STATE OF MISSOURI

DEPARTMENT OF NATURAL RESOURCES

MISSOURI CLEAN WATER COMMISSION

CONSTRUCTION PERMIT

The Missouri Department of Natural Resources hereby issues a permit to:

City of Braymer
Braymer Wastewater Treatment Facility
108 East 2nd Street
Braymer, MO 64624

for the construction of (described facilities):

See attached.

Permit Conditions:

See attached.

Construction of such proposed facilities shall be in accordance with the provisions of the Missouri Clean Water Law, Chapter 644, RSMo., and regulation promulgated thereunder, or this permit may be revoked by the Department of Natural Resources.

As the department does not examine structural features of design or the efficiency of mechanical equipment, the issuance of this permit does not include approval of these features.

A representative of the department may inspect the work covered by this permit during construction. Issuance of a permit to operate by the department will be contingent on the work substantially adhering to the approved plans and specifications.

This permit applies only to the construction of water pollution control components; it does not apply to other environmentally regulated areas.

August 26, 2025
Effective Date

August 25, 2027
Expiration Date

Heather S. Peters, Director, Water Protection Program

CONSTRUCTION PERMIT

I. CONSTRUCTION DESCRIPTION

The proposed upgrades include Triplepoint NitrOx® (MMBR) system, sludge removal from the lagoons, new lagoon outfall piping, new yard piping, new outfall piping through a magnetic flow meter vault, and ultraviolet (UV) disinfection system.

This project will also include general site work appropriate to the scope and purpose of the project, removal and disposal of debris, and all other appurtenant work to make a complete and usable wastewater treatment plant.

II. COST ANALYSIS FOR COMPLIANCE

Pursuant to Section 644.145, RSMo., when issuing permits under this chapter that incorporate a new requirement for discharges from publicly owned combined or separate sanitary or storm sewer systems or publicly owned treatment works, or when enforcing provisions of this chapter or the Federal Water Pollution Control Act, 33 U.S.C. 1251 et seq., pertaining to any portion of a publicly owned combined or separate sanitary or storm sewer system or publicly owned treatment works, the Department of Natural Resources shall make a "finding of affordability" on the costs to be incurred and the impact of any rate changes on ratepayers upon which to base such permits and decisions, to the extent allowable under this chapter and the Federal Water Pollution Control Act. This process is completed through a cost analysis for compliance. Permits that do not include new requirements may be deemed affordable.

The department is not required to determine cost analysis for compliance because the permit contains no new conditions or requirements that convey a new cost to the facility.

III. CONSTRUCTION PERMIT CONDITIONS

The permittee is authorized to construct subject to the following conditions:

1. This construction permit does not authorize discharge.

2. All construction shall be in accordance with the plans and specifications submitted by Bartlett & West on July 16, 2025, signed and sealed by Matthew Vander Tuig, P.E., Jennifer Mcvey, P.E., Micheal Neufeld, P.E., and Chad Yost, P.E., and approved by the department on August 26, 2025.
   - Specifications, signed and sealed on May 27, 2025, May 28, 2025, May 29, 2025, and June 3, 2025.
   - Plans, signed and sealed on May 27, 2025, May 28, 2025, May 29, 2025, and June 2, 2025.

3. Regulation 10 CSR 20-4.040(18)(B)1 requires that projects be publicly advertised, allowing sufficient time for bids to be prepared and submitted. Projects should be advertised at least 30 days prior to bid opening.

4. The department must be contacted in writing prior to making any changes to the approved plans and specifications that would directly or indirectly have an impact on the capacity, flow, system layout, or reliability of the proposed wastewater treatment facilities or any design parameter that is addressed by 10 CSR 20-8, in accordance with 10 CSR 20-8.110(11).

5. As per 10 CSR 20-4.040, all changes in contract price or time within the approved scope of work must be by change order in accordance with Section 19 of this rule.

6. State and federal law does not permit bypassing of raw wastewater; therefore, steps must be taken to ensure that raw wastewater does not discharge during construction. If a sanitary sewer overflow or bypass occurs, report the appropriate information to the department's electronic Sanitary Sewer Overflow/Bypass Reporting system at https://dnr.mo.gov/mogem/ or Northeast Regional Office per 10 CSR 20-7.015(9)(G).

7. In addition to the requirements for a construction permit, 10 CSR 20-6.200 requires land disturbance activities of 1 acre or more to obtain a Missouri State Operating Permit to discharge stormwater. The permit requires best management practices sufficient to control runoff and sedimentation to protect waters of the state. Land disturbance permits will only be obtained by means of the department's ePermitting system available online at https://dnr.mo.gov/data-e-services/missouri-gateway-environmental-management-mogem. See https://dnr.mo.gov/data-e-services/water/electronic-permitting-epermitting for more information.

8. A United States Army Corps of Engineers (USACE) Section 404 Department of Army permit (§404) along with the department's Section 401 Water Quality Certification or waiver (§401) may be required for the activities described in this permit. This permit is not valid until these requirements are satisfied. If construction activity will disturb any land below the ordinary high water mark of jurisdictional waters of the U.S., then a §404/§401 will likely be required. Since the USACE makes determinations on what is jurisdictional, you must contact the USACE to determine permitting requirements. See https://dnr.mo.gov/water/business-industry-other-entities/permits-certification-engineering-fees/section-401-water-quality for more information you may contact the department's Water Protection Program at 573-522-4502 or wpsc401cert@dnr.mo.gov.

9. All construction must adhere to applicable 10 CSR 20-8 (Chapter 8) requirements.

10. Upon completion of construction:

    A. The City of Braymer will become the continuing authority for operation and maintenance of these facilities;

B. Submit an electronic copy of the as-builts if the project was not constructed in accordance with previously submitted plans and specifications; and

C. Submit the enclosed form Statement of Work Completed to the department in accordance with 10 CSR 20-6.010(5)(N) and request the operating permit modification be issued.

IV. REVIEW SUMMARY

1. CONSTRUCTION PURPOSE

The project includes modifications to the existing wastewater treatment system to better meet effluent limitations. The new NitrOx® system will allow for ammonia reduction while the UV disinfection system will help meet *E. coli* limits consistantly. Sludge removal will allow for better treatment and help meet new 5-day biochemical oxygen demand (BOD_5) and total suspended solids (TSS) limits as well as percent removal.

2. FACILITY DESCRIPTION

The exisiting facility has a three-cell lagoon, chlorination/dechlorination system, and sludge is retained in the cells. Additions to the wastewater treatment process include Triplepoint NitrOx® system, UV disinfection system, piping, and the removal of the chlorination/dechlorination system. Sludge will likely be removed from the lagoons. The upgrades will help meet *E. coli*, ammonia, BOD_5, and TSS limits as well as percent removal.

The Braymer Wastewater Treatment Facility (WWTF) project is located at 13510 Southeast Hwy N, Braymer, Missouri, in Caldwell County. The facility has a design average flow of 145,000 gallons per day (gpd) and serves a population equivalent of approximately 1450. The city has approximately 343 residential connections, 12 commercial connections, and no industrial connections. The collection system has approximately 8.43 miles of sewer mains.

3. COMPLIANCE PARAMETERS

The limits following the completion of construction will be applicable to the facility:

Parameter	Units	Daily Maximum	Monthly average limit
Biochemical Oxygen Demand$_5$	mg/L	45	30
Total Suspended Solids	mg/L	45	30
BOD_5 Percent Removal	%	-	85
TSS Percent Removal	%	-	85

4. REVIEW OF MAJOR TREATMENT DESIGN CRITERIA

Existing Components:

- Lagoon Cell Nos. 1, 2, and 3 are non-aerated.
  - Cell No. 1 has a wastewater volume of 14,200,000 gallons and 5.7 feet (ft) side water depth.

- Cell No. 2 has a wastewater volume of 8,800,000 gallons and 7.2 ft side water depth.
- Cell No. 3 has a wastewater volume of 2,500,000 gallons and 7.3 ft side water depth.

<u>New Components:</u>

- Lagoon aerator unit and blowers – one aeration unit will be added near the middle of Lagoon Cell No. 2. The aerator will supply 50 pounds per day of oxygen. Blowers shall be designed to supply a standard air flow of 37.71 standard cubic feet per minute (scfm) per blower. The discharge pressure shall be 5.64 pounds per square gauge (psig) and the minimum horsepower (HP) will be 3.0 HP for each blower. There shall be a minimum of two blower units, one for duty and one standby/backup.

- Airlift – Airflow for the primary airlift will be 8.14 cubic feet per minute (cfm) and the secondary airlift will provide 10.70 cfm. The air lift will push recycled flow from Cell 2 to the NitrOx unit and be accompanied with a 24-inch HDPE pipe.

- Triplepoint Water Technologies, LLC, NitrOx® – The lagoon-treated effluent will be pumped to the NitrOx® system. The NitrOx® system is capable of treating a design average flow of 115,000 gpd. The system is composed of two tanks with each approximately 16 ft x 8 ft with a sidewater depth of 14 ft. Total volume of the two tanks is 26,808 gallons. The average flow hydraulic retention time is 4.4 hours and the peak flow hydraulic retention time is 0.8 hours. A floating insulating cover shall be installed in each tank. An immersion tank heater will be installed to maintain a minimum wastewater temperature of 5°C. Each tank shall be filled with high surface area media. Aeration by means of tri-lobe or bi-lobe positive displacement blowers each capable of supplying a total of 126 scfm with 10 HP motors. The effluent from the NitrOx basins will flow to the clarifier for polishing prior to disinfection and discharge.

- Polishing Clarifier – There will be one polishing clarifier following the NitrOx® treatment. The basin will be 12 ft by 12 ft with approximaterly 17 ft of sidewater depth. The surface overflow rate at the average daily flow of 145,000 gpd equals 1,200 gpd per square foot.

- Ultraviolet Disinfection – Disinfection is the process of removal, deactivation, or killing of pathogenic microorganisms. A two bank UV disinfection system with 8 low pressure mercury slimline lamps in each lamp module shall be provided and capable of treating a peak flow of 290,000 gpd while delivering a minimum UV intensity of 30.0 mJ/cm2 with an expected ultraviolet transmissivity of 50% minimum.

- Flowmeters – Installation of an electro-magnetic partial flow measurement device will aid in wastewater service. An electromagnetic flow meter shall measure the flow from Lagoon Cell No. 3 and Lagoon Cell No. 3 bypass to the UV disinfection system.

5. OPERATING PERMIT

Operating permit MO-0028061 will require a modification to reflect the construction activities. The modified Braymer WWTF, MO-0028061, was successfully public noticed from June 27, 2025, to July 28, 2025 with no comments received. Submit the Statement of Work Completed to the department in accordance with 10 CSR 20-6.010(5)(N) and request the operating permit modification be issued.

Angie Garcia, E.I.
Financial Assistance Center
angie.garcia@dnr.mo.gov

APPENDICES

1. Process Flow Diagram
2. Summary of Design

APPENDIX 1 – PROCESS FLOW DIAGRAM

BAR IS ONE INCH ON OFFICIAL DRAWINGS. 0 1" IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

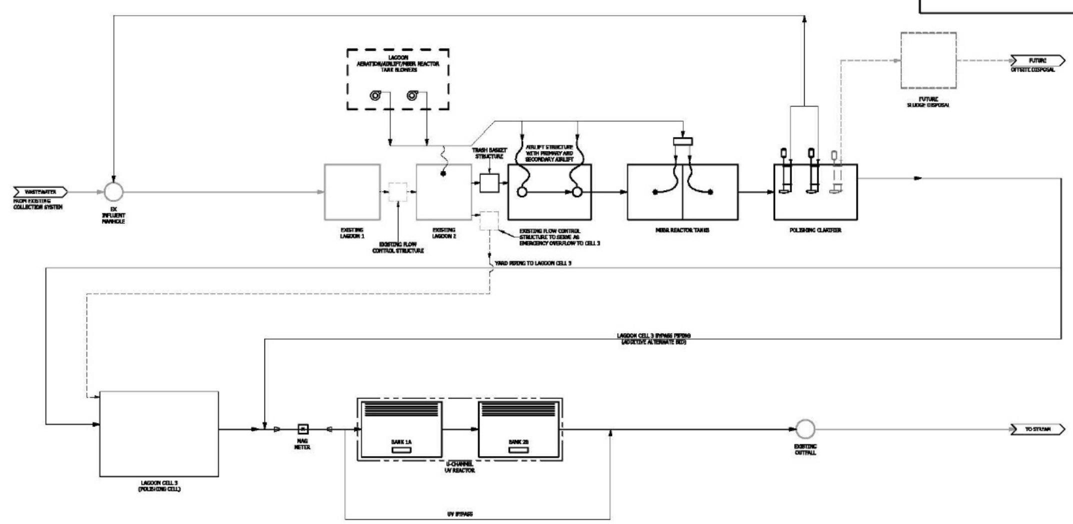
PROPOSED DESIGN CRITERIA	UNITS	VALUE
WWTF PLANT (INTO LAGOONS)		
AVERAGE DAILY FLOW	GPD	115,000
MAXIMUM MONTYLY AVERAGE DAILY FLOW	GPD	148,000
PEAK HOURLY INFLUENT FLOW	GPD	1,450,000
TREATMENT THROUGHPUT (INTO MBBR REACTOR TANKS)		
AVERAGE DAILY FLOW - DESIGN FLOW	GPD	145,000
PEAK DAILY FLOW (MAXIMUM PEAK DAILY HYDRAULIC THROUGHPUT)	GPD	165,085
INFLUENT LOADING @ AVERAGE DAILY FLOW OF 115,000 GPD:		
RAW WASTEWATER INFLUENT BOD	MG/L	191
RAW WASTEWATER INFLUENT TSS	MG/L	154
RAW WASTEWATER INFLUENT TKN	MG/L	25
RAW WASTEWATER INFLUENT ALKALINITY	MG/L	294
RAW WASTEWATER INFLUENT AMMONIA	MG/L	20

GENERAL NOTES:

1. PIPE, FITTINGS, VALVES, EQUIPMENT, ETC., TAGS AND LABELS ARE PROVIDED AS A COURTESY FOR THE CONTRACTOR. IT IS NOT THE INTENT OF THESE CALLOUTS, LABELS, AND TAGS TO BE A BILL OF MATERIALS LIST. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL ITEMS EITHER CALLED OUT OR SHOWN IN THE DRAWINGS AND OR SPECIFICATIONS.
2. NOT ALL PIPE SUPPORTS AND HANGARS ARE SHOWN. CONTRACTOR SHALL ADEQUATELY SUPPORT ALL PIPING PER SPEC SECTION 400521.

LEGEND

- PRIMARY LINE SEGMENT
- SECONDARY LINE SEGMENT
- PRIMARY LINE SEGMENT - FUTURE
- PRIMARY LINE SEGMENT - EXISTING
- EQUIPMENT
- EQUIPMENT BOUNDARY



Bartlett & West

GENERAL PROCESS FLOW DIAGRAM

WASTEWATER SYSTEM IMPROVEMENTS
CITY OF BRAYMER, CALDWELL COUNTY, MISSOURI

NOT FOR CONSTRUCTION

SEALED DATE:	----
DESIGNED BY:	HMD
DRAWN BY:	BDM
APPROVED BY:	MJV
DESIGN PROJ:	20334.003
DATE:	FEBRUARY 2025
DRAWING NO.	G-104
SHEET NO.	4 of 74

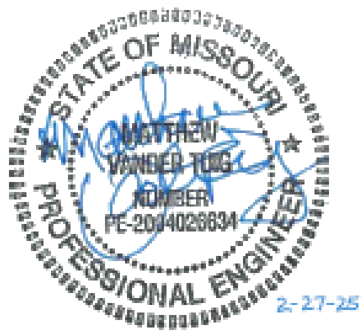
APPENDIX 2 – SUMMARY OF DESIGN

WASTEWATER SYSTEM IMPROVEMENTS

SUMMARY OF DESIGN

FOR

CITY OF BRAYMER, MISSOURI



MATTHEW J. VANDERTUIG – PROFESSIONAL ENGINEER
LICENSE NO. PE-2004026634

BARTLETT & WEST, INC.
MISSOURI CERTIFICATE OF AUTHORITY NO. 000167-ENGINEERING
601 MONROE STREET, SUITE 201
JEFFERSON CITY, MO 65101
573-634-3181

PROJECT NO. 20114.003

TREATMENT DESIGN PARAMETERS:

DESIGN PLANT INFLUENT WASTEWATER		
Plant Flow		
Average Daily Flow - Design Flow	115,000	gpd
Maximum Monthly Average Daily Flow (BASIS FOR TREATMENT CALCS)	145,000	gpd
Peak Hourly Influent Flow	1,450,000	gpd
Treatment Throughput Flow		
Average Daily Flow - Design Flow	115,000	gpd
Peak Daily Flow (maximum peak daily hydraulic throughput)	162,000	gpd
Influent Loading @Average Daily Flow (115,000 gpd)		
BOD	131	mg/L
	125.6	lbs/day
TSS	154	mg/L
	147.7	lbs/day
NH3-N	15	mg/L
	14.4	lbs/day
TKN	25	mg/L
	24.0	lbs/day
Total P	3	mg/L
	2.9	lbs/day
Oil & Grease	15	mg/L
	14.4	lbs/day
Alkalinity	294	mg/L
	282.0	lbs/day
EXISTING LAGOONS		
Cell 1		
Lagoon Bottom Elevation	731.0	ft
Lagoon Bottom Surface Area	309,604	ft2
	7.1	acres
Lagoon Max Elevation (assuming 2-ft freeboard)	736.7	ft
Lagoon Max Level Surface Area (assuming 2-ft freeboard)	359,605	ft2
	8.3	acres
Max Depth	5.7	ft
Cell 2		
Lagoon Bottom Elevation	728.0	ft
Lagoon Bottom Surface Area	148,185	ft2
	3.4	acres
Lagoon Max Elevation (assuming 2-ft freeboard)	735.2	ft
Lagoon Max Level Surface Area (assuming 2-ft freeboard)	182,464	ft2
	4.2	acres
Max Depth	7.2	ft
Cell 3		
Lagoon Bottom Elevation	727.5	ft
Lagoon Bottom Surface Area	38,175	ft2
	0.9	acres
Lagoon Max Elevation (assuming 2-ft freeboard)	734.8	ft
Lagoon Max Level Surface Area (assuming 2-ft freeboard)	56,630	ft2
	1.3	acres
Max Depth	7.3	ft
PERMITTED PLANT EFFLUENT LIMITS		
Permitted Average Daily Flow	145,000	gpd
BOD Monthly Average	30	mg/L
BOD Weekly Average	45	mg/L
TSS Monthly Average	30	mg/L
TSS Weekly Average	45	mg/L
NH3-N Maximum Daily Limit (January)	12.1	mg/L
NH3-N Monthly Average Limit (January)	3.1	mg/L
NH3-N Maximum Daily Limit (February)	10.1	mg/L
NH3-N Monthly Average Limit (February)	2.7	mg/L
NH3-N Maximum Daily Limit (March)	10.1	mg/L
NH3-N Monthly Average Limit (March)	2.7	mg/L
NH3-N Maximum Daily Limit (April)	10.1	mg/L
NH3-N Monthly Average Limit (April)	2.3	mg/L
NH3-N Maximum Daily Limit (May)	12.1	mg/L
NH3-N Monthly Average Limit (May)	1.9	mg/L
NH3-N Maximum Daily Limit (June)	12.1	mg/L
NH3-N Monthly Average Limit (June)	1.5	mg/L
NH3-N Maximum Daily Limit (July)	10.1	mg/L

