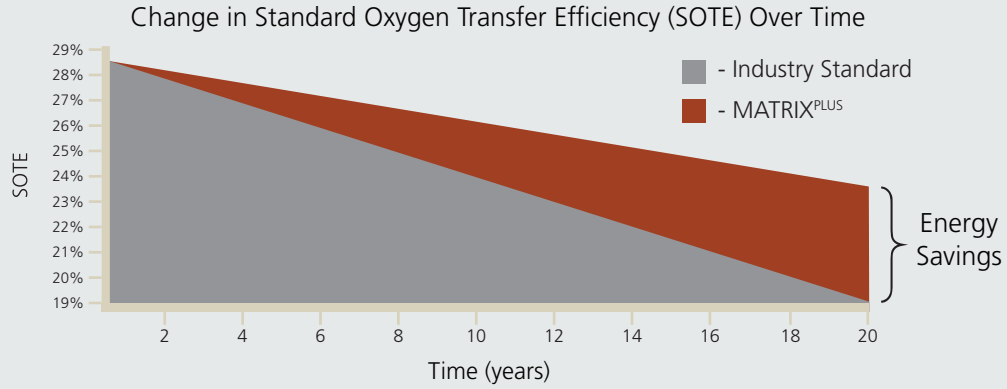
Save Energy, Save Money

Savings are based on a 5 MGD (19,000 m³/day) municipal sewage treatment plant (with a typical system life of 20 years, and anticipated membrane replacement maintenance every 10 years). EDI's MATRIX^{PLUS} membrane is not only more efficient in delivering the functionality you need, but the membranes are 35% more resistant to fouling. This saves you energy, maintenance time and downtime, which saves you money.

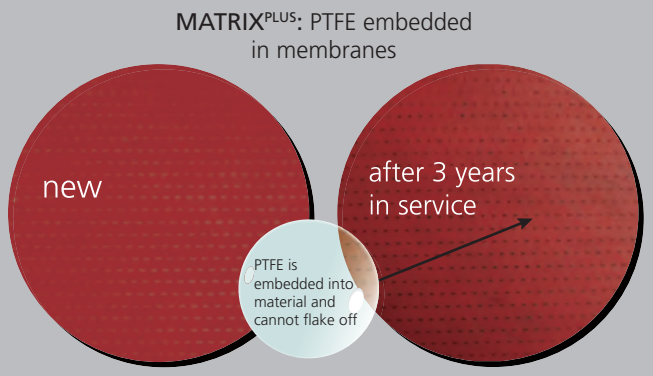
Energy savings

Costs and Savings over 20 years

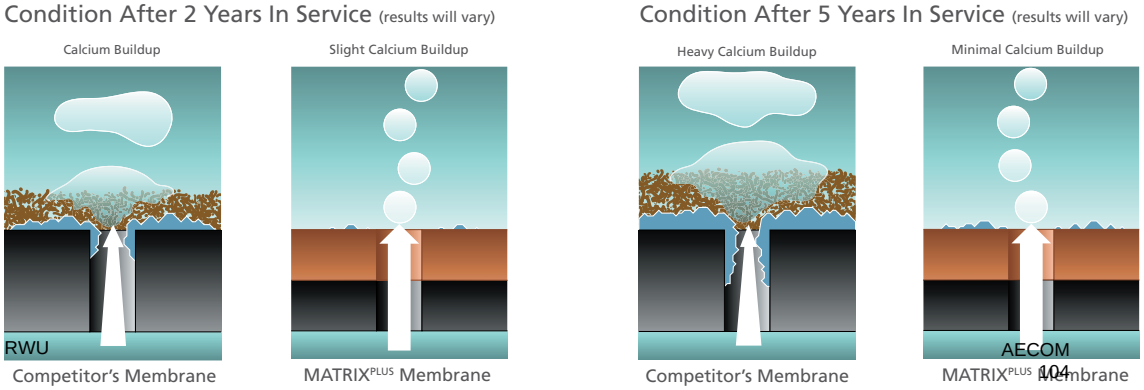




PTFE THAT WILL NEVER WEAR OFF



Fouling resistance



BAB™ Big Bubble Mixers

Advanced Geyser Technology

1. EDI Big Bubble Mixers are engineered to deliver maximum mixing performance, particularly in process applications where minimum O2 transfer is desired.

   BAB™ bubble size is engineered with typical gas bubble volumes of:

   Model 4 = 2 to 3 ft³ **Model 6 = 3 to 4 ft³**

   Selection of the proper model mixer along with the simplified process control on BAB™ advanced Geyser mixing technology delivers maximum flexibility of operation.

2. EDI Big-Bubble technology is specifically designed to mix with minimum O2 transfer to the surrounding liquids for anoxic and anaerobic mixing applications.

3. Low pressure operation using existing aeration blowers.

4. BAB™ mixers incorporate engineered siphon technology to create intermittent bubble release.
   a. Discharge frequency is proportional to the supplied airflow
      (Note: the big bubble volume remains constant, only frequency changes)
   b. Discharge rates are typically one discharge in five minutes up to about 30 discharges/min.

5. Diameter and length of ejection (discharge) pipes to optimize either mixing or pumpage capability.

6. Simple controls! Only airflow to the mixing system is controlled, orifices distribute air to the individual mixers.

7. No complicated stainless-steel piping required for BAB™ systems.

8. BAB™ mixers create 4 synergistic mixing regimens:
   a. Direct pumpage lifts basin contents from near the floor to top of tank providing vertical mixing exchange.
   b. Secondary induced flow enhances total liquid circulation with submerged vertical pumpage creating multiples of the direct flow liquid circulation. Deeper the discharge the greater the secondary circulation velocity and volume.
   c. Bubble bursts create localized turbulence and non-laminar flow.
   d. Interfering current mixing from staggered release of big bubbles from adjacent unit pumpage zone interfaces generate eddy current mixing

BAB™ Big Bubble Mixers

Advanced Geyser Technology

9. Mounting techniques
    a. Fixed-to-floor standard
    b. Suspended from floating laterals for special applications.

10. Best value big bubble mixing system
    a. Economical capital cost.
    b. Low energy consumption.
    c. Easy installation.

11. Install and discharge at any depth *(typical minimum depth is 5 to 6 feet)*
    a. Unit typically mounted on the floor for maximum performance. Maximum depth is only limited by operating pressure of the air supply.
    b. Submergence of the discharge tube can be controlled to deliver significant pumpage and significant bubble displacement.
    c. Mixing is enhanced with greater depth

12. Integrated design

BAB™ technology is specifically engineered to be integrated with diffuser systems in biological process applications. EDI big bubble mixers use air from the same air supply as aeration diffusers simplifies the overall piping vs. those systems which need special air supply, special piping, and valve actuators or high-pressure compressors.

13. Excellent for conventional mixing/pumping applications:
    a. Flow equalization.
    b. Channel mixing.
    c. Lake de-stratification.
    d. Special air lift and liquid transfer projects.

Smart Instrument(s)

composites enduro

WATER & WASTEWATER PRODUCTS

FRP Launder Cover Systems

Corrosion Resistance Superior Strength Long Service Life

Controlling growth of algae formed in the clarifier effluent stream is a challenge for today's modern water and wastewater treatment plants. Left unchecked, algae can change hydraulic dynamics of clarifiers by obstructing weir design features typically found in v–notched weir configurations.

Furthermore, at plants utilizing newer ultraviolet disinfection technology, larger algae strands tend to dislodge and move downstream through the plant to substantially cover UV bulbs making them ineffective and eventually may cause the expensive bulbs to fail all together.

Improving operations, Enduro Launder Covers prevent algae growth plus act as a weather and debris barrier for the launder. In addition, the covers contain odor and gas emissions associated with water and wastewater treatment operations.

Enduro Launder Covers consist of multiple, high strength sections fabricated to the contour of the clarifier or tank. Each section extends from the tank wall inward over the launder and weir to the scum baffle. With superior corrosion resistance and strength, use of FRP components ensures long, maintenance–free service life.

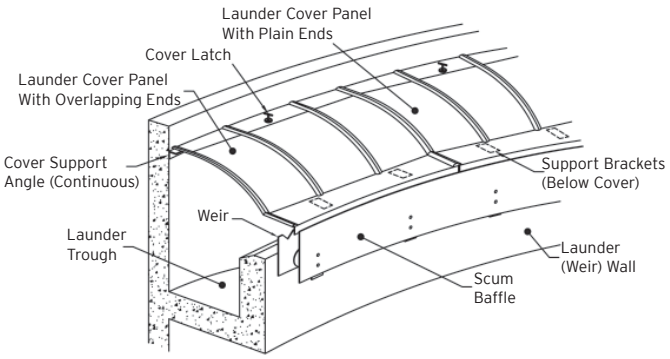
Fiberglass launder covers from Enduro Composites are custom designed for both round and rectangular tanks and provide important value for water and wastewater operations:

- Continuously inhibit algae growth
- Light weight cost effective solution
- Safe, reliable and efficient
- Operable access for inspections and maintenance
- Odor and vapor containment
- Long, reliable service

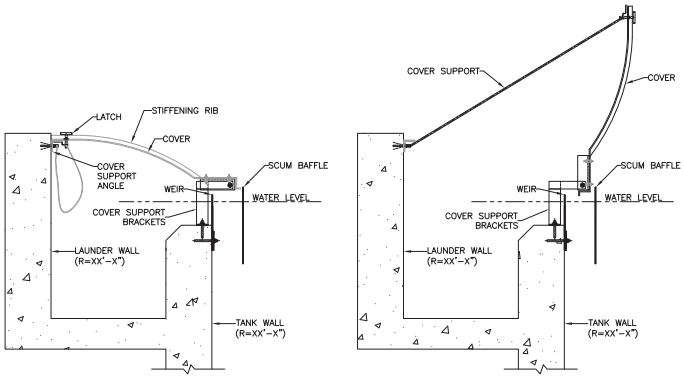
The FRP launder cover system inhibits (direct) sunlight from reaching the elevated growth areas at the clarifier launder and weir by forming a continuous protective environment above the effluent stream. Once installed, the system provides an attractive yet extremely low maintenance, passive structure designed to eliminate algae growth issues.

Additional benefits of the system help to prevent windblown debris like leaves, plastic bags, etc. from entering the stream and may also help to contain localized odors if present in the effluent trough – weir area.

LAUNDER COVER SYSTEM – PERSPECTIVE VIEW



LAUNDER COVER ARRANGEMENT



CLOSED POSITION OPEN POSITION

16602 Central Green Blvd.
Houston, TX 77032
sales@endurocomposites.com

Tel: 800.231.7271 | 713.358.4000
Fax: 713.358.4100
www.endurocomposites.com

SPECIFICATIONS: FIBERGLASS REINFORCED PLASTIC (FRP) LAUNDER COVER

PART 1 – GENERAL

1.01 Description of Work

The work covered by this section shall include materials and installation for the fiberglass reinforced plastic (FRP) Launder Cover Panel System, which includes but is not limited to FRP Launder Cover panels, FRP or stainless steel support brackets, stainless steel fasteners and connections.

1.02 Design Criteria

A. The FRP launder cover system and associated FRP or stainless steel component material shall comply with ANSI/AWWA Standards as applicable for water or wastewater treatment applications.
B. Unique design features incorporated into the size and mounting location of the FRP launder cover system work in conjunction with clarifier configuration to maximize coverage of the affected areas.
C. FRP Launder cover system structural arched design shall be able to support its own weight plus snow and wind loads after installation when the tank is full or empty.

1.03 Design Parameters

The manufacturer relies on the following critical information to provide an accurate arrangement for the design of the launder cover system to function as intended. Actual design requirements, which vary from plant to plant with process, must be established for each application.

Standard Design Parameters (Imperial or Metric):

Tank design (internal or external launder) = _____
External launder wall inner radius = _____
Launder trough width = _____
Internal launder wall width = _____
Internal (weir) wall inner radius = _____
Scum baffle offset from weir = _____
External launder wall top elevation = _____
Internal (weir) wall top elevation = _____
Weir top elevation = _____
Scum baffle top elevation = _____
Water surface elevation = _____
Known obstructions = _____

PART 2 – PRODUCTS

2.01 Manufacturer(s)

A. Standard design and characteristics shall be based on materials and components provided by Enduro Composites, Inc., Houston, TX (713) 358-4000, www.endurocomposites.com.

2.02 Materials

A. FRP Launder cover panels and appurtenances shall be fiberglass reinforced plastic molded to produce uniform smooth surfaces and shall be consistent with environmental and structural conditions present for a particular application. The cover shall be resin rich, free of voids and porosity, without dry spots, crazes or unreinforced areas and shall provide for increased corrosion resistance. Launder cover panels shall include structural glass fiber reinforcements 30% (minimum) by the material weight embedded within UV stabilized Type 1 – Polyester or Isophthalic polyester resin for additional corrosion protection. FRP laminate shall have a minimum 20 mil marine grade gelcoat top surface and a resin rich hot coat bottom surface after a light sanding. Color shall be standard light grey or white. Factory cut edges and drilled holes shall be sealed with ANSI approved material.

B. FRP Launder Cover panels shall exhibit these minimum properties:

Tensile Strength	12,000 psi	ASTM D 638
Flexural Strength	20,000 psi	ASTM D 790
Flexural Modulus	1.0 x 10^6 psi	ASTM D 790
Izod Impact (Notched)	12.0 ft-lb/in	ASTM D 256
Water Absorption	.20% maximum	ASTM D 570
Barcol Hardness	40	ASTM D 2853
Coef. of Thermal Expansion	10.5 x 10^{-6} inch/inch ^{0}F	ASTM D 696

C. FRP Launder Cover Panels
a. Nominal panel size is 1/4" thick x 4 feet long (minimum) x "width" generally described as the unobstructed distance extending from the external tank wall across the effluent trough and weir area to the scum baffle without interfering with the clarifier mechanism or as otherwise indicated on the drawings.
b. The cover system shall be designed and molded of UV protected fiberglass-reinforced polyester resin composite laminate opaque to sunlight.
c. Cover consists of individual adjacent panels that fit together side by side thus forming a continuous rigid structure to inhibit incident (direct) sunlight from reaching the effluent launder and weir area.
d. The cover shall match the tank curvature (if round) or straight (if rectangular) as shown in the drawings.
e. Cover supports shall be located and made in such a manner to hold the panels securely in place yet pivot to provide access to the launder and weir for inspection and maintenance.
f. Designed to withstand common wind and snow loads (if applicable), the cover shall not be intended as a "walk-on" cover capable of supporting the weight of plant personnel.
g. Cover design as shown or intended in the contract documents, shall open away from or toward the operator yet ultimately may depend on certain qualities or parameters associated with a particular tank configuration.
h. Provide a means to restrain the cover from opening in the closed position or closing from the open position and also limit the travel of the operable section to avoid interfering with the clarifier mechanism.
i. Where the trough is interrupted by a bridge-support or another obstacle, provide a fixed panel(s) around the support to ensure the surface of the cover remains continuous around the entire tank. Alternatively, vertical panels may be installed on both sides of the bridge supports to block out sunlight.
j. All panel edges, mounting holes and top surface lap holes shall be factory drilled and sealed with resin unless otherwise noted or directed by the manufacturer for field modification on the approved installation drawings.

D. Hardware
a. Fasteners, anchorage, and other structural hardware shall be stainless steel provided by the manufacturer:
_____304 Stainless Steel _____316 Stainless Steel
b. Cover panel fasteners shall be nut and bolt type assembly with washers and lock washer.
c. Mounting anchors shall be expansion (wedge) type or adhesive type (sized as required).

PART 3 – EXECUTION

3.01 Installation

A. Installer shall erect the FRP cover panels according to sequence shown or stated on the approved installation drawings. Cover panels shall be properly aligned by the installer at all mounting and connection conditions to form a professional looking rigid structure.
B. Unless specifically shown or stated on the approved installation drawings, field modifications of any kind (cuts, copes, holes, etc.) are expressly prohibited without proper notification of the issue and a corrective action approved and authorized by the engineer. Only then will modifications be allowed as directed by Enduro Composites.
C. Installer shall seal all field cut edges and drilled holes with an approved material.
D. Install additional miscellaneous components or hardware as shown on the approved drawings.

LAUNDER COVER SYSTEMS

LAUNDER COVER SYSTEMS

BENEFITS

- Inbibits algae growth
- Contains odors
- Operates 24/7
- Reduces manpower
- Maintenance free

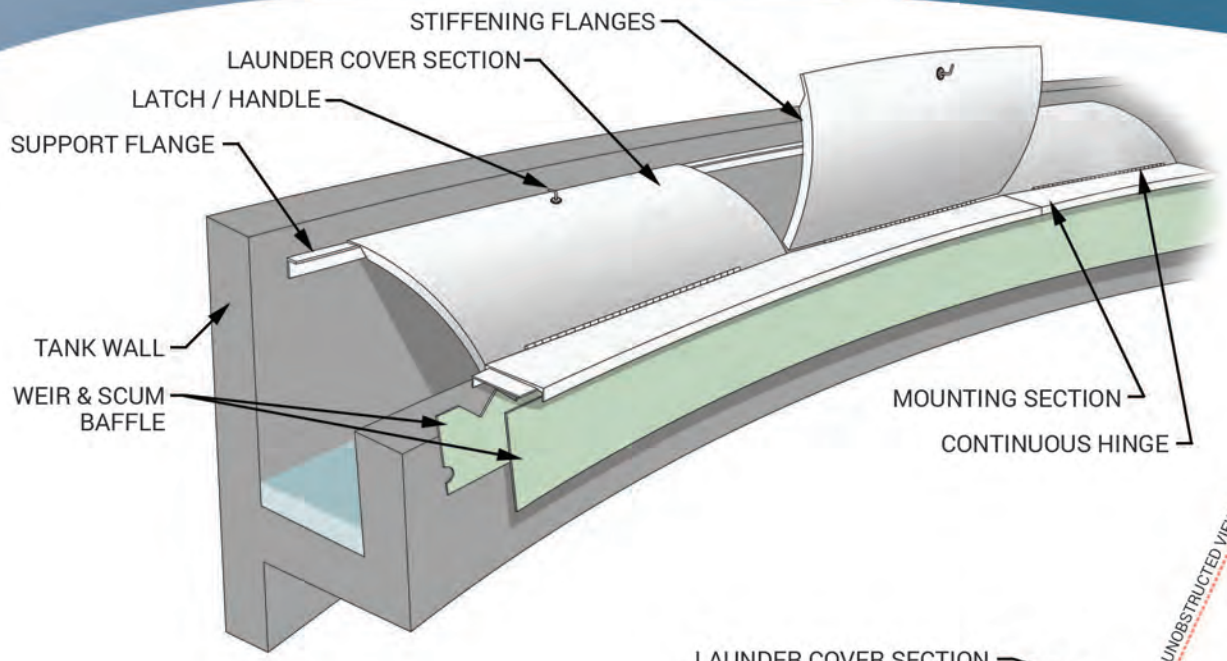
FEATURES

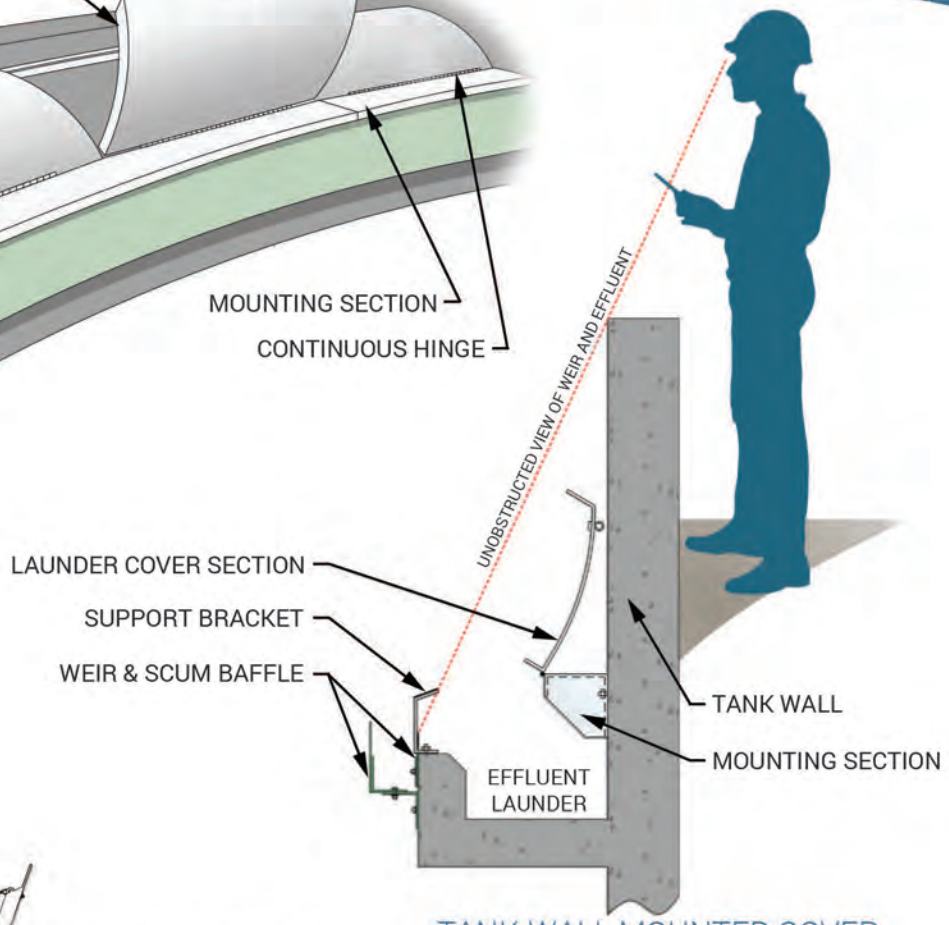
- Hinged cover panels open toward tank center
- Stainless steel latch/handle for safety and security
- Large horizontal projection
- Upper & lower vent opening

NEFCO

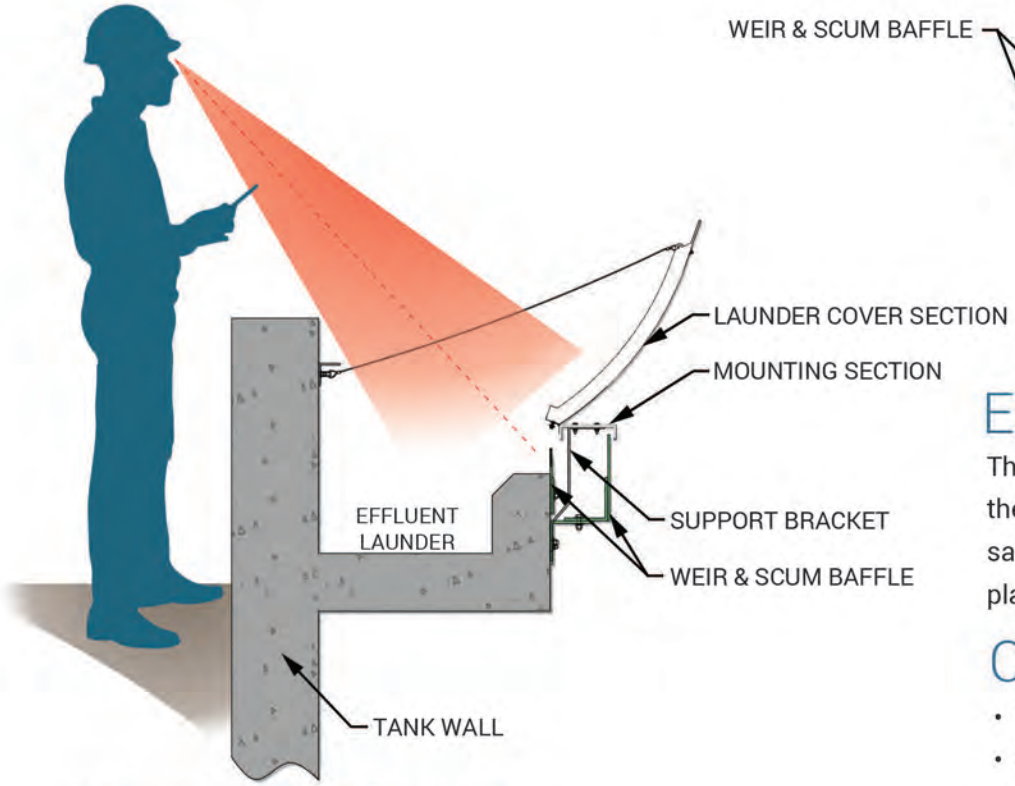
THE CLEAR DIFFERENCE.

REVOLUTIONIZING THE WAY TREATMENT PLANTS DEAL WITH ALGAE





TANK-WALL MOUNTED COVER



WEIR-WALL MOUNTED COVER

ELIMINATE ALGAE

The Covers are passive, yet they work around the clock to inhibit algae in clarifier launders, saving thousands of man-hours of treatment plant labor every day.

COVER PRODUCTS

- Tank-wall mounted
- Weir-wall mounted
- Walk-On covers
- Inboard launder
- Dual inboard launder
- Channel covers
- Peripheral fee open

For more information visit our web site www.nefco.us

Patent No. 6,712,222
Patent No. 7,473,358
Patent No. 7,591,381
Patent No. 9,174,148

NEFCO Systems, Inc.
8895 N Military Trail, Suite 100C
Palm Beach Gardens, FL 33410
(561) 775-9303

2019

Klepp, Barry

From: George Argiris <GArgiris@drydon.com>
Sent: Monday, February 24, 2020 8:20 AM
To: Klepp, Barry
Cc: George Argiris; Paul Schuette
Subject: Drydon - 20B004 Enduro Budget - AECOM - Racine WI - Launder Covers
Attachments: Enduro Launder Cover_Data Sheet_web_03-01-19.pdf; DRAFT 20B004-Racine, WI-(Effchnl) BUDGET Enduro FRP Scope of Product (REV0) (02212020).docx

Importance: High
Sensitivity: Confidential

Per your request – see the information from Enduro for the clarifier launderer covers. Please let me know how we can further assist.

From: Flavio Ortiz <FOrtiz@Endurocomposites.com>
Sent: Friday, February 21, 2020 5:32 PM
To: George Argiris <GArgiris@drydon.com>
Cc: Jonathan Orta-Carrizales <jorta@endurocomposites.com>; Francisco Alvidrez <FAlvidrez@Endurocomposites.com>
Subject: FW: 20B004 Enduro Budget for Drydon - AECOM - Racine WI - Launder Covers
Importance: High
Sensitivity: Confidential

George,

Thanks for your patience on receiving the attached on the consolidated package with overall pricing below. See below for the breakouts for each option proposed.

3 ea – 85 ft FC effluent channel covers – with no scum baffle = $118,666

3 ea – 90 ft. FC effluent channel covers – with scum baffle = $122,896

3 ea – 93 ft. FC effluent channel covers – with no scum baffle = $126,936

From: Bob Strack
Sent: Friday, February 21, 2020 3:50 PM
To: Flavio Ortiz
Cc: Jonathan Orta-Carrizales; Kevin Schmit
Subject: 20B004 Enduro Budget for Drydon - AECOM - Racine WI - Launder Covers
Importance: High
Sensitivity: Confidential

Flavio/Jonathan/Kevin:
Remember to thank George at Drydon for the opportunity.

Here's a draft budget scope and estimate for Racine, WI (WWTP) FRP launder covers as requested along with our LCR data sheet.
The budget was developed from email information (attached) without specs or drawings.

According to the emails from the engineer, the clarifiers are peripheral feed with dual channels located at the tank wall (influent outer and effluent inner) with a concrete dividing wall between them.
While speaking with the engineer (Barry Klepp) earlier, I mentioned possibly quoting the cover over both troughs around all tanks.

Instead, we are only quoting a cover over the inner effluent troughs of each base on his request.
I've included this as a clarification in the scope.

We've quoted 9 tanks total – 3 at 85ft OD, 3 at 90ft OD, and 3 at 93ft OD.
Separate EC price sheet for each PLUS A combined sheet for all 9 tanks.
316 SST hardware and fasteners are included.
NO FREIGHT INCLUDED but I did give a freight price for each shipment on the scope.
Scope PDF will need to be made and sent once you've price it out.

Server link:
\\svr-cgb\Clarifiers\CP BIDS\2020 QUOTES\2020 BUDGETS\20B004-Racine, WI (Budget 9 LCR) (2-21-2020)\+Budget Package

I'll give George a call and let him know you're finishing it up.
Let me know if we need anything.
Once you've finalize this, place final copy in the server folder.
Contact me if you have questions. Thanks

Best regards,
Bob Strack
Mobile 772-205-4482
TF: 888-550-4784
Main: 281-921-9002
Fax 281-921-9100
www.endurocomposites.com
bstrack@endurocomposites.com

Klepp, Barry

From: Dale Storm <Dale.Storm@petersonandmatz.com>
Sent: Thursday, February 20, 2020 4:18 PM
To: Klepp, Barry
Subject: Aluminum Launder cover

Budget pricing for this application is as follows:

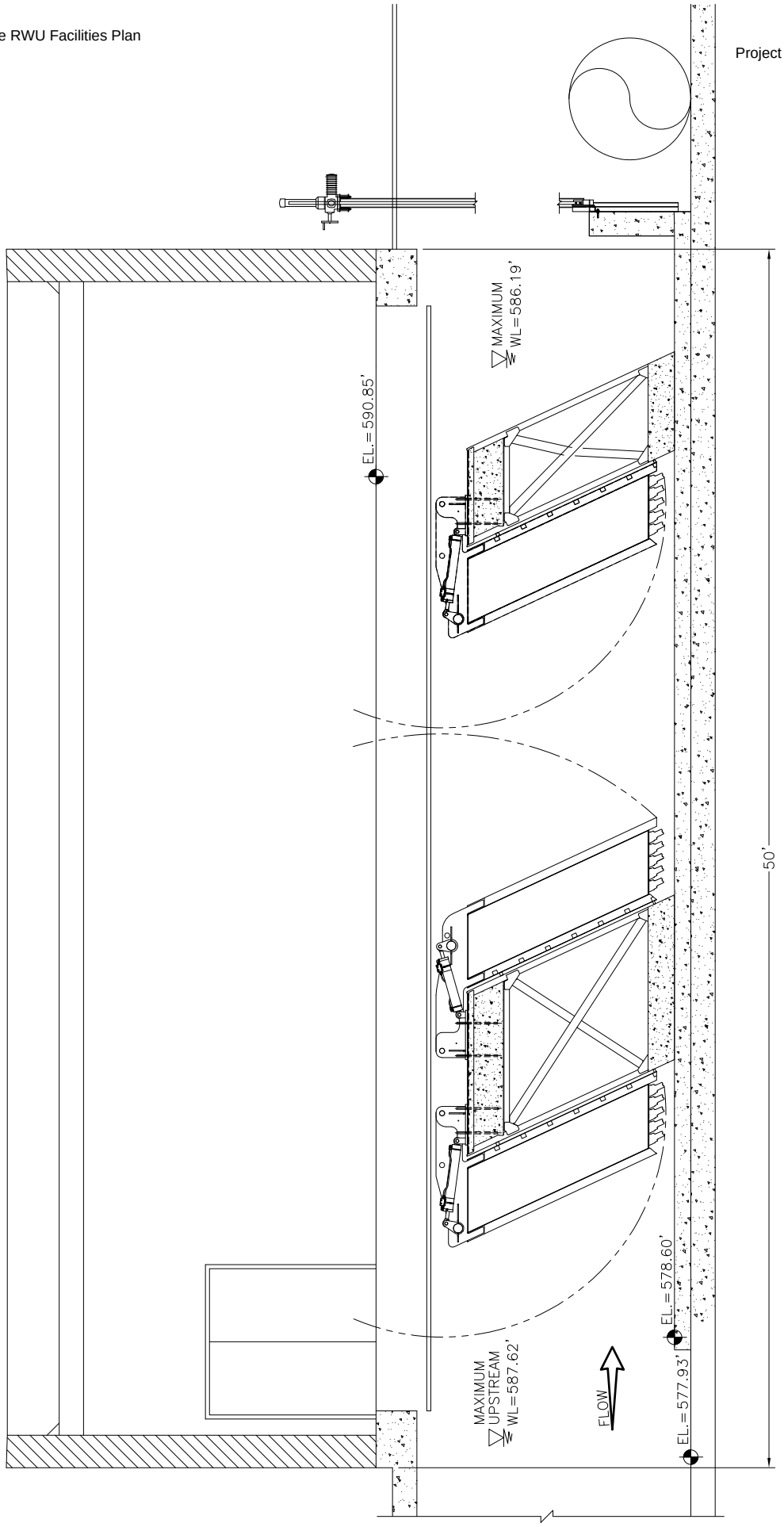
- One 85-ft. diameter Launder cover (Materials Only) - $ 130,250 FOB Jobsite

Please call with any questions or comments.

Regards,

Matthew Sumbera
Ultraflote LLC
3640 W. 12th St.
Houston, TX 77008

Dale W. Storm
Peterson & Matz, Inc.
2250 Point Blvd
Suite 300
Elgin IL 60123
(847) 844-4405 Phone
(847) 844-4409 fax
(847) 624-5228 cell
Dale.storm@petersonandmatz.com


MAXIMUM
WL=586.19'
EL.=590.85'
50'
EL.=578.60'
EL.=577.93'
MAXIMUM
UPSTREAM
WL=587.62'
FLOW

6-160-1
UV DISINFECTION SYSTEM

PROPOSAL FOR RACINE REPLACEMENT, WI
QUOTE: 221318
08/20/2019

TrojanUVSigna™ incorporates revolutionary innovations, including TrojanUV Solo Lamp™ technology, to reduce the total cost of ownership and drastically simplify operation and maintenance. It is the ideal solution for facilities wanting to upgrade their disinfection system easily and cost-effectively.

We are pleased to provide the enclosed TrojanUVSigna proposal. Please do not hesitate to contact us if you have any questions regarding this proposal. We look forward to working with you.

With best regards,

3020 Gore Road
London, Ontario N5V 4T7
Canada
(519) 457 – 3400
uduncan@trojanuv.com

Local Representative:

Dale Storm
Peterson & Matz, Inc.
(847) 844-4405

DESIGN CRITERIA

Peak Design Flow:	**108 MGD(US)**
UV Transmittance:	**65%** (minimum)
Total Suspended Solids:	**25 mg/l (30 Day Average,** grab sample)
Disinfection Limit:	**400 Fecal Coliform per 100 ml**, 30 day Geometric Mean of consecutive daily grab samples

DESIGN SUMMARY

CHANNEL (Refer to Trojan layout drawing for complete details)	
Number of Channels:	**3**
Minimum Channel Length Required:	**~20' (not inlcluding level control area)**
Channel Width at UV Banks:	**5.1'**
Channel Depth Recommended:	**7.8'**
UV BANKS	
Number of Banks per Channel:	**4**
Number of Lamps per Bank:	**22**
Total Number of UV Lamps:	**264**
Maximum Duty Power Draw:	**278 kW**
UV PANELS	
Power Distribution Center Quantity:	**6**
Hydraulic System Center Quantity:	**3**
System Control Center Quantity:	**1**
ANCILLARY EQUIPMENT	
Level Controller Quantity and Type:	**3 Fixed Weirs**
Integral Bank Walls:	**Included**
On-line UVT Monitoring:	**Hach UVAS sc Sensor (Optionally Available)**
Other Equipment:	
ELECTRICAL REQUIREMENTS	
1. Each Power Distribution Center requires an electrical supply of one (1) 480V, 3 phase, 4 wire + GND, 50/60 Hz, 46.80 kVA **2.** Electrical supply for Hydraulic System Center will be (1) 480V, 3 phase, 3 wire + GND, 60 Hz, 2.5 kVA **3.** Electrical supply for System Control Center will be (1) 120V, 1 phase, 2 wire + GND, 60 Hz, 1.8 kVA **4.** Electrical disconnects are not included in this proposal. Refer to local electrical codes	

COMMERCIAL INFORMATION

Total Capital Cost: ~~$1,475,000~~ (USD) $1,700,000 - Dale Storm 4/23/20

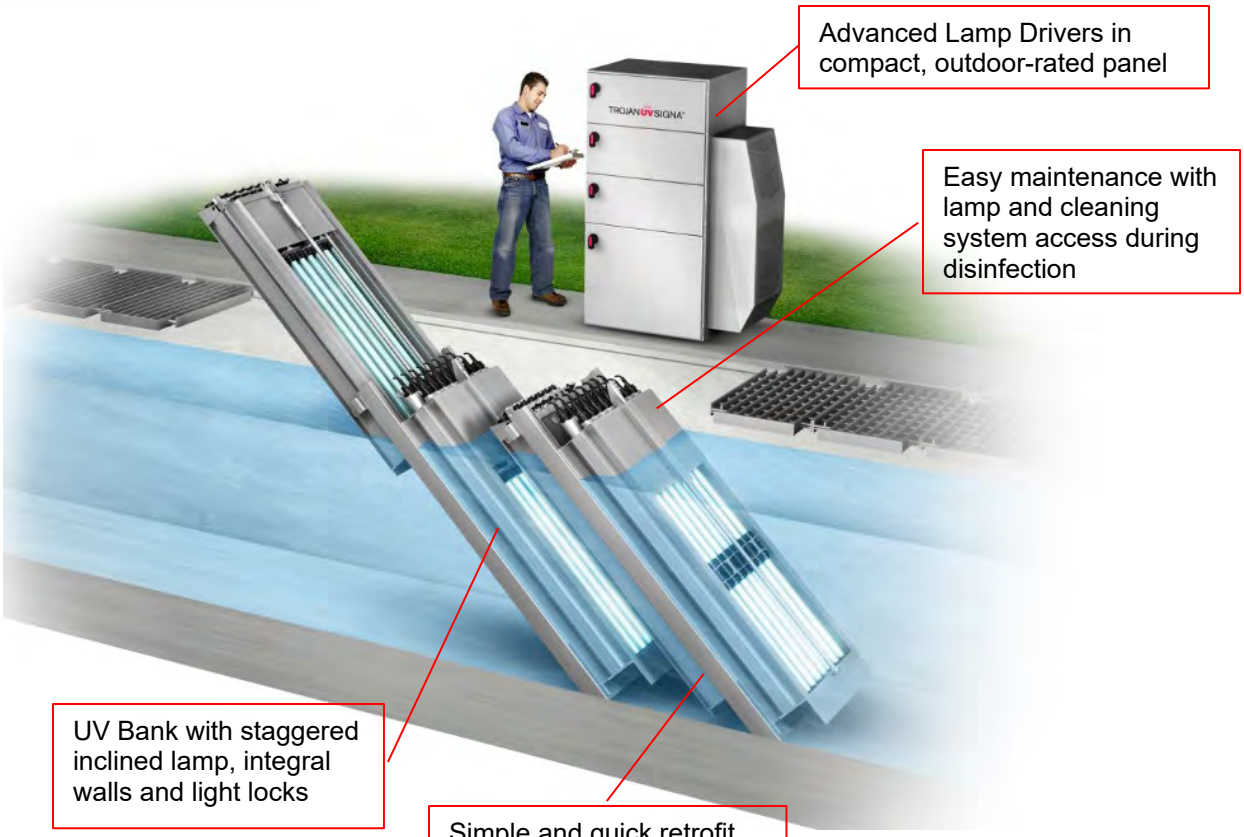
This price excludes any taxes or duties that may be applicable.
Standard equipment warrantees and start up by Trojan-certified technicians are included.

Easy and Cost-Effective Maintenance

- The 1000 watt TrojanUV Solo Lamp combines the benefits of both low pressure and medium pressure lamps
- Fewer lamps, long lamp life and easy change-outs save time and money
- Lamp change-outs and cleaning solution replacement are done while the UV system is in the channel – minimizing downtime and simplifying maintenance
- Routine maintenance can be performed while banks are in the channel, but an Automatic Raising Mechanism (ARM) makes other tasks, such as winterization, simple, safe and easy
- Lamp plugs with LED status indicators and integral safety interlock prevent an operator from accidentally removing an energized lamp
- ActiClean WW™ chemical/mechanical cleaning system to keep sleeves clean during operation

SYSTEM OVERVIEW

SOLO LAMP TECHNOLOGY



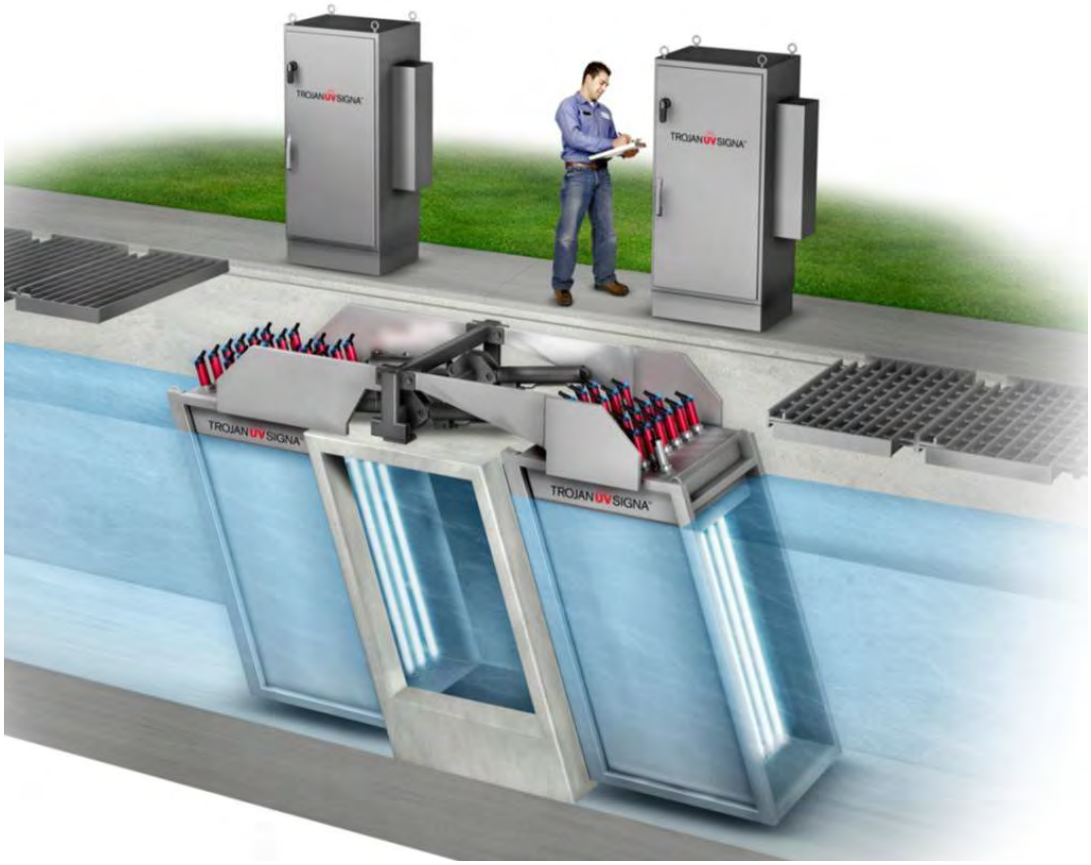
Simple to Design and Install

- Light locks on the UV banks control water level within the channel, reducing dependence on downstream weirs and preventing short-circuiting above the lamp arc
- UV Banks include integral reactor walls to make installation easy and prevent short circuiting at the channel walls
- Stringent tolerances on concrete channel walls are not required – making retrofits simple and cost-effective

Supported by Trojan Technologies

- Trojan Technologies warrants all components of the system (excluding UV lamps) against faulty workmanship and materials for a period of 12 months from date of start-up or 18 months after shipment, whichever comes first.
- UV lamps are warranted for 15,000 hours of operation or 3 years from shipment, whichever comes first. Lamp warranty is pro-rated after 9,000 hours of operation. This means that if a lamp fails prior to 9,000 hours of use, a new lamp is provided at no charge.
- Trojan offers an unparalleled Lifetime Performance Guarantee. The spirit of this guarantee is simple: the Trojan equipment, as sized for the project, will meet the disinfection requirements for the life of the system.

PROPOSAL FOR RACINE REPLACEMENT, WI
QUOTE: 221396



TrojanUVSigna™ incorporates revolutionary innovations, including TrojanUV Solo Lamp™ technology, to reduce the total cost of ownership and drastically simplify operation and maintenance. It is the ideal solution for those large facilities wanting to upgrade their disinfection system or easily and cost-effectively convert from chlorine.

We are pleased to provide the enclosed TrojanUVSigna proposal. Please do not hesitate to contact us if you have any questions regarding this proposal. We look forward to working with you.

Dale Storm,Peterson & Matz, Inc.
(847) 844-4405,

Una Duncan, Trojan Technologies
(519) 457-3400

DESIGN CRITERIA

Peak Design Flow:	**99 MGD(US)**
UV Transmittance:	**65%** (minimum)
Total Suspended Solids:	**25 mg/l** (30 Day Average, grab sample)
Disinfection Limit:	**400 Fecal Coliform per 100 ml**, 30 day Geometric Mean of consecutive daily grab samples

DESIGN SUMMARY

CHANNEL (Refer to Trojan layout drawing for complete details)	
Number of Channels:	**2**
Minimum Channel Length Required:	**40 ft 10.28 in**
Channel Width at UV Banks:	**6 ft 3.6 in**
Channel Depth Recommended:	**10 ft 2.05 in**
UV BANKS	
Number of Banks per Channel:	**3**
Number of Lamps per Bank:	**40**
Total Number of UV Lamps:	**240**
Maximum Duty Power Draw:	**283.32 kW**
UV PANELS	
Power Distribution Center Quantity:	**6**
Hydraulic System Center Quantity:	**2**
System Control Center Quantity:	**1**
ANCILLARY EQUIPMENT	
Level Controller Quantity and Type:	**2 Motorized Weir Gate**
Integral Bank Walls and Culvert:	**Included**
On-line UVT Monitoring:	**Hach UVAS sc Sensor- Optional**
Other Equipment:	

ELECTRICAL REQUIREMENTS

1. Each Power Distribution Center requires an electrical supply of one (1) 480/277V 60Hz, 46.80 kVA
2. Electrical supply for Hydraulic System Center will be (1) 480V 60Hz, 2.5 kVA
3. Electrical supply for System Control Center will be (1) 120V 60Hz, 1.8 kVA
4. Electrical disconnects are not included in this proposal. Refer to local electrical codes

COMMERCIAL INFORMATION

Total Capital Cost: ~~$2,437,200~~ (USD) $2,200,000 - Dale Storm 4/23/20

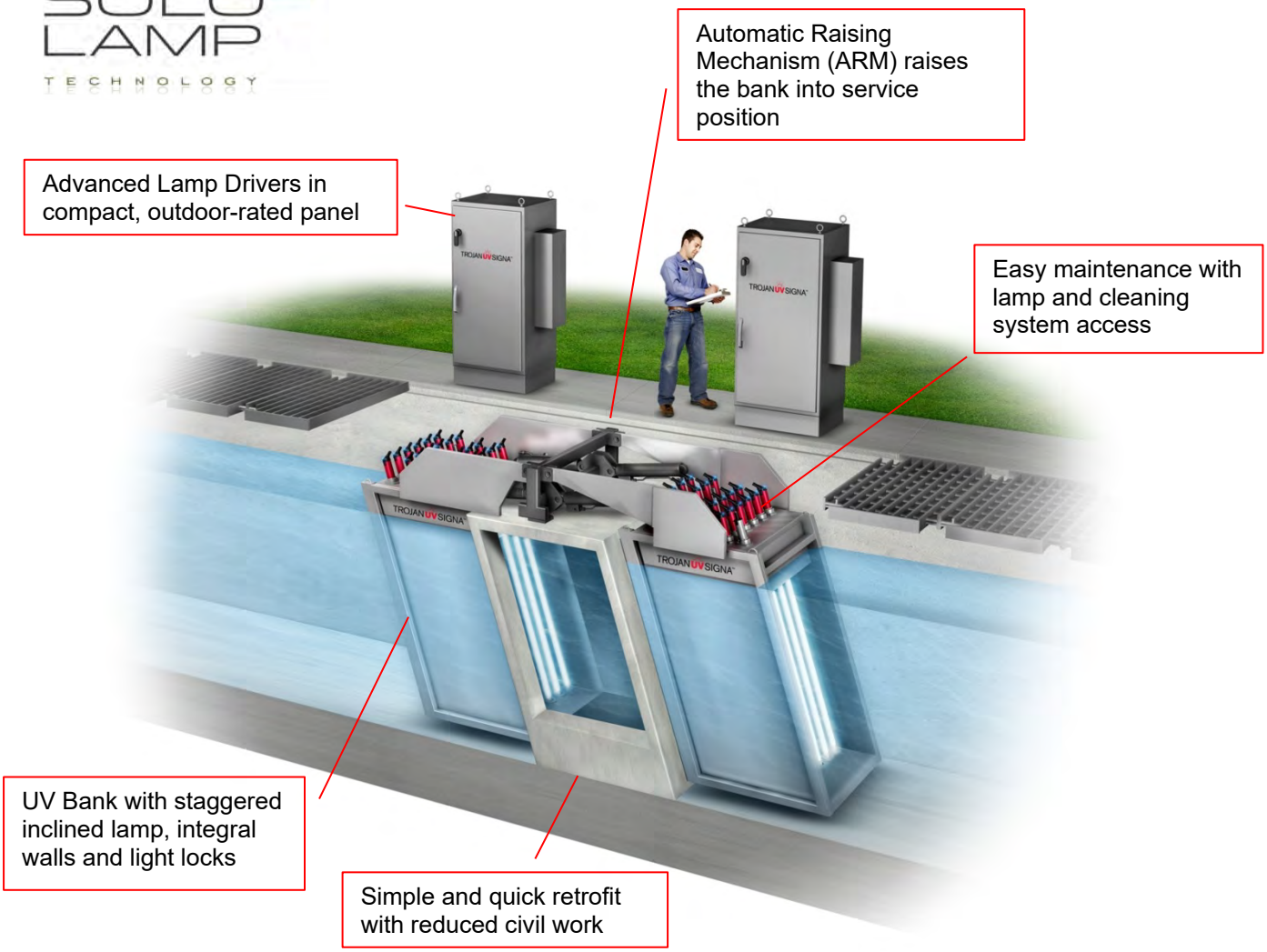
This price excludes any taxes or duties that may be applicable.
Standard equipment warrantees and start up by Trojan-certified technicians are included.

Easy and Cost-Effective Maintenance

- The 1000 watt TrojanUV Solo Lamp combines the benefits of both low pressure and medium pressure lamps
- Fewer lamps, long lamp life and easy change-outs save time and money
- Lamp change-outs and cleaning solution replacement are done while the UV system is in the channel – minimizing downtime and simplifying maintenance
- Routine maintenance can be performed while banks are in the channel, but an Automatic Raising Mechanism (ARM) makes other tasks, such as winterization, simple, safe and easy
- Lamp plugs with LED status indicators and integral safety interlock prevent an operator from accidentally removing an energized lamp

SYSTEM OVERVIEW

SOLO LAMP TECHNOLOGY



Simple to Design and Install

- Light locks in the UV banks and a culvert control water level within the channel, reducing dependence on downstream weirs and preventing short-circuiting above the lamp arc
- UV Banks include integral reactor walls to make installation easy
- Stringent tolerances on concrete channel walls are not required – making chlorine contact tank retrofits simple and cost-effective

Supported by Trojan Technologies

- Trojan Technologies warrants all components of the system (excluding UV lamps) against faulty workmanship and materials for a period of 12 months from date of start-up or 18 months after shipment, whichever comes first.
- UV lamps are warranted for 15,000 hours of operation or 3 years from shipment, whichever comes first. Lamp warranty is pro-rated after 9,000 hours of operation. This means that if a lamp fails prior to 9,000 hours of use, a new lamp is provided at no charge.
- Trojan offers an unparalleled Lifetime Performance Guarantee. The spirit of this guarantee is simple: the Trojan equipment, as sized for the project, will meet the disinfection requirements for the life of the system.

Klepp, Barry

From: Dale Storm <Dale.Storm@petersonandmatz.com>
Sent: Wednesday, August 28, 2019 11:33 AM
To: Klepp, Barry
Subject: Racine barrel covers

Budget pricing for the covers to fit the 12x 90 ft area $ 51,000.00 With out anchors, installation, etc Freight to site included as SWAG estimate in the job site from Salt Lake City

Dale W. Storm
Peterson & Matz Inc
(847) 844-4405 office
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(847) 624-5228 cell
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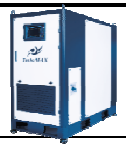
Racine WWTP Alternative 7-185-1
AERATION BLOWERS

Blower Comparison Table - Racine, WI

	Option A Gearless Turbo Model DT-MAX400	Option B Geared Turbo Model GL8	Option C Multistage Model LS24-4
			
Total Number of Blowers	3	3	3
Number of Operating Blowers	2	2	2
Number of Back-Up Blowers	1	1	1
Motor Rating (HP)	400	400	400
Airflow Per Blower (SCFM)	7,860	7,860	7,860
Total Blowers Firm Airflow (SCFM)[1]	23,580	23,580	23,580
Total Blowers Net Airflow (SCFM)[2]	15,720	15,720	15,720
Minimim Airflow (SCFM) @ Design Temperature[3]	3,537	2,751	3,930
Minimim Airflow (SCFM) @ Minimum Temperature[4]	4,323	3,537	3,930
Design Discharge Pressure (PSIG)	9	9	9
Delivery Time from Drawing Approval	14-16 weeks	22-24 weeks	14-16 weeks

Total Blower Equipment Cost[5]	$600,000	$750,000	$470,000
Main Motor Starters Total Cost	VFD/Starter included in Equipmente Cost	$46,500	$46,500
Harmonic filters	Included in Equipment Cost	n/a	n/a
Estimated Blowers Installation Cost[6]	$60,000	$90,000	$90,000
Estiamted Average Annual Blowers Maintenance Total Cost	$12,400	$9,820	$6,600
Estimated Average Annual Blowers Energy Total Cost[7]	$258,280	$253,374	$286,877
20-Year Life Cycle Cost[8]	**$4,800,565**	**$4,912,558**	**$5,095,794**

Notes:
1. All Blowers Operating
2. Back-up Blower Off-Line
3. Design Inlet Conditions of 90 degrees F, 80% RH, 14.37 psia barometric
4. Minimum Inlet Conditions of 10 degrees F, 30% RH, 14.37 psia barometric
5. Budget Equipment Price (Includes PLC Based Controls and Typical Instrumentation for Municipal Project)
6. Estimated Based on Similar Projects
7a. Assumes Average Energy Cost of 0.07 $/kWh
7b. Calculated Based on Wire Power Consumption at a total airflow of 11,450 SCFM @ 9 psig, 65 degrees F, 60% RH
7c. Calculation Assumes Continuous Operation (8,760 hrs/year)
8a. Assumes Annual Discount Rate of 5%
8b. Assumes Annual Inflation Energy Cost Rate of 2.50%

Lone Star Blower

MAX400-C60T1

Standard Specifications

Materials of Construction

Enclosure ..... Fabricated carbon steel
Impeller ..... 5 axis machined anodized 7075 aluminum
Shaft..... Titanium alloy with Sm2CO17 magnets
Casing..... A356 cast aluminum
Bearing type ..... Journal style foil
Bearings ..... X-750 teflon coated Inconel
Finish of enclosure ..... Powder coated

Technical Data

Outlet connection..... 18″ ANSI #150
Blow off connection .... 6″ ANSI #150
Weight ..... 3740 lbs.
Maximum RPM 25,680
Cooling ..... Internally air cooled
Temp range..... 14°F to 104°F
Sound level..... 85 dB @ 3 feet free field
Inlet filter..... ASHRAE Std. 52.1
Mounting ..... Adjustable feet with anchor

Electrical Data

Motor type..... Permanent magnet synchronous motor
Insulation class ..... H
Motor HP rating..... 400
Full load amps 480
Voltage ..... 460V, 3 PH, 60Hz
VFD..... KEB
Controller ..... MI-COM processor (PLC optional)
Communication ..... Ethernet, Modbus RTU, Modbus TCP, Hardwiring

Options

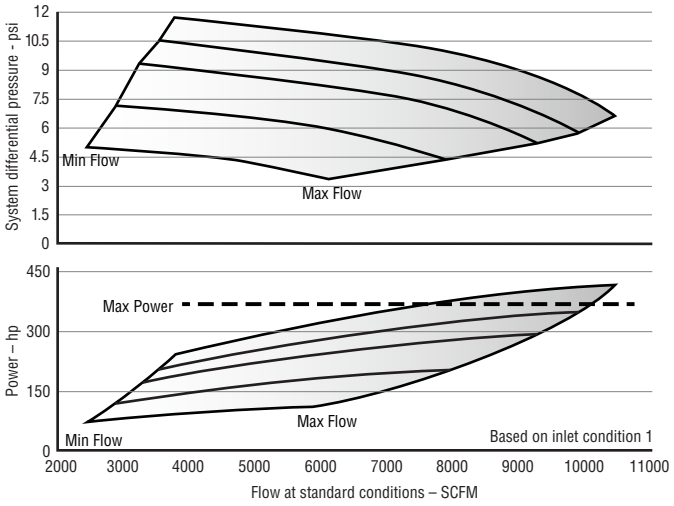
Dust tight/sealed enclosure
High and low ambient temperature
Separated electrical and mechanical enclosure
Stainless steel enclosure
Flanged intake connection
Alternative voltage
Outdoor enclosure

Patents / Certifications

Manufactured by TurboMax
10-0675821, 10-0781298, 10-0870887
CE-TUV K1747/E09, K1480/M09
UL-ULC 508A, 1446, 1004
ISO 9001

General Performance

Standard Conditions (68°F, 36% RH, 14.7 psia)

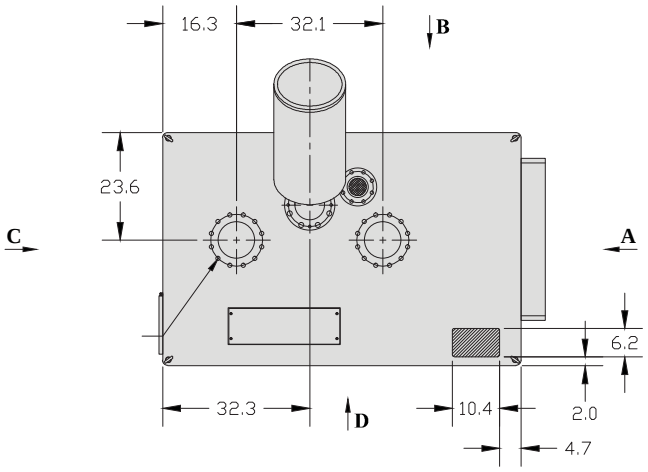


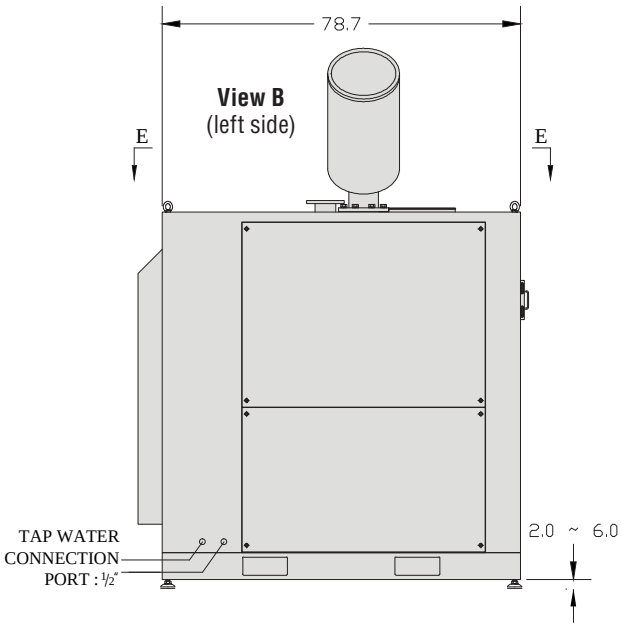
MAX400-C60T1

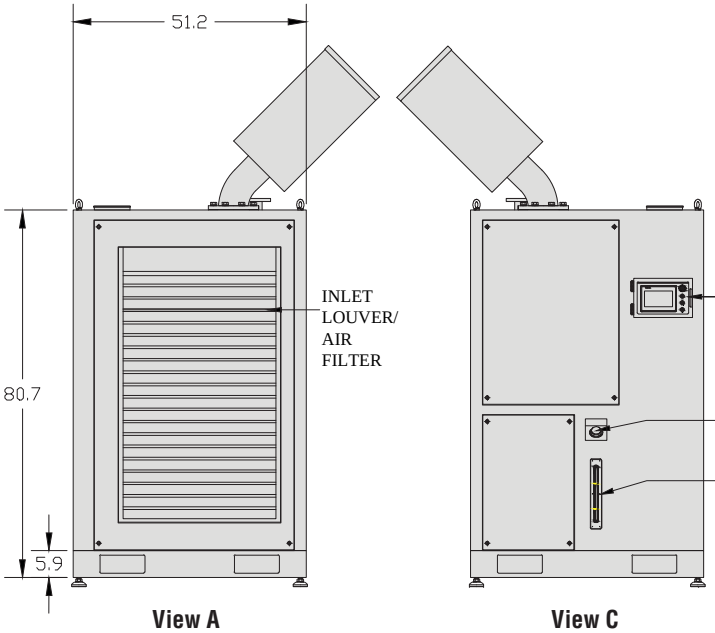
MAX400-C60T1

Discharge Size	Blow-off Size	Total Weight
18”	6”	3740 lbs.

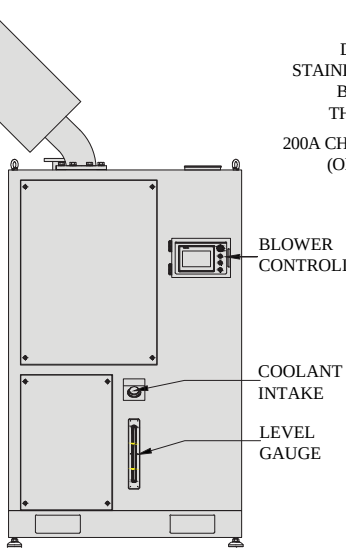
View E-E
(top side)



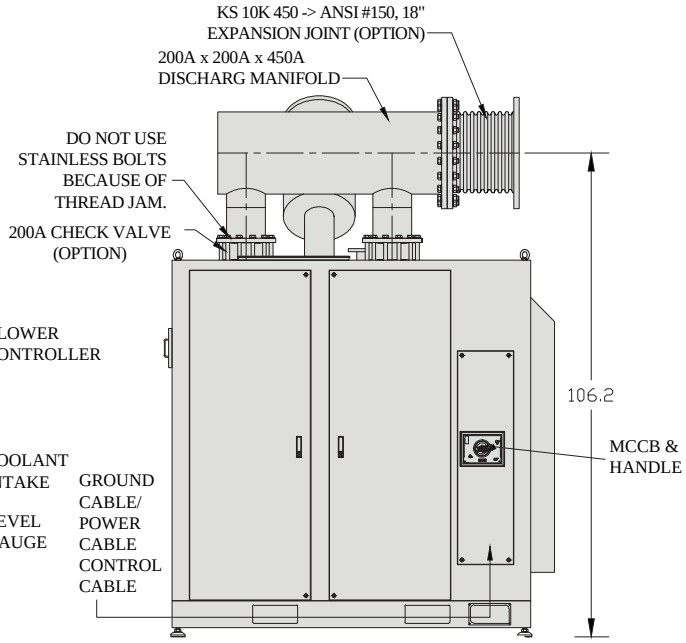




View A
(rear side)

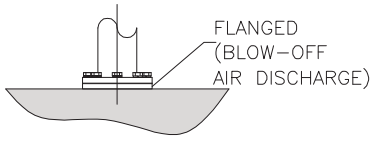


View C
(front side)



View D
(right side)

Note: It is recommended that the blow off air discharge is piped to the outside using piping similar to Figure AA. The discharge air temperature can reach a maximum of 175°F.



Dimensions and specifications may change without notice.

LONE STAR BLOWER
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MAX FINDER

rev. 19.12.19.0

Compressor Datasheet

General information

Customer	: AECOM	Quote number	: AL2074
Customer reference	: Racine WWTP	Size	: MAX400-C060T
Item number	: 51	Stages	: 1
Service	: Aeration	C-Number	: X400C060T1P2
Quantity	: 3	Date last saved	: 2020-1-11 11:58:6

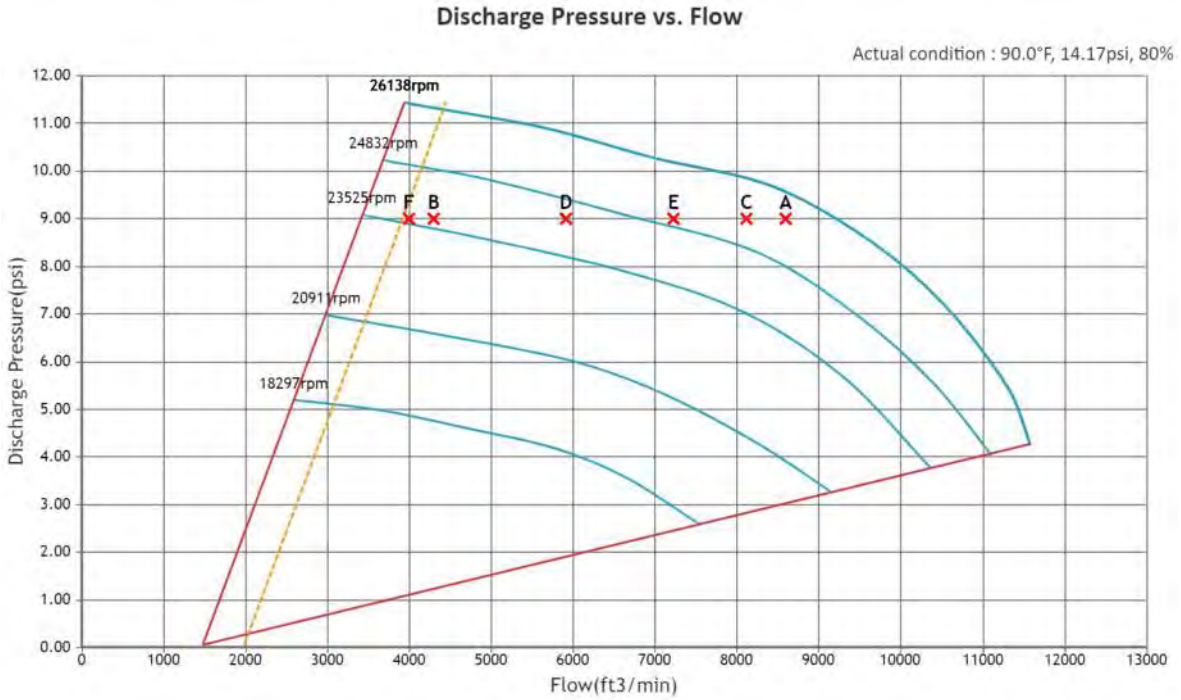
Operating Conditions

		A	B	C	D	E	F
Operating point		Condition A	Condition B	Condition C	Condition D	Condition E	Condition F
Atmospheric pressure	psi.a	14.17	14.17	14.17	14.17	14.17	14.17
Pressure loss factor	psi.a	0.2	0.2	0.2	0.2	0.2	0.2
Elevation	ft	618	618	618	618	618	618
Relative humidity	%	80	80	60	60	30	30
Inlet temperature	°F	90	90	65	65	10	10
Inlet flow (Actual)	ICFM	8595.9	4297.9	8121.9	5915.7	7233.4	4003.2
Inlet flow (68°F, 14.7psi, 36%)	SCFM	7860.0	3930.0	7860.0	5725.0	7860.0	4350.0
Inlet flow (0.0°C, 1.01325bar.g, 0.0%)	Nm3/min	206.8	103.4	206.8	150.6	206.8	114.4
Mass Flow	Kg/s	4.456	2.228	4.456	3.246	4.456	2.466
Discharge pressure	psi.g	9	9	9	9	9	9

Performance

Rise to Surge	psi.g	2.18	0.29	2.03	1.02	1.74	0.29
Turn down ratio	%	61.3	22.7	60.2	45.3	57.8	23.7
Speed	rpm	25605	23600	24758	23686	23141	21710
Temperature rise	°F	114.08	124.16	108.48	111.72	97.24	105.88
Discharge temperature	°F	204.08	214.16	173.48	176.72	107.24	115.88
Power(total)	kW	299.3	163	281	210.6	249.6	150.6

Performance Map



Lone Star Blower

GL8-WX-01

Standard Specifications

Flow Capacity	See performance chart
Flow Range	110% to 40% of rated flow with Combination Control
Pressure Range	3 to 30 PSIG
Noise Level	88 – 91 dB(A) without Enclosure 75 – 78 dB(A) with Enclosure
Gearbox	Helical Gear Set
Bearings	Pinion Shaft: Journal (Tilt Pad Type) Drive Shaft: Journal
Gas	Air, Steam, H2S, Biogas or Custom Gas Configuration
Control System Options	Combination Inlet and Discharge Guide Vanes, Variable Diffuser Vane, Variable Inlet Guide Vanes, Variable Speed Control or Blow Off Control
Controller	Allen Bradley, Siemens, Modicon, Custom Available
HMI	10″ Color Touchscreen, Custom Available
Pressure Sensors	IP55 4-20mA Transmitters
Temperature Sensors	IP55 4-20mA Transmitters
Inlet Filter/Silencer	3-Stage - 99% at 2 Micron (Final)
Expansion Joint	150# Flanged Stainless Steel Bellows Type
Discharge Cone/Silencer	Steel
Local Control Panel	NEMA 12, NEMA 4X, Custom Available
Base Frame	Structural Steel
Blower Driver	Electric Induction Motor 480V thru 13K, 50/60 Hz, Steam Turbine, Engine
Enclosure	Galvanized Steel or Aluminum Custom Available
Discharge Velocity	20 m/s
Vibration Level	1.5 mm/s per ISO 10816-1
Oil Cooling	Air or Water

Safety Monitoring

Surge	Calculated with Backup Anti-Surge Switch
Temperature	Inlet, Oil Reservoir, Bearings, Enclosure, Discharge
Pressure	Oil Pressure, Blower Discharge
Vibration	Blower Gearbox

Auxiliaries

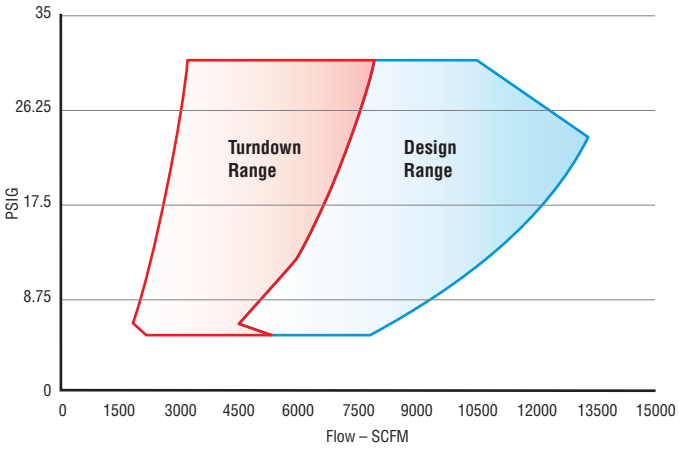
Electric Guide Vane Actuators	Electric Modulated IP67
Master Control Panel	Custom Available

Material Specifications

Casing: Volute	Ductile Iron
Casing: Gearbox	Grey Cast Iron
Impeller	Aluminum Alloy AlCu2MgNi - Anodized, Stainless Steel Custom Available
Diffuser Vanes	316 Stainless Steel
Gears	High Tensile Alloy Steel 20CrNiMo
High Speed Shaft	High Tensile Alloy Steel 20CrNiMo
Slow Shaft	High Tensile Alloy Steel 20CrNiMo
Coupling	Alloy steel 40Cr
Machine Mounts	Vibration Isolators, Seismic Available
Bearings	Alloy Steel with White PAP Alloy
Standards	API 672
Test Procedure	ASME PTC-10, ASME PTC-13, ISO 5389
Quality	ISO 9001

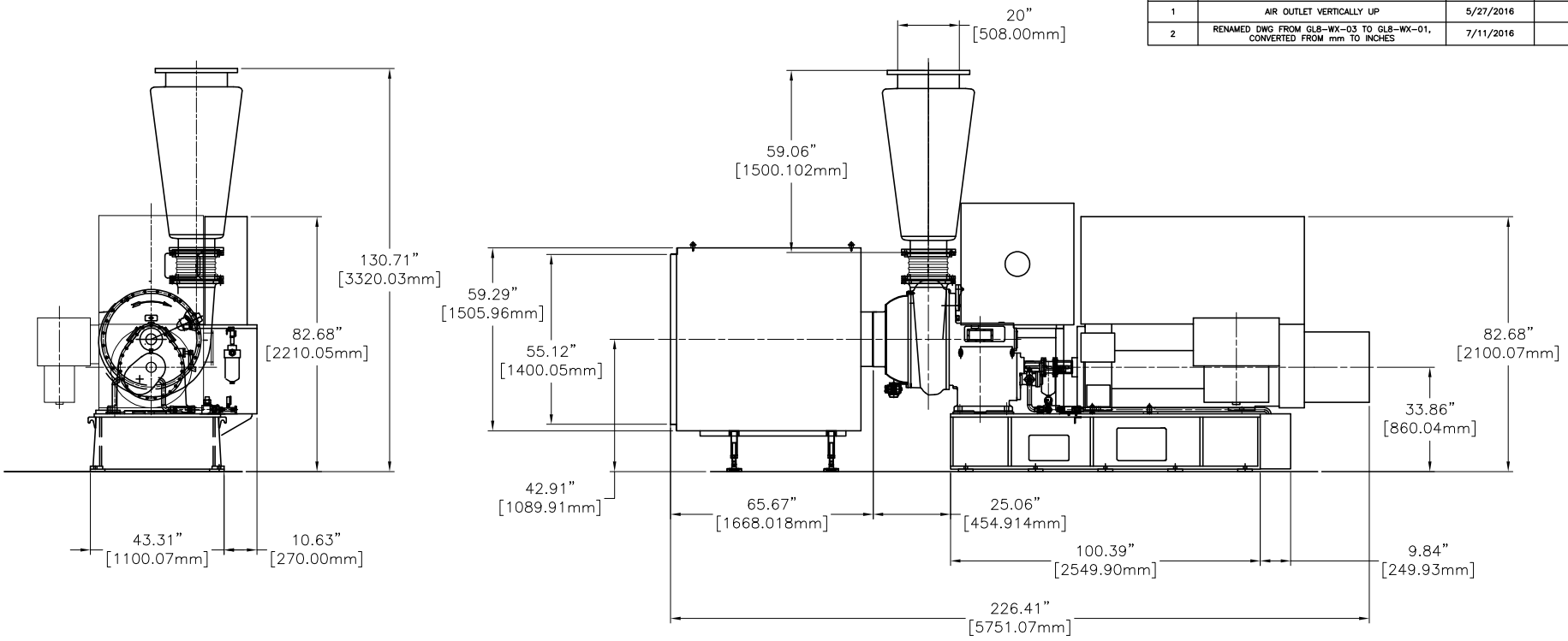
General Performance

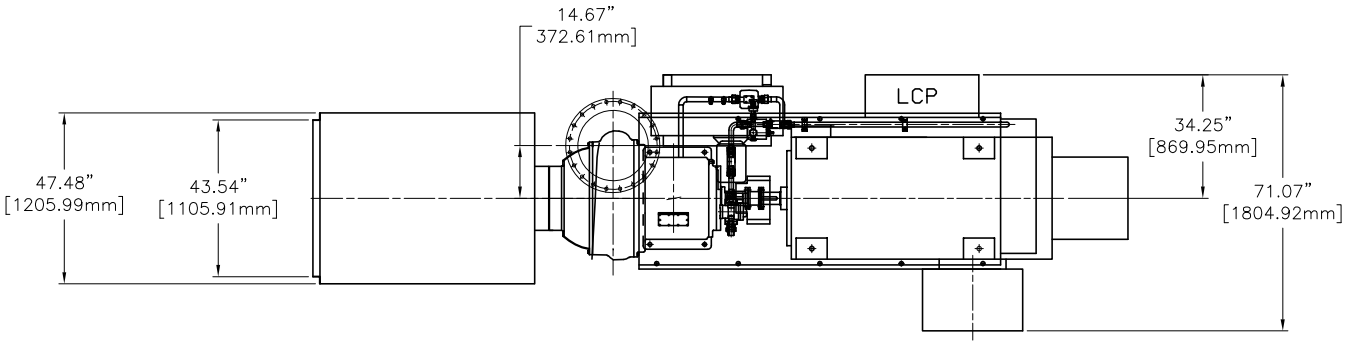
Standard Conditions (68°F, 36% RH, 14.7 psia)



GL8-WX-01

REVISION HISTORY			
REV	DESCRIPTION	DATE	APPROVED
1	AIR OUTLET VERTICALLY UP	5/27/2016	
2	RENAMED DWG FROM GL8-WX-03 TO GL8-WX-01, CONVERTED FROM mm TO INCHES	7/11/2016	





NOTES:
1. BLOWER OUTLET ANGLE ADJUSTABLE EVERY 15° RADIALLY.
2. BLOWER INSTALLED BY EXPANSION BOLTS.

DIMENSIONS & WEIGHTS BY MOTOR SIZE					
MOTOR	"A"	"B"	"C"	"H"	WEIGHT (LBS)
475HP-675HP	100.39	226.41	71.07	82.68	13,625
750HP	100.39	226.41	71.07	82.68	13,845
925HP	100.39	226.41	71.07	82.68	14,286

THIRD ANGLE PROJECTION

DRAWING IS FOR REFERENCE ONLY UNLESS SPECIFIED AS RELEASED.

APPROVALS		
DRAWN	BW	07/011/2016
CHECK		
ENGINEER		
MANUFACTURING		
CONTROL		
APPROVED		

LONE STAR BLOWER

TITLE
GL-8 GEARED TURBO
GENERAL ASSEMBLY 20" CONE

SIZE	CAGE CODE	DWG NUMBER	REV
A	-	GL8-WX-01	02
SCALE		SHEET 1 OF 1	

Lone Star Blower

GL SERIES – GEARED TURBO PERFORMANCE CURVE

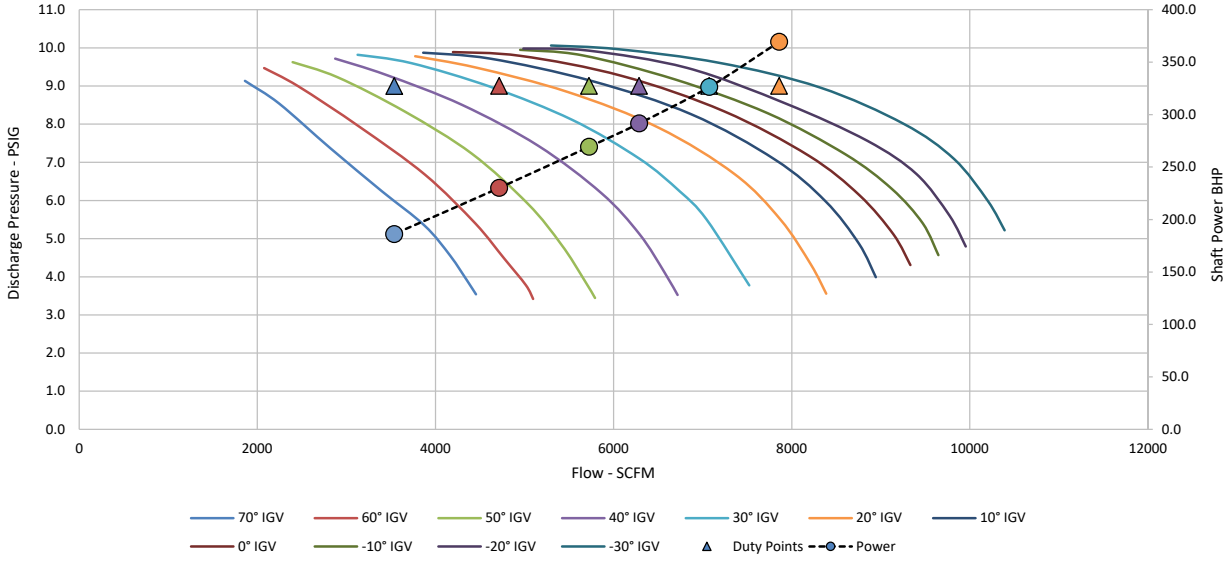
Project:	Racine WWTP
Project Ref:	Aeration Blowers
Engineer:	AECOM
Date:	1/11/20 11:02 AM

Technology:	Geared Turbo
Selected Model:	GL8

	Units		Design Duty 1	Alt Flow 1	Alt Flow 2	Alt Flow 3	Alt Flow 4	Alt Flow 5
Volume Flow at Inlet	ICFM		8,690.3	7,805.4	6,926.2	6,298.4	5,179.5	3,878.3
Specified Volume	Delivered SCFM		7,860	7,074	6,288	5,725	4,716	3,537
Specified Flow defined at	*Pressure*	*14.7 PSIA*						
	Temperature	*68 °F*						
	Relative Humidity	*36 %*						
Inlet Temperature	°F		90	90	90	90	90	90
Relative Humidity	%		80	80	80	80	80	80
Barometric Pressure	PSIA		14.43	14.43	14.43	14.43	14.43	14.43
Inlet Pressure Losses	PSIG		0.15	0.15	0.15	0.15	0.15	0.15
Pressure at Inlet	PSIA		14.28	14.28	14.28	14.28	14.28	14.28
Pressure at Discharge	PSIG		9.00	9.00	9.00	9.00	9.00	9.00
Total Delta Pressure			9.15	9.15	9.15	9.15	9.15	9.15
Temperature at Discharge	°F		189.03	186.42	186.09	186.79	188.83	193.84
Maximum Rise to Surge	PSIG		1.06					
Blower Speed	RPM		11987					
Polytropic Eff.	%		84.86%	86.61%	86.59%	85.80%	83.87%	79.87%
Gearbox Input Shaft Power	HP		369.39	326.40	291.67	269.34	230.12	186.15
	kW		275.45	243.40	217.50	200.85	171.60	138.81
Est. Wire to Air	HP		386.42	342.17	306.53	283.67	243.62	198.87
	kW		288.15	255.16	228.58	211.53	181.67	148.30

*The stated blower performance is stated with a +/- 4% tolerance. Per ASME PTC-10

P-V Curve & Shaft Power: Duty I : 90F/80%



Lone Star Blower

GL SERIES – GEARED TURBO PERFORMANCE CURVE

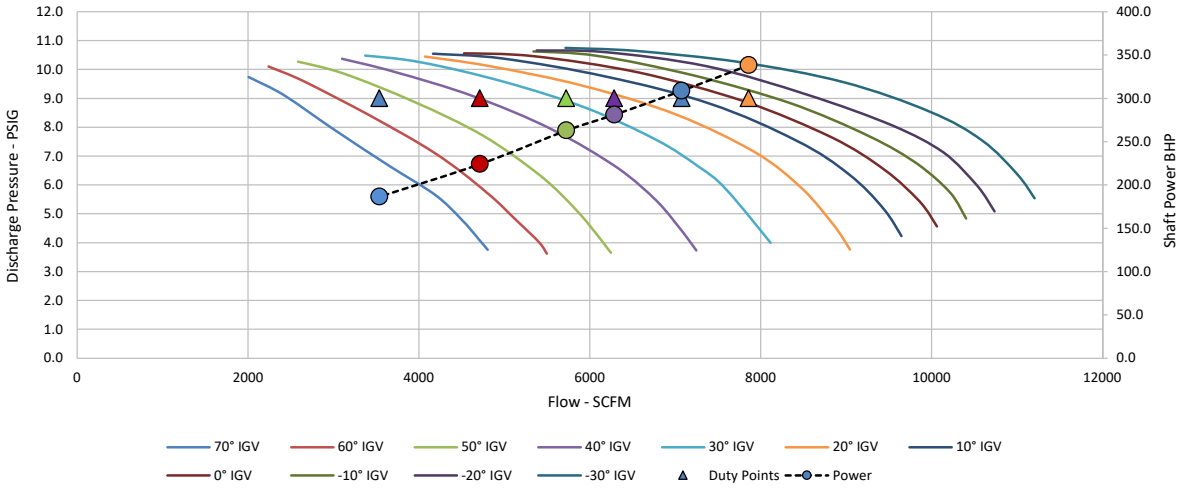
Project:	Walnut Creek WWTP
Project Ref:	Aeration Blowers
Engineer:	AECOM
Date:	1/11/20 12:31 PM

Technology:	Geared Turbo
Selected Model:	GL8

	Units		Design Duty 1	Alt Flow 1	Alt Flow 2	Alt Flow 3	Alt Flow 4	Alt Flow 5
Volume Flow at Inlet	ICFM		7,993.2	7,193.9	6,394.6	5,822.0	4,795.9	3,596.9
Specified Volume	Delivered SCFM		7,860	7,074	6,288	5,725	4,716	3,537
Specified Flow defined at	*Pressure*	*14.7 PSIA*						
	Temperature	*68 °F*						
	Relative Humidity	*36 %*						
Inlet Temperature	°F		65	65	65	65	65	65
Relative Humidity	%		60	60	60	60	60	60
Barometric Pressure	PSIA		14.43	14.43	14.43	14.43	14.43	14.43
Inlet Pressure Losses	PSIG		0.15	0.15	0.15	0.15	0.15	0.15
Pressure at Inlet	PSIA		14.28	14.28	14.28	14.28	14.28	14.28
Pressure at Discharge	PSIG		9.00	9.00	9.00	9.00	9.00	9.00
Total Delta Pressure			9.15	9.15	9.15	9.15	9.15	9.15
Temperature at Discharge	°F		158.91	159.40	160.82	162.68	164.33	172.52
Maximum Rise to Surge	PSIG		1.75					
Blower Speed	RPM		11987					
Polytropic Eff.	%		85.53%	84.82%	83.39%	81.75%	80.24%	74.41%
Gearbox Input Shaft Power[1]	HP		338.41	308.78	281.22	262.89	224.18	186.56
	kW		252.35	230.26	209.70	196.04	167.17	139.12
Est. Wire to Air	HP		354.52	324.08	295.82	277.07	237.57	199.29
	kW		264.36	241.66	220.59	206.61	177.15	148.61

*The stated blower performance is stated with a +/- 4% tolerance. Per ASME PTC-10

P-V Curve & Shaft Power: Duty II : 65F/60%



Lone Star Blower

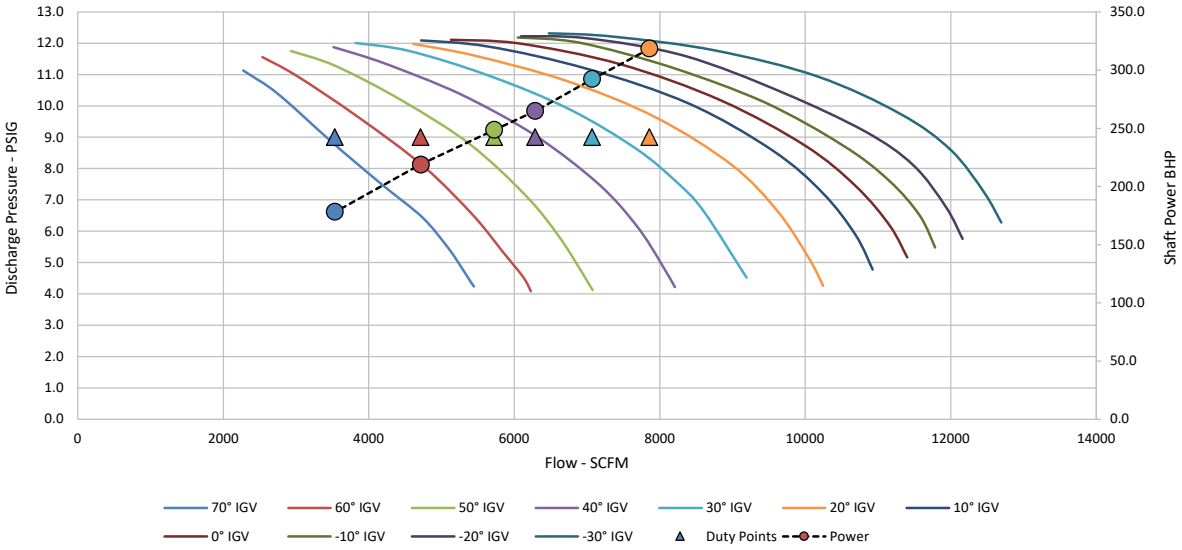
GL SERIES – GEARED TURBO PERFORMANCE CURVE

Project:	Walnut Creek WWTP
Project Ref:	Aeration Blowers
Engineer:	AECOM
Date:	1/11/20 12:31 PM

Technology:	Geared Turbo
Selected Model:	GL8

	Units		Design Duty 1	Alt Flow 1	Alt Flow 2	Alt Flow 3	Alt Flow 4	Alt Flow 5
Volume Flow at Inlet	ICFM		7,071.8	6,364.6	5,657.4	5,150.9	4,243.1	3,182.3
Specified Volume	Delivered SCFM		7,860	7,074	6,288	5,725	4,716	3,537
Specified Flow defined at	*Pressure*	*14.7 PSIA*						
	Temperature	*68 °F*						
	Relative Humidity	*36 %*						
Inlet Temperature	°F		10	10	10	10	10	10
Relative Humidity	%		30	30	30	30	30	30
Barometric Pressure	PSIA		14.43	14.43	14.43	14.43	14.43	14.43
Inlet Pressure Losses	PSIG		0.15	0.15	0.15	0.15	0.15	0.15
Pressure at Inlet	PSIA		14.28	14.28	14.28	14.28	14.28	14.28
Pressure at Discharge	PSIG		9.00	9.00	9.00	9.00	9.00	9.00
Total Delta Pressure			9.15	9.15	9.15	9.15	9.15	9.15
Temperature at Discharge	°F		99.12	100.12	100.96	103.08	108.14	113.39
Maximum Rise to Surge	PSIG		3.32					
Blower Speed	RPM		11987					
Polytropic Eff.	%		81.03%	79.96%	79.05%	77.25%	73.40%	69.83%
Gearbox Input Shaft Power[1]	HP		318.47	292.24	264.82	248.50	219.11	178.06
	kW		237.48	217.93	197.48	185.31	163.39	132.78
Est. Wire to Air	HP		334.02	307.12	279.05	262.37	232.40	190.66
	kW		249.08	229.02	208.09	195.65	173.30	142.18

P-V Curve & Shaft Power: Duty III : 10F/30%



Lone Star Blower

LS24 **Multistage Turbo**

Standard Specifications

Number of Stages	1 to 5 (60 Hz) 1 to 6 (50 Hz)
Inlet Connection	24" Flange, ASA 125# /150# Drilling Optional DIN 600 Flange
Outlet Connection	18" Flange, ASA 125# /150# Drilling Optional DIN 450 Flange
Operating Speed	Design 3,600 RPM - 60 Hz / 3,000 RPM - 50 Hz
Case Pressure	30 PSIG / 2 Bar
Seals (Air)	Labyrinth Type
Seals (Gas)	Carbon Ring with Purge, Custom Available
Bearings	Anti-friction type, AFBMA L10 100,000 hour rating
Lubrication	Splash Lubricated Oil or Oil Mist Connections 34.00 in (863.6 mm) 60 Hz
Impeller Diameter	37in (939.8 mm) 50 Hz
Impeller Tip Speed	527 ft/s (161 m/s) @ 3550 RPM
First Critical	4531 RPM (5 Stage 60 Hz)
Drive Type	Direct Coupled
Shaft End	3.625 in (92.08 mm) Diameter at Coupling
Vibration Tollerance	.18 in/s (4.57 m/s) Maximum

Materials of Construction

Casing	ASTM A48 Class 30 Cast Iron
Bearing Housings	ASTM A48 Class 30 Cast Iron
Oil Reservior	ASTM A48 Class 30 Cast Iron
Shaft	ASTM A109 1045 Carbon Steel
Impellers	ASTM A356-T6 Cast Aluminum ASTM AA-6061 Fabricated
Seals (Air)	ASTM B86 Z35631 Zinc Alloy Aluminum
Seals (Gas)	ASTM C695 Molded Graphite
Interstage Vanes	ASTM A240 304 Stainless Steel
Joint Sealing	RTV Silicone Compound
Tie Rods	ASTM A108 1045 Carbon Steel
Blower Base	ASTM A36 Structural Steel
Motor Pedestal	ASTM A36 Structural Steel
Isolation Pads	Neoprene Rubber
Finish	2 Part Epoxy - Lone Star Gray

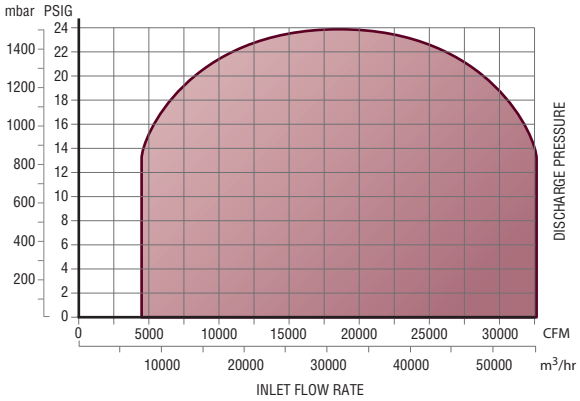
Testing

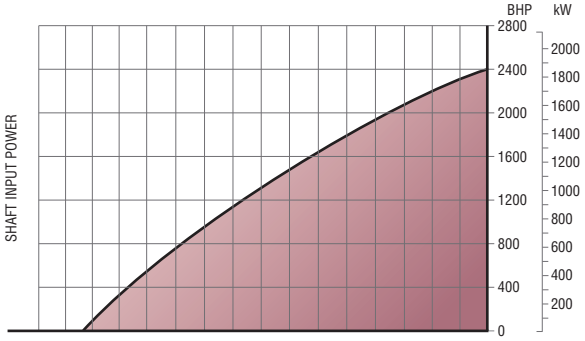
Balancing	Military Standard 167-1 or ISO 1940
Noise Level	OSHA 1910.95, ISO 2151:2004
Performance	ASME PTC-10, PTC-13, ISO 5389
Hydrotesting	API 612 @ 1.5 Times MAWP Witness Testing Available API 617 Option

Engineered Solutions

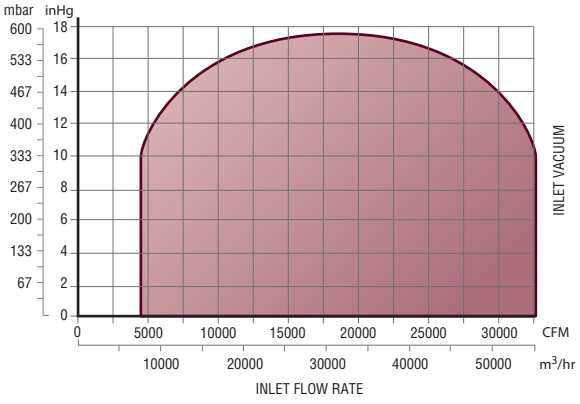
Alternative Materials - Stainless Steel, Ductile, or other
NACE Compliance for Process Gas
Special Coating or Seals
Custom Packaging to Hazardous Area Classification
Call Us Today to Discuss Your Needs

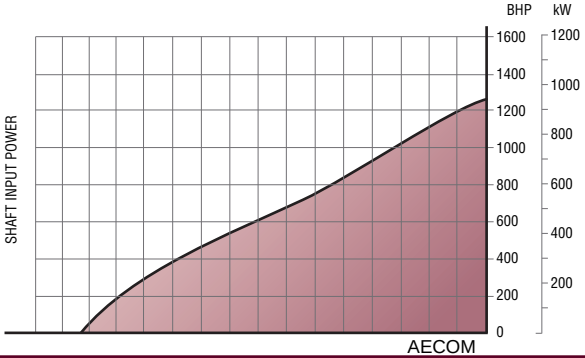
PRESSURE PERFORMANCE





EXAUSTER PERFORMANCE



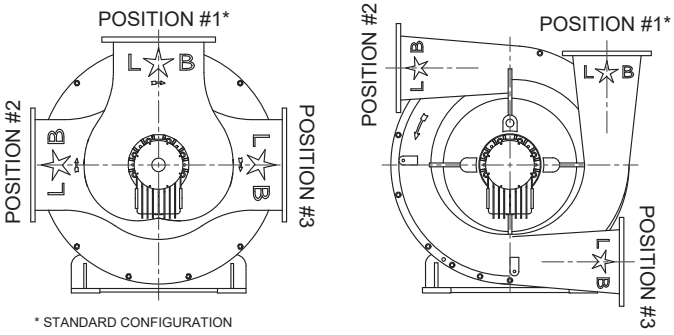


Lone Star Blower

LS24 Multistage Turbo

INLET & OUTLET ORIENTATION OPTIONS

The orientation of the inlet and outlet is selectable from any of the three different positions, as viewed when facing the exterior of the part:

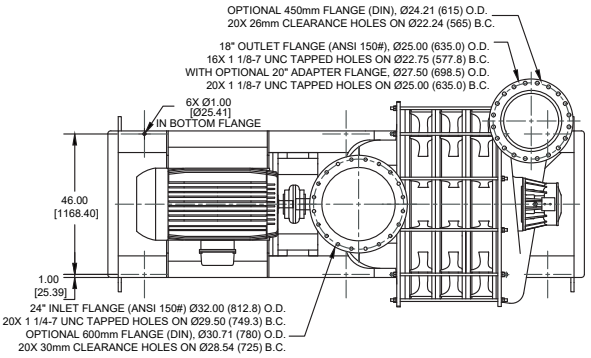


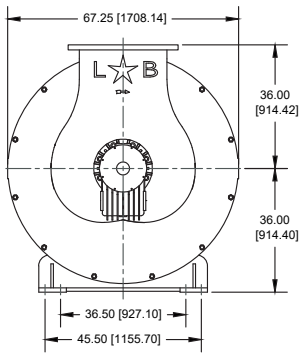
* STANDARD CONFIGURATION

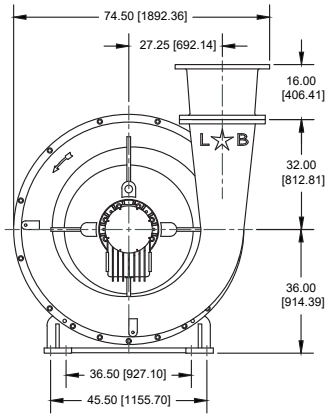
	Weight*		Wk²	
Model	LB	Kg	LB-ft²	Kg-m²
LS24-1	10,600	4,808	74	3.12
LS24-2	12,700	5,761	126	5.31
LS24-3	14,900	6,759	179	7.54
LS24-4	17,300	7,847	232	9.78
LS24-5	18,900	8,573	284	11.97
LS24-6	21,100	9,571	337	14.2

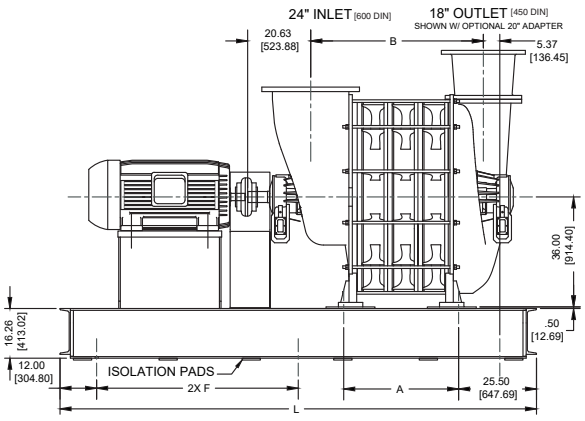
Approximate weight for blower only.

GENERAL ARRANGEMENT









Packaged Dimensions

Model	A*	B*	F†	L†
LS24-1	19.50 (495)	26.75 (679)	57 (1448)	138 (3505)
LS24-2	29.56 (751)	36.81 (935)	63 (1600)	150 (3810)
LS24-3	39.63 (1006)	46.88 (1191)	69 (1753)	162 (4115)
LS24-4	49.69 (1262)	56.94 (1446)	75 (1905)	174 (4420)
LS24-5	59.75 (1518)	67.00 (1702)	81 (2057)	186 (4724)
LS24-6	69.81 (1773)	77.06 (1957)	89 (2261)	202 (5131)

Dimensions are shown in inches (and millimeters) are approximate. Do not use for constructions purposes.

†*Dimensions vary depending on coupling & motor frame size.*

LONE STAR BLOWER
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+1 832 532 3115 Fax
info@lonestarblower.com
www.lonestarblower.com

Compressor Performance Datasheet

Customer	: AECOM	Quote number	: AL2074
Customer reference	: Racine, WI	Size	: LS24
Item number	: 061	Stages	: 4
Service	: Aeration	Based on curve number	: MLS24-I115-4
Quantity	: 3	Date last saved	: 11 Jan 2020 12:28 PM
		Impeller	: 115

Operating Conditions

Standard conditions : (14.70 psi.a , 68.00 deg F , 36.00 %)

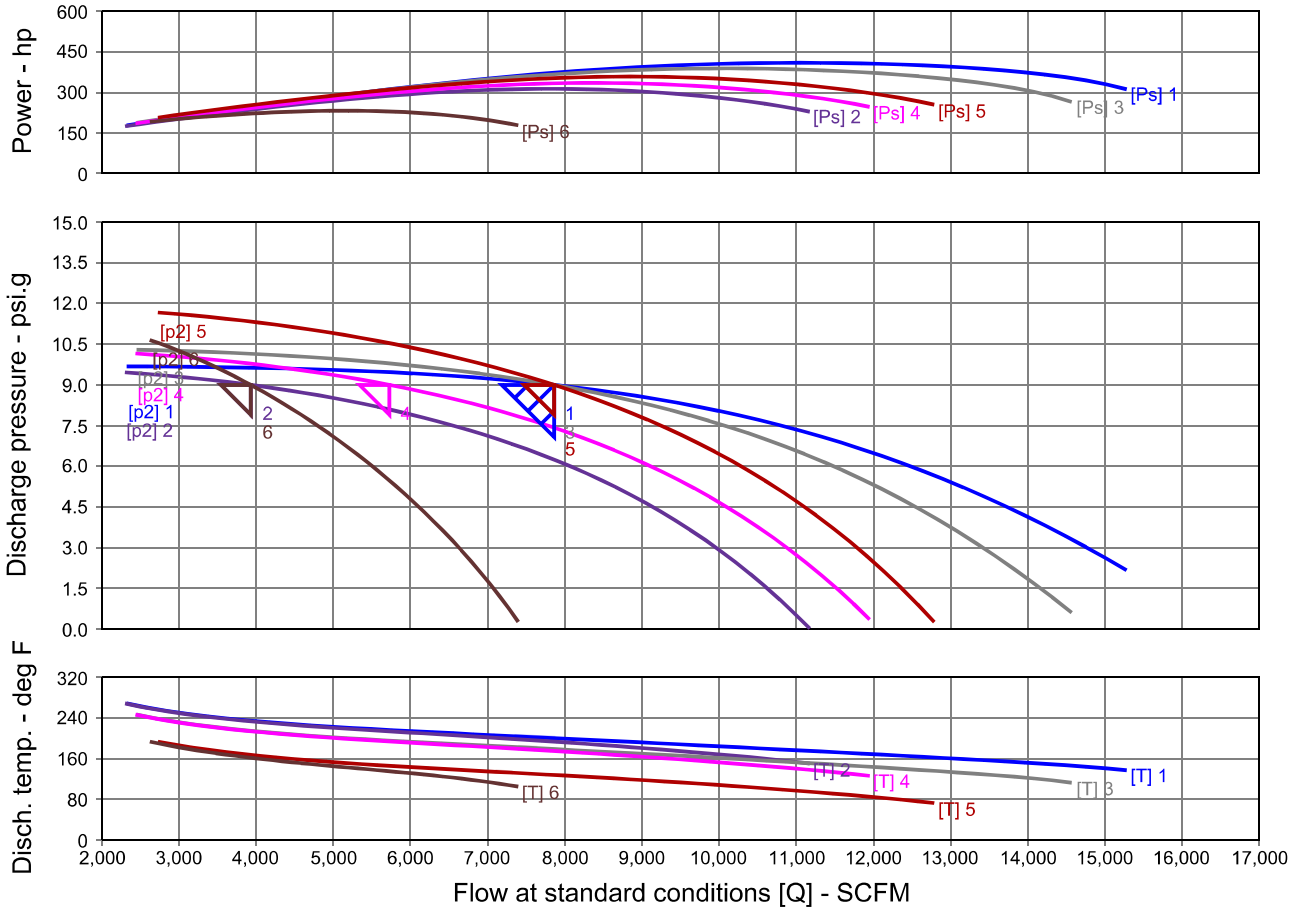
Condition		1	2	3	4	5	6
System inlet volume flow	CFM	8,473.6	4,236.8	8,007.9	5,832.8	7,135.9	3,567.9
Flow at standard conditions	SCFM	7,860.0	3,930.0	7,860.0	5,725.0	7,860.0	3,930.0
Mass flow	lbm/s	9.82	4.91	9.82	7.15	9.82	4.91
Mass flow, dry	lbm/s	9.58	4.79	9.74	7.10	9.81	4.91
System inlet temperature	deg F	90.00	90.00	65.00	65.00	10.00	10.00
System inlet pressure	psi.g	0.00	0.00	0.00	0.00	0.00	0.00
Inlet pressure loss	psi	0.20	0.20	0.20	0.20	0.20	0.20
Compressor discharge pressure	psi.g	9.00	9.00	9.00	9.00	9.00	9.00
Discharge pressure loss	psi						
System discharge pressure [p2]	psi.g	9.00	9.00	9.00	9.00	9.00	9.00
Compressor differential pressure	psi	9.21	9.57	9.62	9.87	10.48	10.77
System differential pressure [dp]	psi	9.00	9.00	9.00	9.00	9.00	9.00
Atmospheric pressure	psi.a	14.37	14.37	14.37	14.37	14.37	14.37
Elevation above sea level	ft	618.0	618.0	618.0	618.0	618.0	618.0
Frequency	Hz	60	60	60	60	60	60
Type of gas		Air	Air	Air	Air	Air	Air
Relative humidity	%	80.00	80.00	60.00	60.00	30.00	30.00
Molecular weight (MW)		28.54	28.54	28.83	28.83	28.96	28.96
Specific heat (Cp)	Btu/(lb.deg F)	0.2460	0.2460	0.2421	0.2421	0.2396	0.2396
Ratio of specific heat (k)		1.39	1.39	1.40	1.40	1.40	1.40

Performance

Quantity of units operating		1	1	1	1	1	1
Speed	rpm	3550	3550	3550	3550	3550	3550
System discharge pressure (actual) [p2]	psi.g	9.00	9.00	9.00	9.00	9.00	9.00
Inlet throttling applied		Yes	Yes	Yes	Yes	Yes	Yes
Efficiency, polytropic [#,p]	%	77.18	64.18	76.72	70.88	75.91	63.05
Efficiency, total	%	-	-	-	-	-	-
Power, shaft [Ps]	hp	373	236	367	298	353	222
Temperature rise	deg F	110.7	143.7	114.1	129.2	118.1	152.1
Discharge temperature	deg F	200.7	233.7	179.1	194.2	128.1	162.1
Rise to surge	psi	0.68	0.46	1.30	1.16	2.67	1.66
Turndown	%	70.50	41.52	68.87	57.50	65.34	33.33
Surge pressure	psi.g	9.68	9.46	10.30	10.16	11.67	10.66
Surge flow	SCFM	2,318.9	2,298.4	2,446.9	2,433.3	2,724.3	2,620.0

Compressor Performance Datasheet

Customer	: AECOM	Quote number	: AL2074
Customer reference	: Racine, WI	Size	: LS24
Item number	: 061	Stages	: 4
Service	: Aeration	Based on curve number	: MLS24-I115-4
Quantity	: 3	Date last saved	: 11 Jan 2020 12:28 PM
		Impeller	: 115

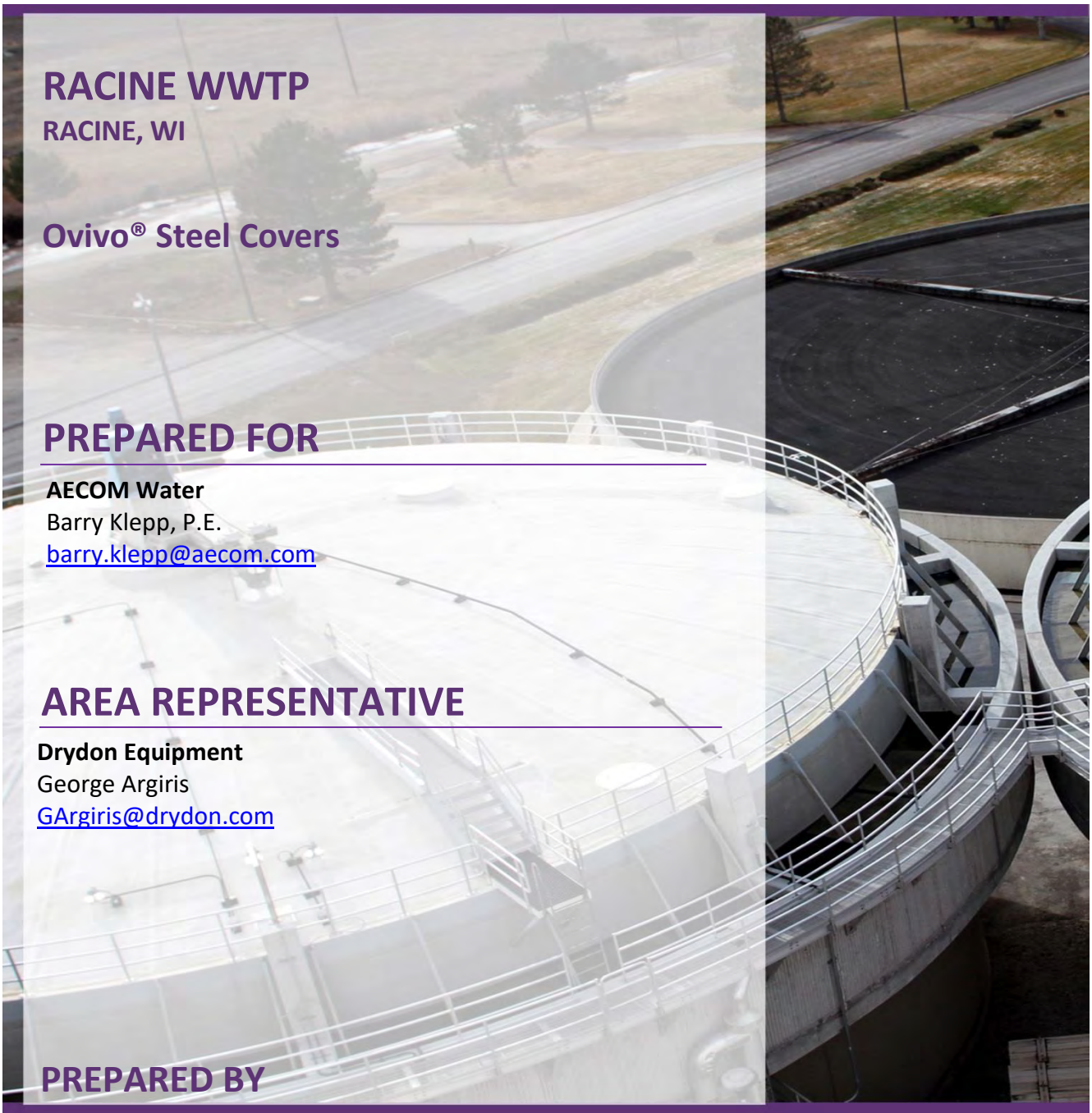


9-177-1
Digester D Cover
Replacement Alternative

OVIVO Worldwide Experts in Water Treatment

BUDGETARY PROPOSAL

MARCH 17, 2020



RACINE WWTP

RACINE, WI

Ovivo® Steel Covers

PREPARED FOR

AECOM Water
Barry Klepp, P.E.
barry.klepp@aecom.com

AREA REPRESENTATIVE

Drydon Equipment
George Argiris
GArgiris@drydon.com

PREPARED BY

Nimesh Patel
c/o James Goldhardt
Phone: (801) 931-3000
James.Goldhardt@ovivowater.com

Ovivo USA, LLC
4246 Riverboat Road – Suite 300
Salt Lake City, Utah 84123-2583
http://www.ovivowater.com/SteelCover

DESIGN PARAMETERS

Number of Digester	One (1) Digester B	One (1) Digester D
Tank Diameter	90.00 ft	90.00 ft
Top of Tank Elevation	598.68 ft	598.68 ft
Maximum Liquid Level Elevation	596.18 ft	596.18 ft
Minimum Liquid Level Elevation	588.18 ft	588.18 ft
Corbel Elevation	588.18 ft	588.18 ft
Bottom of Wall Elevation	578.18 ft	577.18 ft
Bottom of Cone Elevation	569.18 ft	569.68 ft
Tank Height	20.50 ft	21.50 ft
Cone Height	9.00 ft	7.50 ft
Design Pressure*	16 in w.c	16 in w.c
Operating Pressure*	10 in w.c	10 in w.c
Live Load*	55 psf	55 psf
Wind Load*	20 psf	20 psf
Snow Load*	30 psf	30 psf

** Assumed Parameters. Please confirm.*

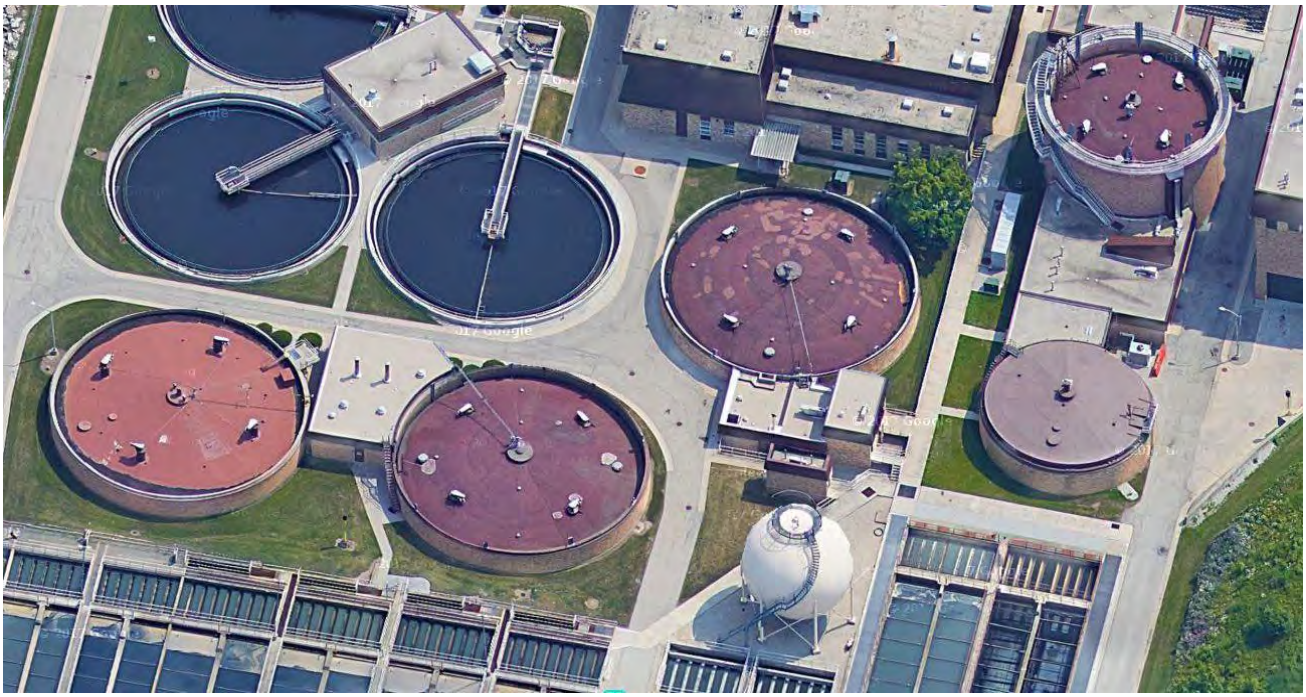


Figure 1 Existing Digester Layout

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PRODUCT HIGHLIGHTS

OVIVO® GASHOLDER STEEL COVER

Figure 2: Ovivo® G1VF Vertical Guided Steel Cover

Ovivo provides a variety of digester steel covers. Each digester cover is constructed as a dome-shaped segment of a sphere, offering maximum strength and structural integrity. The digester steel covers are radial beam designed to be erected quickly and efficiently, this is a simple, rigged structural design. The thrust ring is installed at the periphery of each cover to absorb all design loads without transmitting excessive forces to the concrete digester wall. During erection, the cover is supported by radial beams attached to a center ring and the thrust ring which add strength to the complete unit.

Ovivo's radial beam design uses an added side sheet and ballast for digester gas storage. Submerged ballast blocks are used to maximize cover stability and maintain adequate gas pressure. The vertical guides are attached to the tank wall. Guide devices, spanning from the top to the bottom of the cover side-sheet, are engaged to stabilize the cover and protect the cover from substantial wind loads.

TECHNICAL DATA

For this application and based on the design parameters, Ovivo recommends One (1) Ovivo® 90 G1VF Vertical Guided Steel Covers to be installed on both digester B &D.

Model	**90 G1VF**
Type	Ovivo® Vertical Guided Steel Cover
Size	90'Ø
Max Side Sheet Length	48 in
Gas Storage[1]	4,900 ft^3
Total Weight [2]	130,300 lbs
Estimated Field Welding[2]	4,200 ln ft
Estimated Field Painting (Inside and Outside)[2]	16,900 sq ft

[1] The gas storage capacity is based on the operating pressure and the side sheet length. Any modification to the skirt length will change the estimate cost and gas capacity.

[2] The weights and loads are estimates only, these values will be updated with final values after approved submittals.

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Ovivo's scope of supply does not include installation. We provide the estimate weight, welding and painting requirements only. The final values will be provided after approved submittals. The above field welding estimate was based on the overall welding requirements on Figure 2.

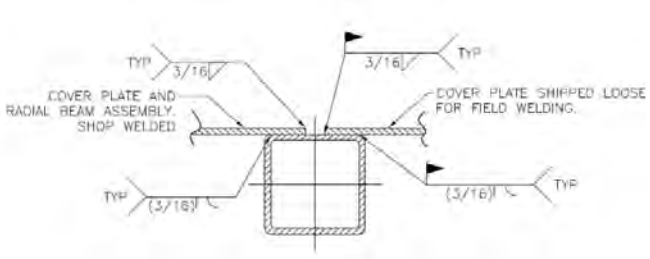

Figure 3: Typical Weld Detail for Radial Beam Connections

BUDGET INFORMATION[1]

Model	90 G1VF	90 G1VF
Quantity	One (1)	Two (2)
Total Price	**$555,000**	**$1,075,000**

[1] *All prices in US Dollars.*

SCOPE OF SUPPLY

Items Included
One (1) 102"Ø center ring with cover plate, flange bolts, nuts and gasket
Two (2) 36"Ø manholes with bolts, gaskets and cover flange. Covers provided by others
Six (6) 8"Ø sample tubes. Covers provided by others
One (1) 6"Ø flanged open nozzle for PRVB assembly. Valves provided by others
One (1) 37"Ø Draft tube mixer ports
One (1) 24"Ø Gas bonnet
Necessary Steel Cover Components such as: - Erection Beams - Cover Plates - Epoxy anchoring assemblies - Side Skirt Sections including ballast support brackets
Nine (9) Slide Guides, with chemical type anchors, as follows: - Slide guides mounted to the concrete tank, HDG - Slide guides mounted to the cover, 304 Stainless Steel - UHMW wear strips on three sides
Side skirts sections with 4 ft long side sheet plates
Mild Steel construction except as noted
EZ Rect™ System
Operation and Maintenance manuals
Service as noted in the "Field Service" segment of this proposal section
FCA Factory, Freight allowed to the jobsite
Items Not Included (But Not Limited To The Following)

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Ballast blocks
Gas handling equipment, unless included above
Valves, unless included above
Sample tube covers
Cover position indicators
Sight glasses
Walkways, stairs, steps, ladders, unless included above
Handrails grates, platforms, grating, unless included above
Piping, fittings, tubing and pipe supports
Coating, prime paint, field touch up or finishing painting
Flange bolts, nuts and gaskets
Grout, Insulation or Roofing
Cover sealant, filling material, caulking, oakum or asphalt
Modifications digester tank or other equipment
Installation
Testing, testing materials and / or testing equipment
Conduit, wiring, or any other control or electrical items
Any items not specifically listed in the “Items Included” table

ADDITIONAL INFORMATION

FIELD SERVICE

Ovivo’s scope includes the service of a qualified service engineer for the following:
One (1) trip of two (2) days total of service, per digester at the site for the supervision of equipment start-up, testing supervision, and instructing the operators.
Additional service days can be purchased at the current rate.

ESTIMATED LEAD TIMES

Submittals: Eight (8) weeks after Purchaser’s receipt of Ovivo’s written acknowledgement of an approved purchase order.
Shipping: Twenty-four (24) weeks after receipt of approved drawings from Purchaser.

EZ-RECT™ SYSTEM

The EZ-Rect™ cover erection system is a feature with the digester cover. Ovivo will provide the digester cover with cover plate/radial beam sections pre-assembled and finish welded in the shop to facilitate the erection of the cover. Each assembly will consist of two (2) beams and one (1) cover plate.

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Ovivo offers this option to reduce the amount of field welding required to erect a cover of this diameter. **This will reduce the total amount of field welding for the digester steel cover.** Furthermore, this will reduce the number of pieces to be handled during erection.

Ovivo suggests a careful consideration of the various offerings in regards to the amount of field welding disclosed by the cover manufacturers. The variance in the various estimates should be within a reasonable amount of the quantity expressed in this proposal. Ultimately, the Contractor is required to make their own estimate of welding requirements.

Painting: The cover side sheets are shipped unpainted, so all necessary cleaning, sandblasting and painting must be done progressively as the assembly proceeds. Be aware that the side sheets will be difficult to paint if they are installed inside the tank. Do not paint within 3 inches of all areas to be welded. It is also imperative that all welds are per the erection drawings and gas tight. Therefore, the erector must be able to certify that no leaks exist prior to painting.

Cover erection is completed in five steps:

1. Side Sheet Assembly
2. Center Ring and Erection Beam Installation
3. EZ-Rect Cover Plate Assembly Installation
4. Remaining Cover Plate Installation
5. Manholes, Spools, Tubes, Etc., Installation

TESTING

After field erection is complete, the Contractor shall test the covers for gas tight construction by filling the tank with water and trapping air under the cover plates. All welded seams and appurtenances shall be checked for leaks by means of a soap suds solution.
The air pressure underneath the dome during the test shall be not less than 14" W.C.

FINISHES

Steel plates, structural shapes and fabricated assemblies shall be shipped unpainted, for field painting by others. After erection, welding, testing and final inspection of erection by manufacturer's representative, the covers shall be painted (not by Ovivo).

GENERAL

The design of the digester steel cover does not fall under any specific code or standard for the design analysis. The current codes and standards are be used as guide lines for the design and analysis of the equipment. The analysis will result with a conservative approach that meets the intent of the present codes and standards.

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EQUIPMENT LAYOUT

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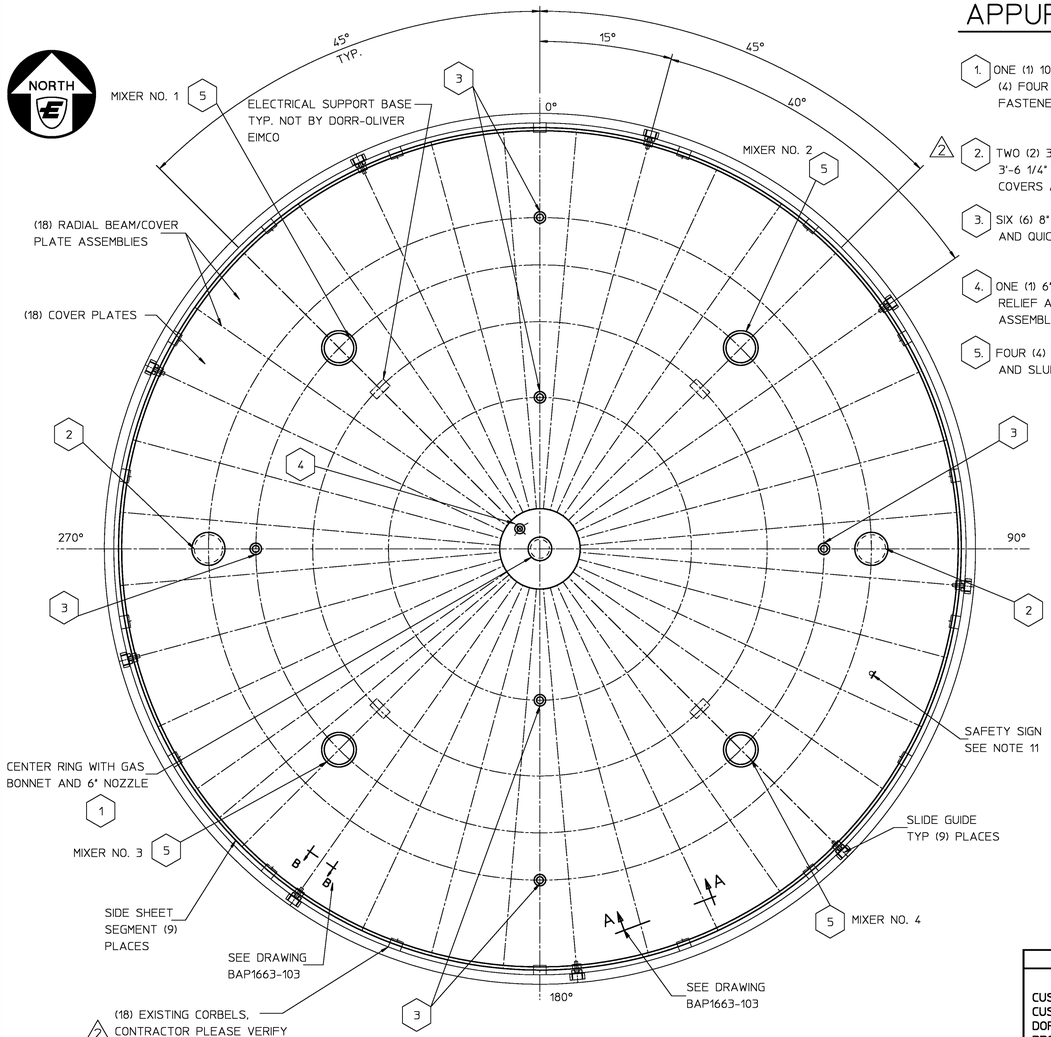
APPURTENANCES :

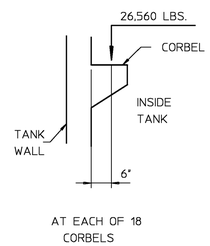
1. ONE (1) 102" DIA. CENTER COMPRESSION RING WITH BOLTED AND GASKETED COVER, (4) FOUR LIFTING HANDLES; 24" DIA. GAS BONNET WITH COVER AND GASKET. ALL FLANGE FASTENERS ARE TO BE A307 HDG.
2. TWO (2) 36" DIAMETER FLANGED MANHOLES WITH (42) 7/8" DIA. MOUNTING HOLES ON 3'-6 1/4" BOLT CIRCLE. MOUNTING FLANGE IS 3/8" PLATE FOR COVER MOUNTING. COVERS ARE NOT BY DORR-OLIVER EIMCO.
3. SIX (6) 8" SCH. 20 SAMPLE TUBES WITH OPEN FLANGE. FASTENERS, GASKETS, AND QUICK OPENING HATCH ARE NOT BY DORR-OLIVER EIMCO.
4. ONE (1) 6" FLANGED OPEN PIPE NOZZLE FOR MOUNTING PRESSURE/VACUUM RELIEF ASSEMBLY. FASTENERS, GASKET AND PRESSURE/VACUUM RELIEF ASSEMBLIES - NOT BY DORR-OLIVER EIMCO.
5. FOUR (4) 37 " DIA. OPEN FLANGED MIXER PORTS. GASKET, FASTENERS AND SLUDGE MIXERS ARE TO BE ACCORDING TO DRAWING BAP1663-301.

NOTES:

1. FOR GENERAL NOTES SEE DRAWING BAP1663-102.
2. WORK THIS DRAWING WITH DRAWINGS BAP1663-102. BAP1663-103 AND BAP1663-104.



DIGESTER A -- PLAN VIEW



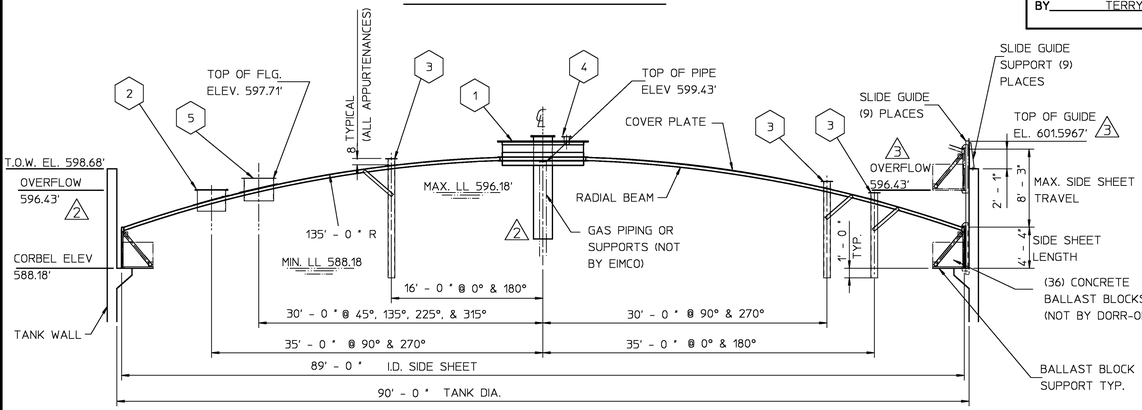
NOTE:
MAXIMUM LOADS
FOR DIGESTER TANK WALL

DIGESTER COVER LOADINGS

THIS DRAWING IS CERTIFIED FOR

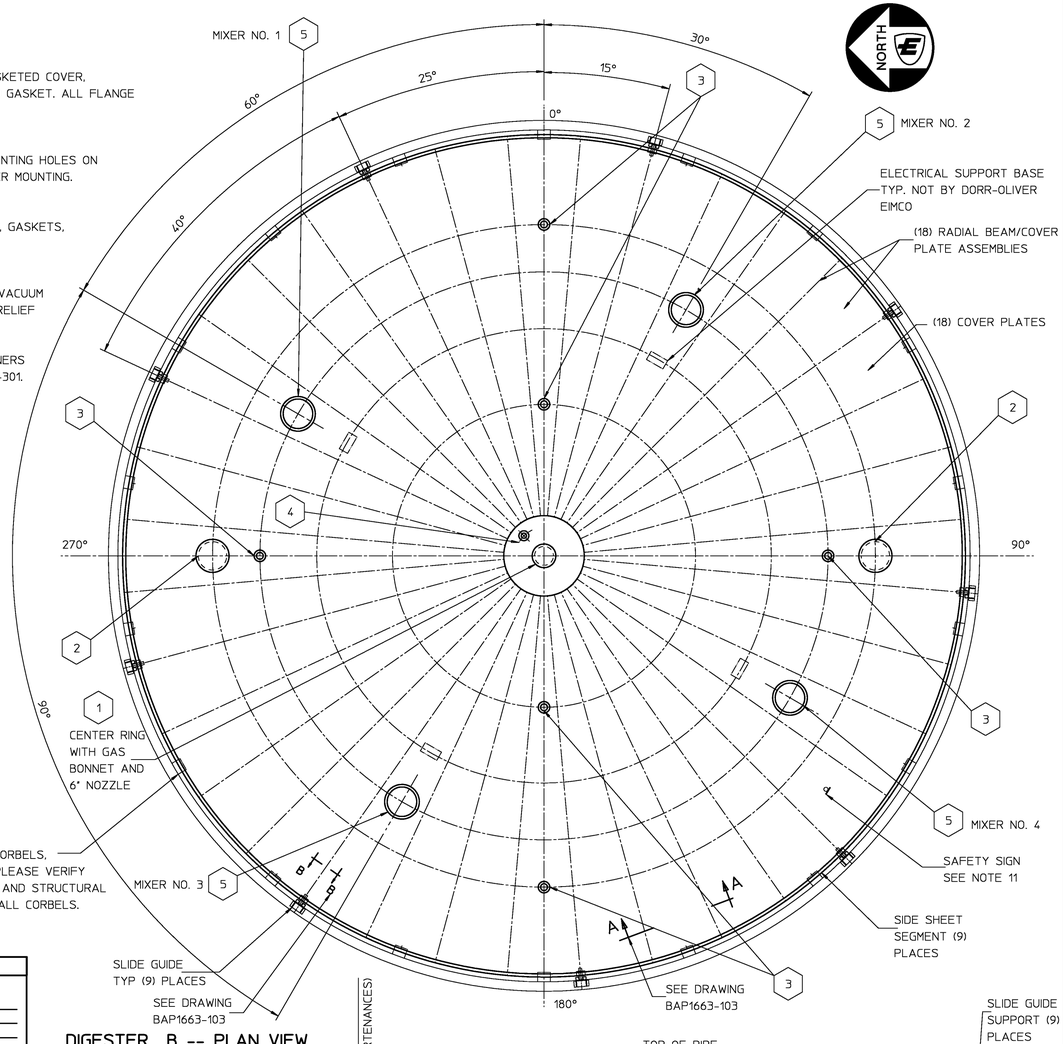
CUSTOMER	ADVANCE MECHANICAL CONTRACTORS, IND.
CUSTOMER ORDER NUMBER	32061T-32DM062
DORR-OLIVER EIMCO NUMBER	BAP1663-100
PROJECT	RACINE WWTP
PROJECT LOCATION	RACINE, WI
CONSULTING ENGINEER	EARTH TECH - APPLIED TECHNOLOGIES
BY	TERRY R. PRICE P.E. DATE 09-30-02

DORR-OLIVER EIMCO

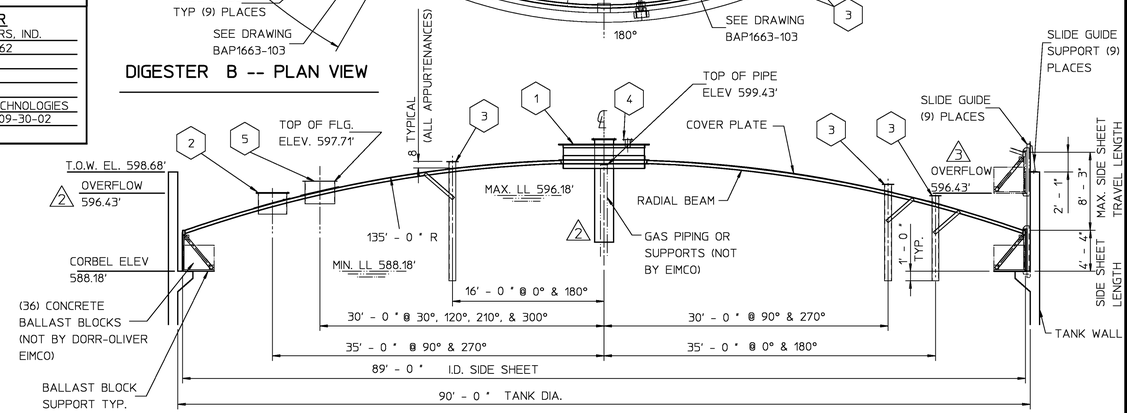


ILLUSTRATIVE SECTION -- DIGESTER A

DEGREES SHOWN REFER TO ORIENTATION OF APPURTENANCES WITH RESPECT TO "REF." ℄ CLOCKWISE



DIGESTER B -- PLAN VIEW



ILLUSTRATIVE SECTION -- DIGESTER B

DEGREES SHOWN REFER TO ORIENTATION OF APPURTENANCES WITH RESPECT TO "REF." ℄ CLOCKWISE

DORR-OLIVER EIMCO — A GE ZENON COMPANY

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D

Rev G (12/02)

REVISION	EN	BY	APPR.	DATE
REVISED PER ENGINEER'S COMMENTS, ADDED DIMENSIONS	19547	JLQ	JRS	3-24-03
REVISED PER ENGINEER'S COMMENTS	19067	JLQ	JRS	1-20-03
INITIAL RELEASE				

DO NOT SCALE PRINTS | FILE SPEC. BAP1663-101 | REF. FROM | ORG S.O.

DATE 9-30-02 | DRAWN TRP | CHECK'D JRS | APPR. TRP

GENERAL ARRANGEMENT

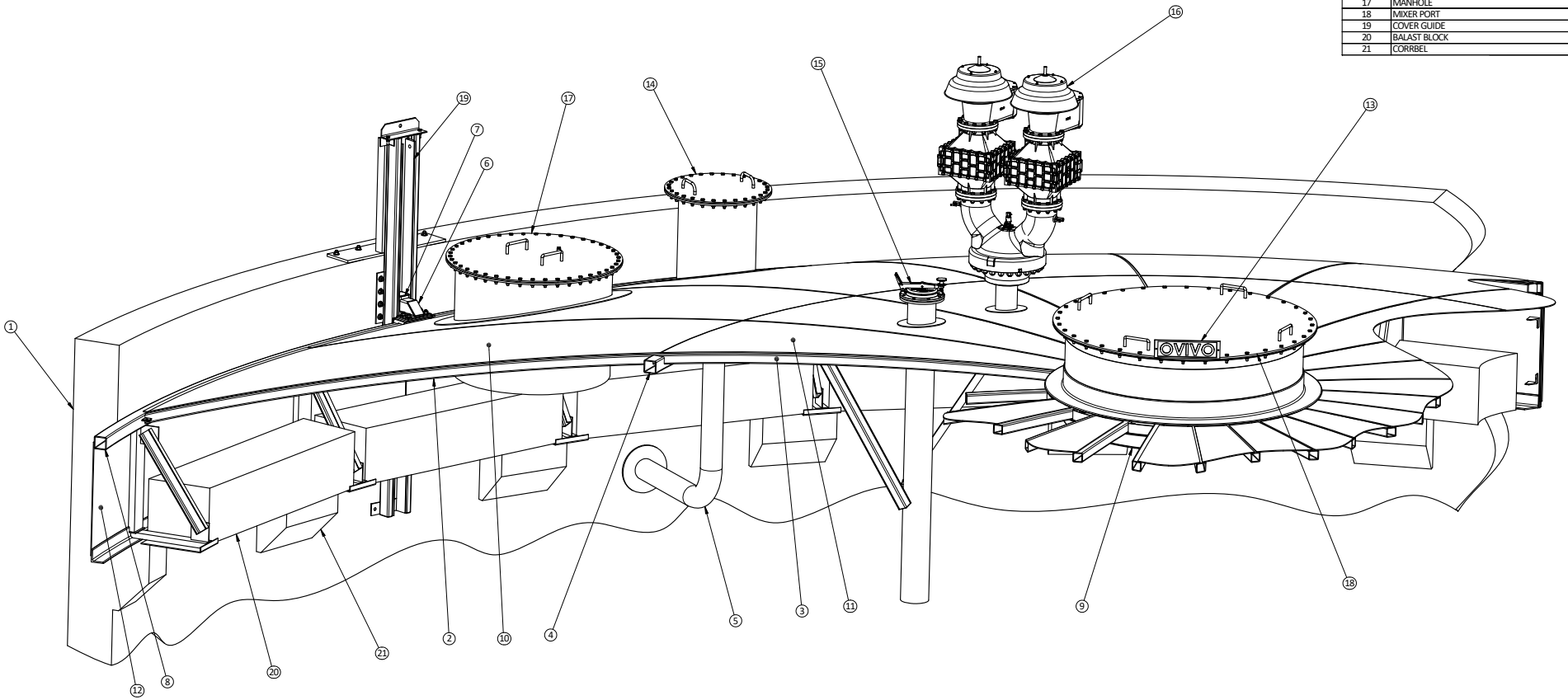
90 FT DIA. G1VF DIGESTER COVER

A.D.N. BAP1663-100

SHEET 1 OF 1

DWG. No. BAP1663-101 REV. 3

ITEM	DESCRIPTION
1	DIGESTER TANK WALL
2	OUTER ERRECTION BEAM
3	INNER ERRECTION BEAM
4	INTERMEDIATE THRUST RING
5	GAS TAKE-OFF PIPE
6	COVER SUPPORT
7	COVER SLIDE
8	THRUST RING
9	CENTER COMPRESSION RING
10	OUTER COVER PLATE
11	INNER COVER PLATE
12	SIDE SKIRT
13	NAME PLATE
14	GAS BONNET
15	SAMPLE TUBE
16	PRESSURE RELIEF - VACUUM BREAKER
17	MANHOLE
18	MIXER PORT
19	COVER GUIDE
20	BALAST BLOCK
21	CORRBEL



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D

THIRD ANGLE PROJECTION

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REF. FROM	DO NOT SCALE PRINTS
DATE [month/day/year]	3/13/2014

WORKMANSHIP STANDARD ES0001 APPLIES

OVIVO
Bringing water to life

**TYPE G1V
FLOATING
DIGESTER COVER**

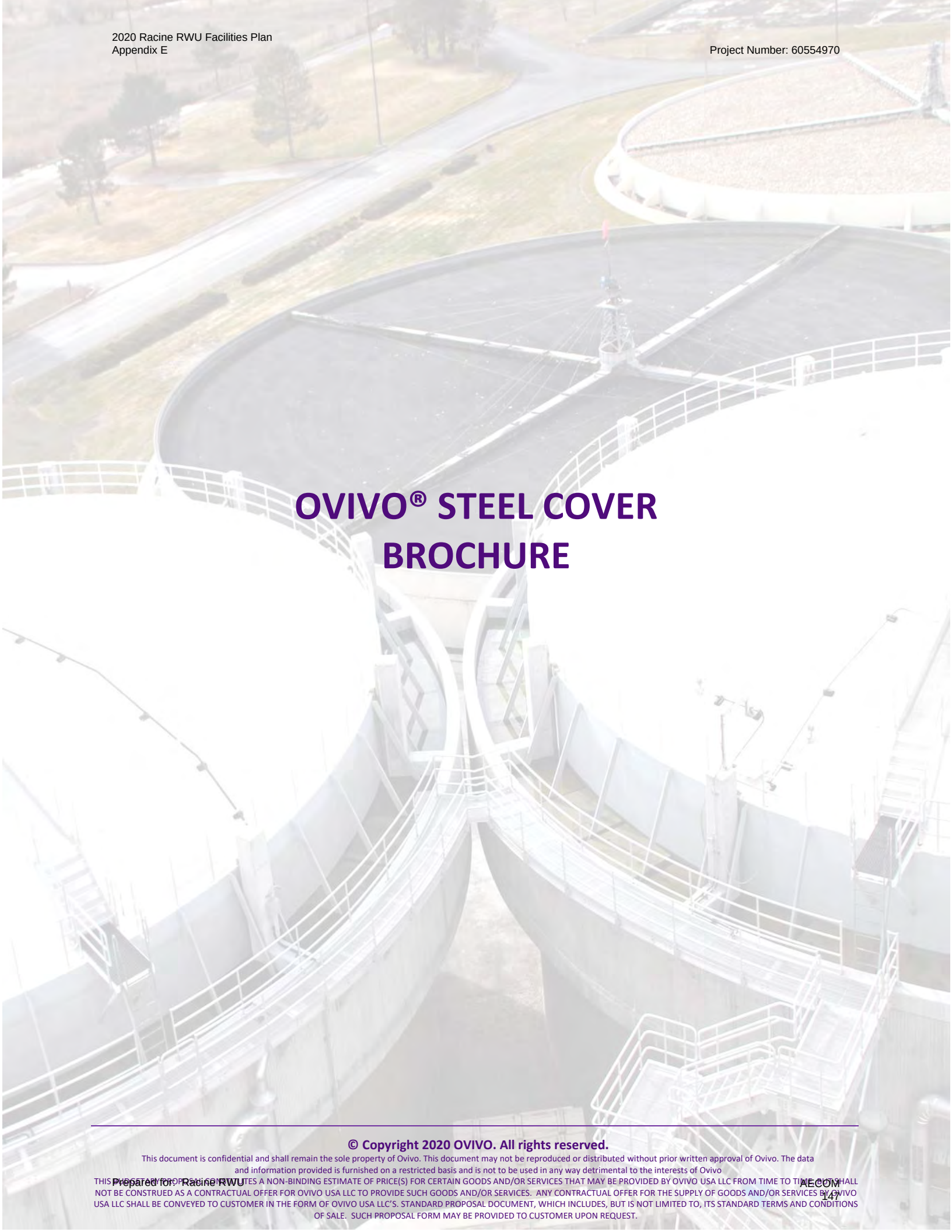
REVISION DESCRIPTION	EN/ECO	BY	CHECK'D	DATE	REV
INITIAL RELEASE					A

DRAWN	JLQ	ORIGINAL S.O.
CHECK'D	EMH	

DWG. NO. -

SHEET 1 OF 1

REV



OVIVO® STEEL COVER BROCHURE

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MUNICIPAL WATEWATER
ANAEROBIC DIGESTION

COST EFFECTIVE SLUDGE STABILIZATION

- Simple installation operation & maintenance
- Flexible design to suit many applications
- Variable sludge storage capabilities
- No moving parts for simplified maintenance
- 30+ year life span

Easy to insulate using commonly available roofing materials. Call us at 1.855.GO.OVIVO to learn more!

OVIVO® ANAEROBIC DIGESTER STEEL COVERS

OVIVO® ANAEROBIC DIGESTER STEEL COVERS

A VARIETY OF STEEL DIGESTER COVERS

Ovivo provides a variety of steel digester covers. Each cover is constructed as a dome-shaped segment of a sphere, offering maximum strength and structural integrity. The steel digester covers are radial beam designed to be erected quickly and efficiently. A thrust ring is installed at the periphery of each cover to absorb all design loads without transmitting excessive forces to the digester wall. During erection, the cover is supported by radial beams attached to a center ring and the thrust ring which add strength to the complete unit.

Our radial beam design includes the following configurations: Fixed, Gasholder, HydroSeal® type and Buoyant steel cover. Ovivo will provide the best option for each application based on the customer needs.

Spanish Fork STP, UT (50' F1) :

Fixed Steel Cover Installation

Salt Lake City WRF, UT (90' G2VL) :

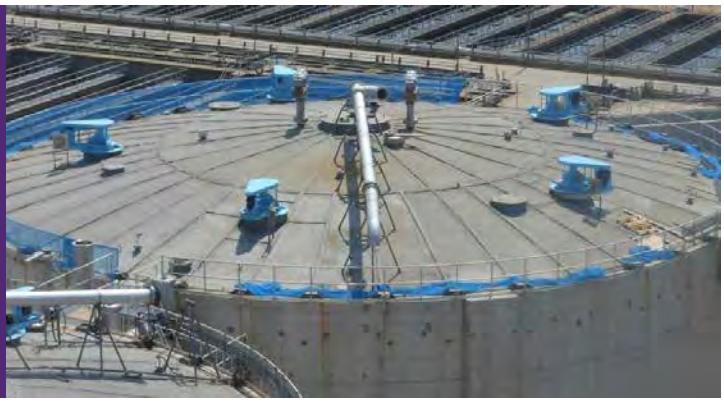
Gasholder Steel Cover Installation

Honouliuli WWTP, HI (90' G2VL):

Gasholder Steel Cover

DC WASA, DC (98.5' F2) :

Fixed Steel Cover



A NUMBER OF BENEFITS

- The use of radial beams allows the cover to be erected quickly and efficiently.
- Ovivo's cover design is compatible with all our available mixing systems to ensure adequate anaerobic digestion process.
- The covers are designed based on the requirements specified for each application, using the latest structural standards.
- A variety of accessories are available with our covers to effectively interface with the consulting engineer's design and comply with the customer requirements.

FIXED STEEL COVER (TYPE F)

The Type F cover is the most economical steel cover. The main application is on digesters with constant water level (primary or first stage digesters). The Fixed covers can be sealed against the tank to combat odors. For this design, the side sheet should be extended below the minimum liquid level. Otherwise, two options are recommended: 1) the supplier of the filler material should confirm that it can withstand the operating pressure 2) an independent clean liquid launder should be provided that allows for a pressure seal at any given sludge level (Contact Ovivo for additional details for this option).

GASHOLDER STEEL COVER (TYPE GV)

The Type GV uses the radial beam design structure with added side sheet and ballast for digester gas storage. Submerged ballast blocks are used to maximize cover stability and maintain adequate gas pressure. The design includes a vertical guide arrangement with guides attached to the tank wall. Guide devices, spanning from the top to the bottom of the cover side sheet, are engaged to stabilize the cover.

HYDROSEAL® STEEL COVER (TYPE GVL)

The separate launder and liquid seal between the digester tank and the cover eliminates gas and VOC emissions, improves service access and improves the maintenance access.

This design allows variable sludge storage capabilities since the side sheet operates independent of sludge storage in clean area. No components come in contact with the sludge.

BUOYANT STEEL COVER (TYPE B)

The Type B uses the radial beam design structure including a peripheral buoyant chamber. The cover floats directly on the digester contents. Precast concrete ballast blocks are placed to maintain a specified gas pressure. A major portion of the buoyant volume which keeps the cover afloat is located at the cover periphery; this feature provides an excellent resistance to tipping. The slide guide system will provide vertical movement without rotation or binding.

OVIVO® ANAEROBIC DIGESTER STEEL COVERS

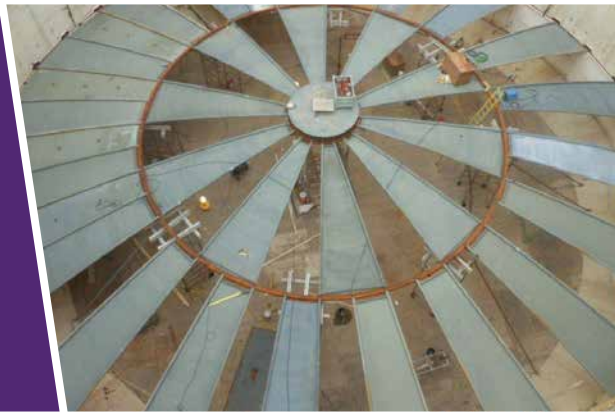
EZ-RECT™ SYSTEM

The EZ-RECT™ cover erection system is a feature with the digester cover. Ovivo offers this option to reduce the amount of field welding.

Ovivo will provide the digester cover with cover plate/radial beam sections pre-assembled and finish welding in the shop to facilitate the erection of the cover. Each assembly will consist of two (2) beams and one (1) cover plate.

COVER ERECTION IS COMPLETED IN FIVE STEPS:

1. Side Sheet Assembly
2. Center Ring and Erection Beam Installation
3. EZ-Rect Cover Plate Assembly Installation
4. Remaining Cover Plate Installation
5. Manholes, Spools, Tubes, Etc., Installation



ANCILLARY EQUIPMENT

Ovivo can supply all plant required equipment for a complete Sludge Treatment / Anaerobic Digestion plant, including but not limited to:

- Ultrastore™ Membrane Gasholder
- Eimix® Mechanical Sludge Mixer
- LM™ Mixer
- Sonolyzer™ Ultrasound Sludge Disintegrator

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UNISON SOLUTIONS

Leaders in Biogas Technology

BUDGET PROPOSAL
GAS CONDITIONING SYSTEM

Date: 02/10/2020
Expires: 30 Days

Bryan Lewis
AECOM

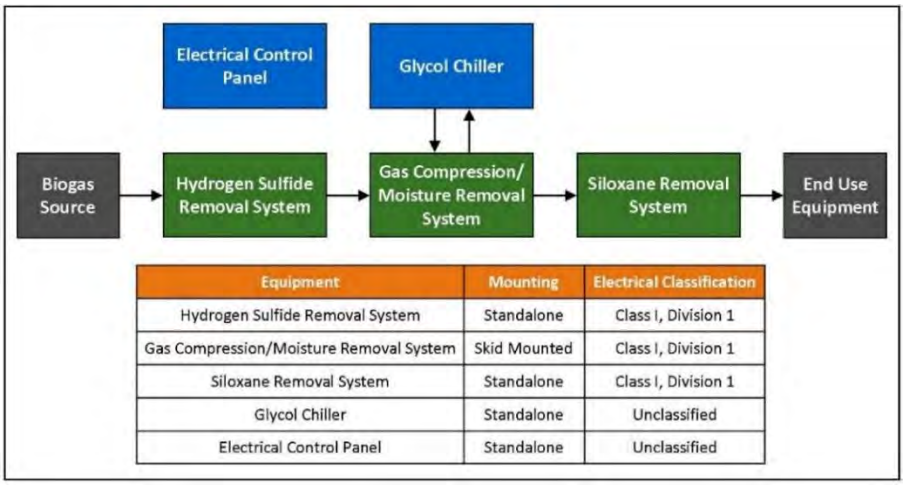
Proposal Number: PX-120-3088.1
Project Name: Racine WWTP – 175scfm

Unison Solutions, Inc. is pleased to provide this **BUDGET** proposal for a Gas Conditioning System for the Racine WWTP Project. This **BUDGET** proposal includes all of the CAD design services, technician labor, fabrication and materials to construct a Gas Conditioning System.

Thank you for giving Unison Solutions the opportunity to provide you with the enclosed proposal. If you have questions or require additional information, please contact me at your convenience.

Sincerely,

Eric Wilgenbusch
Unison Solutions, Inc.
Phone: 563-585-0967
Cell: 563-543-0559



Equipment	Mounting	Electrical Classification
Hydrogen Sulfide Removal System	Standalone	Class I, Division 1
Gas Compression/Moisture Removal System	Skid Mounted	Class I, Division 1
Siloxane Removal System	Standalone	Class I, Division 1
Glycol Chiller	Standalone	Unclassified
Electrical Control Panel	Standalone	Unclassified

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UNISON SOLUTIONS, INC. CERTIFICATIONS

- ASME Certification Number (U-Stamp) - 37,381
- ASME Certification Number (R-Stamp) - R7415
- UL Certification Number - 20110405-E255550

EQUIPMENT/SUB-SYSTEMS

HYDROGEN SULFIDE REMOVAL SYSTEM

- Hydrogen Sulfide Removal Media Vessel
- Work Platform and Ladder
- Initial Charge of H_2S Removal Media

GAS COMPRESSION/MOISTURE REMOVAL SYSTEM

- Gas Blower Inlet Moisture/Particulate Filter
- Gas Blower
- Dual Core Heat Exchanger
- Gas Recirculation
- Skid Base

TEMPERATURE CONTROLLED ENCLOSURE

- Steel Exterior
- Heater
- Ventilation Fan and Intake Louvers
- LEL with Beacon Light
- LED Light Fixtures

GLYCOL CHILLER

- Glycol Chiller
- Initial fill of Propylene Glycol/Water Mixture

SILOXANE REMOVAL SYSTEM

- Siloxane Removal Media Vessels
- Work Platform and Ladder
- Initial charge of Siloxane Removal Media
- Siloxane Removal Final Particulate Filter

CONTROL SYSTEM

- Gas Conditioning System Control Panel
- Transformer

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DESIGN CONDITIONS

SITE INFORMATION

- Minimum Ambient Temperature	0°F
- Maximum Ambient Temperature	100°F
- Site Elevation	0-1,000’ AMSL

SYSTEM REQUIREMENTS

- Minimum Gas Flow	0 scfm
- Maximum Gas Flow	175 scfm

INLET GAS CONDITIONS

- Minimum Inlet Gas Pressure	0”WC
- Maximum Inlet Gas Pressure	10”WC
- Minimum Inlet Gas Temperature	80°F
- Maximum Inlet Gas Temperature	100°F
- Relative Humidity	100%
- Methane (CH_4)	50-62%
- Carbon Dioxide (CO_2)	38-50%
- Nitrogen (N_2)	<1%
- Oxygen (O_2)	<1%
- Hydrogen Sulfide (H_2S)	1,000 ppmv
- VOCs & Siloxanes	<2,000 ppbv

DISCHARGE GAS CONDITIONS

- Discharge Gas Pressure	5.0 psig
- Discharge Gas Temperature	80°F
- Dew Point Temperature	40°F
- Maximum Hydrogen Sulfide	<10 ppmv
- Maximum Siloxane	<100 ppbv
- Particulate Removal	99% removal of >3 micron

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SITE REQUIREMENTS

ELECTRICAL CLASSIFICATION

- NEC Class I, Division 1 Group D Areas
    - Hydrogen Sulfide Removal System
    - Gas Compression/Moisture Removal System
    - Siloxane Removal System
- Unclassified Electrical Areas
    - Glycol Chiller
    - Gas Conditioning System Control Panel
    - Transformer

EQUIPMENT MOUNTING

- Skid Mounted
    - Gas Compression/Moisture Removal System
- Standalone
    - Hydrogen Sulfide Removal System
    - Glycol Chiller
    - Siloxane Removal System
    - Gas Conditioning System Control Panel
    - Transformer

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EQUIPMENT/SUB-SYSTEM DETAILS

HYDROGEN SULFIDE REMOVAL SYSTEM

- (1) Hydrogen Sulfide Removal Media Vessel

    - 8'Ø x 14' straight side
        - 9' of media bed depth
    - Rated for 5psig pressure and 1psig vacuum
    - Materials of construction shall be 304L stainless steel
    - 150# ANSI B16.5 side inlet and outlet connections
    - Flanged and dished top and bottom heads
    - Vessel shall be free-standing on four 304L stainless steel legs
    - Vessel equipped with a 24" top manway
    - Vessel equipped with a 24" side manway
    - Internal supports and grating for media
    - Pressure/Vacuum relief valves included
    - Two top vents with stainless steel ball valves
    - Bottom manual condensate drain with stainless steel ball valves
    - Interconnection pip.

- Work Platform and Ladder

    - Work platform shall be welded carbon steel construction with satin black powder coat finish
    - Ladder shall be galvanized steel construction

- Initial Charge of Media

    - The initial charge of media for each Hydrogen Sulfide Removal Media Vessel will be provided.
    - Media to be loaded into Hydrogen Sulfide Removal Vessel by INSTALLATION CONTRACTOR

GAS COMPRESSION/MOISTURE REMOVAL SYSTEM

- Gas Blower Inlet Moisture/Particulate Filter

    - Mounted upstream of the Gas Blower
    - 99% removal of 3micron and larger particulates and liquid droplets
    - Materials of construction shall be 304L stainless steel
    - 150# ANSI B16.5 side inlet and outlet connections
    - Cleanable polypropylene structured mesh element
    - Differential pressure gauge across the filter element
    - Sight glass for liquid level indication
    - Level switches above the condensate drains to warn of failure
    - Bottom drain with strainer, condensate pump, manual bypass and piping

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- Gas Blower

    - One Rotary Lobe Positive Displacement Blower rated for 175scfm
    - Belt driven 10Hp, 480V/3Ph/60Hz EXP electric motor
    - Motor speed will be controlled by a VFD
    - Cast iron casing
    - Inlet and discharge flex connectors
    - Discharge silencer
    - Discharge check valve
    - Discharge pressure safety valve
    - Belt guard

- Dual Core Heat Exchanger

    - Stage 1 - Gas to gas plate/fin core
        - Materials of constructions shall be aluminum plate and fins
    - Stage 2 - Gas to glycol fin/tube core
        - Materials of construction shall be aluminum fins on 304L stainless steel tubes
    - Mounted in single 304 stainless steel housing
    - 150# ANSI B16.5 inlet and outlet connections
    - All condensation generated during cooling will be removed inside the heat exchanger housing
    - Level switch mounted on the housing to warn of drain failure
    - RTD mounted on the housing to verify the coldest temperature that the gas reaches
    - Bottom drain with strainer, float drain, manual bypass and piping

- Gas Recirculation

    - Modulating Valve shall be provided to allow excess gas to flow from the discharge of the system back to the inlet. This valve shall be controlled by monitoring the delivery pressure of the system.
        - V-port Ball Valve
        - Type 7 explosion proof actuator
        - 120V weatherproof

- Skid Base

    - Welded carbon steel construction with satin black powder coat finish
    - All components mounted, piped and wired on skid base
    - 24V and 120V electrical components wired to one of two junction boxes on edge of skid
    - INSTALLATION CONTRACTOR to provide conduit and wiring to 480V components
    - Conduit shall be rigid aluminum
    - Condensate drains piped to edge of the skid base. Drains to be routed to floor drain by INSTALLATION CONTRACTOR.

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GLYCOL CHILLER

- Glycol Chiller
  - Sized for the process heat load
  - Suitable for outdoor installation
  - Refrigeration System
    - One refrigeration circuit
    - One compressor sized for 100% capacity
    - Chiller capacity: 25% to 100% of rated capacity
    - EC motor driven condenser fans
    - Aluminum micro-channel air cooled condensers
    - 316L stainless steel evaporator
    - R410a refrigerant. R-410a is an HFC refrigerant with 0 ODP
    - Refrigeration circuit has sealed core filter drier, liquid line solenoid valve, liquid line shut-off valve, and sight glass/moisture indicator
    - Electronic expansion valve
    - Glycol Chiller shall be factory tested and shipped with complete refrigerant charge
  - Glycol Circulation
    - One glycol circulation pump sized for 100% capacity
    - Stainless steel end suction centrifugal pump
    - TEFC Pump Motor
    - Pump isolation valves on inlet and outlet
    - Pump discharge check valve
    - Glycol reservoir is a 304 stainless steel closed tank
    - Glycol piping is copper with anti-corrosion coating
    - Armaflex insulation
    - Glycol Chiller to utilize propylene glycol/water mix
    - Initial fill of Propylene glycol will be provided
  - Support Structure
    - G90 galvanized steel base
    - Powder-coated steel cover panels
    - All components mounted, piped and wired on skid
  - Glycol Chiller Control Panel
    - UL Type 4
    - UL 508A Listed Industrial Control Panel
    - Powder coated carbon steel
    - 480V/3Ph/60Hz feed will be required
    - 480V disconnect
    - Microprocessor based controller with full text LCD display
    - 480VAC to 24VAC transformer
    - Phase monitor to protect against loss of phase, unbalance or reversal

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SILOXANE REMOVAL SYSTEM

- (2) Siloxane Removal Media Vessels

  - 3’6”Ø x 10’ straight side
    ≈ 8’ of media bed depth
  - Materials of construction shall be 304L stainless steel
  - 150# ANSI B16.5 inlet and outlet connections
  - Flanged and dished top and bottom heads
  - Vessels shall be free-standing on four 304L stainless steel legs
  - Flanged access nozzle on top of each vessel
  - Internal septas for even gas distribution through media
  - Pressure relief valves included
  - Bottom manual condensate drain with stainless steel ball valves
  - Test/purge ports with ball valves on the inlet and outlet of each Siloxane Removal Media Vessel
  - Lead/Lag piping and valves between Siloxane Removal Media Vessels will be provided

- Work Platform and Ladder

  - Work Platform shall be welded carbon steel construction with satin black powder coat finish
  - Ladder shall be galvanized steel construction

- Initial charge of Siloxane Removal Media

  - The initial charge of siloxane removal media for each Siloxane Removal Media Vessel will be provided.
  - The media shall be specifically engineered for removal of siloxanes and similar contaminants from landfill and digester gas sources.
  - Siloxane media to be loaded into the Siloxane Removal Media Vessels by the INSTALLATION CONTRACTOR.

- Siloxane Removal Final Particulate Filter

  - Mounted downstream of the Siloxane Removal Vessels
  - 99% removal of 3 micron and larger particulates and liquid droplets
  - Materials of construction shall be 304L stainless steel
  - 150# ANSI B16.5 side inlet and outlet connections
  - Cleanable polypropylene structured mesh element

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CONTROL SYSTEM

- Gas Conditioning System Control Panel
  - Enclosure
    - UL Type 4
    - UL 508A Listed Industrial Control Panel
    - Painted carbon steel
    - Indoor location
  - Thermal Management *(as necessary)*
    - Rated for installation in ambient temperatures from 40°F to 104°F
    - Ambient Fan Cooled
  - Power Distribution
    - Fused Disconnect
    - 480V/3Ph/60Hz feed required
    - 35kA Short Circuit Current Rating
    - Over current and branch circuit protection via fuses
    - 480VAC field wiring to terminate at the component or terminal strips inside control panel
  - Surge Suppression
    - 480VAC Transient Voltage Surge Suppressor
    - 120VAC Surge Filter
  - Motor Control
    - (1) 10Hp rated 6 Pulse VFD for Gas Blower Motor
    - ½ HP Motor Starter/Overload for Condensate Pump
  - Programmable Logic Controller
    - Allen Bradley
    - Compact Logix PLC and I/O
    - Native Allen Bradley Ethernet IP data network
  - Human Machine Interface
    - Proface PFXGP4601TAD
    - TFT Color LCD Display
    - 12” diagonal
    - 800 x 600 pixels
  - Instrument wiring to terminate at terminal strips inside Control Panel

- Transformer
  - 3kVA
  - 480VAC to 120VAC
  - NEMA 3R; Painted carbon steel

TEMPERATURE CONTROLLED ENCLOSURE

- All electrical inside the enclosure is rated Class I Division 1
- Mounted to the Gas Compression/Moisture/Siloxane/CO_2 Removal Skid
- Steel stud construction
- Steel exterior with multiple color options for site esthetics. Color selected by owner from manufacturer’s standard color options.
- Fire retardant plywood on the outer side of the steel studs
- Insulated walls and ceiling

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- Green board (mildew resistant drywall) and/or fire-retardant plywood on the inner side of the studs
- White fiberglass reinforced plastic panel interior
- Lighted interior with EXP LED light fixtures
- Thermostatically controlled heater to prevent freezing
- LEL inside enclosure for gas detection and warning
- Ventilation fan and intake louver to prevent over heating inside enclosure
- Double steel entry doors

Notes:

- *Installation Contractor will be required to power the heater, ventilation fan and lights*
- *The equipment enclosure is designed to protect the equipment from weather and for sound reduction purposes. The design of the enclosure accounts for snow and wind loads based on the installation area. The equipment enclosure is not designed to meet national or local building codes and is in no way considered an occupiable space.*

INSTRUMENTATION

- All instrumentation provided will be designed for gas service and rated for use in a NEC Class I, Division 1 Group D area.
- Hydrogen Sulfide Removal System Instrumentation
    - Inlet Pressure Transmitter
- Gas Compression/Moisture Removal System Instrumentation
    - Inlet Pressure Transmitter
    - Level Switches at each Condensate Drain
    - Level Indicators at each Condensate Drain
    - RTD's (3 Wire-100Ω) at each Temperature Change Point
    - RTD (3 Wire-100Ω) to Monitor Glycol Temperature
    - Bi-metal Thermometers at each Temperature Change Point
    - Gas Blower Discharge Pressure Transmitter
- Siloxane Removal System Instrumentation
    - Delivery Pressure Transmitter

PIPING

- Pipe will be SA-312 TP304/304L Weld Pipe, minimum Schedule 10S. Threaded pipe shall be minimum Schedule 40S.
- Flange connections will be ANSI B16.5, SA-182 F304/304L Class 150.
- Pipe welding will follow ASME B31.3 Process Piping. Welded pipe will be visually inspected and pressure tested.
- Gaskets will be 1/16" nitrile bound non-asbestos ring gaskets.

VALVES

- Ball Valves
    - Stainless steel with PTFE or RTFE seat.
    - Valves will be full port.

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- Butterfly Valves
    - Lug style iron body with stainless steel disc and stem and FKM seat.
- Check Valves
    - Will be one of 2 styles; ball or dual-door.
        - Ball check valves shall be stainless steel with RTFE ball.
        - Dual-door check valves shall be wafer style body, material shall be aluminum and/or stainless steel with an FKM seat.
- Globe Valves
    - Stainless steel with PTFE packing

FASTENERS

- Fasteners shall be ASTM F593 304 Stainless Steel

SUBMITTALS

- Quantity: (3) copies of 3 ring binders and (1) electronic CD copy
- Shop Drawings and Product Data will be provided in sufficient detail to confirm compliance with the requirements for the project. Shop Drawings and Product Data will be provided in a complete submittal package.
- Shop Drawings
    - Installation drawings and specifically prepared technical data, including design capacities will be provided.
    - Specifically prepared wiring diagrams unless standard wiring diagrams are submitted with product data will be provided.
    - Written description of operation will be provided.
- Product Data
    - Catalog cuts and product specifications for each product specified will be provided.
    - Standard wiring diagrams unless wiring diagrams are specifically prepared and submitted with Shop Drawings will be provided.

FACTORY TESTING

- The Compression/Moisture Removal System will be tested on ambient air at Unison's facility.
- Media removal vessels will be hydrotested prior to shipment and will not be included in the Factory Testing.
- The CUSTOMER is allowed to witness the testing and Unison will inform the customer (2) weeks prior to anticipated testing date so customer can make travel arrangements.

OPERATION & MAINTENANCE MANUALS

- Quantity: (6) copies of 3 ring binders and (1) electronic CD copy
- After shipment the Gas Conditioning System will be provided with a specifically prepared Operation & Maintenance Manual. The information provided includes a system overview, operator interface, start-up/shut down procedures, communications, alarms procedures, maintenance overview, mechanical component spec sheets and electrical component spec sheets.