TREATMENT DESIGN PARAMETERS:

NH3-N Monthly Average Limit (July)	1.1	mg/l
NH3-N Maximum Daily Limit (August)	12.1	mg/l
NH3-N Monthly Average Limit (August)	1.3	mg/l
NH3-N Maximum Daily Limit (September)	12.1	mg/l
NH3-N Monthly Average Limit (September)	1.7	mg/l
NH3-N Maximum Daily Limit (October)	12.1	mg/l
NH3-N Monthly Average Limit (October)	2.6	mg/l
NH3-N Maximum Daily Limit (November)	12.1	mg/l
NH3-N Monthly Average Limit (November)	3.1	mg/l
NH3-N Maximum Daily Limit (December)	10.1	mg/l
NH3-N Monthly Average Limit (December)	2.7	mg/l
E-Coli Weekly Average (#/100 ml)	1030	#
E-Coli Monthly Average (#/100 ml)	206	#
Oil & Grease Daily Maximum	15	mg/l
Oil & Grease Monthly Average	10	mg/l
pH (min)	6.5	SU
pH (max)	9	SU

Ares Aeration® & NitrOx® Basis of Design

Date: 08-01-2024
Project Name: Braymer, MO
Project Number: 6430

The Aeration Process

Biological Oxygen (BOD) Calculations

Removal of BOD (and CBOD) takes place naturally in an aerated lagoon. The Characteristic Equation for treatment efficiency of 5-Day Biological Oxygen Demand is given in Equations 1 through 3, at the bottom of this report. These calculations are used to size the lagoons. They are independent of the aeration calculations and assume that sufficient dissolved oxygen levels are maintained in the water. The equation is dependent on time and temperature. For lagoons operated in series, the equation is applied separately to each cell and the results are combined.

Aeration Requirement Calculations

Aeration calculations are more complicated than biological calculations as they depend on several factors. These include:

- Site conditions, such as treatment depth, elevation, and temperature.
- Design parameters, such as minimum dissolved oxygen (DO) level and oxygen supply rate.
- Actual Oxygen Requirement (AOR), which is based on the nutrient loading rates (these can include BOD/CBOD and TKN/NH_3-N and are based on the product of nutrient concentrations and the wastewater flowrate).
- Type of aerator.
- Oxygen transfer efficiency (OTE) of the aerator, which should be measured by an independent lab.
- Field condition adjustments (see Equation 2, below).
- Mixing requirements, such as complete or partial mix. The former is generally only required for activated sludge basins (ASB) or other high strength processes with short detention times.

Aerated Lagoons—Long Treatment Times

Aerated lagoons are typified by their comparatively large size and long treatment times (usually greater than 10 days). Influent concentrations are low to moderate (usually less than 300 mg/L of BOD). The bulk of the treatment takes place aerobically with additional anaerobic respiration taking place on the lagoon floor. Aerated lagoons do not generally have a mixed liquor suspended solids (MLSS) or return activated sludge (RAS) component. Partial mixing is required to prevent stratification and eliminate dead zones; however, complete mix is not necessary.

Aerated lagoons are typically designed to operate at a minimum DO level of 2 mg/L. Oxygen is usually supplied at a rate of 1.5 times the BOD demand. If nitrification/denitrification takes place, the oxygen supply rate is designed for 4.6 times the nitrogenous oxygen demand (NBOD).

Activated Sludge Basins (ASB)

Activated sludge basins (ASB) and other related wastewater tanks and lagoons are characterized by short treatment times (usually from 1 to 5 days), high wastewater strengths, and an active biomass that must be maintained in suspension to prevent rapid sludge accumulation. A high strength (greater than 2,000 mg/L) return activated sludge (RAS) component is usually fed back into the basin from a downstream clarifier. Biological nutrient removal is much faster in these basins.

ASBs are typically designed to operate at a minimum DO level of 1 to 2 mg/L. Oxygen is supplied at a rate of 1.0 to 1.5 times the BOD demand. If nitrification/denitrification takes place, the oxygen supply rate is designed for 4.0 to 4.6 times the nitrogenous oxygen demand (NBOD). An aeration system is based on both oxygenation requirements and complete mix requirements, whichever is greater.

TRIPLEPOINT ENVIRONMENTAL
Detailed Design Calculations: Aerated Lagoons

SUMMARY - General Design Parameters

v4.4 B		Design Scenario Name		Max month
	1	Influent Flowrate	MGD	0.145
	2	Influent Concentration	mg/L	131.0
	3	Effluent Conc. (Summer)	mg/L	2.0
	4	Effluent Conc. (Winter)	mg/L	7.7
	5	Actual Oxygen Supplied	lb/day	50.0
	6	Air included for nitrification?		No
	7	Number of Aerators		1
	8	Estimated Tubing Length	ft	300
	9	Standard Airflow	SCFM	37.71
	10	Inlet Airflow	ICFM	44.00
	11	Design Pressure (w/cushion)	psig	5.64
	12	Projected Brake Hp	bhp	1.33
	13	Estimated Design Hp (in NitrOx-Combined Blower)	hp	3.0

1. $FTE = \alpha\,(SOTE)\,\theta^{(T-20)}\,(\beta\,C^*_{\infty T} - DO) \div C^*_{\infty 20}$ *field transfer efficiency*

Where,

α	contaminant factor {contaminants, depth, bubble size} (range: 0.40–0.70)
β	TDS factor {total dissolved solids} (range: 0.90–1.00)
$\theta = 1.024$	temperature factor
DO	target dissolved oxygen level (mg/L)
$C^*_{\infty T}$	saturation oxygen concentration at site—adjusted for water depth
$C^*_{\infty 20}$	sat. oxygen concentration at STP conditions—adjusted for water depth
T	water temperature (Celsius)

2. Airflow = AOR / (25.056 * FTE)
3. $E = 2.3 * k * t / (1 + 2.3 * k * t)$ *biological treatment efficiency*

Where,

k = varies	kinetic coefficient {related to temperature} (range: 0.06 to 0.12)
t = time	treatment time in days

SUMMARY - Biological Treatment Calculations

	Item	Description	Units	Max month
	1	Number of Treatment Cells		3
	2	Flow Regime		Series
	3	Site Elevation - HWL	ft	774
Cell 1				
	4	Wastewater Flowrate	MGD	0.1
	5	Treatment Volume	M-Gal	14.2
	6	Treatment Time	days	97.9
	7	Treatment Type	-	Facultative
	8	Std Reaction Rate, k_{20}	$days^{-1}$	0.06
Summer	9	Design Water Temp	°C	20
Summer	10	Design Reaction Rate, k_T	$days^{-1}$	0.026
Summer	11	Biological Treatment Eff.	%	85.5%
Summer	12	Influent BOD Loading	lb/day	158
Summer	13	Influent BOD Concentration	mg/L	131.0
Summer	14	BOD Removed	lb/day	135
Summer	15	Effluent BOD Loading	lb/day	23
Summer	16	Effluent BOD Concentration	mg/L	19.1
Winter	17	Design Water Temp	°C	0.5
Winter	18	Biological Treatment Eff.	%	74.7%
Winter	19	BOD Removed	lb/day	118.1
Winter	20	Effluent BOD Concentration	mg/L	33.2
	N1	Influent NBOD Loading	lb/day	30
	N2	Influent NBOD Conc.	mg/L	25.0
	N3	Assumed NBOD Removed	lb/day	-
	N4	Effluent NBOD Loading*	lb/day	30
	N5	Assumed Eff. NBOD Conc.	mg/L	25
Cell 2				
	21	Wastewater Flowrate	MGD	0.1
	22	Treatment Volume	M-Gal	8.8
	23	Treatment Time	days	61.0
	24	Treatment Type	-	Facultative
	25	Std Reaction Rate, k_{20}	$days^{-1}$	0.06
Summer	26	Design Water Temp	°C	20
Summer	27	Design Reaction Rate, k_T	$days^{-1}$	0.026
Summer	28	Biological Treatment Eff.	%	78.5%
Summer	29	Influent BOD Loading	lb/day	23
Summer	30	Influent BOD Concentration	mg/L	19.1
Summer	31	BOD Removed	lb/day	18
Summer	32	Effluent BOD Loading	lb/day	5
Summer	33	Effluent BOD Concentration	mg/L	4.1
Winter	34	Design Water Temp	°C	0.5
Winter	35	Biological Treatment Eff.	%	64.7%
Winter	36	BOD Removed	lb/day	26.0
Winter	37	Effluent BOD Concentration	mg/L	11.7
	N6	Influent NBOD Loading	lb/day	30
	N7	Influent NBOD Conc.	mg/L	25.0
	N8	Assumed NBOD Removed	lb/day	-
	N9	Effluent NBOD Loading*	lb/day	30
	N10	Assumed Eff. NBOD Conc.	mg/L	25

Cell 3				
	38	Wastewater Flowrate	MGD	0.1
	39	Treatment Volume	M-Gal	2.5
	40	Treatment Time	days	17.5
	41	Treatment Type	-	Facultative
	42	Std Reaction Rate, k_{20}	$days^{-1}$	0.06
Summer	43	Design Water Temp	°C	20
	44	Design Reaction Rate, k_T	$days^{-1}$	0.026
	45	Biological Treatment Eff.	%	51.3%
	46	Influent BOD Loading	lb/day	4.9
	47	Influent BOD Concentration	mg/L	4.1
	48	BOD Removed	lb/day	3
	49	Effluent BOD Loading	lb/day	2.41
	50	Effluent BOD Concentration	mg/L	2.0
Winter	51	Design Water Temp	°C	0.5
	52	Biological Treatment Eff.	%	34.6%
	53	BOD Removed	lb/day	4.9
	54	Effluent BOD Concentration	mg/L	7.7
	N11	Influent NBOD Loading	lb/day	30
	N12	Influent NBOD Conc.	mg/L	25.0
	N13	Assumed NBOD Removed	lb/day	-
	N14	Effluent NBOD Loading*	lb/day	30
	N15	Assumed Eff. NBOD Conc.	mg/L	25

SUMMARY - Aeration Calculations

Item		Description	Units	Max month
	1	Site Elevation	ft	774
	2	O_2 Loading Factor (BOD_5)	O2/BOD	1.5
	3	Alpha-value, α		0.60
	4	Beta-value, β		0.95
	5	Theta-value, θ		1.02
Cell 2				
	22	Lagoon Side Water Depth	ft	7.20
	23	Air Release Depth	ft	6.45
	24	AOR - Total	lb/day	50
	25	SOTE/ft	%/ft	2.11%
	26	SOTE	%	13.62%
	27	Design DO Concentration	mg/L	2.0
	28	FTE		5.29%
	29	Air requirement	scfm	38
	30	Airflow per aeration unit	scfm	37.7
	31	Aerator Type		750T
	32	Number of aeration units	units	1
	33	Water Pressure	psig	2.79
	34	Aerator Pressure Loss	psig	0.55
	35	Header/Feeder P Loss	psig	1.30
	36	Total Operating Pressure	psig	4.64
	37	Design Motor Pressure	psig	5.64

The NitrOx® Process

The patented NitrOx Process was developed based on the principle that nitrification will reliably occur when the proper conditions are created. For wastewater lagoon systems that receive primarily domestic waste, the critical conditions required for nitrification include:

- **CBOD** of 20–30 mg/L
- **Dissolved Oxygen** of 4.6 lb/O_2 per pound of NH_3-N (Metcalf & Eddy)
- **Sufficient population of Nitrifying bacteria**
- Given sufficient Nitrifying bacteria, a **water temperature of 4–5° C**

The NitrOx Process utilizes the existing lagoon infrastructure for 90% BOD removal, after which nitrifying bacteria begin to nitrify. The effluent from the lagoons then flows hydraulically or is pumped into a two-stage nitrification reactor. In colder climates where the winter water temperature drops below 4° C, a thermal regulation heat exchanger is added in order to increase the water temperature; typically, only a few degrees during the coldest months of the year. In the two NitrOx Reactor cells, there are millions of individual biofilm carriers that provide a habitat for nitrifying bacteria, ensuring that there are sufficient nitrifying bacteria even in the coldest water conditions. Each NitrOx Reactor cell has aeration to provide the necessary oxygen, as well as to create a complete mix environment to keep the biofilm carriers in constant motion. The two cells are covered with floating insulated covers to mitigate heat loss and the media is kept in the tanks with stainless steel sieves. Finally, the effluent from the second NitrOx Reactor is discharged into a final polishing/clarification lagoon prior to the ultimate discharge from the lagoon system.

NitrOx® LAGOON AMMONIA REMOVAL

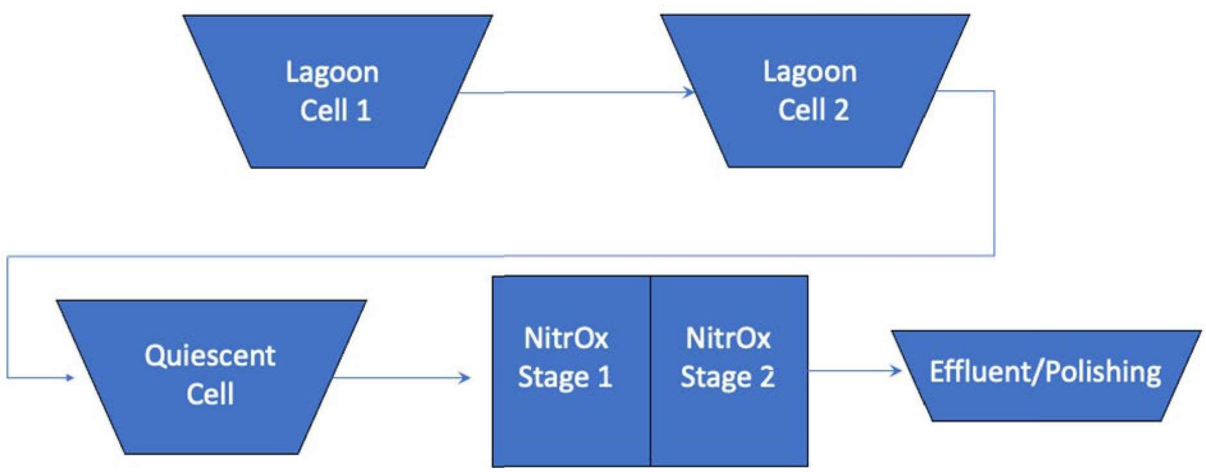


Figure 1: Typical flow process of the NitrOx Lagoon Ammonia Removal Process.
*Note that other configurations are possible.