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MAINTENANCE

- Hydrogen Sulfide Removal System
    - Replace Foam Pad
    - Replace Hydrogen Sulfide Media (9.5' of media bed depth)
    - Estimated Media Cost =$22,000.00*
    - Approximate days to media exhaustion:
        187 Days @ 1,000 ppmv of H2S (147scfm)
        157 Days @ 1,000 ppmv of H2S (175scfm)

    **Labor for change out, disposal and shipping of media not included*

- Gas Compression/Moisture Removal System

    - Clean Gas Compressor Inlet Moisture/Particulate Filter
    - Change Blower Oil
    - Clean Glycol Chiller Condenser
    - Test Glycol for Freeze Point
    - Estimated Cost = $2,500.00*/Year

    **Technician Labor and travel expenses not included*

- Siloxane Removal System
    - Replace Siloxane Media (8' of media bed depth per vessel)
    - Estimated Media Cost =$15,000.00* (2 vessels)
    - Approximate days to media exhaustion: unknown with VOC data

    **Labor for change out, disposal and shipping of media not included*

ELECTRICAL PARASITIC

- Electrical Parasitic
    - *kW values are calculated using motor amperage data from Table 50.1 of UL 508A*

    - Gas Conditioning Skid
        - Condensate Pump = 1 kW
        - Gas Blower Motor = 11.6kW
        - Glycol Chiller = 31.5kW
        - Controls & Auxiliary Equipment = 4 kW

        Total = 41.8 kW (Full Load)
        Total = 38 kW (Average Run Load)

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DELIVERY SCHEDULE

- Submittals delivered **4** to **6** weeks after order acceptance
- Equipment delivery is subject to confirmation at the time of order placement and/or submittal approval

PRICING SUMMARY

- Price includes all labor and expenses associated with the fabrication of the system.
- Prices do not reflect any taxes that may be applicable and are valid for 30 days.
- Price is FCA; Factory, Dubuque, IA 52002, per Incoterms 2010. Shipping costs not included, see estimate below
- Price does not include Start-up and Commissioning. Costs are shown below
- Prices are in US Dollars
- Media Escalation: Media pricing is directly influenced by US imposed tariffs. Unison may adjust pricing for the media provided should there be future tariffs assigned to this product.

BUDGET Hydrogen Sulfide Removal System $105,000.00

BUDGET Gas Compression/Moisture Removal System $355,000.00

BUDGET Siloxane Removal System..... $115,000.00

BUDGET Temperature Controlled Enclosure $120,000.00

Shipping **ESTIMATE** to Racine $10,000-20,000.00
Cost is an estimate and is subject to change without notice. It does not include any special packaging or permitting that may be required and is dependent on the final equipment dimensions and weights.

Start-up and Commissioning Services **ESTIMATE** $15,500.00
Price includes Four (4) consecutive, 8 hour days, for one Unison Technician onsite with travel and expenses included. Additional days may be necessary to complete start-up and commissioning, they will be billed to the Buyer/Owner/End User at the cost of $1,500 per day, per technician, plus travel & expenses.

PAYMENT SCHEDULE

- 30% upon order acceptance
- 30% at midpoint of construction
- 30% upon equipment delivery
- 10% upon site acceptance not to exceed 180 days from shipment
- Net 30 days on all payments
- Payment by Credit Card is NOT accepted (for equipment)

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PROVIDED BY OTHERS

- VPN connection for remote access to Unison supplied equipment for troubleshooting and remote assistance.

PRICE DOES NOT INCLUDE

- Shipping of equipment to jobsite, in equipment pricing
- Start-up and commissioning services, in equipment pricing
- Wind or seismic calculations for all equipment
- Any maintenance work after start-up
- H_2S or Siloxane removal media after initial fill
- Performance guarantee or service/maintenance contract
- Any gas testing or analyses
- Bonds of any kind
- Clean Water State Revolving Fund American Iron & Steel (AIS) compliance, as it is exempt
- Permitting for the installation of the equipment or air permits
- Freeze protection; including insulation and/or heat trace and heat trace power
- Pipe stands for field piping
- Liquidated & Actual Damages are the sole financial responsibility of purchasing contractor

ASSUMPTIONS

VESSELS & MEDIA

- H_2S and VOC's present in the gas will foul Siloxane media, additional gas testing will be necessary to finalize all vessel and media requirements, budget pricing is dependent on gas data given at the time of the proposal.
- Any assumption of media life that has been given is an estimate; additional gas testing will be required at the Buyer/Owner/End Users expense.
- Vessel sizes are estimates only, gas testing will be necessary to finalize all vessel sizing.
- Media Escalation: Media pricing is directly influenced by US imposed tariffs. Unison may adjust pricing for the media provided should there be future tariffs assigned to this product.

MECHANICAL

- Flare is supplied by OTHERS
- If an existing flare is being used, it is assumed this flare is in good working order, with all safety and control equipment.
- Foundations and/or maintenance pads are designed by OTHERS to properly support the equipment.
- Gas conditioning/compression system may have heat rejection associated with cooling of the biogas/oil systems. Buyer/Owner/End Users are responsible for verifying heat load and providing proper ventilation if the unit is installed indoors.

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- Factory Testing is done for Compression/Moisture Removal Systems only. It is assumed that all equipment required, but not supplied by Unison, for Factory Testing will be supplied to Unison Solutions testing. This includes, but is not limited to motors, blowers, chillers, VFDs/motor starters and control panels. Shipping expenses involved with supplying this equipment to Unison will be paid by others.

ELECTRICAL

- 480V/3Ph/60Hz is available
- No historical data acquisition is included in this proposal

INSTALLATION CONTRACTOR RESPONSIBILITIES

- Installation responsibilities are broken out below into three categories to outline the work; these responsibilities by no means fall on any single contractor or individual. It is the responsibility of the Buyer/Owner/End User to ensure all these conditions are adhered to, as necessary. It is responsibility of the Buyer/Owner/End User to install all equipment in compliance with local and national codes applicable to the installation site.

BUYER/OWNER/END USER RESPONSIBILITIES

- All foundations and/or maintenance pads as necessary for equipment
- Provide and seal all roof and building penetrations as necessary
- Provide all anchor bolts, temporary lift equipment, power, labor, and all other incidentals required for proper installation of the equipment shown on the drawings that will be provided by Unison Solutions, Inc.
- All rigging and setting of equipment at job site
- Proper storage of the equipment and media prior to installation
- Provide installation of Equipment/Sub-systems per the Unison Solutions Installation Guide
- Load initial charge of Hydrogen Sulfide Media and Siloxane Media into the vessel(s)

MECHANICAL CONTRACTOR RESPONSIBILITIES

- Provide all field piping between the Equipment/Sub-systems, including but not limited to:
    - Hydrogen Sulfide Removal System
    - Gas Compression/Moisture Removal System
    - Glycol Chiller
    - Siloxane Removal System
- Provide pipe supports as necessary. Piping shall be self-supporting, and not supported off of the Unison supplied equipment.
- Install all field located or shipped loose devices
- Provide all Heat Trace and/or Insulation as necessary to provide proper freeze protection as defined by Unison Solutions.

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ELECTRICAL CONTRACTOR RESPONSIBILITIES

- Provide 480V/3Ph/60Hz feed to the Gas Conditioning System Control Panel and Glycol Chiller.
- Provide all field wiring and conduits between the Equipment/Sub-systems to the Gas Conditioning Control Panel and associated equipment. This includes but not limited to:
    - Hydrogen Sulfide Removal System
    - Gas Compression/Moisture Removal System
    - Glycol Chiller
    - Siloxane Removal System
    - Gas Conditioning System Control Panel
    - Transformer
- Provide local disconnects as necessary
- Provide all Hazardous location conduits & wiring systems per Article 500 of the NEC
- Provide conduit seals entering and/or leaving the Class I, Division 1 Electrical Area. Conduit seals will need to be filled during Start-up and Commissioning after verification of field wiring by Unison's Start-up Technician. Conduit seals are to be filled prior to the introduction of gas to the equipment.
- Provide heat trace power from local lighting panel, as necessary.

WARRANTY

- Unison Solutions, Inc. will warrant all workmanship and materials in conformance with the attached Warranty Statement. Warranty is valid for **18** months from the time the equipment is ready to ship from Unison's factory or **12** months from the date of startup, whichever occurs first.

- This proposal is for product design and equipment manufacturing only and does not include any site or consultative engineering services expressed or implied.

- Unison Solutions, Inc. will not release the PLC program for this system. This is considered proprietary and the intellectual property of Unison Solutions, Inc.

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UNISON SOLUTIONS

WARRANTY STATEMENT

Unison Sol ons, Inc. (Unison) is commi ed to providing quality products and services to its customers. As a demonstr on of this commitment, Unison o rs the following warranty on its products.

Grant of Warranty: Unison provides this warranty for its equipment under the terms and condi ons which are detailed herein. This warranty is granted to the person, corpor on, organiz on, or legal e ty (Owner), which owns the equipment on date of start-up. This warranty applies to the owner during the warranty period, and is not transferable.

Warranty Coverage: Equipment that is determined by Unison to have malfunc oned during the warranty period under normal use solely as a result of defects in manufacturing workmanship or materials shall be repaired or replaced at Unison's o on. Unison's liability under this warranty to the Owner shall be limited to Unison's decision to repair or replace, at its factory or in the eld, items deemed defec ve a er inspec on at the factory or in the eld.

Warranty Exclusions: All equipment, parts and work not manufactured or performed by Unison carry their own manufacturer's warranty and are not covered by this warranty. Unison's warranty does not override, extend, displace or limit those warran es. Unison's only oblig on regarding equipment, parts and work manufactured or performed by others shall be to assign to the Owner whatever warranty Unison receives from the original manufacturer. Unison does not warrant its products from malfunc on or failure due to shipping or storage damage, deterior on due to exposure to the elements, vandalism, accidents, power disturbances, or acts of nature or God. This warranty does not cover damage due to misapplic on, abuse, neglect, misuse, improper install on, or lack of proper service and/or maintenance, nor does it cover normal wear and tear. This warranty does not apply to modi c ons not speci cally authorized in wri ng by Unison or to parts and labor for repairs not made by Unison or an authorized warranty service provider. This warranty does not cover incidental or conseque al damages or expenses incurred by the Owner or any other party resul ng from the order, and/or use of its equipment, whether arising from breach of warranty, non-conformity to order speci c ons, delay in delivery, or any loss sustained by the Owner. No agent or employee of Unison has any authority to make verbal representa ons or warran es of any goods manufactured and sold by Unison without the wri en authoriz on signed by an authorized o er of Unison. Unison warrants the equipment designed and fabricated to perform in accordance with the speci c ons as stated in the proposal for the equipment and while the equipment is properly operated within the site speci c design limits for that equipment. Any alter ons or repair of Unison's equipment by personnel other than those directly employed by, or authorized by Unison shall void the warranty unless otherwise stated under speci c wri en guidelines issued by Unison to the Owner. This warranty does not cover corrosion or premature wear or failure of components resul ng from the e cts caused by siloxanes, hydrogen sul de or vol le organic compounds in excess of the design limits. All media must be purchased through Unison Sol ons or approved in wri ng by Unison Solu ons during warranty period. Media purchased though alternate sources and not approved in wri ng by Unison shall void the warranty. The design limit is based on site speci c gas data provided by the Owner prior to the proposal for the equipment. Owner shall be responsible for all maintenance service, including, but not limited to, lubric ng and cleaning the equipment, replacing expendable parts, media, making minor adjustments and performing oper ng checks, all in accordance with the procedures outlined in Unison's maintenance literature. Unison does not warrant the future availability of expendable maintenance items.

Warranty Period: This Unison warranty is valid for 18 months from the me the equipment is shipped from Unison's factory or 12 months from the date of startup, whichever occurs rst.

Repairs During Warranty Period: All warranty claim requests must be ini ated with a Return Material Authoriz on (RMA) number for processing and tracking purposes. The RMA number shall be issued to the Owner upon claim approval and/or eld inspec on. When eld service is deemed necessary in order to determine a warranty claim, the costs associated with travel, lodging, etc. shall be the responsibility of the Owner except under prior agreement for a eld inspec on. This warranty does not include reimbursement of any costs for shipping the equipment or parts to Unison or an authorized service establishment, or for labor and/or materials required for removal or reinstall on of equipment or parts in connec on with a warranty repair. This warranty covers only those repairs that have been conducted by Unison or by a Unison authorized warranty service provider, or by someone speci cally authorized by Unison to perform a par cular repair or service ac vity. All component parts replaced under the terms of this warranty shall become the property of Unison.

UNISON ASSUMES NO OTHER WARRANTY FOR ITS EQUIPMENT, EITHER EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR NONINFRINGEMENT, OR LIABILITY FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGE.

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UNISON SOLUTIONS

Leaders in Biogas Technology

BUDGET PROPOSAL
GAS CONDITIONING SYSTEM

9-185-1
BIOGAS CONDITIONING ALTERNATIVES

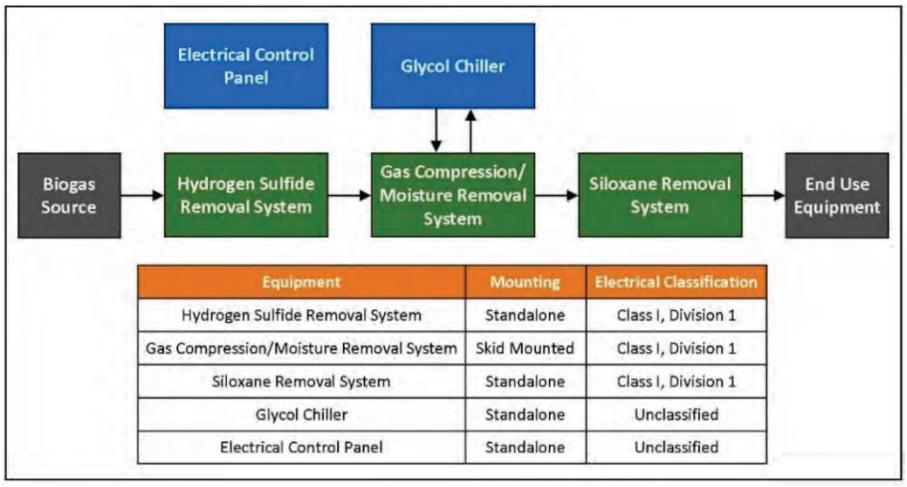
Proposal Number: PX-120-3088.1
Project Name: Racine WWTP – 175scfm

Unison Solutions, Inc. is pleased to provide this **BUDGET** proposal for a Gas Conditioning System for the Racine WWTP Project. This **BUDGET** proposal includes all of the CAD design services, technician labor, fabrication and materials to construct a Gas Conditioning System.

Thank you for giving Unison Solutions the opportunity to provide you with the enclosed proposal. If you have questions or require additional information, please contact me at your convenience.

Sincerely,

Eric Wilgenbusch
Unison Solutions, Inc.
Phone: 563-585-0967
Cell: 563-543-0559



Equipment	Mounting	Electrical Classification
Hydrogen Sulfide Removal System	Standalone	Class I, Division 1
Gas Compression/Moisture Removal System	Skid Mounted	Class I, Division 1
Siloxane Removal System	Standalone	Class I, Division 1
Glycol Chiller	Standalone	Unclassified
Electrical Control Panel	Standalone	Unclassified

UNISON SOLUTIONS, INC. CERTIFICATIONS

- ASME Certification Number (U-Stamp) - 37,381
- ASME Certification Number (R-Stamp) - R7415
- UL Certification Number - 20110405-E255550

EQUIPMENT/SUB-SYSTEMS

HYDROGEN SULFIDE REMOVAL SYSTEM

- Hydrogen Sulfide Removal Media Vessel
- Work Platform and Ladder
- Initial Charge of H_2S Removal Media

GAS COMPRESSION/MOISTURE REMOVAL SYSTEM

- Gas Blower Inlet Moisture/Particulate Filter
- Gas Blower
- Dual Core Heat Exchanger
- Gas Recirculation
- Skid Base

TEMPERATURE CONTROLLED ENCLOSURE

- Steel Exterior
- Heater
- Ventilation Fan and Intake Louvers
- LEL with Beacon Light
- LED Light Fixtures

GLYCOL CHILLER

- Glycol Chiller
- Initial fill of Propylene Glycol/Water Mixture

SILOXANE REMOVAL SYSTEM

- Siloxane Removal Media Vessels
- Work Platform and Ladder
- Initial charge of Siloxane Removal Media
- Siloxane Removal Final Particulate Filter

CONTROL SYSTEM

- Gas Conditioning System Control Panel
- Transformer

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DESIGN CONDITIONS

SITE INFORMATION

- Minimum Ambient Temperature	0°F
- Maximum Ambient Temperature	100°F
- Site Elevation	0-1,000’ AMSL

SYSTEM REQUIREMENTS

- Minimum Gas Flow	0 scfm
- Maximum Gas Flow	175 scfm

INLET GAS CONDITIONS

- Minimum Inlet Gas Pressure	0”WC
- Maximum Inlet Gas Pressure	10”WC
- Minimum Inlet Gas Temperature	80°F
- Maximum Inlet Gas Temperature	100°F
- Relative Humidity	100%
- Methane (CH_4)	50-62%
- Carbon Dioxide (CO_2)	38-50%
- Nitrogen (N_2)	<1%
- Oxygen (O_2)	<1%
- Hydrogen Sulfide (H_2S)	1,000 ppmv
- VOCs & Siloxanes	<2,000 ppbv

DISCHARGE GAS CONDITIONS

- Discharge Gas Pressure	5.0 psig
- Discharge Gas Temperature	80°F
- Dew Point Temperature	40°F
- Maximum Hydrogen Sulfide	<10 ppmv
- Maximum Siloxane	<100 ppbv
- Particulate Removal	99% removal of >3 micron

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SITE REQUIREMENTS

ELECTRICAL CLASSIFICATION

- NEC Class I, Division 1 Group D Areas
    - Hydrogen Sulfide Removal System
    - Gas Compression/Moisture Removal System
    - Siloxane Removal System
- Unclassified Electrical Areas
    - Glycol Chiller
    - Gas Conditioning System Control Panel
    - Transformer

EQUIPMENT MOUNTING

- Skid Mounted
    - Gas Compression/Moisture Removal System
- Standalone
    - Hydrogen Sulfide Removal System
    - Glycol Chiller
    - Siloxane Removal System
    - Gas Conditioning System Control Panel
    - Transformer

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EQUIPMENT/SUB-SYSTEM DETAILS

HYDROGEN SULFIDE REMOVAL SYSTEM

- (1) Hydrogen Sulfide Removal Media Vessel
    - 8'Ø x 14' straight side
        - 9' of media bed depth
    - Rated for 5psig pressure and 1psig vacuum
    - Materials of construction shall be 304L stainless steel
    - 150# ANSI B16.5 side inlet and outlet connections
    - Flanged and dished top and bottom heads
    - Vessel shall be free-standing on four 304L stainless steel legs
    - Vessel equipped with a 24" top manway
    - Vessel equipped with a 24" side manway
    - Internal supports and grating for media
    - Pressure/Vacuum relief valves included
    - Two top vents with stainless steel ball valves
    - Bottom manual condensate drain with stainless steel ball valves
    - Interconnection pip.
- Work Platform and Ladder
    - Work platform shall be welded carbon steel construction with satin black powder coat finish
    - Ladder shall be galvanized steel construction
- Initial Charge of Media
    - The initial charge of media for each Hydrogen Sulfide Removal Media Vessel will be provided.
    - Media to be loaded into Hydrogen Sulfide Removal Vessel by INSTALLATION CONTRACTOR

GAS COMPRESSION/MOISTURE REMOVAL SYSTEM

- Gas Blower Inlet Moisture/Particulate Filter
    - Mounted upstream of the Gas Blower
    - 99% removal of 3micron and larger particulates and liquid droplets
    - Materials of construction shall be 304L stainless steel
    - 150# ANSI B16.5 side inlet and outlet connections
    - Cleanable polypropylene structured mesh element
    - Differential pressure gauge across the filter element
    - Sight glass for liquid level indication
    - Level switches above the condensate drains to warn of failure
    - Bottom drain with strainer, condensate pump, manual bypass and piping

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- Gas Blower

    - One Rotary Lobe Positive Displacement Blower rated for 175scfm
    - Belt driven 10Hp, 480V/3Ph/60Hz EXP electric motor
    - Motor speed will be controlled by a VFD
    - Cast iron casing
    - Inlet and discharge flex connectors
    - Discharge silencer
    - Discharge check valve
    - Discharge pressure safety valve
    - Belt guard

- Dual Core Heat Exchanger

    - Stage 1 - Gas to gas plate/fin core
        - Materials of constructions shall be aluminum plate and fins
    - Stage 2 - Gas to glycol fin/tube core
        - Materials of construction shall be aluminum fins on 304L stainless steel tubes
    - Mounted in single 304 stainless steel housing
    - 150# ANSI B16.5 inlet and outlet connections
    - All condensation generated during cooling will be removed inside the heat exchanger housing
    - Level switch mounted on the housing to warn of drain failure
    - RTD mounted on the housing to verify the coldest temperature that the gas reaches
    - Bottom drain with strainer, float drain, manual bypass and piping

- Gas Recirculation

    - Modulating Valve shall be provided to allow excess gas to flow from the discharge of the system back to the inlet. This valve shall be controlled by monitoring the delivery pressure of the system.
        - V-port Ball Valve
        - Type 7 explosion proof actuator
        - 120V weatherproof

- Skid Base

    - Welded carbon steel construction with satin black powder coat finish
    - All components mounted, piped and wired on skid base
    - 24V and 120V electrical components wired to one of two junction boxes on edge of skid
    - INSTALLATION CONTRACTOR to provide conduit and wiring to 480V components
    - Conduit shall be rigid aluminum
    - Condensate drains piped to edge of the skid base. Drains to be routed to floor drain by INSTALLATION CONTRACTOR.

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GLYCOL CHILLER

- Glycol Chiller
  - Sized for the process heat load
  - Suitable for outdoor installation
  - Refrigeration System
    - One refrigeration circuit
    - One compressor sized for 100% capacity
    - Chiller capacity: 25% to 100% of rated capacity
    - EC motor driven condenser fans
    - Aluminum micro-channel air cooled condensers
    - 316L stainless steel evaporator
    - R410a refrigerant. R-410a is an HFC refrigerant with 0 ODP
    - Refrigeration circuit has sealed core filter drier, liquid line solenoid valve, liquid line shut-off valve, and sight glass/moisture indicator
    - Electronic expansion valve
    - Glycol Chiller shall be factory tested and shipped with complete refrigerant charge
  - Glycol Circulation
    - One glycol circulation pump sized for 100% capacity
    - Stainless steel end suction centrifugal pump
    - TEFC Pump Motor
    - Pump isolation valves on inlet and outlet
    - Pump discharge check valve
    - Glycol reservoir is a 304 stainless steel closed tank
    - Glycol piping is copper with anti-corrosion coating
    - Armaflex insulation
    - Glycol Chiller to utilize propylene glycol/water mix
    - Initial fill of Propylene glycol will be provided
  - Support Structure
    - G90 galvanized steel base
    - Powder-coated steel cover panels
    - All components mounted, piped and wired on skid
  - Glycol Chiller Control Panel
    - UL Type 4
    - UL 508A Listed Industrial Control Panel
    - Powder coated carbon steel
    - 480V/3Ph/60Hz feed will be required
    - 480V disconnect
    - Microprocessor based controller with full text LCD display
    - 480VAC to 24VAC transformer
    - Phase monitor to protect against loss of phase, unbalance or reversal

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SILOXANE REMOVAL SYSTEM

- (2) Siloxane Removal Media Vessels

    - 3’6”Ø x 10’ straight side
        ≈ 8’ of media bed depth
    - Materials of construction shall be 304L stainless steel
    - 150# ANSI B16.5 inlet and outlet connections
    - Flanged and dished top and bottom heads
    - Vessels shall be free-standing on four 304L stainless steel legs
    - Flanged access nozzle on top of each vessel
    - Internal septas for even gas distribution through media
    - Pressure relief valves included
    - Bottom manual condensate drain with stainless steel ball valves
    - Test/purge ports with ball valves on the inlet and outlet of each Siloxane Removal Media Vessel
    - Lead/Lag piping and valves between Siloxane Removal Media Vessels will be provided

- Work Platform and Ladder

    - Work Platform shall be welded carbon steel construction with satin black powder coat finish
    - Ladder shall be galvanized steel construction

- Initial charge of Siloxane Removal Media

    - The initial charge of siloxane removal media for each Siloxane Removal Media Vessel will be provided.
    - The media shall be specifically engineered for removal of siloxanes and similar contaminants from landfill and digester gas sources.
    - Siloxane media to be loaded into the Siloxane Removal Media Vessels by the INSTALLATION CONTRACTOR.

- Siloxane Removal Final Particulate Filter

    - Mounted downstream of the Siloxane Removal Vessels
    - 99% removal of 3 micron and larger particulates and liquid droplets
    - Materials of construction shall be 304L stainless steel
    - 150# ANSI B16.5 side inlet and outlet connections
    - Cleanable polypropylene structured mesh element

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CONTROL SYSTEM

- Gas Conditioning System Control Panel
  - Enclosure
    - UL Type 4
    - UL 508A Listed Industrial Control Panel
    - Painted carbon steel
    - Indoor location
  - Thermal Management *(as necessary)*
    - Rated for installation in ambient temperatures from 40°F to 104°F
    - Ambient Fan Cooled
  - Power Distribution
    - Fused Disconnect
    - 480V/3Ph/60Hz feed required
    - 35kA Short Circuit Current Rating
    - Over current and branch circuit protection via fuses
    - 480VAC field wiring to terminate at the component or terminal strips inside control panel
  - Surge Suppression
    - 480VAC Transient Voltage Surge Suppressor
    - 120VAC Surge Filter
  - Motor Control
    - (1) 10Hp rated 6 Pulse VFD for Gas Blower Motor
    - ½ HP Motor Starter/Overload for Condensate Pump
  - Programmable Logic Controller
    - Allen Bradley
    - Compact Logix PLC and I/O
    - Native Allen Bradley Ethernet IP data network
  - Human Machine Interface
    - Proface PFXGP4601TAD
    - TFT Color LCD Display
    - 12” diagonal
    - 800 x 600 pixels
  - Instrument wiring to terminate at terminal strips inside Control Panel

- Transformer
  - 3kVA
  - 480VAC to 120VAC
  - NEMA 3R; Painted carbon steel

TEMPERATURE CONTROLLED ENCLOSURE

- All electrical inside the enclosure is rated Class I Division 1
- Mounted to the Gas Compression/Moisture/Siloxane/CO_2 Removal Skid
- Steel stud construction
- Steel exterior with multiple color options for site esthetics. Color selected by owner from manufacturer’s standard color options.
- Fire retardant plywood on the outer side of the steel studs
- Insulated walls and ceiling

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- Green board (mildew resistant drywall) and/or fire-retardant plywood on the inner side of the studs
- White fiberglass reinforced plastic panel interior
- Lighted interior with EXP LED light fixtures
- Thermostatically controlled heater to prevent freezing
- LEL inside enclosure for gas detection and warning
- Ventilation fan and intake louver to prevent over heating inside enclosure
- Double steel entry doors

Notes:

- *Installation Contractor will be required to power the heater, ventilation fan and lights*
- *The equipment enclosure is designed to protect the equipment from weather and for sound reduction purposes. The design of the enclosure accounts for snow and wind loads based on the installation area. The equipment enclosure is not designed to meet national or local building codes and is in no way considered an occupiable space.*

INSTRUMENTATION

- All instrumentation provided will be designed for gas service and rated for use in a NEC Class I, Division 1 Group D area.
- Hydrogen Sulfide Removal System Instrumentation
    - Inlet Pressure Transmitter
- Gas Compression/Moisture Removal System Instrumentation
    - Inlet Pressure Transmitter
    - Level Switches at each Condensate Drain
    - Level Indicators at each Condensate Drain
    - RTD's (3 Wire-100Ω) at each Temperature Change Point
    - RTD (3 Wire-100Ω) to Monitor Glycol Temperature
    - Bi-metal Thermometers at each Temperature Change Point
    - Gas Blower Discharge Pressure Transmitter
- Siloxane Removal System Instrumentation
    - Delivery Pressure Transmitter

PIPING

- Pipe will be SA-312 TP304/304L Weld Pipe, minimum Schedule 10S. Threaded pipe shall be minimum Schedule 40S.
- Flange connections will be ANSI B16.5, SA-182 F304/304L Class 150.
- Pipe welding will follow ASME B31.3 Process Piping. Welded pipe will be visually inspected and pressure tested.
- Gaskets will be 1/16" nitrile bound non-asbestos ring gaskets.

VALVES

- Ball Valves
    - Stainless steel with PTFE or RTFE seat.
    - Valves will be full port.

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- Butterfly Valves
    - Lug style iron body with stainless steel disc and stem and FKM seat.
- Check Valves
    - Will be one of 2 styles; ball or dual-door.
        - Ball check valves shall be stainless steel with RTFE ball.
        - Dual-door check valves shall be wafer style body, material shall be aluminum and/or stainless steel with an FKM seat.
- Globe Valves
    - Stainless steel with PTFE packing

FASTENERS

- Fasteners shall be ASTM F593 304 Stainless Steel

SUBMITTALS

- Quantity: (3) copies of 3 ring binders and (1) electronic CD copy
- Shop Drawings and Product Data will be provided in sufficient detail to confirm compliance with the requirements for the project. Shop Drawings and Product Data will be provided in a complete submittal package.
- Shop Drawings
    - Installation drawings and specifically prepared technical data, including design capacities will be provided.
    - Specifically prepared wiring diagrams unless standard wiring diagrams are submitted with product data will be provided.
    - Written description of operation will be provided.
- Product Data
    - Catalog cuts and product specifications for each product specified will be provided.
    - Standard wiring diagrams unless wiring diagrams are specifically prepared and submitted with Shop Drawings will be provided.

FACTORY TESTING

- The Compression/Moisture Removal System will be tested on ambient air at Unison's facility.
- Media removal vessels will be hydrotested prior to shipment and will not be included in the Factory Testing.
- The CUSTOMER is allowed to witness the testing and Unison will inform the customer (2) weeks prior to anticipated testing date so customer can make travel arrangements.

OPERATION & MAINTENANCE MANUALS

- Quantity: (6) copies of 3 ring binders and (1) electronic CD copy
- After shipment the Gas Conditioning System will be provided with a specifically prepared Operation & Maintenance Manual. The information provided includes a system overview, operator interface, start-up/shut down procedures, communications, alarms procedures, maintenance overview, mechanical component spec sheets and electrical component spec sheets.

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MAINTENANCE

- Hydrogen Sulfide Removal System
  - Replace Foam Pad
  - Replace Hydrogen Sulfide Media (9.5' of media bed depth)
  - Estimated Media Cost =$22,000.00*
  - Approximate days to media exhaustion:
    187 Days @ 1,000 ppmv of H2S (147scfm)
    157 Days @ 1,000 ppmv of H2S (175scfm)

  **Labor for change out, disposal and shipping of media not included*

- Gas Compression/Moisture Removal System

  - Clean Gas Compressor Inlet Moisture/Particulate Filter
  - Change Blower Oil
  - Clean Glycol Chiller Condenser
  - Test Glycol for Freeze Point
  - Estimated Cost = $2,500.00*/Year

  **Technician Labor and travel expenses not included*

- Siloxane Removal System
  - Replace Siloxane Media (8' of media bed depth per vessel)
  - Estimated Media Cost =$15,000.00* (2 vessels)
  - Approximate days to media exhaustion: unknown with VOC data

  **Labor for change out, disposal and shipping of media not included*

ELECTRICAL PARASITIC

- Electrical Parasitic
  - *kW values are calculated using motor amperage data from Table 50.1 of UL 508A*

  - Gas Conditioning Skid
    - Condensate Pump = 1 kW
    - Gas Blower Motor = 11.6kW
    - Glycol Chiller = 31.5kW
    - Controls & Auxiliary Equipment = 4 kW

    Total = 41.8 kW (Full Load)
    Total = 38 kW (Average Run Load)

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DELIVERY SCHEDULE

- Submittals delivered **4** to **6** weeks after order acceptance
- Equipment delivery is subject to confirmation at the time of order placement and/or submittal approval

PRICING SUMMARY

- Price includes all labor and expenses associated with the fabrication of the system.
- Prices do not reflect any taxes that may be applicable and are valid for 30 days.
- Price is FCA; Factory, Dubuque, IA 52002, per Incoterms 2010. Shipping costs not included, see estimate below
- Price does not include Start-up and Commissioning. Costs are shown below
- Prices are in US Dollars
- Media Escalation: Media pricing is directly influenced by US imposed tariffs. Unison may adjust pricing for the media provided should there be future tariffs assigned to this product.

BUDGET Hydrogen Sulfide Removal System $105,000.00

BUDGET Gas Compression/Moisture Removal System $355,000.00

BUDGET Siloxane Removal System $115,000.00

BUDGET Temperature Controlled Enclosure $120,000.00

Shipping **ESTIMATE** to Racine $10,000-20,000.00
Cost is an estimate and is subject to change without notice. It does not include any special packaging or permitting that may be required and is dependent on the final equipment dimensions and weights.

Start-up and Commissioning Services **ESTIMATE** $15,500.00
Price includes Four (4) consecutive, 8 hour days, for one Unison Technician onsite with travel and expenses included. Additional days may be necessary to complete start-up and commissioning, they will be billed to the Buyer/Owner/End User at the cost of $1,500 per day, per technician, plus travel & expenses.

PAYMENT SCHEDULE

- 30% upon order acceptance
- 30% at midpoint of construction
- 30% upon equipment delivery
- 10% upon site acceptance not to exceed 180 days from shipment
- Net 30 days on all payments
- Payment by Credit Card is NOT accepted (for equipment)

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PROVIDED BY OTHERS

- VPN connection for remote access to Unison supplied equipment for troubleshooting and remote assistance.

PRICE DOES NOT INCLUDE

- Shipping of equipment to jobsite, in equipment pricing
- Start-up and commissioning services, in equipment pricing
- Wind or seismic calculations for all equipment
- Any maintenance work after start-up
- H_2S or Siloxane removal media after initial fill
- Performance guarantee or service/maintenance contract
- Any gas testing or analyses
- Bonds of any kind
- Clean Water State Revolving Fund American Iron & Steel (AIS) compliance, as it is exempt
- Permitting for the installation of the equipment or air permits
- Freeze protection; including insulation and/or heat trace and heat trace power
- Pipe stands for field piping
- Liquidated & Actual Damages are the sole financial responsibility of purchasing contractor

ASSUMPTIONS

VESSELS & MEDIA

- H_2S and VOC's present in the gas will foul Siloxane media, additional gas testing will be necessary to finalize all vessel and media requirements, budget pricing is dependent on gas data given at the time of the proposal.
- Any assumption of media life that has been given is an estimate; additional gas testing will be required at the Buyer/Owner/End Users expense.
- Vessel sizes are estimates only, gas testing will be necessary to finalize all vessel sizing.
- Media Escalation: Media pricing is directly influenced by US imposed tariffs. Unison may adjust pricing for the media provided should there be future tariffs assigned to this product.

MECHANICAL

- Flare is supplied by OTHERS
- If an existing flare is being used, it is assumed this flare is in good working order, with all safety and control equipment.
- Foundations and/or maintenance pads are designed by OTHERS to properly support the equipment.
- Gas conditioning/compression system may have heat rejection associated with cooling of the biogas/oil systems. Buyer/Owner/End Users are responsible for verifying heat load and providing proper ventilation if the unit is installed indoors.

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- Factory Testing is done for Compression/Moisture Removal Systems only. It is assumed that all equipment required, but not supplied by Unison, for Factory Testing will be supplied to Unison Solutions testing. This includes, but is not limited to motors, blowers, chillers, VFDs/motor starters and control panels. Shipping expenses involved with supplying this equipment to Unison will be paid by others.

ELECTRICAL

- 480V/3Ph/60Hz is available
- No historical data acquisition is included in this proposal

INSTALLATION CONTRACTOR RESPONSIBILITIES

- Installation responsibilities are broken out below into three categories to outline the work; these responsibilities by no means fall on any single contractor or individual. It is the responsibility of the Buyer/Owner/End User to ensure all these conditions are adhered to, as necessary. It is responsibility of the Buyer/Owner/End User to install all equipment in compliance with local and national codes applicable to the installation site.

BUYER/OWNER/END USER RESPONSIBILITIES

- All foundations and/or maintenance pads as necessary for equipment
- Provide and seal all roof and building penetrations as necessary
- Provide all anchor bolts, temporary lift equipment, power, labor, and all other incidentals required for proper installation of the equipment shown on the drawings that will be provided by Unison Solutions, Inc.
- All rigging and setting of equipment at job site
- Proper storage of the equipment and media prior to installation
- Provide installation of Equipment/Sub-systems per the Unison Solutions Installation Guide
- Load initial charge of Hydrogen Sulfide Media and Siloxane Media into the vessel(s)

MECHANICAL CONTRACTOR RESPONSIBILITIES

- Provide all field piping between the Equipment/Sub-systems, including but not limited to:
    - Hydrogen Sulfide Removal System
    - Gas Compression/Moisture Removal System
    - Glycol Chiller
    - Siloxane Removal System
- Provide pipe supports as necessary. Piping shall be self-supporting, and not supported off of the Unison supplied equipment.
- Install all field located or shipped loose devices
- Provide all Heat Trace and/or Insulation as necessary to provide proper freeze protection as defined by Unison Solutions.

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ELECTRICAL CONTRACTOR RESPONSIBILITIES

- Provide 480V/3Ph/60Hz feed to the Gas Conditioning System Control Panel and Glycol Chiller.
- Provide all field wiring and conduits between the Equipment/Sub-systems to the Gas Conditioning Control Panel and associated equipment. This includes but not limited to:
    - Hydrogen Sulfide Removal System
    - Gas Compression/Moisture Removal System
    - Glycol Chiller
    - Siloxane Removal System
    - Gas Conditioning System Control Panel
    - Transformer
- Provide local disconnects as necessary
- Provide all Hazardous location conduits & wiring systems per Article 500 of the NEC
- Provide conduit seals entering and/or leaving the Class I, Division 1 Electrical Area. Conduit seals will need to be filled during Start-up and Commissioning after verification of field wiring by Unison's Start-up Technician. Conduit seals are to be filled prior to the introduction of gas to the equipment.
- Provide heat trace power from local lighting panel, as necessary.

WARRANTY

- Unison Solutions, Inc. will warrant all workmanship and materials in conformance with the attached Warranty Statement. Warranty is valid for **18** months from the time the equipment is ready to ship from Unison's factory or **12** months from the date of startup, whichever occurs first.

- This proposal is for product design and equipment manufacturing only and does not include any site or consultative engineering services expressed or implied.

- Unison Solutions, Inc. will not release the PLC program for this system. This is considered proprietary and the intellectual property of Unison Solutions, Inc.

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UNISON SOLUTIONS

WARRANTY STATEMENT

Unison Solu. ons, Inc. (Unison) is committed to providing quality products and services to its customers. As a demonstration of this commitment, Unison offers the following warranty on its products.

Grant of Warranty: Unison provides this warranty for its equipment under the terms and conditions which are detailed herein. This warranty is granted to the person, corporation, organization, or legal entity (Owner), which owns the equipment on date of start-up. This warranty applies to the owner during the warranty period, and is not transferable.

Warranty Coverage: Equipment that is determined by Unison to have malfunctioned during the warranty period under normal use solely as a result of defects in manufacturing workmanship or materials shall be repaired or replaced at Unison's option. Unison's liability under this warranty to the Owner shall be limited to Unison's decision to repair or replace, at its factory or in the field, items deemed defective after inspection at the factory or in the field.

Warranty Exclusions: All equipment, parts and work not manufactured or performed by Unison carry their own manufacturer's warranty and are not covered by this warranty. Unison's warranty does not override, extend, displace or limit those warranties. Unison's only obligation regarding equipment, parts and work manufactured or performed by others shall be to assign to the Owner whatever warranty Unison receives from the original manufacturer. Unison does not warrant its products from malfunction or failure due to shipping or storage damage, deterioration due to exposure to the elements, vandalism, accidents, power disturbances, or acts of nature or God. This warranty does not cover damage due to misapplication, abuse, neglect, misuse, improper installation, or lack of proper service and/or maintenance, nor does it cover normal wear and tear. This warranty does not apply to modifications not specifically authorized in writing by Unison or to parts and labor for repairs not made by Unison or an authorized warranty service provider. This warranty does not cover incidental or consequential damages or expenses incurred by the Owner or any other party resulting from the order, and/or use of its equipment, whether arising from breach of warranty, non-conformity to order specifications, delay in delivery, or any loss sustained by the Owner. No agent or employee of Unison has any authority to make verbal representations or warranties of any goods manufactured and sold by Unison without the written authorization signed by an authorized officer of Unison. Unison warrants the equipment designed and fabricated to perform in accordance with the specifications as stated in the proposal for the equipment and while the equipment is properly operated within the site specific design limits for that equipment. Any alterations or repair of Unison's equipment by personnel other than those directly employed by, or authorized by Unison shall void the warranty unless otherwise stated under specific written guidelines issued by Unison to the Owner. This warranty does not cover corrosion or premature wear or failure of components resulting from the effects caused by siloxanes, hydrogen sulfide or volatile organic compounds in excess of the design limits. All media must be purchased through Unison Solutions or approved in writing by Unison Solutions during warranty period. Media purchased though alternate sources and not approved in writing by Unison shall void the warranty. The design limit is based on site specific gas data provided by the Owner prior to the proposal for the equipment. Owner shall be responsible for all maintenance service, including, but not limited to, lubricating and cleaning the equipment, replacing expendable parts, media, making minor adjustments and performing operating checks, all in accordance with the procedures outlined in Unison's maintenance literature. Unison does not warrant the future availability of expendable maintenance items.

Warranty Period: This Unison warranty is valid for 18 months from the time the equipment is shipped from Unison's factory or 12 months from the date of startup, whichever occurs first.

Repairs During Warranty Period: All warranty claim requests must be initiated with a Return Material Authorization (RMA) number for processing and tracking purposes. The RMA number shall be issued to the Owner upon claim approval and/or field inspection. When field service is deemed necessary in order to determine a warranty claim, the costs associated with travel, lodging, etc. shall be the responsibility of the Owner except under prior agreement for a field inspection. This warranty does not include reimbursement of any costs for shipping the equipment or parts to Unison or an authorized service establishment, or for labor and/or materials required for removal or reinstallation of equipment or parts in connection with a warranty repair. This warranty covers only those repairs that have been conducted by Unison or by a Unison authorized warranty service provider, or by someone specifically authorized by Unison to perform a particular repair or service activity. All component parts replaced under the terms of this warranty shall become the property of Unison.

UNISON ASSUMES NO OTHER WARRANTY FOR ITS EQUIPMENT, EITHER EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR NONINFRINGEMENT, OR LIABILITY FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGE.

5451 Chavenelle Road, Dubuque, Iowa 52002 ■ [O] 563.585.0967 [F] 563.585.0970 ■ www.unisonsolutions.com

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Project Number: 60554970

9-185-2A
BIOGAS CHP
Engine Generator

Racine, WI WWTP

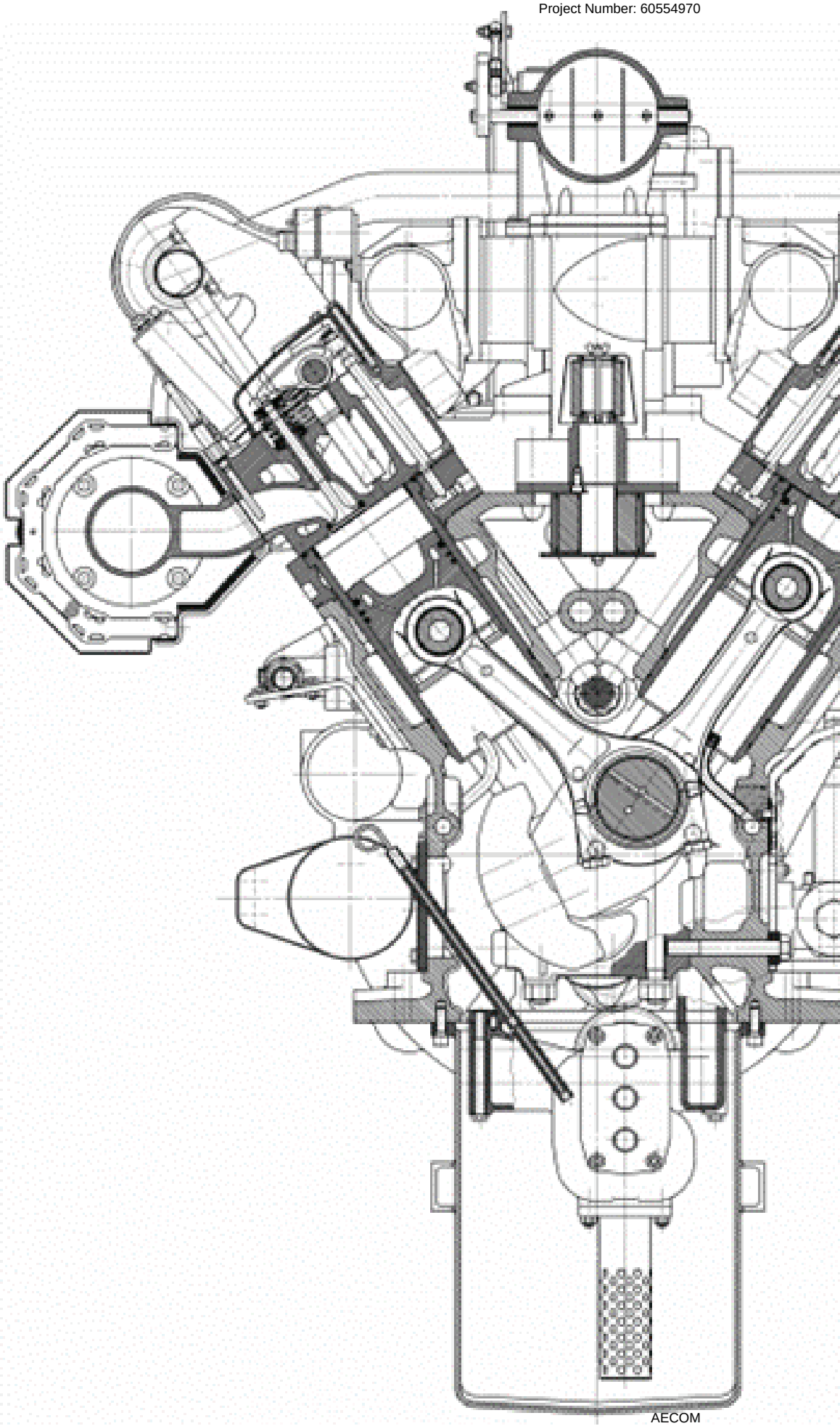
COMBINED HEAT & POWER GENERATION SYSTEM

WI0042 LC01 200313

Clarke Energy USA Inc.

March 13, 2020

Quality Integrity Reliability Accountability



Project Number: 60554970

WI0042LC01/JS

March 13, 2020

RACINE, WI WWTP – GAS ENGINE GENERATION SYSTEM

Clarke Energy is pleased to enclose our **budgetary proposal** for the following gas fired power units for the Racine, WI Waste Water Treatment Plant located in Wisconsin:

Description	Gas	Electrical Output	Thermal Output	Electrical Efficiency	Thermal Efficiency	Voltage
1 x JMS312GS-B.L (Dual Fuel - Version D825/D805)	Sewage Gas	633kW$_e$	2,683MBTU/hr	38.1%	47.4%	480V
	Natural Gas	633 kW$_e$	2,579MBTU/hr	39.0%	46.5%	

Clarke Energy is a leading engineering, installation and service company, with a global presence in the renewable and natural gas fired power generation sectors. We are the largest independent distributor for INNIO Jenbacher Gas Engines, representing 30% of the total equipment sales through the factory. Across the Clarke Group we have installed over 7GW$_e$ capacity in 27 territories worldwide with vast experience of a range of power generation, co-generation and tri-generation applications utilizing different gaseous fuels.

Our philosophy is a simple one. Deliver quality projects that are reliable, with the highest levels of integrity and accountability from all of the 1,200 people we employ.

We trust that we have correctly interpreted your immediate requirements and would welcome the opportunity to meet with you to discuss the project further and assist with its development. Should you have any queries please do not hesitate to contact us.

Yours sincerely,

On behalf of CLARKE ENERGY USA Inc.

Jonathan Shepherd
Proposals Engineer

Charlie Mayer
Sales Engineer

Clarke Energy USA Inc. 2100 Pewaukee Road, Waukesha, Wisconsin 53188
Tel: +1 262 565 5020
www.clarke-energy.com

Respondent Contacts

Any and all queries pertaining to the respondent's proposals herein should be directed to:

	Primary Contact	Secondary Contact
Name:	Ryan DeGeorge	Victoria Kay
Title:	Sales Engineer	Senior Proposals Engineer
Email:	Ryan.degeorge@clarke-energy.com	victoria.kay@clarke-energy.com
Contact Number:	262-844-0041	+44 151 546 4446

Table of Contents

Section Number	Section Description
1	Detailed Scope of Works
2	Demarcation Schedule
3	Pricing Schedule
4	Terms & Conditions
Appendix Number	**Appendices**
A1	Technical Specification
A2	Technical Instructions

ClarkeEnergy®
A KOHLER COMPANY
Engineer - Install - Maintain

1 Detailed Scope of Works

Description	CEL Scope	
	Supply	Exclusions
1.0 – Generation Module		
1.1 – Gas Engine Generator Set		
Spark ignition gas engine	✓	
Self-excited self-regulated three-phase generator	✓	
Flexible coupling, bell housing, base frame	✓	
Cooling system	✓	
Automatic lube oil replenishing system	✓	
Natural Gas fuel gas train (gas pressure 1.79-2.9psig, LHV 917BTU/scft) – NFPA37 compliant	✓	
Sewage Gas fuel gas train (gas pressure 1.79-2.9psig, LHV 550BTU/scft) – NFPA37 compliant	✓	
Starting batteries	✓	
Electric jacket water preheating	✓	
1.2 – Generator Control System and Generator Synchronisation		
Module control panel (MCP) (Dia.ne XT4) including motor starters and controls for engine auxiliaries	✓	
Modbus card	✓	
Island mode software		✓
Black start software		✓
Gas and smoke detection, alarm and shutdown system	✓	
Synchronizing device, automatic	✓	
Grid monitoring device	✓	
1.3 – Factory Testing		
Engine testing on natural gas in Jenbach, Austria	✓	
Airfares, accommodation, meals and transportation expenses associated with client witnessing test		✓
1.4 – Delivery Terms		
DDP Racine, WI, according to INCOTERMS 2020	✓	

Description	CEL Scope	
	Supply	Exclusions
2.0 – Mechanical Works		
2.1 – Equipment Offloading and Positioning		
Craneage to offload equipment from transport		✓
Offload and position supplied equipment		✓
2.2 – Engine Exhaust System		
Exhaust gas heat exchanger (ASME)	✓	
Exhaust gas bypass		✓
Exhaust silencer		✓
Pressure Relief Device		✓
Oxi-Cat chamber – 650mg/Nm^3 @ 5% O2	✓	
Exhaust pipes, bellows and supports work		✓
Lagging and cladding of exhaust pipes and equipment		✓
2.3 – Engine Low Temperature (LT) Water Circuit		
LT dump radiator with inverter driven fans		✓
LT water circulating pump, 3-way control valve and expansion vessel		✓
LT circuit pipe work and valves between engine and radiator		✓
2.4 – Engine High Temperature (HT) Water Circuit		
HT dump radiator with inverter driven fans		✓
HT water circulating pump, 3-way control valves and expansion vessel		✓
HT water circuit interface plate heat exchanger	✓	
Heat meter to measure gross heat recovery		✓
HT circuit pipe work and valves between engine, interface plate heat exchanger and radiator		✓
Insulation of pipe work		✓
2.5 – LTHW Distribution Circuit		
Process water pipe work, valves and circulating pump between secondary side of the interface plate heat exchanger and the site heating circuit		✓
Insulation of equipment and pipe work in CEL supply		✓

Description	CEL Scope	
	Supply	Exclusions
2.6 – Engine Fuel Gas System		
Gas isolation valve installed on inlet to building		✓
Gas slam shut valve		✓
Flow meter with pressure/temperature compensator and signal output to engine control panel		✓
Gas pipe work, valves and supports between site gas connection and engine		✓
2.7 – Engine Lube Oil System		
Clean oil bunded tank c/w heater, level gauges and oil transfer pump		✓
Waste oil bunded tank		✓
Day tank inside building including transfer pipe work to engine		✓
Oil transfer pipe work (single skin) between storage tanks and engine day tank		✓
3.0 - Generator Enclosure and Ventilation		
Acoustic enclosure with demountable acoustic panel for engine access		✓
Cell ventilation including fan(s), Intake air filter panel, intake and discharge air attenuators and motorised dampers		✓
Lifting beams for engine maintenance		✓
Ducting from intake/discharge attenuators to weather louvers		✓
Building weather louvers for intake and discharge air		✓
Building lighting and small power		✓
Handrails and access ladders to building roof		✓
4.0 - Electrical Works		
4.1 – Switchgear and Cabling		
District Network Operator (DNO) switchgear and earthing		✓
CT's / VT's and transducer installed at site incomer for Export Control including control cabling back to CHP control panel		✓
Power system stabiliser		✓
480V synchronising switchgear	✓	
MCC panel	✓	

Description	CEL Scope	
	Supply	Exclusions
Step up transformer		✓
Ring main unit		✓
LV cabling between alternator terminals and LV synchronising switchgear		✓
LV cabling between synchronising switchgear and step up transformer		✓
HV cabling between step up transformer/RMU and site interface		✓
Provision of upstream breaker for inter trip		✓
4.2 – Auxiliary Power and Control Wiring		
LV power supply to module control panel (MCP)		✓
Power & control wiring - MCP to CHP auxiliaries in engine enclosure		✓
Power & control wiring - MCP to dump radiator		✓
Power & control wiring – MCP to gas isolation valves		✓
Power & control wiring - MCP to gas slam shut valve		✓
Power & control wiring - MCP to gas flow meters		✓
Power & control wiring - MCP to gas boosters		✓
Power & control wiring – MCP to gas dehumidifier		✓
Power & control wiring – MCP to heat meters		✓
Power & control wiring – MCP to bulk lube oil storage system		✓
Control wiring – MCP to upstream breaker for status / inter trip		✓
Control wiring – MCP to Site DCS/SCADA/Power Management		✓
Ladder racking and cable trays required for supplied cables		✓
4.3 – Earthing Works		
Earth bonding of supplied equipment to earth bar within engine building		✓
Provision of station mat		✓
Earth cable from earth bar within building to station earth		✓
Lightning protection		✓
Neutral earthing resistor / transformer (required for island mode)		✓
4.4 – Remote Monitoring and Control		
Auto dialler installation		✓
SCADA/Power Management/DCS/BMS		✓

Description	CEL Scope	
	Supply	Exclusions
Site load management system to manage the application and shedding of load in line with Jenbacher's technical instruction for isolated operation		✓
2 telephone lines (one to be broadband enabled) for remote monitoring of the gas engine generator set		✓
4.5 – Tariff Metering		
Generated power metering		✓
Parasitic load metering		✓
5.0 – Civil/ Building Works and Permanent Facilities		
Concrete foundations where required for supplied equipment		✓
Trench work for cabling installations		✓
Cable ducts		✓
Fencing and barriers installed around equipment		✓
Stoning up between equipment foundations		✓
Surface water drainage		✓
Other site buildings		✓
Dewatering of site		✓
6.0 – Surveys, Applications, Permits and Reporting		
Discharge of planning conditions		✓
Dispersion modelling		✓
Environmental permits		✓
Back ground noise study		✓
Discrimination / power system studies		✓
Grid connection application		✓
Earthing system study		✓
Arc flash study		✓
Noise study		✓
Vibration study		✓

Description	CEL Scope	
	Supply	Exclusions
7.0 – Site Establishment		
Site security fencing		✓
Site office		✓
Site Welfare facilities		✓
Hook up to a local electricity and water supply		✓
Electricity and water supply charges		✓
Open and covered storage at site		✓
Waste disposal		✓
Scaffolding during installation works		✓
8.0 – Consumables		
Lubricating oil for first fill of engine sump for commissioning		✓
Lubricating oil for first fill of clean oil bulk tank		✓
Cooling water, antifreeze/inhibitor for engine cooling systems		✓
9.0 – Testing and Site Commissioning		
Pre-commissioning checks for CEL scope	✓	
Start-up and commissioning	✓	
Generator performance test	✓	
10.0 – Project and Site Management		
Clarke Energy Project Manager	✓	
Clarke Energy Site Supervisor for 16 weeks only	✓	
Quality control in accordance with ISO 9001	✓	
Environmental management in accordance with ISO 14001	✓	
Operator familiarisation during commissioning	✓	
11.0 – Documentation		
Operation and maintenance manual	✓	
Spare parts manual	✓	

Description	CEL Scope	
	Supply	Exclusions
Engineering design and drawings for the scope offered: • Equipment layout drawing • P&I Diagrams • Single line diagram • Earthing general schematic diagram • Ventilation, Fire & Gas Interconnection details • Electrical schematic LT Water system • Electrical schematic HT Water system • Electrical schematic LT Radiator • Electrical schematic HT Radiator • Electrical schematic Gas Train • Electrical schematic Oil system • Electrical schematic connections A panel to L panel • Electrical schematic connections A panel to M panel	✓	
As built drawings	✓	
Equipment foundation loading drawings	✓	
Civil design drawings and calculations		✓
Grid code simulation studies		✓

2 Demarcation Schedule

Termination Point	Description
Fuel Gas	• Inlet flange on engine
Heat Rejection/Recovery System	• Flow and return connections on engine for primary connections to shipped loose plate heat exchanger • Primary/secondary connections on plate heat exchanger
Lubricating Oil	• Fill connection on engine • Engine sump
Exhaust	• Engine exhaust outlet flange on engine
Generated Power	• Outgoing terminals on 480V alternator • Incoming/Outgoing terminals on 480V switchgear
Auxiliaries Supply	• Incoming terminal on engine control panel
Remote Monitoring	• Terminal for connection of broadband enabled telephone line at CHP control panel • Terminal for connection of Modbus/Profibus communications link to client BMS at CHP control panel

3 Pricing Schedule

Item No.	Description	Value ($)
1	Supply and delivery of Jenbacher JMS 312 GS-B.L (D825/D805) and associated equipment as per the above scope of works; including preliminaries and commissioning*	$607,114
	Contract Total:	**$607,114**

* DDP Racine, WI according to INCOTERMS 2020.

The EUR exchange elements within the Price Schedule have been calculated using the prevailing exchange rate of **€1 = $1.170.** The Price is subject to adjustment should the exchange rate have changed at time of order.

Shipping companies are unwilling to provide firm quotations for freight charges, due to world-wide fluctuations in costs, including oil prices & the US Dollar exchange rate. Quoted prices for shipping & inland transportation costs are estimates and will be subject to confirmation at time of dispatch.

4 Terms & Conditions

The provisions of these Special Conditions shall apply in addition to Clarke Energy's Standard Terms & Conditions of Trading, where in the event of any conflict between the two, these Special Conditions shall take precedence.

4.1 EFFECTIVE ORDER DATE

Any agreement will come into force upon signing of the Order by both parties and on receipt by the Supplier of the Buyer's purchase order. All program dates and lead times will be based from this date and any previous or proposed program and timescales will be adjusted accordingly if necessary.

4.2 BASIS OF AGREEMENT PRICE

The Seller has based the price on the tender or enquiry documentation, specifications, drawings and information made available for the purposes of the tender (or enquiry) documentation. The Seller's interpretation or assumptions detailed in the quotation or tender submission form the basis of this agreement. Should any data or site conditions vary from the information provided in the enquiry/tender documentation which result in additional costs or time, then the Seller may adjust the Agreement Price or extend the program accordingly.

4.3 TERMS OF PAYMENT

The Buyer shall pay the Supplier as milestone payments in the following manner:

	Payment Milestone Value	Documents Required for Payment by Buyer	Due Date for Supplier's Invoice	Final date for Payment by Buyer
1	30% of the Order Price	Supplier's Invoice	Date of Buyer's Order	30 days from date of Supplier's Invoice
2	65% of the Order Price	Supplier's Invoice	Supplier's written notice confirming the readiness to dispatch the Jenbacher equipment from the factory in Austria	30 days from date of Supplier's Invoice
3	5% of the Order Price	Supplier's Invoice	Satisfactory completion of commissioning and evidence of the generator sets meeting the performance standards on Site	30 days from date of Supplier's Invoice or 90 days after the Supplier's written notice of readiness to dispatch the Jenbacher equipment where delays due to the Buyer have prevented the Supplier from commissioning the gas engines

The Buyer shall not be entitled to apply any reductions for early payment of Supplier invoices.

INCOTERMS 2020: DDP to installation site.

4.4 CHANGES

Buyer may, by written change order or make mutually agreed changes to the Works. If any such change results in an increase or decrease in the cost or time required for completion of the Works under the Agreement, there shall be an equitable adjustment in the Agreement Price and the Scheduled Delivery. Seller shall not be obligated to proceed with the changed or extra work until the price of such change and its effect on the Scheduled Delivery have been agreed upon in a written change order.

4.5 DEFAULT ON PAYMENT

All invoices are due and payable at the specified payment date as noted in 4.3. Interest will be charged on all overdue accounts at the rate of 2% above prime, such interest to be calculated on a daily basis from the due date until the date of payment.

If the Buyer is in any default on payment, the Seller may demand immediate payment of the entire remaining Agreement amount; but this shall not affect Seller's right to terminate the Agreement for default in payment. If the Seller retains a collection agency, an attorney or other third party to collect outstanding claims, all collection charges (including legal fees) shall be borne by Buyer.

If Buyer is in default with payment or any other services, Seller is entitled, notwithstanding any other claims, to withhold delivery of the Works until the Buyer becomes current on its contractual obligations or to rescind and terminate the Agreement for non-performance, after granting a reasonable grace period, and to assert damages (in particular for non-performance).

4.6 DELIVERY PERIOD

The Delivery Period (FCA) for INNIO Jenbacher power generation equipment is currently 28 weeks from the Commencement Date. Actual delivery date(s) will be advised at time of order.

Goods will usually be delivered during normal working hours. Actual time of delivery will be advised by the Supplier beforehand to ensure necessary access is available. Special delivery arrangements or weekend delivery may be subject to additional charges.

Where the Buyer is unable to accept delivery of the Goods at Site within 3 days of the Supplier's notification of readiness to dispatch the Goods, the Goods shall be delivered to a secure warehouse and stored in accordance with the manufacturer's instructions. In the event of a long-term delay Goods shall be preserved according to the manufacturer's recommendations, which in respect of the generator set shall be in accordance with Jenbacher Technical Instruction TI1000-0004.

All costs associated with warehouse storage charges, additional insurance, preserving and protecting of the Goods shall be paid for by the Buyer.

With regard to any lifting operations performed in connection with delivery and offloading of the Goods at any storage location or Site, the Buyer shall comply with the requirements of BS7121.

The Buyer is therefore obliged to liaise with Supplier or Supplier's appointed representative in order to ensure that sufficient time is allowed for a lift to be planned. Buyer shall also provide ground condition information for the crane setup area as required.

4.7 WARRANTY PERIOD

The goods offered are guaranteed against all material and workmanship defects for a period of 12 months from start-up of the equipment, or 8,000 operating hours, or a maximum of period of 15 months from the factory shipment date, or acknowledgement of readiness to deliver date, whichever is the soonest.

The warranty guarantee will be invalidated if the goods are not operated and maintained in accordance with manufacturer's instructions or the gas quality is outside acceptable limits. In respect of the gas engines reference should be made to the Jenbacher technical instruction 1000-0300 Fuel Gas Quality, 1100-0110 Parameters for Jenbacher Gas Engines and 1400-0091 Lack of Condensate Concerning Fuel Gases.

If the goods are found to be defective during the warranty period, then, Buyer shall, as soon as reasonably practicable but not later 14 days after discovering a defect, notify the Seller in writing detailing the particulars of the defect. The Seller shall be responsible for making well by repair or replacement (at the Seller's option) the defect so notified by the Buyer and the Buyer shall so far as may be necessary place the goods at the Seller's disposal for this purpose.

If the Seller fails take such actions as may be required to correct all notified defects, the Buyer may, provided he does so without undue delay, take such steps as may, in all circumstances be reasonable to make good such defects, in which event all related costs and expenses and other reasonable charges shall be for Seller's account.

Any repaired or replaced goods, or part thereof shall have a warranty on the same terms as set forth above, with the warranty period being the greater of the original unexpired warranty or six (6) months after repair or replacement.

Seller's warranty shall not cover defects or damage to the delivered goods or services, which are due to:

- normal wear and tear on parts whose normal life expectancy is less than the warranty period,
- improper assembly or maintenance, negligence or other improper application by the Buyer;
- non OEM spare parts have been used by the Buyer;
- fuel gas quality is outside the specified limits as provided to the Buyer by the Seller;
- detrimental air inlet conditions or erosion, corrosion or material deposits from fluids;
- the Buyer continuing to make further use of the goods after having given a notice to the Seller of a defect.

4.8 TITLE – RISK OF LOSS AND INSURANCE:

Buyer will provide the Seller a certificate of insurance. Title to and risk of loss for all equipment to be supplied hereunder by Seller shall pass to Buyer upon arrival of same at the Customer's site as provided; However, that Buyer shall grant to Seller a present and continuing security interest in the equipment supplied hereunder until Seller has been paid in full pursuant to the terms hereof. Buyer shall promptly execute and deliver such documentation as may be required by Seller, in proper form, to perfect Seller's security interest under the Uniform Commercial Code or any other relevant statute, law, or regulation. Buyer will not cause or permit any other security interest, lien, encumbrance or claim to attach to the

system which shall have priority over or be ahead of Seller's security interest, as described herein, and Buyer authorizes Seller to make any public filings necessary to perfect or maintain its security interest under the Uniform Commercial Code, or any other relevant statue, law, or regulation.

Until Seller has received full payment of the purchase price, Seller shall have all rights and remedies of a Seller and secured party as established or permitted upon agreement by the Uniform Commercial Code, in addition to all other rights as established herein, which rights and remedies, to the extent permitted by law, shall be cumulative.

From the time of receipt of the equipment to be supplied hereunder by Seller until payment in full has been received for same by Seller, Buyer will maintain insurance coverage on the equipment supplied hereunder by Seller in an amount sufficient to pay any outstanding sums due or that will become due from Buyer to Seller for said equipment. Seller will be listed as a named insured on all such insurance coverage. If so requested by Seller, Buyer will cause certificates of insurance to be supplied to Buyer for verification that the insurance coverage described herein is in place. Such insurance will not be materially reduced or cancelled without the prior written consent of Buyer.

4.9 ERECTION/COMMISSIONING

The preservation and packing of the Goods will be suitable for shipment and transportation to site assuming that erection and commissioning is carried out promptly on arrival at Site.

If for any reason of delay or failure on the part of the Buyer or other contractor employed by the Buyer, the Supplier is prevented from installing and/or commissioning the Goods, the Goods shall be stored in accordance with the manufacturer’s instructions. In the event of a long term delay the Goods shall be preserved according to manufacturer’s recommendations, which in respect of the generator set shall be in accordance with Technical Instruction TI1000-0004. All costs associated with preserving and protecting the Goods shall be paid for by the Buyer.

Unless stated otherwise commissioning of the Goods is limited to 10 working days (8 hours per day). In case of delays caused by reasons beyond the Supplier’s control the cost of additional working days shall be borne by the Buyer.

4.10 MAINTENANCE PAYMENTS

If the Goods are to be maintained by the Supplier whilst it is being used by the Buyer for beneficial generation prior to taking over the Goods, any maintenance work required to be carried out on the Goods by the Supplier, will be paid for by the Buyer at the agreed contracted rates.

4.11 PERMITS, LICENCES, DUTIES ETC.

The Buyer before the commencement of the Order is responsible for obtaining all permits, consents, licenses, duties, building regulation approval or planning permissions applicable to the site or installation works of the Goods.

4.12 TERMINATION CHARGES

The Buyer may terminate this Order at any time upon written notice to Supplier and payment of termination charges in accordance with the schedule set forth below:

Days after Order Effective Date	Termination Charge as % of Order Price
Less than 30	10%
31-60	30%
61-90	50%
91- date of notice of readiness to dispatch	70%
After date of notice of readiness to dispatch	100%

4.13 LIQUIDATED DAMAGES

Delay in Delivery - If an agreed delivery milestone is delayed by more than 7 days beyond the agreed milestone date due to causes not excused by the provision of the Order, the Supplier shall pay the Buyer as liquidated damages, a sum equal to 0.5% of that portion of the Order Price attributable to the delayed Goods for each subsequent full week of delay, up to an aggregate maximum of 5% of the Order Price. The liquidated damages shall be the Supplier's sole and exclusive liability for delays.

Notwithstanding the foregoing, Supplier shall have no liability to the Buyer for the foregoing liquidated damages, unless the Suppliers delay causes deferment of the initial operation date of the equipment and the Buyer suffers actual damages.

Shortfall in Guaranteed Performance Levels - If when first tested at site the Goods fail to achieve the guaranteed performance for either output or electrical efficiency, the Supplier shall be afforded a period to be agreed (but in no event less than 90 days) during which it can correct and adjust the equipment (the "Correction Period").

If, when retested within or at the latest at the end of the Correction Period, the Goods again fail to achieve the guaranteed performance for either output or electrical efficiency the Supplier shall pay to the Buyer as liquidated damages a sum calculated in accordance with the table below.

Criteria	Liquidated Damage
Output	0.5% of the Order Price allocable to the non-performing unit for each full 1.0% deficiency in the guaranteed performance
Electrical Efficiency	0.5% of the Order Price allocable to the non-performing unit for each full 1.0% shortfall in the guaranteed performance

The liquidated damages payable in respect of deficiencies in performance shall not exceed 5% of the Order Price allocable to the non performing unit(s). The liquidated damages shall be the Suppliers sole and exclusive liability for performance deficiencies.

Total limitation on Liquidated Damages - The Supplier's total liability hereunder for all forms of liquidated damages provided for under this Order shall not exceed 10% of the Order Price.

The Parties agree that the amount of liquidated damages set forth above are reasonable in light of the anticipated harm caused by the breach of the duty related thereto and the difficulties of proof of loss and inconvenience or non-feasibility of obtaining an adequate remedy and the parties are stopped from contesting the validity or enforceability of such a liquidated damage.

All liquidated damages due hereunder shall be the Suppliers sole and exclusive liability and the Buyers sole and exclusive remedy for delay and performance deficiencies under this contract.

4.14 EXCUSABLE DELAY FORCE MAJEURE

The Seller shall not have any liability or be considered to be in breach or default of its obligations under the Agreement to the extent that performance of such obligations is delayed or prevented, directly or indirectly, due to:

(a) causes beyond its reasonable control; or

(b) acts of God, acts (or failures to act) of governmental authorities, fires howsoever caused, severe weather conditions, earthquakes, strikes or other labor disturbances, floods, war (declared or undeclared), epidemics, civil unrest, riots, delays or accidents in transportation; or

(c) Acts (or omissions) of the Buyer including failure to promptly: (a) provide the Seller with information and approvals necessary to permit the Seller to proceed with work immediately and without interruption, or (b) comply with the terms of payment.

The Seller shall notify the Buyer of any such delay and strive to mitigate the delay to the extent practicable. If the Seller is delayed by acts or omissions of the Buyer, or by the prerequisite work of the Buyer's other contractors or suppliers, the Seller shall also be entitled to any additional costs incurred.

If such excusable delay extends for more than ninety (90) days and the Parties have not agreed upon a revised basis for continuing the work at the end of the delay, including adjustment of the price, then either Party (except where delay is caused by the Buyer, in which event only the Seller), upon thirty (30) days written notice, may terminate the Agreement.

4.15 COMMERCIAL GENERAL LIABILITY

The Supplier shall provide Commercial General Liability for the duration of its liability under the Order as an occurrence type policy with an aggregate limit that applies on a per project basis with no exclusions related to Blanket Contractual Liability or Broad Form Property Damage Hazard. General liability coverage will cover all claims and liabilities arising out of the performance of Work by Supplier and its subcontractors. Liability limits shall not be less than a combined single limit of $1,000,000, a general aggregate limit of $2,000,000, products/completed ops aggregate limit of $2,000,000 and personal & advertising limit of $1,000,000.

4.16 AUTOMOBILE LIABILITY

This policy shall be written in comprehensive form to include personal/bodily injury and third party property damage per accident. Coverage shall apply to all motor vehicles licensed for highway use (owned, non-owned, scheduled and hired). Liability limits shall not be less than $1,000,000 per occurrence, combined single limit.

4.17 UMBRELLA LIABILITY

This insurance shall cover claims and liabilities in excess of the limits provided under all liability policies held by the Supplier with the exception of Professional Liability Insurance. Liability limits shall not be less than $15,000,000 per occurrence, $15,000,000 policy aggregate.

4.18 WORKERS COMPENSATION AND EMPLOYERS' LIABILITY

This insurance covers an employer's liability, as defined by state, under workers compensation laws that arise out of an employees work related injuries. Liability limits will be issued at statutory limits as defined by the state where the Work will be performed and shall comply with all federal requirements with no exclusions or limitations. Also, this insurance covers the Supplier's liability arising out of employee work related injuries that are not covered by the Workers Compensation statute. Liability limits shall not be less than $1,000,000 per accident, $1,000,000 per employee and have an aggregate limit of $1,000,000.

4.19 INDIRECT OR CONSEQUENTIAL DAMAGES

In no event, whether as a result of breach of contract, warranty, indemnity, tortuous damage (including negligence), strict or product liability, impossibility of service, positive breach of an obligation, or otherwise, shall Supplier or Supplier's subcontractors or suppliers be liable for loss of profit or revenues, loss of use of the Goods or any associated equipment, cost of capital, cost of substitute equipment, facilities, services or replacement power, downtime costs, fines or penalties charged to the Buyer for failure to meet permits, financing or additional borrowing costs, or for any special, consequential, incidental, indirect or exemplary damages.

4.20 LIMIT OF LIABILITY

Other than liability arising under clauses 4.11, 4.12, 4.13 and 4.14, the total aggregate liability of the Supplier under or in connection with the Order whether related to performance or non-performance of the Order in respect of all causes of action under, arising out of or in connection with the Order, whether for breach of contract, including breach of duty, in tort (including but not limited to negligence), by way of indemnity, warranty or otherwise, including (but not limited to) liability for defects and liquidated damages shall not exceed the Order price.

4.21 MITIGATION OF LOSS

In all cases the party establishing or alleging a breach of the Order or a right to be indemnified in accordance with the Order shall be under a duty to take reasonable steps to mitigate the loss which has occurred provided that he can do so without unreasonable inconvenience or cost.

4.22 CONFIDENTIALITY

The Buyer and Seller shall treat the details of the Agreement and any information made available in relation thereto as private and confidential and neither Party shall publish or disclose any particular details thereof (save in so far as may be necessary for the purposes of the Agreement or required by law) without the consent of the other provided that nothing in this clause shall prevent the publication or disclosure of any such information that has come within the public domain otherwise than breach of this clause.

4.23 VALIDITY

For budgetary purposes only.

Appendix Number	Appendices
A1	Technical Specification
A2	Technical Instructions

A1 Technical Specification

JENBACHER

Technical Description

Cogeneration Unit

JMS 312 GS-B.L D825/D805 480V

no special Grid Code

Racine, WI WWTP

*Standard ratings of the engines in the specification is valid for full load operation for an installation at **≤ 670 ft (204m)** and air intake temperature **T1<91.4°F (33°C)**. For **91.4°F <T1<104°F**, an output derate of **0.83%/°F (1.5%/°C)** derate will occur. Above **104°F (40°C)**, an output derate of **1.11%/°F (2.0%/°C**) derate will occur. Natural gas performance based on **MN=90**.*

SRT WF XXXXXX: TC

Electrical output	633	kW el.
Thermal output – Sewage gas	2683	MBTU/hr
Thermal output – Natural gas est.	2579	MBTU/hr

Emission values

NOx < 1.1 g/bhp.hr (NO2)

CO < 650 mg/Nm³ (5% O2) | < 250 mg/Nm³ (15% O2)

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0.01 Technical Data (at module) – Sewage gas D825

			100%	75%	50%
Power input	[2]	MBTU/hr	5,666	4,408	3,143
Gas volume	*)	scfhr	10,302	8,015	5,715
Mechanical output	[1]	bhp	881	661	441
Electrical output	[4]	kW el.	633	473	311
Recoverable thermal output (calculated with Glykol 37%)					
~ Intercooler 1st stage	[9]	MBTU/hr	394	153	44
~ Lube oil		MBTU/hr	364	328	279
~ Jacket water		MBTU/hr	681	574	467
~ Exhaust gas cooled to 356 °F		MBTU/hr	1,244	1,063	786
Total recoverable thermal output	[5]	MBTU/hr	2,683	2,118	1,576
Heat to be dissipated (calculated with Glykol 37%)					
~ Intercooler 2nd stage		MBTU/hr	69	39	17
~ Lube oil		MBTU/hr	~	~	~
~ Surface heat	ca. [7]	MBTU/hr	213	~	~
Spec. fuel consumption of engine electric	[2]	BTU/kWel.hr	8,947	9,325	10,092
Spec. fuel consumption of engine	[2]	BTU/bhp.hr	6,431	6,669	7,127
Lube oil consumption	ca. [3]	gal/hr	0.06	~	~
Electrical efficiency			38.1%	36.6%	33.8%
Thermal efficiency			47.4%	48.1%	50.1%
Total efficiency	[6]		85.5%	84.6%	84.0%
Hot water circuit:					
Forward temperature		°F	185.0	177.4	170.1
Return temperature		°F	149.0	149.0	149.0
Hot water flow rate		GPM	167.1	167.1	167.1
Fuel gas LHV		BTU/scft	550		

*) approximate value for pipework dimensioning
[ ] Explanations: see 0.10 - Technical parameters

All heat data is based on standard conditions according to attachment 0.10. Deviations from the standard conditions can result in a change of values within the heat balance, and must be taken into consideration in the layout of the cooling circuit/equipment (intercooler; emergency cooling; ...). In the specifications in addition to the general tolerance of ±8 % on the thermal output a further reserve of +5 % is recommended for the dimensioning of the cooling requirements.

0.01 Technical Data (at module) – Natural gas D805 Est.

			100%	75%	50%
Power input	[2]	MBTU/hr	5,548	4,306	3,074
Gas volume	*)	scfhr	6,050	4,696	3,353
Mechanical output	[1]	bhp	881	661	441
Electrical output	[4]	kW el.	633	473	312
Recoverable thermal output (calculated with Glykol 37%)					
~ Intercooler 1st stage	[9]	MBTU/hr	344	138	33
~ Lube oil		MBTU/hr	369	300	252
~ Jacket water		MBTU/hr	737	631	495
~ Exhaust gas cooled to 356 °F		MBTU/hr	1,129	959	723
Total recoverable thermal output	[5]	MBTU/hr	2,579	2,028	1,503
Heat to be dissipated (calculated with Glykol 37%)					
~ Intercooler 2nd stage		MBTU/hr	82	60	27
~ Lube oil		MBTU/hr	~	~	~
~ Surface heat	ca. [7]	MBTU/hr	209	~	~
Spec. fuel consumption of engine electric	[2]	BTU/kWel.hr	8,760	9,108	9,867
Spec. fuel consumption of engine	[2]	BTU/bhp.hr	6,297	6,513	6,968
Lube oil consumption	ca. [3]	gal/hr	0.06	~	~
Electrical efficiency			39.0%	37.5%	34.6%
Thermal efficiency			46.5%	47.1%	48.9%
Total efficiency	[6]		85.4%	84.6%	83.5%
Hot water circuit:					
Forward temperature		°F	185.0	177.3	170.0
Return temperature		°F	149.0	149.0	149.0
Hot water flow rate		GPM	160.6	160.6	160.6
Fuel gas LHV		BTU/scft	917		

*) approximate value for pipework dimensioning
[ ] Explanations: see 0.10 - Technical parameters

All heat data is based on standard conditions according to attachment 0.10. Deviations from the standard conditions can result in a change of values within the heat balance, and must be taken into consideration in the layout of the cooling circuit/equipment (intercooler; emergency cooling; ...). In the specifications in addition to the general tolerance of ±8 % on the thermal output a further reserve of +5 % is recommended for the dimensioning of the cooling requirements.

JENBACHER

Main dimensions and weights (at module)

Length	in	~ 190
Width	in	~ 90
Height	in	~ 90
Weight empty	lbs	~ 20,950
Weight filled	lbs	~ 22,010

Connections

Hot water inlet and outlet [A/B]	in/lbs	3"/145
Exhaust gas outlet [C]	in/lbs	10"/145
Fuel Gas (at module) [D]	in/lbs	3"/232
Water drain ISO 228	G	½"
Condensate drain	in/lbs	2"/145
Safety valve - jacket water ISO 228 [G]	in/lbs	1½"/2.5
Safety valve - hot water	in/lbs	2"/232
Lube oil replenishing (pipe) [I]	in	1.1
Lube oil drain (pipe) [J]	in	1.1
Jacket water - filling (flex pipe) [L]	in	0.5
Intercooler water-Inlet/Outlet 1st stage	in/lbs	3"/145
Intercooler water-Inlet/Outlet 2nd stage [M/N]	in/lbs	2½"/145

Output / fuel consumption

ISO standard fuel stop power ICFN	bhp	881
Mean effe. press. at stand. power and nom. speed	psi	218
Fuel gas type		Sewage gas / Natural gas
Based on methane number | Min. methane number	MN	135 | 117 / 94 | 75 d)
Compression ratio	Epsilon	12.5
Min./Max. fuel gas pressure at inlet to gas train	psi	1.16 - 2.9 c)
Max. rate of gas pressure fluctuation	psi/sec	0.145
Maximum Intercooler 2nd stage inlet water temperature	°F	140 / 122
Spec. fuel consumption of engine	BTU/bhp.hr	6,431 / 6,297
Specific lube oil consumption	g/bhp.hr	0.22
Max. Oil temperature	°F	189
Jacket-water temperature max.	°F	203
Filling capacity lube oil (refill)	gal	~ 57

c) Lower gas pressures upon inquiry
d) based on methane number calculation software AVL 3.2

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0.02 Technical data of engine

Manufacturer		JENBACHER
Engine type		J 312 GS-D825
Working principle		4-Stroke
Configuration		V 70°
No. of cylinders		12
Bore	in	5.31
Stroke	in	6.69
Piston displacement	cu.in	1,782
Nominal speed	rpm	1,800
Mean piston speed	in/s	402
Length	in	94
Width	in	57
Height	in	81
Weight dry	lbs	7,055
Weight filled	lbs	7,782
Moment of inertia	lbs-ft²	184.41
Direction of rotation (from flywheel view)		left
Radio interference level to VDE 0875		N
Starter motor output	kW	7
Starter motor voltage	V	24

JENBACHER

100% Sewage gas D825

Thermal energy balance

Power input	MBTU/hr	5,666
Intercooler	MBTU/hr	463
Lube oil	MBTU/hr	364
Jacket water	MBTU/hr	681
Exhaust gas cooled to 356 °F	MBTU/hr	1,244
Exhaust gas cooled to 212 °F	MBTU/hr	1,538
Surface heat	MBTU/hr	116

Exhaust gas data

Exhaust gas temperature at full load	[8]	°F	936
Exhaust gas temperature at bmep= 163.2 [psi]		°F	~ 1000
Exhaust gas temperature at bmep= 108.8 [psi]		°F	~ 1041
Exhaust gas mass flow rate, wet		lbs/hr	7,907
Exhaust gas mass flow rate, dry		lbs/hr	7,332
Exhaust gas volume, wet		scfhr	98,966
Exhaust gas volume, dry		scfhr	87,506
Max.admissible exhaust back pressure after engine		psi	0.870

Combustion air data

Combustion air mass flow rate	lbs/hr	7,273
Combustion air volume	SCFM	90,151
Max. admissible pressure drop at air-intake filter	psi	0.145

100% Natural gas D805 Est.

Thermal energy balance

Power input	MBTU/hr	5,548
Intercooler	MBTU/hr	426
Lube oil	MBTU/hr	369
Jacket water	MBTU/hr	737
Exhaust gas cooled to 356 °F	MBTU/hr	1,129
Exhaust gas cooled to 212 °F	MBTU/hr	1,416
Surface heat	MBTU/hr	113

Exhaust gas data

Exhaust gas temperature at full load	[8]	°F	901
Exhaust gas temperature at bmep= 163.2 [psi]		°F	~ 957
Exhaust gas temperature at bmep= 108.8 [psi]		°F	~ 999
Exhaust gas mass flow rate, wet		lbs/hr	7,661
Exhaust gas mass flow rate, dry		lbs/hr	7,103
Exhaust gas volume, wet		scfhr	97,430
Exhaust gas volume, dry		scfhr	86,341
Max.admissible exhaust back pressure after engine		psi	0.870

Combustion air data

Combustion air mass flow rate	lbs/hr	7,414
Combustion air volume	SCFM	1,531
Max. admissible pressure drop at air-intake filter	psi	0.145

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Sound pressure level

Aggregate a)		dB(A) re 20µPa	98
31,5	Hz	dB	83
63	Hz	dB	90
125	Hz	dB	94
250	Hz	dB	94
500	Hz	dB	93
1000	Hz	dB	92
2000	Hz	dB	89
4000	Hz	dB	89
8000	Hz	dB	92
Exhaust gas b)		dB(A) re 20µPa	115
31,5	Hz	dB	108
63	Hz	dB	119
125	Hz	dB	113
250	Hz	dB	117
500	Hz	dB	112
1000	Hz	dB	111
2000	Hz	dB	103
4000	Hz	dB	101
8000	Hz	dB	98

Sound power level

Aggregate	dB(A) re 1pW	118
Measurement surface	ft²	1,044
Exhaust gas	dB(A) re 1pW	123
Measurement surface	ft²	67.60

a) average sound pressure level on measurement surface in a distance of 3.28ft (converted to free field) according to DIN 45635, precision class 3.
b) average sound pressure level on measurement surface in a distance of 3.28ft according to DIN 45635, precision class 2.
The spectra are valid for aggregates up to bmep=217.55661 psi. (for higher bmep add safety margin of 1dB to all values per increase of 15 PSI pressure).
Engine tolerance ± 3 dB

0.03 Technical data of generator

Manufacturer		STAMFORD e)
Type		CG 634 J e)
Type rating	kVA	867
Driving power	bhp	881
Ratings at p.f.= 1.0	kW	633
Ratings at p.f. = 0.8	kW	629
Rated output at p.f. = 0.8	kVA	786
Rated reactive power at p.f. = 0.8	kVAr	471
Rated current at p.f. = 0.8	A	945
Frequency	Hz	60
Voltage	V	480
Speed	rpm	1,800
Permissible overspeed	rpm	2,250
Power factor (lagging - leading)		0,8 - 1,0
Efficiency at p.f.= 1.0		96.4%
Efficiency at p.f. = 0.8		95.7%
Moment of inertia	lbs-ft²	531.17
Mass	lbs	5,071
Radio interference level to EN 55011 Class A (EN 61000-6-4)		N
Cable outlet		left
Ik" Initial symmetrical short-circuit current	kA	9.64
Is Peak current	kA	24.53
Insulation class		H
Temperature rise (at driving power)		F
Maximum ambient temperature	°F	104

Reactance and time constants (saturated) at rated output

xd direct axis synchronous reactance	p.u.	1.789
xd' direct axis transient reactance	p.u.	0.145
xd" direct axis sub transient reactance	p.u.	0.097
x2 negative sequence reactance	p.u.	0.127
Td" sub transient reactance time constant	ms	30
Ta Time constant direct-current	ms	50
Tdo' open circuit field time constant	s	3.03

e) JENBACHER reserves the right to change the generator supplier and the generator type. The contractual data of the generator may thereby change slightly. The contractual produced electrical power will not change.

0.04 Technical data of heat recovery

General data - Hot water circuit (SG/NG est.)

Total recoverable thermal output	MBTU/hr	2,683 / 2,579
Return temperature	°F	149.0
Forward temperature	°F	185.0
Hot water flow rate	GPM	167.1 / 160.6
Design pressure of hot water	lbs	145
min. operating pressure	psi	51.0
max. operating pressure	psi	131.0
Pressure drop hot water circuit	psi	11.60
Maximum Variation in return temperature	°F	+0/-21
Max. rate of return temperature fluctuation	°F/min	18

General data - Cooling water circuit (SG/NG est.)

Heat to be dissipated (calculated with Glykol 37%)	MBTU/hr	69 / 82
Return temperature	°F	140 / 122
Cooling water flow rate	GPM	66
Design pressure of cooling water	lbs	145
min. operating pressure	psi	7.0
max. operating pressure	psi	73.0
Loss of nominal pressure of cooling water	psi	~
Maximum Variation in return temperature	°F	+0/-21
Max. rate of return temperature fluctuation	°F/min	18

Exhaust gas heat exchanger

Type	shell-and-tube

PRIMARY:

Exhaust gas pressure drop approx	psi	0.22
Exhaust gas connection	in/lbs	10"/145

SECONDARY:

Pressure drop hot water circuit	psi	2.90
Hot water connection	in/lbs	3"/145

The final pressure drop will be given after final order clarification and must be taken from the P&ID order documentation.

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100% Sewage gas D825 - connection variant F

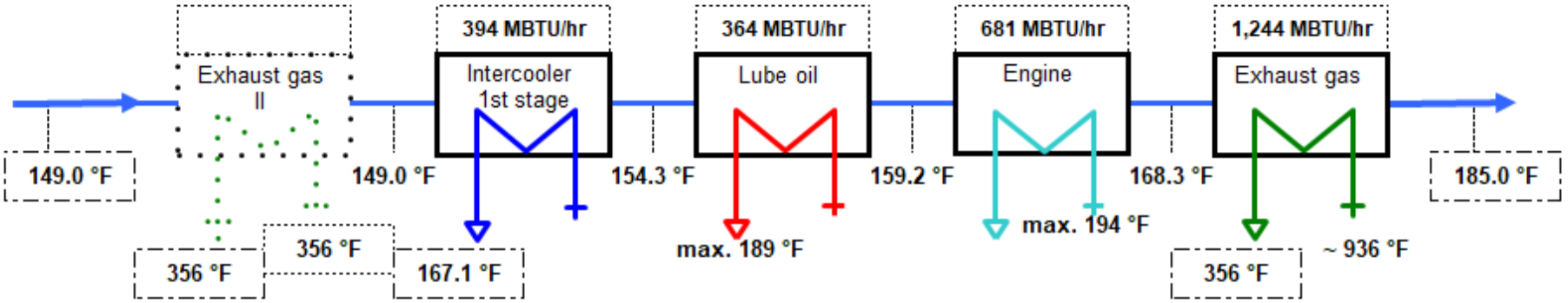
J 312 GS-D825

Hot water circuit (calculated with Glykol 37%)

Recoverable thermal output = 2,683 MBTU/hr

(±8 % tolerance +5 % reserve for cooling requirements)

Hot water flow rate = 167.1 GPM

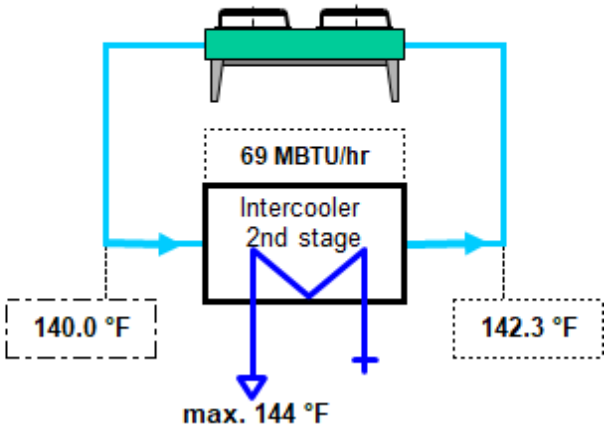


Low Temperature circuit (calculated with Glykol 37%)

Heat to be dissipated = 69 MBTU/hr

(±8 % tolerance +5 % reserve for cooling requirements)

Cooling water flow rate = 66.0 GPM



JENBACHER

100% Natural gas D805 - connection variant F

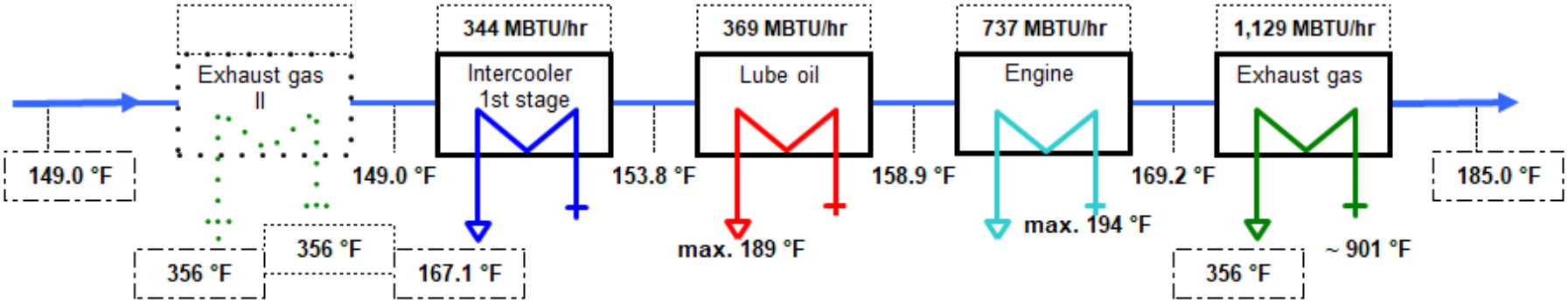
J 312 GS-D805

Hot water circuit (calculated with Glykol 37%)

Recoverable thermal output = 2,579 MBTU/hr

(±8 % tolerance +5 % reserve for cooling requirements)

Hot water flow rate = 160.6 GPM

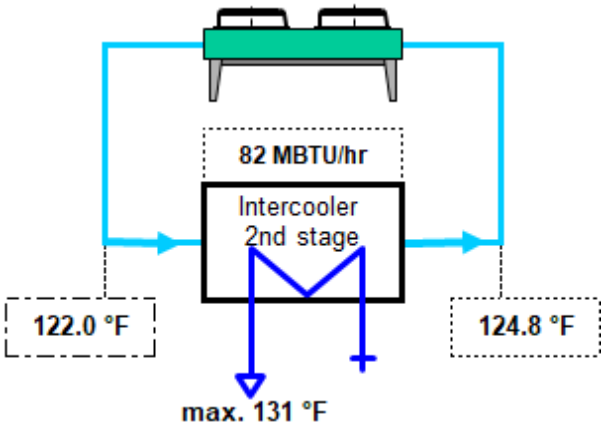


Low Temperature circuit (calculated with Glykol 37%)

Heat to be dissipated = 82 MBTU/hr

(±8 % tolerance +5 % reserve for cooling requirements)

Cooling water flow rate = 66.0 GPM



0.10 Technical parameters

The following “Technical Instruction (TA) of JENBACHER” form an integral part of the contract and must be strictly observed:
TA 1000-0004 - Preservation of Jenbacher modules
TA 1100-0110 – Boundary Conditions for Jenbacher Gas Engines
TA 1100-0111 – General Conditions – Operation and Maintenance
TA 1100-0112 – Installation of Jenbacher Units
These Technical Instructions reference other guides and instructions which can be provided upon request. These instructions should be carefully reviewed by all personnel involved with the application, installation design, installation construction, and overall maintenance of any Jenbacher gas engine.

All data in the technical specification are based on engine full load (unless stated otherwise) at specified temperatures as well as the methane number and subject to technical development and modifications. For isolated operation an output reduction may apply according to the block load diagram. Before being able to provide exact output numbers, a detailed site load profile needs to be provided (motor starting curves, etc.).

All pressure indications are to be measured and read with pressure gauges (psi.g.).

(1) At nominal speed and standard reference conditions ICFN according to DIN-ISO 3046 and DIN 6271, respectively
(2) According to DIN-ISO 3046 and DIN 6271, respectively, with a tolerance of +**5** %.
Efficiency performance is based on a new unit (immediately upon commissioning).Effects of degradation during normal operation can be mitigated through regular service and maintenance work.
reference value --> 55%CH4 / 40%CO2 / rest N2, O2
(3) Average value between oil change intervals according to maintenance schedule, without oil change amount
(4) At p. f. = 1.0 according to VDE 0530 REM / IEC 34.1 with relative tolerances, all direct driven pumps are included
(5) Total output with a tolerance of ±8 %
(6) According to above parameters (1) through (5)
(7) Only valid for engine and generator; module and peripheral equipment not considered (at p. f. = 0,8) ,(guiding value)
(8) Exhaust temperature with a tolerance of ±8 %
(9) Intercooler heat on:
*** standard conditions** - If the turbocharger design is done for air intake temperature > 86°F w/o de-rating, the intercooler heat of the 1st stage need to be increased by 2%/K starting from 77°F. Deviations between 77 – 86°F will be covered with the standard tolerance.
*** Hot Country application (V1xx)** - If the turbocharger design is done for air intake temperature > 104°F w/o de-rating, the intercooler heat of the 1st stage need to be increased by 2%/K starting from 95°F. Deviations between 95 – 104°F will be covered with the standard tolerance.

Radio interference level
The ignition system of the gas engines complies the radio interference levels of CISPR 12 and EN 55011 class B, (30-75 MHz, 75-400 MHz, 400-1000 MHz) and (30-230 MHz, 230-1000 MHz), respectively.

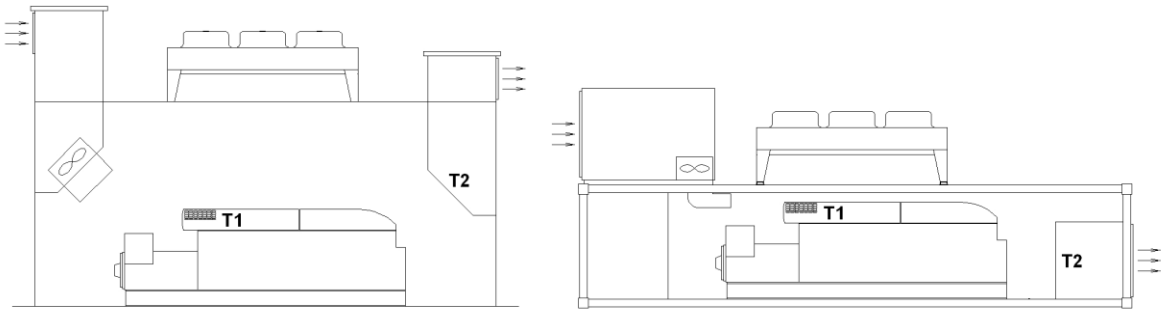
Definition of output

- ISO-ICFN continuous rated power:
  Net break power that the engine manufacturer declares an engine is capable of delivering continuously, at stated speed, between the normal maintenance intervals and overhauls as required by the manufacturer. Power determined under the operating conditions of the manufacturer's test bench and adjusted to the standard reference conditions.
- Standard reference conditions:
  Barometric pressure: 14.5 psi (1000 mbar) or 328 ft (100 m) above sea level
  Air temperature: 77°F (25°C) or 298 K
  Relative humidity: 30 %

- Volume values at standard conditions (fuel gas, combustion air, exhaust gas)
  Pressure: 1 atmosphere (1013.25 mbar)
  Temperature: 32°F (0°C)

Output adjustment for turbo charged engines

Standard rating of the engines is for an installation at an altitude ≤ **200 ft** and combustion air temperature ≤ **95 °F** (T1)
Engine room outlet temperature: **122°F** (T2) -> engine stop



The minimum recommended air change ratio (C) must be observed to maintain the required air quality and prevent unwanted gas accumulations (refer to Section ⇨ Potentially explosive
Atmospheres as per TA1100-0110). The calculation of the minimum air change rate is based on the formula below and is Cmin= $50h^{-1}$ for all JENBACHER modules.

If the actual methane number is lower than the specified, the knock control responds. First the ignition timing is changed at full rated power. Secondly the rated power is reduced. These functions are done by the engine management.
Exceedance of the voltage and frequency limits for generators according to IEC 60034-1 Zone A will lead to a derate in output.

Parameters for the operation of JENBACHER gas engines

The genset fulfills the limits for mechanical vibrations according to ISO 8528-9.
The following "Technical Instruction of JENBACHER" forms an integral part of a contract and must be strictly observed: **TA 1000-0004, TA 1100 0110, TA 1100-0111**, and **TA 1100-0112.**
Transport by rail should be avoided. See **TA 1000-0046** for further details

Failure to adhere to the requirements of the above mentioned TA documents can lead to engine damage and may result in loss of warranty coverage.

Parameters for the operation of control unit and the electrical equipment
Relative humidity 50% by maximum temperature of 104°F.
Altitude up to 2000m above the sea level.

0.11 Additional technical parameters

- Syngas gasification processes may create substances which may be hazardous or harmful to health. The relevant Health & Safety instructions and precautions need to be considered when dealing with the potential substances in the gas, deposits or condensates.
- Island operation (without grid) is not allowed.
- The engine room ventilation must be designed as a forced system (with intake fans), so that there is always a slight overpressure in the engine room. This ensures that any unburned exhaust gas will be forced out of the exhaust system and cannot leak back into the engine room.
- The engine room ventilation must be designed so that in case of leaks no ignitable amounts of gas can form.
- It must be insured that during any operational mode no ignitable gas mixture is evident at any of JENBACHER delivered components. See TA 1100-0110.
- An emergency shut off valve that can be controlled by JENBACHER shall be installed outside of the engine room.
- The gas warning system must be designed according to TA 1100-0110.
- All persons in the immediate vicinity of the site must be equipped with a suitable wearable gas warning sensor. Relevant warning and security notification boards for CO, H2 and other poisonous and flammable gases/substances must be visible positioned and in a manner that informs and motivates personal correctly.
- The gas, according to TA 1000-0300 and at the given parameters must be free of condensate and/or sublimates
- The measurement at the central test bench is carried out with natural gas and can only partially simulate the operation with special gas (gas mixtures with hydrogen, CO, etc.). In particular, the measured gas consumption does not correspond to the expected value with the real gas due to the different gas composition and the resulting different combustion properties of hydrogen mixtures.

0.20 Mode of Operation

Grid Parallel Mode
The genset is running in parallel to the utility. The unit load can be adjusted via its power control set point or designated option.
Procedure in the event of mains failure:
When the mains monitor relay (protective relay ANSI No. 27, 59, 81, 78- provided either by JENBACHER or the customer) is activated due to a mains failure, the engine is isolated from the mains by opening the generator breaker. The module is shut down without any cool-down run.

Island operation is not available in this case!
The module can be restarted following the restoration of mains power after a 5-minute mains stabilization period.

1.00 Scope of supply - Module

Design:
The module is built as a compact package. The engine and generator are mounted on a common base when a low voltage generator is specified (<1000 V). In case of a medium voltage generator the engine base is bolted to the generator base.
The Engine output shafting is connected through a coupling to the generator. To provide the best possible isolation from the transmission of vibrations, the engine rests on the engine base-frame by means of anti-vibration mounts. The remaining vibrations are eliminated by mounting the complete module on isolating pads (e.g. Sylomer). This, in principle, allows for placing of the module to be directly on any floor capable of carrying the static load. No special foundation is required. Prevention of sound conducted through solids has to be provided locally.

1.01 Spark ignited gas engine

Four-stroke, air/gas mixture turbocharged, aftercooled, with high performance ignition system and electronically controlled air/gas mixture system.
The engine is equipped with the most advanced

LEANOX® LEAN-BURN COMBUSTION SYSTEM

developed by JENBACHER.

1.01.01 Engine design

Engine block
Single-piece crankcase and cylinder block made of special casting, crank case covers for engine inspection, welded steel oil pan.

Crankshaft and main bearings
Drop-forged, precision ground, surface hardened, statically and dynamically balanced; main bearings (upper bearing shell: 3-material bearing / lower bearing shell: sputter bearing) arranged between crank pins, drilled oil passages for forced-feed lubrication of connecting rods.

Vibration damper
Maintenance free viscous damper

Flywheel
With ring gear for starter motor

Pistons
Single-piece, made of light metal alloy, with piston ring carrier and oil passages for cooling; piston rings made of high quality material, main combustion chamber specially designed for lean burn operation.

Connecting rods
Drop-forged, heat-treated, big end diagonally split and toothed. Big end bearings (upper bearing shell: sputter bearing / lower bearing shell: grooved bearing) and connecting rod bushing for piston pin.

Cylinder liner
Chromium alloy gray cast iron, wet, individually replaceable.

Cylinder head
Specially designed and developed for JENBACHER-lean burn engines with optimized fuel consumption and emissions; water cooled, made of special casting, individually replaceable; Valve seats and valve guides and spark plug sleeves individually replaceable; exhaust and inlet valve made of high quality material.

Crankcase breather
Connected to combustion air intake system

Valve train
Camshaft, with replaceable bushings, driven by crankshaft through intermediate gears, valve lubrication by splash oil through rocker arms.

Combustion air/fuel gas system
Motorized carburetor for automatic adjustment according fuel gas characteristic. Exhaust driven turbocharger, mixture manifold with bellows, water-cooled intercooler, throttle valve and distribution manifolds to cylinders.

Ignition system
Most advanced, fully electronic high performance ignition system, external ignition control.

Lubricating system
Gear-type lube oil pump to supply all moving parts with filtered lube oil, pressure control valve, pressure relief valve and full-flow filter cartridges. Cooling of the lube oil is arranged by a heat exchanger.

Engine cooling system
Jacket water pump complete with distribution pipework and manifolds.

Exhaust system
Turbocharger and exhaust manifold

Exhaust gas temperature measuring
Thermocouple for each cylinder

Electric actuator
For electronic speed and output control

Electronic speed monitoring for speed and output control

By magnetic inductive pick up over ring gear on flywheel

Starter motor
Engine mounted electric starter motor

1.01.02 Additional equipment for the engine (spares for commissioning)

The initial set of equipment with the essential spare parts for operation after commissioning is included in the scope of supply.

1.01.03 Engine accessories

Insulation of exhaust manifold:
Insulation of exhaust manifold is easily installed and removed

Sensors at the engine:
- Jacket water temperature sensor
- Jacket water pressure sensor
- Lube oil temperature sensor
- Lube oil pressure sensor
- Mixture temperature sensor
- Charge pressure sensor
- Minimum and maximum lube oil level switch
- Exhaust gas thermocouple for each cylinder
- Knock sensors
- Gas mixer / gas dosing valve position reporting.

Actuator at the engine:
- Actuator - throttle valve
- Bypass-valve for turbocharger
- Control of the gas mixer / gas dosing valve

1.01.04 Standard tools (per installation)

The tools required for carrying out the most important maintenance work are included in the scope of supply and delivered in a toolbox.

1.02 Generator-low voltage

The 2 bearing generator consists of the main generator (built as rotating field machine), the exciter machine (built as rotating armature machine) and the digital excitation system.
The digital regulator is powered by an auxiliary winding at the main stator or a PMG system

Main components:

- Enclosure of welded steel construction
- Stator core consist of thin insulated electrical sheet metal with integrated cooling channels.
- Stator winding with 2/3 Pitch
- Rotor consist of shaft with shrunken laminated poles, Exciter rotor, PMG (depending on Type) and fan.
- Damper cage
- Excitation unit with rotating rectifier diodes and overvoltage protection
- Dynamically balanced as per ISO 1940, Balance quality G2,5
- Drive end bracket with re greaseable antifriction bearing
- Non-drive end bracket with re grease antifriction bearing
- Cooling IC01 - open ventilated, air entry at non-drive end , air outlet at the drive end side
- Main terminal box includes main terminals for power cables
- Regulator terminal box with auxiliary terminals for thermistor connection and regulator.
- Anti-condensation heater
- 3 pieces PTC thermistors for winding temperature monitoring+3 pieces PTC thermistors spare

Option:
Current transformer for protection and measuring in the star point
xx/1A, 10P10 15VA , xx/1A, 1FS5, 15VA

Electrical data and features:

- Standards: IEC 60034, EN 60034, VDE 0530, ISO 8528-3, ISO 8528-9
- Voltage adjustment range: +/- 10 % of rated voltage (continuous)
- Frequency: -6/+4% of rated frequency
- Overload capacity: 10% for one hour within 6 hours, 50% for 30 seconds
- Asymmetric load: max. 8% I2 continuous, in case of fault I2 x t=20
- Altitude: < 1000m
- Max permitted generator intake air temperature: 5°C - 40°C
- Max. relative air humidity: 90%
- Voltage curve THD Ph-Ph: <4% at idle operation and <5% at full load operation with linear symmetrical load
- Generator suitable for parallel operating with the grid and other generators
- Sustained short circuit current at 3-pole terminal short circuit: minimum 3 times rated current for 5 seconds.
- Over speed test with 1.2 times of rated speed for 2 minutes according to IEC 60034

Digital Excitation system ABB Unitrol 1010 mounted within the AVR Terminal box with following features:

- Compact and robust Digital Excitation system for Continuous output current up to 10 A (20A Overload current 10s)
- Fast AVR response combined with high excitation voltage improves the transient stability during LVRT events.
- The system has free configurable measurement and analog or digital I/Os. The configuration is done via the local human machine interface or CMT1000
- Power Terminals

3 phase excitation power input from PMG or auxiliary windings
Auxiliary power input 24VDC

- Excitation output
- Measurement terminals: 3 phase machine voltage, 1 phase network voltage, 1 phase machine current
- Analog I/Os: 2 outputs / 3 inputs (configurable), +10 V / -10 V
- Digital I/O: 4 inputs only (configurable), 8 inputs / outputs (configurable)
- Serial fieldbus: RS485 for Modbus RTU or VDC (Reactive power load sharing for up to 31 JENBACHER engines in island operation), CAN-Bus for dual channel communication
- Regulator Control modes: Bump less transfer between all modes
  Automatic Voltage Regulator (AVR) accuracy 0,1% at 25°C ambient temperature
  Field Current Regulator (FCR)
  Power Factor Regulator (PF)
  Reactive Power Regulator (VAR)
- Limiters: Keeping synchronous machines in a safe and stable operation area
  Excitation current limiter (UEL min / OEL max)
  PQ minimum limiter
  Machine current limiter
  V / Hz limiter
  Machine voltage limiter
- Voltage matching during synchronization
- Rotating diode monitoring
- Dual channel / monitoring: Enables the dual channel operation based on self diagnostics and setpoint follow up over CAN communication.. As Option available
- Power System Stabilizer (PSS) is available as option. Compliant with the standard IEEE 421.5-2005 2A / 2B, the PSS improves the stability of the generator over the highest possible operation range.
- Computer representation for power system stability studies: ABB 3BHS354059 E01
- Certifications: CE, cUL certification according UL 508c (compliant with CSA), DNV Class B,

- **Commissioning and maintenance Tool CMT1000** (for trained commissioning/ maintenance personal)
- With this tool the technician can setup all parameters and tune the PID to guarantee stable operation. The CMT1000 software allows an extensive supervision of the system, which helps the user to identify and locate problems during commissioning on site. The CMT1000 is connected to the target over USB or Ethernet port, where Ethernet connection allows remote access over 100 m.
- Main window
  - Indication of access mode and device information.
  - Change of parameter is only possible in CONTROL access mode.
  - LED symbol indicates that all parameter are stored on none volatile memory.
- Setpoint adjust window
  - Overview of all control modes, generator status, active limiters status and alarms.
  - Adjust set point and apply steps for tuning of the PID.
- Oscilloscope
- 4 signals can be selected out of 20 recorded channels. The time resolution is 50ms.Save files to your PC for further investigation.
- Measurement
  - All measurements on one screen.

Routine Test

Following routine tests will be carried out by the generator manufacturer

- Measuring of the DC-resistance of stator and rotor windings
- Check of the function of the fitted components (e.g. RTDs, space heater etc.)
- Insulation resistance of the following components
  - Stator winding, rotor winding
  - Stator winding RTDs
  - Bearing RTDs
  - Space heater
- No Load saturation characteristic (remanent voltage)
- Stator voltage unbalance
- Direction of rotation, phase sequence
- High voltage test of the stator windings (2 x Unom. + 1000 V) and the rotor windings (min. 1500 V)

1.03 Module Accessories

Base frame
Common Base Frame fabricated with welded structural steel. Frame to mount the engine, jacket water heat exchangers, pumps and engine auxiliaries, as well as generator.

Coupling
Engine to Generator coupling is provided. The coupling isolates the major sub-harmonics of engine alternating torque from generator.

Coupling housing
Provided for Coupling

Anti-vibration mounts
2 sets of isolation, one is arranged between engine block assembly and base frame. The second is via insulating pads (SYLOMER) for placement between base frame and foundation, delivered loose.

Exhaust gas connection
A flanged connection is provided that collects the exhaust gas turbocharger output flows, includes flexible pipe connections (compensators) to compensate for heat expansions and vibrations.

Combustion air filter
A Dry type air filter with replaceable filter cartridges is fitted. The assembly includes flexible connections to the fuel mixer/carburetor and service indicator.

Interface panel (M1 cabinet)
Totally enclosed sheet steel cubicle with hinged doors, pre-wired to terminals, ready to operate. All Cable entry will be via bottom mounted cable gland plates.

Painting: RAL 7035

Protection: External NEMA 3 (IP 54), Internal IP 20 (protection against direct contact with live parts)

Cabinet design is according to IEC 439-1 (EN 60 439-1/1990) and DIN VDE 0660 part 500, respectively.

Ambient temperature 41 - 104 °F (5 - 40 °C), Relative humidity 70%

Dimensions:
- Height: 51 in (1300 mm)
- Width: 47 in (1200 mm)
- Depth: 16 in (400 mm)

Control Power Source: The starter batteries and the cabinet mounted battery chargers will provide the power source for this enclosure.

Interface Panel contents and control functions:
- The cabinet houses the unit Battery Charger and primary 24VDC Control Power Distribution (breakers, fuses, and terminals) from the unit Batteries
- Distributed PLC Input and Output cards, located in the cabinet, gather all Engine and Generator Control I/O. These cards transmit data via data bus interface to the central engine control of the module control panel located in the A1 cabinet. Data bus is via CAN and B&R Proprietary Data Highway (Data Cables provided by JENBACHER)
- Speed monitoring relays for protection are provided.
- Gas Train I/O Collection, including interface relays and terminals for gas train shutoff valves.
- Transducer for generator functions, such as excitation voltage.
- Door Mounted Emergency Stop Switch with associated Emergency Stop Loop interface relays.
- Miscellaneous control relays, contacts, fuses, etc. for additional control valves, and auxiliaries.
- Interface Terminal Strips

Skid Mounted 3 Phase Devices are Powered by 3 x **480**/**277** V, **60** Hz, 50 A

AC Power for engine mounted auxiliaries (heater, pumps, etc.) are routed through a separate J-box mounted on the side M1 cabinet (Box E1). This is done to maintain signal segregation (AC from control)

NOTE: Generator Current Transformer wiring is connected directly to the Generator and does NOT pass through the M1 cabinet.

1.03.01 Engine jacket water system

Closed cooling circuit, consisting of:
- Expansion tank
- Filling device (check and pressure reducing valves, pressure gauge)
- Safety valve(s)
- Thermostatic valve
- Required pipework on module
- Vents and drains
- Jacket water pump, including check valve
- Jacket water preheat device

1.03.02 Automatic lube oil replenishing system incl. extension tank

Automatic lube oil replenishing system:
Includes float valve in lube oil feed line, including inspection glass. Electric monitoring system will be provided for engine shut-down at lube oil levels "MINIMUM" and "MAXIMUM". Solenoid valve in oil feed line is only activated during engine operation. Manual override of the solenoid valve, for filling procedure during oil changes is included.

Oil drain
By set mounted cock

Oil sump extension tank 39.6 gal
To increase the time between oil changes

Aftercooling oil pump:
Mounted on the module base frame; it is used for the aftercooling of the turbocharger; period of operation of the pump is 15 minutes from engine stop.
Consisting of:
- Oil pump 250 W, 480/277 V
- Oil filter
- Necessary pipework

1.03.03 Oxidizing catalyst

Catalytic reactor, consisting of a metal support structure with precious metal coating to reduce the emissions. The catalyst is delivered loose and will be mounted at the exhaust gas system after start up and commissioning of the engine.

1.04 Heat recovery

The heat exchangers are mounted to the engine and/or to the module base frame, complete with interconnecting pipe work.
The connection design of the heat exchangers is determined on a project specific basis. The connection design, temperatures and flow rates are shown on page 12 of this document. Interfaces to the customer circuit are shown as connection points A and B (see page 6).

Heat exchanger - exhaust gas to warm water
Single duct, tube-type heat exchanger, provided as a component of the heat recovery system

Consisting of:
- Inlet chamber
- Tube type heat exchanger
- Outlet chamber with condensate drain

Thermocouple for monitoring of exhaust gas outlet temperatureThe exhaust gas heat eschanger is delivered loose..

The insulation of heat exchangers and pipe work is not included in JENBACHER scope of supply and should be provided locally if needed.

1.04.01 De-coupling Heat Exchanger for High Temperature Circuit

Plate type heat exchanger for warm water/glycol circuit delivered loose
Design parameters:
- glycol circuit: temperatures xx/xx°F, 87PSI
- warm water circuit: temperatures xx/xx°F, 87PSI

1.05.01.a Gas train <500mbar (7.3 psi) – Sewage Gas

Pre-assembled, delivered loose, for installation into gas pipework to the module.

Consisting of:
- Manual shut off valve
- Gas filter, filter fineness <3 µm
- Pressure gauge with push button valve
- Gas admission pressure regulator
- Solenoid valves
- Leakage detector
- Gas pressure switch (min.)
- TEC JET (has to be implemented horizontal)
- Gas flow meter (option)
- p/t compensation (option)

The gas train complies with DIN - DVGW regulations.
Maximum distance from TEC JET outlet to gas entry on engine, including flexible connections, is 39,37in (1m)

1.05.01.b Gas train <500mbar (7.3 psi) – Natural Gas

Pre-assembled, delivered loose, for installation into gas pipework to the module.

Consisting of:
- Manual shut off valve
- Gas filter, filter fineness <3 µm
- Pressure gauge with push button valve
- Gas admission pressure regulator
- Solenoid valves
- Leakage detector
- Gas pressure switch (min.)
- TEC JET (has to be implemented horizontal)
- Gas flow meter (option)
- p/t compensation (option)

The gas train complies with DIN - DVGW regulations.
Maximum distance from TEC JET outlet to gas entry on engine, including flexible connections, is 39,37in (1m)

JENBACHER

1.07 Painting

- Quality: Oil resistant prime layer
  Synthetic resin varnish finishing coat

- Color:

Engine:	RAL 6018 (green)
Base frame:	RAL 6018 (green)
Generator:	RAL 6018 (green)
Module interface panel:	RAL 7035 (light grey)
Control panel:	RAL 7035 (light grey)

1.11 Engine generator control panel per module- Dia.ne XT4 incl. Single synchronization of the generator breaker

Dimensions:

- Height: 91 in (including 8 in pedestal *)
- Width: 32 -48 in*)
- Depth: 24 in *)

Protection class:

- external IP42
- Internal IP 20 (protection again direct contact with live parts)

*) Control panels will be dimensioned on a project specific basis. Actual dimensions will be provided in the preliminary documentation for the project.

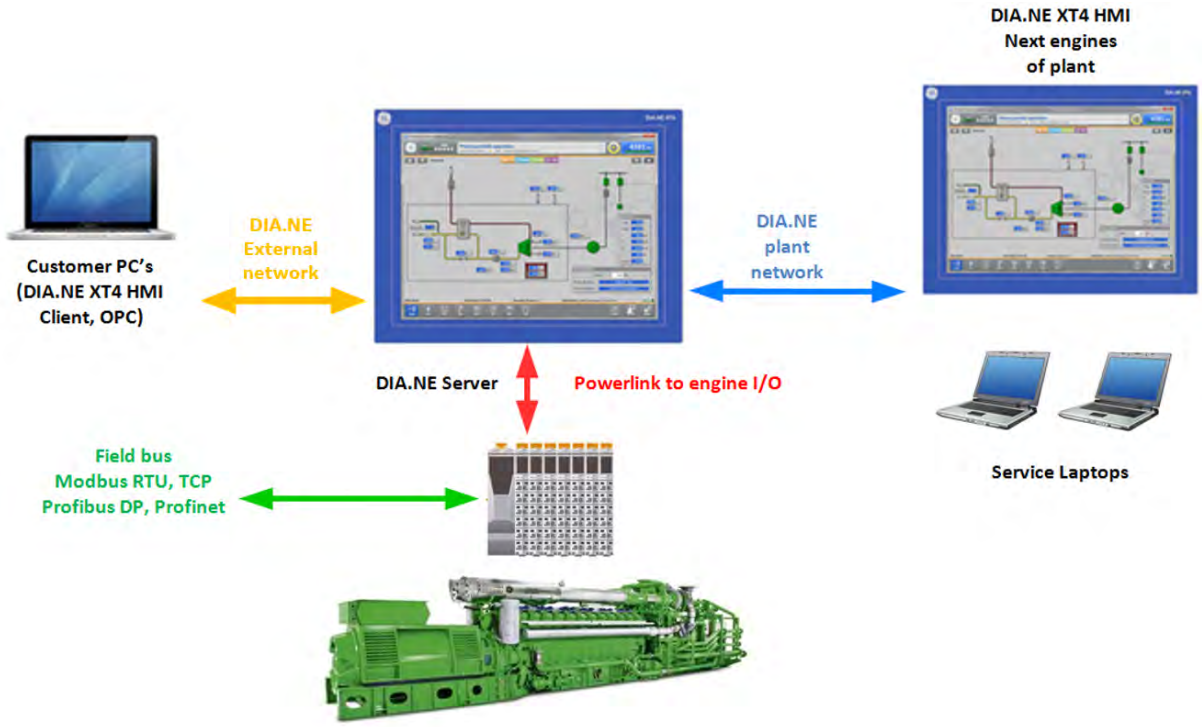
Control supply voltage from starter and control panel batteries: 24V DC

Auxiliaries power supply: (from provider of the auxiliary supply)
3 x **480**/**277** V, **60** Hz

Consisting of:
Motor - Management - System DIA.NE

Setup:

- a) Touch display visualization
- b) Central engine and unit control



Touch Display Screen:

15“ Industrial color graphic display with resistive touch.

Interfaces:

- 24V voltage supply
- DVI display connection
- USB interface for resistive touch

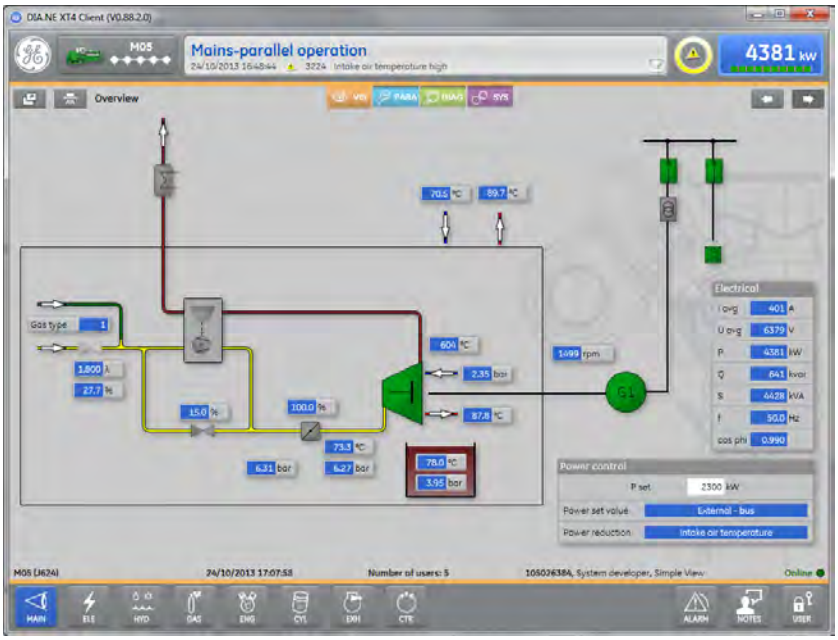
Protection class of DIA.NE XT panel front: IP 65

The screen shows a clear and functional summary of the measurement values and simultaneously shows a graphical summary.

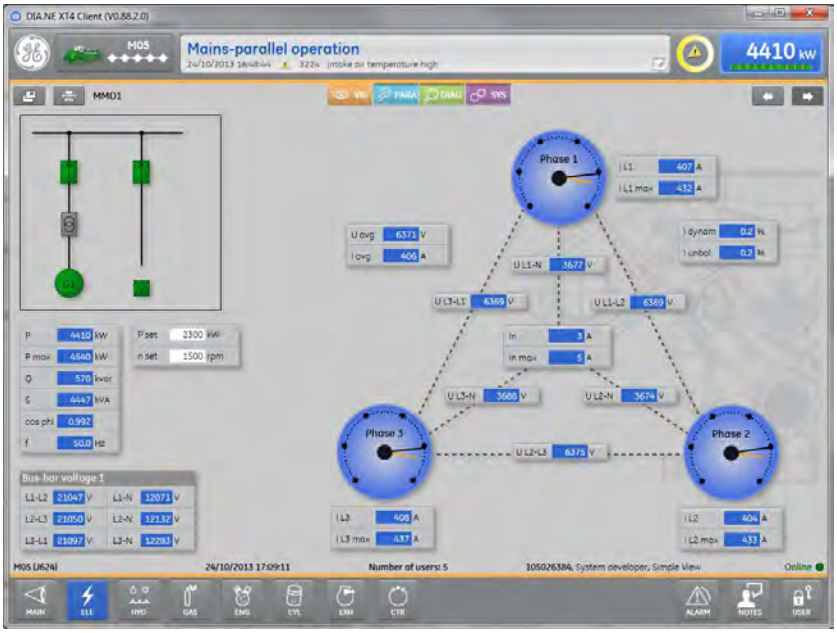
Operation is via the screen buttons on the touch screen
Numeric entries (set point values, parameters…) are entered on the touch numeric pad or via a scroll bar.
Determination of the operation mode and the method of synchronization via a permanently displayed button panel on the touch screen.

Main screens (examples):

Main: Display of the overview, auxiliaries' status, engine start and operating data.



ELE: Display of the generator connection with electrical measurement values and synchronization status



Trending
Trend with 100ms resolution

Measurement values:

- 500 data points are stored
- Measurement interval = 100ms
- Raw data availability with 100ms resolution: 3 hours + max. 50.000.000 changes in value at shut down (60 mins per shut down)
- Compression level 1: min, max, and average values with 1000ms resolution: 1 day
- Compression level 2: min, max, and average values with 30s resolution: 1 month
- Compression level 3: min, max, and average values with 10min resolution: 10 years

Messages:
1.000.000 message events

Actions (operator control actions):
100.000 Actions

System messages:
100.000 system messages

Central engine and module control:

An industrial PC- based modular industrial control system for module and engine sequencing control (start preparation, start, stop, aftercooling and control of auxiliaries) as well as all control functions.

Interfaces:

- Ethernet (twisted pair) for remote monitoring access
- Ethernet (twisted pair) for connection between engines
- Ethernet (twisted pair) for the Powerlink connection to the control input and output modules.
- USB interface for software updates

Connection to the local building management system according to the JENBACHER option list (OPTION)

- MODBUS-TCP Slave,

Control functions:

- Speed control in idle and in island mode
- Power output control in grid parallel operation, or according to an internal or external set point value on a case by case basis
- LEANOX control system which controls boost pressure according to the power at the generator terminals, and controls the mixture temperature according to the engine driven air-gas mixer
- Knocking control: in the event of knocking detection, ignition timing adjustment, power reduction and mixture temperature reduction (if this feature is installed)
- Load sharing between engines in island mode operation (option)
- Linear power reduction in the event of excessive mixture temperature and misfiring
- Linear power reduction according to CH4 signal (if available)
- Linear power reduction according to gas pressure (option)
- Linear power reduction according to air intake temperature (option)

Multi-transducer to record the following alternator electrical values:

- Phase current (with slave pointer))
- Neutral conductor current
- Voltages Ph/Ph and Ph/N
- Active power (with slave pointer)
- Reactive power
- Apparent power
- Power factor
- Frequency
- Active and reactive energy counter

Additional 0 (4) - 20 mA interface for active power as well as a pulse signal for active energy

The following alternator monitoring functions are integrated in the multi-measuring device:

- Overload/short-circuit [51], [50]
- Over voltage [59]
- Under voltage [27]
- Asymmetric voltage [64], [59N]
- Unbalance current [46]
- Excitation failure [40]
- Over frequency [81>]
- Under frequency [81<]

Lockable operation modes selectable via touch screen:

- "OFF" operation is not possible, running units will shut down immediately;
- "MANUAL" manual operation (start, stop) possible, unit is not available for fully automatic operation.
- "AUTOMATIC" fully automatic operation according to external demand signal:

Demand modes selectable via touch screen:

- external demand off („OFF“)
- external demand on („REMOTE“)
- overide external demand („ON“)

Malfunction Notice list:

Shut down functions e.g.:

- Low lube oil pressure
- Low lube oil level
- High lube oil level
- High lube oil temperature
- Low jacket water pressure
- High jacket water pressure
- High jacket water temperature
- Overspeed
- Emergency stop/safety loop
- Gas train failure
- Start failure
- Stop failure
- Engine start blocked
- Engine operation blocked
- Misfiring
- High mixture temperature
- Measuring signal failure
- Overload/output signal failure
- Generator overload/short circuit
- Generator over/undervoltage
- Generator over/underfrequency

- Generator asymmetric voltage
- Generator unbalanced load
- Generator reverse power
- High generator winding temperature
- Synchronizing failure
- Knocking failure

Warning functions e.g.:
- Cooling water temperature min.
- Cooling water pressure min.
- Generator winding temperature max.

Remote signals:
(volt free contacts)

1NO = 1 normally open
1NC = 1 normally closed
1COC = 1 change over contact

• Ready for automatic start (to Master control)	1NO
• Operation (engine running)	1NO
• Demand auxiliaries	1NO
• Collective signal "shut down"	1NC
• Collective signal "warning"	1NC

External (by others) provided command/status signals:

• Engine demand (from Master control)	1S
• Auxiliaries demanded and released	1S

Single synchronizing Automatic

For automatic synchronizing of the module with the generator circuit breaker to the grid by PLC- technology, integrated within the module control panel.

Consisting of:
- Hardware extension of the programmable control for fully automatic synchronization selection and synchronization of the module and for monitoring of the generator circuit breaker closed signal.
- Lockable synchronization selection via touch screen with the following selection modes:
  - "MANUAL" Manual initiation of synchronization via touch screen button followed by fully automatic synchronization of the module
  - "AUTOMATIC" Automatic module synchronization, after synchronizing release from the module control
  - "OFF" Selection and synchronization disabled
    Control of the generator circuit breaker according to the synchronization mode selected via touch screen.

- "Generator circuit breaker CLOSED/ Select" Touch-button on DIA.NE XT
- "Generator circuit breaker OPEN" Touch-button on DIA.NE XT

Status signals:
Generator circuit breaker closed
Generator circuit breaker open

Remote signals:
(volt free contacts)
Generator circuit breaker closed 1 NO

The following reference and status signals must be provided by the switchgear supplier:

- Generator circuit breaker CLOSED 1 NO
- Generator circuit breaker OPEN 1 NO
- Generator circuit breaker READY TO CLOSE 1 NO
- Mains circuit breaker CLOSED 1 NO
- Mains circuit breaker OPEN 1 NO

Mains voltage 3 x **480**/**277**V or 3x 110V/v3 other measurement voltages available on request
Bus bar voltage 3 x **480**/**277** V or 3x 110V/v3 – other measurement voltages available on request
Generator voltage 3 x **480 V** or 3x 110V/v3 – other measurement voltages available on request

Voltage transformer in the star point with minimum 50VA and Class 0,5

The following volt free interface-signals will be provided by JENBACHER to be incorporated in switchgear:

- CLOSING/OPENING command for generator circuit breaker (permanent contact) 1 NO + 1 NC
- Signal for circuit breaker undervoltage trip 1 NO

Maximum distance between module control panel and engine/interface panel:	99ft
Maximum distance between module control panel and power panel:	164ft
Maximum distance between module control panel and master control panel:	164ft
Maximum distance between alternator and generator circuit breaker:	99ft

1.11.01 Remote messaging over MODBUS-TCP

Data transfer from the JENBACHER module control system to the customer's on-site central control system via MODBUS TCP using the ETHERNET 10 BASE-T/100BASE-TX protocol TCP/IP.

The JENBACHER module control system operates as a SLAVE unit.
The data transfer via the customer's MASTER must be carried out in cycles.

Data transmitted:
Individual error messages, operational messages, measured values for generator power, oil pressure, oil temperature, cooling water pressure, cooling water temperature, cylinder and collective exhaust gas temperatures.

JENBACHER limit of supply:
RJ45 socket at the interface module in the module control cabinet

1.11.06 Remote Data-Transfer with DIA.NE XT4

General
DIA.NE XT4 offers remote communication using an Ethernet connection.

Applications:

1.) DIA.NE XT4 HMI
DIA.NE XT4 HMI is the Human-Machine-Interface of DIA.NE XT4 engine control and visualization system for JENBACHER gas engines.
The system offers extensive facilities for commissioning, monitoring, servicing and analysis of the site.
By installation of the DIA.NE XT4 HMI client program it can be used to establish connection to site, if connected to a network and access rights are provided.
The system runs on Microsoft Windows Operating systems (Windows XP, Windows 7, Windows 8, Windows 10)

Function
Functions of the visualization system at the engine control panel can be used remotely. These functions provide control, monitoring, trend indications, alarm management, parameter management, and access to long term data recording. By providing access to multiple systems, also with multiple clients in parallel, additional useful functions are available like

- Multi-user system
- Remote control
- Print and export functions
- Data backup.

The DIA.NE XT4 is available in several languages.

Option - Remote demand/blocking

If the service selectors switch at the module control panel is in position "Automatic" and the demand-selector switch in position "Remote", it is possible to enable (demanded) or disable (demand off) the module with a control button at the DIA.NE XT4 HMI
Note:

With this option, it makes no sense to have an additional clients demand (via hardware or data bus) or a self-guided operation (via JENBACHER master control, grid import /export etc.).

Option - Remote - reset (see TA-No. 1100-0111 chapter 1.7 and 1.9)

Scope of supply

- Software package DIA.NE XT4 HMI Client Setup (Download)
- Number of DIA.NE XT4 HMI - Client user license (Simultaneous right to access of one user to the engine control)

Nr. of license	Access
1	1 Users can be logged in at the same time with a PC (Workplace, control room or at home).
2 - “n“ (Optional)	2- “n” Users can be logged in at the same time with a PC (Workplace, control room or at home). If 2- “n” users are locally connected at Computers from office or control room, then it is not possible to log in from home.

Caution! This option includes the DIA.NE XT4 HMI client application and its license only – NO secured, encrypted connection will be provided by JENBACHER! A secured, encrypted connection – which is mandatory – has to be provided by the customer (via LAN connection or customer-side VPN), or can be realized by using option myPlant™.

Customer requirements

- Broad band network connection via Ethernet(100/1000BASE-TX) at RJ45 Connector (ETH3) at DIA.NE XT4 server inside module control panel
- Standard PC with keyboard, mouse or touch and monitor (min. resolution 1024*768)
- Operating system Windows XP, Windows 7, Windows 8, Windows 10
- DirectX 9.0 c compatible or newer 3D display adapter with 64 MB or higher memory

2.) myPlant™

myPlant* is the remote data transfer and diagnostics solution from JENBACHER

	Available functions	**Asset Visibility (previously Connect)**	**Reliability Management (previously Protect)**
Asset Management	On-line data transfer	✓	✓
	Big Data cloud storage	✓	✓
	Engine status	✓	✓
	Alarms and warnings	✓	✓
	Underlying data trends	✓	✓
	HMI remote access	-	✓

	Unlimited data trend	-	✓
	Enhanced diagnostics	-	✓
Fleet Management	Fleet status on a map of the world	-	✓
	Fleet totals and reports	-	✓
Mobility	Text messaging /e-mail	-	✓
	Smart phone app	✓	✓

Scope of supply

- Access to myPlant™
- Integration of the plant in the myPlant™ system

Equipment to be provided by the customer

- Permanent Internet connection (wired or wireless)
  (see also option 4)
- Technical requirements as per TA 2300-0008
- Outward data connection (from the plant server to the Internet) - INWARD connections are NOT PERMITTED!

CAUTION: The customer must take technical precautions to ensure that direct access to the plant server from the Internet is prevented (e.g. by means of a firewall):
This security measure CANNOT be assumed and guaranteed by JENBACHER

3.) Mobile Internet (OPTION)
Connection Plant - Customer via secured Internet - connection
See also technical instruction **TA 2300 - 0006**

Scope of delivery

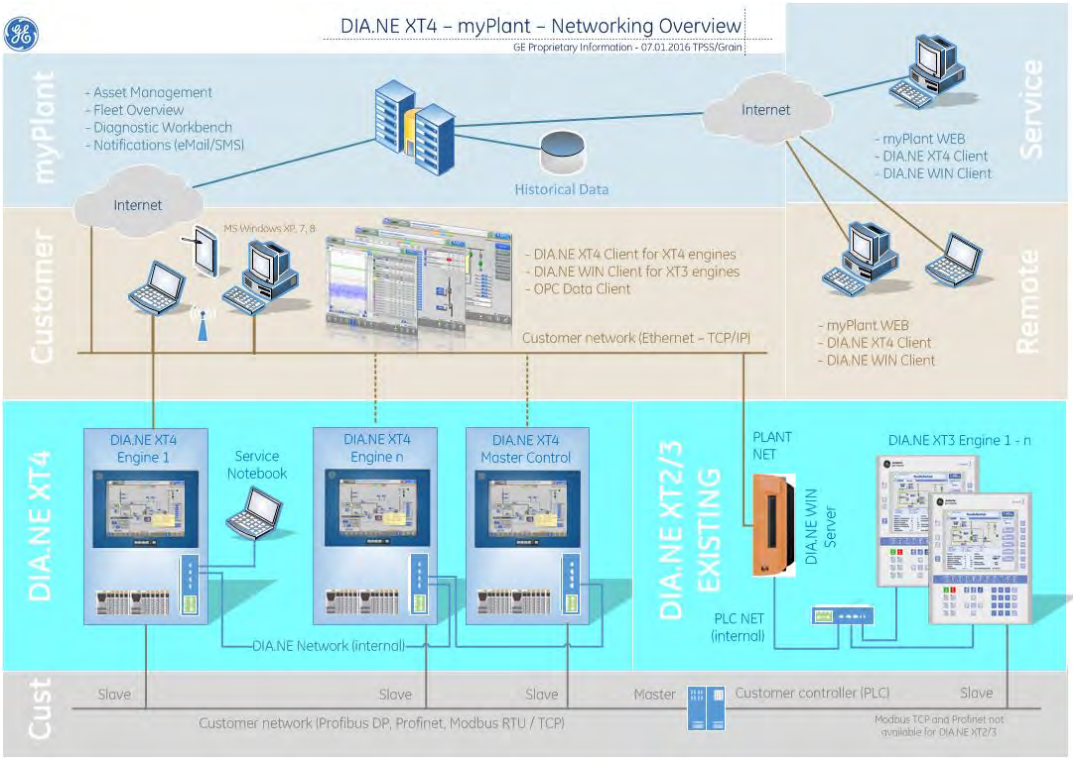
- Mobile Internet router with antenna to connect to the DIA.NE Server XT4

Customer requirements

- SIM card for 3G / 4G

4.) Network overview

For information only!



1.11.10 Active power limitation, Reactive power control per module

Active power limitation:
The module can be operated with a reduced power output if the network operator requires a temporary limitation on feed-in power. Power logging is carried out at the generator terminals.

The customer has the option to engage in module control using the following signals:
- 0/4 - 20mA for the continuous limitation of generator active power from 100 % - 50(PMin) %
- 4 potential-free contacts for the limitation of generator active power from 100 % - 50(PMin) %
- 1 potential-free contact for blocking the module

The following signal is provided to the customer by JENBACHER:
- 0/4 - 20mA for the actual value of generator active power

Reactive power control:
The reactive power/power factor control point is at the generator terminals

The module is designed for the process of reactive power control described below.

Set point setting via the customer using the following signals:

- 0/4 - 20mA for the continuous cos phi set point setting in the range of 0.8 overexcited to 0.95 under-excited

The following signal is provided to the customer by JENBACHER:

- 0/4 - 20mA for the actual value of generator reactive power
- 0/4 - 20mA for the actual value of generator active power

Further interfaces upon request!

1.11.25 Control Strategy and Options (USA)

1.11.25.1 Per Unit Customer Enclosure Controls

Diane XT4 System will be provided with the following additional features to operate a customer enclosure

Option 1C Ventilation Fan control

Discrete IO is provided to demand operation of customer container ventilation fans. Start/Stop signals for each fan are provided. It is assumed that the customer MCC will provide starter motor protection and that the customer provides any temperature sequencing and control

Option 1D Ventilation System Louver Control

Electrical and Control features are provided for louver opening and closing based on engine operation and compartment temperature.

4 Louver driver contacts are provided
4 Louver feedback signals are required

Option 1E Discrete Input for Air Filter Differential Pressure

Additional Discrete Input and associated software for control

Option 3 Audible and Visual Alarm Indications

Hardware and software to drive a customer provided one (1) horn and two (2) strobes. Power for these devices is provided from the control system and is 24VDC

1.11.25.2 Per Unit Balance of Plant Controls

For all following controls only, the panel control parts and software are included. The power supply is in customer scope.

Option 1A Hot Water Pump

- The option will add specific contact output and feedback input to/from an MCC for the Hot Water Pump. This will include relays and software.

Option 1B Hot Water Monitoring (check if needed, or second HW loop)

- This option will monitor hot water loop switches (flow, pressure and temperature). This option includes hardwired relays added to the trip loop, and internal software (Feedback Signal to customer)

Option 1C Hot Water Return Temperature Control

- This feature will provide all necessary controls to operate a 3 Way temperature control valve. The customer will provide a PT100 as a feedback signal and the Diane will provide a 4-20mA Analog Output to a customer provided valve. Control and Display Software are also provided.

Option 2A Intercooler Temperature Control

- This feature will provide all necessary controls to operate a 3 Way temperature control valve in the IC Loop if Not Required by Site Conditions. The Diane will provide a 4-20mA Analog Output to a customer provided valve and will utilize mixture temperature as a feedback input. Control and Display Software are also provided.

Option 2B Intercooler Pump Control

- The option will add specific contact output and feedback input to/from an MCC for the Intercooler Water Pump. This will include relays and software.

Option 2C Intercooler Loop Pressure

- This feature will provide a discrete input and associated software for the Intercooler Loop system pressure.

Option 3D Dual Circuit GMM Radiator Control

- This feature will provide controls for a customer Güntner Motor Management (GMM) 2 circuit radiator. The MCC control signals (DO/DI), and GMM control signals (4-20mA, DI and DO signals) will be provided.

Option 6A Release Main gas valve

The option will add specific contact output to release the main gas valve.

Option 6B Gas Flow Meter Trending

Gas Flowmeter Trending and Display (Flowmeter not included)

- Includes a 4-20mA input that will accept the pressure and temperature corrected gas flow from a customer provided flow meter computer and will incorporate the signal into trending and displays in the Diane system.

Option 6C Gas Flow Meter Correction (natural gas)

Gas Flowmeter temperature and pressure compensation.

- Option includes three (3) 4-20mA inputs that will represent actual measured flow, pressure and temperature. Along with a customer provided flow meter calibration sheet, these 3 signals will be input to a calculation that will compensate the flowmeter flow signal to current gas conditions. The results will be incorporated into trending and displays in the Diane system.
- In the measurement are these interfaces included:
  - Pulse gas counter (1 pulse = 1000 fm)
  - Power supply 24VDC, 6A
  - Gas quantity (4 – 20 mA = …Nm^3)
  - Gas temperature (4 – 20 mA = 0 – 100°C)
  - Gas pressure at gas inlet (4 – 20 mA = …mbar)

Option 6D Gas Flow Meter Correction (second gas)

Gas Flowmeter temperature and pressure compensation.

- Option includes three (3) 4-20mA inputs that will represent actual measured flow, pressure and temperature. Along with a customer provided flow meter calibration sheet, these 3 signals will be input to a calculation that will compensate the flowmeter flow signal to current gas conditions. The results will be incorporated into trending and displays in the Diane system.
- In the measurement are these interfaces included:

- Pulse gas counter (1 pulse = 1000 fm)
- Power supply 24VDC, 6A
- Gas quantity (4 – 20 mA = …Nm³)
- Gas temperature (4 – 20 mA = 0 – 100°C)
- Gas pressure at gas inlet (4 – 20 mA = …mbar)

Option 6E gas mixing for dual gas

Boundary conditions

The gases must always comply with TA 1000-0300. The engine may only be run at the permitted maximum power for any alternative gas.

Gas switch-over for start of the engine

The gas type is selected by an on-site/external preselected contact when in "Manual" or "Automatic" mode. Modules in operation must be shut down before switching the start gas type. At the next start, the engine will use the other selected gas.

Gas mixing in operation

The gas mixing is selected by an on-site/external preselected contact. The mixing will be released in mains parallel operation, when the „release mixing operation“ contact is set.
The mixing of the gas follows a mA set point from the customer, what mixes the gas according the pre-set gas ramp in operation.

These interfaces are required:

- Gas selection, 0 = high cal. gas, 1 = low cal. gas
- Release mixing in operation
- Set point gas mixing, 4-20mA = 0-100%

1.11.25.4 Mains Parallel Control Strategy for single units

Option 1 Grid Parallel with active power (KW) Control

- Real Power Load Control of the Generator set will be either via a 4-20mA input from the customer representing a unit KW load setpoint or a KW load setpoint entered on the Diane XT screen. Upon breaker closure, the unit will ramp to the setpoint at a maximum rate of (Rated Unit KW) / 180 seconds.

Option 2 Grid Parallel with power factor (cos phi) Control

- Reactive Power Load Control of the Generator set will be either via a 4-20mA input from the customer representing a unit Power Factory setpoint or a Power Factor setpoint entered on the Diane XT screen. Upon breaker closure, the unit will maintain the setpoint.

Option 4 Grid Parallel with import / export Control (single unit only)

- Only possible in single unit use. If there are multiple engines with import / export control on site, a master control is needed
- Load Control via an Import/Export KW level entered on the Diane XT screen. Required will be a customer 4-20mA signal representing the Site KW (Imported and/or Exported Power) that is to be controlled. Upon breaker closure, the unit will ramp to a load that will drive the KW value represented by the 4-20mA input signal to the level entered on Customer Import/Export Setpoint entered in the Diane XT screen. Once at the setpoint, the unit will raise and lower load to maintain this value. If the generator load required to maintain this setpoint drops below the minimum load level of the generator set, the unit 52G circuit breaker will be opened.

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1.20.03 Starting system

Starter battery:
2 piece 12 V AGM battery, 125 Ah (according to DIN 72311).

Battery voltage monitoring:
Monitoring by PLC.

Battery charging equipment:
Capable for charging the starter battery with I/U characteristic and for the supply of all connected D.C. consumers.
Charging device is mounted inside of the module interface panel or module control panel.

- **General data:**
  - Power supply — **3 x 320 - 575 V, 47 - 63 Hz**
  - max. power consumption — 1040 W / 1550 W (5 sec)
  - Nominal D.C. voltage — 24 V(+/-1%)
  - Voltage setting range — 24V to 28V (adjustable)
  - Nominal current (max.) — 40 A
  - Degree of protection — IP20 to IEC 60529
  - Operating temperature — 32 °F – 158 °F (0 °C - 70 °C)
  - Protection class — 1
  - Humidity class — 3K3, no condensation.
  - Natural air convection
  - Standards — EN60950,EN50178
    UL/cUL (UL508 / UL 60950-1)

Signalling:
Green Led: Output voltage > 21.6V

Control accumulator:
- Pb battery 24 VDC/18 Ah

1.20.05 Electric jacket water preheating

Installed in the jacket water cooling circuit, consisting of:
- Heating elements
- Water circulating pump

The jacket water temperature of a stopped engine is maintained between 133 °F (56°C) and 140°F (60°C), to allow for immediate loading after engine start.

1.20.08 Flexible connections

Following flexible connections per module are included in the JENBACHER -scope of supply:

No.	Connection	Unit	Dimension	Material
2	Warm water in-/outlet	**IN/LBS**	**3"/145**	Stainless steel
1	Exhaust gas outlet	**IN/LBS**	**10"/145**	Stainless steel
1	Fuel gas inlet	**IN/LBS**	**3"/232**	Stainless steel
2	Intercooler in-/outlet	**IN/LBS**	**2½"/**	Stainless steel
2	Lube oil connection	**IN**	**1.1**	Hose

Seals and flanges for all flexible connections are included.

1.20.25 Warm water monitoring

The monitoring device is included in the warm water circuit. The components are delivered loose.

Consisting of:

- 1 Flow control — Shut down signal: minimum flow
- 1 Pressure switch — Shut down signal: maximum pressure
- 1 Temperature switch — Shut down signal: maximum temperature
- 1 Pressure relief valve

2.00 Electrical equipment

Totally enclosed floor mounted sheet steel cubicle with front door wired to terminals. Ready to operate, with cable entry at bottom. Naturally ventilated or with forced ventilation.

Protection:	IP 42 external, NEMA 12	
	IP 20 internal (protection against direct contact with live parts)	

Design according to EN 61439-2 / IEC 61439-2 / UL 508 A and ISO 8528-4.
Ambient temperature 41 - 104 °F (5 - 40 °C), 70 % Relative humidity

Standard painting:	Panel:	RAL 7035
	Pedestal:	RAL 7020 (Rittal TS8)
		RAL 7020 (Rittal VX25)

2.02 Grid monitoring device

Standard without static Grid - 60Hz alternator

Function:
For immediate disconnection of the generator from the grid in case of grid failures.

Consisting of:
- High/low voltage monitoring
- High/low frequency monitoring
- Specially adjustable independent time for voltage and frequency monitoring
- Vector jump monitoring or df/dt monitoring for immediate disconnection of the generator from the grid for example at short interruptions
- Indication of all reference dimensions for normal operation and at the case of disturbance over LCD and LED
- Adjusting authority through password protection against adjusting of strangers

Scope of supply:
Digital grid protection relay with storage of defect data, indication of reference dimensions as well as monitoring by itself.

Grid protection values:

Parameter	Parameter limit	Max time delay[s]	**Comments**
59-61Hz			Do work normal
f<[ANSI 81U]	59Hz	0,5	Load reduction with 10%/HZ below 59Hz!
f<<[ANSI 81U]	58.5Hz	0,1	
f>[ANSI 81O]	61,5Hz	0,1	Load reduction with 30%/HZ above 61Hz!
U<[ANSI 27]	90%	1	Load reduction with 1%P /%U below 95%
U<<[ANSI 27]	80%	0,2	Load reduction with 1%P /%U below 95%
U>[ANSI 59]	110%	30	Load reduction with 1%P /%U above 105%

U>>[ANSI 59]	115%	0,2	Load reduction with 1% P/%U above 105%
Df/dt [ANSI 81R] **Or** **Vector shift** [ANSI 78]	2Hz/s, 5 Periods Or 8° -3pol		Cos phi range: 0,8ind (overexcited) - 1

2.03.01 Power control

Mains import/export - power control

Function:
The output is controlled via the mains power import/export set point.
This control system can for example reduce the consumption from the mains to a minimum (depending on the mains power import/export setpoint).

The measured value acquisition of the mains power consumption is performed by an on-site measuring transducer (0/4 - 20 mA, potential free measured signal).

Power adjustment:
The running unit perform within the load range of 50 - 100 % nominal load.

Start and stop of the engine in accordance of the module demand from the customer.

The client provides the following signals for JENBACHER control:
- 0(4) - 20 mA for mains import/export power
- Demand module (1 NO contact)

3.71 Vibration Switch

A structural Vibration Switch will be installed on the package base frame to detect excessive vibrations. A signal we will sent to the control panel to indicate an alarm condition.

4.00 Delivery, installation and commissioning

4.01 Carriage
According to contract.

4.02 Unloading
Unloading, moving of equipment to point of installation, mounting and adjustment of delivered equipment on intended foundations is not included in JENBACHER scope of supply.

4.03 Assembly and installation
Assembly and installation of all JENBACHER -components is not included in JENBACHER scope of supply.

4.04 Storage
The customer is responsible for secure and appropriate storage of all delivered equipment.

4.05 Start-up and commissioning
Start-up and commissioning with the JENBACHER start-up and commissioning checklist is not included.
Plants with island operation require internet connection.

4.06 Trial run
After start-up and commissioning, the plant will be tested in an 8-hour trial run. The operating personnel will be introduced simultaneously to basic operating procedures.
Is not included in JENBACHER scope of supply.

4.07 Emission measurement with exhaust gas analyzer
Emission measurement by JENBACHER personnel, to verify that the guaranteed toxic agent emissions have been achieved (costs for measurement by an independent agency will be an extra charge).

5.01 Limits of delivery

Electrical:
- Module:
  - At terminals of module interface panel
  - At terminals of generator terminal box, must use flexible cable (lugs and glands to be provided locally)
- Module control panel:
  At terminal strips
- Auxiliaries:
  At terminals of equipment which is supplied separately

Mechanical
Suitable bellows and flexible connections **must be provided locally** for all connections.

Warm water
At inlet and outlet flanges on module

Low temperature water
At inlet and outlet flanges at the module

Exhaust gas
At outlet flange of exhaust gas heat exchanger at module

Combustion air
The air filters are set mounted

Fuel gas
- At inlet and outlet flanges of gas train
- At inlet flange of gas pipe work on module

Lube oil
At lube oil connections on module

Draining connections and pressure relief
At module

Condensate
At condensate drain on exhaust gas heat exchanger

Insulation
Insulation of heat exchangers and pipe work is not included in our scope of supply and must be provided locally.

First filling
The first filling of module, (lube oil, engine jacket water, anti freeze-, anti corrosive agent) is not included in our scope of supply.

The composition and quality of the used consumables are to be strictly monitored in accordance with the "Technical Instructions" of JENBACHER.

5.02 Factory tests and inspections

The individual module components shall undergo the following tests and inspections:

5.02.01 Engine tests

Carried out as combined Engine- and Module test according to DIN ISO 3046 at JENBACHER test bench. The following tests are made at 100%, 75% and 50% load, and the results are reported in a test certificate:
- Engine output
- Fuel consumption
- Jacket water temperatures
- Lube oil pressure

- Lube oil temperatures
- Boost pressure
- Exhaust gas temperatures, for each cylinder

5.02.02 Generator tests
Carried out on the premises of the generator supplier.

5.02.03 Module tests
The engine will be tested with natural gas (methane number 94). The performance data achieved at the test bench may therefore vary from the data as defined in the technical specification due to differences in fuel gas quality.
Carried out as combined Engine- and Module test commonly with module control panel at JENBACHER test bench, according to ISO 8528, DIN 6280. The following tests are made and the results are reported in a test certificate:
Visual inspection of scope of supply per specifications.
- Functional tests per technical specification of control system.
  - Starting in manual and automatic mode of operation
  - Power control in manual and automatic mode of operation
  - Function of all safety systems on module
- Measurements at 100%, 75% and 50% load:
  - Frequency
  - Voltage
  - Current
  - Generator output
  - Power factor
  - Fuel consumption
  - Lube oil pressure
  - Jacket water temperature
  - Boost pressure
  - Mixture temperature
  - Exhaust emission (NOx)

The module test will be carried out with the original generator, except if it is not possible because of the delivery date. Then a test generator will be used for the module test.
To prove characteristics of the above components, which are not tested on the test bench by JENBACHER, the manufacturers' certificate will be provided.

5.03 Documentation

60 days advance documentation, as per the technically clarified order placement
- Module drawing **1)**
- Technical diagram **1)**
- Drawings of the cabinet views **3**
- Electrical interface list **2)**
- Technical specification of the control system **2)**
- Technical drawings of accessories (if included in scope of supply of INNIO Jenbacher GmbH & Co OG) **1**

Before delivery(depending on progress in ordering the components, on request)

- Technical drawings for BoP components supplied separately (if included in scope of supply of INNIO Jenbacher GmbH & Co OG) **1)**

Upon delivery

- Circuit diagrams **3)**
- Cable list **3)**

Delivered with the engine

- Brief instructions (transport, erection, moving) **1)**

For commissioning

- Operation and maintenance instructions **4)**
- Spare parts catalogue **4)**
- Original supplier operation and maintenance instructions for any BoP components (installed in the INNIO Jenbacher GmbH & Co OG scope of supply) as Appendix **1)**

All the components found in the INNIO Jenbacher GmbH & Co OG scope of supply are described in the operation and maintenance instructions, and in the spare parts catalogue.
In addition, the manufacturer's original operation and maintenance instructions will be provided for every BoP component, in German and English as standard, as an Appendix for the operation and maintenance manual provided.

Additional costs of producing or providing the required documents using the KKS (power station coding system) and/or integration in subcontractors' documentation, or additional approval, design and proof of testing documentation must be negotiated or ordered separately.

This standard offer does not include:

- Approval documentation
- Design documentation
- Proof of testing documentation
- Printed copies and digital off-line versions (e.g. printed versions, CD, pdf, etc.) must be negotiated separately and ordered accordingly.

Available languages (language codes as per ISO 639-1):

4	3	2	1		
				de	German
				en	English
				fr	French
				it	Italian
				es	Spanish
				nl	Dutch
				hu	Hungarian
				ru	Russian
				pl	Polish
				tr	Turkish
				cs	Czech
				pt	Portuguese
				da	Danish
				sk	Slovakian
				sl	Slovenian
				sr	Serbian
				lv	Latvian
				et	Estonian
				ro	Rumanian
				no	Norwegian
				hr	Croatian
				fi	Finnish
				zh	Chinese
				el	Greek
				bg	Bulgarian
				lt	Lithuanian
				sv	Swedish

A2 Technical Instructions *-150 page document available- not included in this appendix*

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IN POWER. SINCE 1920.

Clarke Energy USA Inc.
2100 Pewaukee Road,
Waukesha, WI 53188

Tel: +1 262 565 5020
www.clarke-energy.com

Project Number: 60554970

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9-185-2A
BIOGAS CHP
Engine Generator

Racine, WI WWTP

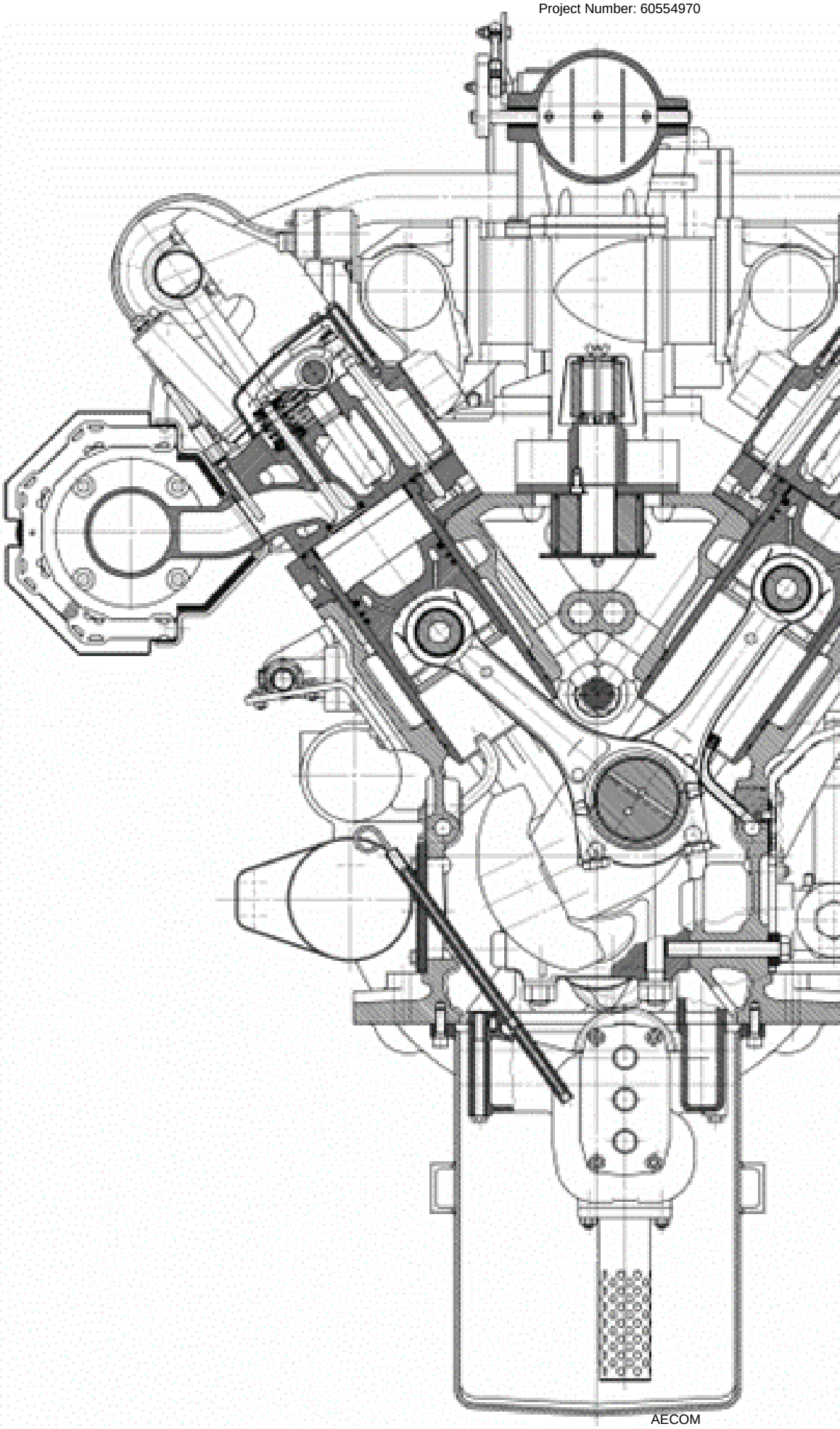
COMBINED HEAT & POWER GENERATION SYSTEM

WI0042 LC01 200313

Clarke Energy USA Inc.

March 13, 2020

Quality Integrity Reliability Accountability



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WI0042LC01/JS

March 13, 2020

Bryan Lewis
AECOM
2985 South Ridge Road, Suite B
Green Bay, WI 54304
USA

Dear Mr. Lewis,

RACINE, WI WWTP – GAS ENGINE GENERATION SYSTEM

Clarke Energy is pleased to enclose our **budgetary proposal** for the following gas fired power units for the Racine, WI Waste Water Treatment Plant located in Wisconsin:

Description	Gas	Electrical Output	Thermal Output	Electrical Efficiency	Thermal Efficiency	Voltage
1 x JMS312GS-B.L (Dual Fuel - Version D825/D805)	Sewage Gas	633kW$_e$	2,683MBTU/hr	38.1%	47.4%	480V
	Natural Gas	633 kW$_e$	2,579MBTU/hr	39.0%	46.5%	

Clarke Energy is a leading engineering, installation and service company, with a global presence in the renewable and natural gas fired power generation sectors. We are the largest independent distributor for INNIO Jenbacher Gas Engines, representing 30% of the total equipment sales through the factory. Across the Clarke Group we have installed over 7GW$_e$ capacity in 27 territories worldwide with vast experience of a range of power generation, co-generation and tri-generation applications utilizing different gaseous fuels.

Our philosophy is a simple one. Deliver quality projects that are reliable, with the highest levels of integrity and accountability from all of the 1,200 people we employ.

We trust that we have correctly interpreted your immediate requirements and would welcome the opportunity to meet with you to discuss the project further and assist with its development. Should you have any queries please do not hesitate to contact us.

Yours sincerely,

On behalf of CLARKE ENERGY USA Inc.

Jonathan Shepherd
Proposals Engineer

Charlie Mayer
Sales Engineer

Respondent Contacts

Any and all queries pertaining to the respondent's proposals herein should be directed to:

	Primary Contact	Secondary Contact
Name:	Charlie Mayer	Victoria Kay
Title:	Sales Engineer	Senior Proposals Engineer
Email:	charlie.mayer@clarke-energy.com	victoria.kay@clarke-energy.com
Contact Number:	262.444.7722	+44 151 546 4446

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1	Detailed Scope of Works
2	Demarcation Schedule
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A1	Technical Specification
A2	Technical Instructions

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1 Detailed Scope of Works

Description	CEL Scope	
	Supply	Exclusions
1.0 – Generation Module		
1.1 – Gas Engine Generator Set		
Spark ignition gas engine	✓	
Self-excited self-regulated three-phase generator	✓	
Flexible coupling, bell housing, base frame	✓	
Cooling system	✓	
Automatic lube oil replenishing system	✓	
Natural Gas fuel gas train (gas pressure 1.79-2.9psig, LHV 917BTU/scft) – NFPA37 compliant	✓	
Sewage Gas fuel gas train (gas pressure 1.79-2.9psig, LHV 550BTU/scft) – NFPA37 compliant	✓	
Starting batteries	✓	
Electric jacket water preheating	✓	
1.2 – Generator Control System and Generator Synchronisation		
Module control panel (MCP) (Dia.ne XT4) including motor starters and controls for engine auxiliaries	✓	
Modbus card	✓	
Island mode software		✓
Black start software		✓
Gas and smoke detection, alarm and shutdown system	✓	
Synchronizing device, automatic	✓	
Grid monitoring device	✓	
1.3 – Factory Testing		
Engine testing on natural gas in Jenbach, Austria	✓	
Airfares, accommodation, meals and transportation expenses associated with client witnessing test		✓
1.4 – Delivery Terms		
DDP Racine, WI, according to INCOTERMS 2020	✓	

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Description	CEL Scope	
	Supply	Exclusions
2.0 – Mechanical Works		
2.1 – Equipment Offloading and Positioning		
Craneage to offload equipment from transport		✓
Offload and position supplied equipment		✓
2.2 – Engine Exhaust System		
Exhaust gas heat exchanger (ASME)	✓	
Exhaust gas bypass		✓
Exhaust silencer		✓
Pressure Relief Device		✓
Oxi-Cat chamber – 650mg/Nm^3 @ 5% O2	✓	
Exhaust pipes, bellows and supports work		✓
Lagging and cladding of exhaust pipes and equipment		✓
2.3 – Engine Low Temperature (LT) Water Circuit		
LT dump radiator with inverter driven fans		✓
LT water circulating pump, 3-way control valve and expansion vessel		✓
LT circuit pipe work and valves between engine and radiator		✓
2.4 – Engine High Temperature (HT) Water Circuit		
HT dump radiator with inverter driven fans		✓
HT water circulating pump, 3-way control valves and expansion vessel		✓
HT water circuit interface plate heat exchanger	✓	
Heat meter to measure gross heat recovery		✓
HT circuit pipe work and valves between engine, interface plate heat exchanger and radiator		✓
Insulation of pipe work		✓
2.5 – LTHW Distribution Circuit		
Process water pipe work, valves and circulating pump between secondary side of the interface plate heat exchanger and the site heating circuit		✓
Insulation of equipment and pipe work in CEL supply		✓

Description	CEL Scope	
	Supply	Exclusions
2.6 – Engine Fuel Gas System		
Gas isolation valve installed on inlet to building		✓
Gas slam shut valve		✓
Flow meter with pressure/temperature compensator and signal output to engine control panel		✓
Gas pipe work, valves and supports between site gas connection and engine		✓
2.7 – Engine Lube Oil System		
Clean oil bunded tank c/w heater, level gauges and oil transfer pump		✓
Waste oil bunded tank		✓
Day tank inside building including transfer pipe work to engine		✓
Oil transfer pipe work (single skin) between storage tanks and engine day tank		✓
3.0 - Generator Enclosure and Ventilation		
Acoustic enclosure with demountable acoustic panel for engine access		✓
Cell ventilation including fan(s), Intake air filter panel, intake and discharge air attenuators and motorised dampers		✓
Lifting beams for engine maintenance		✓
Ducting from intake/discharge attenuators to weather louvers		✓
Building weather louvers for intake and discharge air		✓
Building lighting and small power		✓
Handrails and access ladders to building roof		✓
4.0 - Electrical Works		
4.1 – Switchgear and Cabling		
District Network Operator (DNO) switchgear and earthing		✓
CT's / VT's and transducer installed at site incomer for Export Control including control cabling back to CHP control panel		✓
Power system stabiliser		✓
480V synchronising switchgear	✓	
MCC panel	✓	

Description	CEL Scope	
	Supply	Exclusions
Step up transformer		✓
Ring main unit		✓
LV cabling between alternator terminals and LV synchronising switchgear		✓
LV cabling between synchronising switchgear and step up transformer		✓
HV cabling between step up transformer/RMU and site interface		✓
Provision of upstream breaker for inter trip		✓
4.2 – Auxiliary Power and Control Wiring		
LV power supply to module control panel (MCP)		✓
Power & control wiring - MCP to CHP auxiliaries in engine enclosure		✓
Power & control wiring - MCP to dump radiator		✓
Power & control wiring – MCP to gas isolation valves		✓
Power & control wiring - MCP to gas slam shut valve		✓
Power & control wiring - MCP to gas flow meters		✓
Power & control wiring - MCP to gas boosters		✓
Power & control wiring – MCP to gas dehumidifier		✓
Power & control wiring – MCP to heat meters		✓
Power & control wiring – MCP to bulk lube oil storage system		✓
Control wiring – MCP to upstream breaker for status / inter trip		✓
Control wiring – MCP to Site DCS/SCADA/Power Management		✓
Ladder racking and cable trays required for supplied cables		✓
4.3 – Earthing Works		
Earth bonding of supplied equipment to earth bar within engine building		✓
Provision of station mat		✓
Earth cable from earth bar within building to station earth		✓
Lightning protection		✓
Neutral earthing resistor / transformer (required for island mode)		✓
4.4 – Remote Monitoring and Control		
Auto dialler installation		✓
SCADA/Power Management/DCS/BMS		✓

Description	CEL Scope	
	Supply	Exclusions
Site load management system to manage the application and shedding of load in line with Jenbacher's technical instruction for isolated operation		✓
2 telephone lines (one to be broadband enabled) for remote monitoring of the gas engine generator set		✓
4.5 – Tariff Metering		
Generated power metering		✓
Parasitic load metering		✓
5.0 – Civil/ Building Works and Permanent Facilities		
Concrete foundations where required for supplied equipment		✓
Trench work for cabling installations		✓
Cable ducts		✓
Fencing and barriers installed around equipment		✓
Stoning up between equipment foundations		✓
Surface water drainage		✓
Other site buildings		✓
Dewatering of site		✓
6.0 – Surveys, Applications, Permits and Reporting		
Discharge of planning conditions		✓
Dispersion modelling		✓
Environmental permits		✓
Back ground noise study		✓
Discrimination / power system studies		✓
Grid connection application		✓
Earthing system study		✓
Arc flash study		✓
Noise study		✓
Vibration study		✓

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Description	CEL Scope	
	Supply	Exclusions
7.0 – Site Establishment		
Site security fencing		✓
Site office		✓
Site Welfare facilities		✓
Hook up to a local electricity and water supply		✓
Electricity and water supply charges		✓
Open and covered storage at site		✓
Waste disposal		✓
Scaffolding during installation works		✓
8.0 – Consumables		
Lubricating oil for first fill of engine sump for commissioning		✓
Lubricating oil for first fill of clean oil bulk tank		✓
Cooling water, antifreeze/inhibitor for engine cooling systems		✓
9.0 – Testing and Site Commissioning		
Pre-commissioning checks for CEL scope	✓	
Start-up and commissioning	✓	
Generator performance test	✓	
10.0 – Project and Site Management		
Clarke Energy Project Manager	✓	
Clarke Energy Site Supervisor for 16 weeks only	✓	
Quality control in accordance with ISO 9001	✓	
Environmental management in accordance with ISO 14001	✓	
Operator familiarisation during commissioning	✓	
11.0 – Documentation		
Operation and maintenance manual	✓	
Spare parts manual	✓	

Description	CEL Scope	
	Supply	Exclusions
Engineering design and drawings for the scope offered: • Equipment layout drawing • P&I Diagrams • Single line diagram • Earthing general schematic diagram • Ventilation, Fire & Gas Interconnection details • Electrical schematic LT Water system • Electrical schematic HT Water system • Electrical schematic LT Radiator • Electrical schematic HT Radiator • Electrical schematic Gas Train • Electrical schematic Oil system • Electrical schematic connections A panel to L panel • Electrical schematic connections A panel to M panel	✓	
As built drawings	✓	
Equipment foundation loading drawings	✓	
Civil design drawings and calculations		✓
Grid code simulation studies		✓

2 Demarcation Schedule

Termination Point	Description
Fuel Gas	• Inlet flange on engine
Heat Rejection/Recovery System	• Flow and return connections on engine for primary connections to shipped loose plate heat exchanger • Primary/secondary connections on plate heat exchanger
Lubricating Oil	• Fill connection on engine • Engine sump
Exhaust	• Engine exhaust outlet flange on engine
Generated Power	• Outgoing terminals on 480V alternator • Incoming/Outgoing terminals on 480V switchgear
Auxiliaries Supply	• Incoming terminal on engine control panel
Remote Monitoring	• Terminal for connection of broadband enabled telephone line at CHP control panel • Terminal for connection of Modbus/Profibus communications link to client BMS at CHP control panel

3 Pricing Schedule

Item No.	Description	Value ($)
1	Supply and delivery of Jenbacher JMS 312 GS-B.L (D825/D805) and associated equipment as per the above scope of works; including preliminaries and commissioning*	$607,114
	Contract Total:	**$607,114**

* DDP Racine, WI according to INCOTERMS 2020.