TRIPLEPOINT ENVIRONMENTAL
Detailed Design Calculations: NitrOx

SUMMARY - Design Input Values			
	Plant Influent Characteristics	**Units**	**Values**
1	Annual Average Daily Flow	gpd	115,000
2	Maximum Monthly Average Daily Flow	gpd	145,000
3	Peak Daily Flow	gpd	179,001
4	Peak Hourly Flow	gpd	1,450,000
5	Influent BOD	mg/L	131
6	Influent BOD	lbs/day	158.4
7	Influent TSS	mg/L	154
8	Influent TSS	lbs/day	186.2
9	Influent NH3-N	mg/L	20.0
10	Influent NH3-N	lbs/day	24.2
11	Influent TKN	mg/L	25.0
12	Influent TKN	lbs/day	30.2
A1	Influent NOx-N	mg/L	0.0
A2	Influent NOx-N	lbs/day	0.0
13	Influent pH		7
14	Water Temperature	deg-C	12
	NitrOx Influent Characteristics	**Units**	**Values**
15	Annual Average Daily Flow	gpd	115,000
16	Maximum Monthly Average Daily Flow	gpd	145,000
17	Peak Daily Flow	gpd	162,000
18	Peak Hourly Flow	gpd	797,500
19	Influent BOD	mg/L	20
20	Influent TSS	mg/L	20
21	Influent NH3-N	mg/L	20.0
22	Influent TKN	mg/L	25.0
23	Design Influent TKN	mg/L	25.0
A3	Design Influent NOx-N	mg/L	0
A4	Alkalinity Required as CaCO3 (Minumum)	mg/L	200
24	Influent pH		7
25	NitrOx Water Temperature	deg-C	5

SUMMARY - General Design Parameters			
	NitrOx Tank Sizing Summary	**Units**	**Values**
26	Number of Treatment Trains Proposed		1
27	Number of Tanks Per Train		2
28	Total Number of Tanks		2
29	Length of Each	ft	16.0
30	Width of Each	ft	8.0
31	Side Water Depth of Each	ft	14
32	Tank Height of Each	ft	17
33	Volume of Each	gallons	13,404
34	Volume Total	gallons	26,808
35	Hydraulic Retention Time at Max Month Flow	hours	4.4
36	Hydraulic Retention Time at Peak Hourly Flow	hours	0.8
40	Number of Ares Units per Tank		2
41	Total Number of Ares Units		4

	NitrOx Air Requirement (Per Treatment Train)	Stage 1	Stage 2
42	AOR (lbs/day)	86	86
43	Assumed Diffuser Subm. at AWL (ft.)	13.25	13.25
44	Elevation (ft.)	774	774
45	Alpha	0.70	0.70
46	Beta	0.95	0.95
47	Target DO Residual (MBBR Process) (mg/L)	5.0	5.0
48	SOR (lbs/day)	261	260
49	Target Diffuser Efficiency/ft. Submergence	2.3	2.3
50	**Airflow (scfm)**	**34**	**34**

	NitrOx Blower Requirement Summary	Units	Values
51	No. of Blowers (Includes one redundant)		2
52	Airflow Requirement per Blower	scfm	68 + 20 SCFM Airlift
53	Airflow per 1,000 scfm	scfm/1,000 cf	19
54	Water Pressure at Air Release Depth	psig	5.74
55	Piping and Diffuser Losses	psig	1.50
57	**Maximum Design Discharge Pressure**	**psig**	**7.24**
58	Assumed Overall Efficiency		0.62
59	Approximate BHP Requirement/Blower	bhp	3.3
60	Approximate BHP Requirement Total	bhp	3.3
61	Estimated Nameplate HP / Blower (adder for lagoon aeration requirement and airlift included)	hp	10.0
62	Blower Type		Tri-Lobe PD

SUMMARY - Calculated Output Values

	NitrOx Effluent Parameters	Units	Values
63	Effluent SCBOD	mg/L	7.5
64	Effluent SCBOD	lbs/day	9.1
65	Effluent NH3-N in Winter (Monthly Average)	mg/L	2.6
66	Effluent NH3-N in Winter (Monthly Average)	lbs/day	3.1
67	Effluent NH3-N in Summer (Monthly Average)	mg/L	1.1
68	Effluent NH3-N in Summer (Monthly Average)	lbs/day	1.3

4. $FTE = \alpha\ (SOTE)\ \theta^{(T-20)}\ (\beta\ C^*_{\infty T} - DO) \div C^*_{\infty 20}$ *field transfer efficiency*

Where,

α	contaminant factor {contaminants, depth, bubble size} (range: 0.40–0.70)
β	TDS factor {total dissolved solids} (range: 0.90–1.00)
$\theta = 1.024$	temperature factor
DO	target dissolved oxygen level (mg/L)
$C^*_{\infty T}$	saturation oxygen concentration at site—adjusted for water depth
$C^*_{\infty 20}$	sat. oxygen concentration at STP conditions—adjusted for water depth
T	water temperature (Celsius)

Braymer Primary Air Lift Calculations (162,085 GPO)

Calculations for an air lift assembly

Enter data in green cells only

Pumping rate	162,085	gallon/day	Input data
Pipe diameter	4.03	inch	
submergence	9.18	ft	
lift	2.37	ft	
% submergence	80%		
cross-sectional area of pipe	0.088	ft2	Don't change anything
Pipe volume	0.81	ft3	
Pipe volume/cu.ft.	7.48	gallon	
Vl (Flow rate)	112.56	GPM	
A (Pipe area)	0.088	ft2	
L (Lift)	2.4	ft	
D (Pipe diameter)	4.026	inch	
Lf (density of fluid)	62.4	lb/ft3	
S (submergence)	9.18	ft	
Lg (Gas density)	0.0765	lb/ft3	
Value of Ordinate	65,167	6.52E+04	
Value of Abscissa	100<Y<10,225	7.68	
	10,225<Y<73,637	7.24	
	73,637<Y<117,690	7.17	
	117,690<Y<123.645	0.14	
	123,645<Y<128,308	0.00	
	128,308<Y<99,018	8.98	
Graph reading	7.24		
Vg (Gas flow)	8.14	ft3/min	Answer
Pressure	3.98	psi	

Results from left	
gal/day	162,085
gal/hr	6753.54
gal/min	112.56

Calculate needed gals/day	
4166.667	gal/hr
100,000	gal/day

Calculation of maximum air lift pump capacity								
total length	10.83	feet	330.0984	cm	feet of water	7.2561		
submergence	67	%	0.67	feet of rise		3.5739		
pipe diameter	4.03	inches	10.2362	cm				
water flow	472.148	liter/min	124.742	gal/min	179,627.85	gal/day		

optimal air flow range for these parameters				
8%	437.17	liter/min	15.43	cfm
9%	433.16	liter/min	15.29	cfm
pressure	3.14	PSI		

Braymer Secondary Air Lift Calculations (162,085 GPD)

Enter data in green cells only

Calculations for an air lift assembly

Pumping rate	162,085	gallon/day
Pipe diameter	4.03	inch
submergence	10.88	ft
lift	3.62	ft
% submergence	75%	

Input data

cross-sectional area of pipe		0.088	ft2
Pipe volume		0.96	ft3
Pipe volume/cu.ft.		7.48	gallon
Vl (Flow rate)		112.56	GPM
A (Pipe area)		0.088	ft2
L (Lift)		3.6	ft
D (Pipe diameter)		4.026	inch
Lf (density of fluid)		62.4	lb/ft3
S (submergence)		10.88	ft
Lg (Gas density)		0.0765	lb/ft3
Value of Ordinate		69,358	6.94E+04
Value of Abscissa	100<Y<10,225		8.18
	10,225<Y<73,637		7.70
	73,637<Y<117,690		7.65
	117,690<Y<123.645		0.24
	123,645<Y<128,308		0.00
	128,308<Y<99,018		9.79
Graph reading		7.70	

Don't change anything

Vg (Gas flow)	10.70	ft3/min
Pressure	4.71	psi

Answer

Results from left	
gal/day	162,085
gal/hr	6753.54
gal/min	112.56

Calculate needed gals/day	
4166.667	gal/hr
100,000	gal/day

Calculation of maximum air lift pump capacity							
total length	10.83	feet	330.0984	cm	feet of water	7.2561	
submergence	67	%	0.67	feet of rise		3.5739	
pipe diameter	4.03	inches	10.2362	cm			
water flow	472.148	liter/min	124.742	gal/min	179,627.85	gal/day	

optimal air flow range for these parameters				
8%	437.17	liter/min	15.43	cfm
9%	433.16	liter/min	15.29	cfm
pressure	3.14	PSI		

Braymer Primary Air Lift Calculations (115,000 GPO) Enter data in green cells only

Pumping rate	115,000	gallon/day
Pipe diameter	4.03	inch
submergence	8.47	ft
lift	3.08	ft
% submergence	73%	

Input data

cross-sectional area of pipe	0.088	ft2
Pipe volume	0.75	ft3
Pipe volume/cu.ft.	7.48	gallon
Vl (Flow rate)	79.86	GPM
A (Pipe area)	0.088	ft2
L (Lift)	3.1	ft
D (Pipe diameter)	4.026	inch
Lf (density of fluid)	62.4	lb/ft3
S (submergence)	8.47	ft
Lg (Gas density)	0.0765	lb/ft3
Value of Ordinate	56,665	5.67E+04
Value of Abscissa	100<Y<10,225	6.71
	10,225<Y<73,637	6.35
	73,637<Y<117,690	6.26
	117,690<Y<123.645	0.04
	123,645<Y<128,308	0.00
	128,308<Y<99,018	7.50
Graph reading	6.35	

Don't change anything

Vg (Gas flow)	8.14	ft3/min
Pressure	3.67	psi

Answer

Calculations for an air lift assembly

Results from left	
gal/day	115,000
gal/hr	4791.67
gal/min	79.86

Calculate needed gals/day	
4166.667	gal/hr
100,000	gal/day

Calculation of maximum air lift pump capacity							
total length	10.83	feet	330.0984	cm	feet of water	7.2561	
submergence	67	%	0.67	feet of rise		3.5739	
pipe diameter	4.03	inches	10.2362	cm			
water flow	472.148	liter/min	124.742	gal/min	179,627.85	gal/day	

optimal air flow range for these parameters				
8%	437.17	liter/min	15.43	cfm
9%	433.16	liter/min	15.29	cfm
pressure	3.14	PSI		

Braymer Secondary Air Lift Calculations (115,000 GPD)

Enter data in green cells only

Pumping rate	115,000	gallon/day
Pipe diameter	4.03	inch
submergence	9.85	ft
lift	4.65	ft
% submergence	68%	

Input data

cross-sectional area of pipe	0.088	ft2
Pipe volume	0.87	ft3
Pipe volume/cu.ft.	7.48	gallon
Vl (Flow rate)	79.86	GPM
A (Pipe area)	0.088	ft2
L (Lift)	4.7	ft
D (Pipe diameter)	4.026	inch
Lf (density of fluid)	62.4	lb/ft3
S (submergence)	9.85	ft
Lg (Gas density)	0.0765	lb/ft3
Value of Ordinate	60,931	6.09E+04
Value of Abscissa	100<Y<10,225	7.19
	10,225<Y<73,637	6.79
	73,637<Y<117,690	6.70
	117,690<Y<123.645	0.08
	123,645<Y<128,308	0.00
	128,308<Y<99,018	8.22
Graph reading	6.79	

Don't change anything

Vg (Gas flow)	10.70	ft3/min
Pressure	4.26	psi

Answer

Calculations for an air lift assembly

Results from left	
gal/day	115,000
gal/hr	4791.67
gal/min	79.86

Calculate needed gals/day	
4166.667	gal/hr
100,000	gal/day

Calculation of maximum air lift pump capacity							
total length	10.83	feet	330.0984	cm	feet of water	7.2561	
submergence	67	%	0.67	feet of rise		3.5739	
pipe diameter	4.03	inches	10.2362	cm			
water flow	472.148	liter/min	124.742	gal/min	179,627.85	gal/day	

optimal air flow range for these parameters				
8%	437.17	liter/min	15.43	cfm
9%	433.16	liter/min	15.29	cfm
pressure	3.14	PSI		

CHECK OF RECIRCULATION NEEDS FOR HIGH EVAPORATION DURING DRY SUMMER MONTHS TO MAINTAIN FLOW THROUGH TRIPLEPOINT

CHECK OF BRAYMER PROJECT

Evaporation in Inches per Month											
Jan	Fob	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.00	0.00	0.00	4.07	5.04	6.11	6.66	6.10	4.63	3.49	0.86	0.29
Average Rainfall in Inches per Month											
Jan	Fob	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1.20	1.40	2.70	3.60	5.00	4.40	4.30	3.30	4.50	3.30	2.60	1.80
Net Rainfall in Inches per Month											
Jan	Fob	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1.20	1.40	2.70	-0.47	-0.04	-1.71	-2.36	-2.80	-0.13	-0.19	1.74	1.51

Total from MO Atlas 37.25 {FIGURE 152 of ATLAS)

Total 38.10 *(MONTHLY DATA I5 IN FIGURES 3 THROUGH 14 OF ATLAS, CHECK TOTAL AGAINST FIGURE TOTAL SHOWN IN FIGURE 2)*

Total 0.85

Braymer Lagoon Cell 1 Surface Area: 349,750.00 ft[1]
BraymerlagoonCell2SurfaceArea: 184,465.00 ft^2
Average Daily Flow (ADF): 45,253.00 gallons per day

SSOAPP analysis shows low flow of dry weather diurnal pattern at 92,094 GPO and an average daily flow of 115,000, the facility plan suggest a current hydraulic loading of 88,604 GPD

	Net Gallons into Lagoon (without consideration of collection system I&I) (AVERAGE YEAR)											
	Jan	Fob	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
days/month:	31	- 28	- 31	- 30	- 31	- 30	M31	- 31	- 30	31	30	31
Gallons per Month:	1,802,436	1,733,276	2,301,927	1,200,169	1,389,552	788,654	618,624	470,549	1,313,001	1,338,452	1,936,694	1,907,056
Gallons per Day:	58,143	61,903	74,256	40,006	44,824	26,288	19,956	15,179	43,767	43,176	64,556	61,518

Average Rainfall in Inches per Month (1 in 10 driest year)											
Jan	Fob	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.89	1.03	1.99	2.66	3.69	3.25	3.17	2.43	3.32	2.43	1.92	1.33
Net Rainfall in Inches per Month											
Jan	Fob	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.89	1.03	1.99	-1.42	-1.35	-2.86	-3.48	-3.67	-1.32	-1.06	1.06	1.04

Total from MO Atlas 28.1 •per month values figure from per month percentage for avg year applied to total inches for 1 in 10 driest year
(MONTHLY DATA JS IN FIGURES 3 THROUGH 14 OF ATLAS, CHECK TOTAL AGAINST FIGURE TOTAL SHOWN IN FIGURE 2)

Total -9.15

	Net Gallons into Lagoon (without consideration of collection system I&I) (1in 10Driest Year)											
	Jan	Fob	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
days/month:	31	28	31	30	31	30	31	31	30	31	30	31
	1,697,556	1,610,916	2,065,947	885,529	952,552	404,094	242,804	182,129	919,701	1,050,032	1,709,454	1,749,736
	54,760	57,533	66,643	29,518	30,727	13,470	7,832	5,875	30,657	33,872	56,982	56,443

Gallons per Month:
Gallons per Day:

Design Flow: 145,000 GPO

Percentage of Design Flow 4.05% <30% SO RECIRCULATION IS REQUIRED

Net Rainfall in Inches per Month (Drought)											
Jan	Fob	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Net Rainfall in Inches per Month											
Jan	Fob	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.00	0.00	0.00	-4.07	-5.04	-6.11	-6.66	-6.10	-4.63	-3.49	-0.86	-0.29

	Net Gallons into Lagoon (without consideration of collection system I&I) (in drought conditions)											
	Jan	Fob	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
days/month:	31	28	31	30	31	30	31	31	30	31	30	31
Gallons per Month:	1,402,843	1,267,084	1,402,843	1,390	275,418	676,519	813,250	628,331	-185,472	239,572	1,070,909	1,307,67
Gallons per Day:	45,253	45,253	45,253	46	8,884	-22,551	-26,234	-20,269	6,182	7,728	35,697	42,183

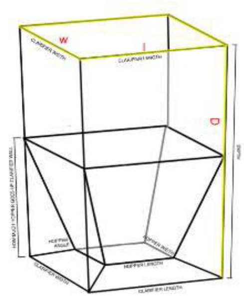
f these flows were negative, we may consider the impact of extreme drought

CLARIFIER SIZING CALCULATIONS

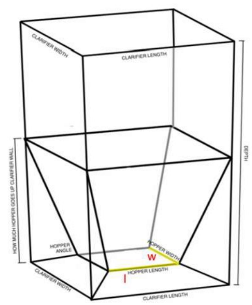
Indicate

Indicate alue (do not edit formula)

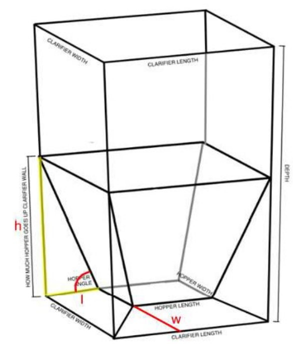
Clarifier Sizing **Length and width dimension must match for volume calculations to be correct in this tab. The equations for the hopper corners are based on right triangular** pyramids, and additional calculations are necessary if perfect right angles do not exist (length/width dimensions differ)		
length (l	12.00	ft
width(w	12.00	ft
depth (d	17.00	ft



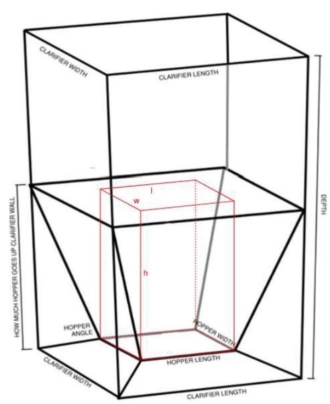
Hopper Bottom Dimensions Length and Width Dimensions must match for volume calculations to be **correct in this tab.**		
length (l	4.50	ft
width(w	4.50	ft



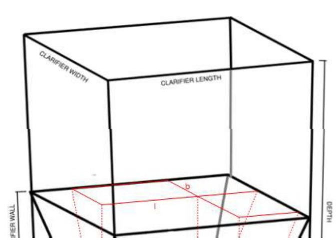
Height of Hopper on Side Walls			check on width
Length between Hopper and Side Wall (l	3.75	ft	3.75
Angle of Hopper	60.00	deg	60.00
Height hopper goes up Clarifier Wall (h	6.50	ft	6.50
			OK

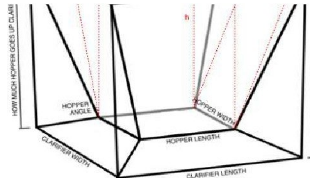


Volume of Hopper Rectangle		
length (l	4.50	ft
width(w	4.50	ft
height (h	6.50	ft
Volume	131.53	ft^3

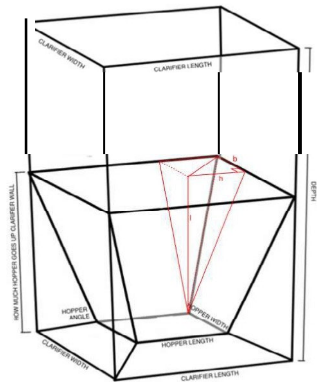


Volume of Hopper Right Triangular Prisms		
base length (b	3.75	ft
prism length (l	4.50	ft
height (h	6.50	ft
Volume Per Prism	54.80	ft^3
Total Volume (4 Prisms)	219.21	ft^3

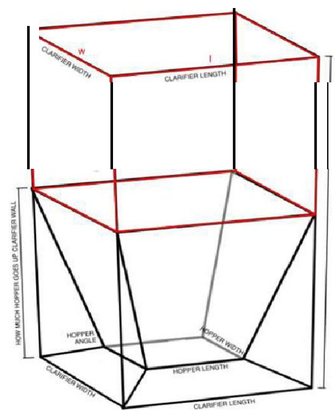




Volume of Hopper Right Triangular Pyramids		
Triangle base length (b	3.75	ft
Triangle height (h	3.75	ft
Pyramid Length (l	6.50	ft
Volume Per Pyramid	15.22	ft^3
Total Volume (8 Pyramids	121.78	ft^3