The EUR exchange elements within the Price Schedule have been calculated using the prevailing exchange rate of **€1 = $1.170.** The Price is subject to adjustment should the exchange rate have changed at time of order.

Shipping companies are unwilling to provide firm quotations for freight charges, due to world-wide fluctuations in costs, including oil prices & the US Dollar exchange rate. Quoted prices for shipping & inland transportation costs are estimates and will be subject to confirmation at time of dispatch.

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4 Terms & Conditions

The provisions of these Special Conditions shall apply in addition to Clarke Energy's Standard Terms & Conditions of Trading, where in the event of any conflict between the two, these Special Conditions shall take precedence.

4.1 EFFECTIVE ORDER DATE

Any agreement will come into force upon signing of the Order by both parties and on receipt by the Supplier of the Buyer's purchase order. All program dates and lead times will be based from this date and any previous or proposed program and timescales will be adjusted accordingly if necessary.

4.2 BASIS OF AGREEMENT PRICE

The Seller has based the price on the tender or enquiry documentation, specifications, drawings and information made available for the purposes of the tender (or enquiry) documentation. The Seller's interpretation or assumptions detailed in the quotation or tender submission form the basis of this agreement. Should any data or site conditions vary from the information provided in the enquiry/tender documentation which result in additional costs or time, then the Seller may adjust the Agreement Price or extend the program accordingly.

4.3 TERMS OF PAYMENT

The Buyer shall pay the Supplier as milestone payments in the following manner:

	Payment Milestone Value	Documents Required for Payment by Buyer	Due Date for Supplier's Invoice	Final date for Payment by Buyer
1	30% of the Order Price	Supplier's Invoice	Date of Buyer's Order	30 days from date of Supplier's Invoice
2	65% of the Order Price	Supplier's Invoice	Supplier's written notice confirming the readiness to dispatch the Jenbacher equipment from the factory in Austria	30 days from date of Supplier's Invoice
3	5% of the Order Price	Supplier's Invoice	Satisfactory completion of commissioning and evidence of the generator sets meeting the performance standards on Site	30 days from date of Supplier's Invoice or 90 days after the Supplier's written notice of readiness to dispatch the Jenbacher equipment where delays due to the Buyer have prevented the Supplier from commissioning the gas engines

The Buyer shall not be entitled to apply any reductions for early payment of Supplier invoices.

INCOTERMS 2020: DDP to installation site.

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4.4 CHANGES

Buyer may, by written change order or make mutually agreed changes to the Works. If any such change results in an increase or decrease in the cost or time required for completion of the Works under the Agreement, there shall be an equitable adjustment in the Agreement Price and the Scheduled Delivery. Seller shall not be obligated to proceed with the changed or extra work until the price of such change and its effect on the Scheduled Delivery have been agreed upon in a written change order.

4.5 DEFAULT ON PAYMENT

All invoices are due and payable at the specified payment date as noted in 4.3. Interest will be charged on all overdue accounts at the rate of 2% above prime, such interest to be calculated on a daily basis from the due date until the date of payment.

If the Buyer is in any default on payment, the Seller may demand immediate payment of the entire remaining Agreement amount; but this shall not affect Seller's right to terminate the Agreement for default in payment. If the Seller retains a collection agency, an attorney or other third party to collect outstanding claims, all collection charges (including legal fees) shall be borne by Buyer.

If Buyer is in default with payment or any other services, Seller is entitled, notwithstanding any other claims, to withhold delivery of the Works until the Buyer becomes current on its contractual obligations or to rescind and terminate the Agreement for non-performance, after granting a reasonable grace period, and to assert damages (in particular for non-performance).

4.6 DELIVERY PERIOD

The Delivery Period (FCA) for INNIO Jenbacher power generation equipment is currently 28 weeks from the Commencement Date. Actual delivery date(s) will be advised at time of order.

Goods will usually be delivered during normal working hours. Actual time of delivery will be advised by the Supplier beforehand to ensure necessary access is available. Special delivery arrangements or weekend delivery may be subject to additional charges.

Where the Buyer is unable to accept delivery of the Goods at Site within 3 days of the Supplier's notification of readiness to dispatch the Goods, the Goods shall be delivered to a secure warehouse and stored in accordance with the manufacturer's instructions. In the event of a long-term delay Goods shall be preserved according to the manufacturer's recommendations, which in respect of the generator set shall be in accordance with Jenbacher Technical Instruction TI1000-0004.

All costs associated with warehouse storage charges, additional insurance, preserving and protecting of the Goods shall be paid for by the Buyer.

With regard to any lifting operations performed in connection with delivery and offloading of the Goods at any storage location or Site, the Buyer shall comply with the requirements of BS7121.

The Buyer is therefore obliged to liaise with Supplier or Supplier's appointed representative in order to ensure that sufficient time is allowed for a lift to be planned. Buyer shall also provide ground condition information for the crane setup area as required.

4.7 WARRANTY PERIOD

The goods offered are guaranteed against all material and workmanship defects for a period of 12 months from start-up of the equipment, or 8,000 operating hours, or a maximum of period of 15 months from the factory shipment date, or acknowledgement of readiness to deliver date, whichever is the soonest.

The warranty guarantee will be invalidated if the goods are not operated and maintained in accordance with manufacturer's instructions or the gas quality is outside acceptable limits. In respect of the gas engines reference should be made to the Jenbacher technical instruction 1000-0300 Fuel Gas Quality, 1100-0110 Parameters for Jenbacher Gas Engines and 1400-0091 Lack of Condensate Concerning Fuel Gases.

If the goods are found to be defective during the warranty period, then, Buyer shall, as soon as reasonably practicable but not later 14 days after discovering a defect, notify the Seller in writing detailing the particulars of the defect. The Seller shall be responsible for making well by repair or replacement (at the Seller's option) the defect so notified by the Buyer and the Buyer shall so far as may be necessary place the goods at the Seller's disposal for this purpose.

If the Seller fails take such actions as may be required to correct all notified defects, the Buyer may, provided he does so without undue delay, take such steps as may, in all circumstances be reasonable to make good such defects, in which event all related costs and expenses and other reasonable charges shall be for Seller's account.

Any repaired or replaced goods, or part thereof shall have a warranty on the same terms as set forth above, with the warranty period being the greater of the original unexpired warranty or six (6) months after repair or replacement.

Seller's warranty shall not cover defects or damage to the delivered goods or services, which are due to:

- normal wear and tear on parts whose normal life expectancy is less than the warranty period,
- improper assembly or maintenance, negligence or other improper application by the Buyer;
- non OEM spare parts have been used by the Buyer;
- fuel gas quality is outside the specified limits as provided to the Buyer by the Seller;
- detrimental air inlet conditions or erosion, corrosion or material deposits from fluids;
- the Buyer continuing to make further use of the goods after having given a notice to the Seller of a defect.

4.8 TITLE – RISK OF LOSS AND INSURANCE:

Buyer will provide the Seller a certificate of insurance. Title to and risk of loss for all equipment to be supplied hereunder by Seller shall pass to Buyer upon arrival of same at the Customer's site as provided; However, that Buyer shall grant to Seller a present and continuing security interest in the equipment supplied hereunder until Seller has been paid in full pursuant to the terms hereof. Buyer shall promptly execute and deliver such documentation as may be required by Seller, in proper form, to perfect Seller's security interest under the Uniform Commercial Code or any other relevant statute, law, or regulation. Buyer will not cause or permit any other security interest, lien, encumbrance or claim to attach to the

system which shall have priority over or be ahead of Seller's security interest, as described herein, and Buyer authorizes Seller to make any public filings necessary to perfect or maintain its security interest under the Uniform Commercial Code, or any other relevant statue, law, or regulation.

Until Seller has received full payment of the purchase price, Seller shall have all rights and remedies of a Seller and secured party as established or permitted upon agreement by the Uniform Commercial Code, in addition to all other rights as established herein, which rights and remedies, to the extent permitted by law, shall be cumulative.

From the time of receipt of the equipment to be supplied hereunder by Seller until payment in full has been received for same by Seller, Buyer will maintain insurance coverage on the equipment supplied hereunder by Seller in an amount sufficient to pay any outstanding sums due or that will become due from Buyer to Seller for said equipment. Seller will be listed as a named insured on all such insurance coverage. If so requested by Seller, Buyer will cause certificates of insurance to be supplied to Buyer for verification that the insurance coverage described herein is in place. Such insurance will not be materially reduced or cancelled without the prior written consent of Buyer.

4.9 ERECTION/COMMISSIONING

The preservation and packing of the Goods will be suitable for shipment and transportation to site assuming that erection and commissioning is carried out promptly on arrival at Site.

If for any reason of delay or failure on the part of the Buyer or other contractor employed by the Buyer, the Supplier is prevented from installing and/or commissioning the Goods, the Goods shall be stored in accordance with the manufacturer's instructions. In the event of a long term delay the Goods shall be preserved according to manufacturer's recommendations, which in respect of the generator set shall be in accordance with Technical Instruction TI1000-0004. All costs associated with preserving and protecting the Goods shall be paid for by the Buyer.

Unless stated otherwise commissioning of the Goods is limited to 10 working days (8 hours per day). In case of delays caused by reasons beyond the Supplier's control the cost of additional working days shall be borne by the Buyer.

4.10 MAINTENANCE PAYMENTS

If the Goods are to be maintained by the Supplier whilst it is being used by the Buyer for beneficial generation prior to taking over the Goods, any maintenance work required to be carried out on the Goods by the Supplier, will be paid for by the Buyer at the agreed contracted rates.

4.11 PERMITS, LICENCES, DUTIES ETC.

The Buyer before the commencement of the Order is responsible for obtaining all permits, consents, licenses, duties, building regulation approval or planning permissions applicable to the site or installation works of the Goods.

4.12 TERMINATION CHARGES

The Buyer may terminate this Order at any time upon written notice to Supplier and payment of termination charges in accordance with the schedule set forth below:

Days after Order Effective Date	Termination Charge as % of Order Price
Less than 30	10%
31-60	30%
61-90	50%
91- date of notice of readiness to dispatch	70%
After date of notice of readiness to dispatch	100%

4.13 LIQUIDATED DAMAGES

Delay in Delivery - If an agreed delivery milestone is delayed by more than 7 days beyond the agreed milestone date due to causes not excused by the provision of the Order, the Supplier shall pay the Buyer as liquidated damages, a sum equal to 0.5% of that portion of the Order Price attributable to the delayed Goods for each subsequent full week of delay, up to an aggregate maximum of 5% of the Order Price. The liquidated damages shall be the Supplier's sole and exclusive liability for delays.

Notwithstanding the foregoing, Supplier shall have no liability to the Buyer for the foregoing liquidated damages, unless the Suppliers delay causes deferment of the initial operation date of the equipment and the Buyer suffers actual damages.

Shortfall in Guaranteed Performance Levels - If when first tested at site the Goods fail to achieve the guaranteed performance for either output or electrical efficiency, the Supplier shall be afforded a period to be agreed (but in no event less than 90 days) during which it can correct and adjust the equipment (the "Correction Period").

If, when retested within or at the latest at the end of the Correction Period, the Goods again fail to achieve the guaranteed performance for either output or electrical efficiency the Supplier shall pay to the Buyer as liquidated damages a sum calculated in accordance with the table below.

Criteria	Liquidated Damage
Output	0.5% of the Order Price allocable to the non-performing unit for each full 1.0% deficiency in the guaranteed performance
Electrical Efficiency	0.5% of the Order Price allocable to the non-performing unit for each full 1.0% shortfall in the guaranteed performance

The liquidated damages payable in respect of deficiencies in performance shall not exceed 5% of the Order Price allocable to the non performing unit(s). The liquidated damages shall be the Suppliers sole and exclusive liability for performance deficiencies.

Total limitation on Liquidated Damages - The Supplier's total liability hereunder for all forms of liquidated damages provided for under this Order shall not exceed 10% of the Order Price.

The Parties agree that the amount of liquidated damages set forth above are reasonable in light of the anticipated harm caused by the breach of the duty related thereto and the difficulties of proof of loss and inconvenience or non-feasibility of obtaining an adequate remedy and the parties are stopped from contesting the validity or enforceability of such a liquidated damage.

All liquidated damages due hereunder shall be the Suppliers sole and exclusive liability and the Buyers sole and exclusive remedy for delay and performance deficiencies under this contract.

4.14 EXCUSABLE DELAY FORCE MAJEURE

The Seller shall not have any liability or be considered to be in breach or default of its obligations under the Agreement to the extent that performance of such obligations is delayed or prevented, directly or indirectly, due to:

(a) causes beyond its reasonable control; or

(b) acts of God, acts (or failures to act) of governmental authorities, fires howsoever caused, severe weather conditions, earthquakes, strikes or other labor disturbances, floods, war (declared or undeclared), epidemics, civil unrest, riots, delays or accidents in transportation; or

(c) Acts (or omissions) of the Buyer including failure to promptly: (a) provide the Seller with information and approvals necessary to permit the Seller to proceed with work immediately and without interruption, or (b) comply with the terms of payment.

The Seller shall notify the Buyer of any such delay and strive to mitigate the delay to the extent practicable. If the Seller is delayed by acts or omissions of the Buyer, or by the prerequisite work of the Buyer's other contractors or suppliers, the Seller shall also be entitled to any additional costs incurred.

If such excusable delay extends for more than ninety (90) days and the Parties have not agreed upon a revised basis for continuing the work at the end of the delay, including adjustment of the price, then either Party (except where delay is caused by the Buyer, in which event only the Seller), upon thirty (30) days written notice, may terminate the Agreement.

4.15 COMMERCIAL GENERAL LIABILITY

The Supplier shall provide Commercial General Liability for the duration of its liability under the Order as an occurrence type policy with an aggregate limit that applies on a per project basis with no exclusions related to Blanket Contractual Liability or Broad Form Property Damage Hazard. General liability coverage will cover all claims and liabilities arising out of the performance of Work by Supplier and its subcontractors. Liability limits shall not be less than a combined single limit of $1,000,000, a general aggregate limit of $2,000,000, products/completed ops aggregate limit of $2,000,000 and personal & advertising limit of $1,000,000.

4.16 AUTOMOBILE LIABILITY

This policy shall be written in comprehensive form to include personal/bodily injury and third party property damage per accident. Coverage shall apply to all motor vehicles licensed for highway use (owned, non-owned, scheduled and hired). Liability limits shall not be less than $1,000,000 per occurrence, combined single limit.

4.17 UMBRELLA LIABILITY

This insurance shall cover claims and liabilities in excess of the limits provided under all liability policies held by the Supplier with the exception of Professional Liability Insurance. Liability limits shall not be less than $15,000,000 per occurrence, $15,000,000 policy aggregate.

4.18 WORKERS COMPENSATION AND EMPLOYERS' LIABILITY

This insurance covers an employer's liability, as defined by state, under workers compensation laws that arise out of an employees work related injuries. Liability limits will be issued at statutory limits as defined by the state where the Work will be performed and shall comply with all federal requirements with no exclusions or limitations. Also, this insurance covers the Supplier's liability arising out of employee work related injuries that are not covered by the Workers Compensation statute. Liability limits shall not be less than $1,000,000 per accident, $1,000,000 per employee and have an aggregate limit of $1,000,000.

4.19 INDIRECT OR CONSEQUENTIAL DAMAGES

In no event, whether as a result of breach of contract, warranty, indemnity, tortuous damage (including negligence), strict or product liability, impossibility of service, positive breach of an obligation, or otherwise, shall Supplier or Supplier's subcontractors or suppliers be liable for loss of profit or revenues, loss of use of the Goods or any associated equipment, cost of capital, cost of substitute equipment, facilities, services or replacement power, downtime costs, fines or penalties charged to the Buyer for failure to meet permits, financing or additional borrowing costs, or for any special, consequential, incidental, indirect or exemplary damages.

4.20 LIMIT OF LIABILITY

Other than liability arising under clauses 4.11, 4.12, 4.13 and 4.14, the total aggregate liability of the Supplier under or in connection with the Order whether related to performance or non-performance of the Order in respect of all causes of action under, arising out of or in connection with the Order, whether for breach of contract, including breach of duty, in tort (including but not limited to negligence), by way of indemnity, warranty or otherwise, including (but not limited to) liability for defects and liquidated damages shall not exceed the Order price.

4.21 MITIGATION OF LOSS

In all cases the party establishing or alleging a breach of the Order or a right to be indemnified in accordance with the Order shall be under a duty to take reasonable steps to mitigate the loss which has occurred provided that he can do so without unreasonable inconvenience or cost.

4.22 CONFIDENTIALITY

The Buyer and Seller shall treat the details of the Agreement and any information made available in relation thereto as private and confidential and neither Party shall publish or disclose any particular details thereof (save in so far as may be necessary for the purposes of the Agreement or required by law) without the consent of the other provided that nothing in this clause shall prevent the publication or disclosure of any such information that has come within the public domain otherwise than breach of this clause.

4.23 VALIDITY

For budgetary purposes only.

Appendix Number	Appendices
A1	Technical Specification
A2	Technical Instructions

A1 Technical Specification

A2 Technical Instructions

ClarkeEnergy®
A KOHLER COMPANY

Engineer - Install - Maintain

KOHLER®
IN POWER. SINCE 1920.

Clarke Energy USA Inc.
2100 Pewaukee Road,
Waukesha, WI 53188

Tel: +1 262 565 5020
www.clarke-energy.com

DN TANKS
Generations Strong

100 West Court Avenue, Suite 109, Jeffersonville, IN 47130 I 317.517.5771

February 4, 2020

10-165-1
FILTRATE EQUALIZATION TANK ALTERNATIVE

Reference: Proposed 0.39 MG Filtrate Storage Tank
for Racine, WI

Dear Barry,

Thank you for taking the time to discuss your project and your interest in a prestressed concrete tank for this project. As a follow up to our conversation, a suitable budget-estimating figure for a 0.39 MG wire-wound, prestressed concrete storage tank with approximate dimensions of 47' ID X 30' Side Water Depth is **$650,000**. **This figure is anticipating 2021 construction timeframe**. In addition to the base tank I am including a **$80,000** appurtenance allowance covering 12" inlet and outlet pipes, interior and exterior ladders, a SAF-T Climb device for both ladders, an extra hatch, 60' of handrail, and a 25" manway. As additional detail is developed we can make adjustments to this allowance figure to provide more detailed pricing. With the appurtenance allowance the overall tank budget becomes **$730,000**.

Approximate on-site construction time required for one 0.39 MG storage tank is 9 weeks, not including any required site work. We are able to work up until Thanksgiving each fall and our construction season can begin as early as late March, depending upon weather conditions.

The budget-estimating figure above reflects the tank complete including the items listed above. **It does not include any site work, geotechnical concerns, additional separate piping or tank accessories other than those listed above.** Local, state and federal taxes, if applicable, are also **not** included in the above price. Please note that this pricing assumes a union atmosphere, burial of about 5', more than enough for frost protection and a 4" thick membrane floor.

The above tank is designed and constructed in accordance with AWWA standard D110, Type III, precast concrete walls with steel diaphragm, wire prestressing, and freestanding concrete dome roof.

To assist in developing the contract documents DN Tanks can provide the following complimentary services and information:

1. Preliminary design drawings and calculations in electronic format
2. Complete performance specification in electronic format
3. Geotechnical requirements for wire-wound concrete tanks and geotechnical report review
4. Value engineering from our Engineering and Estimating departments
5. Site layout and estimated site work cost from our Estimating Department
6. Review of preliminary drawings and specifications to provide updated tank and site work budget estimates

Thank you for this opportunity to be of service and I truly appreciate your consideration. Please feel free to contact me if you have any questions or if I can be of any further assistance as this project progresses.

Sincerely,

Steve Applegate, Regional Manager
DN TANKS | *Generations Strong*
www.dntanks.com | steve.applegate@dntanks.com
Mobile: 317-517-5771

SA / vc

Milton Roy Company
Flow Control Division
201 Ivyland Road, Ivyland, PA 18974
Main: 215-441-0800
www.MiltonRoy.com

13-47-1
EFFLUENT DECHLORINATION PUMPS

Project Number: 60554970

MR Proposal No:	Revision:
2020-0324-DJB	0
Bid Date:	Time:
TBD	12:00 PM

Customer Information:
General Contractors
Attn: Estimator
Tel:
Fax:
CC: Briam Mahony

Project Reference: Racine Sodium Bisulfite Pumps
Specification Section : €► 11352 - Chemical Diaphragm Metering Pumps Rev 0
ADDENDUM(s): 0
Consultant: AECOM
Reprsentative: Drydon Equipment
Attn: George Argiris
Tele: 630-814-9150

No.	Qty.	Application	Scope Of Supply	Tag Numbers	Material/Capacity/Size
1					
		Sodium Bisulfite	**Duplex Chemical Feed Skid**		
		120 GPH @ 75 PSI			
	2		Milton Roy MacRoy D Mechanical Actuated Diaphragm, PVC LE, Manual Stroke Control		PVC / 127 GPH @ 75 psi
	2		Motor: 1750 RPM 1/2 HP, AC Inverter, 56C Frame 208/230/430 VAC/ 3 Ph/60 Hz		1/2 HP
	2		Pulsation Dampener (Discharge Side)		10 cu in PVC (wetted)
	2		Calibration Column		1000 mL / PVC
	2		Pressure Safety Valve		1/2 in - PVC
	2		Back Pressure Valve .		1/2 in -PVC
	2		Pressure Gauge and Switch with Diaphragm Seal Assembly		
	1		**Duplex Pump Skid Injection Package with:**		
			Duplex backplane integrated skid package complete with all of the above pumps shelf mounted		
			accessories, plumbed and piped to solvent weld / glued Sch.80 PVC piping with ture union vented ball valves.		
			Skid package unit will incldue all of the above accessories listed with:		
			• Skid is PVC/HDPE with PVC Drip pan		
	2		**NEMA 4X FRP Simplex Control Panel**		
			• TVSS Surge Protection & Door Disconnect for Incoming Power		
			• Pump Motor H-O-A and Pump Starter		
			• Digital and Analog I/O Signals for Remote Status		
			• Allen Bradley Powerflex 525 with Remote Keypad		
			• All Necessary lights, relays, wire, wireway etc.		
			SPARES:		
	2		RPM Kits (Suction/Discharge check cartridge + diaphragm)		

ENGINEERING & DOCUMENTATION:

1	Submittals (Electronic - No Charge)
1	O&M Manuals (Electronic No Charge)
	Note: In accordance with our stated goals to be environmentally responsible, we will provide one (1) hard copy Submittals & O&M Manuals. Additional binder copies will cost $ 350.00 each.

INSTALLATION, START UP, TRAINING FIELD SERVICES:

1	8-Hour- Day(s) per Man **Installation Inspection & Assistance**
1	Trip
1	8-Hour- Day(s) per Man **Start Up & Field Sevice**
1	Trip
1	8-Hour- Day(s) per Man **Operator Training**
	Trip (Combined with Start Up)
	Additional field service required beyond allocated per project contract as noted above will be charged per diem rate TBD.

DELIVERY:	**Drawings: 6-8 Weeks ARO**
	Equipment: 8-10 Weeks ARAD
FREIGHT:	**FOB Ivyland with Freight Allowed to Jobsite**
PAYMENT TERMS:	**Net 30. All contract order subject to credit review and approval of Milton Roy Finance**
BUDGET PRICE:	**$38,200**

Project Number: 60554970

Milton Roy Company
Flow Control Division
201 Ivyland Road, Ivyland, PA 18974
Main: 215-441-0800
www.MiltonRoy.com

MR Proposal No:	Revision:
2020-0324-DJB	0
Bid Date:	Time:
TBD	12:00 PM

Customer Information:		**Project Reference:**	**Racine Sodium Bisulfite Pumps**
General Contractors	Attn: Estimator	**Specification Section :**	**11352 - Chemical Diaphragm Metering Pumps Rev 0**
	Tel:	**ADDENDUM(s):**	0
	Fax:	**Reprsentative:**	**Drydon Equipment**
		Attn:	**George Argiris**
	CC: Briam Mahony	**Tele:**	630-814-9150

Consultant: AECOM

.

No.	Qty.	Application	Scope Of Supply	Tag Numbers	Material/Capacity/Size

Notes:

Milton Roy Company proposes to furnish materials, and/or equipment as explicitly described aforementioned for the above project.
Any items not shown above as detailed under "Scope Of Supply", or other attachments to this proposal, are strictly **Excluded**.
In addition, installation labor, miscellaneous plumbing, valves, fittings, packaged skid integration, chemical supply, gauges, supports, anchor bolts and electrical conduit, fully assembled skid integration packages including PLC/SCADA/ethernet bus control interface support not specifically mentioned above, shall be supplied by others.

Any orders resulting from this proposal are subject to the seller's terms and conditions of sale attached. Bid price is valid for 60 days.

Thank You for your interest in Milton Roy FCD Products. Please contact our Regional Sales Manager for assistance. We are committed to meeting your expectations on all of your chemical metering systems.

Comments & Clarifications:

1. Flooded suction recommended. NPSH calculations recommended to be performed at submittals.
2. Milton Roy standard performance test, paint, and documents
3. Milton Roy Standard Terms and Conditions attached shally apply. Milton Roy Company does not accept liquidated or consequential damages and any contract orders resulting from this Proposal will be subjected to review and final acceptance by Milton Roy Contract Sales team.
4. Submittal packages will not be started until Terms & Conditions are agreed and signed between both parties.

Project number: 60554970

Appendix F Facilities Condition Assessment Memorandum

FACILITIES PLAN CONDITIONS ASSESSMENT
RACINE WWTP – RACINE WASTEWATER UTILITY (RWU)

BUILDINGS & STRUCTURES REPORT

The architectural and HVAC discipline design staff accompanied project process staff to the site and met with the owner team to review a list of staff comments and concerns. The team then conducted a walkthrough of the critical facilities of the plant as listed in the following table.

Findings	Recommendations
GENERAL CONSTRUCTION	
Architectural	
1. A hazardous material survey (asbestos, lead paint, chemicals, etc.) should be completed with plant staff at the next phase. 2. Buildings have metal mansards that are deteriorating.	1. Conduct a hazardous material survey, with plant staff, at the next phase. 2. Repair/replace deteriorating metal mansards.
Mechanical	
1. Typical plant HVAC equipment is aged and nearing the end of anticipated service life per industry standards set forth by the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE). 2. Most Reznor heaters are corroded, high maintenance, and beyond the ASHRAE anticipated useful service life (13 years).	1. Benchmark planned HVAC equipment replacements based on the ASHRAE guidelines as further indicated below. 2. Initiate planned replacement of 15 year old Reznor heaters.
30 - EQ SCREENING BUILDING	
Architectural	
1. Building EQ-1 interior building surfaces and piping deteriorating.	1. Repaint interior walls, ceiling and piping of Building EQ1.
Mechanical	
1. No apparent critical mechanical issues.	1. No action required,
110 – ADMINISTRATION BUILDING	
Architectural	
1. Future staffing needs requires needs (programing) discussion for remodeling (i.e. Pre-treatment group). 2. Prepare list of new equipment/vehicles and storage (records and parts). 3. The roof of combined Administration, Chemical and Lab Bldg. has roof and wall leaks. 4. Existing lobby restrooms and women's locker rooms do not meet ADA codes or needs of staff/public.	1. Conduct staff interviews, complete building "as-builts" and prepare future building remodeling program for RWU approval. 2. Include new equipment, etc. information with above remodeling program. 3. Reroof Admin, Chem and Lab Bldgs. with matching roof systems. Include replacement of parapet coping and patching of adjacent walls.

	4. Provide new lobby restrooms and women's locker rooms to meet codes and RWT needs.
Mechanical	
1. Existing split system air handler and condensing unit are nearing the end of ASHRAE anticipated useful service life (15 years).	1. Initiate planned replacement of nearly 15 year old heating and cooling system components.
120 - CHEMICAL WING BUILDING	
Architectural	
1. Chemical unloading area not safe for unloading 2. Chemical unloading area does not have compliant containment area	1. Provide safe unloading area for chemical and supplies handling using hydraulic ramp or similar design. 2. Provide code compliant containment area.
Mechanical	
1. Plant staff concerned with safety of tank fill lines running overhead.	1. Reroute overhead chemical fill lines.
125 – LAB/OFFICE BUILDING	
Architectural	
1. None of the current lab fume hoods are designed for "metals-free" testing. 2. Lab grade dishwashers nearing end of practical life. 3. Lab flooring nearing end of practical, safe life. 4. Lab needs additional file and storage space.	1. Provide new lab hood for metals-free testing. 2. Provide new lab grade dishwashers. 3. Replace lab floor with new chemical resistant type. 4. Remodel existing lab and adjacent spaces for increased and efficient file and materials storage.
Mechanical	
1. Existing split system air handlers and condensing units are nearing the end of ASHRAE anticipated useful service life (15 years). a. System refrigerant is obsolete, expensive, and environmentally discouraged 2. Lab-grade water production and distribution system is undersized and poorly configured. 3. Gas handling safety and efficiency could be improved by reconfiguration of the lab gas system.	1. Initiate planned replacement of two nearly 15 year old split system heating and cooling systems with packaged rooftop air conditioners. a. Vacates mechanical room space for alternate use. 2. Upgrade to lab-wide reagent grade water production and distribution system. 3. Reconfigure lab gas system for improved safety and efficiency. a. Provide additional lab gas types as practical.
130 – PRELIMINARY TREATMENT BUILDING	
Architectural	
1. No apparent critical building issues.	1. No action required,
Mechanical	
1. Occasional Grit Pump Room HVAC system deficiency is noted. 2. Existing drains are high maintenance.	1. Evaluate upgrade Grit Pump Room heating and cooling systems. 2. Evaluate more maintenance efficient drain configuration.
139 – AERATION BASIN/GALLERY & BUILDING	

Architectural	
1. No apparent critical building issues. 2. Evaluate guardrails and access for safety compliance.	1. No action required. 2. Budget for guardrail repair/replacement.
Mechanical	
1. No apparent critical mechanical issues.	1. No action required.
141 – FINAL CLARIFIERS	
Architectural	
1. No apparent critical building issues.	1. No action required.
Mechanical.	
1. No apparent critical mechanical issues.	1. No action required.
145 – RAS PUMP STATION	
Architectural	
1. No apparent critical building issues	1. No action required.
Mechanical	
1. No apparent critical mechanical issues.	1. No action required.
150 – PLANT GENERATOR BUILDING	
Architectural	
1. No apparent critical building issues except building mansards.	1. Mansard repairs budgeted elsewhere.
Mechanical	
1. No apparent critical mechanical issues.	1. No action required.
165 – SOLIDS PROCESSING BUILDING	
Architectural	
1. No apparent critical bldg. Issues.	1. No action required.
Mechanical	
1. Building is not currently served by the plant hot water loop 2. Existing natural gas fired air handling units are oversized, costly to operate, and nearing the end of ASHRAE anticipated useful service life (15 years). 3. Plumbing water supply and drainage system deficiencies are noted for the 1st and 2nd floors.	1. Evaluate extension of the plant hot water loop to include the Solids Processing Building. 2. Evaluate replacement of 15 year old air handling units with properly sized, modulating, hot water heating based units. 3. Evaluate plumbing water supply and drainage system configuration for improved performance.
172, 173 – DIGESTER CONTROL BUILDINGS 1 & 2	
Architectural	
1. No apparent critical bldg. Issues.	1. No action required.
Mechanical	
1. No apparent critical mechanical issues.	1. No action required.
170, 175, 176, 177, 182 - DIGESTERS A THRU E	
Architectural	
1. Digester B - Roof leak listed by staff. 2. Digester B – Problem with snow loading tipping cover. Digester D – Roof leak reported by staff.	1. Action by roofing maintenance contractor. 2. Evaluate possible solutions for tipping cover during final design. Roof leak by roof maintenance contractor.
Mechanical	
1. No apparent critical mechanical issues.	1. No action required.

183 – PLANT TUNNEL SYSTEM	
Architectural	
1. tunnel system has minor wall or ceiling leaks, 2. Area near 185 Main Equipment Building has leakage.	1. Evaluate solutions for staff repairs. 2. Investigate injection and/or grading solution.
Mechanical	
1. No apparent critical mechanical issues.	1. No action required.
185 – MAIN EQUIPMENT BUILDING	
Architectural	
1. No apparent critical building issues except floor tile.	1. Replace asbestos floor tile installation. Verify location.
Mechanical	
1. No apparent critical mechanical issues.	1. No action required.
190 – GAS HOLDING SPHERE	
Architectural	
1. No apparent critical structural issues	1. No action required
Mechanical	
1. No apparent critical mechanical issues.	1. No action required.

Appendix G Technical Advisory Committee Meeting Minutes

Minutes

Meeting name
RWWU Technical Advisory Committee 1

Meeting date
12June19
Issued 8July19
Revised 21Aug19

Attendees
See attendance sheet-attached

Time
1:30 PM

Location
RWWU Offices
City Hall Annex

AECOM project number
60554970

Prepared by
Mike Zapinski

Ref	Action	Responsible	Due by	Status
01	Introductions	---	---	---
02	Project Background - drivers Caledonia Capacity Request 20yr. Planning Period – 1998 Facilities Plan Mike Gitter commented that there have been no exceedances during the current stretch of wet weather.	---	---	---
03	Current Capacity Allowances Jeff Sietz raised the issue of redistributing allocations based on plant rerating. Mike Gitter stated that capacity is not available due to the ammonia limits in permit. Ammonia limits anticipated to remain the same in new permit.	---	---	---
04	Peak Hour Exceedances Discussion of appropriate storm event for facility plan model. AECOM reviewing rain events other than the August 2007 event used in EQ study. Storm selection will be discussed at TAC. Dan Snyder asked if it was appropriate for WDNR to participate in TAC. Rusty stated initial meeting already held with DNR and that we intend to invite them to future meetings as appropriate.	AECOM to review.	---	---
05	Information Required from SSR Rusty Schroedel requested CMOM reports from each community.	---	---	---

Ref	Action	Responsible	Due by	Status
06	Projects Under Construction TID 5/KR Lift Station and Force main. Lift station is in design – In construction at the end of the year. New LS, 40 MGD for the capacity and updatable to 75 MGD. Force mains are under discussion. 2-36 inch planned. One will go online to discharge to the 48-inch but the second will not be constructed immediately. One consideration is land near KR station: The village has acquired the property and has the ability to place multiple basins near the KR station. The existing lift station is an element of the TID 5. The abandonment of the existing KR lift station was not known at the time but is a given now.	---	---	---
07	Foxconn Status Total peak flow given by Foxconn has not changed. The loadings have not been provided, kept secret. Keith Hass discussed with Foxconn. A zero-discharge plant is planned. Pretreatment was discussed. Impacts of pretreatment failure are currently not known. Sigma working on wastewater for Foxconn.	---	---	---
08	Chicory Road Foth conducting study; flowmeters at 8 locations indicate some clearwater issues.	---	---	---
09	LS2 EQ Basin Basin is now full. Brian Rogne should have incorporated in model.	---	---	---
10	Mt Pleasant sub basin 12 moratorium to be lifted.	---	---	---
11	Hood's Creek 1.5 MG storage currently constructed; additional cells planned. Growth anticipated, currently limited by downstream lift station.	---	---	---
12	Lift Station 31/River's Bend Rogne has modeled. 30% design complete. Under consideration as a Safety Site.	---	---	---
13	North Park EQ and LS Tom Ludwig approaching commission regarding a facility plan.	---	---	---
14	Racine City Projects 233 Lake development is still a year off. North Beach LS under design. Root Works development in master plan.			

Ref	Action	Responsible	Due by	Status
15	Sturtevant Land use plans changing- Some Industrial now switching to Commercial. Trying to get additional loading capacity or look at pretreatment. Up to 1 MG might be needed. SEWRPC 2050 may not have these changes.	---	---	---
16	RWWU may need to upgrade some interceptors based on CCTV inspections.	---	---	---
17	Raymond and Yorkville Neither expressed interest in going to RWWU, joining IGA. Keith requested AECOM send them letters confirming their decisions to not be included in Facility Plan.	AECOM	---	---
18	Wind Point- Caledonia did a lot of sewer lining in 2018-19.	---	---	---
19	Safety Sites Records of releases are available from RWWU- flow duration, time. 20 years of basement backup complaints available in Excel spreadsheet.			
20	Green Infrastructure Terry McCarthy asked about including green infrastructure in plan. Rusty said AECOM has a green infrastructure project with City, will consider as part of sustainability efforts for facility plan.			
21	NEXT TAC MEETING: Wednesday, July 10, 1:30 PM. City Hall Annex			
22				
23				
24				
25				
26				
27				

SIGN-IN SHEET

Racine Facilities Plan
Technical Advisory Committee Meeting
12June19, 1:30 PM

Name	Village/Firm	Telephone #	Email
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Minutes

Meeting name
RWWU Technical Advisory Committee 2

Meeting date
10July19
Issued 21Aug19

Attendees
See attendance sheet-attached

Time
1:30 PM

Location
RWWU Offices
City Hall Annex

AECOM project number
60554970

Prepared by
Mike Zapinski

Ref	Action	Responsible	Due by	Status
01	Introductions	---	---	---
02	Review of June 12, 2019 Minutes	AECOM	---	Revised minutes issued
03	Collection System Caledonia Storage Tank- Bob Lui will provide flow data Hood's Creek and Riverbend- Caledonia will provide design (design storm, level of service, growth projection) data Working with Bryan Rogne to get model, start calibration activities	RWWU Caledonia	---	---
04	KR Lift Station Model is successful. Bryan complete with the gravity line; still working on lift station. Need to decide when modeling is complete enough for use in overall system model, provide model	Mt. Pleasant	---	---
05	Backups and Overflows Al Wheeler will provide the sewer call spreadsheet records.	RWWU	---	Provided to AECOM

Ref	Action	Responsible	Due by	Status
06	Anticipated Flow Needs Discussed population projections for plan. Highlights: Ruekert and Milke have 2018 population projections from recent report regarding cost sharing. RWWU will provide. Jeff remined that the 7100 population for Sturtevant includes 1800 in the prison. RWWU has correspondence from SSR communities correlating their industrial discharges with population equivalents. RWWU will provide. Open discussion of including low-medium-high projections in the Facilities Plan	RWWU RWWU	---	Received, along with report. Reviewing data provided.
07	Raymond and Yorkville RWWU will request confutation from each community that they are not participating in the planning process and they will manage their sewage accordingly.	RWWU	---	---
08	Schedule Dan Snyder requested discussion of project milestones at next TAC meeting	AECOM	---	---
09	Next Meetings TAC agreed to have a standing meeting date of the second Wednesday of each month, 1:30 PM. SEWRPC and WDNR will be added to invitees.	AECOM	---	Invitations issued. August meeting postponed until 21st.
10		---	---	---
11		---	---	---
12		---	---	---

Minutes

Meeting name
RWWU Technical Advisory Committee 3

Meeting date
21August19
Issued 21Aug19
Rev 4Oct19

Attendees
See attendance sheet- attached

Time
1:30 PM

Location
RWWU Offices
City Hall Annex

AECOM project number
60554970

Prepared by
Mike Zapinski

Ref	Action	Responsible	Due by	Status
01	**Introductions** Ron Pritzlaff provided a CD of Mt Pleasant sewer related activities.	---	---	---
02	**Review of July 10, 2019 Minutes** No comments on the July 10 minutes. Bob Lui's phone number will be added to attendees list. Dan Snyder noted that the revised June 12 minutes still referred to Foxconn keeping data secret. This language will be revised.	AECOM	1Sep19	Revised June 12 minutes will be issued
03	**Storm Selection** These storms under consideration as calibration and/or design level events for model. AECOM noted we are still in need of detailed data for these storm events from RWWU. General consensus that a storm less conservative than the August 2007 event is worth considering.	RWWU	1Sep19	---
04	**Population Projections** Presented 2035 DOA population projections to be used in the Facilities Plan as the 2040 projections. Table attached to minutes. Racine, Caledonia and Mt Pleasant to confer with their city planner or equivalent to confirm they are in agreement. Caledonia showed a population decrease during the last revenue sharing report. Dan Snyder noted there may be a large mutli-family development planned for Mt Pleasant. Jeff noted that Sturtevant will not likely grow by thousands. Use 6666 as the current and future population.	Mt. Pleasant Caledonia Racine	1Sep19 1Sep19 1Sep19	---

Event	Date	Start Time	End Time	Rainfall (in)	# of SSO/Bypass Activa
1	4/18/2013	4/8/2013 7 AM	4/18/2013 8 PM	6.31	7
2	5/12/2014	5/12/2014 5 PM	5/13/2014 1 AM	2.7	6
3	7/12/2017	7/12/2017 12 AM	7/12/2017 10 AM	2.8	2
4	5/14/2018	5/10/2018 10 PM	5/14/2018 9 PM	3.62	3
5	10/6/2018	9/30/2018 9 PM	10/6/2018 7 AM	5.4	10

Ref	Action	Responsible	Due by	Status
05	Wastewater Treatment Plant Site visit completed and technical memoranda are in progress. Assessing the need to visit a couple of additional structures. New WPDES permit is due 29Sep19. Mary Frances recommended we discuss Kenosha's new permit with them. They needed to present a case for getting their major safety site added back in to their permit. RWWU planning on keeping all of theirs..	---	---	---
06	Interceptor Model Status Currently modeling the KR lift station and force main concepts. Mt Pleasant/Foth to provide a completion date. RWWU is also using Bryan Rogne to model some areas where Mt Pleasant and Racine discharge jointly to an interceptor- Basins F1A and F1B. Minor likely does not affect overall system model. Riverbend Lift Station- Caledonia will be constructing a 16-inch force main parallel to the existing 12-inch out to Green Bay Rd. AECOM requested design report, plans.	---	---	
07	Foxconn Sigma confirmed that the maximum discharge at full buildout will be 3.6 MGD to the Village. Loads are currently unknown at this time, may be handled as a categorical discharge for electronics. First phase discharge will be 18 gpm of normal sanitary wastewater.	----	---	---
08	Sturtevant Village is built out. May need an increased allocation for load during planning time frame.	AECOM	---	---
09	Mt. Pleasant Requested an increase of 8 MGD flow allocation (average) to their allocation of 11.49 MGD in a 2018 letter. They request an early phase increase of 4 MGD.	AECOM	---	
10	Caledonia Requested an increase of 9.75 MGD (avg) to their allocation of 5.13 MGD. Keith Haas will provide the community flow letters from 2018.	RWWU	Sept 19	----

Ref	Action	Responsible	Due by	Status
11	Yorkville Keith confirmed he sent letter to Yorkville confirming their decision to opt out of planning process. Has not received a reply.			
12	Next Meetings September 11, 2019 Mid-course review with the WDNR may replace the regular October TAC.	AECOM	---	---
13		---	---	---
14		---	---	---

Minutes

Meeting name
RWWU Technical Advisory Committee 4

Meeting date
19Sep19
Issued 7Oct19
Rev 20Nov19

Attendees
See attendance sheet- attached

Time
1:30 PM

Location
RWWU Offices
City Hall Annex

AECOM project number
60554970

Prepared by
Mike Zapinski

Ref	Action	Responsible	Due by	Status
01	**Review of August 21, 2019 Minutes** Dan Snyder noted that Mt. Pleasant requested an early phase requirement of 4.0 MGD capacity allocation. Will add to minutes.	AECOM	4Oct19	**Revised August 21 minutes will be issued**
02	**Storm Selection** AECOM received data from RWWU for the 5 requested storm events. September 9-12 rain event was not as severe in Racine as it was farther south in Kenosha. 4.8 inches over the three days. Peak flow of 154 MG at plant, blended approximately 15.46 MG gallons. Caledonia put 250,000 gallons into the Hoods Creek tank during this event. Terry McCarthy recommend we obtain WDNR agreement with design storm selection prior to or at the mid-course review.	---	---	---
03	**Collection Model** AECOM met with Bryan Rogne on September 19 to get a debrief on model additions since the 2009 Optimization study and an update on current modeling he is working on. Collection model has been calibrated to the 2007 storm event.			

Ref	Action	Responsible	Due by	Status
04	**Flow and Population Projections** Caledonia and Mt. Pleasant confirmed the population projections and capacity allocation/future flow requests for use in the Facilities Plan. Caledonia peak projection is a wet weather estimate and the average projection is for dry weather. Mt. Pleasant is the average flow to Bryn Mawr Station. AECOM was reminded to check flows against the results of the 2009 Optimization Study. Need to confirm the flow projections are consistent with the SEWRPC sewer service area boundaries. Will an Area wide Plan Revision be required.	---	---	---
05	**Wastewater Treatment Plant** Site visit assessment technical memoranda are still in progress. Process model has been calibrated for existing conditions. DO levels are in question. Requested DO data and probe locations from RWWU.	---	---	**---**
06	**Use of Collection Model** Tom Ludwig asked if the service level of protection will be backed up into the system. Model will be used to establish headwater at points in the system.			
07	**KR Lift Station Update** Bryan Rogne is modeling the peak flows through the existing interceptor. Chicory Road study proceeding. Nothing conclusive per Dan Snyder. Dan stated the there are plans for a temporary KR lift station, a triplex pump setup in a manhole.	---	---	
08	**Foxconn** No further updates.	----	---	**---**
09	**North Beach Lift Station** Keith Haas requested AECOM to verify how the North Beach Lift Station, designed by SEH, fits into the model.	AECOM	---	**---**

Ref	Action	Responsible	Due by	Status
10	**WDNR Mid-Course Review** Discussed getting agenda/topics to Andrew Dutcher (WDNR) prior to meeting. Agreed to set deadline for sending agenda suggestions to AECOM by October 2. Potential dates for meeting are the afternoon of October 23, with October 21 as backup. Many members thought they could attend on those dates. Subsequent to this meeting, Andrew Dutcher said he could not make those dates. A meeting the week of October 28 is an option. The mid-course meeting will likely replace the October TAC.	AECOM	---	
11	**Next Meetings** TBD Mid-course review with the WDNR may replace the regular October TAC.	AECOM	October 4	**---**
12		---	---	**---**
13		---	---	**---**

Minutes

Meeting name	Meeting date	Attendees
RWWU Technical Advisory Committee 5	20Nov19 Issued 08Jan20	See attendance sheet- attached

Time	Location
1:30 PM	RWWU Offices City Hall Annex

AECOM project number	Prepared by
60554970	Mike Zapinski

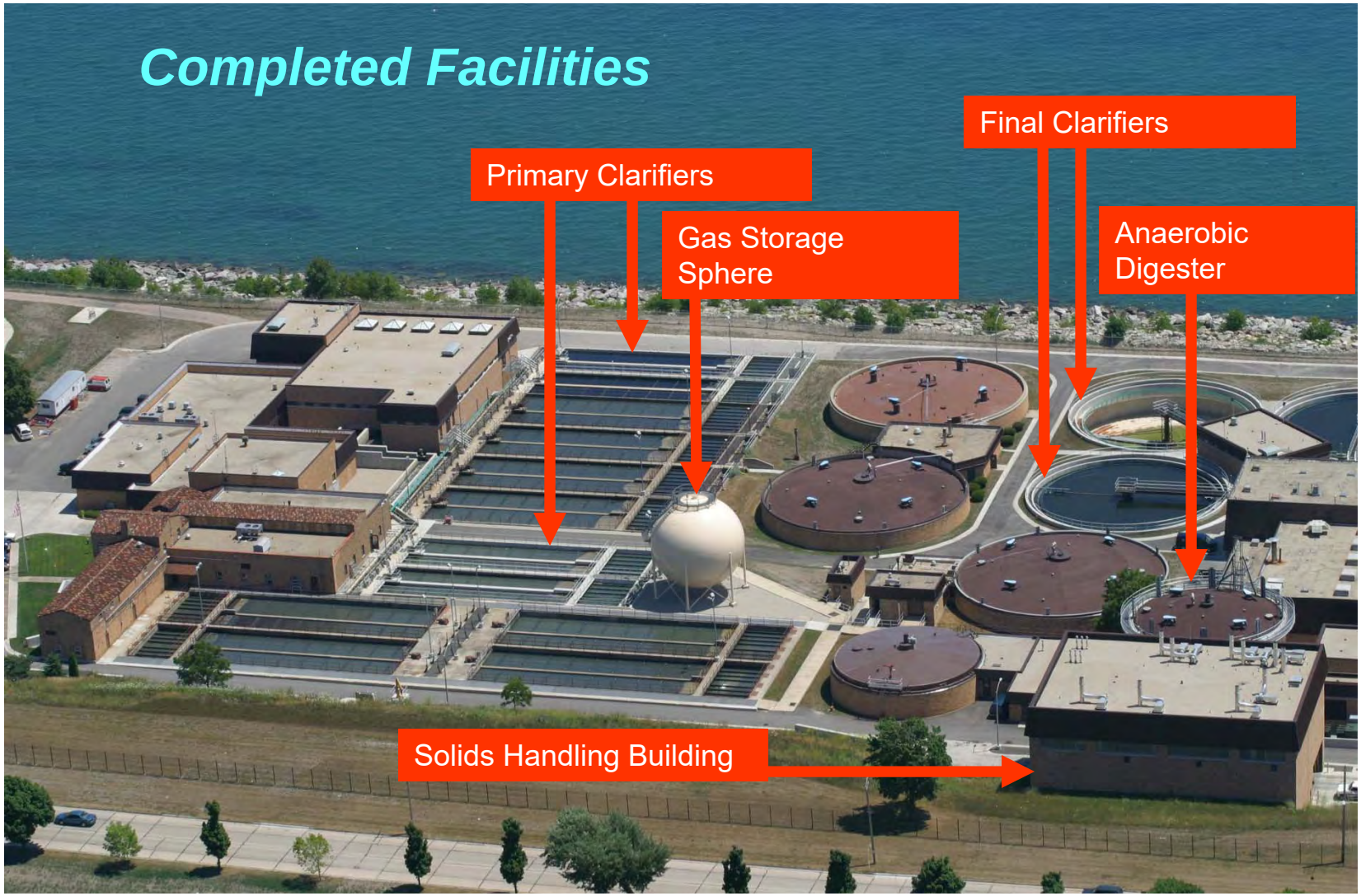
Ref	Action	Responsible	Due by	Status
01	Reissued September 19, 2019 Minutes	---	---	---
02	Review WDNR Mid-Course Review Meeting AECOM reviewed highlights of the meeting. Most notably WDNR will seriously consider the approach of using synthetic design storms to evaluate system performance in the MIKE Urban model. Sensitivity will be analyzed by selecting two design storms, one of greater intensity and shorter duration and one of longer duration and total overall rainfall but with a lesser peak intensity.	---	---	---
03	WWTP Upgrades and Revisions AECOM presented an outline of the WWTP revisions under consideration for the Facilities Plan. The slides are attached as part of these minutes. Noted that if all communities received their current flow allocation requests plant capacity would need to be increased from 36 MGD to 48 MGD. Draft WPDES permit has been issued. No significant changes. Revisions reviewed with TAC, documented in slides. A number of near-term (0-5 years) projects identified for plant during our review: • Improvements to engine blowers and biogas utilization system • Filtrate storage • UV equipment replacement			

Ref	Action	Responsible	Due by	Status
04	Conceptual Plant Expansion Discussed use of the CNH property for a conceptual plant expansion along with potential for equalization. Contamination issues should not prohibit development. Contaminated soil can be managed on-site or landfilled. Monitoring of population growth, community contributions to plant flows and loading will be included in the Facilities Plan, with a discussion of phasing any projects to expand plant paucity. General discussion of community allocations. Questions as to whether Racine could lease or sell some unused capacity to other sewer service recipients.	---	---	---
05	Collection system Model Model calibrated to 2007 storm event. Calibration to more recent storm events is proceeding. Peak flows should be modeled by the time of the January TAC meeting for discussion of alternatives.	---	---	---
06	KR Lift Station Update KR (Pike River) Lift Station is currently scheduled to bid in February 2020.	---	---	
07	Foxconn No further updates.	----	---	---
08	Next Meetings Next TAC scheduled for January 8, 2020	AECOM	---	---
09		---	---	---
10		---	---	---

Wastewater Treatment Plant

AECOM

Completed Facilities


Completed Facilities
Final Clarifiers
Primary Clarifiers
Gas Storage Sphere
Anaerobic Digester
Solids Handling Building

Completed Facilities

Completed Facilities

AECOM

Future Flows and Loadings

- Current plant flows and loadings well within current capacity due to less population 2020 than projected back in 1998 as basis of plant.
- Future allocation requests significantly exceed current average capacity; however population projections for 2040 do not correlate to requests.
- Future flow allocation requests and/or potential lower ammonia limits warrant land acquisition consideration.
- Loadings based on population projections and future flow allocations
- Collection system analysis will likely show need for additional equalization

Wastewater Flows

COMMUNITY	2018 AVERAGE (MGD)	CURRENT ALLOCATION, AVG DAY	REQUESTED ALLOCATION	SOURCES/COMMENT
City of Racine	12.75	17.06	17.06	Assumed projection - no increase.
Mt. Pleasant	6.28	11.49	19.6	2018 request
Caledonia	4.15	5.13	9.75	2018 request
Sturtevant	1.13	1.78	2	Round up current allocation
Elmwood Park	0.13			
North Bay	0.09			
Wind Point				
TOTAL	24.53	35.46	48.41	Plant rating 36 MGD average

COLLECTION SYSTEM –PERMIT FACT SHEET

No changes in safety site sample points or flow bypass monitoring.

WWTP INFLUENT PERMIT CHANGES- PERMIT FACT SHEET

– Influent Flow Rate sampling frequency was changed from continuous to daily.

– Monitoring influent for Total Phosphorus and Total Ammonia Nitrogen is discontinued.

WWTP EFFLUENT PERMIT CHANGES- PERMIT FACT SHEET

- **E. coli:** Monitoring frequency was increased from May-September to year-round.
- **Fecal Coliform:** A weekly average limit of 970#/100mL geometric mean was added.
- **Total Residual Chlorine:** A weekly average limit of 38 ug/L and a monthly average limit of 38 ug/L was added. The daily maximum mass limit of 58 lbs/day was removed.
- **Ammonia Nitrogen:** A weekly average limit of 62 mg/L was added. The monthly average limit of 34 mg/L was decreased to 25 mg/L.
- **Mercury, Total Recoverable:** The daily maximum limit of 5.8 ng/L was decreased to 4.0 ng/L.
- **Total Phosphorus:** The monthly average interim limit of 1.0 mg/L was decreased to 0.86 mg/L.

WWTF EFFLUENT PERMIT CHANGES- PERMIT FACT SHEET

- **Maximum Temperature:**

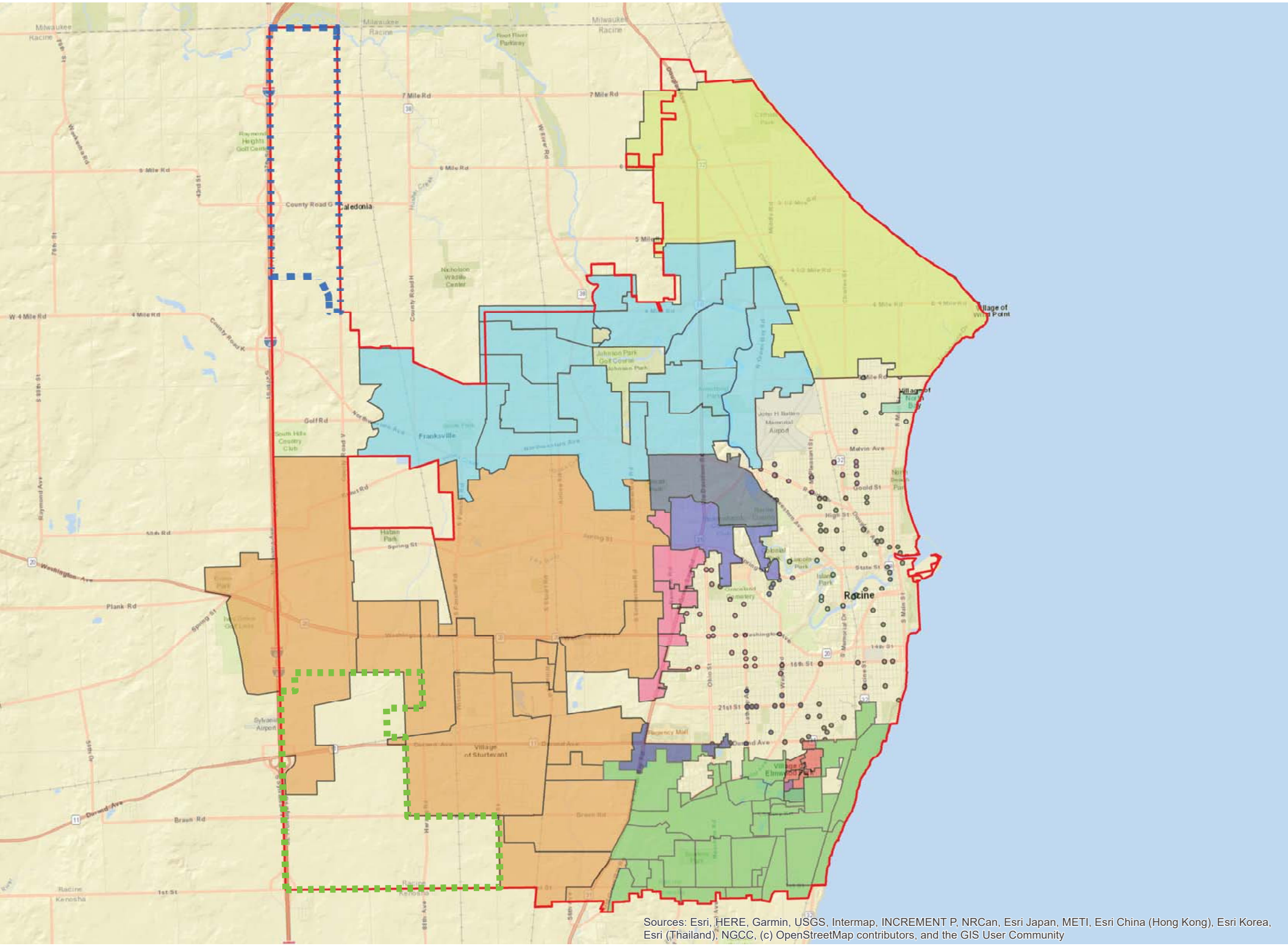
- Weekly average temperature limitations for October (61F), November (62F), and December (52F) were added.

- Year-round temperature monitoring was added for calendar year 2023 (January – December)

- Dissipative cooling demonstration as outlined by WDNR is intended alternative compliance strategy to meet temperature limitations.

Treatment Plant Issues

Plant Area	Recommendation
Equalization	Screen upgrade and structural improvements
Preliminary Treatment	Minor improvements
Primary Treatment	Mechanism rehab, structural, influent channel
Secondary Treatment	Blowers. Check diffusers. Piping improvements.
Phosphorus Removal	Retain existing. Assess future Bio-P.
Anaerobic Digestion	Cover and roofing improvements
Solids Management	Piping upgrades. Filtrate storage?
Digester Gas System	Engine/generator or other biogas utilization alternatives
Disinfection	UV equipment replacement
WWTP Facilities	Misc. upgrades to Buildings, HVAC, roofs, pavement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Racine
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Golf Rd
Nicholson Wildlife Center
Johnson Park Golf Course
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High St
State St
Washington Ave
Plank Rd
Spring St
Durand Ave
Braun Rd
Village of Sturtevant
Regency Mall
Sylvania Airport
Racine
Kenosha
1st St
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

Minutes

Meeting name	Meeting date	Attendees
RWWU Technical Advisory Committee 6	08Jan20 Issued 12Feb20	See attendance sheet- attached

Time	Location
1:30 PM	RWWU Offices City Hall Annex

AECOM project number	Prepared by
60554970	Mike Zapinski

Ref	Action	Responsible	Due by	Status
01	**Issued November 20, 2019 Minutes**	---	---	**---**
02	**WWTP Upgrades and Revisions** AECOM presented updated details of WWTP revisions under development for the Facilities Plan. Major upgrades- no capacity increase- include: • Biogas cogeneration system including new electrically driven blowers • Additional primary influent channel for redundancy • UV equipment replacement • Belt press filtrate equalization			
03	**Conceptual Plant Expansion** Capacity increase from 36 to 48 MGD is proposed to be accomplished by development of a satellite plant up on the CNH property. Presented conceptual layout and details for this plant. Concept is for liquid only treatment at the satellite, with sludge sent to main plant for treatment. The development of this satellite plant raised a number of questions and comments for discussion: Keith - can plant be shifted north under the assumption that a waiver of the 500 ft setback or property acquisition will be achieved? Mary Frances – will two WPDES permits be required? This might be tied to the number of outfalls. Will a second air permit be required or can both facilities be covered under a “bubble”?	---	---	---

Ref	Action	Responsible	Due by	Status
	Mary Frances- can the satellite aeration tanks be used for equalization until the need for the entire plant. Monitoring of population growth, community contributions to plant flows and loading will be included in the Facilities Plan, with a discussion of phasing any projects to expand plant capacity. General discussion of community allocations. Questions as to whether Racine could lease or sell some unused capacity to other sewer service recipients. Dan asked how unused capacity allocations will be addressed in the plan. Mary Frances noted capacity of the existing outfall is closely tied to lake levels and needs to be considered in discussion of future capacity.			
04	**Collection System Model** Model calibrated to the more recent smaller storm events similar to the synthetic design storms selected for use as the basis of the facilities plan analysis and alternatives. Peak flows at plant and safety site discharge were reviewed for comparison. Peak flows from the synthetic design storms will be modeled by the time of the February TAC meeting for discussion of alternatives.	AECOM	February 11	---
05	**KR Lift Station Update** KR (Pike River) Lift Station is currently scheduled to bid in February 2020. Might be brought before the Commission January meeting.	---	---	
06	**Foxconn** No further updates. Mt Pleasant has their monthly meeting next week.	----	---	---
07	**Schedule** AECOM stated the draft facilities plan will be submitted for review in mid- to late march.	AECOM	March 31	
08	**Next Meetings** Next TAC scheduled for February 11, 2020	AECOM	---	---

Wastewater Treatment Plant

AECOM

Condition Assessment Summary

Racine Wastewater Utility
Wastewater Treatment Facility Plan Condition Assessment
AECOM - November 2019 (REV 11-19-19)

P&ID	TAG #	Struct No.	Drawing No.	Equipment	Condition Assessment	Facility Plan Summary Recommendation	Comments
09-N-01				*PROCESS INTERFACE SUMMARY*			
NA		02	02-CF- 2-10	CIVIL FACILITIES			
		02	02-CG- -	CIVIL GRADING	Long term needs for paving	Consider addressing cost for repaing roads	Allow for funding by facility plan project
NA		02	02-CP-2 - 11	CIVIL PIPING	No apparent issues.	Consider video inspection of pipe condition?	
NA		06	06-SM-o-1	FLOW CONTROL STRUCTURE	Facility staff note that only one of 5 flow meters to EQ work.	Validate that Flow Meter Replacement is accounted for	RWWU staff note this is covered in CIP planning
NA		07	07-AMH-o-1	SAMPLER BUILDING	Not assessed. No issues noted.	SEPTAGE Sampler upgrade	
NA		08		COMBINATION BOX STRUCTURE	Not assessed. No issues noted.	No upgrades or replacement required	
NA		20	20-SM-1	DIVERSION STRUCTURE	Not assessed. No issues noted.	No upgrades or replacement required	
NA		20	30-SM-2	INFLUENT SIPHON GATE NOS. 1 &2	Not assessed. No issues noted.	No upgrades or replacement required	
NA		20	20-SM-1	DIVERSION STRUCTURE	Not assessed. No issues noted.	No upgrades or replacement required	
NA		25	25-R-1	JUNCTION STRUCTURE	Not assessed. No issues noted.	No upgrades or replacement required	
		30	30-M-n-3	EQ SCREENING BUILDING	Facility staff noted deficiencies in screen performance	Replace Bar Screens	Allocate cost for screen replacement
		40	40-M-n-1	EAST EQUALIZATION BASIN - EQ #1	Concrete in poor condition around perimeter. Facility staff note	Rehabilitate EQ #1 Allocate for costs of surface rehab of coating system and include replacement of concrete around perimeter. Evaluate overall EQ capacity needs and improve peak flow management of collection system and WWTP	All Flow Meters to EQ being replaced by RWWU in CIP. Peak flow management in collection system and WWTP is critical issue for Facility Plan. Prepare alternative improvement items when collection system flow inputs provided.
		45	40	WEST EQUALIZATION BASIN - EQ #2	Condition not assessed. No concerns noted by staff		
		47	02-CP-5	JUNCTION STRUCTURE	Not assessed. No issues noted.	No upgrades or replacement required	
		50		PRIMARY EFFLUENT JUCTION STRUCTURE	Not assessed. No issues noted.	No upgrades or replacement required	
		60	02-CP-o-1	SECONDARY EFFLUENT JUCTION STRUCTURE	Not assessed. No issues noted.	No upgrades or replacement required	
		91	91-PHE-s-1	EFFLUENT METERING STATION	Not assessed. No issues noted.	No upgrades or replacement required	
		95	95-PH-s-1	LIQUID CHLORINE BUILDING	Not assessed. No issues noted.	No upgrades or replacement required	
		106	106-SM-01	VACTOR DUMP STATION	Not a true septage receiving station- concrete containment area	Consideration of value of better management of storing/ blending/metering of high strength waste?	Convert to Septage Receiving Station? Not a priority for RWWU
		110		***ADMINISTRATION BUILDING***	*Various upgrades requested*	*See Arch/HVAC assessment and cost estimate*	
		120		***CHEMICAL WING***	*Need to seal concrete above tunnel.*	*See Arch/HVAC assessment and cost estimate*	Need to UPGRADE protected water system tanks and backflow prevention
09-N-47		*120*		***FERRIC CHLORIDE SYSTEM***	*FRP tanks have limited remaining useful life; no spill containment at truck unloading.*	*Upgrade ferric chloride tank, unloading, and spill containment system. Add hydraulic ramp and building loading dock.*	*Plant addressed need for spill containment*
		125		***LAB***	*Replace roof top air handling and make up air system equipment ; laboratory requested updates to flooring and utility support systems*	*Arch/HVAC assessment and cost allocation*	
		130	130-M-2	PRELIMINARY TREATMENT BUILDING	Building work completed in 2005. No apparent issues.		
09-N-50	T-13-1-1	130	130-M-2	SODIUM BISULFITE SYSTEM	There is a temporary bisulfite feed line in place. a permanent line should be installed with a flow-paced feed system.	Install bisulfite line extension and add pump controls.	Bisulfite feed system shown on Dwg. 09-N-50. Specific costs not required.
09-N-02	30-GT-11 THRU 12	130	30-SM-2	INFLUENT SIPHON GATE #1 AND #2	Not assessed. No issues noted.		At 30?
09-N-02	P-3-3-1	130	30-SME-3	RAW WASTEWATER SAMPLE PUMP	Calibrated process model indicates that sampling is not representative of calibrated mass balance of solids.	Allow for cost to address sampling system design and opearation in design phase	See forthcoming RESULTS of CALIBRATED PROCESS MODEL -Kevin Frank analysis. REVIEW system model with RWWU.
09-N-02	FE&PIT 3-1-1 THRU 2	130	30-SME-3	RAW WASTEWATER INFLUENT FLOW METER #1 & #2	Not assessed.	~~To be replaced. RWWU addressing these flow meters.~~	~~Flow data is not accurate. Effluent Flow is used.~~
09-N-02	FCV 3-1-1 THRU 2	130	130-M-1	INFLUENT FLOW CONTROL VALVE #1 & #2	Not assessed. No issues noted.		
09-N-03	M-2-12-1 THRU 4	130	130-M-2	SCREENING	4 - 6-ft wide Vulcan Crawler screens with 1/2-in spacing. Screens appeared to be in good working order - no issues noted. Screens are close to 20 years old. Climber-type screens not as favored as when they were installed.	Replacement may be warranted due to age of equipment. Not a priority for RWWU as in good condition.	If compactors are in need of replacement, a budgetary cost to be obtained from a manufacturer.
		130	130-M-2	SCREENING	There isn't adequate access to the drain valves in the screen channels.	Install 4 hatches in the channels downstream of the screens.	Specific costs not required.
09-N-04	M-2-18-1 THRU 4	130	130-M-2	SCREEN WASH PRESSES AND CONVEYORS	4 - Vulcan units. Washer/presses and conveyor appeared to be in good working order - no issues noted. Equipment is close to 20 years old. (Better discharge guide to conveyor possible?)	Replacement may be warranted due to age of equipment. Not a priority for RWWU as in good condition.	If compactors are in need of replacement, a budgetary cost to be obtained from a manufacturer.
09-N-05	M-2-27-1 THRU 2	130	130-M-2	DEGRITTERS	2 - Vortex grit units with maximum capacity of 70 MGD. Units appeared to be in good working order - no issues noted. Equipment is close to 20 years old.		
09-N-05	P-2-28-1 THRU 2	130	130-M-1	GRIT PUMPS	2 - recessed impeller pumps; 250 gpm at 32-ft. Pumps appeared to be in good working order - no issues noted. Equipment is close to 20 years old.		
09-N-05	M-2-40-1 THRU 2	130	130-M-2	GRIT CONCENTRATOR	2 - 6-in dia. units; 250 gpm capacity. Units appeared to be in good working order - no issues noted. Equipment is close to 20 years old.		
09-N-05	M-2-28-1 THRU 2	130	130-M-2	GRIT DEWATERING SCREW CONVEYOR	2 - 9-in dia. units. Units appeared to be in good working order - no issues noted. Equipment is close to 20 years old.		
09-N-05	M-2-30-1 THRU 2	130	130-M-2	GRIT WASHER AUTOMATIC LUBRICATOR	No apparent issues.		
09-N-06	M-3-1-1 THRU 4	136	135-M-1 - 2	PRIMARY CLARIFIER NO. 1-6 (WEST BANK)	Mechanisms are in need of rehab.	Replace wear parts, such as collector chains, drive chains, flights, wear shoes, and wear strip (wall bearings?). Replace GRATING.	A budgetary cost to be obtained from a manufacturer.

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Facility Plan Needs

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Facility Plan Needs
Rehab Primary Clarifier Mechanisms
Anaerobic Digester Roof Upgrades
Critical Path Vulnerabilities
Solids Handling Piping Upgrades

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Facility Plan Needs & Alternatives

AECOM

Facility Plan Needs

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Future Flows and Loadings

- Current plant flows and loadings well within current capacity due to less population 2020 than projected back in 1998 as basis of plant.
- Future allocation requests significantly exceed current average capacity; however population projections for 2040 do not correlate to requests.
- Future flow allocation requests and/or potential lower ammonia limits warrant land acquisition consideration.
- Loadings based on population projections and future flow allocations
- Collection system analysis will likely show need for additional equalization

Wastewater Flows

COMMUNITY	2018 AVERAGE (MGD)	CURRENT ALLOCATION, AVG DAY	REQUESTED ALLOCATION	SOURCES/COMMENT
City of Racine	12.75	17.06	17.06	Assumed projection - no increase.
Mt. Pleasant	6.28	11.49	19.6	2018 request
Caledonia	4.15	5.13	9.75	2018 request
Sturtevant	1.13	1.78	2	Round up current allocation
Elmwood Park	0.13			
North Bay	0.09			
Wind Point				
TOTAL	24.53	35.46	48.41	Plant rating 36 MGD average

Comparison of projected 2040 loading conditions and current plant capacity

PROJECTED DESIGN CONDITIONS (150,685 POPULATION, DESIGN YEAR 2040)

Parameter	Unit		Annual Average Conditions		Maximum 30d Average	
Flow	(MGD)		23.9		**41.3**	
TSS	(lbs/d)	(mg/L)	29,538	148	**38,400**	112
BOD	(lbs/d)	(mg/L)	26,188	132	**32,211**	94
TKN	(lbs/d)	(mg/L)	3,828	19.2	**4,593**	13.3
TP	(lbs/d)	(mg/L)	452	2.3	**542**	1.6

EXISTING DESIGN CRITERIA (175,503 POPULATION, DESIGN YEAR 2020)

Parameter	Unit		Annual Average Conditions		Maximum 30d Average	
Flow	(MGD)		36.0		**48.9**	
TSS	(lbs/d)	(mg/L)	40,541	135	**53,109**	130
BOD	(lbs/d)	(mg/L)	31,591	105	**37,909**	93
TKN	(lbs/d)	(mg/L)	4,650	15.5	**6,231**	15.3
TP	(lbs/d)	(mg/L)	913	3.0	**1,168**	2.9

COLLECTION SYSTEM –PERMIT FACT SHEET

No changes in safety site sample points or flow bypass monitoring.

WWTP INFLUENT PERMIT CHANGES- PERMIT FACT SHEET

– Influent Flow Rate sampling frequency was changed from continuous to daily.

– Monitoring influent for Total Phosphorus and Total Ammonia Nitrogen is discontinued.

WWTP EFFLUENT PERMIT CHANGES- PERMIT FACT SHEET

- **E. coli:** Monitoring frequency was increased from May-September to year-round.
- **Fecal Coliform:** A weekly average limit of 970#/100mL geometric mean was added.
- **Total Residual Chlorine:** A weekly average limit of 38 ug/L and a monthly average limit of 38 ug/L was added. The daily maximum mass limit of 58 lbs/day was removed.
- **Ammonia Nitrogen:** A weekly average limit of 62 mg/L was added. The monthly average limit of 34 mg/L was decreased to 25 mg/L.
- **Mercury, Total Recoverable:** The daily maximum limit of 5.8 ng/L was decreased to 4.0 ng/L.
- **Total Phosphorus:** The monthly average interim limit of 1.0 mg/L was decreased to 0.86 mg/L.

WWTF EFFLUENT PERMIT CHANGES- PERMIT FACT SHEET

- **Maximum Temperature:**

- Weekly average temperature limitations for October (61F), November (62F), and December (52F) were added.

- Year-round temperature monitoring was added for calendar year 2023 (January – December)

- Dissipative cooling demonstration as outlined by WDNR is intended alternative compliance strategy to meet temperature limitations.

Treatment Plant Issues

Plant Area	Capital Project Estimate Range
Equalization	In Progress
Preliminary Treatment	Minor improvements < $100K
Primary Treatment	Mechanism rehab, structural, influent channel $2 - $5 million
Secondary Treatment	Blowers & Piping < $ 3 million
Phosphorus Removal	Retain existing; Bio-P is feasible with pros and cons.
Anaerobic Digestion	Cover and roofing improvements- In Progress
Solids Management	Piping upgrades.
Digester Gas System	CHP System $3.5- $5 Million
Disinfection	UV equipment replacement $4.5 - $5.5 Million
WWTP Facilities	Misc. upgrades to Buildings, HVAC, roofs, pavement

BIOGAS UTILIZATION GOALS

1. PROVIDE SUSTAINABLE EFFICIENT ENERGY UTILIZATION

2. ELIMINATE NEED TO UPGRADE OLD INEFFICIENT BLOWER ENGINES AND FLARE EXCESS BIOGAS

3. IMPROVE AIR EMISSIONS (LOW NOX BURNERS) AND OBTAIN MORE FAVORABLE AIR PERMIT

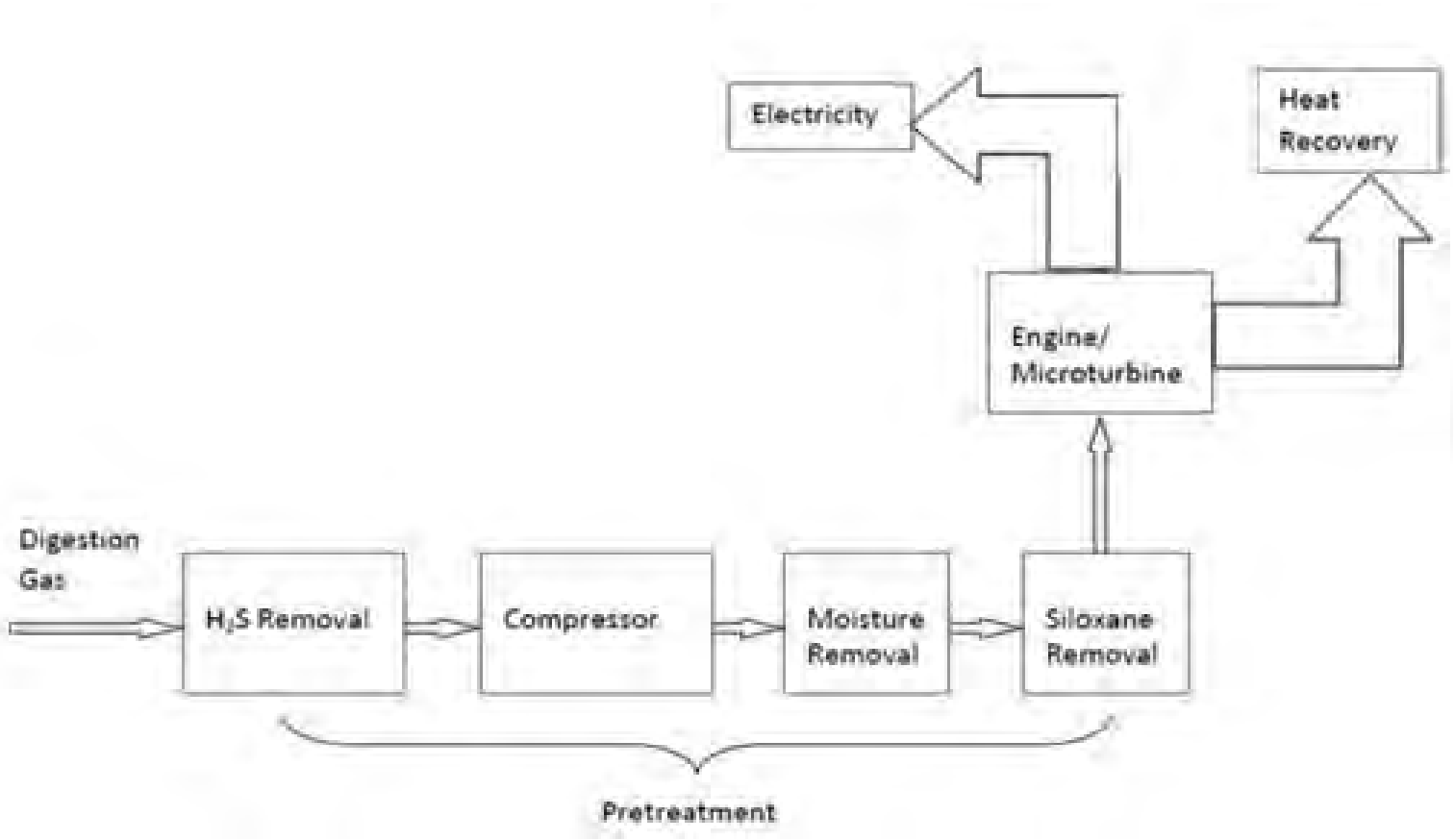
BIOGAS UTILIZATION ALTERNATIVE EVALUATION						
Goals:						
	1Improve energy efficiency and sustainability, in utiliza					

ENGINE DRIVEN BLOWERS

AECOM

EXCESS BIOGAS- FLARING

BIOGAS UTILIZATION UPGRADE



BIOGAS UTILIZATION CONCEPT – ALTERNATIVE 1

1. REMOVE OLD ENGINE DRIVEN BLOWERS

2. PROVIDE NEW HIGH EFFICIENCY ELECTRIC MOTOR DRIVEN BLOWERS AND REVISE PIPING TO INCORPORATE LAYOUT

3. PROVIDE NEW PRETREATMENT SYSTEM FOR DIGESTER GAS

4. PROVIDE NEW IC-ENGINES WITH LOW NOX BURNERS OR MICROTURBINES

5. UPGRADE ON-SITE ELECTRICAL DISTRIBUTION AND THERMAL RECOVERY.

TYPICAL MICROTURBINE

Wastewater Flows

COMMUNITY	2018 AVERAGE (MGD)	CURRENT ALLOCATION, AVG DAY	REQUESTED ALLOCATION	SOURCES/COMMENT
City of Racine	12.75	17.06	17.06	Assumed projection - no increase.
Mt. Pleasant	6.28	11.49	19.6	2018 request
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Sturtevant	1.13	1.78	2	Round up current allocation
Elmwood Park	0.13			
North Bay	0.09			
Wind Point				
TOTAL	24.53	35.46	48.41	Plant rating 36 MGD average

Racine WWU Auxiliary Plant Summary

- **Influent Conditions**
-
- Annual Average Flow 12.0 mgd
- Peak Flow 23.2 mgd
- Population Equivalent 120,000
- Average BOD Loading 20,400 lb/d

Primary Clarifiers

– Sizing Criteria:

– Average Design Flow	1,000 gpd/ft^2 (Chapter NR 110)
– Maximum Hourly Flow	1,500 gpd/ft^2 (Chapter NR 110)
– Total Required Area	12,000 ft^2 (Average)
–	15,490 ft^2 (Maximum Hourly)
– Overall Dimensions	110 ft x 145 ft (for Maximum Hourly)

Aeration Tanks

– <u>Sizing Criteria:</u>

– Organic Loading Rate — 15 lb BOD_5/d/1,000 ft^3 (Chapter NR 110 – Extended Aeration)

–

– Total Required Volume — 1,360,000 ft^3

– Surface Area — 97,140 ft^2 (assuming 14 ft depth)

– Overall Dimensions — 220 ft x 440 ft

Final Clarifiers

– Sizing Criteria:

– Maximum Hourly Flow	1,000 gpd/ft^2 (Chapter NR 110 – Extended Aeration)
– Total Required Area	23,230 ft^2
– No. of Tanks	3
– Area per Tank	7,745 ft^2
– Dimensions	100 ft diameter

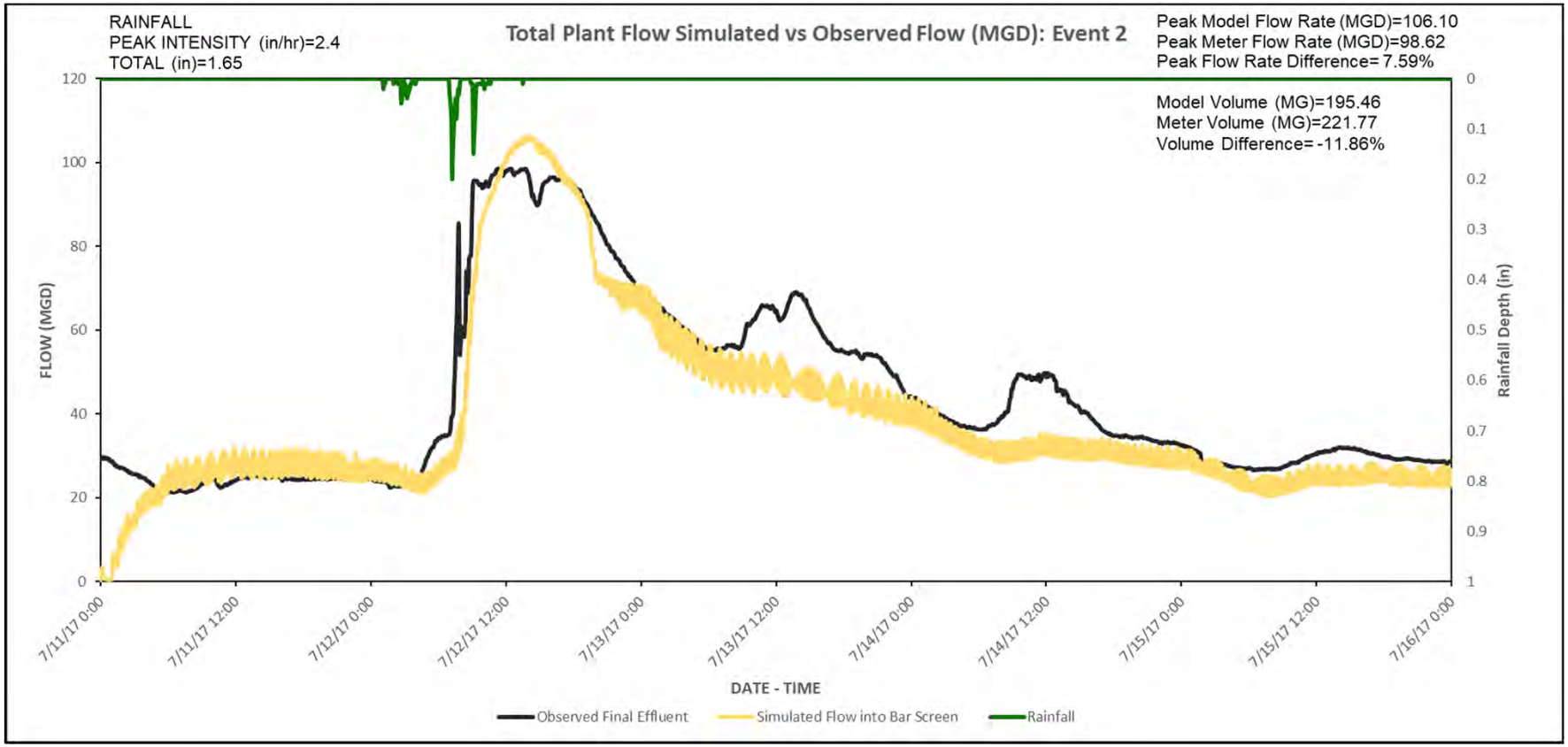
12 MGD WWTP Concept

- Headworks
- Preliminary Clarifier
- Aeration
- Final Clarifiers
- UV Disinfection
- Solids to Main Plant

Calibration Results - WWTP

Final Effluent

Event 2 - 07122017



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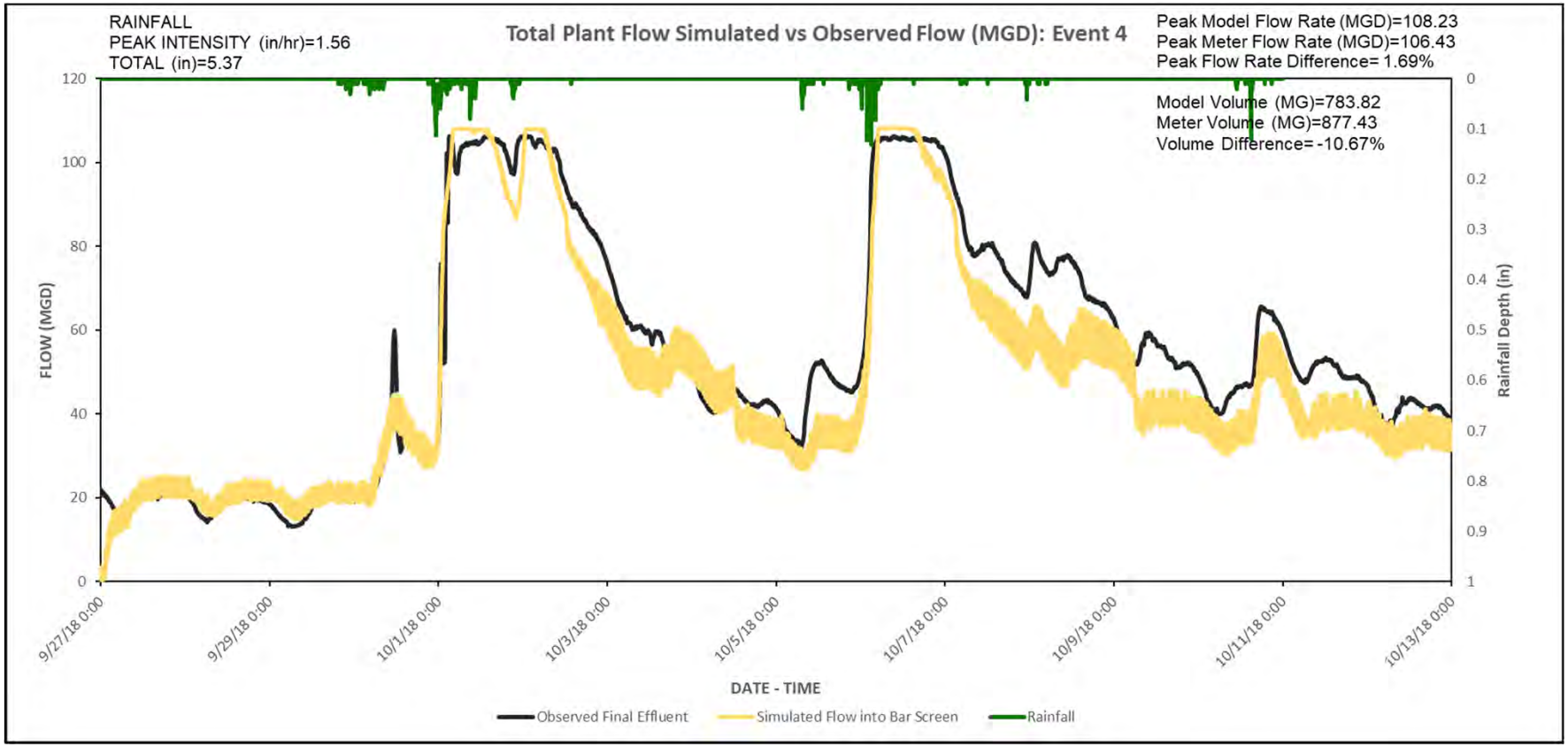
Final Effluent

Event 4 - 10012018



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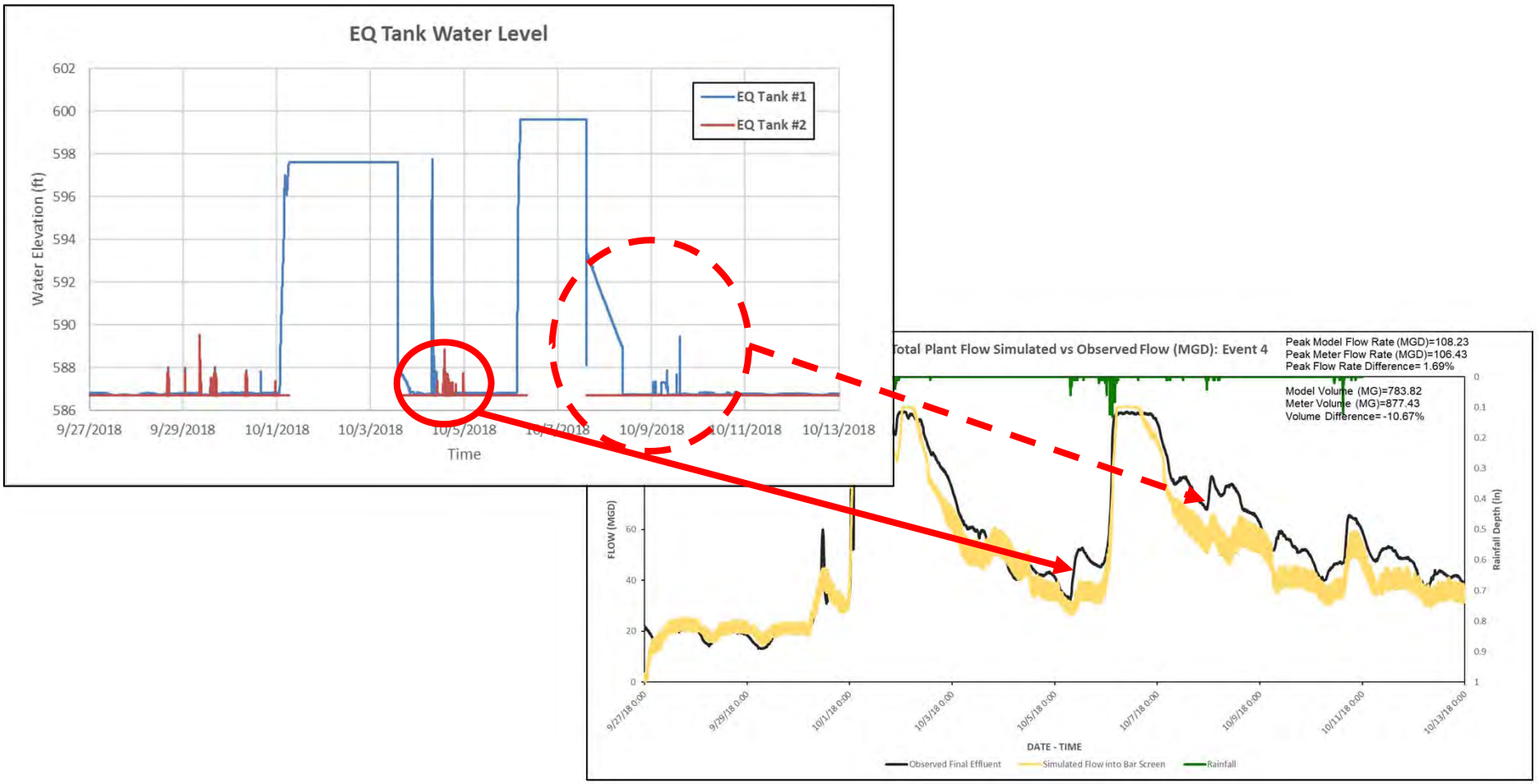
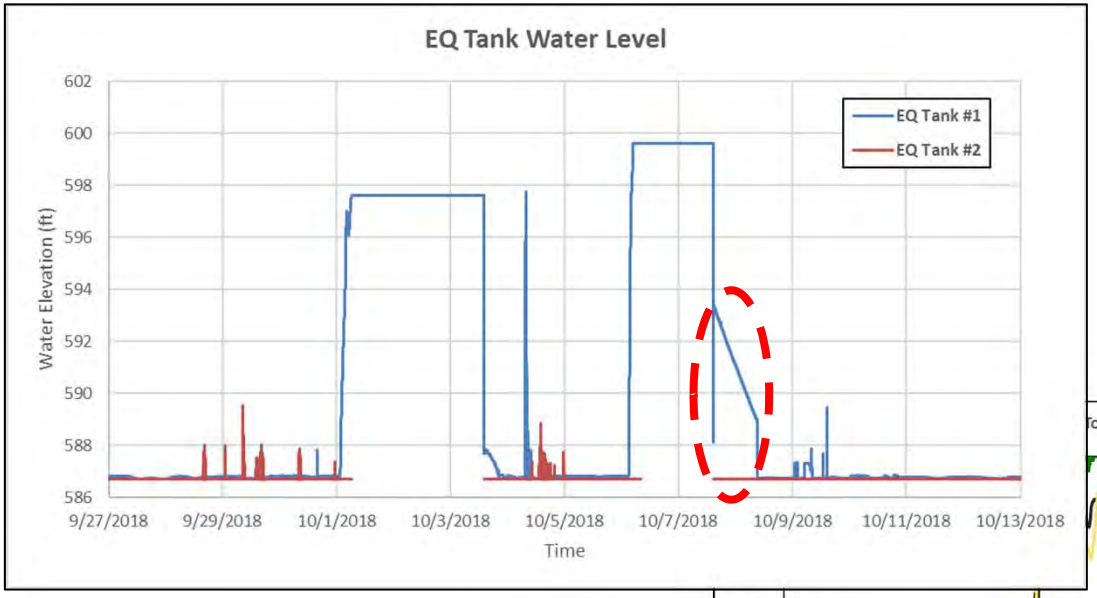
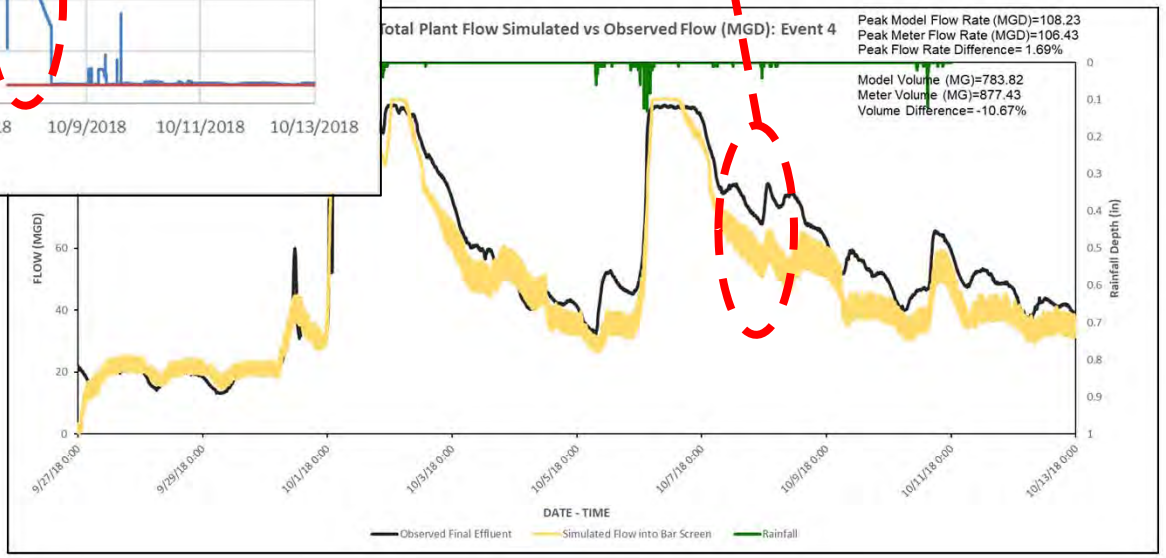
Dewatering of EQ Tanks



Difference between Model and Meter Data during Dewatering Period



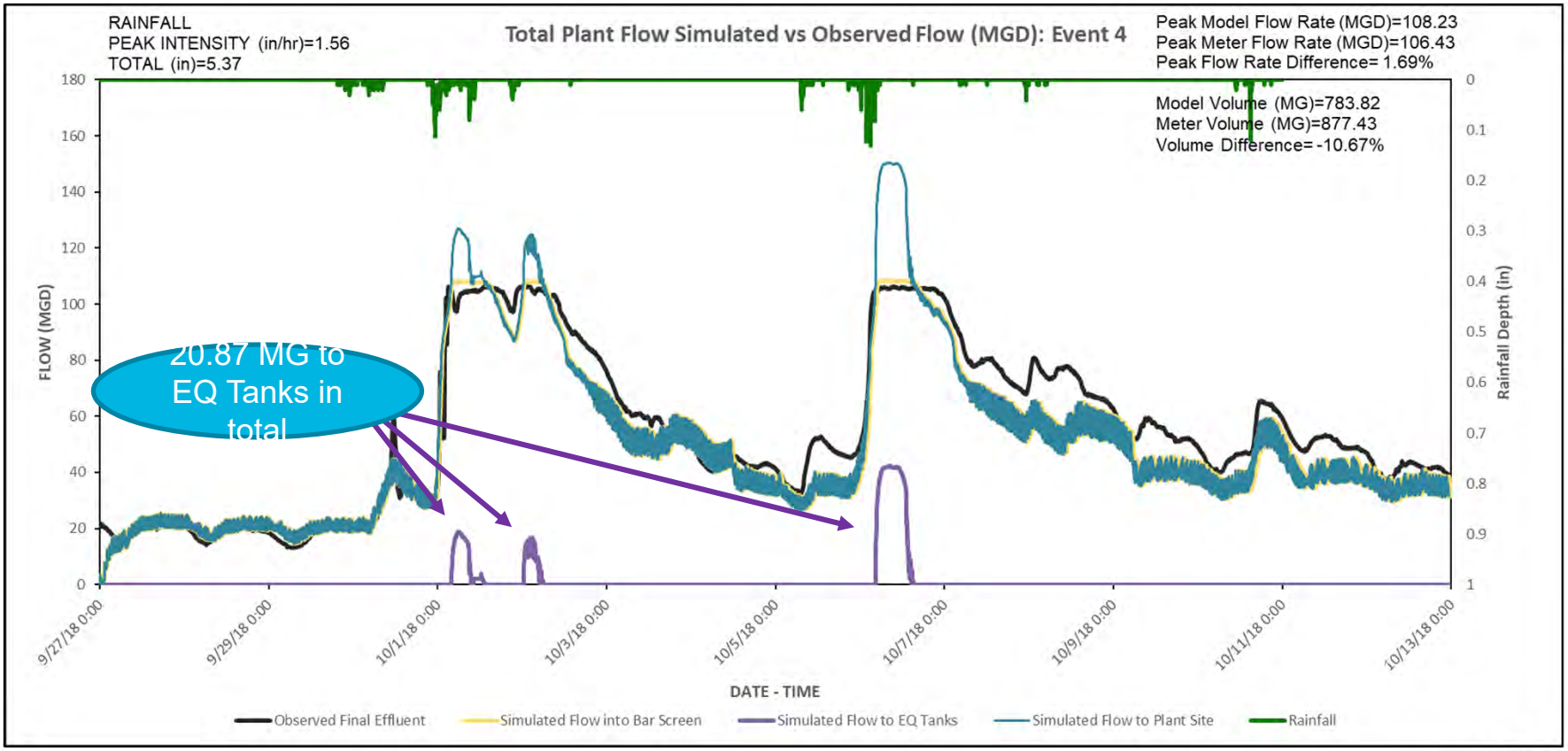
Predicted Volume: 44.5 MG
Observed Volume: 56.9 MG
Difference: 12.4 MG



=> Collection model may under-predict infiltration because of the volume difference (12.4 MG) larger than total EQ tanks volume (5.4 MG)

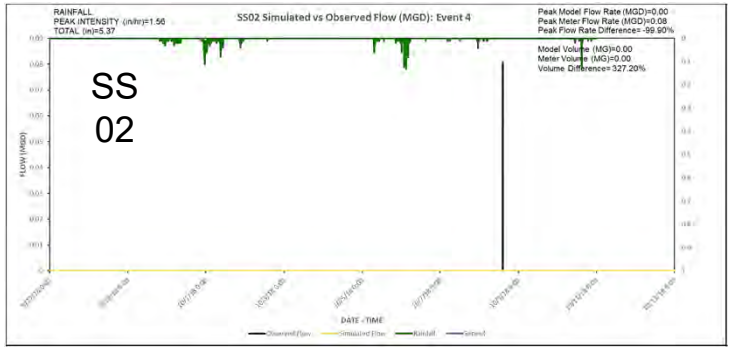
Simulated WWTP Flow, EQ Flow, and Total Flow to Plant

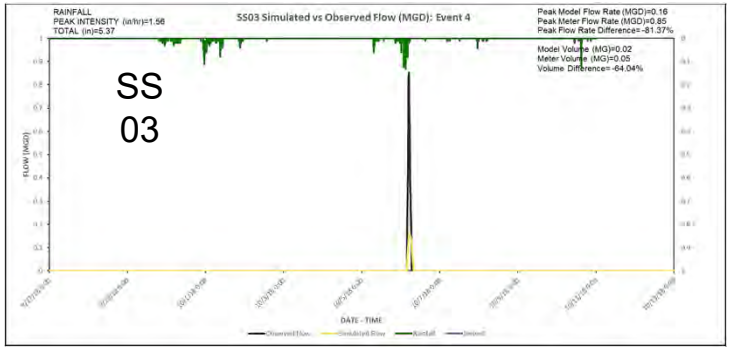
Event 4 - 10012018

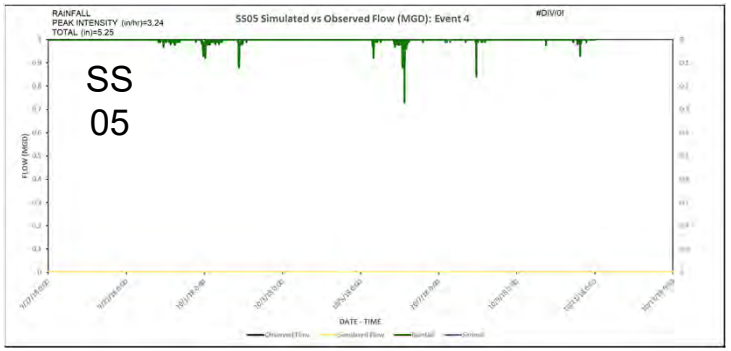


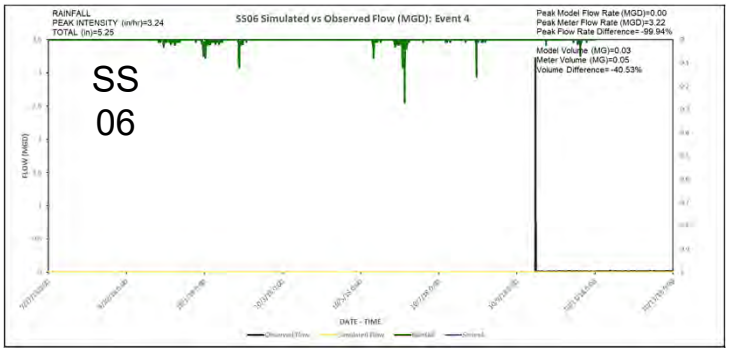
=> Total EQ tanks volume is 5.4 MG (2.7 MG each), and therefore the predicted bypass volume is 15.47 MG

Calibration Results – Safety Sites









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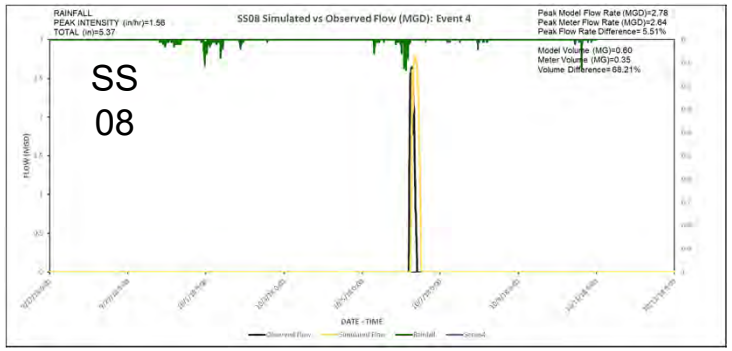
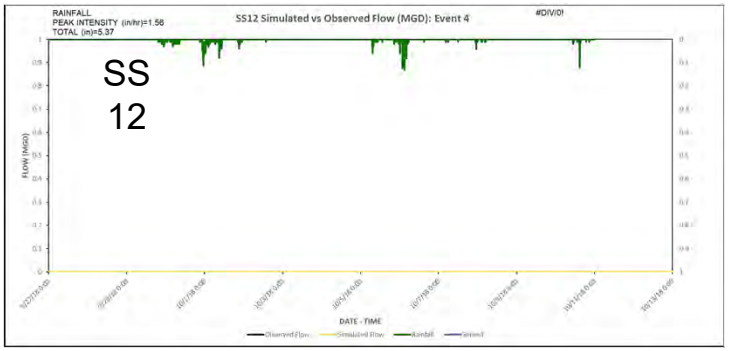
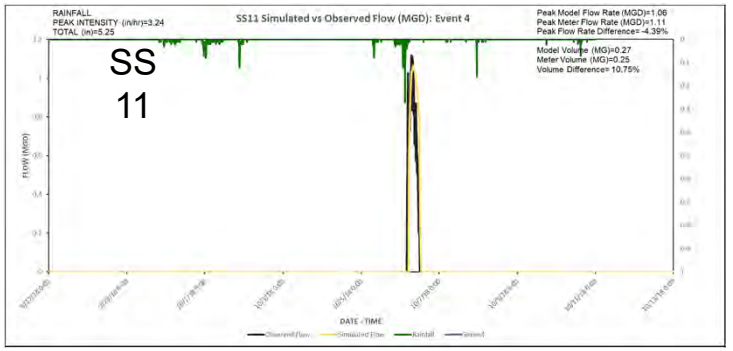
Calibration Results – Safety Sites







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Legend:

Approximate Property Boundary

0' 150' 300' 600'
SCALE

N

Notes:
1. Aerial map from Google Earth Pro, dated: 2018

AECOM
Milwaukee Office
1555 RiverCenter Dr
Milwaukee, WI
414.944.6080

AECOM

CONCEPTUAL 12 MGD
PLANT LAYOUT

Project Number:	Drawn By:	Date:	Figure
60554970	CAS	1/7/2020	

Minutes

Meeting name
RWWU Technical Advisory Committee 7

Meeting date
12Feb20

Attendees
See attendance sheet- attached

Time
1:30 PM

Location
RWWU Offices
City Hall Annex

AECOM project number
60554970

Prepared by
Mike Zapinski

Ref	Action/Discussion	Responsible	Due by	Status
01	Issued January 8, 2020 Minutes	---	---	---
02	Conveyance System AECOM presented slides of the current modeling and conveyance system performance, attached to these minutes. Model results for the 2020 existing and 2040 design conditions were included, including safety site discharges and identification of target areas for improvements.			
03	Conveyance System Discussion Dan Snyder stated part of the Foxconn extension could be considered existing and modeled that way. Bryn Mawr/Chicory road- Tom Ludwig inquired about the model results for the restriction at Bryn Mawr. Dan Snyder asked how high the surcharge was? Eric stated it is a flooded manhole. Dan disagreed that Chicory Road is surcharged due to being undersized. Caledonia/LS 31- The forcemain is not installed yet but should be in the next 18 months. This will be modeled as a 2040 or other future condition. Eric asked for information regarding the pumps and other upgrades. Caledonia to provide. Pike River LS- A 2040 option might include the existing 72-inch plus a 36-inch forcemain all the way to the plant. Caledonia- should have a facilities plan for additional storage at the far north end of the system. By Hoods Creek there is 1.5 MG storage, might be another 1.5 MG by 2040. Racine- Keith Haas noted that the 84-inch interceptor at City Hall is set up to function as storage. LS01 is a target area, with a potential need for additional storage.	---	---	---

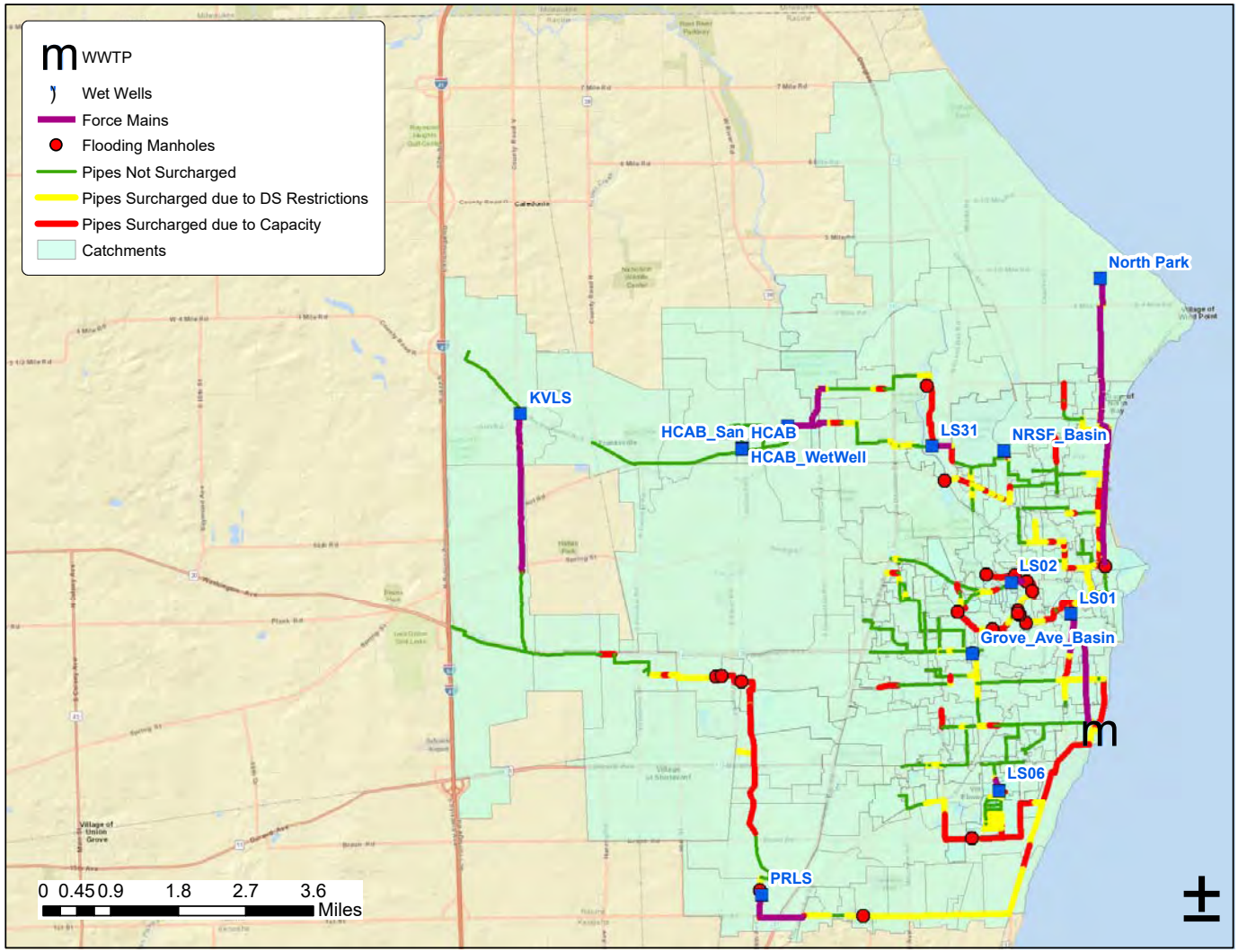
Ref	Action/Discussion	Responsible	Due by	Status
	John Rooney is very interested in creative ideas for LS01 storage that do not impede development of surrounding properties. AECOM is scheduling a separate meeting with John to discuss. Mount Pleasant is quite interested in whether or not additional storage at Pike River LS relieves the surcharge situation at Chicory Road. AECOM will schedule a separate working session to review and brainstorm regarding the conveyance model. Mary Frances inquired about the source of the 108 MGD hydraulic peak capacity at the plant. Source is 1998 Facilities Plan and subsequent design.			
04	KR/Pike River Lift Station Update Pike River Lift Station is currently scheduled to advertise for bids next week. Anticipated bid opening is March 26.	---	---	
05	Foxconn Anticipated to send initial flows after March 1. This will be domestic wastewater only form the existing building. The first process facility Phase 0 is scheduled to come online.	----	---	---
06	Schedule AECOM stated the draft facilities plan will be submitted for review in May.	AECOM	May	
07	Next Meetings Next TAC scheduled for March 11, 2020	AECOM	---	---

SIGN-IN SHEET

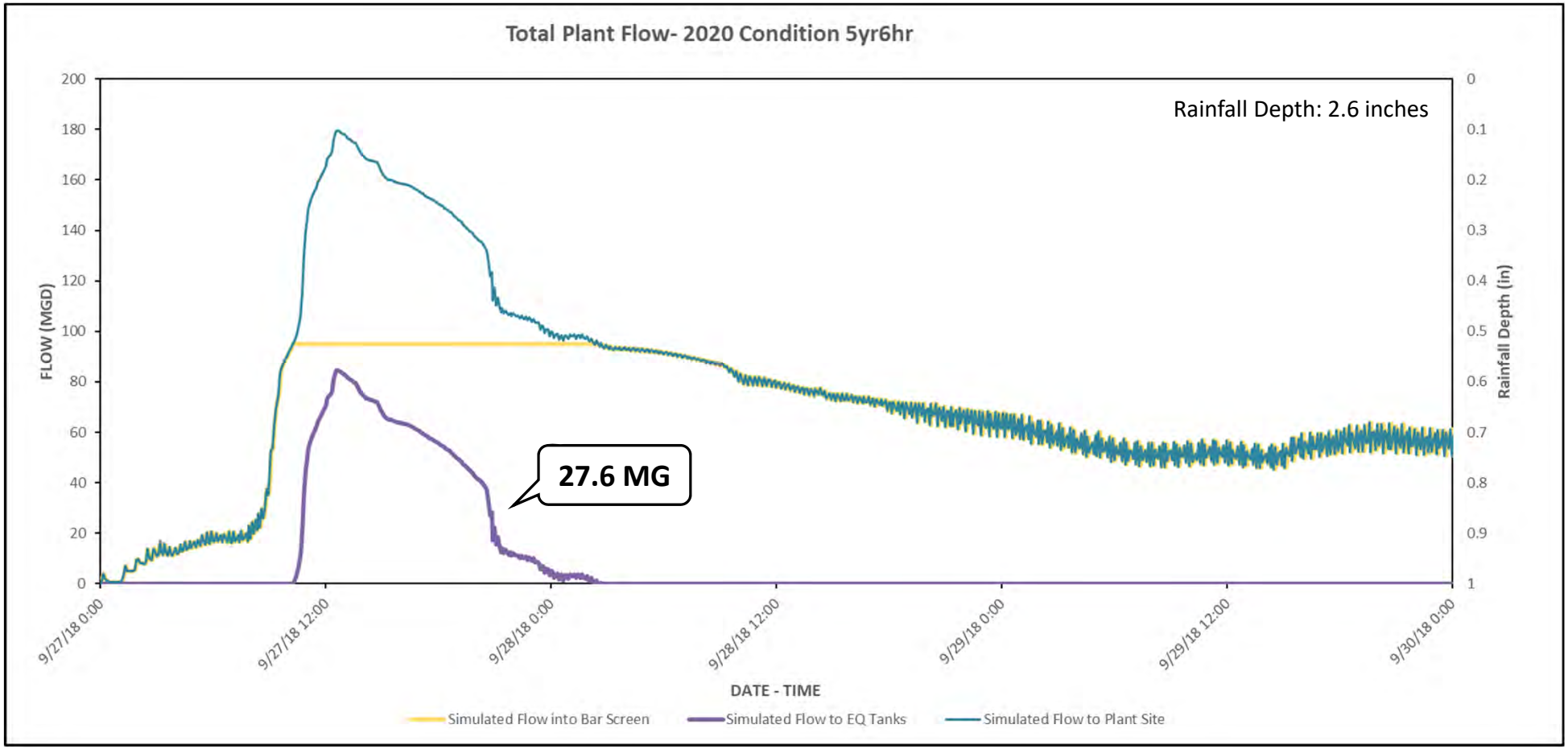
Racine Facilities Plan
Technical Advisory Committee Meeting
12Feb20, 1:30 PM

Name	Initial	Village/Firm	Telephone #	Email
Dan Snyder	X	Foth	262-939-0209	Dan.snyder@foth.com
Ron Pritzlaff		Mt. Pleasant	262-664-7842	rpritzlaff@mtpleasantwi.gov
Tom Ludwig	X	Foth/Caledonia	262-336-7905	tom.ludwig@foth.com
Tony Bunkelman	X	Caledonia Utility	262-835-6416	abunkleman@caledonia-wi.gov
Bob Lui		Caledonia Utility	262-681-3900	blui@caledoniawiutility.com
John Rooney	X	City of Racine	262-636-9460	John.rooney@cityofracine.org
Rusty Schroedel	X	AECOM	414-944-6140	rusty.schroedel@aecom.com
Keith Haas	X	Racine WW	262-363-9434	Keith.haas@cityofracine.org
Mike Gitter	X	Racine WW	262-636-9430	Mike.gitter@cityofracine.org
Mary Frances Klimek	X	Racine WW	262-636-9524	Maryfrances.klimek@cityofracine.org
Cara Pratt	X	City of Racine	262-822-8956	Cara.pratt@cityofracine.org
Eric Bartlein	X	AECOM	414-944-6114	Eric.bartlein@aecom.com
Bryan Lewis		AECOM	920-918-8820	Bryan.lewis@aecom.com
Mike Zapinski	X	AECOM	414-944-6204	Mike.zapinski@aecom.com
Amanda Kaminski	X	Racine WW	262-636-9552	Amanda.kaminski@cityofracine.org

Collection System Performance – 5-Year, 6-Hour Storm, 2020 Condition w/ PRLS

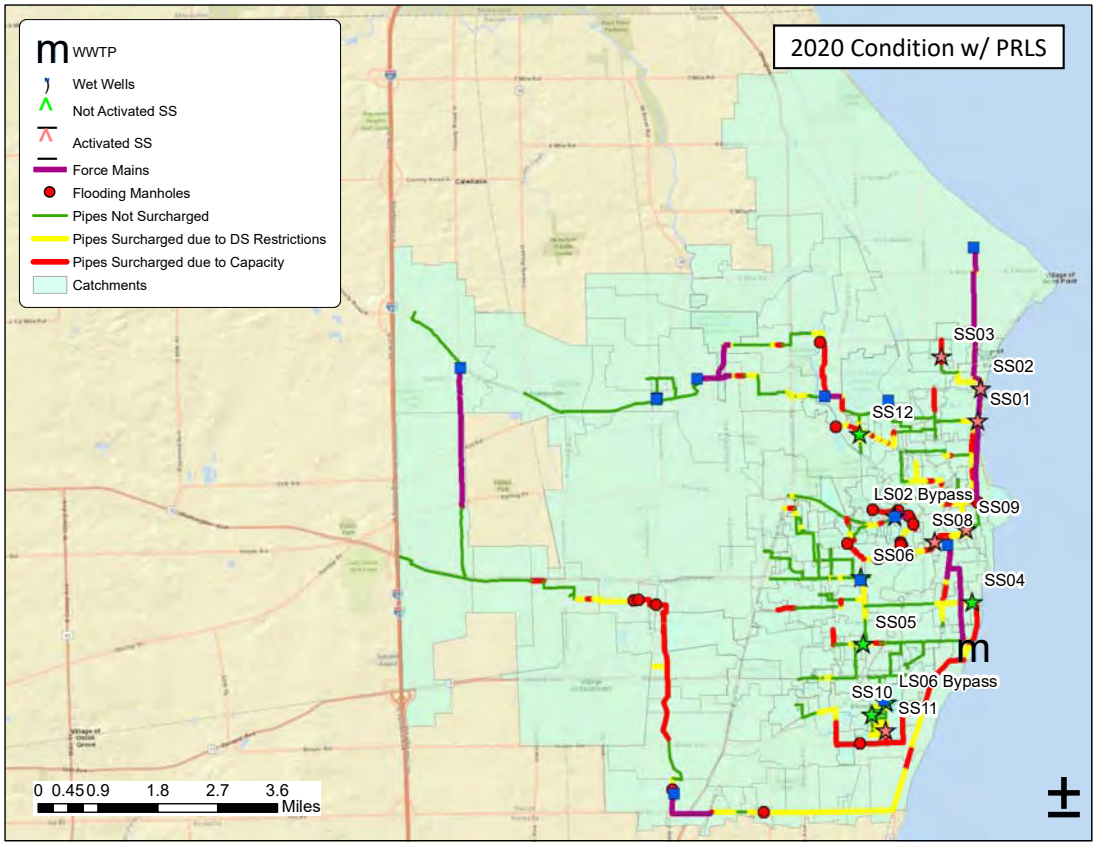


Predicted Flows into WWTP - 5-Year, 6-Hour Storm, 2020 Condition w/ PRLS, 95 MGD

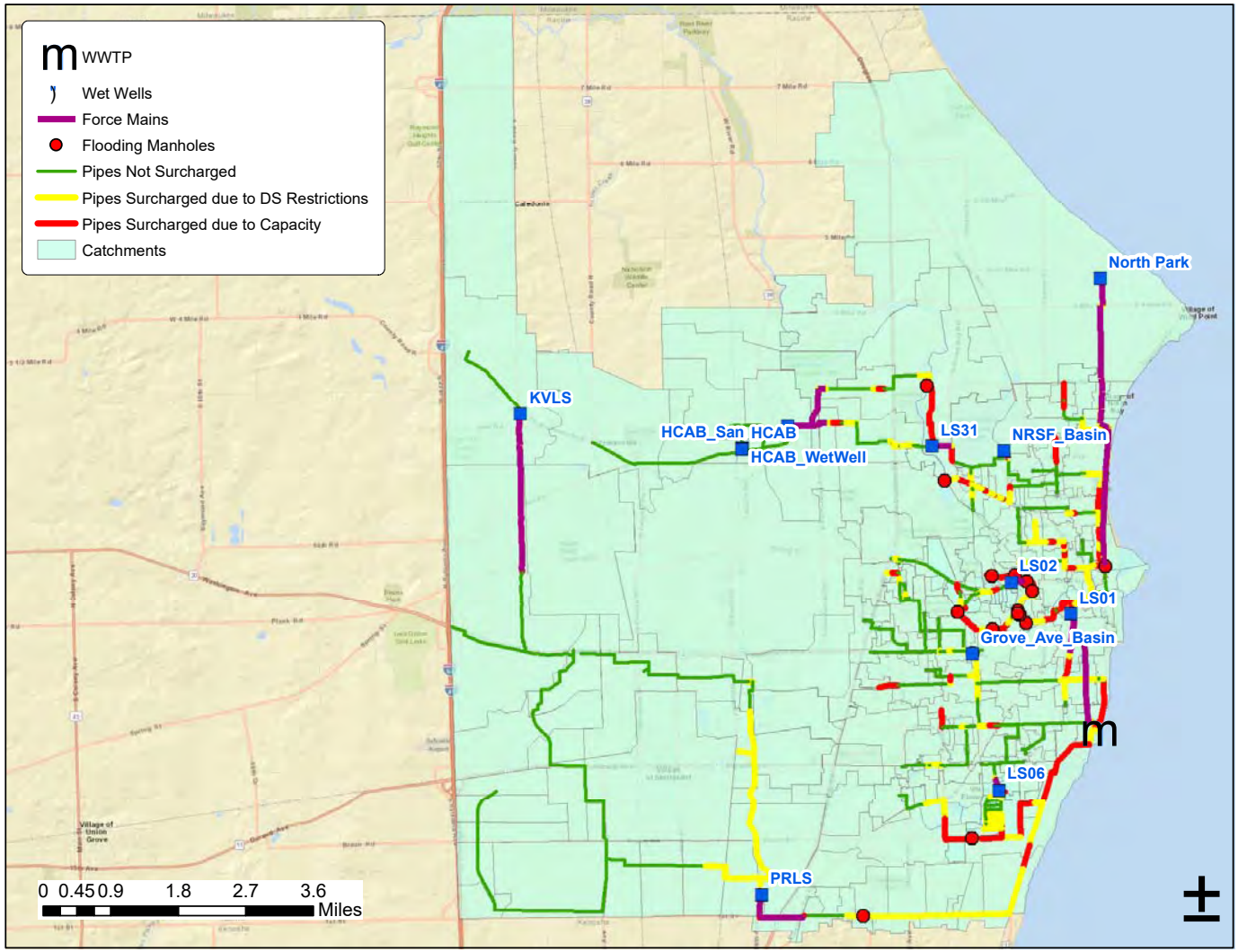


Safety Sites Overflow Stats – 2020 Condition w/ PRLS

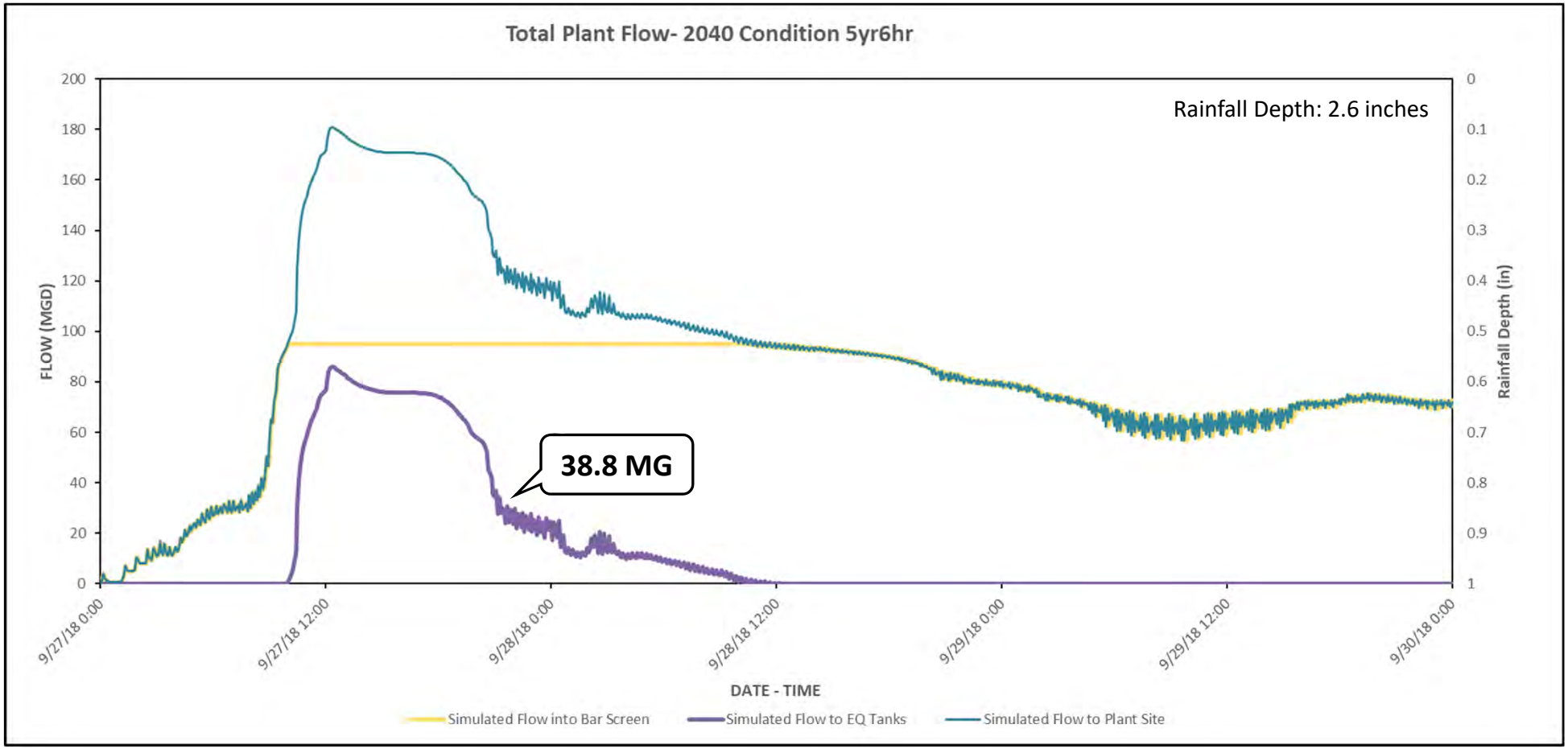
Safety Sites	5-Year, 6-Hour Storm 2020 Condition w/ PRLS Volume (MG)	Peak Flow (MGD)	Duration (hrs)
SS01	0.1	1.4	2.6
SS02	0.7	4.9	5.8
SS03	0.0	0.3	5.3
SS04	0.0	0.0	0.0
SS05	0.0	0.0	0.0
SS06	0.0	0.0	0.0
SS08	1.0	6.5	7.6
SS09	0.7	4.3	5.9
SS10	0.0	0.0	0.0
SS11	0.5	1.8	8.4
SS12	0.0	0.0	0.0
LS02 Bypass	0.0	0.0	0.0
LS06 Bypass	0.0	0.0	0.0



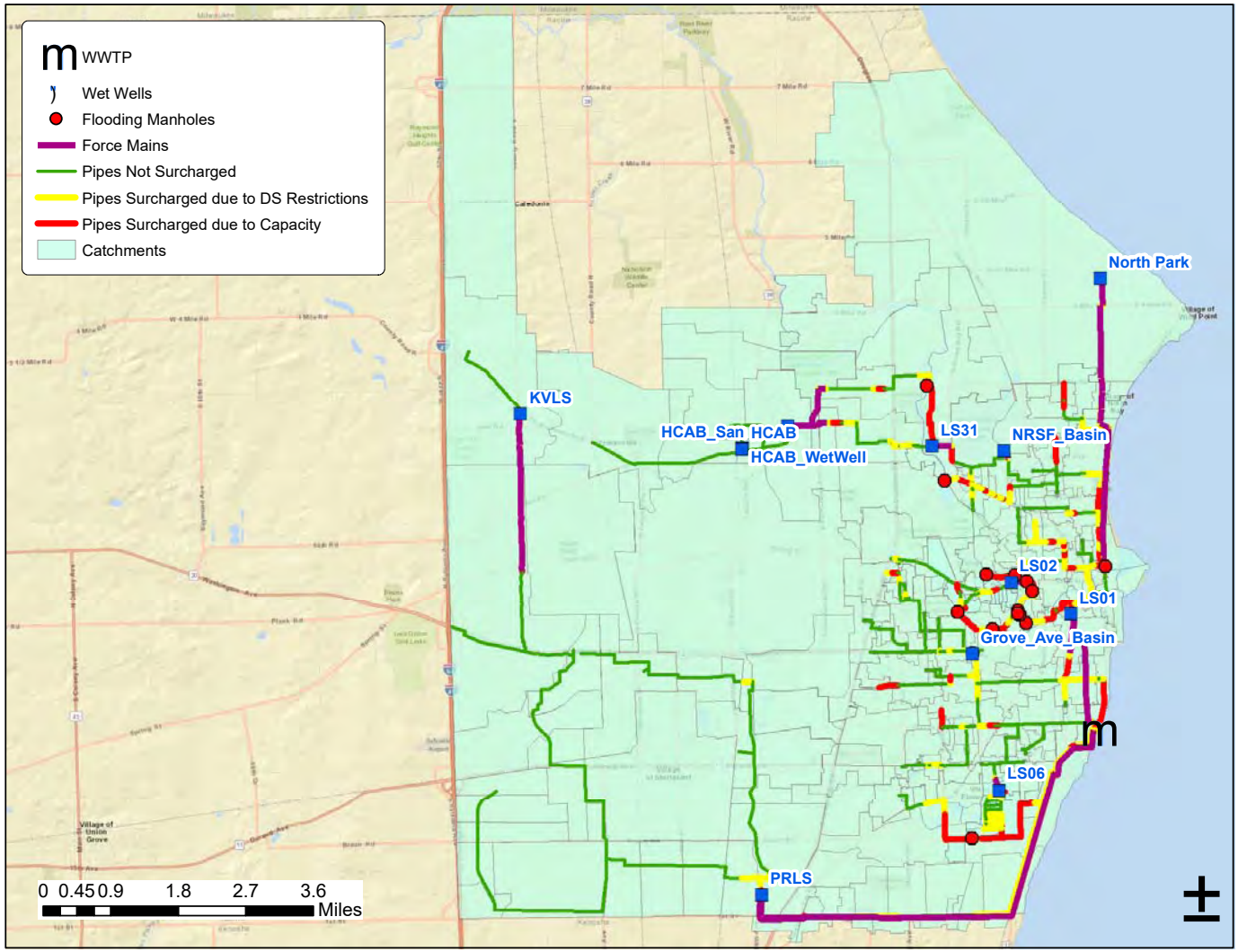
Collection System Performance – 5-Year, 6-Hour Storm, 2040 Design Condition



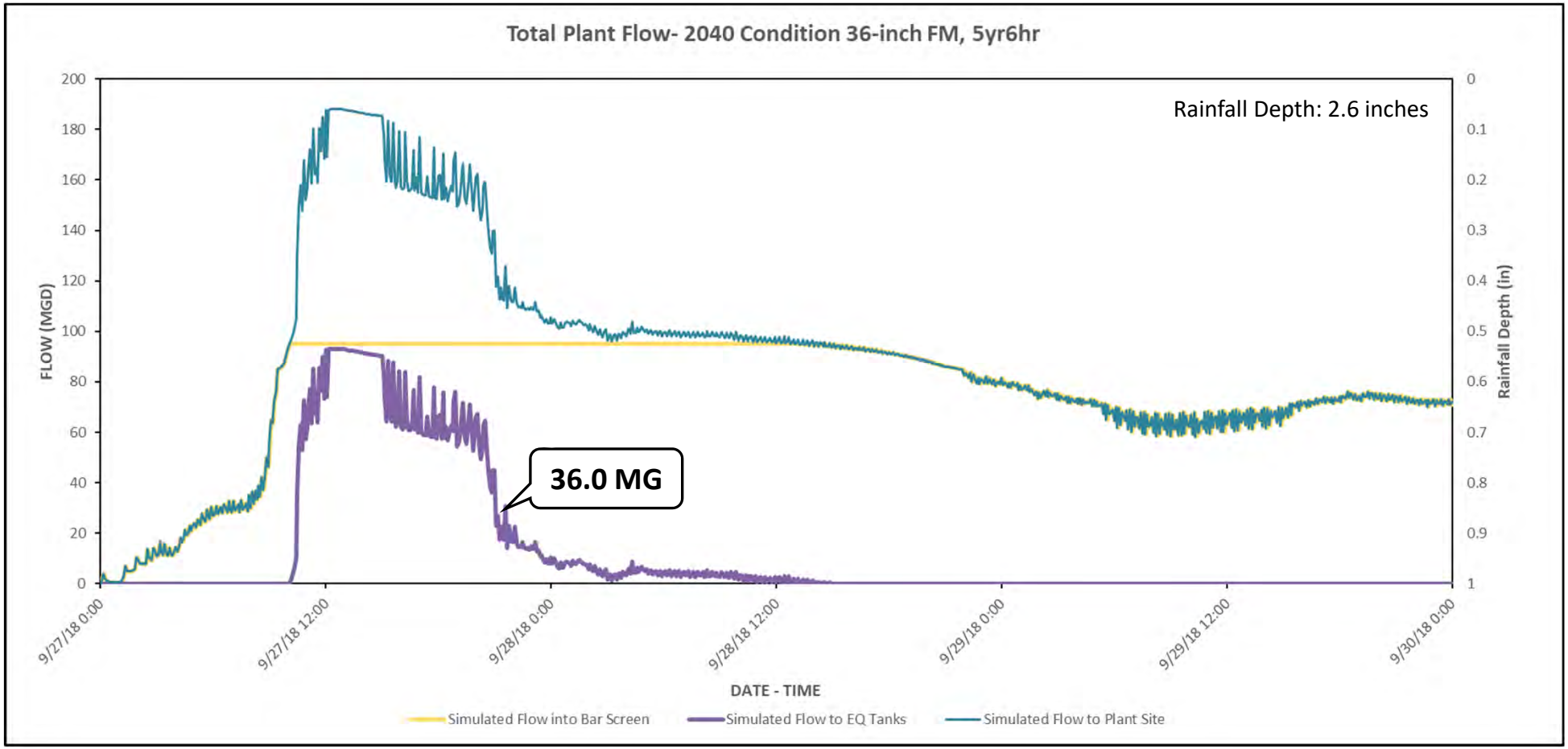
Predicted Flows into WWTP - 5-Year, 6-Hour Storm, 2040 Design Condition, 95 MGD



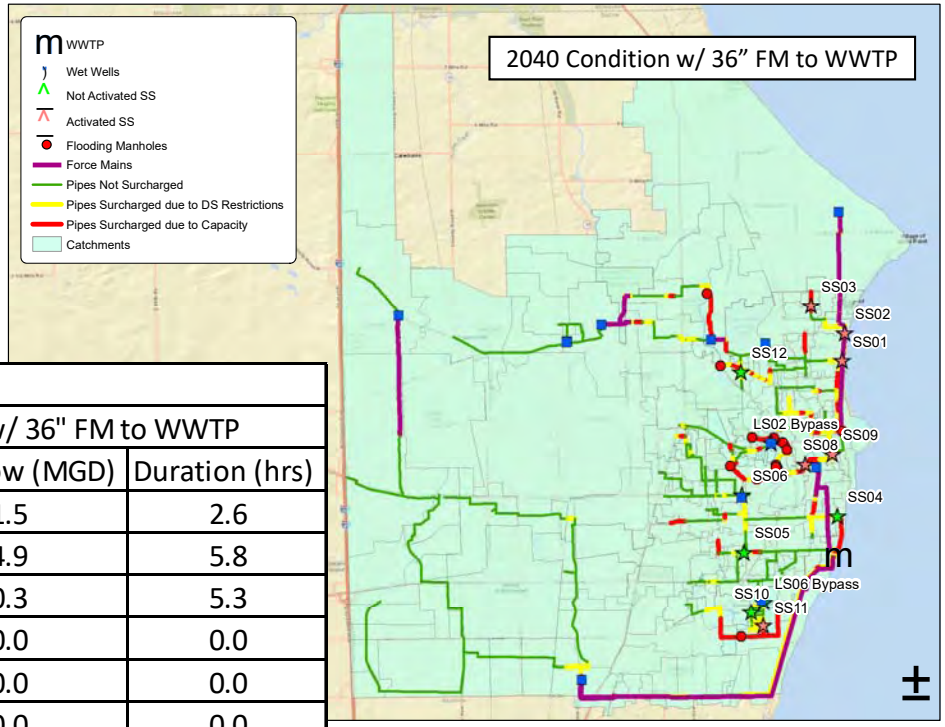
Collection System Performance – 5-Year, 6-Hour Storm, 2040 Design Condition w/ 36-inch FM to WWTP



Predicted Flows into WWTP - 5-Year, 6-Hour Storm, 2040 Condition w/ PRLS & 36-inch FM to WWTP, 95 MGD



Safety Sites Overflow Stats – 2040 Design Condition



	5-Year, 6-Hour Storm					
	2040 Condition w/o 36" FM to WWTP			2040 Condition w/ 36" FM to WWTP		
Safety Sites	Volume (MG)	Peak Flow (MGD)	Duration (hrs)	Volume (MG)	Peak Flow (MGD)	Duration (hrs)
SS01	0.1	1.5	2.6	0.1	1.5	2.6
SS02	0.7	4.9	5.8	0.7	4.9	5.8
SS03	0.0	0.3	5.3	0.0	0.3	5.3
SS04	0.0	0.0	0.0	0.0	0.0	0.0
SS05	0.0	0.0	0.0	0.0	0.0	0.0
SS06	0.0	0.0	0.0	0.0	0.0	0.0
SS08	1.0	6.5	7.6	1.0	6.5	7.6
SS09	0.7	4.3	5.9	0.7	4.4	5.9
SS10	0.0	0.0	0.0	0.0	0.0	0.0
SS11	0.6	1.8	9.3	0.5	1.7	8.7
SS12	0.0	0.0	0.0	0.0	0.0	0.0
LS02 Bypass	0.0	0.0	0.0	0.0	0.0	0.0
LS06 Bypass	0.0	0.0	0.0	0.0	0.0	0.0

Alternatives – Target Areas

Interceptor Between LS01 & LS02
- Storage at LS01
- In-line/Parallel Storage on Water St
- Interceptor Upsizing

Michigan Blvd
- LS01 Storage
- Lakeview Park Storage
- Interceptor Upsizing
- North Park FM Extension

Extend LS01 West FM to Relieve Downstream Interceptors

CNH Site
- Storage
- PR FM

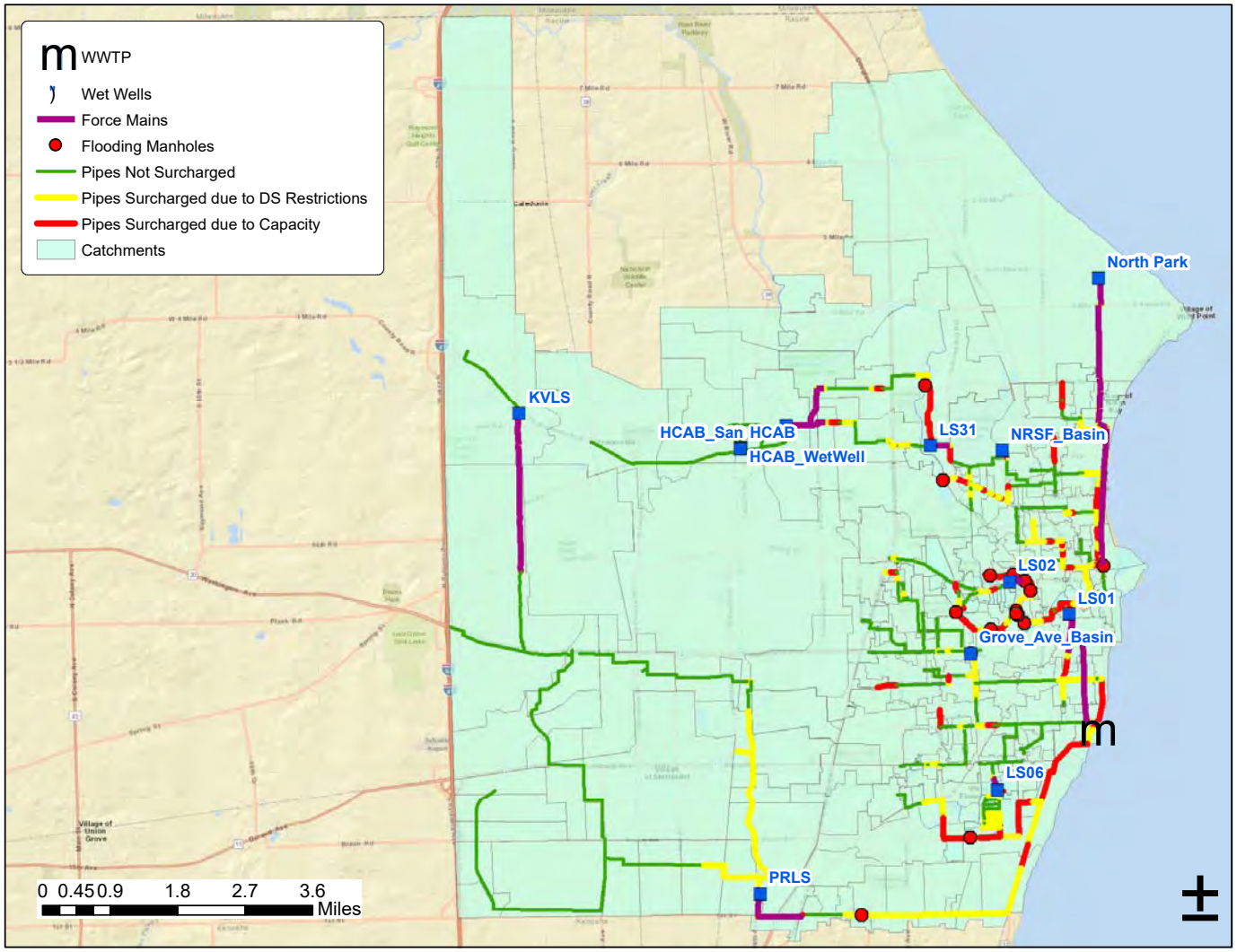
LS31 Upstream and Downstream Interceptors

Osbourne/Kinzie Interceptor
- In-line/Parallel Storage at Washington Park

Chicory Road Interceptor

LaSalle Sewer Upsizing

2040 Design Condition - 5-Year, 6-Hour Storm



Minutes

Meeting name
RWWU Technical Advisory Committee 8

Meeting date
01April 20

Attendees
See attendance sheet- attached

Time
1:30 PM

Location
Virtual Teams Meeting

AECOM project number
60554970

Prepared by
Mike Zapinski

Ref	Action	Responsible	Due by	Status
01	Subject of meeting is the slide deck sent to TAC members on March 25, 2020	---	---	---
02	WWTP Upgrades and Revisions Bryan Lewis presented the major projects under consideration. Noted that projects are being assigned 3 priority levels: Correct Immediate Deficiencies Improvements to Address Future needs Need Further Evaluation Keith Haas addressed the need to identify some projects that may qualify for stimulus funding. These could include: • Biogas cogeneration system including new electrically driven blowers • Additional primary influent channel for redundancy • UV equipment replacement • Belt press filtrate equalization Mount Pleasant has $3MM of work ready to go. Terry McCarthy asked if the use of the CNH property is still in the plan. It is included, proposed as a satellite plant if long-term needs require it.			
03	Conveyance System Model Review Eric Bartlein led our presentation of the conveyance system model. Dan Snyder: Are the flooded nodes on the MtPleasant-Sturtevant interceptor really flooded? Eric: will check, probably not.	---	---	---

Ref	Action	Responsible	Due by	Status
	Tom Ludwig: Caledonia adding more storage to Rivers Bend. Caledonia's peak may increase to 20 MGD. Be sure the second forcemain is modelled. Confirmed that peak flows to WWTP are decreased in 2040 compared to 2020 with the addition of the Pike River storage. Dan S recommended that surcharge be defined more clearly- 2 inches is classified the same as 10 feet currently. Also, would like to see key points labeled on the interceptor profiles to orient the reader. Dan S and Tom Ludwig felt that more attention should have been paid on how the conveyance system surcharges may affect local collector systems. Central Racine Area- John Rooney acknowledged that some laterals are tied to interceptors. Surcharge may affect some basements. Team discussed the concept of acceptable surcharge. Eric had to modify weir elevations to get the storage at LS02 to activate in model runs. John LaPointe added that AECOM will look at the potential for I/I reduction to help the area in the SS-08 sewershed. Chicory Road- Dan S asked if the storage could be moved upstream to help alleviate surcharge.			
04	Next Meetings An April TAC meeting to further discuss the conveyance model will be scheduled.	AECOM	April 8	---

Racine Wastewater Utility
Facilities Plan
Technical Advisory Committee

March 2020 Information

March 2020

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Treatment Plant

Treatment Plant Major Issues

Plant Area	Description
Equalization	Upgrades to improve O&M and peak flow management
Preliminary Treatment	Minor improvements
Primary Treatment	Access and equipment upgrades
Secondary Treatment	New aeration blower system; RAS/WAS improvements
Phosphorus Removal	Retain existing; Bio-P is feasible with pros and cons.
Anaerobic Digestion	Cover and roofing improvements
Solids Management	Piping upgrades.
Digester Gas System	New biogas conditioning and CHP System
Disinfection	UV equipment replacement
WWTP Facilities	Misc. upgrades to buildings, HVAC, roofs; CNH site.

Facility Plan Needs

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Facility Plan Needs

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Facility Plan Needs & Alternatives

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Facility Plan Needs

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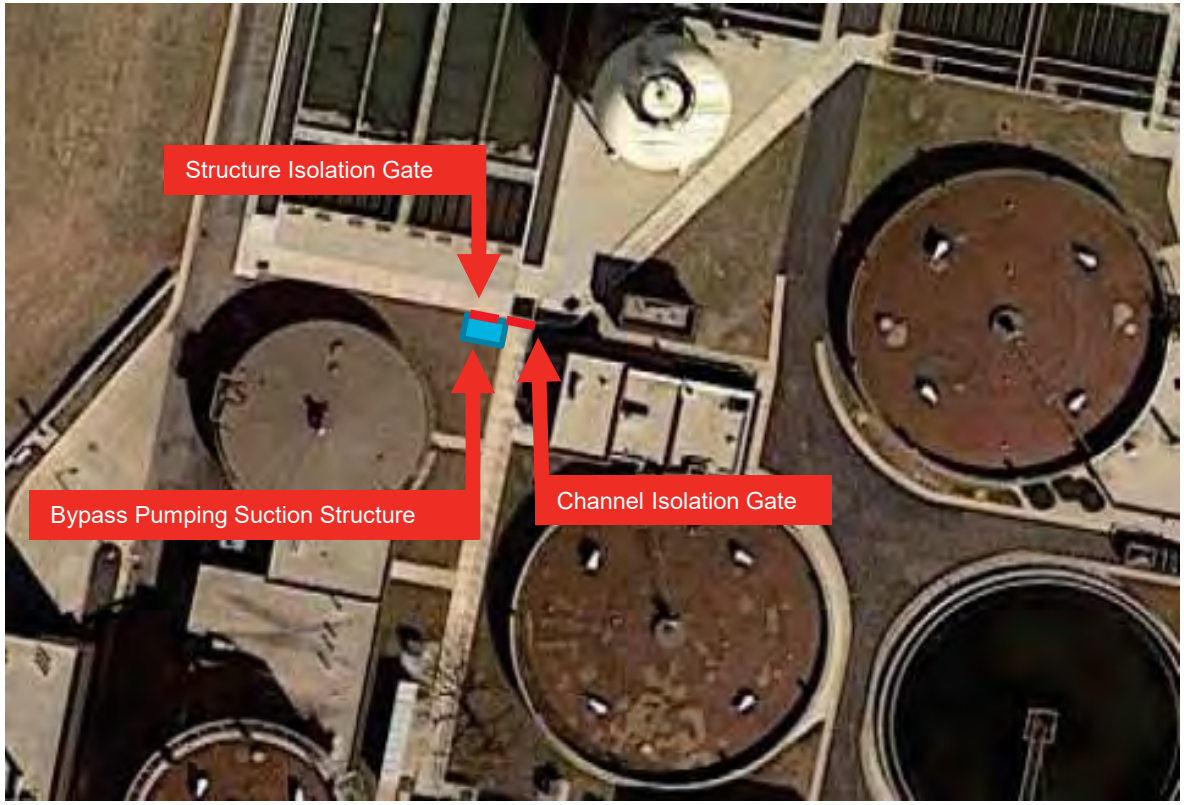
Facility Plan Needs



Primary Effluent Channel Bypass Facilities

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Facility Plan Alternatives

Typical Half–Barrel Covers –
Cover for Effluent Junction Chamber

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Facility Plan Alternatives

BFP Filtrate Storage Tank Location:
Volume - 380,000 gallons

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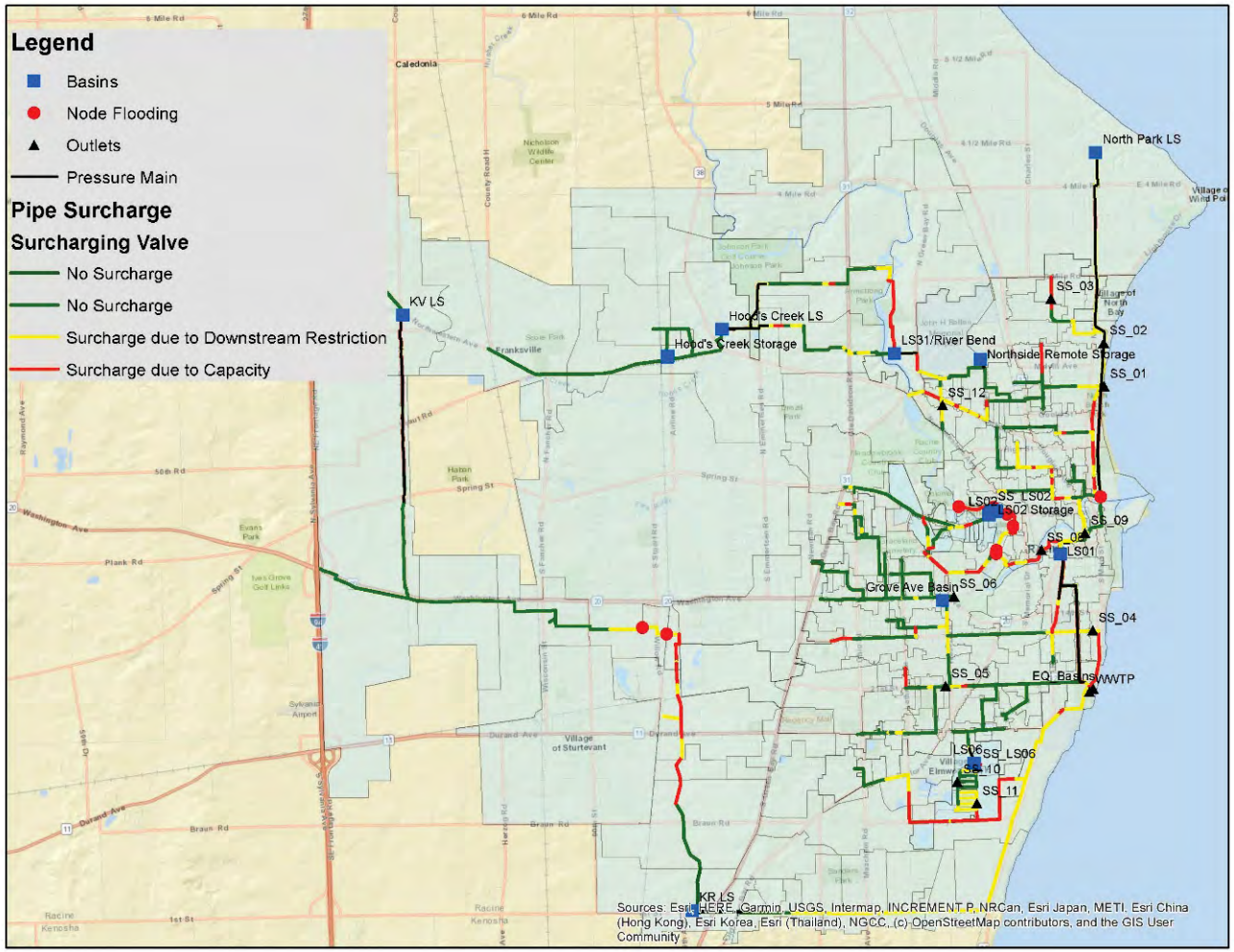
Collection System

2020 Condition
(DWF from I-94 Catchments only)



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Safety Site Discharging

2020 Condition

To Node	Qmax [cfs]	Qmax MGD	Volume [ft3]	Volume MG
WWTP EQ Basins	70.795	45.7562	1826083.5	13.6609307
SS_09_OUT	1.865	1.20539	15783	0.11807262
SS_08_OUT	7.844	5.06973	85765.7	0.6416132
SS_01_OUT	0.823	0.53192	2692.2	0.02014035
SS_02_OUT	6.588	4.25796	72546.3	0.54271887
SS_04_OUT	0.001	0.00065	176.6	0.00132114
SS_11_OUT	1.932	1.24869	46291.5	0.34630671
SS_03_OUT	0.17	0.10987	1712.3	0.01280972
SS_12_OUT	0.001	0.00065	320.6	0.00239841
SS_05_OUT	0.001	0.00065	418.6	0.00313155
SS_LS06_OUT	0.001	0.00065	310.9	0.00232584
SS_10	0	0	22	0.00016458
SS_06	0.003	0.00194	985.1	0.00736953
SS_LS02	0	0	0	0

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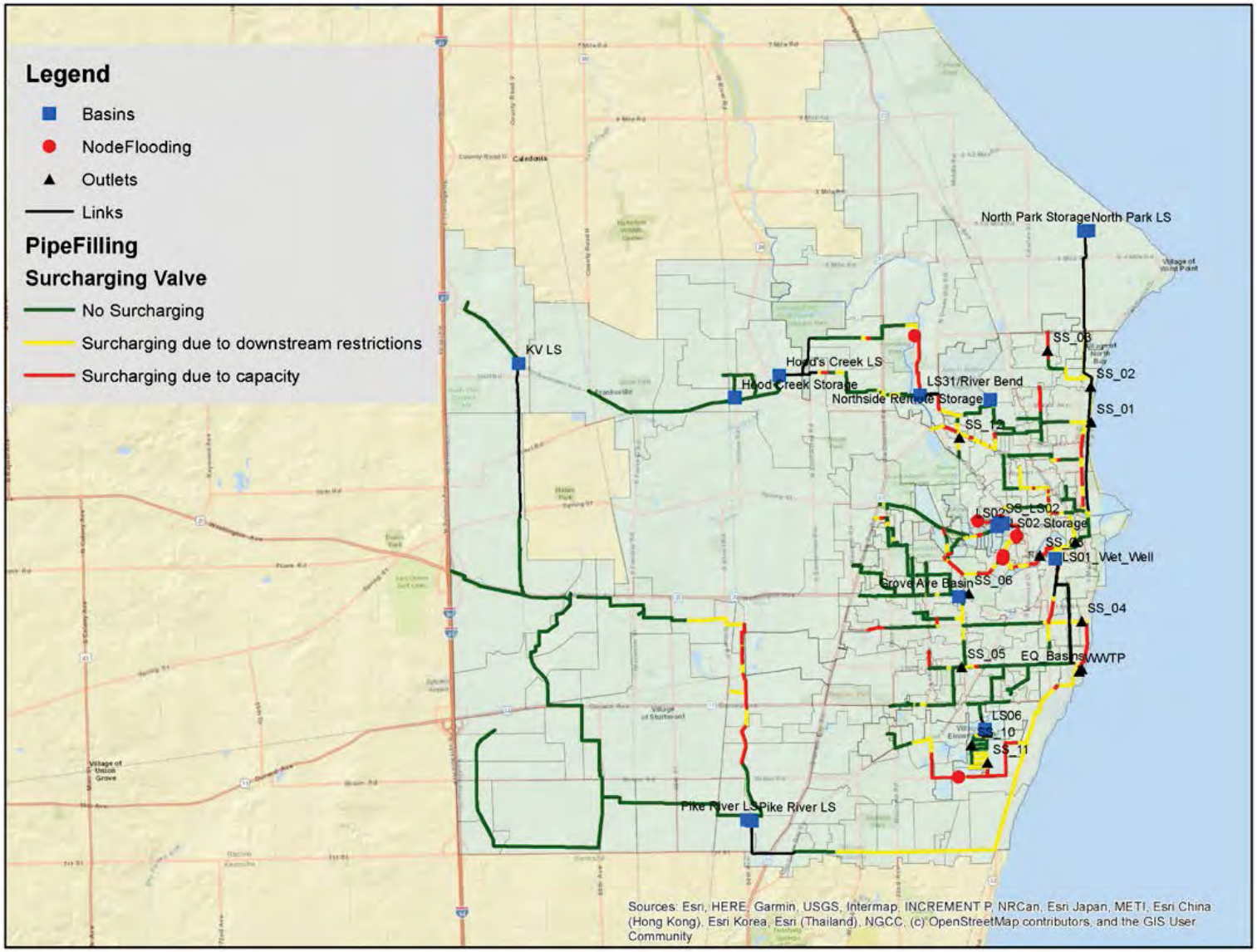
2030 Condition

11 MG Pike River (PR) Storage, 3.5 MG North Park, and 3.0 MG at Hood's Creek.

Due to the recalibration at KR with the I-94 catchments only providing DWF (no WWF during the rain event), WWF contributions along the MP interceptor increased which shows surcharging even with the new TID 5 interceptor redirecting flows from the I-94 area.



2030 Condition

11 MG Pike River (PR) Storage, 3.5 MG North Park, and 3.0 MG at Hood's Creek.

Safety Site	Qmax MGD	Volume MG
EQ Basins	57.1968	21.28
SS_09	1.1544	0.07453
SS_08	4.30301	0.70756
SS_01	2.94447	0.24559
SS_02	5.46581	0.86865
SS_04	0.00065	0.00132
SS_11	1.77521	0.53842
SS_03	0.31912	0.04377
SS_12	0.00065	0.0024
SS_05	0.00065	0.00313
SS_LS06	0.00065	0.00233
SS_10	0	0.00016
SS_06	0.00194	0.0074
SS_LS02	0	0

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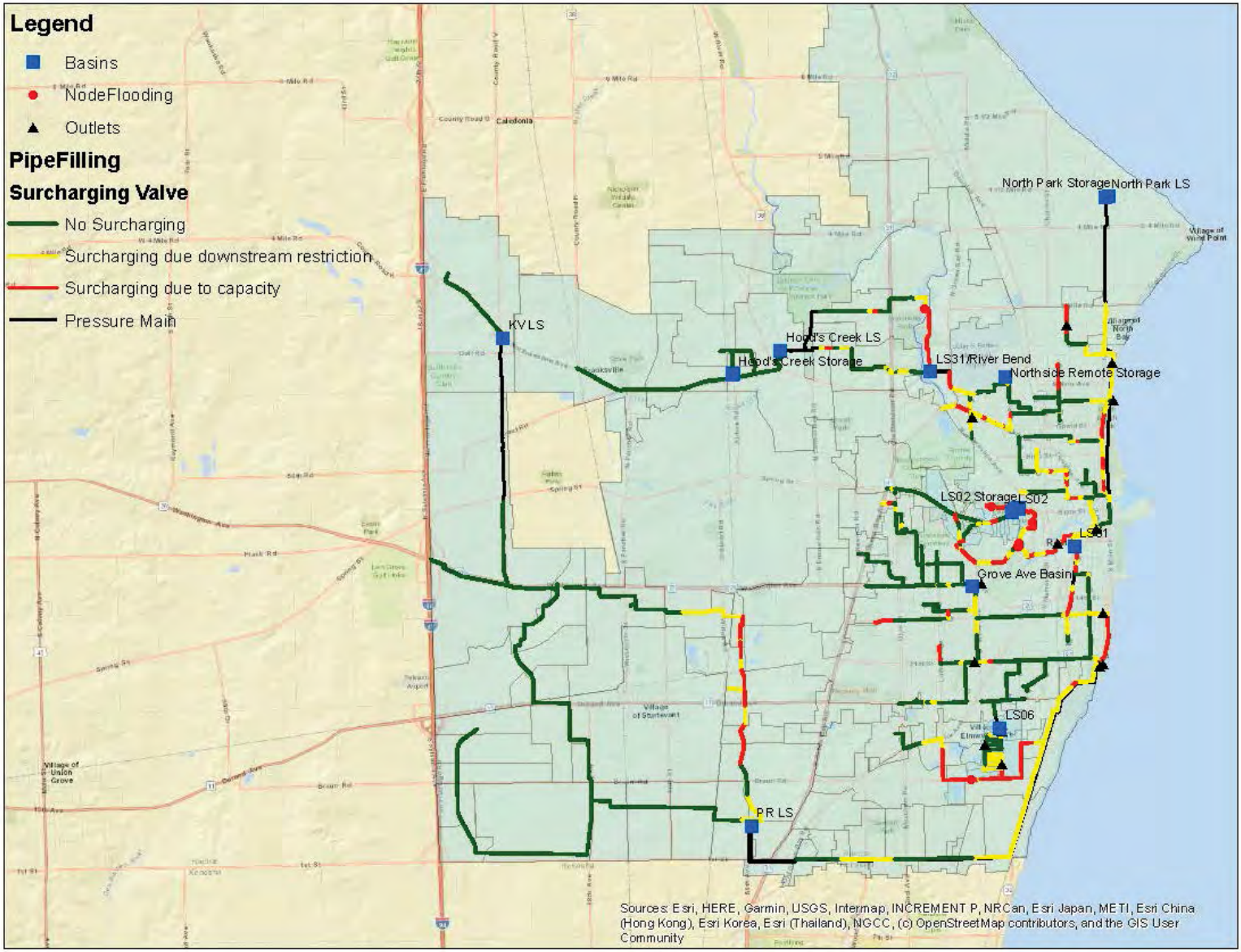
2030 Condition

PR FM to WWTP, 3.5 MG North Park, and 3.0 MG at Hood's Creek.