Volume of Clarifier Above Hopper		
length (l	12.00	ft
width(w	12.00	ft
height (h	10.50	ft
Volume	1512.69	ft^3



Usable Volume Summary		
Volume of Hopper	472.53	ft^3
Volume above Hopped	1,512.69	ft^3
Total Usable Volume	1,985.22	ft^3

DOUBLE CHECK USING ONLINE CALCULATOR HERE:

	Design Average Daily Flow	Design Average Daily Flow (with 1 Q return)	Peak Flow	Peak Flow (with 1Q return)
Q(gal/day)	145,000	290,000	162,085	307,085
SOR (gpd/ft2)	1,006.94	2,013.89	1,125.59	2,132.53
DT (hours)	2.46	1.23	2.20	1.16
WOR (gpd/ft)	6,041.67	12,083.33	6,753.54	12,795.21
SLR (lb/day/ft2)	0.38	0.76	0.42	0.80

CLARIFIER	
length (ft)	12.00
width (ft)	12.00
depth (ft)	17.00
area(ft'2)	144.00
volume(ft'3)	2,448.00
volume(gal)	18,312.31
TSS(mg/L)	45.00

Nitrox Tank length	12
Nitrox Tank width	
Nitrox Tank depth	17

USABLE CLARIFIER	
volume(ft'3)	1,985.22
volume(gal)	14,850.46

SOR	Surface Overflow Rate	Design Flow= 1,200 gpd/ft2 Minimum= 800 gpd/ft2 Maximum = 3,000 gpd/ft2	10 CSR 20-8.160 (3) (B) 2
DT	Dentention Time	Minimum= 1.5 hours Maximum = 2.5 hours	Civil Engineering Reference Manual
WOR	Weir Overflow Rate	Maximum = 20,000 gpd/ft	10 CSR 20-8.160 (3) (C)
SLR	Solids Loading Rate	Typical Min= 0.8 lb/day/ft2 Typical Max= 1.2 lb/day/ft2	Metcalf & Eddy Table 8-34 (pg 890 - 5th Edition)
SWD	Side Water depth	Minimum= 12 ft Maximum = 20 ft	Metcalf and Eddy (pg 837 - 4th Edition)

**th

**this not a requirement we are super concerned with - generally applies to clarifiers following activated

CLARIFIER WEIR TROUGH CALCULATIONS

Bartlett & West

Project No. 20114.003
Project: Braymer Wastewater System Improvements
Subject: Weir Trough Design
Location: Braymer, MO

Weir Trough Orifice Discharge Calculations
Orifice calcs:

Equations Used:

$Q_o = C_o A_o \sqrt{2g(H - E_o)}$

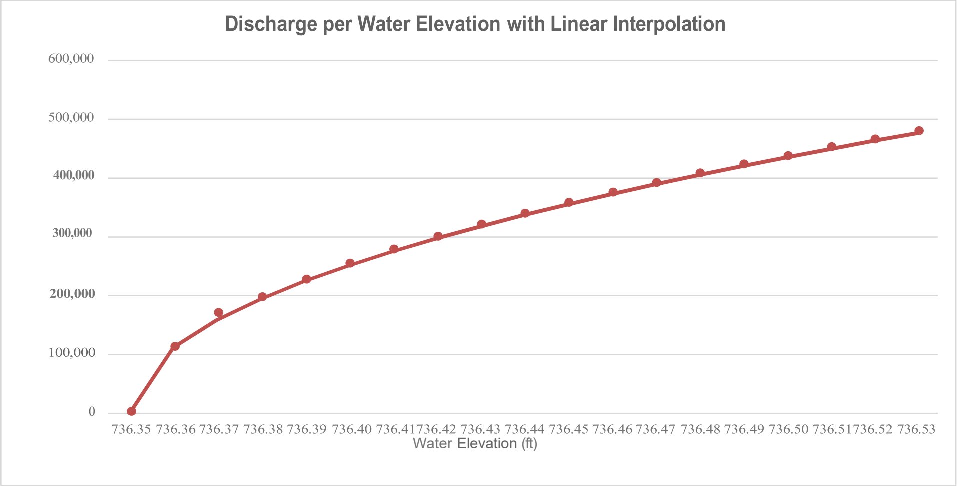
Orifice:
Q = orifice outflow
C_o = orifice discharge coefficient
g = acceleration due to gravity 32.2 ft/s^2
A = net opening area= $\pi d^2/4$
H = water Elevation
E_o = elevation of orifice

C_o = 0.62

Weir Saw Tooth Elevation: 736.85 peak flow plus IQ 277,085
dimension to bottom of trough (in) 6 verify with jetincorp cut sheet

#1:
FL orifice= 736.35 ft (assuming hole in bottom of weir trough)
Number of orifices= 1
Diameter of Orifice = 8 in

Water Elevation (ft)	H (ft)	Q (cfs)	Q (gpd)	H (m)	
736.35	0.00	0.00	0	0.00	
736 36	0 01	0.17	112,242	0.12	ADF
736.37	0.02	0.25	158,735	0.24	peak
736 38	0 03	0.30	194,410	0.36	
736.39	0.04	0.35	224,485	0.48	
736.40	0 05	0.39	250,982	0.60	
736.41	0.06	0.43	274,937	0.72	peak plus 1XQ return
736.42	0 07	0.46	296,966	0.84	
736.43	0.08	0.49	317,470	0.96	
736.44	0 09	0.52	336,727	1.08	
736.45	0.10	0.55	354,942	1.20	
736.46	0 11	0.58	372,266	1.32	
736.47	0.12	0.60	388,819	1.44	
736.48	0 13	0.63	404,696	1.56	
736.49	0.14	0.65	419,973	1.68	
736 50	0 15	0.67	434,713	1.80	
736.5 1	0.16	0.69	448,970	1.92	
736 52	0 17	0.72	462,788	2.04	
736.53	0.18	0.74	476,205	2.16	



Bartlett & West

Project No. 20114.003
Project: Braymer Wastewater System Improvements
Subject: Weir Trough Design
Location: Braymer, MO

Clarifier Weir using the Kindsvater-Shen equation

CLARIFIER WEIR:

Inputs:

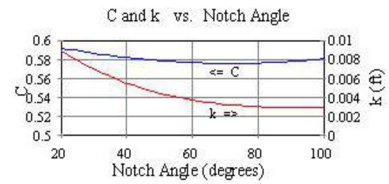
Qmin (MGD):	0
Qmax (MGD):	0.277085
θ (degrees):	90
spacing between v notch weirs (in):	6
length of weir (ft):	**24**
Elevation of v-notch weir opening (ft):	736.85
Total opening height of each v-notch weir (in):	3.00

Outputs:

C:	0.5779049
k (ft)	0.0029025
Number of v notch weirs:	48

$$Q = 4.28\ C \tan\left(\frac{\theta}{2}\right)(h+k)^{5/2}$$

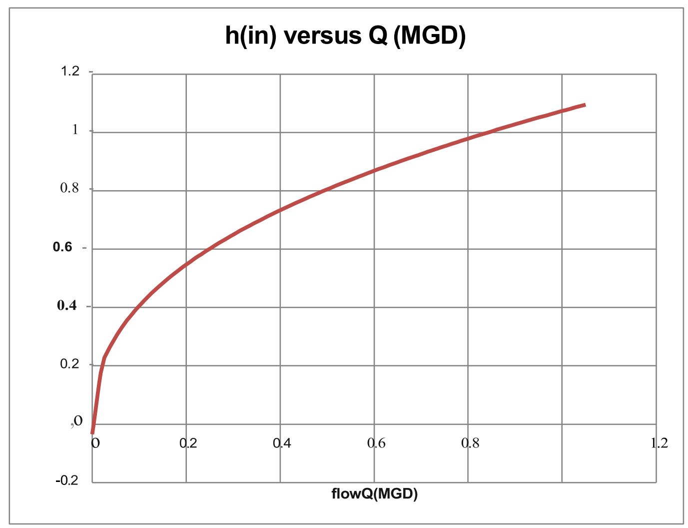
where Q = Discharge (cfs)
C = Discharge Coefficient
θ = Notch Angle
h = Head (ft)
k=Head Correction Factor (ft)



$C = 0.607165052 - 0.000874466963\ Ø + 6.10393334\times10^{-6}\ Ø^2$
$k\ (ft.) = 0.0144902648 - 0.00033955535\ Ø + 3.29819003\times10^{-6}\ Ø^2 - 1.06215442\times10^{-8}\ Ø^3$
where Ø is the notch angle in degrees

Q vs h table:

Q(MGD)	Q	h (ft)	h (in)	WSE (ft)	
0.000	0.00	-0.0029	-0.03	736.85	
0.006	3.85	0.0192	0.23	736.87	
0.011	7.70	0.0262	0.31	736.88	
0.017	11.55	0.0313	0.38	736.88	
0.022	15.39	0.0355	0.43	736.89	
0.028	19.24	0.0391	0.47	736.89	
0.033	23.09	0.0423	0.51	736.89	
0.039	26.94	0.0451	0.54	736.90	
0.044	30.79	0.0478	0.57	736.90	
0.050	34.64	0.0502	0.60	736.90	
0.055	38.48	0.0525	0.63	736.90	
0.061	42.33	0.0546	0.66	736.90	
0.067	46.18	0.0567	0.68	736.91	
0.072	50.03	0.0586	0.70	736.91	
0.078	53.88	0.0605	0.73	736.91	
0.083	57.73	0.0622	0.75	736.91	
0.089	61.57	0.0639	0.77	736.91	
0.094	65.42	0.0656	0.79	736.92	(low diurnal pattern of dry weather flow)
0.100	69.27	0.0672	0.81	736.92	
0.105	73.12	0.0687	0.82	736.92	
0.111	76.97	0.0702	0.84	736.92	
0.116	80.82	0.0716	0.86	736.92	(ADF)
0.122	84.66	0.0730	0.88	736.92	
0.127	88.51	0.0744	0.89	736.92	
0.133	92.36	0.0757	0.91	736.93	
0.139	96.21	0.0770	0.92	736.93	
0.144	100.06	0.0783	0.94	736.93	(max month/permitted design flow)
0.150	103.91	0.0795	0.95	736.93	
0.155	107.76	0.0807	0.97	736.93	
0.161	111.60	0.0819	0.98	736.93	
0.166	115.45	0.0831	1.00	736.93	(peak flow from cell 2 per HEC-HMS)
0.172	119.30	0.0842	1.01	736.93	



0.177	123.15	0.0853	1.02	736.94	
0.183	127.00	0.0864	1.04	736.94	
0.188	130.85	0.0875	1.05	736.94	
0.194	134.69	0.0885	1.06	736.94	
0.200	138.54	0.0896	1.07	736.94	
0.205	142.39	0.0906	1.09	736.94	
0.211	146.24	0.0916	1.10	736.94	
0.216	150.09	0.0926	1.11	736.94	
0.222	153.94	0.0935	1.12	736.94	
0.227	157.78	0.0945	1.13	736.94	
0.233	161.63	0.0954	1.15	736.95	(ADF plus 1 times return Q)
0.238	165.48	0.0964	1.16	736.95	
0.244	169.33	0.0973	1.17	736.95	
0.249	173.18	0.0982	1.18	736.95	
0.255	177.03	0.0991	1.19	736.95	
0.260	180.87	0.1000	1.20	736.95	
0.266	184.72	0.1008	1.21	736.95	
0.272	188.57	0.1017	1.22	736.95	
0.277	192.42	0.1025	1.23	736.95	(peak flow from cell 2 per HEC-HMS plus 1 times return Q)
0.283	196.27	0.1034	1.24	736.95	
0.288	200.12	0.1042	1.25	736.95	
0.294	203.97	0.1050	1.26	736.96	
0.299	207.81	0.1058	1.27	736.96	
0.305	211.66	0.1066	1.28	736.96	
0.310	215.51	0.1074	1.29	736.96	
0.316	219.36	0.1082	1.30	736.96	
0.321	223.21	0.1090	1.31	736.96	
0.327	227.06	0.1098	1.32	736.96	
0.333	230.90	0.1105	1.33	736.96	
0.338	234.75	0.1113	1.34	736.96	
0.344	238.60	0.1120	1.34	736.96	
0.349	242.45	0.1128	1.35	736.96	
0.355	246.30	0.1135	1.36	736.96	
0.360	250.15	0.1142	1.37	736.96	
0.366	253.99	0.1149	1.38	736.96	
0.371	257.84	0.1156	1.39	736.97	
0.377	261.69	0.1163	1.40	736.97	
0.382	265.54	0.1170	1.40	736.97	
0.388	269.39	0.1177	1.41	736.97	
0.393	273.24	0.1184	1.42	736.97	
0.399	277.09	0.1191	1.43	736.97	
0.405	280.93	0.1198	1.44	736.97	
0.410	284.78	0.1205	1.45	736.97	

Manning's Equation (for open channels)

Location: BRAYMER WEIR TROUGH

input:

Channel Length (ft):	6	
Channel Slope (ft/fl):	0.0010	verify with jetincorp cut sheet
Bottom Width (fl):	1	verify with jetincorp cut sheet
Left Side Slope (X:1):	vertical walls	
Right Side Slope (X:1):	vertical walls	
Depth (fl):	0.2	or 2.4 inches
Ditch Conditions:	Steel	

output:

Storm Drain Length (fl):	6.00	
A (fl^2):	0.20	
p (ft):	1.40	
R(fl):	0.142857143	
n:	0.012	
Q (ft^3/s):	0.21	
Q(gpm):	96.31	
Q(GPD):	138,692	half of peak future flow condition (each half of 12' length of weir) is 277,100/2 = 138,550 GPO
Depth (in):	2.4	
V (ft/s):	1.07	
lime in ditch (min):	0.09	

CLARIFIER PUMP HYDRAULIC CALCULATIONS

SYSTEM CURVE CALCULATION

Qmin (gal/min): 0

Q_{max} (gal/min): 200 Design Flow (gpm): 79,88 Note on design flow: should be approximately ADF for recirculation from clarifier

	2"	2,5"	3"	4"
Velocity (ft/sec) based on Q_{max}:	17,16	11,71	7,91	4,78
Velocity (ft/sec) based on 1Q:	6.85	4.67	3.16	1.91
viscosity ν (ft²/sec):	0,00001217	0,00001217	0,00001217	0,00001217
Specific Roughness ε (ft):	0,000005	0,000005	0,000005	0,000005
Inside Diameter D (in):	2.182	2.642	3.214	4.133
Pipe Area (ft²):	0.026	0.038	0.056	0.093
Relative Roughness ε/D:	0,0000275	0,0000227	0,0000187	0,0000145

Q (gal/min)	friction factor, f in 2"	velocity in 2" (ft/sec)	friction factor, f in 2,5"	velocity in 2,5" (ft/sec)	friction factor, f in 3"	velocity in 3" (ft/sec)	friction factor, f in 4"	velocity in 4" (ft/sec)
0,00	0,00068	0,00	0,00097	0,00	0,00096	0,00	0,00095	0,00
1,00	0,08020	0,09	0,06487	0,06	0,07024	0,04	0,07617	0,02
2,00	0,04691	0,17	0,05010	0,12	0,05371	0,08	0,05898	0,05
3,00	0,04109	0,26	0,04369	0,18	0,04662	0,12	0,05084	0,07
4,00	0,03759	0,34	0,03986	0,23	0,04241	0,16	0,04605	0,10
5,00	0,03518	0,43	0,03723	0,29	0,03952	0,20	0,04279	0,12
6,00	0,03338	0,51	0,03527	0,35	0,03738	0,24	0,04038	0,14
7,00	0,03196	0,60	0,03373	0,41	0,03570	0,28	0,03849	0,17
8,00	0,03081	0,69	0,03247	0,47	0,03433	0,32	0,03697	0,19
9,00	0,02984	0,77	0,03143	0,53	0,03319	0,36	0,03569	0,22
10,00	0,02901	0,86	0,03053	0,59	0,03222	0,40	0,03461	0,24
11,00	0,02830	0,94	0,02976	0,64	0,03138	0,44	0,03367	0,26
12,00	0,02766	1,03	0,02907	0,70	0,03064	0,47	0,03285	0,29
13,00	0,02710	1,12	0,02847	0,76	0,02998	0,51	0,03212	0,31
14,00	0,02660	1,20	0,02792	0,82	0,02939	0,55	0,03146	0,33
15,00	0,02614	1,29	0,02743	0,88	0,02886	0,59	0,03087	0,36
16,00	0,02572	1,37	0,02698	0,94	0,02837	0,63	0,03033	0,38
17,00	0,02534	1,46	0,02657	0,99	0,02793	0,67	0,02984	0,41
18,00	0,02498	1,54	0,02619	1,05	0,02752	0,71	0,02938	0,43
19,00	0,02466	1,63	0,02583	1,11	0,02714	0,75	0,02896	0,45
20,00	0,02435	1,72	0,02551	1,17	0,02678	0,79	0,02857	0,48
21,00	0,02407	1,80	0,02520	1,23	0,02645	0,83	0,02821	0,50
22,00	0,02380	1,89	0,02492	1,29	0,02615	0,87	0,02787	0,53
23,00	0,02355	1,97	0,02465	1,35	0,02586	0,91	0,02755	0,55
24,00	0,02332	2,06	0,02439	1,40	0,02558	0,95	0,02725	0,57
25,00	0,02310	2,15	0,02415	1,44	0,02533	0,99	0,02697	0,60
26,00	0,02289	2,23	0,02393	1,52	0,02508	1,03	0,02670	0,62
27,00	0,02269	2,32	0,02371	1,58	0,02485	1,07	0,02644	0,65
28,00	0,02250	2,40	0,02351	1,64	0,02463	1,11	0,02620	0,67
29,00	0,02232	2,49	0,02332	1,70	0,02442	1,15	0,02597	0,69
30,00	0,02214	2,57	0,02313	1,76	0,02422	1,19	0,02575	0,72
31,00	0,02198	2,66	0,02295	1,81	0,02403	1,23	0,02554	0,74
32,00	0,02182	2,75	0,02278	1,87	0,02385	1,27	0,02534	0,77
33,00	0,02167	2,83	0,02262	1,93	0,02368	1,31	0,02515	0,79
34,00	0,02152	2,92	0,02247	1,99	0,02351	1,35	0,02497	0,81
35,00	0,02138	3,00	0,02232	2,05	0,02335	1,38	0,02479	0,84
36,00	0,02125	3,09	0,02217	2,11	0,02319	1,42	0,02462	0,86
37,00	0,02112	3,17	0,02203	2,17	0,02304	1,46	0,02446	0,88
38,00	0,02099	3,26	0,02190	2,22	0,02290	1,50	0,02430	0,91
39,00	0,02087	3,35	0,02177	2,28	0,02276	1,54	0,02415	0,93
40,00	0,02076	3,43	0,02165	2,34	0,02263	1,58	0,02400	0,96
41,00	0,02065	3,52	0,02152	2,40	0,02250	1,62	0,02386	0,98
42,00	0,02054	3,60	0,02141	2,46	0,02237	1,66	0,02372	1,00
43,00	0,02043	3,69	0,02130	2,52	0,02225	1,70	0,02359	1,03
44,00	0,02033	3,78	0,02119	2,58	0,02213	1,74	0,02346	1,05
45,00	0,02023	3,86	0,02108	2,63	0,02202	1,78	0,02333	1,08
46,00	0,02013	3,95	0,02098	2,69	0,02191	1,82	0,02321	1,10
47,00	0,02004	4,03	0,02089	2,75	0,02180	1,86	0,02310	1,12
48,00	0,01995	4,12	0,02078	2,81	0,02170	1,90	0,02298	1,15
49,00	0,01986	4,20	0,02068	2,87	0,02160	1,94	0,02287	1,17
50,00	0,01978	4,29	0,02059	2,93	0,02150	1,98	0,02276	1,20
51,00	0,01969	4,38	0,02050	2,98	0,02140	2,02	0,02266	1,22
52,00	0,01961	4,46	0,02042	3,04	0,02131	2,06	0,02256	1,24
53,00	0,01953	4,55	0,02033	3,10	0,02122	2,10	0,02246	1,27
54,00	0,01945	4,63	0,02025	3,16	0,02113	2,14	0,02236	1,29
55,00	0,01938	4,72	0,02017	3,22	0,02104	2,18	0,02226	1,32
56,00	0,01931	4,81	0,02009	3,28	0,02096	2,21	0,02217	1,34
57,00	0,01923	4,89	0,02001	3,34	0,02087	2,25	0,02208	1,36
58,00	0,01916	4,98	0,01994	3,39	0,02079	2,29	0,02199	1,39
59,00	0,01910	5,06	0,01986	3,45	0,02071	2,33	0,02191	1,41
60,00	0,01903	5,15	0,01979	3,51	0,02064	2,37	0,02182	1,43
61,00	0,01896	5,23	0,01972	3,57	0,02056	2,41	0,02174	1,46
62,00	0,01890	5,32	0,01965	3,63	0,02049	2,45	0,02166	1,48
63,00	0,01884	5,41	0,01959	3,69	0,02042	2,49	0,02158	1,51
64,00	0,01877	5,49	0,01952	3,75	0,02035	2,53	0,02150	1,53
65,00	0,01871	5,58	0,01946	3,80	0,02028	2,57	0,02143	1,55
66,00	0,01866	5,66	0,01939	3,86	0,02021	2,61	0,02135	1,58
67,00	0,01860	5,75	0,01933	3,92	0,02014	2,65	0,02128	1,60
68,00	0,01854	5,83	0,01927	3,98	0,02008	2,69	0,02121	1,63
69,00	0,01849	5,92	0,01921	4,04	0,02002	2,73	0,02114	1,65
70,00	0,01843	6,01	0,01915	4,10	0,01995	2,77	0,02107	1,67
71,00	0,01838	6,09	0,01910	4,16	0,01989	2,81	0,02101	1,70
72,00	0,01833	6,18	0,01904	4,21	0,01983	2,85	0,02094	1,72
73,00	0,01827	6,26	0,01898	4,27	0,01977	2,89	0,02088	1,75
74,00	0,01822	6,35	0,01893	4,33	0,01971	2,93	0,02081	1,77
75,00	0,01817	6,44	0,01888	4,39	0,01966	2,97	0,02075	1,79
76,00	0,01813	6,52	0,01882	4,45	0,01960	3,01	0,02069	1,82
77,00	0,01808	6,61	0,01877	4,51	0,01955	3,05	0,02063	1,84
78,00	0,01803	6,69	0,01872	4,57	0,01949	3,08	0,02057	1,87
79,00	0,01798	6,78	0,01867	4,62	0,01944	3,12	0,02051	1,89
80,00	0,01794	6,86	0,01863	4,68	0,01939	3,16	0,02046	1,91
81,00	0,01789	6,95	0,01858	4,74	0,01934	3,20	0,02040	1,94

PROPOSED CONDITION SYSTEM CURVE

	System Curve (ft) without Segments	System Curve (ft) Segment 1 STA 0+00 - 14+75 (includes 12' vertical wetwell pipe)	System Curve (ft) Segment 2 STA 14+75 - 22+34
Start (or lowest) Elevation (ft):	736,75	736,75	740,2
End (or highest) Elevation (ft):	732,8	740,2	732,8
Static Head (ft):	-3,95	3,45	-7,4
Length of 2":	0	0	0
Length of 2.5":	0	0	0
Length of 3":	2,259	1,501	758
Length of 4":	0	0	0
Sum of K values (2"):	0,20	0,20	0,00
Sum of K values (2,5"):	0,00	0,00	0,00
Sum of K values (3"):	4,59	4,44	0,15
Sum of K values (4"):	0,00	0,00	0,00

PUMP CURVES

	Sulzer Medium Duty 3 Phase	Sulzer Medium Duty 3 Phase	Sulzer Premium Duty (continuous duty) 3 Phase	Sulzer Premium Duty (continuous duty) 3 Phase	Sulzer Premium Duty (continuous duty) Single Phase
Model	EJ D-2 60 HZ, 2" discharge	EJ D-2 60 HZ, 2" discharge	XFP 80C VX 60HZ (2,95 hp)	XFP 80C VX 60HZ (4,69 hp)	XFP 80C VX 60HZ (3,75 hp)
Impeller	5-3/16" impeller	6-1/4" impeller	6-5/16" impeller	7-3/8" impeller	6-5/16" impeller

Q (gal/min)	System Curve (ft) without Segments	System Curve (ft) Segment 1	System Curve (ft) Segment 2	Cumulative System Curve with Segments (ft)	EJ D-2, 5-3/16" impeller	EJ D-2, 6-1/4" impeller	XFP 80C (2,95 hp), 6-5/16" impeller	XFP 80C (4,69 hp), 7-3/8" impeller	XFP 80C (3,75 hp), 6-5/16" impeller
0,00	-3,95	3,45	-7,40	3,45	29,54	44,58	31,19	42,77	32,81
1,00	-3,94	3,46	-7,40	3,46					
2,00	-3,91	3,48	-7,39	3,48					
3,00	-3,86	3,51	-7,37	3,51					
4,00	-3,81	3,54	-7,35	3,54					
5,00	-3,74	3,59	-7,33	3,59					
6,00	-3,67	3,64	-7,31	3,64					
7,00	-3,59	3,69	-7,28	3,69					
8,00	-3,49	3,76	-7,25	3,76					
9,00	-3,39	3,83	-7,21	3,83					
10,00	-3,28	3,90	-7,18	3,90	28,94				
11,00	-3,16	3,98	-7,14	3,98					
12,00	-3,03	4,07	-7,10	4,07					
13,00	-2,89	4,16	-7,05	4,16					
14,00	-2,74	4,26	-7,00	4,26					
15,00	-2,59	4,36	-6,95	4,36					
16,00	-2,43	4,47	-6,90	4,47					
17,00	-2,26	4,59	-6,84	4,59					
18,00	-2,08	4,71	-6,79	4,71					
19,00	-1,90	4,83	-6,73	4,83					
20,00	-1,70	4,96	-6,66	4,96	28,29	43,06	29,75	41,07	31,83
21,00	-1,50	5,10	-6,60	5,10					
22,00	-1,29	5,24	-6,53	5,24					
23,00	-1,08	5,38	-6,46	5,38					
24,00	-0,85	5,53	-6,39	5,53					
25,00	-0,62	5,69	-6,31	5,69					
26,00	-0,39	5,85	-6,23	5,85					
27,00	-0,14	6,01	-6,15	6,01					
28,00	0,11	6,18	-6,07	6,18					
29,00	0,37	6,36	-5,99	6,36					
30,00	0,64	6,53	-5,90	6,53	27,60				
31,00	0,91	6,72	-5,81	6,72					
32,00	1,19	6,91	-5,72	6,91					
33,00	1,48	7,10	-5,62	7,10					
34,00	1,77	7,30	-5,53	7,30					
35,00	2,07	7,50	-5,43	7,50					
36,00	2,38	7,71	-5,33	7,71					
37,00	2,69	7,92	-5,23	7,92					
38,00	3,02	8,14	-5,12	8,14					
39,00	3,34	8,36	-5,02	8,36					
40,00	3,68	8,59	-4,91	8,59	26,89	41,42	28,35	40,40	30,56
41,00	4,02	8,82	-4,79	8,82					
42,00	4,37	9,05	-4,68	9,05					
43,00	4,72	9,29	-4,57	9,29					
44,00	5,09	9,53	-4,45	9,53					
45,00	5,46	9,78	-4,33	9,78					
46,00	5,83	10,04	-4,21	10,04					
47,00	6,21	10,29	-4,08	10,29					
48,00	6,60	10,55	-3,96	10,55					
49,00	6,99	10,82	-3,83	10,82					
50,00	7,39	11,09	-3,70	11,09	26,15				
51,00	7,80	11,37	-3,57	11,37					
52,00	8,21	11,64	-3,43	11,64					
53,00	8,63	11,93	-3,29	11,93					
54,00	9,06	12,22	-3,16	12,22					
55,00	9,49	12,51	-3,01	12,51					
56,00	9,93	12,80	-2,87	12,80					
57,00	10,38	13,10	-2,73	13,10					
58,00	10,83	13,41	-2,58	13,41					
59,00	11,29	13,72	-2,43	13,72					
60,00	11,75	14,03	-2,28	14,03	25,35	39,67	27,00	39,08	29,33
61,00	12,22	14,35	-2,13	14,35					
62,00	12,70	14,67	-1,97	14,67					
63,00	13,18	15,00	-1,82	15,00					
64,00	13,67	15,33	-1,66	15,33					
65,00	14,16	15,66	-1,50	15,66					
66,00	14,67	16,00	-1,33	16,00					
67,00	15,17	16,34	-1,17	16,34					
68,00	15,69	16,69	-1,00	16,69					
69,00	16,21	17,04	-0,83	17,04					
70,00	16,73	17,40	-0,66	17,40	24,52				
71,00	17,26	17,75	-0,49	17,75					
72,00	17,80	18,12	-0,32	18,12					
73,00	18,35	18,49	-0,14	18,49					
74,00	18,90	18,86	0,04	18,90					
75,00	19,45	19,23	0,22	19,45					
76,00	20,01	19,61	0,40	20,01					
77,00	20,58	20,00	0,59	20,58					
78,00	21,16	20,38	0,77	21,16					
79,00	21,74	20,78	0,96	21,74					
80,00	22,32	21,17	1,15	22,32	23,89	37,81	25,65	37,77	27,88
81,00	22,91	21,57	1,34	22,91			25,58		

SYSTEM CURVE CALCULATION

Qmin (gal/min): 0

Q_{max} (gal/min): 200

Design Flow (gpm): 79,88 Note on design flow: should be approximately ADF for recirculation from clarifier

	2"	2,5"	3"	4"
Velocity (ft/sec) based on Q_{max}:	17,16	11,71	7,91	4,78
Velocity (ft/sec) based on 1Q:	6,85	4,67	3,16	1,91
viscosity ν (ft^2/sec):	0,00001217	0,00001217	0,00001217	0,00001217
Specific Roughness ϵ (ft):	0,000005	0,000005	0,000005	0,000005
Inside Diameter D (in):	2.182	2.642	3.214	4.133
Pipe Area (ft^2):	0.026	0,038	0,056	0,093
Relative Roughness ϵ/D:	0,0000275	0,0000227	0,0000187	0,0000145

Q (gal/min)	friction factor, f in 2"	velocity in 2" (ft/sec)	friction factor, f in 2,5"	velocity in 2,5" (ft/sec)	friction factor, f in 3"	velocity in 3" (ft/sec)	friction factor, f in 4"	velocity in 4" (ft/sec)
82,00	0,01785	7,04	0,01853	4,80	0,01929	3,24	0,02034	1,96
83,00	0,01781	7,12	0,01848	4,86	0,01924	3,28	0,02029	1,98
84,00	0,01776	7,21	0,01844	4,92	0,01919	3,32	0,02024	2,01
85,00	0,01772	7,29	0,01839	4,97	0,01914	3,36	0,02018	2,03
86,00	0,01768	7,38	0,01835	5,03	0,01909	3,40	0,02013	2,06
87,00	0,01764	7,46	0,01831	5,09	0,01905	3,44	0,02008	2,08
88,00	0,01760	7,55	0,01826	5,15	0,01900	3,48	0,02003	2,10
89,00	0,01756	7,64	0,01822	5,21	0,01896	3,52	0,01998	2,13
90,00	0,01752	7,72	0,01818	5,27	0,01891	3,56	0,01993	2,15
91,00	0,01748	7,81	0,01814	5,33	0,01887	3,60	0,01989	2,18
92,00	0,01745	7,89	0,01810	5,38	0,01882	3,64	0,01984	2,20
93,00	0,01741	7,98	0,01806	5,44	0,01878	3,68	0,01979	2,22
94,00	0,01737	8,07	0,01802	5,50	0,01874	3,72	0,01975	2,25
95,00	0,01734	8,15	0,01798	5,56	0,01870	3,76	0,01970	2,27
96,00	0,01730	8,24	0,01794	5,62	0,01866	3,80	0,01966	2,30
97,00	0,01727	8,32	0,01790	5,68	0,01862	3,84	0,01961	2,32
98,00	0,01723	8,41	0,01787	5,74	0,01858	3,88	0,01957	2,34
99,00	0,01720	8,49	0,01783	5,79	0,01854	3,92	0,01953	2,37
100,00	0,01716	8,58	0,01779	5,85	0,01850	3,95	0,01949	2,39
101,00	0,01713	8,67	0,01776	5,91	0,01846	3,99	0,01944	2,42
102,00	0,01710	8,75	0,01772	5,97	0,01842	4,03	0,01940	2,44
103,00	0,01707	8,84	0,01769	6,03	0,01839	4,07	0,01936	2,46
104,00	0,01703	8,92	0,01766	6,09	0,01835	4,11	0,01932	2,49
105,00	0,01700	9,01	0,01762	6,15	0,01831	4,15	0,01928	2,51
106,00	0,01697	9,10	0,01759	6,20	0,01828	4,19	0,01924	2,54
107,00	0,01694	9,18	0,01756	6,26	0,01824	4,23	0,01920	2,56
108,00	0,01691	9,27	0,01752	6,32	0,01821	4,27	0,01917	2,58
109,00	0,01688	9,35	0,01749	6,38	0,01817	4,31	0,01913	2,61
110,00	0,01685	9,44	0,01746	6,44	0,01814	4,35	0,01909	2,63
111,00	0,01682	9,52	0,01743	6,50	0,01810	4,39	0,01906	2,65
112,00	0,01679	9,61	0,01740	6,56	0,01807	4,43	0,01902	2,68
113,00	0,01676	9,70	0,01737	6,61	0,01804	4,47	0,01898	2,70
114,00	0,01674	9,78	0,01734	6,67	0,01801	4,51	0,01895	2,73
115,00	0,01671	9,87	0,01731	6,73	0,01797	4,55	0,01891	2,75
116,00	0,01668	9,95	0,01728	6,79	0,01794	4,59	0,01888	2,77
117,00	0,01665	10,04	0,01725	6,85	0,01791	4,63	0,01884	2,80
118,00	0,01663	10,12	0,01722	6,91	0,01788	4,67	0,01881	2,82
119,00	0,01660	10,21	0,01719	6,96	0,01785	4,71	0,01878	2,85
120,00	0,01657	10,30	0,01716	7,02	0,01782	4,75	0,01874	2,87
121,00	0,01655	10,38	0,01713	7,08	0,01779	4,79	0,01871	2,89
122,00	0,01652	10,47	0,01711	7,14	0,01776	4,82	0,01868	2,92
123,00	0,01650	10,55	0,01708	7,20	0,01773	4,86	0,01865	2,94
124,00	0,01647	10,64	0,01705	7,26	0,01770	4,90	0,01862	2,97
125,00	0,01644	10,73	0,01702	7,32	0,01767	4,94	0,01858	2,99
126,00	0,01642	10,81	0,01700	7,37	0,01764	4,98	0,01855	3,01
127,00	0,01640	10,90	0,01697	7,43	0,01762	5,02	0,01852	3,04
128,00	0,01637	10,98	0,01695	7,49	0,01759	5,06	0,01849	3,06
129,00	0,01635	11,07	0,01692	7,55	0,01756	5,10	0,01846	3,09
130,00	0,01632	11,15	0,01689	7,61	0,01753	5,14	0,01843	3,11
131,00	0,01630	11,24	0,01687	7,67	0,01751	5,18	0,01840	3,13
132,00	0,01628	11,33	0,01684	7,73	0,01748	5,22	0,01837	3,16
133,00	0,01625	11,41	0,01682	7,78	0,01745	5,26	0,01835	3,18
134,00	0,01623	11,50	0,01680	7,84	0,01743	5,30	0,01832	3,20
135,00	0,01621	11,58	0,01677	7,90	0,01740	5,34	0,01829	3,23
136,00	0,01619	11,67	0,01675	7,96	0,01738	5,38	0,01826	3,25
137,00	0,01616	11,76	0,01672	8,02	0,01735	5,42	0,01823	3,28
138,00	0,01614	11,84	0,01670	8,08	0,01733	5,46	0,01821	3,30
139,00	0,01612	11,93	0,01668	8,14	0,01730	5,50	0,01818	3,32
140,00	0,01610	12,01	0,01665	8,19	0,01728	5,54	0,01815	3,35
141,00	0,01608	12,10	0,01663	8,25	0,01725	5,58	0,01813	3,37
142,00	0,01606	12,18	0,01661	8,31	0,01723	5,62	0,01810	3,40
143,00	0,01604	12,27	0,01659	8,37	0,01720	5,66	0,01807	3,42
144,00	0,01602	12,36	0,01656	8,43	0,01718	5,69	0,01805	3,44
145,00	0,01600	12,44	0,01654	8,49	0,01716	5,73	0,01802	3,47
146,00	0,01598	12,53	0,01652	8,54	0,01713	5,77	0,01800	3,49
147,00	0,01596	12,61	0,01650	8,60	0,01711	5,81	0,01797	3,52
148,00	0,01594	12,70	0,01648	8,66	0,01709	5,85	0,01795	3,54
149,00	0,01592	12,78	0,01646	8,72	0,01706	5,89	0,01792	3,56
150,00	0,01590	12,87	0,01644	8,78	0,01704	5,93	0,01790	3,59
151,00	0,01588	12,96	0,01641	8,84	0,01702	5,97	0,01787	3,61
152,00	0,01586	13,04	0,01639	8,90	0,01700	6,01	0,01785	3,64
153,00	0,01584	13,13	0,01637	8,95	0,01697	6,05	0,01782	3,66
154,00	0,01582	13,21	0,01635	9,01	0,01695	6,09	0,01780	3,68
155,00	0,01580	13,30	0,01633	9,07	0,01693	6,13	0,01778	3,71
156,00	0,01578	13,39	0,01631	9,13	0,01691	6,17	0,01775	3,73
157,00	0,01576	13,47	0,01629	9,19	0,01689	6,21	0,01773	3,75
158,00	0,01575	13,56	0,01627	9,25	0,01687	6,25	0,01771	3,78
159,00	0,01573	13,64	0,01625	9,31	0,01685	6,29	0,01768	3,80
160,00	0,01571	13,73	0,01624	9,36	0,01683	6,33	0,01766	3,83
161,00	0,01569	13,81	0,01622	9,42	0,01681	6,37	0,01764	3,85
162,00	0,01567	13,90	0,01620	9,48	0,01679	6,41	0,01762	3,87
163,00	0,01566	13,99	0,01618	9,54	0,01677	6,45	0,01760	3,90