2030 Condition

PR FM to WWTP, 3.5 MG North Park, and 3.0 MG at Hood's Creek.

Safety Site	Qmax [cfs]	Qmax MGD	Volume [ft3]	Volume MG
EQ_Outlet	129.122	83.4128	3472460	25.9775
SS_09	1.691	1.09239	9092.7	0.06802
SS_08	6.389	4.12729	92257.6	0.69018
SS_01	2.026	1.3088	10392.8	0.07775
SS_02	7.557	4.88182	97894	0.73235
SS_04	0.001	0.00065	176.6	0.00132
SS_11	2.686	1.73516	69527	0.52013
SS_03	0.494	0.31912	5851.5	0.04378
SS_12	0.001	0.00065	320.6	0.0024
SS_05	0.001	0.00065	418.6	0.00313
SS_LS06	0.001	0.00065	310.9	0.00233
SS_10	0	0	22	0.00016
SS_06	0.003	0.00194	994	0.00744
SS_LS02	0	0	0	0

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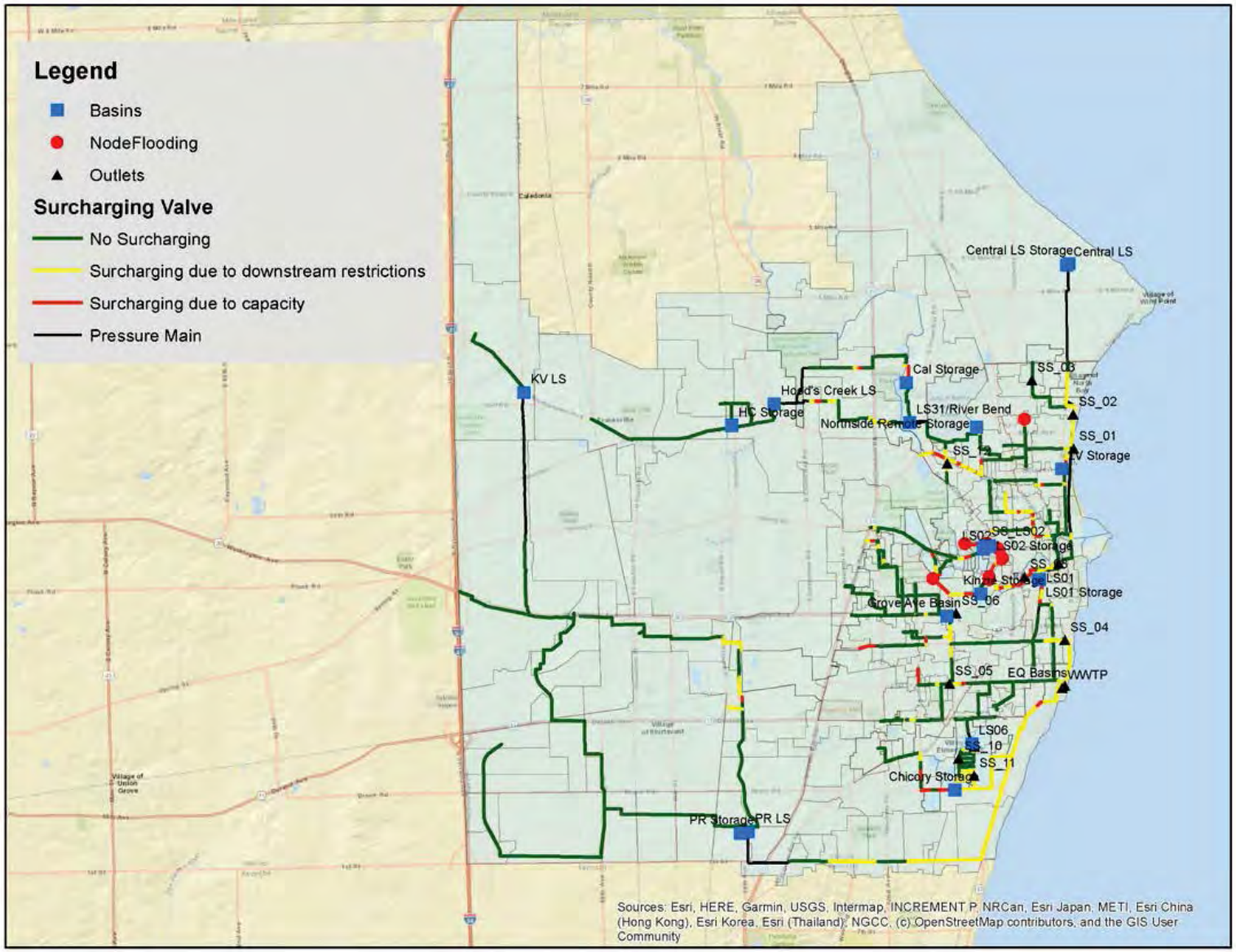
2040 Condition

- 3.5 MG Storage at North Park
- 3.0 MG Storage at Hoods Creek
- 11 MG Storage at PR
- 0.8 MG Storage at Lakeview Park
- 1.0 MG at River's Bend Park north of LS31
- 10 MG at LS01
- 1.0 MG on Kinzie east of Mound Cemetery
- Interceptor Upgrades
  - MPS Interceptor
  - Green Bay Road south of LS3
  - LaSalle St
  - Geneva St



2040 Condition

- 3.5 MG Storage at North Park
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- 11 MG Storage at PR
- 0.8 MG Storage at Lakeview Park
- 1.0 MG at River's Bend Park north of LS31
- 10 MG at LS01
- 1.0 MG on Kinzie east of Mound Cemetery
- Interceptor Upgrades
  - MPS Interceptor
  - Green Bay Road south of LS31
  - LaSalle St
  - Geneva St

Safety Site	Qmax MGD	Volume MG
SS_LS02	0	0.00107
SS_09	0.00065	0.00377
SS_08	3.71316	0.44177
SS_01	0	0.0006
SS_02	1.71794	0.14077
SS_04	0.00065	0.00132
SS_11	0	0.00035
SS_03	0	0.00022
SS_12	0.00065	0.0024
SS_05	0.00065	0.00313
SS_LS06	0.00065	0.00233
SS_10	0	0.00016
SS_06	0.00194	0.00741

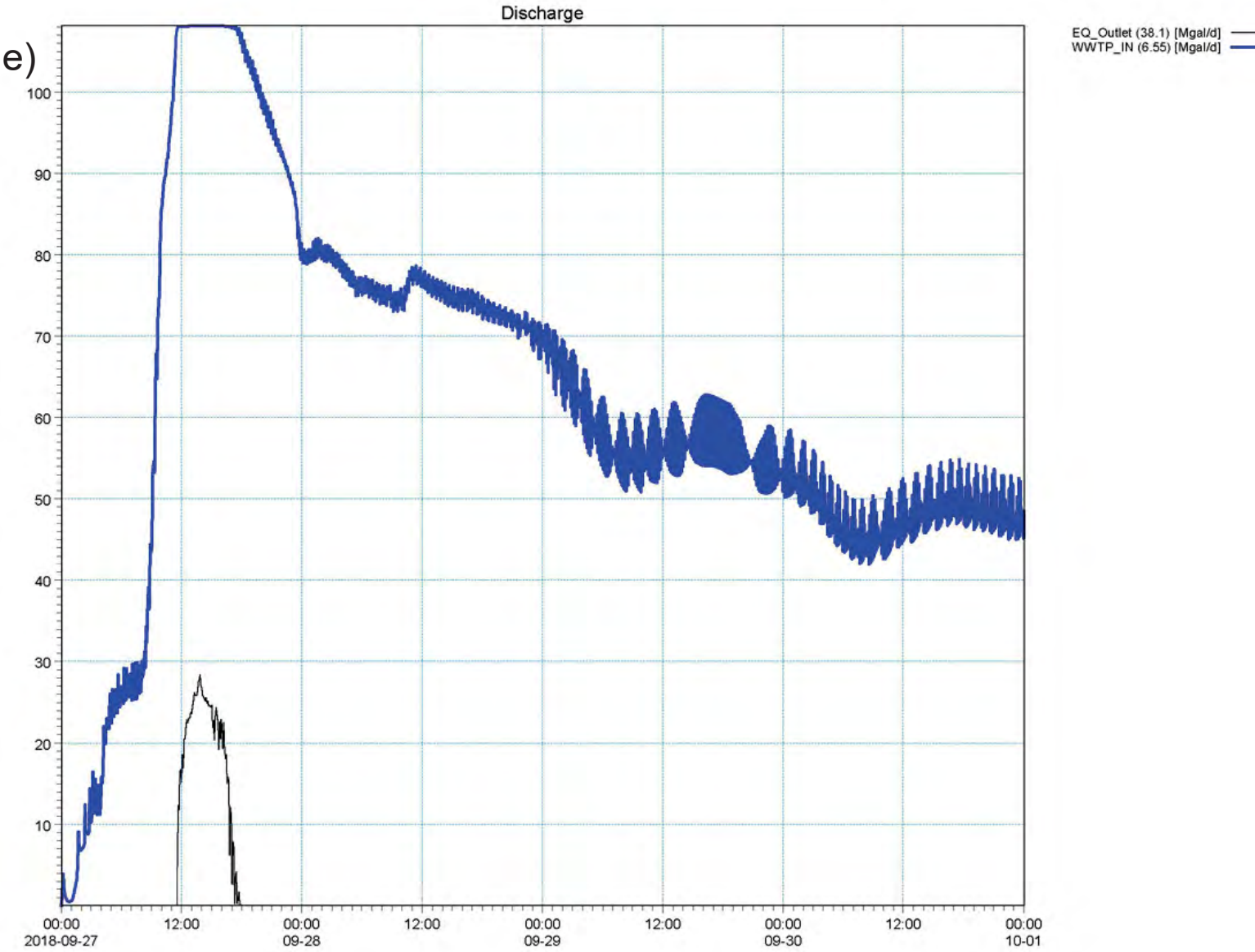
2040 Condition (PR Storage)

Discharge at the Plant
- Blue = WWTP
- Black = EQ Basins

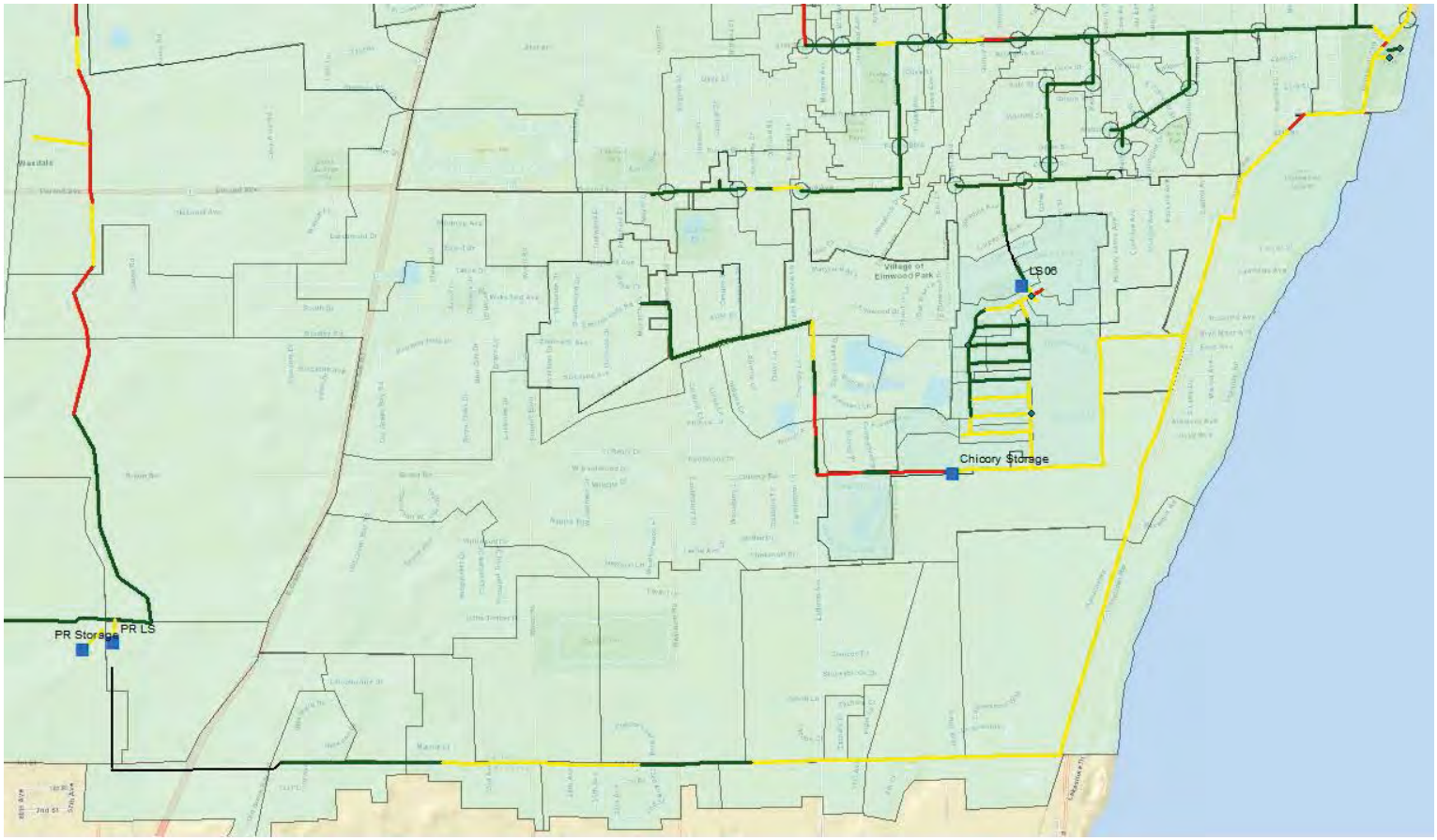
Peak Flows
- Approximately 29MGD to EQ Basins with the at 105 MGD
- Or 39 MGD to EQ Basins with the plant at 95 MGD

Volumes (95 MGD to WWTP)
- Approximately 7 MG to EQ Basins
- 243 MG to the Plant

Volumes (105 MGD to WWTP)
- Approximately 4.5 MG to EQ Basins
- 250 MG to the Plant



KR Interceptor with PR Storage – 11 MG



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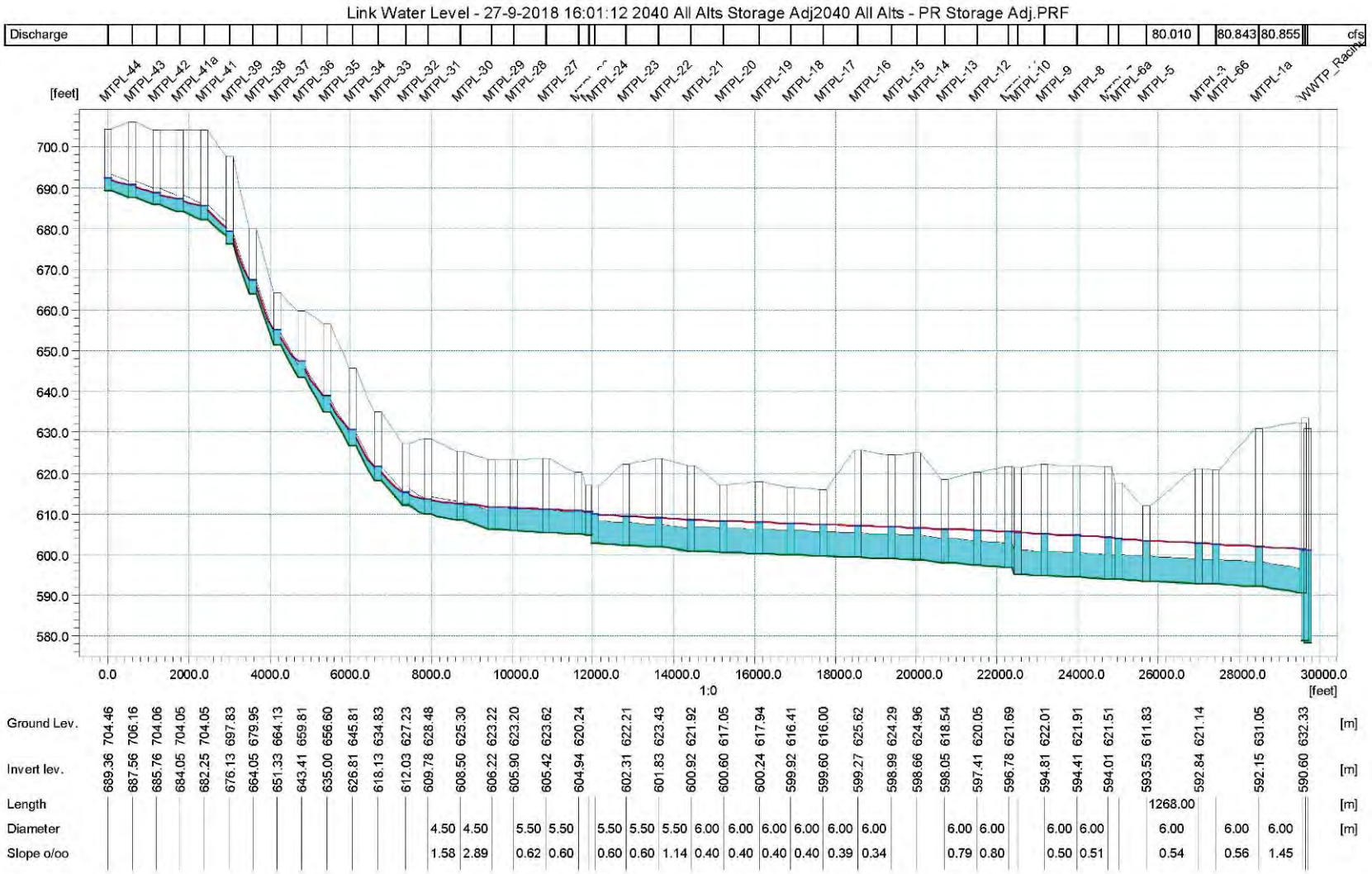
Link Water Level - 27-9-2018 16:01:12 2040 All Alts Storage Adj2040 All Alts - PR Storage Adj.PRF
Discharge
80.010
80.843
80.855
cfs
[feet]
MTPL-44
MTPL-43
MTPL-42
MTPL-41a
MTPL-41
MTPL-39
MTPL-38
MTPL-37
MTPL-36
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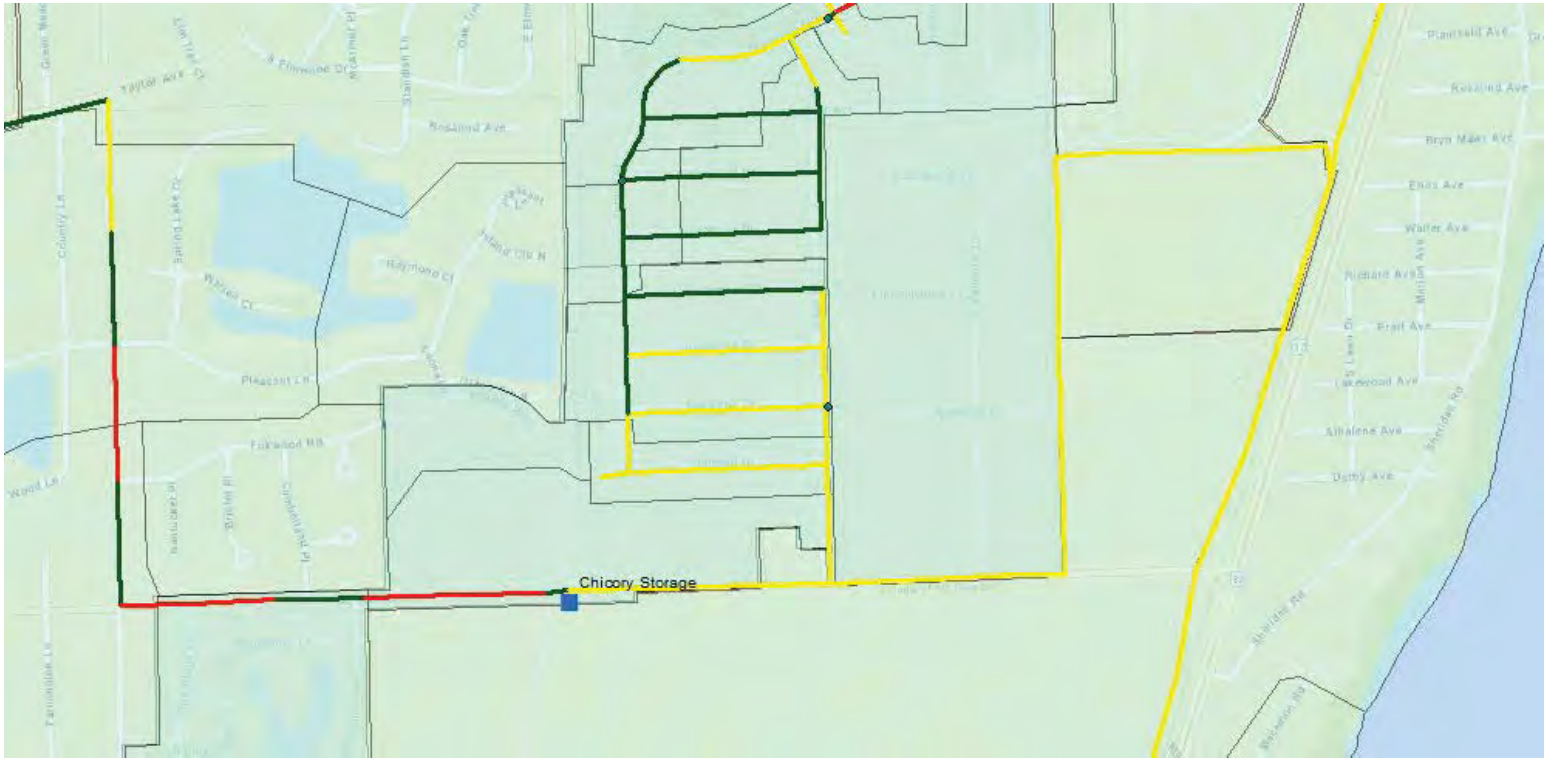
MTPL-10
MTPL-9
MTPL-8
MTPL-6a
MTPL-5
MTPL-3
MTPL-66
MTPL-1a
WWTP_Racine
700.0
690.0
680.0
670.0
660.0
650.0
640.0
630.0
620.0
610.0
600.0
590.0
580.0
0.0
2000.0
4000.0
6000.0
8000.0
10000.0
12000.0
14000.0
16000.0
18000.0
20000.0
22000.0
24000.0
26000.0
28000.0
30000.0
1:0
[feet]
Ground Lev. 704.46 706.16 704.06 704.05 704.05 697.83 679.95 664.13 659.81 656.60 645.81 634.83 627.23 628.48 625.30 623.22 623.20 623.62 620.24 622.21 623.43 621.92 617.05 617.94 616.41 616.00 625.62 624.29 624.96 618.54 620.05 621.69 622.01 621.91 621.51 611.83 621.14 631.05 632.33 [m]
Invert lev. 689.36 687.56 685.76 684.05 682.25 676.13 664.05 651.33 643.41 635.00 626.81 618.13 612.03 609.78 608.50 606.22 605.90 605.42 604.94 602.31 601.83 600.92 600.60 600.24 599.92 599.60 599.27 598.99 598.66 598.05 597.41 596.78 594.81 594.41 594.01 593.53 592.84 592.15 590.60 [m]
Length 1268.00 [m]
Diameter 4.50 4.50 5.50 5.50 5.50 5.50 5.50 6.00 6.00 6.00 6.00 6.00 6.00 6.00 6.00 6.00 6.00 6.00 6.00 6.00 [m]
Slope o/oo 1.58 2.89 0.62 0.60 0.60 0.60 1.14 0.40 0.40 0.40 0.40 0.39 0.34 0.79 0.80 0.50 0.51 0.54 0.56 1.45

Chicory Road Storage – 1 MG



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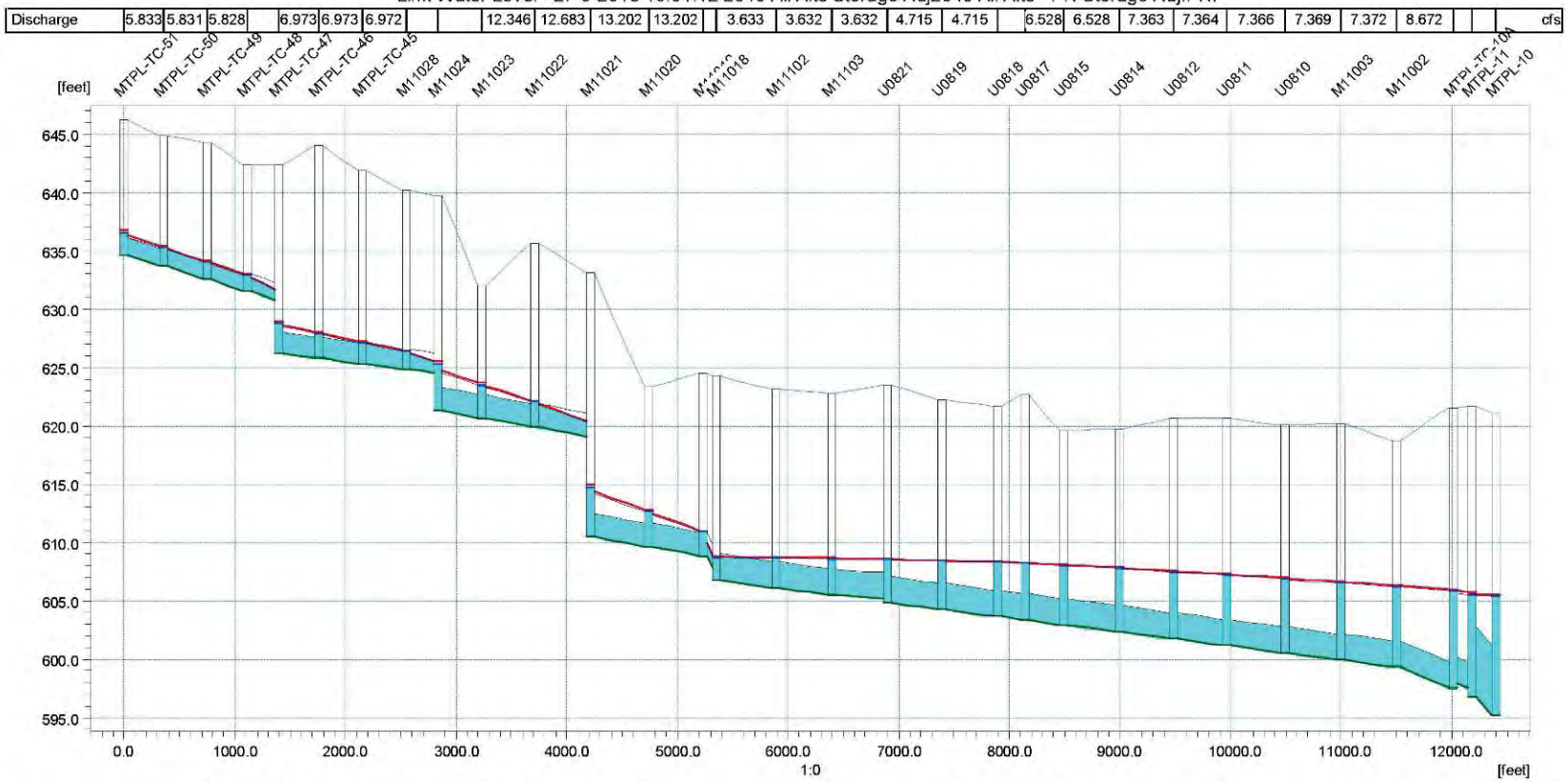
Link Water Level - 27-9-2018 15:01:12 2040 All Alts Storage Adj2040 All Alts - PR Storage Adj.PRF



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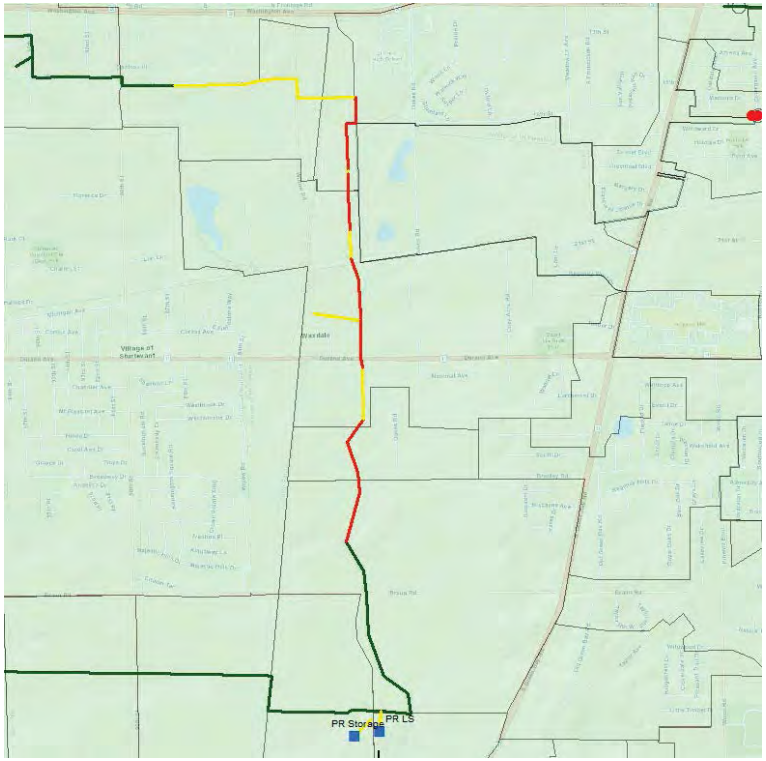
Mount Pleasant Interceptor



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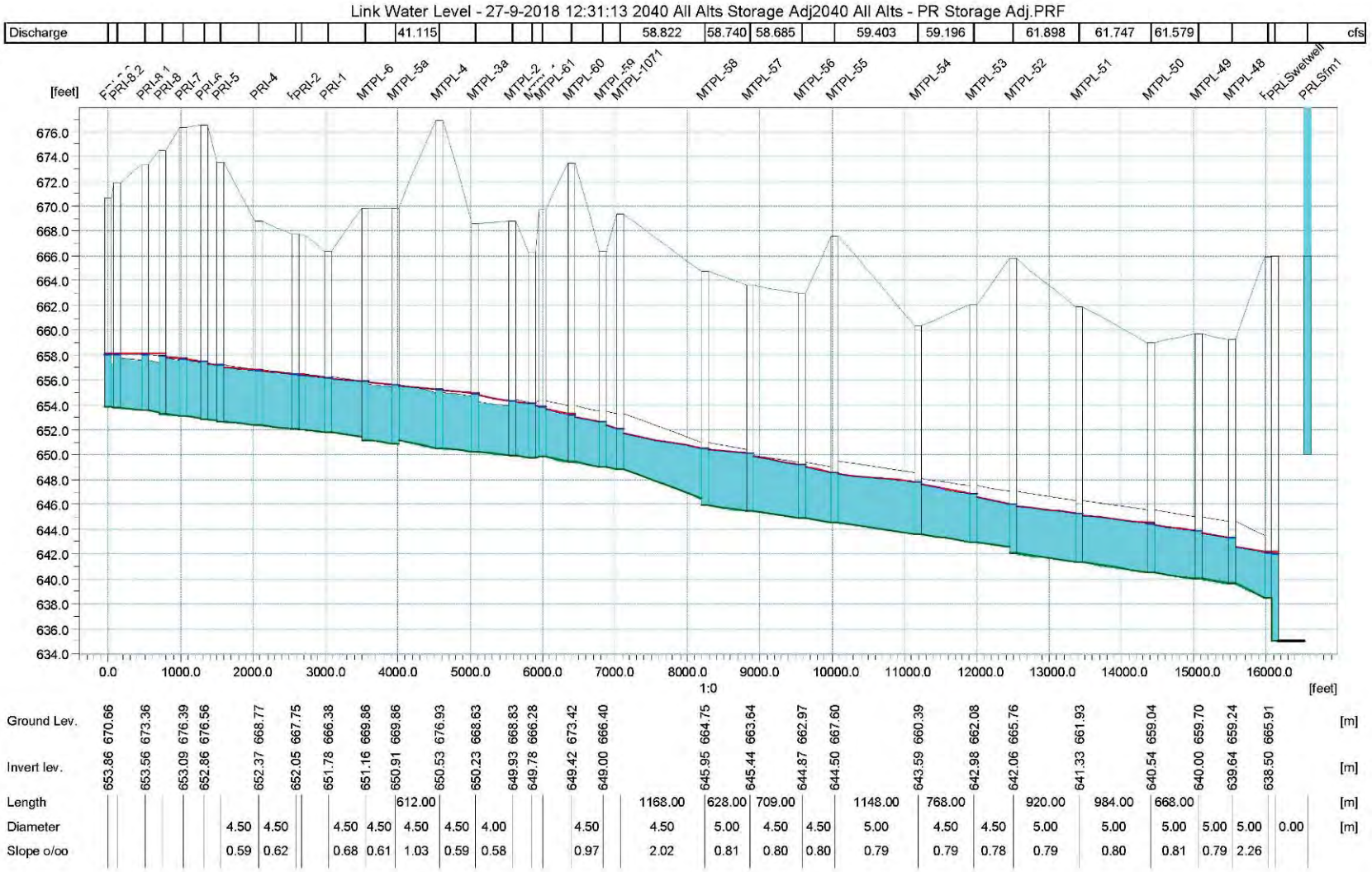
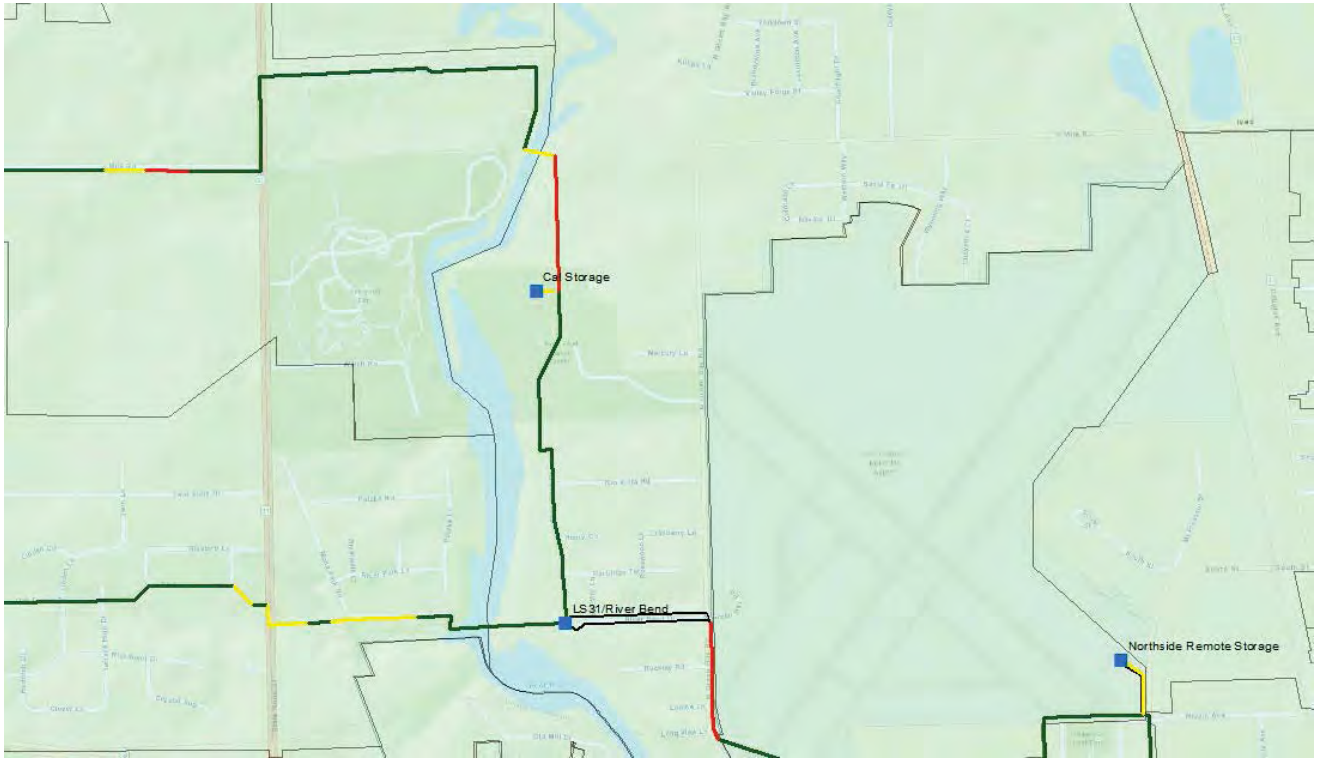
Link Water Level - 27-9-2018 12:31:13 2040 All Alts Storage Adj2040 All Alts - PR Storage Adj.PRF

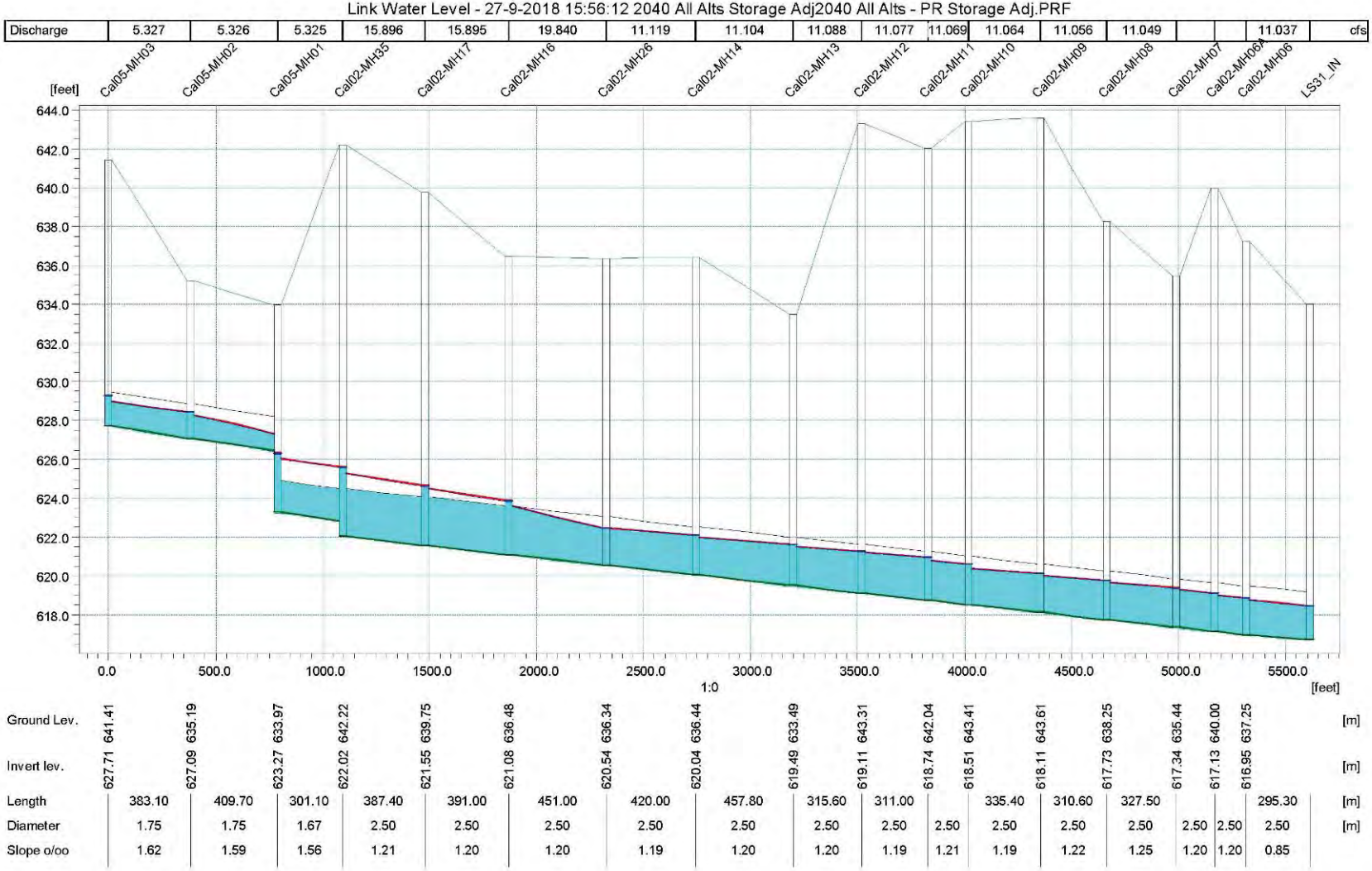


Caledonia Storage – 1 MG

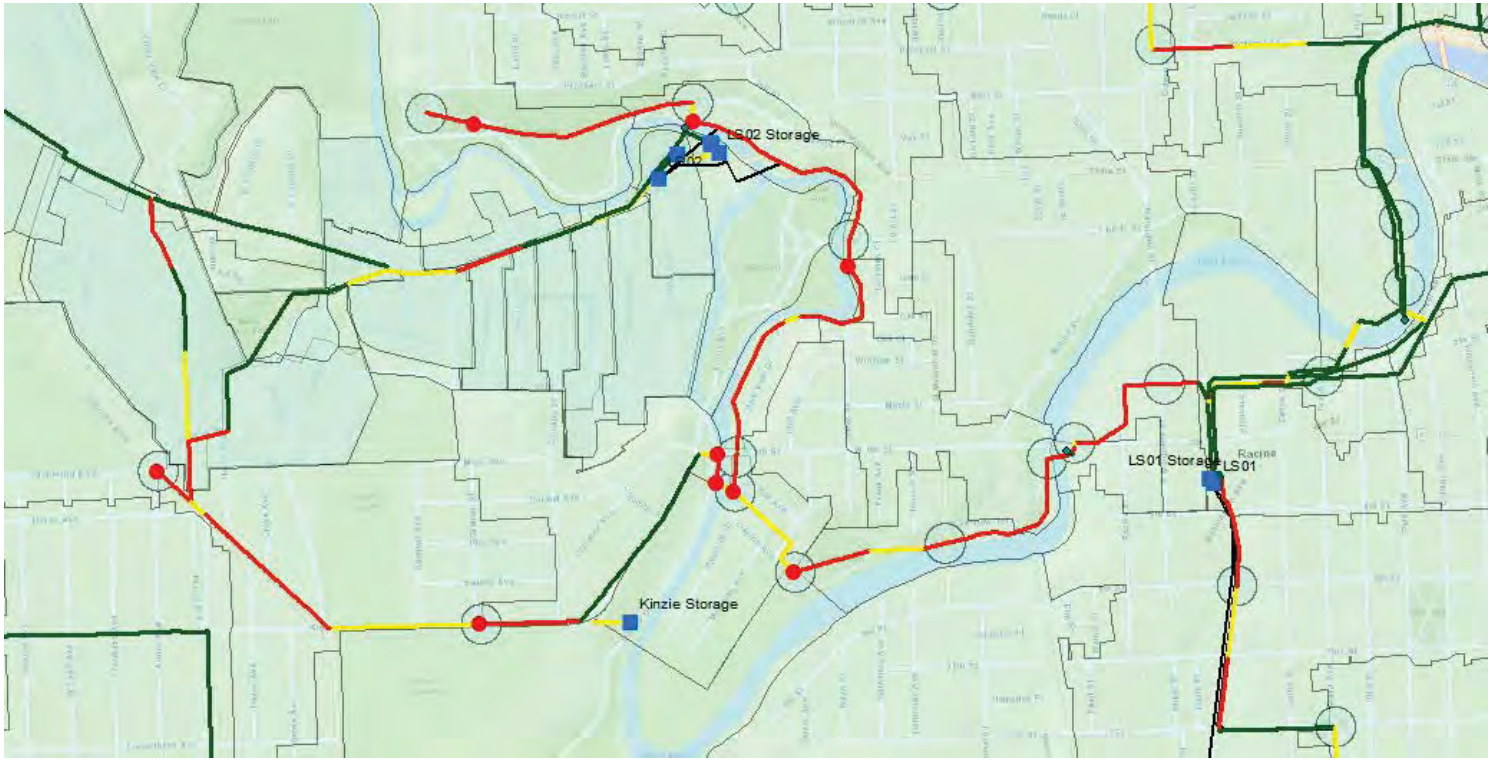


AECOM

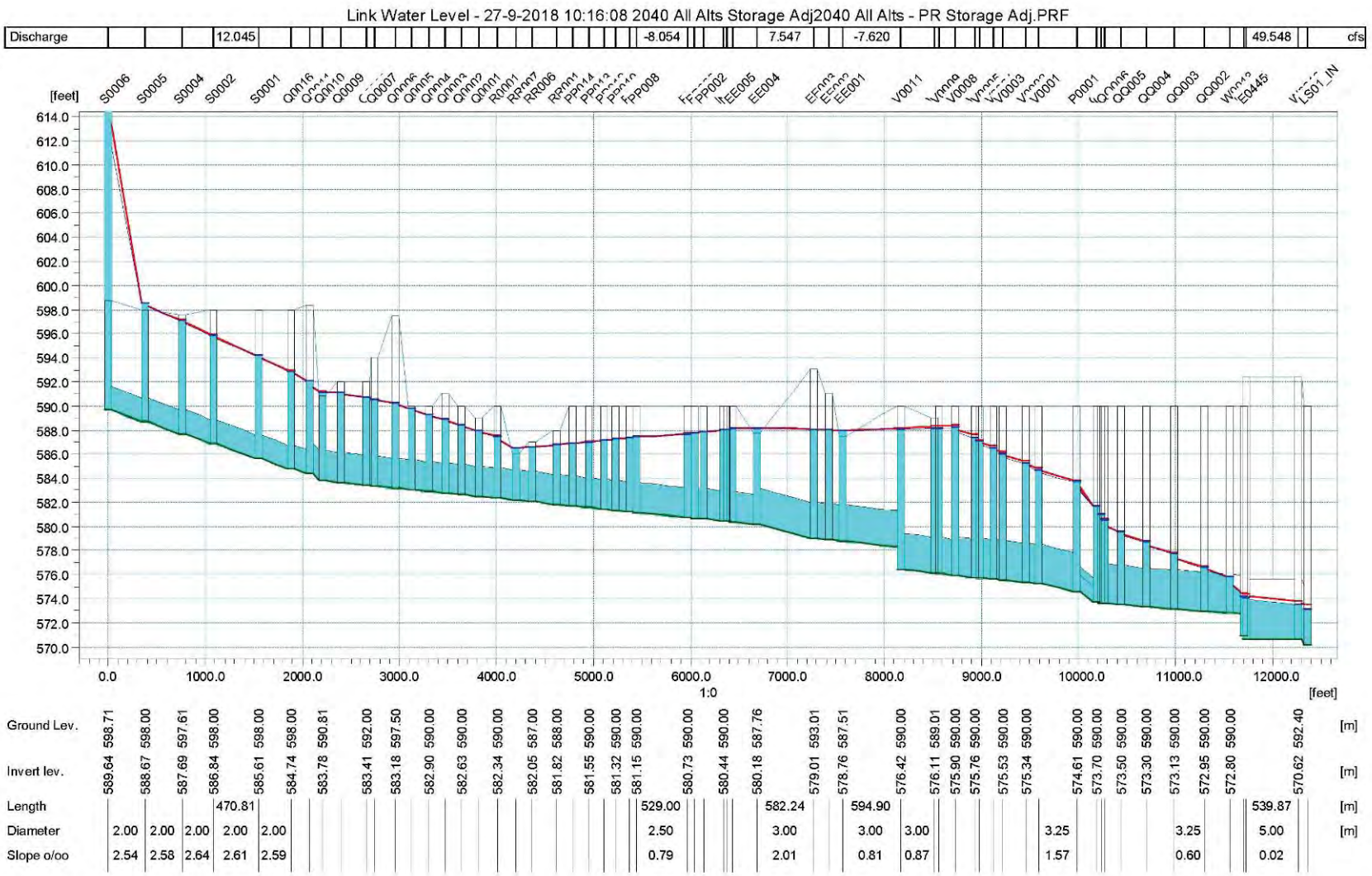
Link Water Level - 27-9-2018 15:56:12 2040 All Alts Storage Adj2040 All Alts - PR Storage Adj.PRF



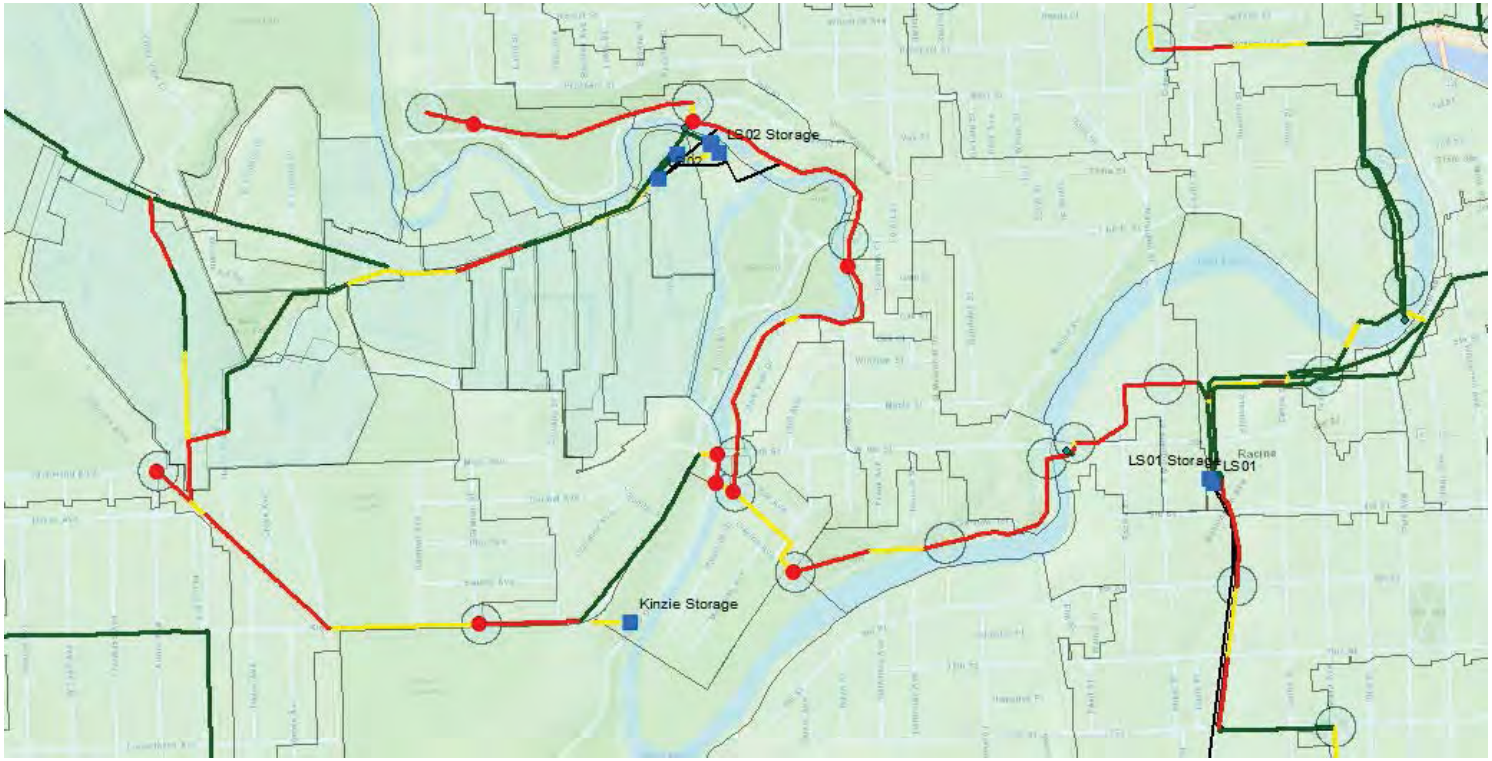
LS02 to LS01 Interceptor



AECOM


Link Water Level - 27-9-2018 10:16:08 2040 All Alts Storage Adj2040 All Alts - PR Storage Adj.PRF
Discharge
12.045
-8.054
7.547
-7.620
49.548
cfs
[feet]
614.0
612.0
610.0
608.0
606.0
604.0
602.0
600.0
598.0
596.0
594.0
592.0
590.0
588.0
586.0
584.0
582.0
580.0
578.0
576.0
574.0
572.0
570.0
0.0
1000.0
2000.0
3000.0
4000.0
5000.0
6000.0
7000.0
8000.0
9000.0
10000.0
11000.0
12000.0
1:0
[feet]
Ground Lev.
598.71 598.00 597.61 598.00 598.00 598.00 590.81 592.00 597.50 590.00 590.00 590.00 587.00 588.00 590.00 590.00 590.00 590.00 590.00 590.00 590.00 587.76 593.01 587.51 590.00 589.01 590.00 590.00 590.00 590.00 590.00 590.00 590.00 590.00 590.00 590.00 590.00 592.40
[m]
Invert lev.
589.64 588.67 587.69 586.84 585.61 584.74 583.78 583.41 583.18 582.90 582.63 582.34 582.05 581.82 581.55 581.32 581.15 580.73 580.44 580.18 579.01 578.76 576.42 576.11 575.90 575.76 575.53 575.34 574.61 573.70 573.50 573.30 573.13 572.95 572.80 570.62
[m]
Length
470.81 529.00 582.24 594.90 539.87
[m]
Diameter
2.00 2.00 2.00 2.00 2.00 2.50 3.00 3.00 3.00 3.25 3.25 5.00
[m]
Slope o/oo
2.54 2.58 2.64 2.61 2.59 0.79 2.01 0.81 0.87 1.57 0.60 0.02

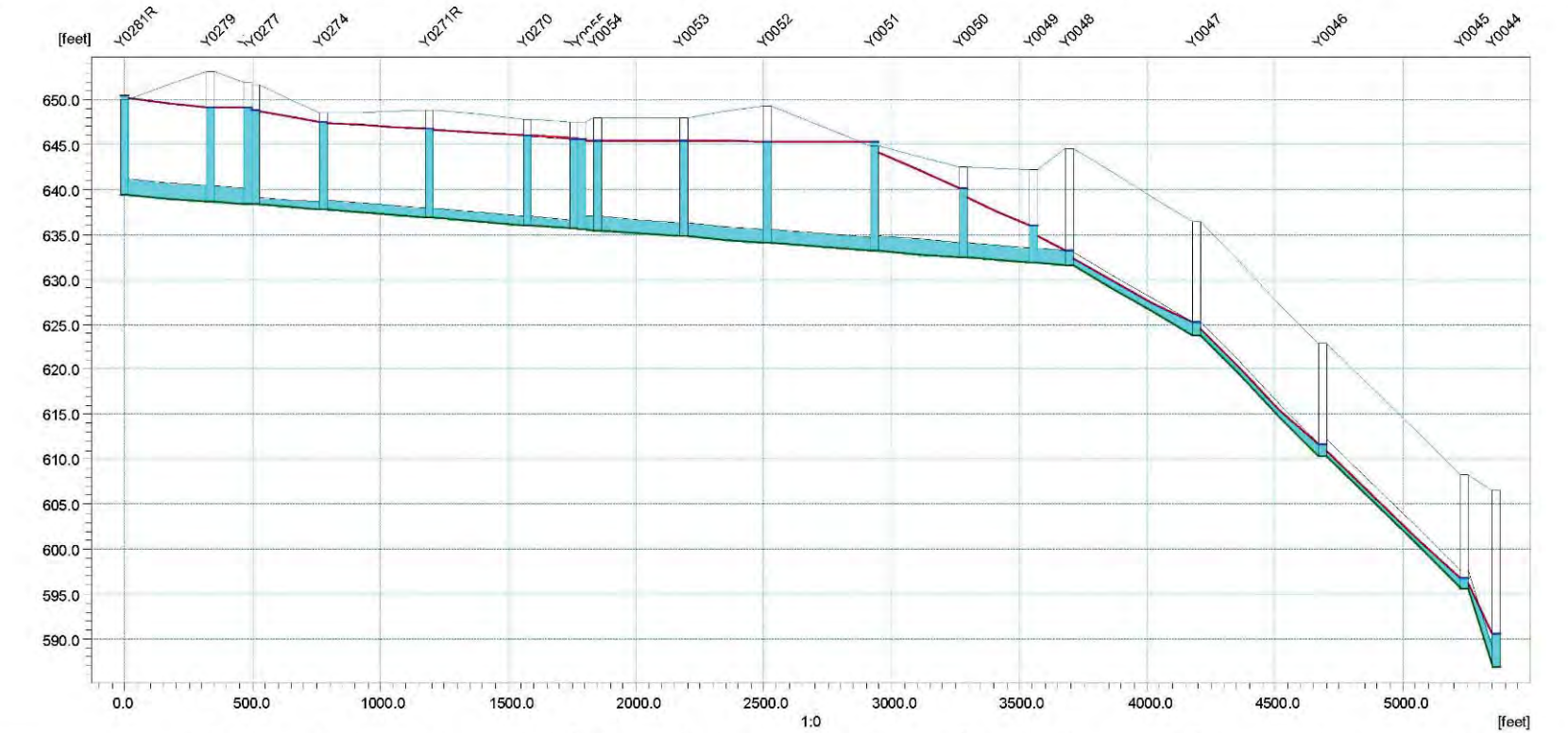
Kinzie Interceptor Storage – 1MG



AECOM

Link Water Level - 27-9-2018 10:56:11 2040 All Alts Storage Adj2040 All Alts - PR Storage Adj.PRF

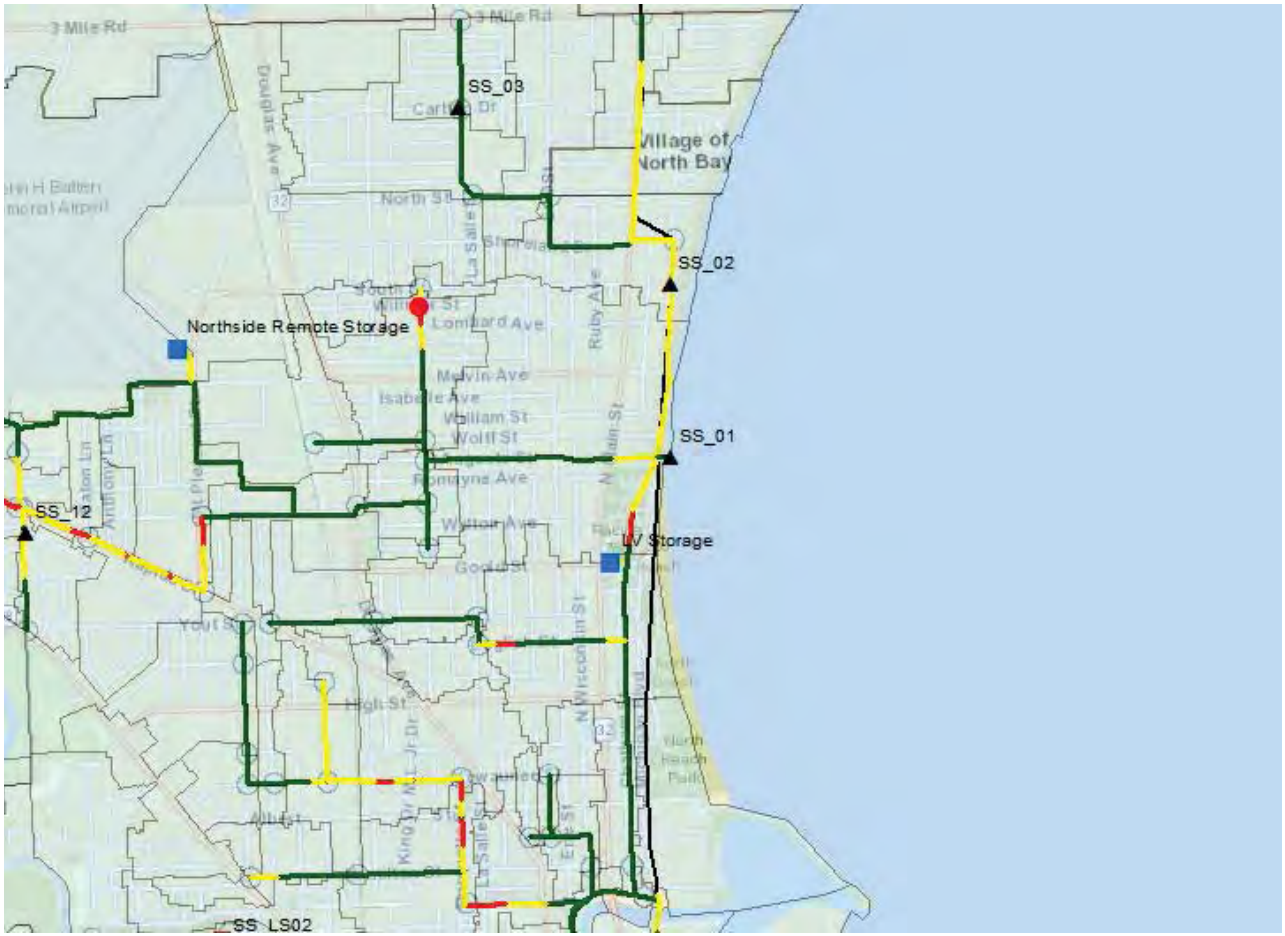
Discharge	9.443		1.592	1.592	1.592	1.592		1.591	1.591	1.591	16.477	16.477		9.064	9.064	9.064		cfs



Ground Lev.	650.07		653.16	651.97	648.52		648.81		647.86	647.50	647.92	648.02	649.24		644.87	642.50	642.24	644.53	636.46	622.82	608.24	[m]
Invert lev.	639.38		638.66	638.35	637.76		636.87		636.06	635.67	635.48	634.76	634.06		633.16	632.43	631.84	631.53	623.76	610.32	595.59	[m]
Length		335.50			262.80	416.90		381.20				337.50	329.50	420.00		343.50	276.40		497.00	493.80	555.50	[m]
Diameter		1.75	1.75		0.83	1.00	1.00		1.00			1.50	1.50	1.50	1.67		1.67	1.67	1.50	1.50	2.00	[m]
Slope o/oo		2.15	2.15		2.13	2.13	2.12		2.17			2.13	2.12	2.14	2.13		2.13	2.17	15.63	27.23	26.28	

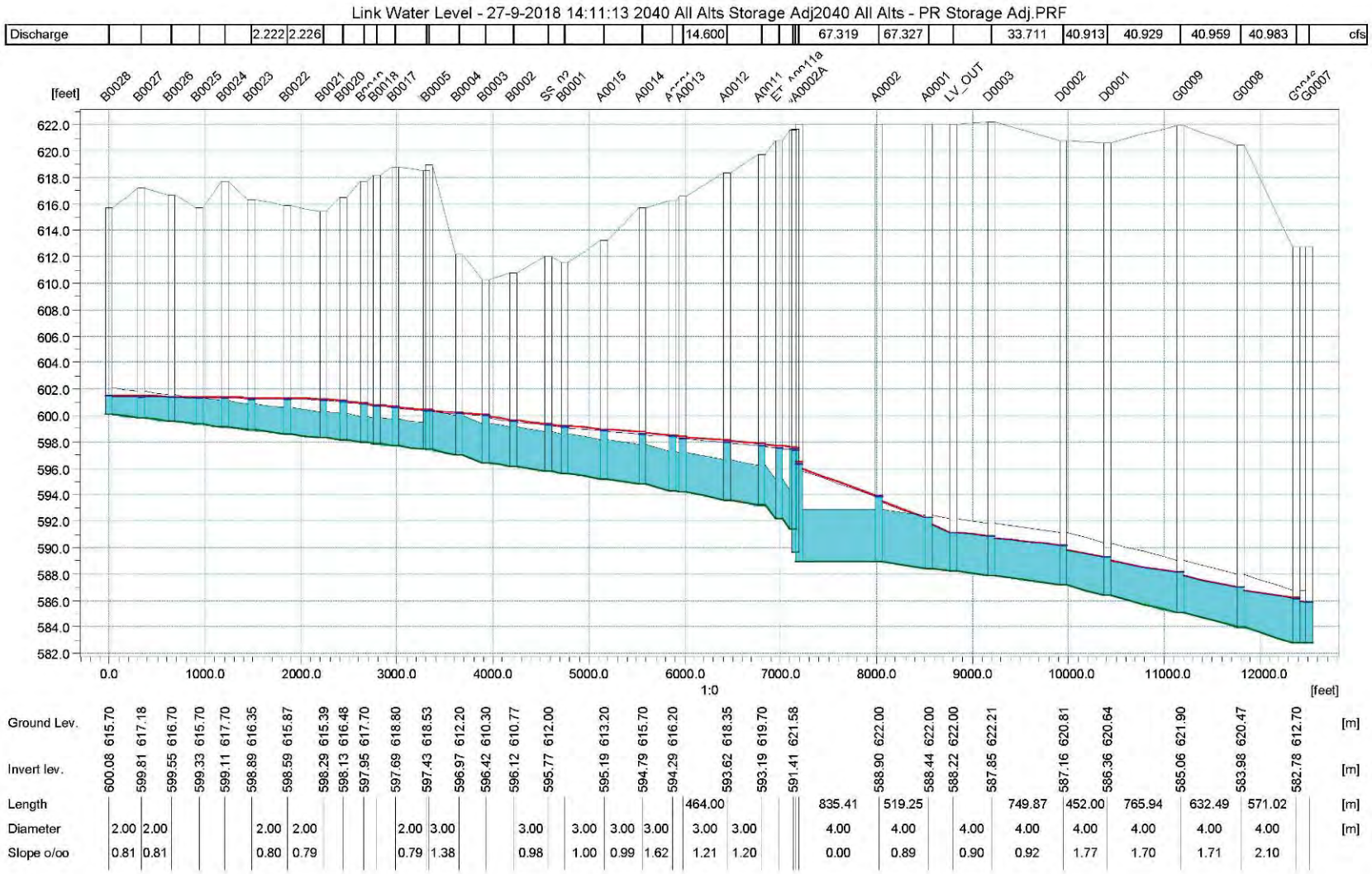
COM

Michigan Interceptor Storage – 0.8 MG



AECOM

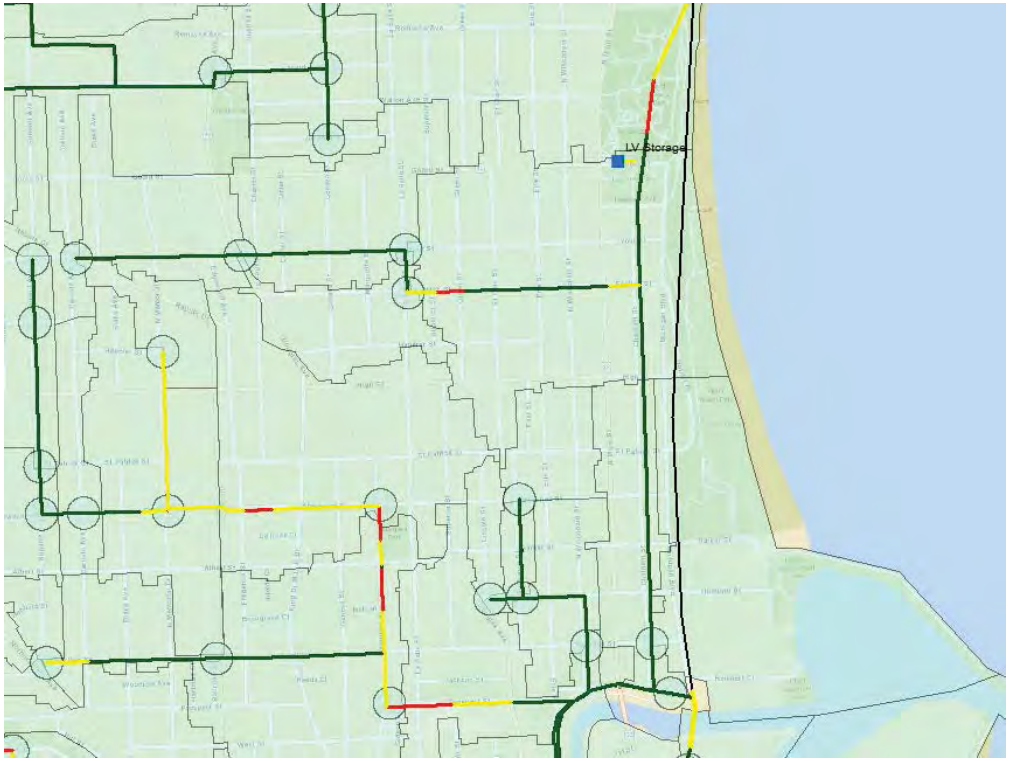
Link Water Level - 27-9-2018 14:11:13 2040 All Alts Storage Adj2040 All Alts - PR Storage Adj.PRF



COM

North Memorial To Marquette

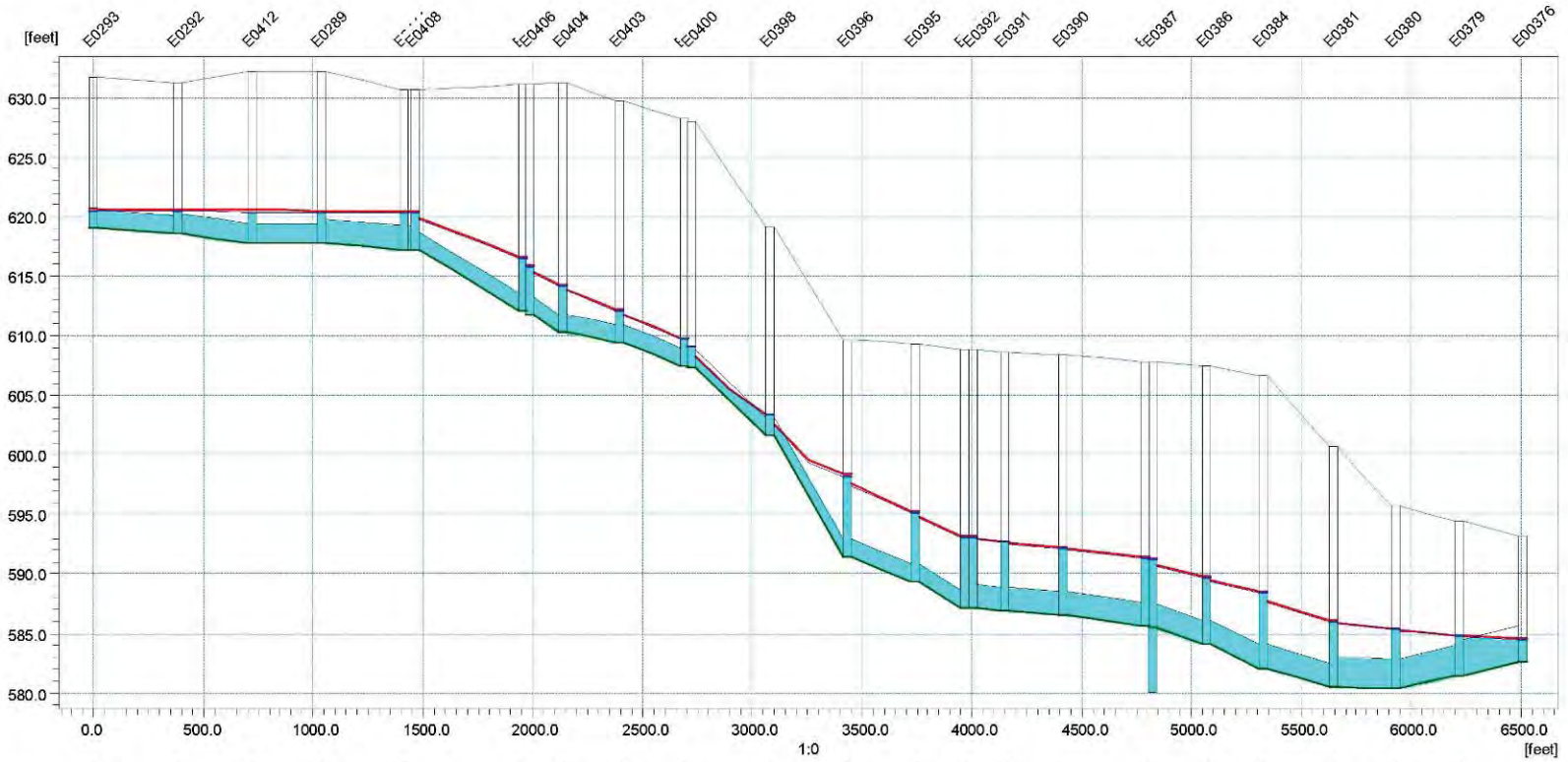
No planned improvements due limited surcharging and no known problems.



AECOM

Link Water Level - 27-9-2018 16:01:12 2040 All Alts Storage Adj2040 All Alts - PR Storage Adj.PRF

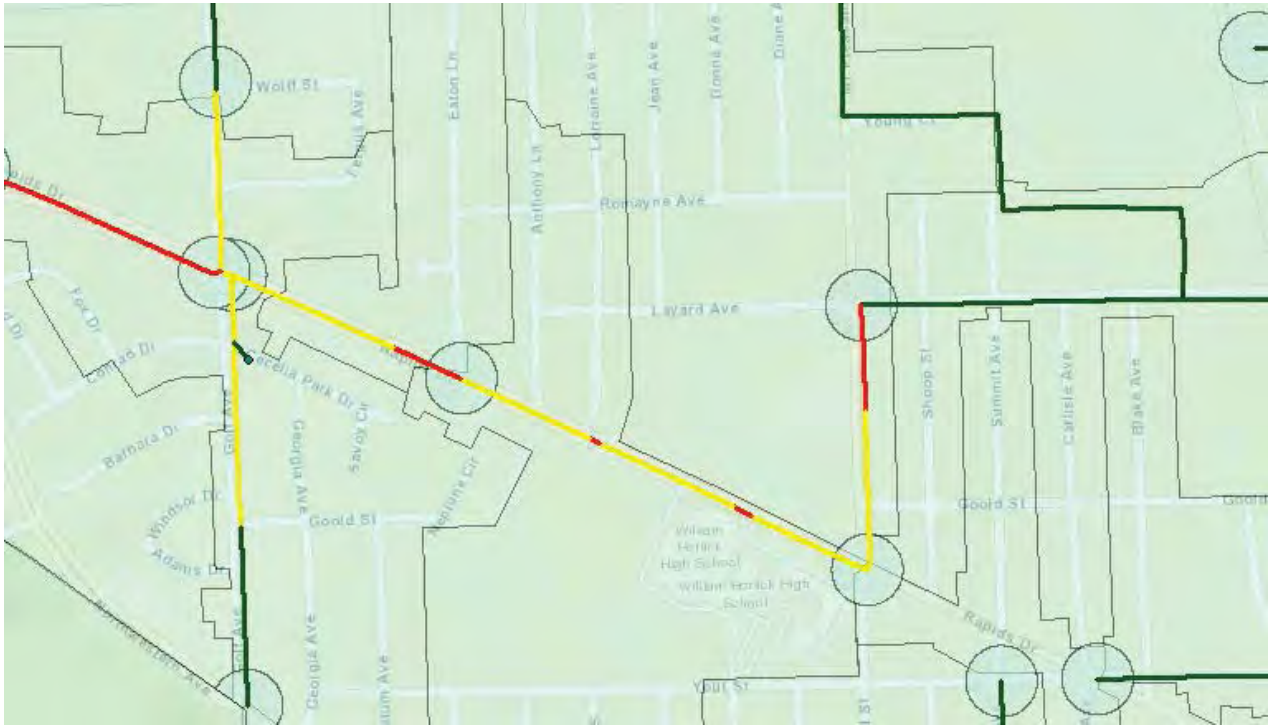
Discharge	1.157	1.167	1.172	1.177	8.292		8.299	8.300	8.302	8.310	8.674	8.678		8.814	8.817	13.347	13.349	15.505	15.517	15.535	15.532	cfs



Ground Lev.	631.70	631.20	632.20	632.20	630.70		631.07	631.20	629.68	628.20	619.20	609.70	609.28	608.85	608.66	608.37	607.85	607.45	606.70	600.70	595.70	594.46	[m]
Invert lev.	619.05	618.58	617.78	617.78	617.24		612.11	610.30	609.48	607.50	601.70	591.50	589.38	587.15	586.92	586.57	585.65	584.15	582.10	580.50	580.40	581.50	[m]
Length	378.62	340.00	320.00	374.03	489.00		256.00	295.00	355.00	352.00	311.00	589.38	587.15	260.00	380.00	243.42	256.00	322.00	285.00	286.00	290.10		[m]
Diameter	1.50	1.67	1.67	2.00	1.50		1.50	1.50	1.50	1.50	1.50	1.50		2.00	2.00	2.00	2.00	2.00	2.50	2.50	3.00		[m]
Slope o/oo	1.24	2.35	0.00	1.44	10.48		3.20	6.71	15.86	28.98	6.82	9.78		1.35	2.42	5.42	8.01	4.97	0.35	3.85	3.83		

Rapids Interceptor

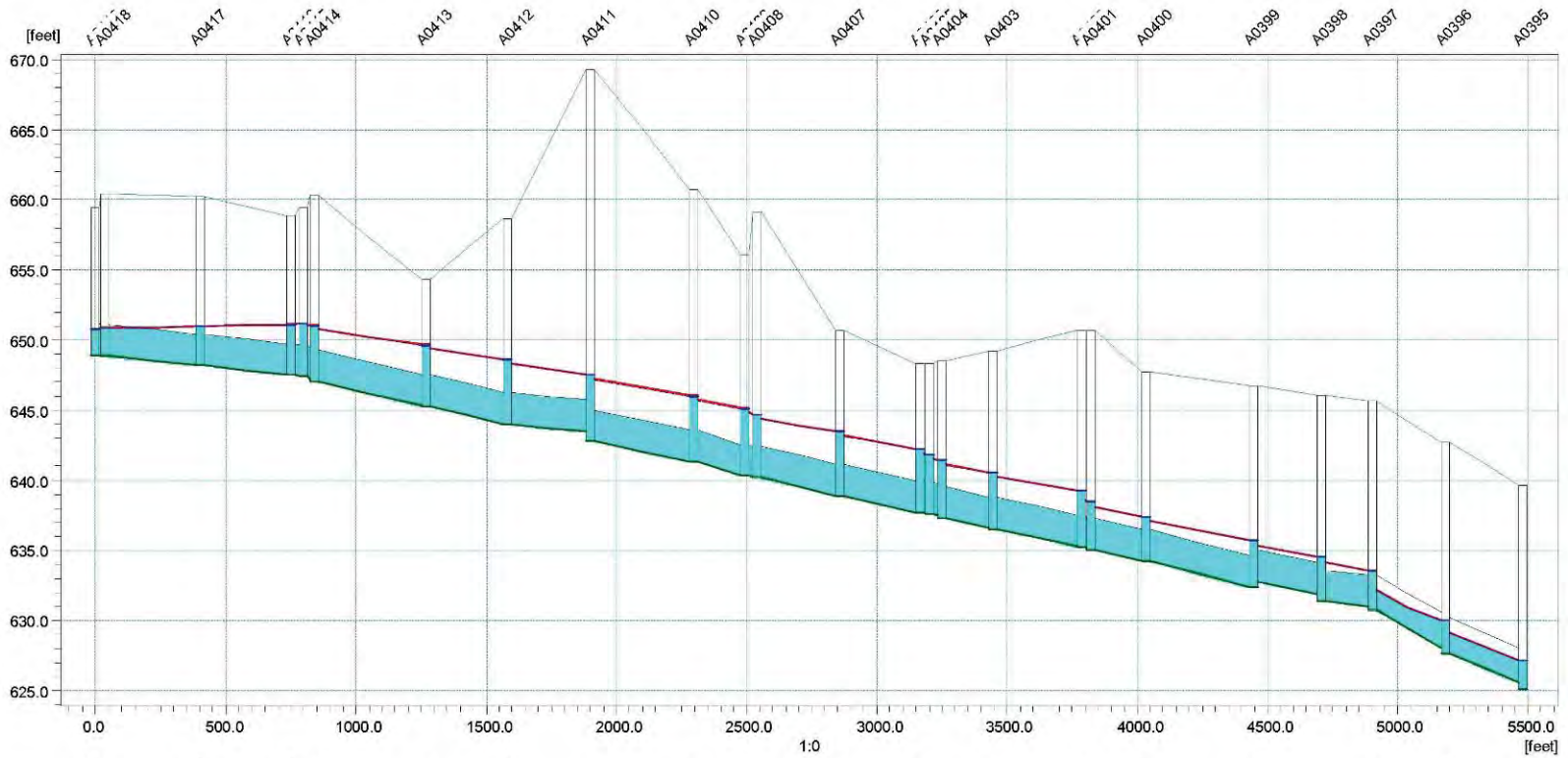
No planned improvements due limited surcharging and no known problems.



AECOM

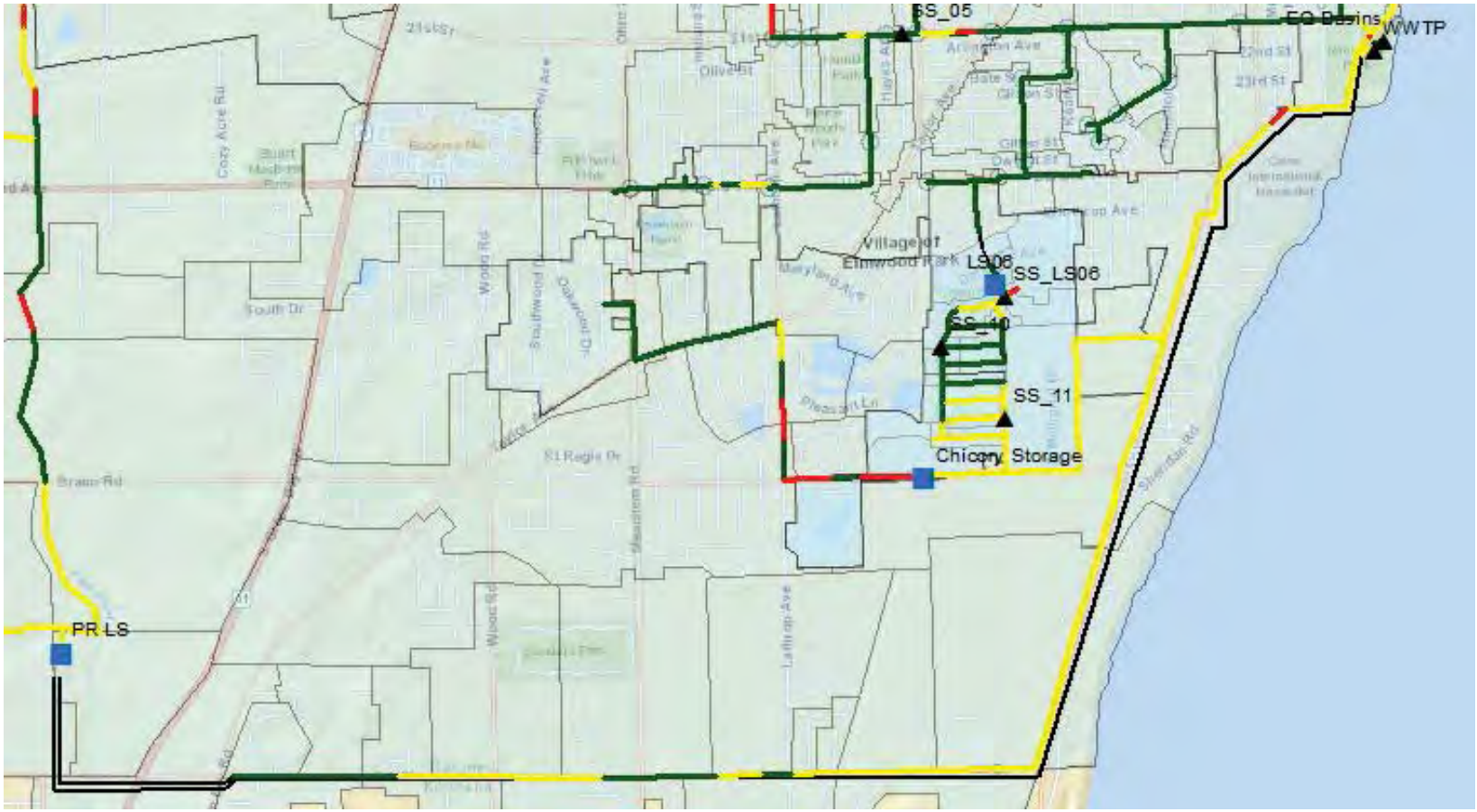
Link Water Level - 27-9-2018 12:46:12 2040 All Alts Storage Adj2040 All Alts - PR Storage Adj.PRF

Discharge	-5.148	-5.149	15.265	15.265	15.265	16.369	16.369	16.368	16.368	16.366	16.366	17.451	17.451	17.451	17.451	21.815	21.812	cfs



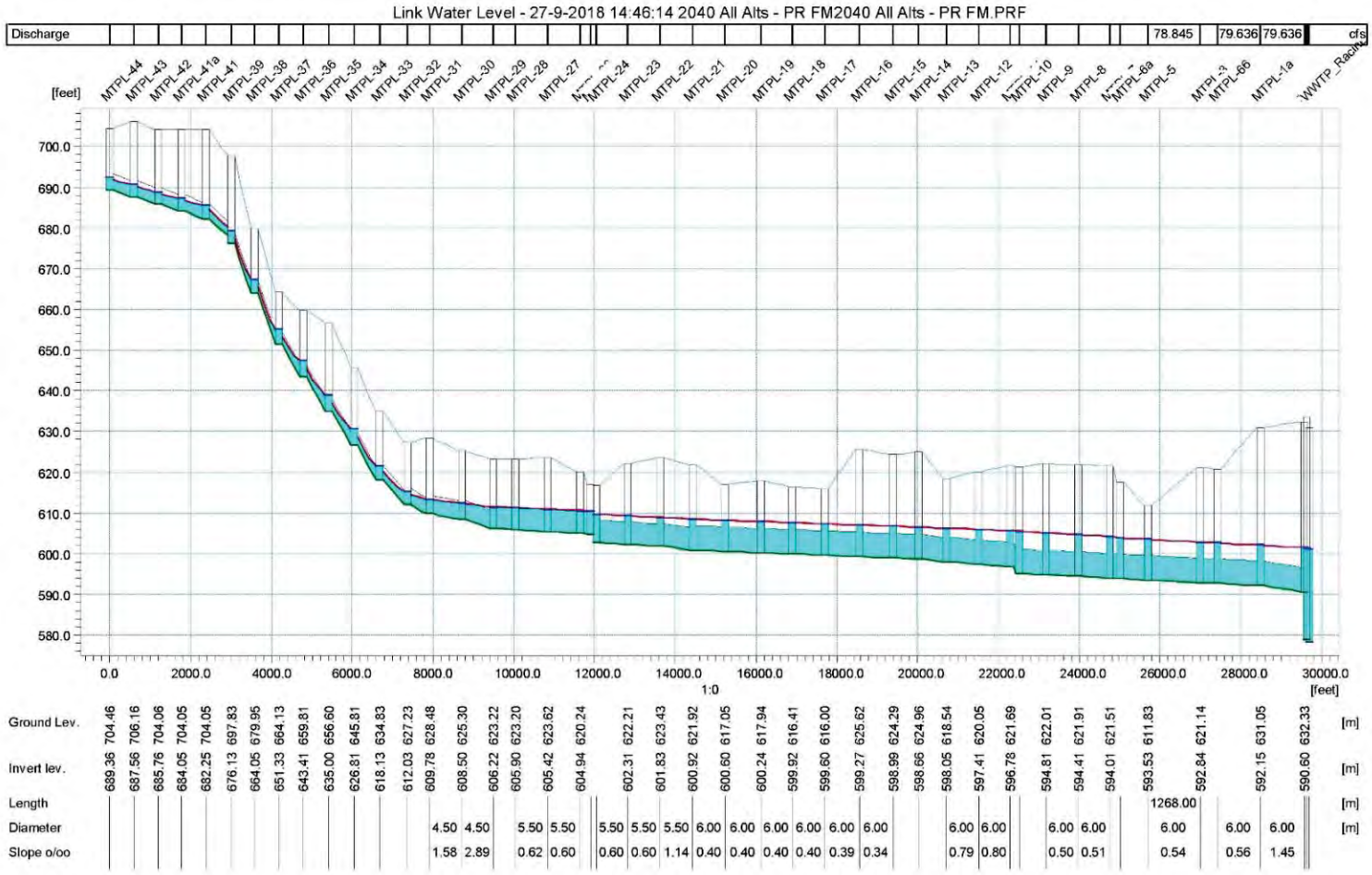
Ground Lev.	659.40		660.20		658.90	660.31		654.31		658.70		669.31		660.71	656.11		650.71	648.31		649.21	650.71	647.71		646.71	646.11	645.71		642.70		[m]
Invert lev.	648.92		648.19		647.50	647.04		645.32		644.01		642.77		641.31	640.31		638.91	637.70		636.51	635.21	634.23		632.41	631.36	630.76		627.68		[m]
Length		365.03		349.83			428.81		317.30		315.20		399.00			313.88			308.00				342.49		211.01		415.00		258.65		282.37		293.88	[m]
Diameter		2.25		2.25			2.25		2.25		2.25		2.25	2.25		2.25			2.25			2.25	2.25		2.25		2.25		2.25	2.25	2.50		2.50	[m]
Slope o/oo		1.84		1.97			4.01		4.10		1.71		3.66	5.09		4.11			3.83			3.79	3.59		3.93		4.39		3.32	1.65	9.53		7.15	

2040 Condition W/ PR 36” FM to WWTP (No Storage at PR)



AECOM

2040 Condition W/ PR 36” FM to WWTP (No Storage at PR)



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2040 Condition W/ PR 36” FM to WWTP (No Storage at PR)

Safety Site	Qmax [cfs]	Qmax MGD	Volume [ft3]	Volume MG
SS_LS02	0	0	142.9	0.00107
SS_09	0.001	0.00065	504.5	0.00377
SS_08	5.762	3.72225	59067.8	0.44189
SS_01	0	0	80.6	0.0006
SS_02	2.714	1.75324	19321.9	0.14455
SS_04	0.001	0.00065	176.6	0.00132
SS_11	0	0	47.2	0.00035
SS_03	0	0	29.1	0.00022
SS_12	0.001	0.00065	320.6	0.0024
SS_05	0.001	0.00065	418.6	0.00313
SS_LS06	0.001	0.00065	310.9	0.00233
SS_10	0	0	22	0.00016
SS_06	0.003	0.00194	992.9	0.00743

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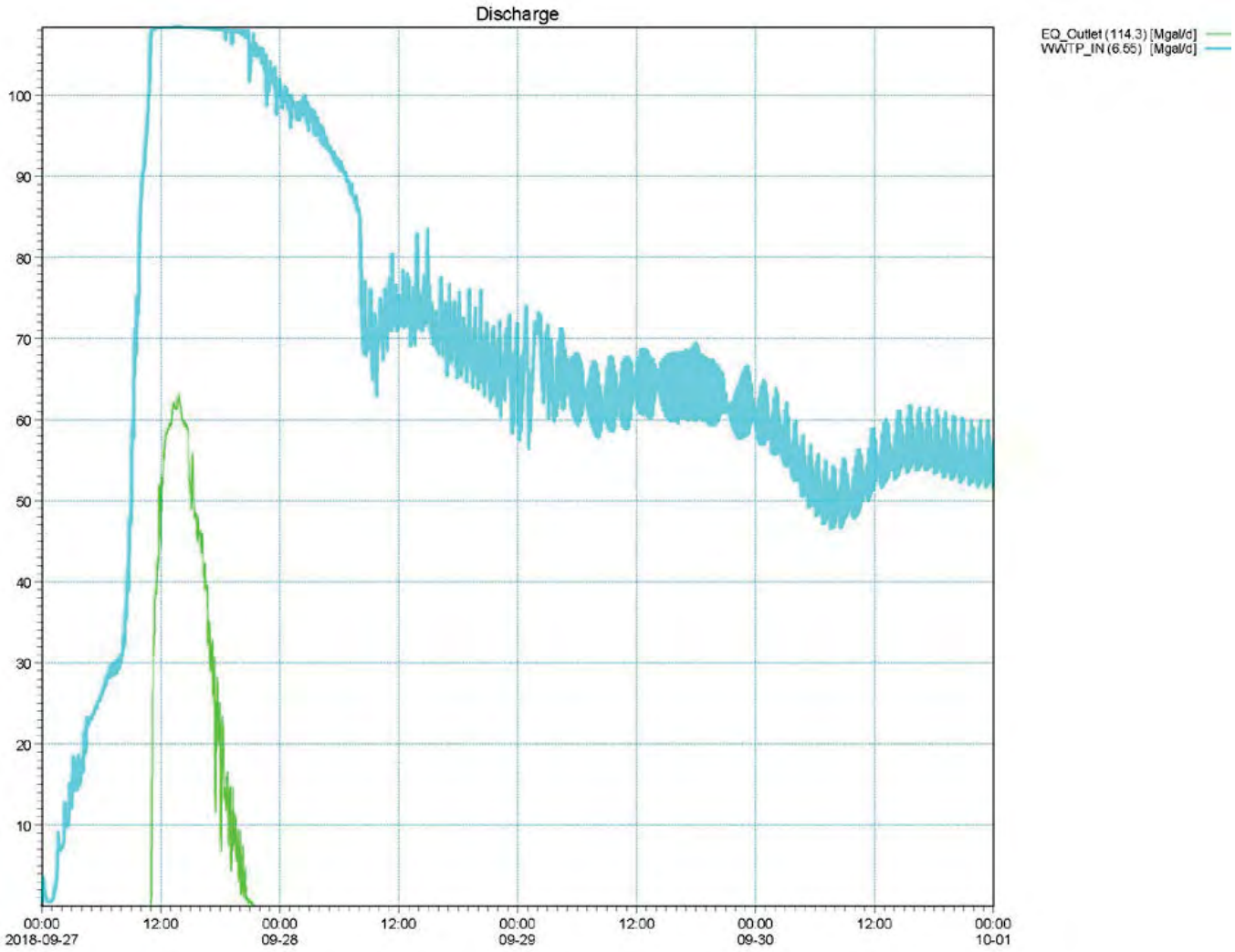
2040 Condition W/ PR 36” FM to WWTP (No Storage at PR)

Discharge at the Plant
- Blue = WWTP
- Black = EQ Basins

Peak Flows
- Approximately 63MGD to EQ Basins with the at 105 MGD
- Or 73 MGD to EQ Basins with the plant at 95 MGD

Volumes (95 MGD to WWTP)
- Approximately 24 MG to EQ Basins
- 260.6 MG to the Plant

Volumes (105 MGD to WWTP)
- Approximately 14.6 MG to EQ Basins
- 270 MG to the Plant



Alternatives – In Progress

- Interceptor between LS02 & LS01
  - Storage at Clayton Park between LS02 & Ls01
  - LS02 LS/Storage Operation Modifications
  - LS02 FM
  - LS01 FM Ext. to WWTP
- Larger storage at PR

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PRIORITIZATION AND TIME FRAME OF CONVEYANCE IMPROVEMENTS

Priority No. 1:	Pike River Lift Station, including Flow Equalization Storage and Forcemain to KR Interceptor Project Time Frame: 2020 - 2025
Priority No. 2:	Tax Increment District 5 (TID 5) interceptor sewer system for the Village of Mount Pleasant. Project Time Frame: 2020 - 2030
Priority No. 3:	3.0 MG of Flow Equalization Storage at North Park Lift Station Project Time Frame: 2025 - 2030
Priority No. 4:	Additional 1.5 MG of Flow Equalization Storage at Hood's Creek Lift Station. Project Time Frame: 2025 - 2030
Priority No. 5:	10.0 MG Flow Equalization Storage at Lift Station 01 Project Time Frame: 2030 - 2035
Priority No. 6:	Additional 1.0 MG Flow Equalization Storage at Caledonia 1. (LS 31 Upstream Capacity Constraints) Project Time Frame: 2030 - 2035
Priority No. 7:	Additional Flow Equalization Storage at Lift Station 31 / Interceptor Upgrade – North Green Bay Road /. (LS 31 Downstream Capacity Constraints) Project Time Frame: 2035 – 2040
Priority No. 8:	1.0 MG Flow Equalization For Chicory Road Interceptor Capacity Constraint Project Time Frame: 2035 – 2040
Priority No. 9:	Flow Equalization Storage at Lakeview Park. (Michigan Blvd Capacity Constraints) Project Time Frame: 2035 – 2040

PRIORITIZATION AND TIME FRAME OF CONVEYANCE IMPROVEMENTS

Priority No. 10: Miscellaneous Interceptor and Trunk Sewer Upsizing

- Rapids Drive Interceptor
- LaSalle Street Trunk Sewer
- Geneva Street Interceptor
- MP/ST Interceptor

Project Time Frame: 2035 – 2040

Priority No. 11: Additional Improvement No. 1 – I / I Reduction in the Safety Site No. 8 Sewershed

Project Time Frame: 2035 – 2040

Priority No. 12: Additional Improvement No. 2 – Flow Equalization in Safety Site No. 8 Sewershed

Project Time Frame: 2035 – 2040

Questions

Minutes

Meeting name
RWWU Technical Advisory Committee – Interceptor Model

Meeting date
16April20

Attendees
See attendance sheet- attached

Time
1:30 PM

Location
Virtual

AECOM Project number
60554970

Prepared by
Mike Zapinski

Ref	Action	Responsible	Due by	Status
01	Meeting was centered around a 12-page slide deck prepared and presented by AECOM			
02	WWTP Peak Flow Tom Ludwig noted that the WWTP peak flows are almost the same in the 2020 and 2030 scenarios. Acknowledged. While alternatives are implemented in 2030 scenario, development has increased.	---	---	---
03	WWTP Peak Flows in 2040 Scenario Dan Snyder questioned why the WWTP peak flows dropped greatly from 2030 to 2040. TAC speculated that it was due to the addition of the 10 MG storage at LS 01 since that was the single largest change, but in combination with the other smaller alternatives implemented. AECOM will perform a sensitivity analysis of the alternatives model for the 10 year, 6- hr storm as discussed with WDNR at the October 28, 2019 meeting.			
04	Chicory Road Interceptor and Storage Dan S asked if moving the location of the Chicory Road storage would help with interceptor surcharging. Eric explained that this was a likely location due to the open land. Dan acknowledged this could be refined at a later date. Keith Haas asked if parallel storage along Chicory could help eliminate some surcharge issues; asked Dan how the Chicory Road study was coming along. Dan acknowledged that the problem areas were west of the interceptor covered in the Facilities Plan.	---	---	---

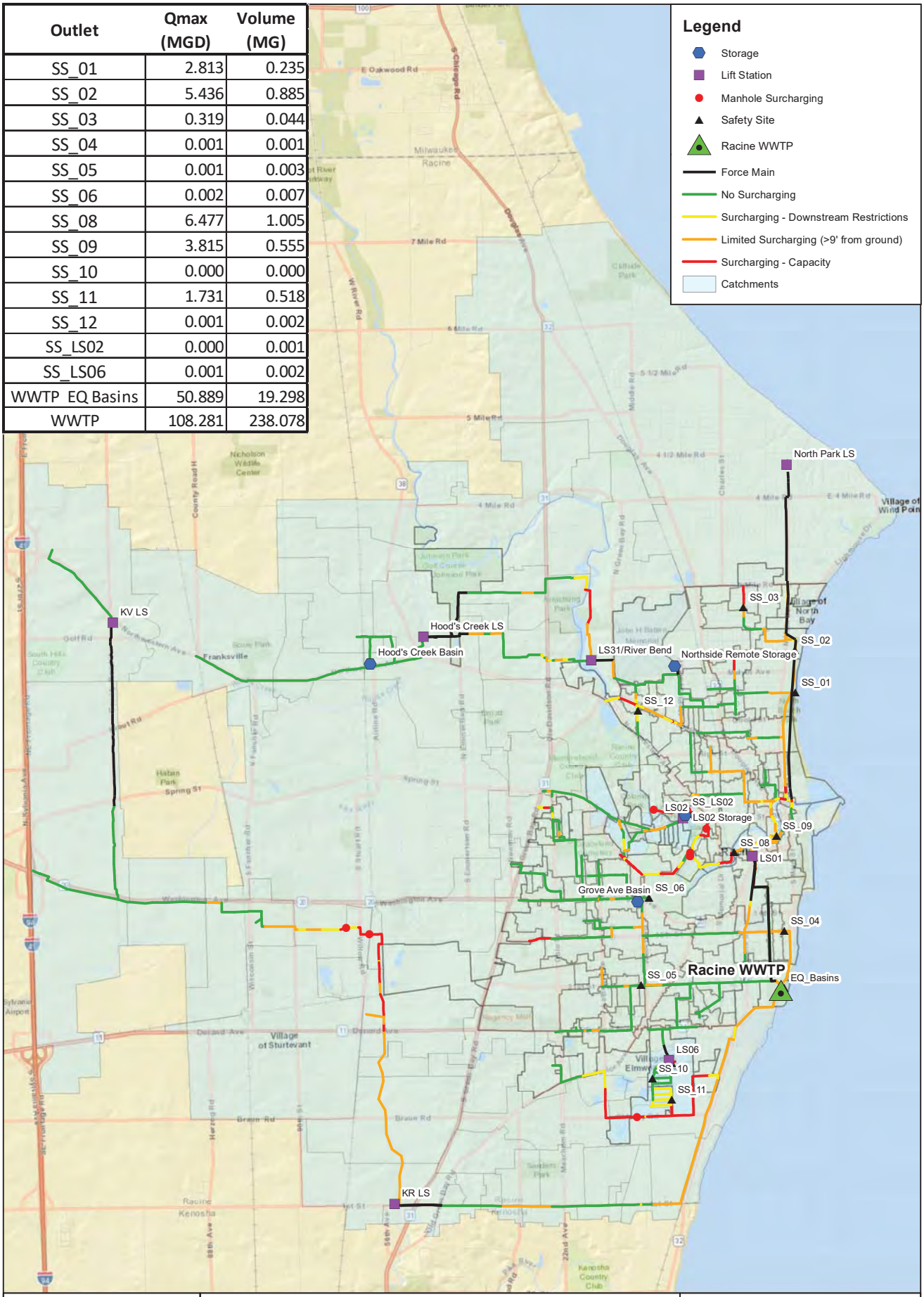
Ref	Action	Responsible	Due by	Status
05	LS01-S08 Sewershed Issues Keith advised that a section of sewer from downstream of S08 at the corner of W 6th St and Racine St. Is being upgraded from 39-inch to 42-inch starting April 21. Keith provided K Singh plans on Friday, April 17th. Keith and John Rooney described the junction chamber upstream of LS-01 that was added to separate the 84-inch and 60-inch interceptors. This allows water to back up for storage in the 84-inch interceptor. Keith provided further information to AECOM on April 20. Team had a discussion of the likelihood of significant inflow into these sewers. Downspouts have been disconnected. A large quantity of foundation drains are still connected to the sanitary system. The clay soils on the north side drive more flow into foundation drains. John LaPointe noted that Waterloo, Iowa opted to fund and disconnect sump pumps in lieu of spending money n storage, but they were under a consent decree. John asked if the 6th Street siphon was a bottleneck in the system and if improvements there would decrease the need for 10 MG storage. Eric Bartlein replied that we modeled another siphon but that did not improve the situation. SS-08 sewershed wide issue, not just siphon.	---	---	---
06	General Tom Ludwig remined AECOM that communities would like a table of inflows and outflows at key points in the system, especially storage basins. Data should include storage volumes. Tom asked if we were updating the model to include the update to Rivers Bend that Caledonia recently provided. Eric replied that the 2A option still needed to be modeled, may need more information from Caledonia.	---	---	
07				---
08				
09				---

SIGN-IN SHEET

Racine Facilities Plan
Technical Advisory Committee Meeting
16April20, 1:30 PM

Name	Initial	Village/Firm	Telephone #	Email
Dan Snyder	X	Foth	262-939-0209	Dan.snyder@foth.com
Ron Pritzlaff	X	Mt. Pleasant	262-664-7842	rpritzlaff@mtpleasantwi.gov
Tom Ludwig	X	Foth/Caledonia	262-336-7905	tom.ludwig@foth.com
Tony Bunkelman	X	Caledonia Utility	262-835-6416	abunkleman@caledonia-wi.gov
Bob Lui	X	Caledonia Utility	262-681-3900	blui@caledoniawiutility.com
John Rooney		City of Racine	262-636-9460	John.rooney@cityofracine.org
Rusty Schroedel	X	AECOM	414-944-6140	rusty.schroedel@aecom.com
Keith Haas	X	Racine WW	262-363-9434	Keith.haas@cityofracine.org
Mike Gitter	X	Racine WW	262-636-9430	Mike.gitter@cityofracine.org
Mary Frances Klimek	X	Racine WW	262-636-9524	Maryfrances.klimek@cityofracine.org
Cara Pratt	X	City of Racine	262-822-8956	Cara.pratt@cityofracine.org
Eric Bartlein	X	AECOM	414-944-6114	Eric.bartlein@aecom.com
Bryan Lewis		AECOM	920-918-8820	Bryan.lewis@aecom.com
Mike Zapinski	X	AECOM	414-944-6204	Mike.zapinski@aecom.com
Amanda Kaminski	X	Racine WW	262-636-9552	Amanda.kaminski@cityofracine.org
Terry McCarthy	X	City of Racine	262-770-7390	mccartte@yahoo.com
John LaPointe	X	AECOM		

Outlet	Qmax (MGD)	Volume (MG)
SS_01	2.813	0.235
SS_02	5.436	0.885
SS_03	0.319	0.044
SS_04	0.001	0.001
SS_05	0.001	0.003
SS_06	0.002	0.007
SS_08	6.477	1.005
SS_09	3.815	0.555
SS_10	0.000	0.000
SS_11	1.731	0.518
SS_12	0.001	0.002
SS_LS02	0.000	0.001
SS_LS06	0.001	0.002
WWTP EQ Basins	50.889	19.298
WWTP	108.281	238.078



AECOM

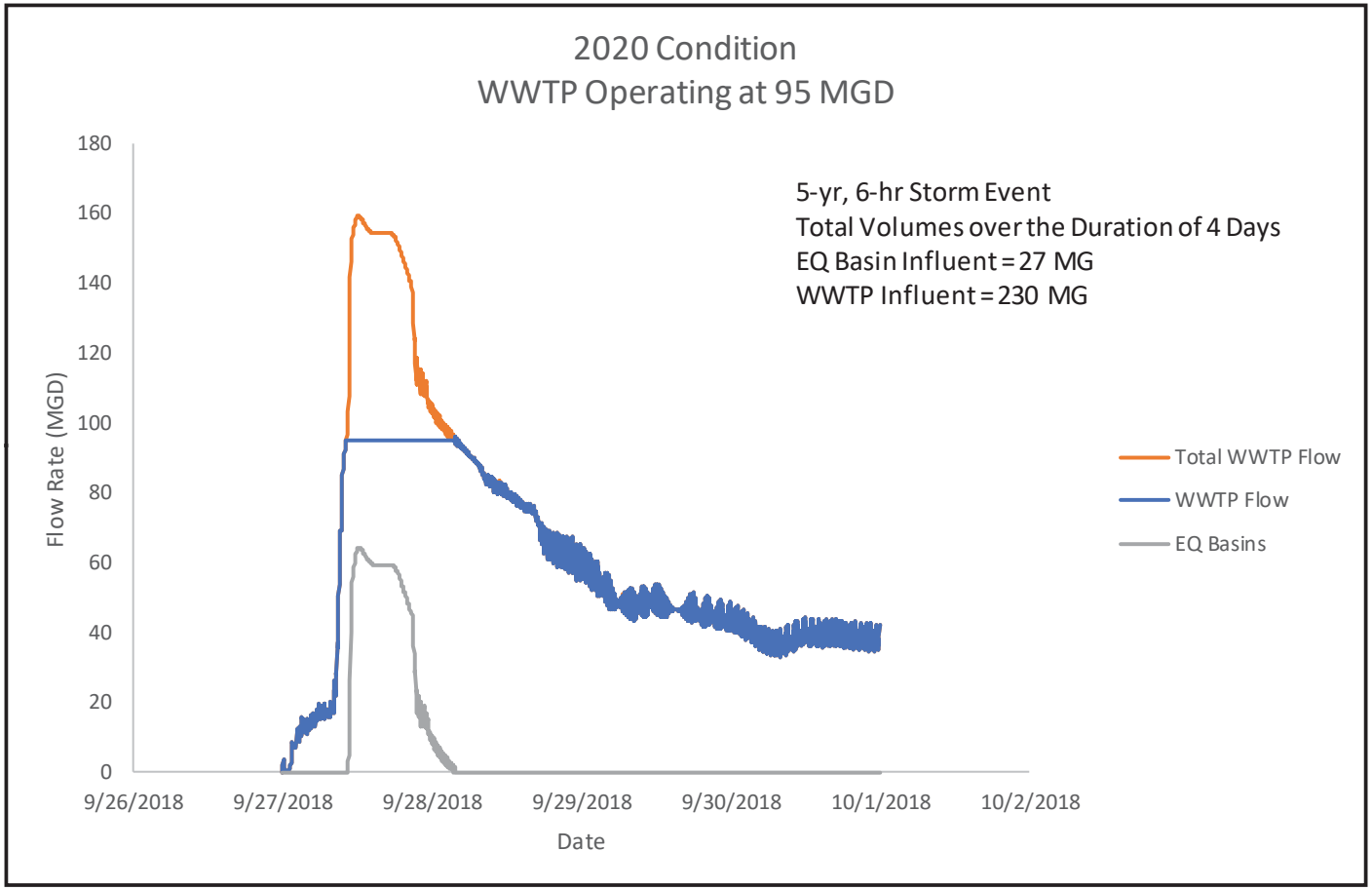
Figure 1 - 2020 Condition

Projection:
NAD_1927_StatePlane_Wisconsin_South_FIPS_4803

Drawn By: JFP
Checked By:
Date:
Project #: 60554970

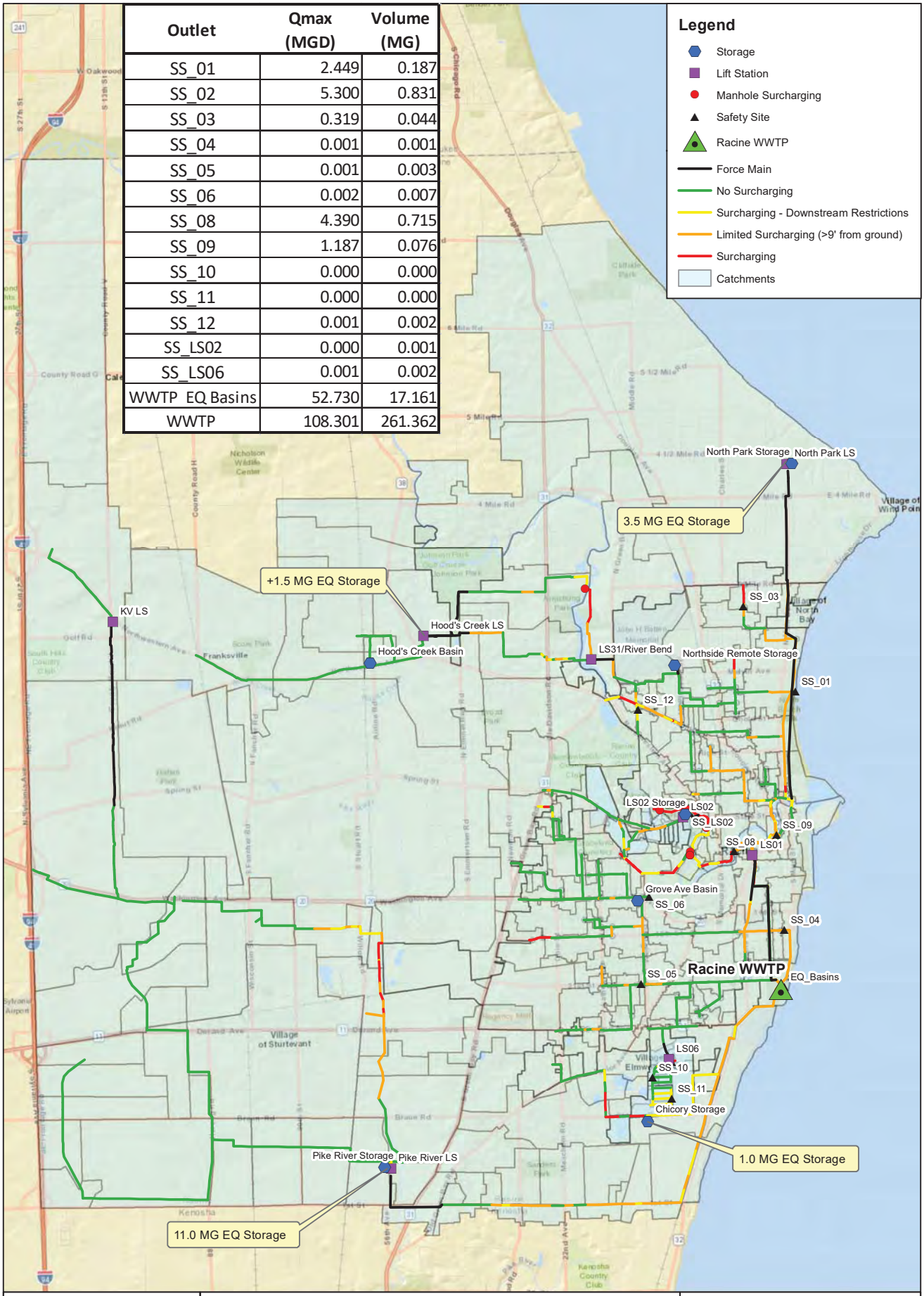
Racine Facilities Plan
Racine Wastewater Utility

0 0.5 1 2 Miles



AECOM	**2020 Hydrograph**
Drawn By: JFP	Racine Facilities Plan Racine Wastewater Utility
Checked By:	
Date:	
Project #: 60554970	

Outlet	Qmax (MGD)	Volume (MG)
SS_01	2.449	0.187
SS_02	5.300	0.831
SS_03	0.319	0.044
SS_04	0.001	0.001
SS_05	0.001	0.003
SS_06	0.002	0.007
SS_08	4.390	0.715
SS_09	1.187	0.076
SS_10	0.000	0.000
SS_11	0.000	0.000
SS_12	0.001	0.002
SS_LS02	0.000	0.001
SS_LS06	0.001	0.002
WWTP EQ Basins	52.730	17.161
WWTP	108.301	261.362



AECOM

Figure 2 - 2030 Condition

Projection: NAD_1927_StatePlane_Wisconsin_South_FIPS_4803

Drawn By: JFP

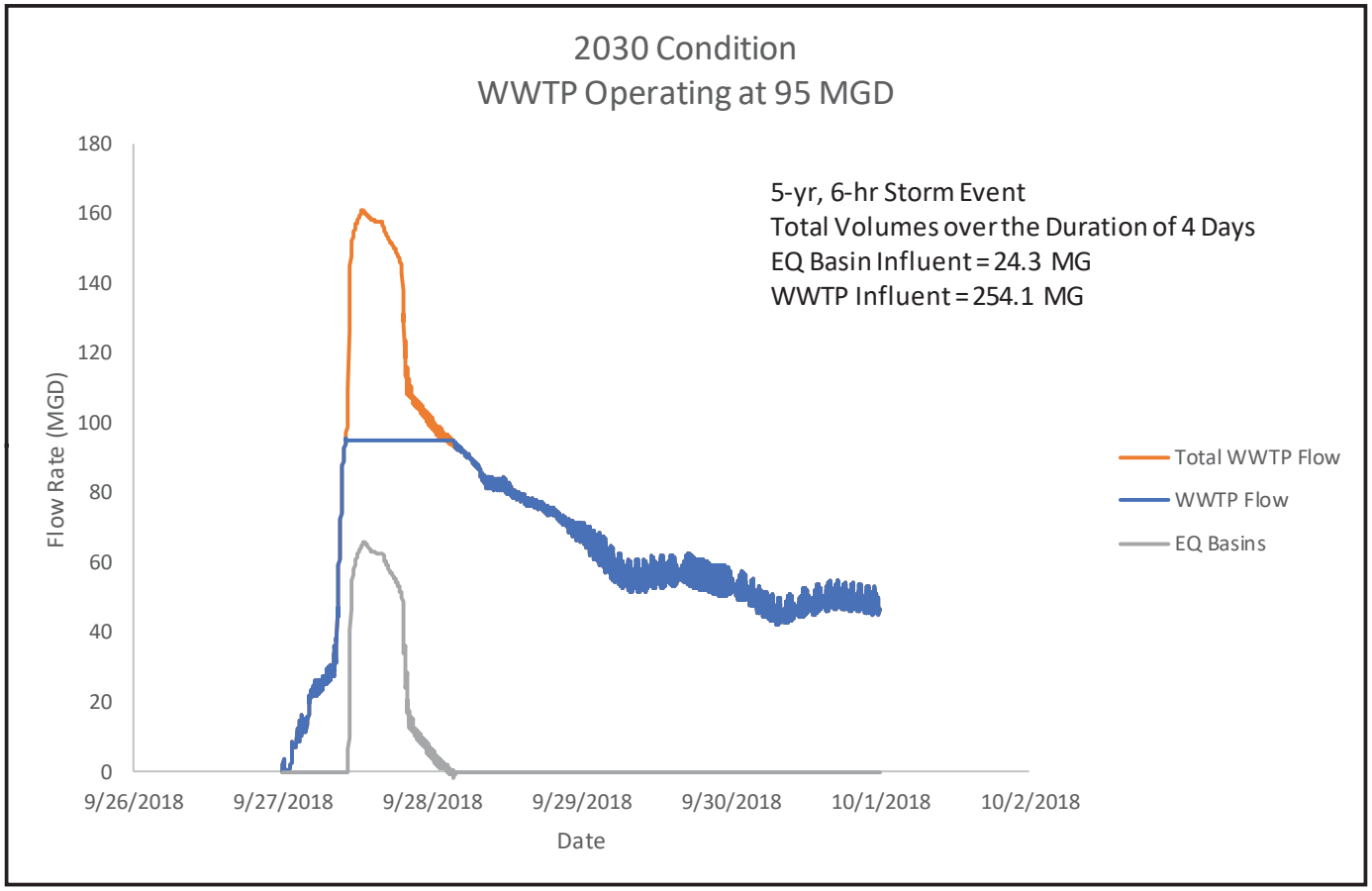
Checked By:

Date:

Project #: 60554970

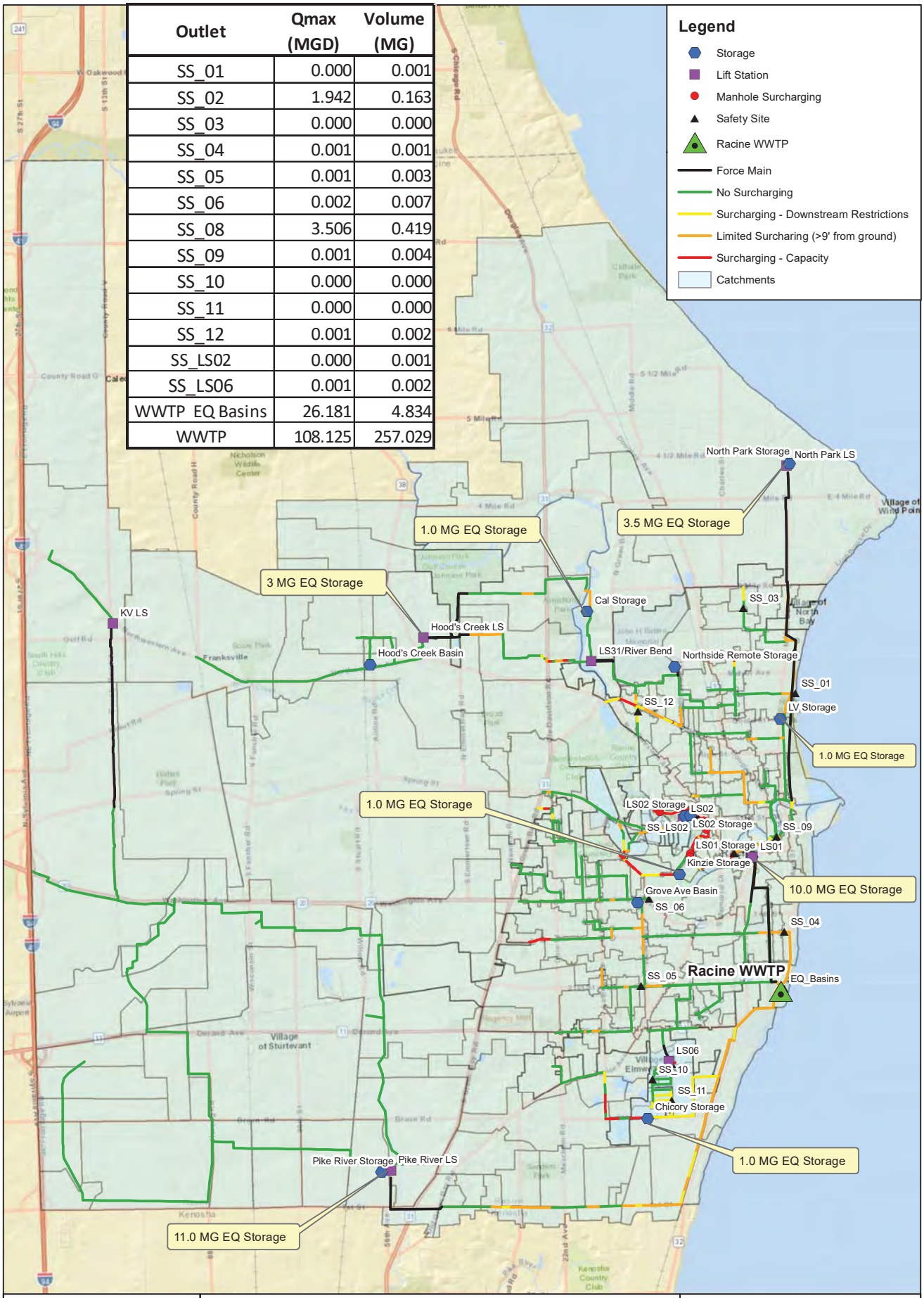
Racine Facilities Plan
Racine Wastewater Utility

0 0.5 1 2 Miles



AECOM	**2030 Hydrograph**
Drawn By: JFP	Racine Facilities Plan Racine Wastewater Utility
Checked By:	
Date:	
Project #: 60554970	

Outlet	Qmax (MGD)	Volume (MG)
SS_01	0.000	0.001
SS_02	1.942	0.163
SS_03	0.000	0.000
SS_04	0.001	0.001
SS_05	0.001	0.003
SS_06	0.002	0.007
SS_08	3.506	0.419
SS_09	0.001	0.004
SS_10	0.000	0.000
SS_11	0.000	0.000
SS_12	0.001	0.002
SS_LS02	0.000	0.001
SS_LS06	0.001	0.002
WWTP EQ Basins	26.181	4.834
WWTP	108.125	257.029



AECOM

Figure 3 - 2040 Baseline Condition

Projection: NAD_1927_StatePlane_Wisconsin_South_FIPS_4803

Drawn By: JFP

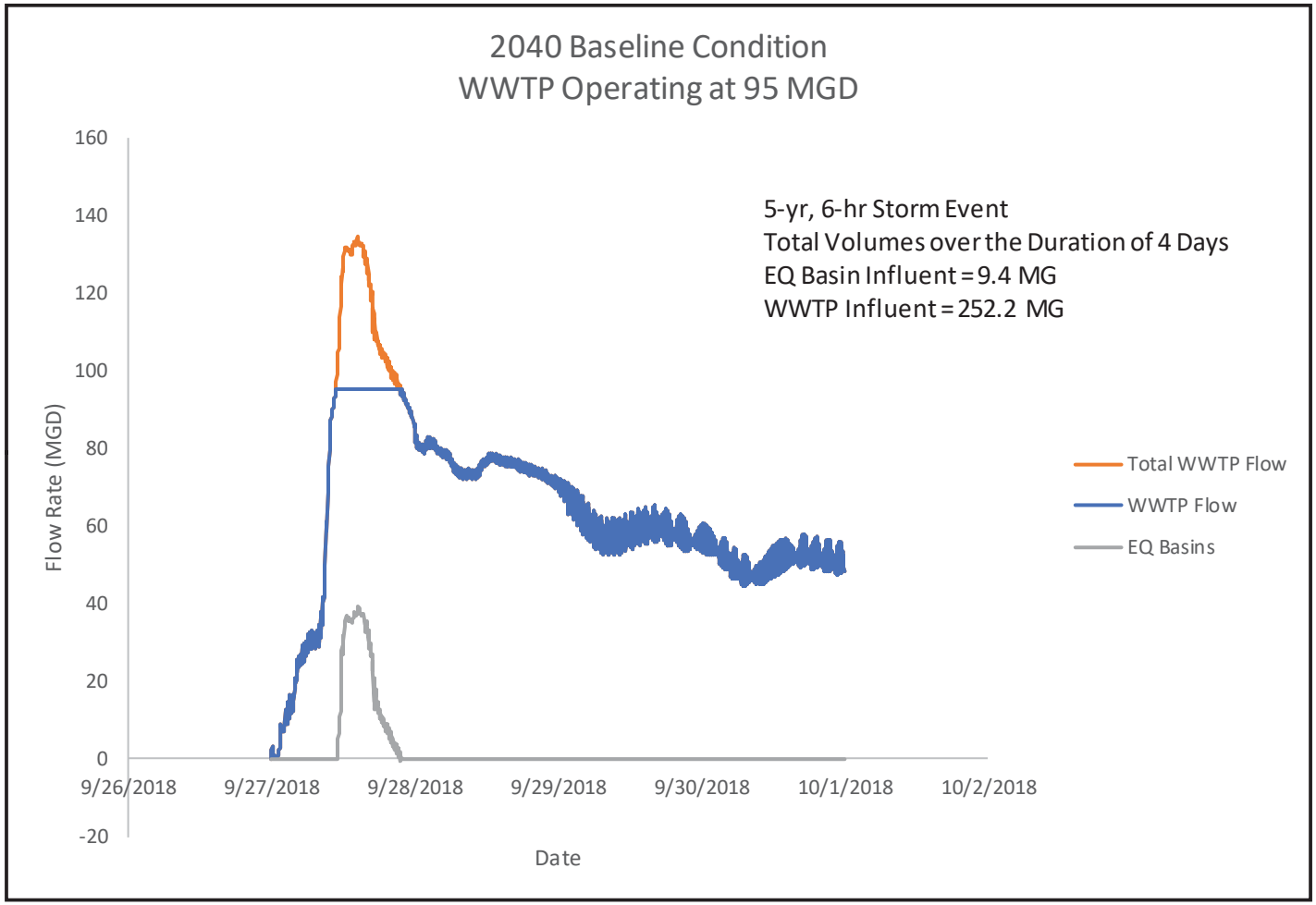
Checked By:

Date:

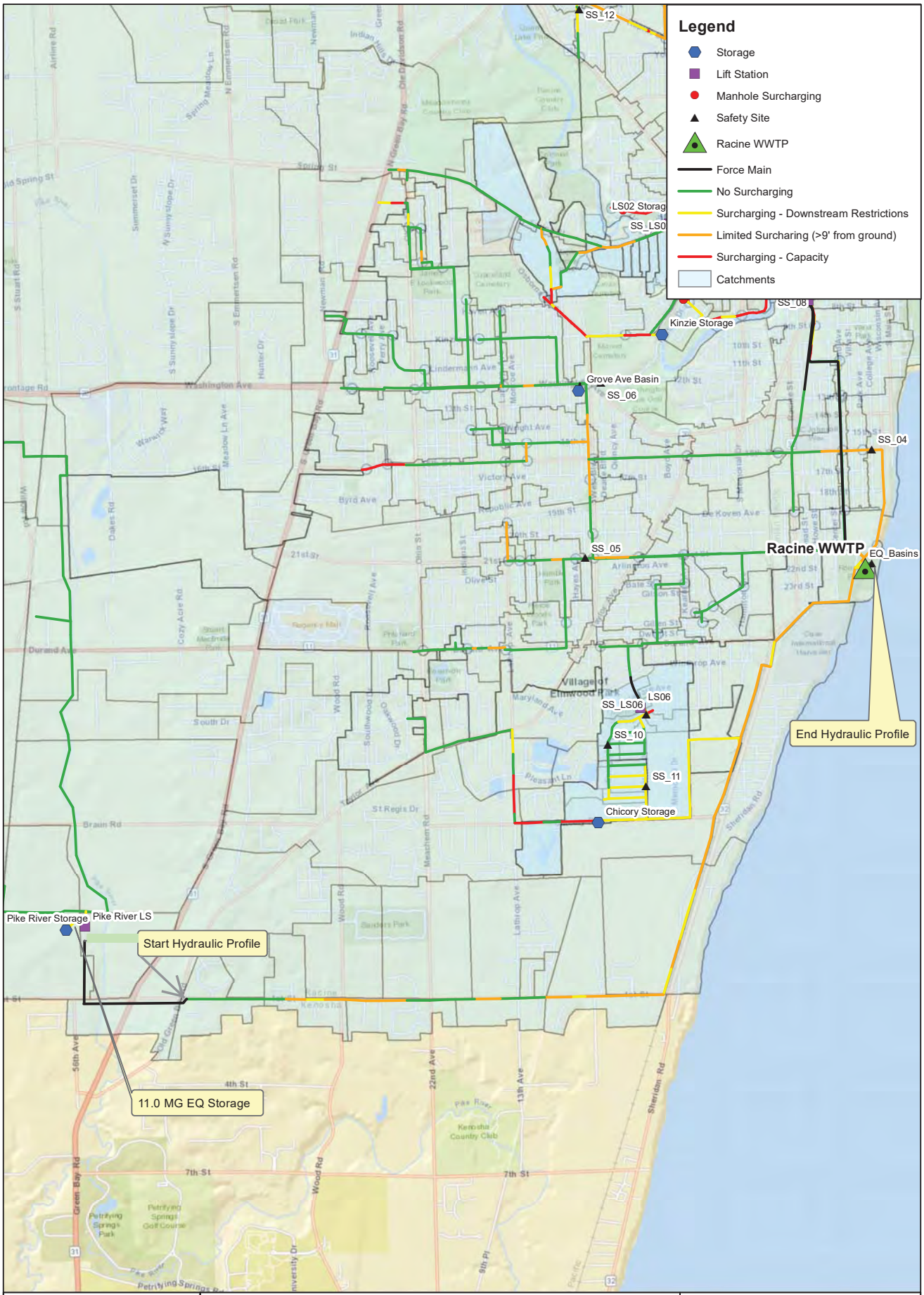
Project #: 60554970

Racine Facilities Plan
Racine Wastewater Utility

0 0.5 1 2 Miles



AECOM	**2040 Baseline Hydrograph**
Drawn By: JFP	Racine Facilities Plan Racine Wastewater Utility
Checked By:	
Date:	
Project #: 60554970	



AECOM

Figure 4 - KR Interceptor (2040 Baseline Condition)

Projection: NAD_1927_StatePlane_Wisconsin_South_FIPS_4803

Drawn By: JFP

Checked By:

Date:

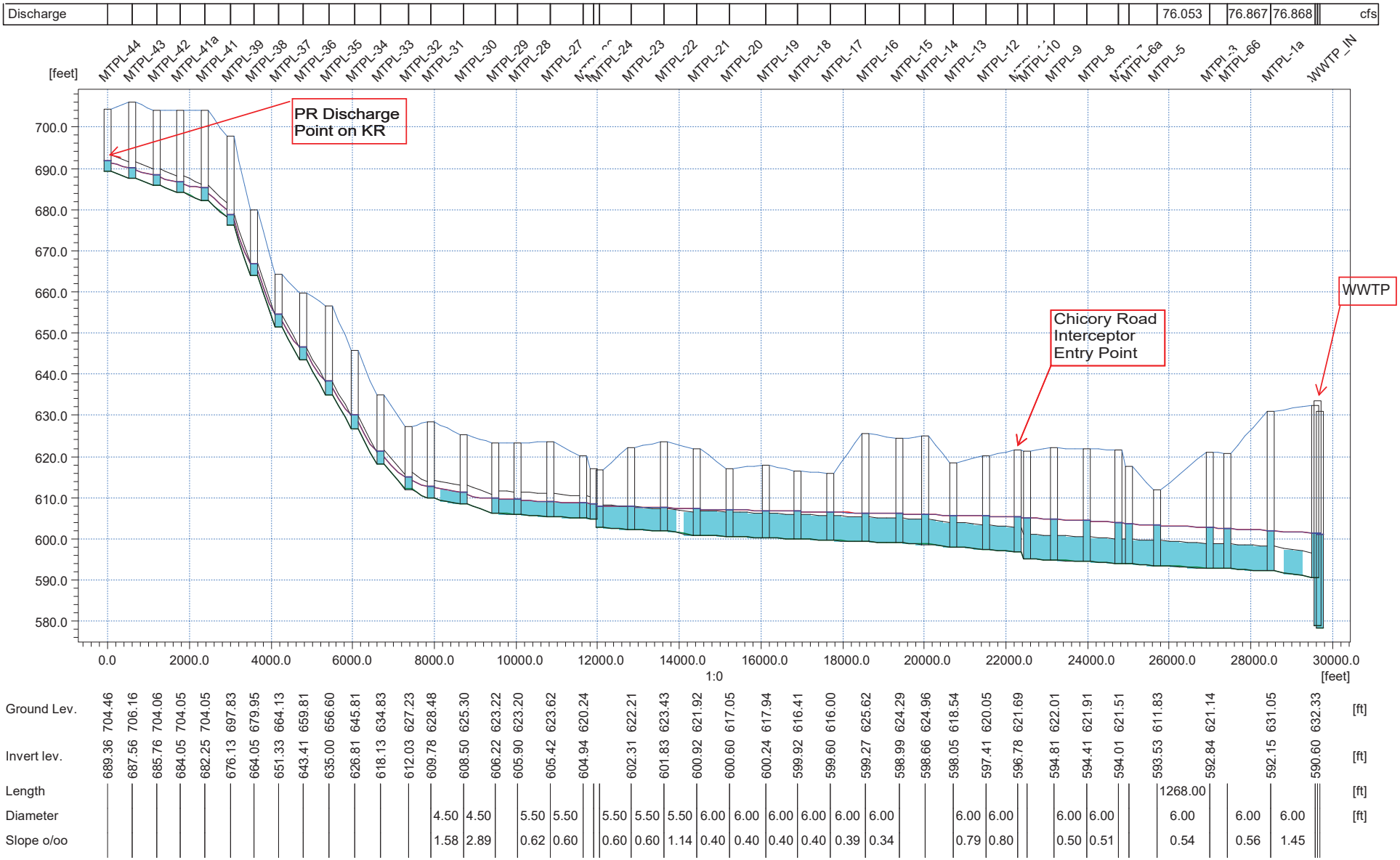
Project #: 60554970

Racine Facilities Plan
Racine Wastewater Utility

0 0.25 0.5 1 Miles

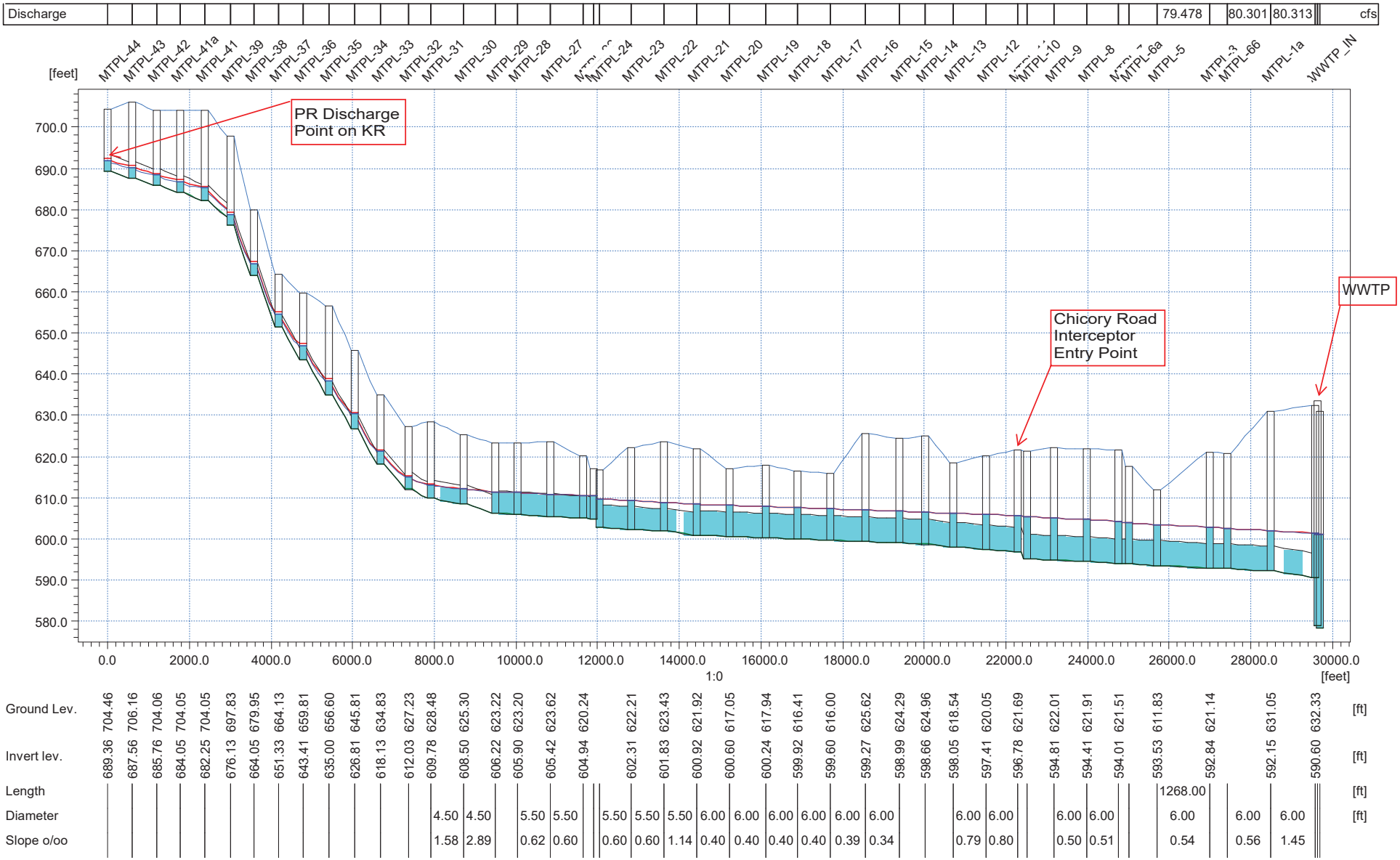
2020 Condition - KR Interceptor

5-year, 6-hour Event

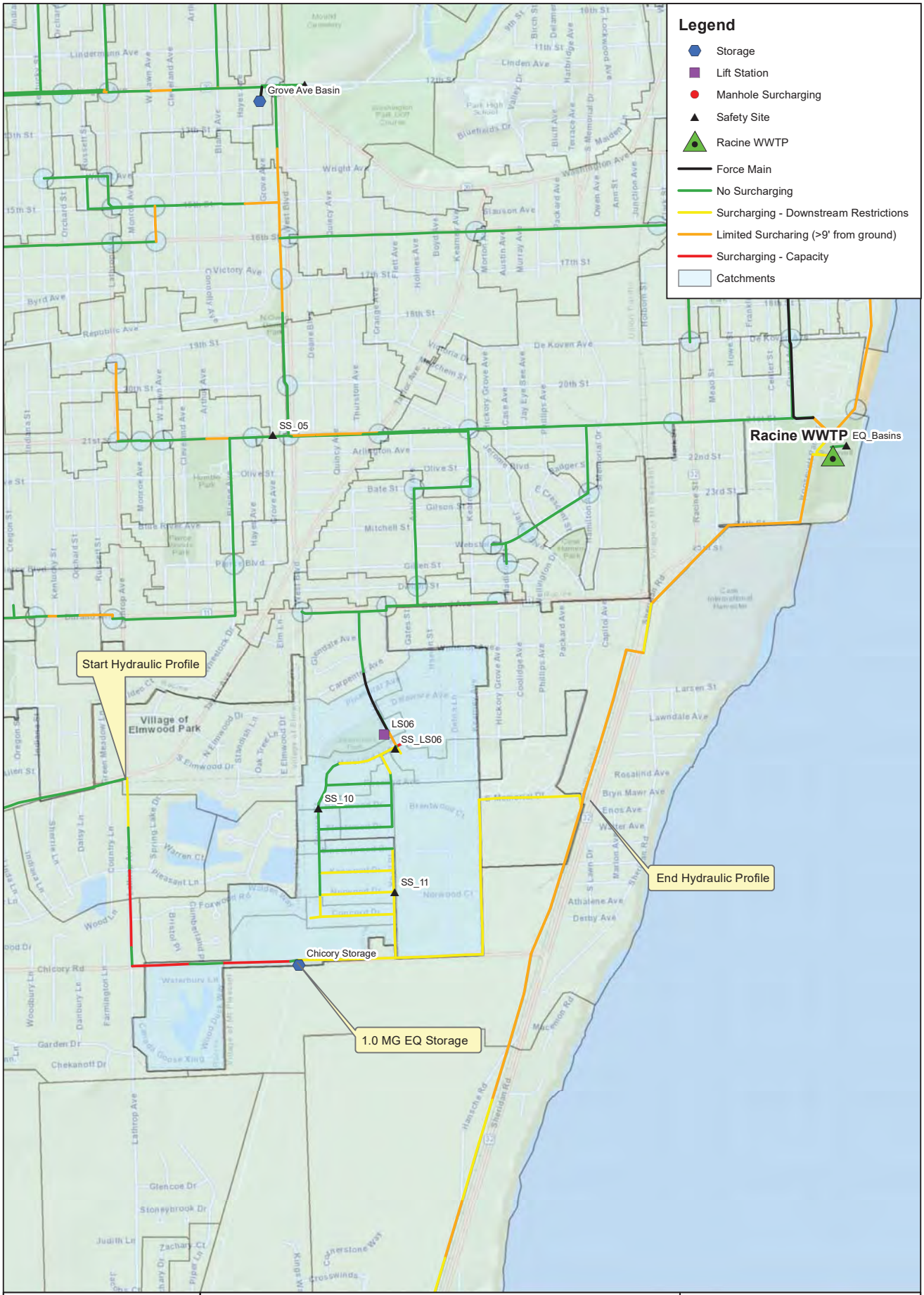


| | | |

2040 Baseline Condition - KR Interceptor
5-year, 6-hour Event



| | | |



AECOM

Figure 7 - Chicory Road Interceptor (2040 Baseline Condition)

Drawn By: JFP

Checked By:

Date:

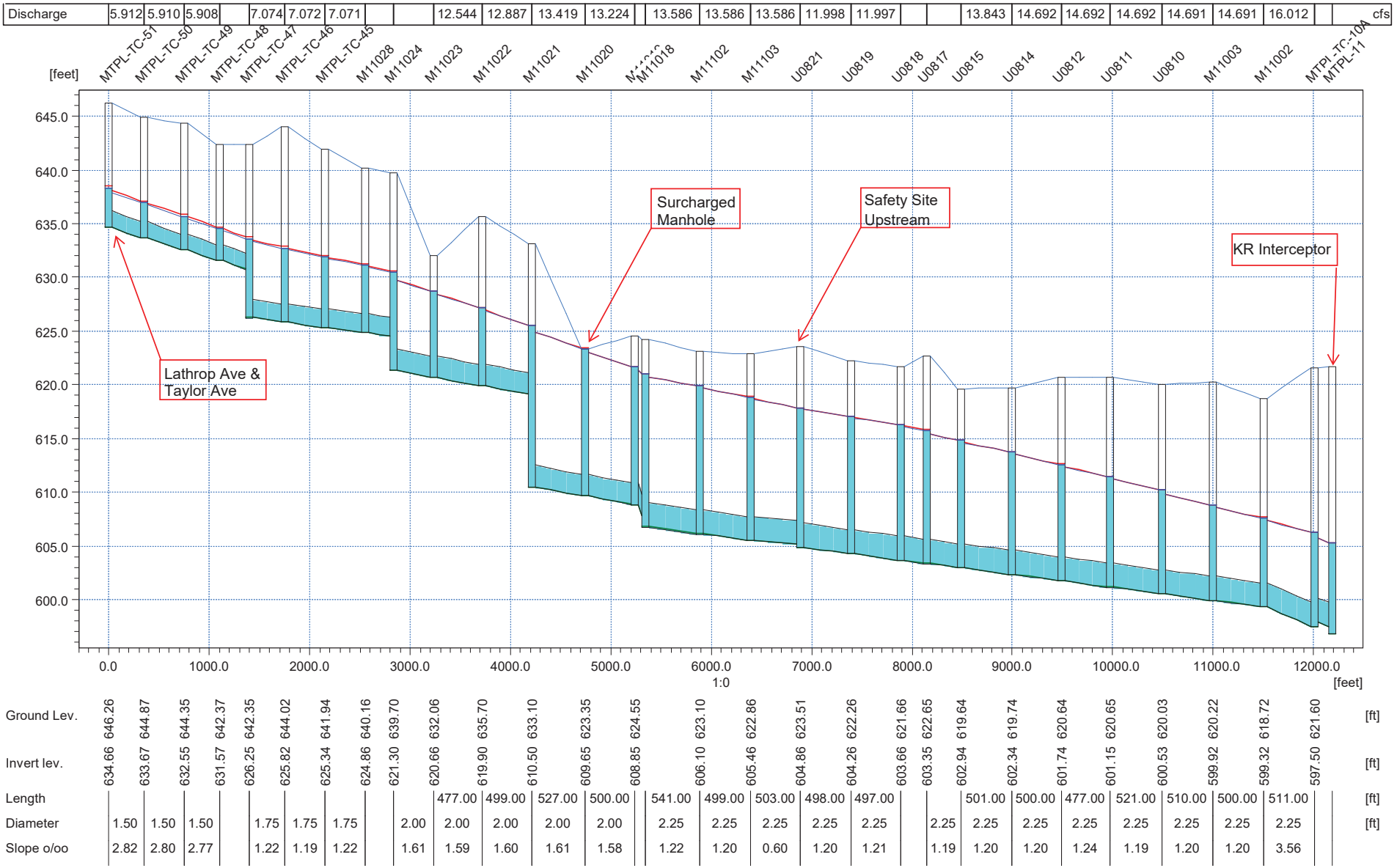
Project #: 60554970

Racine Facilities Plan
Racine Wastewater Utility

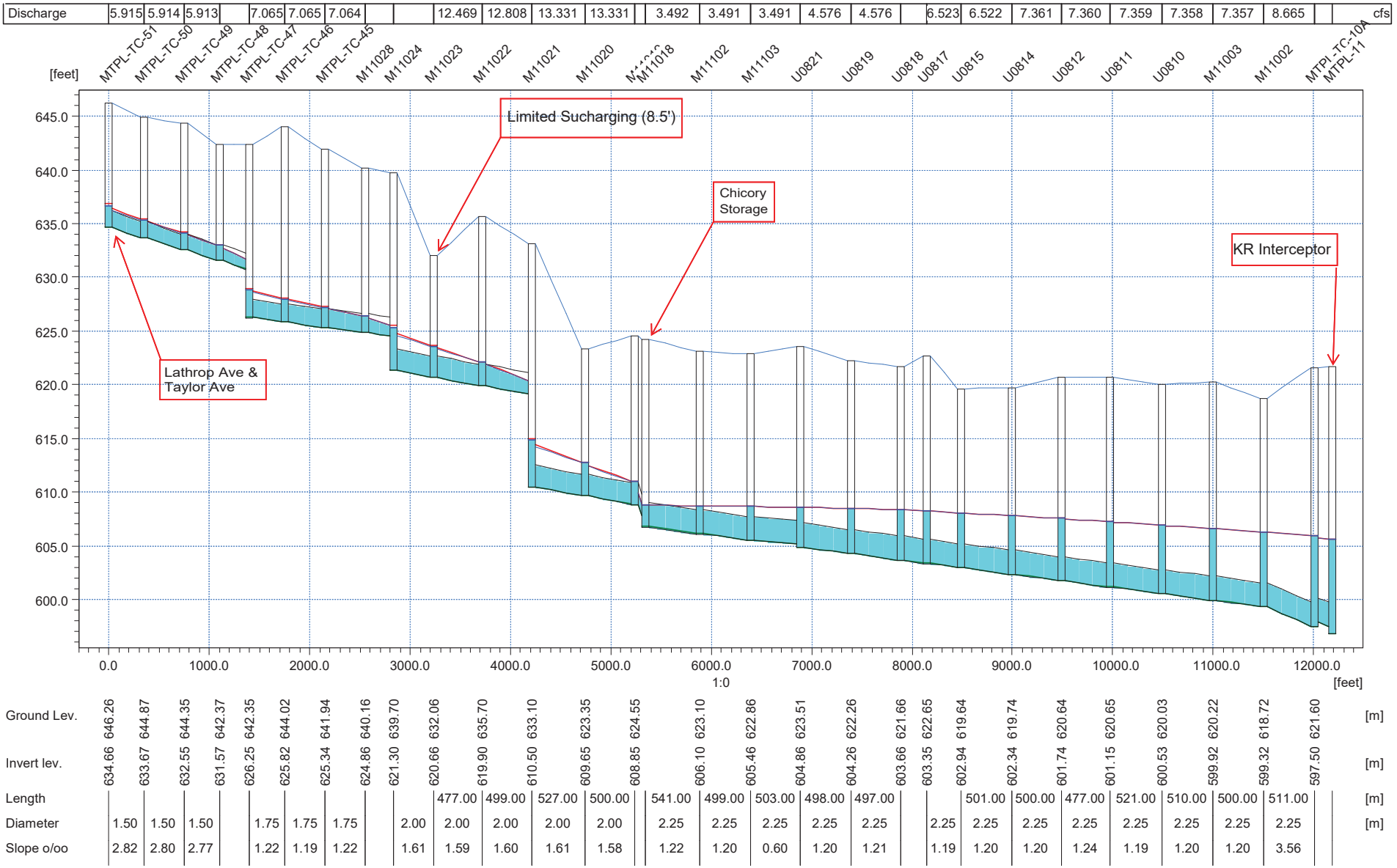
Projection:
NAD_1927_StatePlane_Wisconsin_South_FIPS_4803

0 0.125 0.25 0.5 Miles

2020 Condition - Chicory Road Interceptor
5-year, 6-hour Event



2040 Baseline Condition - Chicory Road Interceptor
5-year, 6-hour Event



Discharge	5.915	5.914	5.913		7.065	7.065	7.064			12.469	12.808	13.331	13.331		3.492	3.491	3.491	4.576	4.576		6.523	6.522	7.361	7.360	7.359	7.358	7.357	8.665			cfs
	MTPL-TC-51	MTPL-TC-50	MTPL-TC-49	MTPL-TC-48	MTPL-TC-47	MTPL-TC-46	MTPL-TC-45	M11028	M11024	M11023	M11022	M11021	M11020	M11019 M11018	M11102	M11103	U0821	U0819	U0818	U0817	U0815	U0814	U0812	U0811	U0810	M11003	M11002	MTPL-TC-10A MTPL-11			
Ground Lev.	646.26	644.87	644.35	642.37	642.35	644.02	641.94	640.16	639.70	632.06	635.70	633.10	623.35	624.55	623.10	622.86	623.51	622.26	621.66	622.65	619.64	619.74	620.64	620.65	620.03	620.22	618.72	621.60			[m]
Invert lev.	634.66	633.67	632.55	631.57	626.25	625.82	625.34	624.86	621.30	620.66	619.90	610.50	609.65	608.85	606.10	605.46	604.86	604.26	603.66	603.35	602.94	602.34	601.74	601.15	600.53	599.92	599.32	597.50			[m]
Length										477.00	499.00	527.00	500.00		541.00	499.00	503.00	498.00	497.00			501.00	500.00	477.00	521.00	510.00	500.00	511.00			[m]
Diameter	1.50	1.50	1.50		1.75	1.75	1.75		2.00	2.00	2.00	2.00	2.00		2.25	2.25	2.25	2.25	2.25		2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25			[m]
Slope o/oo	2.82	2.80	2.77		1.22	1.19	1.22		1.61	1.59	1.60	1.61	1.58		1.22	1.20	0.60	1.20	1.21		1.19	1.20	1.20	1.24	1.19	1.20	1.20	3.56			

Project number: 60554970

Appendix H Relationship of Facilities Plan to Actual Construction Commitments by the Racine Wastewater Utility

APPENDIX K

RELATIONSHIP OF FACILITIES PLAN TO ACTUAL CONSTRUCTION COMMITMENTS BY THE RACINE WASTEWATER UTILITY

APPENDIX K

RELATIONSHIP OF FACILITIES PLAN TO ACTUAL CONSTRUCTION COMMITMENTS BY THE RACINE WASTEWATER UTILITY

Prepared by Walter Kuhlmann
Davis & Kuelthau, S.C.
Special Counsel to the Racine Wastewater Utility

Introduction

The facilities planning process should be conducted independently of ongoing negotiations about future contracts regarding service. This independence allows the communities and the DNR to learn about likely future growth scenarios and the least cost mix of engineering options in the wastewater system which would be desired in the event all legal and policy issues among the communities can be amicably resolved. Also, a comprehensive and searching inquiry into engineering options is an indispensable basis for agreements on costs and the extent of service over the long run. It is appropriate that the analysis in this Facilities Plan precedes the completion of agreements on costs and extent of service.

Since the planning analysis precedes the execution of service agreements, it is not known at the time of submittal of the Facilities Plan to the DNR, and presentation to the public, whether agreements can be reached on the allocation of costs and the extent of service. In the event such agreements cannot be reached, this could have a number of significant impacts on the extent and timing of facilities that are ultimately constructed.

The Utility will not concur in service area expansions in the outlying communities (nor build related facilities) unless commitments are in place from the outlying communities which will result in the outlying communities bearing the full costs of service imposed by them on the regional system. Also, some of the key assumptions in choosing the most cost-

effective engineering solution overall for the region involve specific performance by the outlying communities, such as a desired level of I/I reduction. In the event such actions by the outlying communities are not forthcoming, the overall plan cannot be accomplished in the most cost-effective manner for the entire region.

In short, the public reviewing this Facilities Plan, as well as the DNR, should understand that the Facilities Plan is only a recommended Plan, and the nature and extent of its ultimate implementation is very much contingent upon a series of further legal and policy decisions and actions by the outlying communities as well as the Racine Wastewater Utility.

Brief History of Service Arrangements in the Service Area

In August of 1974, shortly after the passage of the Clean Water Act (CWA), the City of Racine created a wastewater utility to operate its wastewater treatment plant and related interceptors and lift stations, and to provide broader regional service under the planning concepts of the CWA. The Utility was created by Ordinance No. 29-74, adopted August 20, 1974.

A regional service contract was signed between the City (acting by and through its Utility) and the outlying communities effective January 1, 1977. That agreement terminated by its own terms twenty years later, on December 31, 1996.

At the time of execution of that contract, the vast majority of wastewater in the area originated within City limits. Since that first post-CWA contract was signed over 20 years ago, suburban sprawl and the exodus of Racine industry and residential development to the outlying communities have resulted in a larger share of the regional wastewater load emanating from the suburbs (now about 35% of flow). Pursuant to its WPDES permit, the Utility is required by the Department of Natural Resources (DNR) to engage in facilities planning for the next 20 years (as to plant) and next 30 years (as to interceptors). Under forecasts of growth derived largely from the Southeast Wisconsin Regional Planning Commission (SEWRPC), *over 95% of the increased capacity that will be built during this upcoming planning horizon will be attributable to growth and demand for service by the outlying communities.*

The Utility and the outlying communities have been engaged in discussions regarding facilities planning and a new service contract since early 1996. Early in 1996, the Utility began communicating with the outlying communities to request planning information, and to

request comment on population data and planning assumptions being used by the Utility's facilities planning consultants. On July 22, 1996, senior Utility staff and their facilities planning consulting firm, rate consultant, and legal counsel met with elected officials, staff and counsel for the outlying communities to: (a) explain the status of the facilities planning process, (b) specifically describe proposed changes to the Utility's rate system that would be instituted in early 1997 that were unrelated to facilities planning issues, and (c) specifically describe additional proposed changes that would address cost allocations for new capacity to be built pursuant to the facilities planning process. Counsel for the outlying communities requested more detail on the proposed changes to be instituted effective January 1, 1997, and the Utility provided that information. The Utility has furnished draft chapters of its facilities plan related to population and flow projections to the outlying communities for review and comment. After several iterations of review and comment, and after the Utility modified projections in response to such comments, the Utility's consultants have finalized usage projections and are now engaged in designing alternative plans for handling projected future usage. The Utility's growth and usage projections have been reviewed and approved by SEWRPC and DNR.

The January 1, 1977 regional service contract expired, by its own terms, on December 31, 1996. In order to fill gaps in the City ordinances for the Utility that had previously been addressed by the service contract, and to institute the rate concepts presented at the July 22, 1996 meeting that were unrelated to the pending facilities planning process, the Utility Commission and the Common Council adopted new ordinances. Ordinance 27-96 was adopted by the Common Council, upon recommendation of the Utility Commission, effective January 1, 1997, for these purposes.

During 1997, staff and counsel for the Utility have held several meetings with counsel for the outlying communities, and the Utility has proposed a detailed outline (15 pages, single-spaced) of a new service contract. Those discussions are progressing, and the Utility anticipates further meetings in 1998 as facilities planning information on design and costs, and proposed allocations of those costs, become available.

Until such time as new service contracts may be executed between the Utility and the outlying communities, the Utility will continue to provide wastewater service based on a utility-customer relationship within the Utility's service area as defined by law, and as currently mapped by SEWRPC, and as such area may be modified from time to time according to law.

Contingencies Affecting Construction Commitments by the Utility.

The Facilities Plan is prepared on the premise that the Utility needs to comprehend the facilities that would be required to serve current load, growth in the current service area, and potential growth in capacity due to possible future expansions of that area. Whether and when those expansions ever in fact occur, and whether the facilities described in this Plan are indeed constructed, depend on many factors, including but not limited to the existence of service agreements between the municipalities in the service area and the Racine Wastewater Utility, agreed expansions of the service area during the planning period pursuant to such service agreements, and enforceable commitments from outlying communities regarding I/I reduction.

Although there are a number of contingencies which will affect the ultimate decision by the Utility to commence construction of various aspects of the proposed Plan, it is important that this Plan examine the most expansive reasonably likely scenario for future treatment needs, so that the most cost-effective solutions for the region can be identified, and can be utilized for purposes of obtaining the necessary commitments from the outlying communities to accomplish the most cost-effective solution in the long run.

As one example, the proposed Plan includes a system-wide program to reduce I/I by 10 to 13%. If the outlying communities do not commit to, and begin effective implementation of, such a program, other aspects of the Plan will need to be revisited, and engineering responses which would not have been as cost-effective from system-wide perspective may need to be reconsidered. This is one example of how the system-wide proposed Plan is dependent on the cooperation and binding commitments of all local governments in the service area. If such commitments cannot be obtained, then this will have practical implications for the facilities that are ultimately constructed by the Utilities, and the timing and nature of implementation of the proposed Plan.

Another example would be those components of the proposed Plan which are largely if not exclusively required to serve increased populations in the outlying communities. The Utility will not concur in service area expansions in the outlying communities (nor build related facilities) unless commitments are in place from the outlying communities which will result in the outlying communities bearing the full costs of service imposed by them on the regional system.

The fact that facilities are proposed in this Plan shall not be construed as a consent or acquiescence by the City of Racine or the Utility in any service area expansions, and both the City of Racine and the Utility expressly do not give any such consent or acquiescence. Further, the fact that facilities are proposed in this Plan shall not be construed as a commitment or agreement by either the City of Racine or the Utility to actually construct any such facilities, which will be determined in subsequent decisions independent of, and outside of, this planning process, and which will be dependent on many factors in addition to Facilities planning, including WPDES permit requirements, ordinances, wastewater service contracts, and other matters. These same contingencies will also affect the timing and extent of preparation of plans and specifications related to specific construction activities, and the Utility may be precluded from proceeding with some or all of the preparation of plans and specifications if these contingencies are not resolved. This bifurcation of the planning process (to examine potential needs and facilities) and the ultimate decisions to construct specific facilities, is a fundamental premise of the Utility in issuing this Facilities Plan, and is an integral part of this Facilities Plan which the Utility will deem accepted if this Facilities Plan is approved.

G:\WK\2298\22713\0\WK2120.WPD

Appendix I SSR Flow Requests

Zapinski, Mike

From: Haas, Keith <Keith.Haas@cityofracine.org>
Sent: Wednesday, August 21, 2019 5:08 PM
To: Schroedel, Rusty; Zapinski, Mike
Subject: FW: Future Mt Pleasant sewer capcity
Attachments: Letter to Haas--Facilities Planning-2050 Flows 8-24-18.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

see attached letter referred to today with MP flow predictions

Keith E. Haas P.E.
General Manager
Racine Water and Wastewater Utilities
262-636-9434

From: Tony Beyer [tbeyer@mtpleasantwi.gov]
Sent: Wednesday, October 10, 2018 8:44 AM
To: Haas, Keith; dan.snyder@foth.com
Subject: RE: Future Mt Pleasant sewer capcity

Is this what you are looking for?

Anthony J. Beyer, P.E.
Village Engineer/Sanitary Sewer & Storm Water Utility Manager

Village of Mount Pleasant
8811 Campus Drive [MAP]
Mount Pleasant, Wisconsin 53406
Direct 262.664.7849
Main 262.664.7800
Fax 262.664.7801
tbeyer@mtpleasantwi.gov
www.mtpleasantwi.gov

From: Haas, Keith [mailto:Keith.Haas@cityofracine.org]
Sent: Wednesday, October 10, 2018 4:53 AM

To: dan.snyder@foth.com; Tony Beyer
Subject: Future Mt Pleasant sewer capcity

Tony and Dan:

My recollection is that in the past few months one or both of you has communicated a future need for the Village of Mt Pleasant for facilities planning on a 20 and 40 year planning horizon. I seem to be struggling to find that communication. If this did happen if one of you can refresh my memory with a sent email or copy of a letter I would greatly appreciate it. If it has not happened then i am simply hallucinating.

thanks for keeping me on the straight and narrow.

Keith E. Haas P.E.
General Manager
Racine Water and Wastewater Utilities
262-636-9434

VILLAGE OF
MOUNT PLEASANT
WISCONSIN

SEWER UTILITY
DISTRICT NO. 1

8811 Campus Drive
Mount Pleasant, WI
53406

T: 262.664.7800
F: 262.664.7848
info@mtpleasantwi.gov
www.mtpleasantwi.gov

August 24th, 2018

Mr. Keith Haas, P.E.—General Manager
Racine Water and Wastewater Utility
800 Center Street, Room 227
Racine, WI 53403

Re: Regional Facilities Planning—Projected Year 2050 Flows
Village of Mount Pleasant

Dear Mr. Haas,

The purpose of this letter is to provide the Village's estimated incremental waste water projections for the year 2050 to assist in the upcoming Regional Facilities Planning effort. Based on anticipated growth over the next 30 years, we have assumed that the entire Village would be developed. This assumption would require historic levels of development, however it does seem appropriate based on the Foxconn and ancillary developments (TID 1, 4 and 5 and adjacent lands).
We have relied on the Village's Master Land Use Plan and have supplemented this plan with potential land uses in those areas not currently identified as urbanized in the plan.

For the TID 5 and I-94 corridor areas, we utilized the flows generated as part of the TID 5 Facilities Plan. For all other areas of the Village, we developed individual incremental flow estimates for each sewershed and connection point. The total estimated incremental flow rate (average daily) is approximately 13.6 MGD.
Based on information supplied by your staff, we have estimated that the Village's average daily flow over the past 3-5 years has been about 6.0 MGD. The existing total treatment capacity allocation for Mt Pleasant after the transfer of 1.0 MGD from Caledonia will be 11.49 MGD. This leaves about 5.49MGD (11.49-6.0) of existing residual allocation. Therefore the net incremental 2050 average daily flow would be 8.11 MGD (13.6 MGD – 5.49MGD).

In order to provide more flexibility in planning for future waste water needs, we request that the proposed Facility Plan address needs and costs associated with an incremental daily flow for the Village of 8.11 MGD as well as a potential first phase need of approximately 4.0MGD.

We also request that the Technical Advisory Committee be reactivated to help guide the facility planning effort. We look forward to working with you on this important plan and are available to discuss any questions at your convenience.

Please contact me if you have any questions at (262) 664-7849.

Sincerely,
Mt. Pleasant Sewer Utility District #1

Anthony J. Beyer, P.E.
Utility Manager

Cc: Sewer Commission
Dan Snyder

From: Haas, Keith <Keith.Haas@cityofracine.org>
Sent: Wednesday, August 21, 2019 5:04 PM
To: Schroedel, Rusty; Zapinski, Mike
Subject: FW: Village of Caledonia - Wastewater Flow Projections
Attachments: Caledonia Flow Projection 7-27-18.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

See email chain below and attachment for forecasted Caledonia Flow

Keith E. Haas P.E.
General Manager
Racine Water and Wastewater Utilities
262-636-9434

From: Haas, Keith
Sent: Tuesday, August 07, 2018 4:00 PM
To: Schroedel, Ralph; brogne@BrwnCald.com; Peot, Kurt
Subject: FW: Village of Caledonia - Wastewater Flow Projections

Rusty and others:

The email below and the attached file will contain useful information for those of us that are involved in facilities planning, peak flow and modeling and cost of service studies. One piece of the puzzle anyway.

Keith E. Haas P.E.
General Manager
Racine Water and Wastewater Utilities
262-636-9434

From: Tony Bunkelman [ABunkelman@caledonia-wi.gov]
Sent: Wednesday, August 01, 2018 9:12 PM
To: Haas, Keith
Cc: Utilty- Bob Lui; Gitter, Mike
Subject: FW: Village of Caledonia - Wastewater Flow Projections

Keith

Attached is the Caledonia Utility District approved recommendations for sanitary sewer treatment capacity for the Village of Caledonia.
This information is for the Wastewater Treatment Capacity request sent out last August.

This Village of Caledonia is requesting 9.75 MGD of annual average daily flow.
This would be an increase from 5.13 to 9.75, total increase of 4.62 MGD daily.

If you have any questions please let me know.

Thanks

Tony

Anthony A. Bunkelman P.E.
Utility Director

VILLAGE OF CALEDONIA
5043 Chester Lane
Racine, WI 53402
262-835-6416
abunkelman@caledoniawi.com

From: Ludwig, Tom [mailto:Tom.Ludwig@Foth.com]
Sent: July 27, 2018 3:01 PM
To: Tony Bunkelman <ABunkelman@caledonia-wi.gov>
Subject: RE: Village of Caledonia - Wastewater Flow Projections

Tony,

Here you go. We can discuss when you get some time.

Thanks, Tom

Thomas J. Ludwig, PE, Client Director
Foth Infrastructure & Environment, LLC
Lincoln Center II
2514 South 102nd Street
Milwaukee, WI 53227
Ph: General (414) 336-7900
Direct (414) 336-7905

http://www.foth.com

From: Tony Bunkelman [mailto:ABunkelman@caledoniawi.com]
Sent: Thursday, July 26, 2018 10:37 AM
To: Ludwig, Tom <Tom.Ludwig@Foth.com>
Subject: Village of Caledonia - Wastewater Flow Projections

Tom

Due to the agreed upon changes (but yet to be certified) in the allocations to the connection points can you update the attached sheet with the new numbers.

Give me a call about this when you get a chance too.

Thanks

Tony

Anthony A. Bunkelman P.E.
Utility Director

VILLAGE OF CALEDONIA
5043 Chester Lane
Racine, WI 53402
262-835-6416
abunkelman@caledoniawi.com

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From: Jeffrey Seitz <Seitzj@sturtevant-wi.gov>
Sent: Thursday, April 9, 2020 9:13 AM
To: Zapinski, Mike; Schroedel, Rusty; Keith Haas
Subject: [EXTERNAL] Sewer capacity allocation

The Village of Sturtevant requests that in the Racine Wastewater Facility planning efforts an allocated capacity of 3 MGD ave daily flow be used for Sturtevant.

If there are any questions, please feel free to contact me directly.

Jeffrey A. Seitz, P.E.
Village Engineer / Public Works Director

2801 89th St.
Sturtevant, Wi 53177
Office 262-886-7202
Cell 262-770-2886
seitzj@sturtevant-wi.gov

Appendix J Summary of Public Participation