PROPOSED CONDITION SYSTEM CURVE

	System Curve (ft) without Segments	System Curve (ft) Segment 1 STA 0+00 – 14+75 (includes 12' vertical wetwell pipe)	System Curve (ft) Segment 2 STA 14+75 – 22+34	Cumulative System Curve with Segments
Start (or lowest) Elevation (ft):	736,75	736,75	740,2	
End (or highest) Elevation (ft):	732,8	740,2	732,8	
Static Head (ft):	-3,95	3,45	-7,4	
Length of 2":	0	0	0	
Length of 2.5":	0	0	0	
Length of 3":	2,259	1,501	758	
Length of 4":	0	0	0	
Sum of K values (2"):	0,20	0,20	0,00	
Sum of K values (2,5"):	0,00	0,00	0,00	
Sum of K values (3"):	4,59	4,44	0,15	
Sum of K values (4"):	0,00	0,00	0,00	

PUMP CURVES

Q (gal/min)	System Curve (ft)	System Curve (ft) Segment 1	System Curve (ft) Segment 2	Cumulative System Curve (ft)	Sulzer Medium Duty 3 Phase, EJ D-2 60 HZ, 2" discharge, 5-3/16" impeller	Sulzer Medium Duty 3 Phase, EJ D-2 60 HZ, 2" discharge, 6-1/4" impeller	Sulzer Premium Duty (continuous duty) 3 Phase, XFP 80C VX 60HZ (2,95 hp), 6-5/16" impeller	Sulzer Premium Duty (continuous duty) 3 Phase, XFP 80C VX 60HZ (4,69 hp), 7-3/8" impeller	Sulzer Premium Duty (continuous duty) Single Phase, XFP 80C VX 60HZ (3,75 hp), 6-5/16" impeller
82,00	23,51	21,98	1,54	23,51			25,51		
83,00	24,12	22,39	1,73	24,12			25,44		
84,00	24,73	22,80	1,93	24,73			25,37		
85,00	25,34	23,21	2,13	25,34			25,30		
86,00	25,96	23,63	2,33	25,96			25,23		
87,00	26,59	24,06	2,53	26,59			25,16		
88,00	27,22	24,48	2,74	27,22			25,10		
89,00	27,88	24,92	2,95	27,88			25,03		
90,00	28,51	25,35	3,16	28,51	22,79		24,96		
91,00	29,16	25,79	3,37	29,16			24,89		
92,00	29,82	26,24	3,58	29,82			24,82		
93,00	30,48	26,69	3,79	30,48			24,75		
94,00	31,15	27,14	4,01	31,15			24,68		
95,00	31,82	27,59	4,23	31,82			24,61		
96,00	32,50	28,05	4,45	32,50			24,55		
97,00	33,19	28,52	4,67	33,19			24,48		
98,00	33,88	28,98	4,90	33,88			24,41		
99,00	34,58	29,46	5,12	34,58			24,34		
100,00	35,28	29,93	5,35	35,28	21,90	35,81	24,27	36,46	26,33
101,00	35,99	30,41	5,58	35,99					
102,00	36,70	30,89	5,81	36,70					
103,00	37,42	31,38	6,04	37,42					
104,00	38,15	31,87	6,28	38,15					
105,00	38,88	32,37	6,52	38,88					
106,00	39,62	32,86	6,75	39,62					
107,00	40,36	33,37	6,99	40,36					
108,00	41,11	33,87	7,24	41,11					
109,00	41,87	34,38	7,48	41,87					
110,00	42,63	34,90	7,73	42,63	20,90				
111,00	43,39	35,42	7,97	43,39					
112,00	44,16	35,94	8,22	44,16					
113,00	44,94	36,46	8,48	44,94					
114,00	45,72	36,99	8,73	45,72					
115,00	46,51	37,53	8,98	46,51					
116,00	47,31	38,06	9,24	47,31					
117,00	48,10	38,61	9,50	48,10					
118,00	48,91	39,15	9,76	48,91					
119,00	49,72	39,70	10,02	49,72					
120,00	50,54	40,25	10,29	50,54	19,04	33,71	22,89	35,15	24,77
121,00	51,36	40,81	10,55	51,36					
122,00	52,19	41,37	10,82	52,19					
123,00	53,02	41,93	11,09	53,02					
124,00	53,86	42,50	11,36	53,86					
125,00	54,70	43,07	11,63	54,70					
126,00	55,55	43,65	11,91	55,55					
127,00	56,41	44,22	12,19	56,41					
128,00	57,27	44,81	12,46	57,27					
129,00	58,14	45,39	12,74	58,14					
130,00	59,01	45,98	13,03	59,01	18,02				
131,00	59,89	46,58	13,31	59,89					
132,00	60,77	47,17	13,59	60,77					
133,00	61,66	47,78	13,88	61,66					
134,00	62,55	48,38	14,17	62,55					
135,00	63,45	48,99	14,46	63,45					
136,00	64,35	49,60	14,75	64,35					
137,00	65,27	50,22	15,05	65,27					
138,00	66,18	50,84	15,34	66,18					
139,00	67,11	51,46	15,64	67,11					
140,00	68,03	52,09	15,94	68,03	17,90	31,50	21,46	33,75	23,04
141,00	68,97	52,72	16,24	68,97					
142,00	69,90	53,36	16,55	69,90					
143,00	70,85	54,00	16,85	70,85					
144,00	71,80	54,64	17,16	71,80					
145,00	72,75	55,28	17,47	72,75					
146,00	73,71	55,93	17,78	73,71					
147,00	74,67	56,59	18,09	74,67					
148,00	75,65	57,24	18,40	75,65					
149,00	76,62	57,91	18,72	76,62					
150,00	77,60	58,57	19,03	77,60	16,77				
151,00	78,59	59,24	19,35	78,59					
152,00	79,58	59,91	19,67	79,58					
153,00	80,58	60,59	19,99	80,58					
154,00	81,58	61,26	20,32	81,58					
155,00	82,59	61,95	20,64	82,59					
156,00	83,60	62,63	20,97	83,60					
157,00	84,62	63,32	21,30	84,62					
158,00	85,65	64,02	21,63	85,65					
159,00	86,68	64,72	21,96	86,68					
160,00	87,71	65,42	22,30	87,71	15,69	29,21	20,00	32,29	21,27
161,00	88,75	66,12	22,63	88,75					
162,00	89,80	66,83	22,97	89,80					
163,00	90,85	67,54	23,31	90,85					

SYSTEM CURVE CALCULATION

Qmin (gal/min): 0

Q_{max} (gal/min): 200 Design Flow (gpm): 79,88 Note on design flow: should be approximately ADF for recirculation from clarifier

	2"	2,5"	3"	4"
Velocity (ft/sec) based on Q_{max}:	17,16	11,71	7,91	4,78
Velocity (ft/sec) based on 1Q:	6.85	4.67	3.16	1.91
viscosity μ (ft^2/sec):	0,00001217	0,00001217	0,00001217	0,00001217
Specific Roughness € (ft):	0,000005	0,000005	0,000005	0,000005
Inside Diameter D (in):	2.182	2.642	3.214	4.133
Pipe Area (ft^2):	0.026	0.038	0.056	0.093
Relative Roughness €/D:	0,0000275	0,0000227	0,0000187	0,0000145

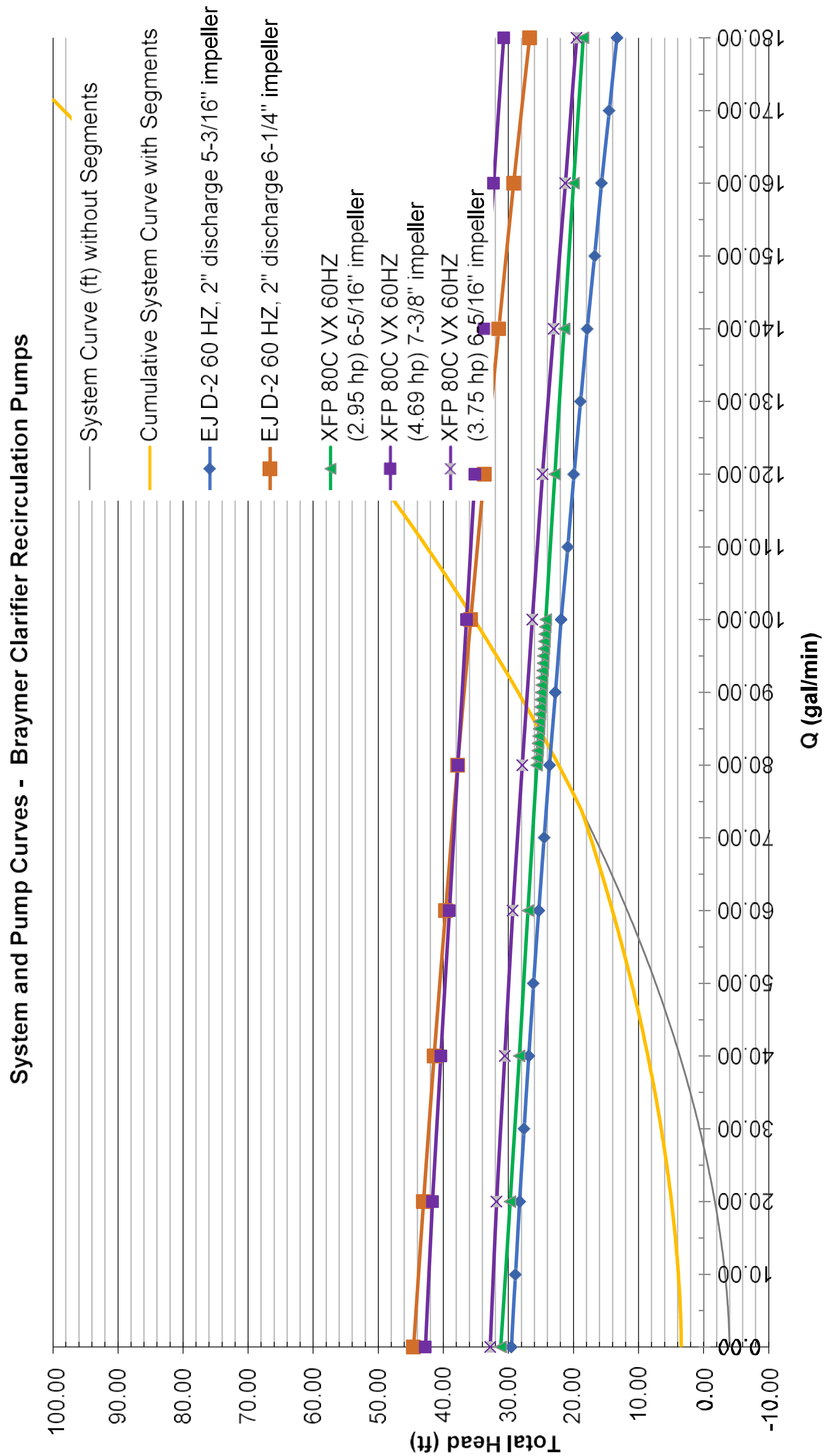
PROPOSED CONDITION SYSTEM CURVE

	System Curve (ft) without Segments	System Curve (ft) Segment 1 STA 0+00 – 14+75 (includes 12' vertical wetwell pipe)	System Curve (ft) Segment 2 STA 14+75 – 22+34	Cumulative System Curve with Segments
Start (or lowest) Elevation (ft):	736,75	736,75	740,2	
End (or highest) Elevation (ft):	732,8	740,2	732,8	
Static Head (ft):	-3,95	3,45	-7,4	
Length of 2":	0	0	0	
Length of 2.5":	0	0	0	
Length of 3":	2,259	1,501	758	
Length of 4":	0	0	0	
Sum of K values (2"):	0,20	0,20	0,00	
Sum of K values (2,5"):	0,00	0,00	0,00	
Sum of K values (3"):	4,59	4,44	0,15	
Sum of K values (4"):	0,00	0,00	0,00	

Q (gal/min)	friction factor, f in 2"	velocity in 2" (ft/sec)	friction factor, f in 2,5"	velocity in 2,5" (ft/sec)	friction factor, f in 3"	velocity in 3" (ft/sec)	friction factor, f in 4"	velocity in 4" (ft/sec)
164,00	0,01564	14,07	0,01616	9,60	0,01675	6,49	0,01757	3,92
165,00	0,01562	14,16	0,01614	9,66	0,01673	6,53	0,01755	3,95
166,00	0,01561	14,24	0,01612	9,72	0,01671	6,57	0,01753	3,97
167,00	0,01559	14,33	0,01610	9,77	0,01669	6,60	0,01751	3,99
168,00	0,01557	14,42	0,01609	9,83	0,01667	6,64	0,01749	4,02
169,00	0,01555	14,50	0,01607	9,89	0,01665	6,68	0,01747	4,04
170,00	0,01554	14,59	0,01605	9,95	0,01663	6,72	0,01745	4,07
171,00	0,01552	14,67	0,01603	10,01	0,01661	6,76	0,01743	4,09
172,00	0,01551	14,76	0,01602	10,07	0,01659	6,80	0,01741	4,11
173,00	0,01549	14,84	0,01600	10,13	0,01657	6,84	0,01739	4,14
174.00	0.01547	14.93	0.01598	10.18	0.01655	6.88	0.01737	4.16
175,00	0.01546	15.02	0.01596	10.24	0.01654	6.92	0.01735	4.19
176,00	0,01544	15,10	0,01595	10,30	0,01652	6,96	0,01733	4,21
177,00	0,01543	15,19	0,01593	10,36	0,01650	7,00	0,01731	4,23
178,00	0,01541	15,27	0,01591	10,42	0,01648	7,04	0,01729	4,26
179,00	0,01540	15,36	0,01590	10,48	0,01646	7,08	0,01727	4,28
180,00	0,01538	15,44	0,01588	10,53	0,01645	7,12	0,01725	4,30
181,00	0,01536	15,53	0,01586	10,59	0,01643	7,16	0,01723	4,33
182,00	0,01535	15,62	0,01585	10,65	0,01641	7,20	0,01721	4,35
183,00	0,01533	15,70	0,01583	10,71	0,01639	7,24	0,01719	4,38
184,00	0,01532	15,79	0,01582	10,77	0,01638	7,28	0,01717	4,40
185,00	0,01531	15,87	0,01580	10,83	0,01636	7,32	0,01715	4,42
186,00	0.01529	15.96	0.01578	10.89	0.01634	7.36	0.01714	4.45
187,00	0,01528	16,05	0,01577	10,94	0,01633	7,40	0,01712	4,47
188,00	0,01526	16,13	0,01575	11,00	0,01631	7,44	0,01710	4,50
189,00	0,01525	16,22	0,01574	11,06	0,01629	7,47	0,01708	4,52
190,00	0,01523	16,30	0,01572	11,12	0,01628	7,51	0,01706	4,54
191,00	0,01522	16,39	0,01571	11,18	0,01626	7,55	0,01705	4,57
192,00	0,01520	16,47	0,01569	11,24	0,01624	7,59	0,01703	4,59
193,00	0,01519	16,56	0,01568	11,30	0,01623	7,63	0,01701	4,62
194,00	0,01518	16,65	0,01566	11,35	0,01621	7,67	0,01699	4,64
195,00	0,01516	16,73	0,01565	11,41	0,01620	7,71	0,01698	4,66
196,00	0,01515	16,82	0,01563	11,47	0,01618	7,75	0,01696	4,69
197,00	0.01514	16.90	0,01562	11.53	0.01616	7.79	0.01694	4.71
198,00	0,01512	16,99	0,01560	11,59	0,01615	7,83	0,01692	4,74
199,00	0,01511	17,08	0,01559	11,65	0,01613	7,87	0,01691	4,76
200,00	0,01510	17,16	0,01558	11,71	0,01612	7,91	0,01689	4,78

PUMP CURVES

Q (gal/min)	System Curve (ft)	System Curve (ft)	System Curve (ft)	System Curve (ft)	Sulzer Medium Duty 3 Phase – EJ D-2 60 HZ, 2" discharge – 5-3/16" impeller	Sulzer Medium Duty 3 Phase – EJ D-2 60 HZ, 2" discharge – 6-1/4" impeller	Sulzer Premium Duty (continuous duty) 3 Phase – XFP 80C VX 60HZ (2,95 hp) – 6-5/16" impeller	Sulzer Premium Duty (continuous duty) 3 Phase – XFP 80C VX 60HZ (4,69 hp) – 7-3/8" impeller	Sulzer Premium Duty (continuous duty) Single Phase – XFP 80C VX 60HZ (3,75 hp) – 6-5/16" impeller
164,00	91,91	68,26	23,65	91,91					
165,00	92,97	68,98	23,99	92,97					
166,00	94,04	69,70	24,34	94,04					
167,00	95,11	70,43	24,68	95,11					
168,00	96,19	71,16	25,03	96,19					
169,00	97,27	71,89	25,38	97,27					
170,00	98,36	72,63	25,73	98,36	14,50				
171,00	99,46	73,37	26,09	99,46					
172,00	100,55	74,11	26,44	100,55					
173,00	101,66	74,86	26,80	101,66					
174.00	102,77	75,61	27,16	102,77					
175,00	103,88	76,37	27,51	103,88					
176,00	105,01	77,13	27,88	105,01					
177,00	106,13	77,89	28,24	106,13					
178,00	107,26	78,66	28,60	107,26					
179,00	108,40	79,43	28,97	108,40					
180,00	109,54	80,20	29,34	109,54	13,33	26,75	18,52	30,73	19,52
181,00	110,69	80,98	29,71	110,69					
182,00	111,84	81,76	30,08	111,84					
183,00	113,00	82,54	30,45	113,00					
184,00	114,16	83,33	30,83	114,16					
185,00	115,33	84,12	31,21	115,33					
186,00	116,50	84,92	31,58	116,50					
187,00	117,68	85,72	31,96	117,68					
188,00	118,86	86,52	32,35	118,86					
189,00	120,05	87,32	32,73	120,05					
190,00	121,25	88,13	33,11	121,25	12,08				
191,00	122,45	88,95	33,50	122,45					
192,00	123,65	89,76	33,89	123,65					
193,00	124,86	90,58	34,28	124,86					
194,00	126,07	91,40	34,67	126,07					
195,00	127,30	92,23	35,06	127,30					
196,00	128,52	93,06	35,46	128,52					
197,00	129,75	93,90	35,86	129,75					
198,00	130,99	94,73	36,25	130,99					
199,00	132,23	95,57	36,65	132,23					
200,00	133,47	96,42	37,06	133,47	10,83	24,21	16,86	29,04	17,71


System and Pump Curves - Braymer Clarifier Recirculation Pumps
System Curve (ft) without Segments
Cumulative System Curve with Segments
EJ D-2 60 HZ, 2" discharge 5-3/16" impeller
EJ D-2 60 HZ, 2" discharge 6-1/4" impeller
XFP 80C VX 60HZ (2.95 hp) 6-5/16" impeller
XFP 80C VX 60HZ (4.69 hp) 7-3/8" impeller
XFP 80C VX 60HZ (3.75 hp) 6-5/16" impeller
Total Head (ft)
Q (gal/min)
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-10.00
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00
100.00
110.00
120.00
130.00
140.00
150.00
160.00
170.00
180.00

Braymer, MO WWTF
HYDRAULIC CALCULATIONS FOR low ADF (low flow from HEC-HMS model using low flow from dry weather diurnal pattern)

DESCRIPTION: WWTF outfall from lagoon cell 3 through mag meter and UV to WWTF outfall
FLOW(GPDJ: 92,094 (low flow from dry weather Jay diurnal pattern)
FLOW(GPM)· 63.95
FLOW(MGD): 0.09

ELEMENT	MATERIAL	FLOW (GPM)	C FACTOR	PIPE CLASS	NOM. DIA (IN)	OUT. DIA (IN)	ID (IN)	VELOCITY (FPS)	LENGTH (FT)	PIPE LOSS	K FACTOR	FIT. LOSS (FT)	CUM. LOSS (FT)	HGL (FT)	COMMENTS
Upstream from outfall through mag meter through UV equipment to cell 3														732.0000	100 year flood elevation
SWING CHECK VALVE	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37			2.20	0.0047	0.0047	732.0047	
EXIT LOSS	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37			1.00	0.0021	0.0068	732.0068	
PIPE	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37	25.50	0.0020			0.0088	732.0088	
TEE - BRANCH FLOW	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37			1.80	0.0039	0.0127	732.0127	tee downstream of UV
PIPE	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37	11.50	0.0009			0.0136	732.0136	
45° BEND	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37			0.15	0.0003	0.0139	732.0139	
PIPE	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37	40.50	0.0032			0.0171	732.0171	
90° BEND	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37			0.30	0.0006	0.0177	732.0177	90 deg vertical bend DS of UV under slab
PIPE	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37	7.50	0.0006			0.0183	732.0183	vertical pipe length, to be verified with pdf plan set
90° BEND	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37			0.30	0.0006	0.0190	732.0190	90 deg vertical bend DS of UV above slab
PLUG VALVE	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37			0.50	0.0011	0.0200	732.0200	90 deg vertical bend DS of UV above slab
PIPE	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37	2.50	0.0002			0.0202	732.0202	
SHARP-EDGE ENTRANCE	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37			0.50	0.0011	0.0213	732.0213	HGL just DS of Trojan UV internal weir, max HGL here per UV vendor is 733.64 (depends on elevation of housekeeping pad and this elevation is based on 290kgpd)
														734.1500	**Elevation of HGL on US end of Trojan UV per UV vendor. Assumes 3" housekeeping pad which will require the 90 deg vertical bend be location outside the concrete pad footprint for maintenance of the FL-FL connection**
EXIT LOSS	DIP	63.95	130	CL 52	8.0	9.050	8.390	0.37			1.00	0.0021	0.0021	734.1521	
PIPE	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37	2.50	0.0002			0.0023	734.1523	pipe just upstream of UV unit
90° BEND	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37			0.30	0.0006	0.0030	734.1530	90 deg vertical bend US of UV above slab
PLUG VALVE	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37			0.50	0.0011	0.0040	734.1540	90 deg vertical bend US of UV above slab
PIPE	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37	7.50	0.0006			0.0046	734.1546	vertical pipe length, to be verified with pdf plan set
90° BEND	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37			0.30	0.0006	0.0053	734.1553	90 deg vertical bend US of UV under slab
PIPE	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37	54.00	0.0042			0.0095	734.1595	
45° BEND	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37			0.15	0.0003	0.0098	734.1598	
PIPE	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37	3.00	0.0002			0.0101	734.1601	pipe DS of mag meter/flow splitter vault
45° BEND	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37			0.15	0.0003	0.0104	734.1604	
PIPE	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37	1.00	0.0001			0.0105	734.1605	pipe DS of plug valve in vault - length to be confirmed with plan set pdf
PLUG VALVE	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37			0.50	0.0011	0.0115	734.1615	
PIPE	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37	3.00	0.0002			0.0118	734.1618	pipe US of plug valve in vault - length to be confirmed with plan set pdf
TEE - BRANCH FLOW	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37			1.80	0.0039	0.0156	734.1656	WYE fitting at connection to existing 8" serving as UV bypass
PIPE	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37	10.00	0.0008			0.0164	734.1664	run through 8-inch mag meter size which appears to meet 10% fill requirements - see: "W:\Proj\2000\20114\20114.003\Documents\DesignCalcs\Mag meter\check of 8-inch mag meter for min 10 percent full.xlsx"
TEE - LINE FLOW	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37			0.30	0.0006	0.0171	734.1671	
PIPE	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37	17.00	0.0013			0.0184	734.1684	
TEE - LINE FLOW	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37			0.30	0.0006	0.0190	734.1690	
PIPE	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37	1.50	0.0001			0.0191	734.1691	
PLUG VALVE	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37			0.50	0.0011	0.0202	734.1702	
PIPE	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37	29.50	0.0023			0.0225	734.1725	
45° BEND	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37			0.15	0.0003	0.0228	734.1728	
PIPE	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37	1.00	0.0001			0.0229	734.1729	
SHARP-EDGE ENTRANCE	DIP	63.95	140	CL 52	8.0	9.050	8.390	0.37			0.50	0.0011	0.0240	734.1740	**HGL in lagoon cell 3 outfall structure downstream of weir gate. Anything greater than WSE shot during survey @ 734.60 suggests that we need to lower the UV p-trap or internal weir. 2 ft freeboard is 734.79.**

Braymer, MO WWTF
HYDRAULIC CALCULATIONS FOR ADF (permitted design flow)

DESCRIPTION: WWTF outfall from lagoon cell 3 through mag meter and UV to WWTF outfall
FLOW(GPDJ: 115,000 (ADF)
FLOW(GPM)· 79.86
FLOW(MGD): 0.12

ELEMENT	MATERIAL	FLOW (GPM)	C FACTOR	PIPE CLASS	NOM. DIA (IN)	OUT. DIA (IN)	ID (IN)	VELOCITY (FPS)	LENGTH (FT)	PIPE LOSS	K FACTOR	FIT. LOSS (FT)	CUM. LOSS (FT)	HGL (FT)	COMMENTS
Upstream from outfall through mag meter through UV equipment to cell 3														732.0000	**100 year flood elevation**
SWING CHECK VALVE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46			2.20	0.0073	0.0073	732.0073	
EXIT LOSS	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46			1.00	0.0033	0.0107	732.0107	
PIPE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46	25.50	0.0030			0.0137	732.0137	
TEE - BRANCH FLOW	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46			1.80	0.0060	0.0197	732.0197	tee downstream of UV
PIPE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46	11.50	0.0014			0.0211	732.0211	
45° BEND	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46			0.15	0.0005	0.0216	732.0216	
PIPE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46	40.50	0.0048			0.0263	732.0263	
90° BEND	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46			0.30	0.0010	0.0274	732.0274	90 deg vertical bend DS of UV under slab
PIPE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46	7.50	0.0009			0.0282	732.0282	vertical pipe length, to be verified with pdf plan set
90° BEND	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46			0.30	0.0010	0.0292	732.0292	90 deg vertical bend DS of UV above slab
PLUG VALVE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46			0.50	0.0017	0.0309	732.0309	90 deg vertical bend DS of UV above slab
PIPE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46	2.50	0.0003			0.0312	732.0312	
SHARP-EDGE ENTRANCE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46			0.50	0.0017	0.0329	732.0329	HGL just DS of Trojan UV internal weir, max HGL here per UV vendor is 733.64 (depends on elevation of housekeeping pad and this elevation is based on 290kgpd)
														734.1500	**Elevation of HGL on US end of Trojan UV per UV vendor. Assumes 3" housekeeping pad which will require the 90 deg vertical bend be location outside the concrete pad footprint for maintenance of the FL-FL connection**
EXIT LOSS	DIP	79.86	130	CL 52	8.0	9.050	8.390	0.46			1.00	0.0033	0.0033	734.1533	
PIPE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46	2.50	0.0003			0.0036	734.1536	pipe just upstream of UV unit
90° BEND	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46			0.30	0.0010	0.0046	734.1546	90 deg vertical bend US of UV above slab
PLUG VALVE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46			0.50	0.0017	0.0063	734.1563	90 deg vertical bend US of UV above slab
PIPE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46	7.50	0.0009			0.0072	734.1572	vertical pipe length, to be verified with pdf plan set
90° BEND	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46			0.30	0.0010	0.0082	734.1582	90 deg vertical bend US of UV under slab
PIPE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46	54.00	0.0064			0.0146	734.1646	
45° BEND	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46			0.15	0.0005	0.0151	734.1651	
PIPE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46	3.00	0.0004			0.0154	734.1654	pipe DS of mag meter/flow splitter vault
45° BEND	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46			0.15	0.0005	0.0159	734.1659	
PIPE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46	1.00	0.0001			0.0161	734.1661	pipe DS of plug valve in vault - length to be confirmed with plan set pdf
PLUG VALVE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46			0.50	0.0017	0.0177	734.1677	
PIPE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46	3.00	0.0004			0.0181	734.1681	pipe US of plug valve in vault - length to be confirmed with plan set pdf
TEE - BRANCH FLOW	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46			1.80	0.0060	0.0241	734.1741	WYE fitting at connection to existing 8" serving as UV bypass
PIPE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46	10.00	0.0012			0.0253	734.1753	run through 8-inch mag meter size which appears to meet 10% fill requirements - see: "W:\Proj\20000\20114\20114.003\Documents\DesignCalcs\Mag meter\check of 8-inch mag meter for min 10 percent full.xlsx"
TEE - LINE FLOW	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46			0.30	0.0010	0.0263	734.1763	
PIPE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46	17.00	0.0020			0.0283	734.1783	
TEE - LINE FLOW	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46			0.30	0.0010	0.0293	734.1793	
PIPE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46	1.50	0.0002			0.0295	734.1795	
PLUG VALVE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46			0.50	0.0017	0.0311	734.1811	
PIPE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46	29.50	0.0035			0.0346	734.1846	
45° BEND	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46			0.15	0.0005	0.0351	734.1851	
PIPE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46	1.00	0.0001			0.0352	734.1852	
SHARP-EDGE ENTRANCE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46			0.50	0.0017	0.0369	734.1869	**HGL in lagoon cell 3 outfall structure downstream of weir gate. Anything greater than WSE shot during survey @ 734.60 suggests that we need to lower the UV p-trap or internal weir. 2 ft freeboard is 734.79.**

Braymer, MO WWTF

HYDRAULIC CALCULATIONS FOR max month ADF (permitted design flow) (used for Triplepoints Basis of Design)

DESCRIPTION:	WWTF outfall from lagoon cell 3 through mag meter and UV to WWTF outfall	
FLOW(GPDJ:	145,000	(max month/permitted design flow)
FLOW(GPM)·	100.69	
FLOW(MGD):	0.15	

ELEMENT	MATERIAL	FLOW (GPM)	C FACTOR	PIPE CLASS	NOM. DIA (IN)	OUT. DIA (IN)	ID (IN)	VELOCITY (FPS)	LENGTH (FT)	PIPE LOSS	K FACTOR	FIT. LOSS (FT)	CUM. LOSS (FT)	HGL (FT)	COMMENTS
Upstream from outfall through mag meter through UV equipment to cell 3														**732.0000**	**100 year flood elevation**
SWING CHECK VALVE	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58			2.20	0.0117	0.0117	732.0117	
EXIT LOSS	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58			1.00	0.0053	0.0170	732.0170	
PIPE	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58	25.50	0.0046			0.0216	732.0216	
TEE - BRANCH FLOW	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58			1.80	0.0095	0.0311	732.0311	tee downstream of UV
PIPE	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58	11.50	0.0021			0.0332	732.0332	
45° BEND	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58			0.15	0.0008	0.0340	732.0340	
PIPE	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58	40.50	0.0074			0.0414	732.0414	
90° BEND	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58			0.30	0.0016	0.0430	732.0430	90 deg vertical bend DS of UV under slab
PIPE	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58	7.50	0.0014			0.0443	732.0443	vertical pipe length, to be verified with pdf plan set
90° BEND	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58			0.30	0.0016	0.0459	732.0459	90 deg vertical bend DS of UV above slab
PLUG VALVE	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58			0.50	0.0027	0.0486	732.0486	90 deg vertical bend DS of UV above slab
PIPE	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58	2.50	0.0005			0.0490	732.0490	
SHARP-EDGE ENTRANCE	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58			0.50	0.0027	0.0517	732.0517	HGL just DS of Trojan UV internal weir, max HGL here per UV vendor is 733.64 (depends on elevation of housekeeping pad and this elevation is based on 290kgpd)
														734.1500	**Elevation of HGL on US end of Trojan UV per UV vendor. Assumes 3" housekeeping pad which will require the 90 deg vertical bend be location outside the concrete pad footprint for maintenance of the FL-FL connection**
EXIT LOSS	DIP	100.69	130	CL 52	8.0	9.050	8.390	0.58			1.00	0.0053	0.0053	734.1553	
PIPE	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58	2.50	0.0005			0.0058	734.1558	pipe just upstream of UV unit
90° BEND	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58			0.30	0.0016	0.0073	734.1573	90 deg vertical bend US of UV above slab
PLUG VALVE	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58			0.50	0.0027	0.0100	734.1600	90 deg vertical bend US of UV above slab
PIPE	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58	7.50	0.0014			0.0114	734.1614	vertical pipe length, to be verified with pdf plan set
90° BEND	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58			0.30	0.0016	0.0130	734.1630	90 deg vertical bend US of UV under slab
PIPE	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58	54.00	0.0098			0.0228	734.1728	
45° BEND	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58			0.15	0.0008	0.0236	734.1736	
PIPE	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58	3.00	0.0005			0.0241	734.1741	pipe DS of mag meter/flow splitter vault
45° BEND	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58			0.15	0.0008	0.0249	734.1749	
PIPE	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58	1.00	0.0002			0.0251	734.1751	pipe DS of plug valve in vault - length to be confirmed with plan set pdf
PLUG VALVE	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58			0.50	0.0027	0.0277	734.1777	
PIPE	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58	3.00	0.0005			0.0283	734.1783	pipe US of plug valve in vault - length to be confirmed with plan set pdf
TEE - BRANCH FLOW	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58			1.80	0.0095	0.0378	734.1878	WYE fitting at connection to existing 8" serving as UV bypass
PIPE	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58	10.00	0.0018			0.0396	734.1896	**run through 8-inch mag meter size which appears to meet 10% fill requirements - see: "W:\Proj\2000\20114\20114.003\Documents\DesignCalcs\Mag meter\check of 8-inch mag meter for min 10 percent full.xlsx"**
TEE - LINE FLOW	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58			0.30	0.0016	0.0412	734.1912	
PIPE	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58	17.00	0.0031			0.0443	734.1943	
TEE - LINE FLOW	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58			0.30	0.0016	0.0459	734.1959	
PIPE	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58	1.50	0.0003			0.0462	734.1962	
PLUG VALVE	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58			0.50	0.0027	0.0488	734.1988	
PIPE	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58	29.50	0.0054			0.0542	734.2042	
45° BEND	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58			0.15	0.0008	0.0550	734.2050	
PIPE	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58	1.00	0.0002			0.0552	734.2052	
SHARP-EDGE ENTRANCE	DIP	100.69	140	CL 52	8.0	9.050	8.390	0.58			0.50	0.0027	0.0578	734.2078	**HGL in lagoon cell 3 outfall structure downstream of weir gate. Anything greater than WSE shot during survey @ 734.60 suggests that we need to lower the UV p-trap or internal weir. 2 ft freeboard is 734.79.**

Braymer, MO WWTF
HYDRAULIC CALCULATIONS FOR peak daily flow (peak flow from HEC-HMS model using SCS rip run)

DESCRIPTION: WWTF outfall from lagoon cell 3 through mag meter and UV to WWTF outfall
FLOW(GPDJ: 162,085 (peak outflow from cell 2 per HEC-HMS- rip run scenario)
FLOW(GPM)· 112.56
FLOW(MGD): 0.16

ELEMENT	MATERIAL	FLOW (GPM)	C FACTOR	PIPE CLASS	NOM. DIA (IN)	OUT. DIA (IN)	ID (IN)	VELOCITY (FPS)	LENGTH (FT)	PIPE LOSS	K FACTOR	FIT. LOSS (FT)	CUM. LOSS (FT)	HGL (FT)	COMMENTS
Upstream from outfall through mag meter through UV equipment to cell 3														**732.0000**	**100 year flood elevation**
SWING CHECK VALVE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65			2.20	0.0146	0.0146	732.0146	
EXIT LOSS	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65			1.00	0.0066	0.0212	732.0212	
PIPE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65	25.50	0.0057			0.0269	732.0269	
TEE - BRANCH FLOW	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65			1.80	0.0119	0.0388	732.0388	tee downstream of UV
PIPE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65	11.50	0.0026			0.0414	732.0414	
45° BEND	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65			0.15	0.0010	0.0424	732.0424	
PIPE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65	40.50	0.0090			0.0514	732.0514	
90° BEND	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65			0.30	0.0020	0.0534	732.0534	90 deg vertical bend DS of UV under slab
PIPE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65	7.50	0.0017			0.0551	732.0551	vertical pipe length, to be verified with pdf plan set
90° BEND	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65			0.30	0.0020	0.0571	732.0571	90 deg vertical bend DS of UV above slab
PLUG VALVE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65			0.50	0.0033	0.0604	732.0604	90 deg vertical bend DS of UV above slab
PIPE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65	2.50	0.0006			0.0610	732.0610	
SHARP-EDGE ENTRANCE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65			0.50	0.0033	0.0643	732.0643	HGL just DS of Trojan UV internal weir, max HGL here per UV vendor is 733.64 (depends on elevation of housekeeping pad and this elevation is based on 290kgpd)
														734.1500	**Elevation of HGL on US end of Trojan UV per UV vendor. Assumes 3" housekeeping pad which will require the 90 deg vertical bend be location outside the concrete pad footprint for maintenance of the FL-FL connection**
EXIT LOSS	DIP	112.56	130	CL 52	8.0	9.050	8.390	0.65			1.00	0.0066	0.0066	734.1566	
PIPE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65	2.50	0.0006			0.0072	734.1572	pipe just upstream of UV unit
90° BEND	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65			0.30	0.0020	0.0092	734.1592	90 deg vertical bend US of UV above slab
PLUG VALVE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65			0.50	0.0033	0.0125	734.1625	90 deg vertical bend US of UV above slab
PIPE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65	7.50	0.0017			0.0142	734.1642	vertical pipe length, to be verified with pdf plan set
90° BEND	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65			0.30	0.0020	0.0161	734.1661	90 deg vertical bend US of UV under slab
PIPE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65	54.00	0.0121			0.0282	734.1782	
45° BEND	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65			0.15	0.0010	0.0292	734.1792	
PIPE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65	3.00	0.0007			0.0299	734.1799	pipe DS of mag meter/flow splitter vault
45° BEND	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65			0.15	0.0010	0.0309	734.1809	
PIPE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65	1.00	0.0002			0.0311	734.1811	pipe DS of plug valve in vault - length to be confirmed with plan set pdf
PLUG VALVE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65			0.50	0.0033	0.0344	734.1844	
PIPE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65	3.00	0.0007			0.0351	734.1851	pipe US of plug valve in vault - length to be confirmed with plan set pdf
TEE - BRANCH FLOW	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65			1.80	0.0119	0.0470	734.1970	WYE fitting at connection to existing 8" serving as UV bypass
PIPE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65	10.00	0.0022			0.0492	734.1992	**run through 8-inch mag meter size which appears to meet 10% fill requirements - see: "W:\Proj\20000\20114\20114.003\Documents\DesignCalcs\Mag meter\check of 8-inch mag meter for min 10 percent full.xlsx"**
TEE - LINE FLOW	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65			0.30	0.0020	0.0512	734.2012	
PIPE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65	17.00	0.0038			0.0550	734.2050	
TEE - LINE FLOW	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65			0.30	0.0020	0.0570	734.2070	
PIPE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65	1.50	0.0003			0.0573	734.2073	
PLUG VALVE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65			0.50	0.0033	0.0606	734.2106	
PIPE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65	29.50	0.0066			0.0672	734.2172	
45° BEND	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65			0.15	0.0010	0.0682	734.2182	
PIPE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65	1.00	0.0002			0.0685	734.2185	
SHARP-EDGE ENTRANCE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65			0.50	0.0033	0.0718	734.2218	**HGL in lagoon cell 3 outfall structure downstream of weir gate. Anything greater than WSE shot during survey @ 734.60 suggests that we need to lower the UV p-trap or internal weir. 2 ft freeboard is 734.79.**

Braymer, MO WWTF
HYDRAULIC CALCULATIONS FOR UV Unit Capacity Flow (for information only)

DESCRIPTION:	WWTF outfall from lagoon cell 3 through mag meter and UV to WWTF outfall	
FLOW(GPDJ:	290,000	(Capacity of the UV unit)
FLOW(GPM):	201.39	
FLOW(MGD):	0.29	

ELEMENT	MATERIAL	FLOW (GPM)	C FACTOR	PIPE CLASS	NOM. DIA (IN)	OUT. DIA (IN)	ID (IN)	VELOCITY (FPS)	LENGTH (FT)	PIPE LOSS	K FACTOR	FIT. LOSS (FT)	CUM. LOSS (FT)	HGL (FT)	COMMENTS
Upstream from outfall through mag meter through UV equipment to cell 3														732.0000	**100 year flood elevation**
SWING CHECK VALVE	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17			2.20	0.0467	0.0467	732.0467	
EXIT LOSS	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17			1.00	0.0212	0.0679	732.0679	
PIPE	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17	25.50	0.0167			0.0846	732.0846	
TEE - BRANCH FLOW	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17			1.80	0.0382	0.1228	732.1228	tee downstream of UV
PIPE	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17	11.50	0.0075			0.1303	732.1303	
45° BEND	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17			0.15	0.0032	0.1335	732.1335	
PIPE	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17	40.50	0.0265			0.1600	732.1600	
90° BEND	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17			0.30	0.0064	0.1664	732.1664	90 deg vertical bend DS of UV under slab
PIPE	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17	7.50	0.0049			0.1713	732.1713	vertical pipe length, to be verified with pdf plan set
90° BEND	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17			0.30	0.0064	0.1776	732.1776	90 deg vertical bend DS of UV above slab
PLUG VALVE	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17			0.50	0.0106	0.1883	732.1883	90 deg vertical bend DS of UV above slab
PIPE	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17	2.50	0.0016			0.1899	732.1899	
SHARP-EDGE ENTRANCE	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17			0.50	0.0106	0.2005	732.2005	HGL just DS of Trojan UV internal weir, max HGL here per UV vendor is 733.64 (depends on elevation of housekeeping pad and this elevation is based on 290kgpd)
														734.1500	**Elevation of HGL on US end of Trojan UV per UV vendor. Assumes 3" housekeeping pad which will require the 90 deg vertical bend be location outside the concrete pad footprint for maintenance of the FL-FL connection**
EXIT LOSS	DIP	201.39	130	CL 52	8.0	9.050	8.390	1.17			1.00	0.0212	0.0212	734.1712	
PIPE	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17	2.50	0.0016			0.0228	734.1728	pipe just upstream of UV unit
90° BEND	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17			0.30	0.0064	0.0292	734.1792	90 deg vertical bend US of UV above slab
PLUG VALVE	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17			0.50	0.0106	0.0398	734.1898	90 deg vertical bend US of UV above slab
PIPE	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17	7.50	0.0049			0.0447	734.1947	vertical pipe length, to be verified with pdf plan set
90° BEND	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17			0.30	0.0064	0.0511	734.2011	90 deg vertical bend US of UV under slab
PIPE	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17	54.00	0.0354			0.0865	734.2365	
45° BEND	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17			0.15	0.0032	0.0896	734.2396	
PIPE	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17	3.00	0.0020			0.0916	734.2416	pipe DS of mag meter/flow splitter vault
45° BEND	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17			0.15	0.0032	0.0948	734.2448	
PIPE	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17	1.00	0.0007			0.0955	734.2455	pipe DS of plug valve in vault - length to be confirmed with plan set pdf
PLUG VALVE	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17			0.50	0.0106	0.1061	734.2561	
PIPE	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17	3.00	0.0020			0.1080	734.2580	pipe US of plug valve in vault - length to be confirmed with plan set pdf
TEE - BRANCH FLOW	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17			1.80	0.0382	0.1462	734.2962	WYE fitting at connection to existing 8" serving as UV bypass
PIPE	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17	10.00	0.0066			0.1528	734.3028	**run through 8-inch mag meter size which appears to meet 10% fill requirements - see: "W:\Proj\20000\20114\20114.003\Documents\DesignCalcs\Mag meter\check of 8-inch mag meter for min 10 percent full.xlsx"**
TEE - LINE FLOW	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17			0.30	0.0064	0.1591	734.3091	
PIPE	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17	17.00	0.0111			0.1703	734.3203	
TEE - LINE FLOW	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17			0.30	0.0064	0.1766	734.3266	
PIPE	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17	1.50	0.0010			0.1776	734.3276	
PLUG VALVE	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17			0.50	0.0106	0.1882	734.3382	
PIPE	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17	29.50	0.0193			0.2075	734.3575	
45° BEND	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17			0.15	0.0032	0.2107	734.3607	
PIPE	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17	1.00	0.0007			0.2114	734.3614	
SHARP-EDGE ENTRANCE	DIP	201.39	140	CL 52	8.0	9.050	8.390	1.17			0.50	0.0106	0.2220	734.3720	**HGL in lagoon cell 3 outfall structure downstream of weir gate. Anything greater than WSE shot during survey @ 734.60 suggests that we need to lower the UV p-trap or internal weir. 2 ft freeboard is 734.79.**

Braymer, MO WWTF

HYDRAULIC CALCULATIONS FOR peak daily flow (peak flow from HEC-HMS model using SCS rip run)

DESCRIPTION: Lagoon cell2 through MBBR to lagoon cell 3

FLOW(GPD): 115,000 (peak outflow from cell 2 with 4inch pipe per HEC-HMS -rip run scenario)

FLOW(GPM): 79.86

FLOW(MGD): 0.12

ELEMENT	MATERIAL	FLOW (GPM)	C FACTOR	PIPE CLASS	NOM. DIA (IN)	OUT. DIA (IN)	ID (IN)	VELOCITY (FPS)	LENGTH (FT)	PIPE LOSS	K FACTOR	FIT. LOSS (FT)	CUM. LOSS (FT)	HGL (FT)	COMMENTS
														735.1400	ELEVATION OVER EXISTING FLOW CONTROL WEIR (LAGOON CELL 3 WSE)
EXIT LOSS	DIP	79.86	140	CL 52	6.0	6.900	6.280	0.83			1.00	0.0106	0.0106	735.1506	
PIPE	DIP	79.86	140	CL 52	6.0	6.900	6.280	0.83	31.50	0.0153			0.0259	735.1659	
PLUG VALVE	DIP	79.86	140	CL 52	6.0	6.900	6.280	0.83			0.50	0.0053	0.0312	735.1712	
PIPE	DIP	79.86	140	CL 52	6.0	6.900	6.280	0.83	2.50	0.0012			0.0324	735.1724	
TEE - LINE FLOW	DIP	79.86	140	CL 52	6.0	6.900	6.280	0.83			0.30	0.0032	0.0356	735.1756	
PIPE	DIP	79.86	140	CL 52	6.0	6.900	6.280	0.83	3.50	0.0017			0.0373	735.1773	
45° BEND	DIP	79.86	140	CL 52	6.0	6.900	6.280	0.83			0.15	0.0016	0.0389	735.1789	horizontal bend
PIPE	DIP	79.86	140	CL 52	6.0	6.900	6.280	0.83	17.00	0.0082			0.0471	735.1871	
45° BEND	DIP	79.86	140	CL 52	6.0	6.900	6.280	0.83			0.15	0.0016	0.0487	735.1887	horizontal bend
PIPE	DIP	79.86	140	CL 52	6.0	6.900	6.280	0.83	10.00	0.0048			0.0536	735.1936	
REDUCER	DIP	79.86	140	CL 52	6.0	6.900	6.280	0.83			0.20	0.0021	0.0557	735.1957	
PIPE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46	3.50	0.0004			0.0561	735.1961	
90° BEND	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46			0.30	0.0010	0.0571	735.1971	90 deg bend under weir trough
PIPE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46	1.50	0.0002			0.0573	735.1973	vertical pipe to weir trough
														736.9200	HGL per weir trough calcs
EXIT LOSS	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46			1.00	0.0033	0.0033	736.9233	
PIPE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46	4.00	0.0005			0.0038	736.9238	
TEE - BRANCH FLOW	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46			1.80	0.0060	0.0098	736.9298	
PIPE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46	3.00	0.0004			0.0102	736.9302	(common wall)
												0.0833	0.0935	737.0135	PLACE HOLDER FOR MBBR MEDIA RETENTION SEIVE HEADLOSSES - THIS WAS PULLED FROM CLARKSBURG
RUBBER FLAPPER CHECK: V < 6 FPS												0.1100	0.2035	737.1235	this headloss is pulled from duckbill headloss spreadsheet that was built from headlosses provided by vendor - may need to be modified
PIPE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46	1.50	0.0002			0.2037	737.1237	(common wall)
												0.0833	0.2870	737.2070	PLACE HOLDER FOR MBBR RETENTION SEIVE HEADLOSSES - THIS WAS PULLED FROM CLARKSBURG
RUBBER FLAPPER CHECK: V < 6 FPS												0.1100	0.3970	737.3170	this headloss is pulled from duckbill headloss spreadsheet that was built from headlosses provided by vendor - may need to be modified
PIPE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46	3.00	0.0004			0.3974	737.3174	(common wall)
90° BEND	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46			0.30	0.0010	0.3984	737.3184	
PIPE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46	6.00	0.0007			0.3991	737.3191	vertical pipe in air lift structure
PROJECTING ENTRANCE	DIP	79.86	140	CL 52	8.0	9.050	8.390	0.46			0.80	0.0027	0.4017	737.3217	HGL IN AIR LIFT VERTICAL OUTFALL PIPING
														733.0800	FL into airlift at 732.80, HGL from true gravity flow is 733.03
EXIT LOSS	PVC_ASTM	79.86	130	SDR 26 (160 PSI)	6.0	6.630	6.110	0.87			1.00	0.0119	0.0119	733.0919	
PIPE	PVC_ASTM	79.86	130	SDR 26 (160 PSI)	6.0	6.630	6.110	0.87	5.00	0.0032			0.0150	733.0950	
45° BEND	PVC_ASTM	79.86	130	SDR 26 (160 PSI)	6.0	6.630	6.110	0.87			0.15	0.0018	0.0168	733.0968	FL at 732.82, HGL from true gravity flow is 733.05
PIPE	PVC_ASTM	79.86	130	SDR 26 (160 PSI)	6.0	6.630	6.110	0.87	15.00	0.0095			0.0263	733.1063	
22.5° BEND	PVC_ASTM	79.86	130	SDR 26 (160 PSI)	6.0	6.630	6.110	0.87			0.08	0.0009	0.0272	733.1072	FL at 732.90, HGL from true gravity flow is 733.13
PIPE	PVC_ASTM	79.86	130	SDR 26 (160 PSI)	6.0	6.630	6.110	0.87	27.50	0.0175			0.0447	733.1247	
SHARP-EDGE ENTRANCE	PVC_ASTM	79.86	130	SDR 26 (160 PSI)	6.0	6.630	6.110	0.87			0.50	0.0059	0.0506	733.1306	FL at trash basket structure = 733.03, HGL from true gravity flow is 733.26
														733.2600	CONTROLLING HGL at US end of 6" (HGL in trash basket structure)
														733.7300	bottom of trash basket, to be confirmed
			130									0.5000	0.5000	734.2300	PLACE HOLDER FOR TRASH BASKET HEADLOSS
EXIT LOSS	PVC_ASTM	79.86	130	SDR 26 (160 PSI)	6.0	6.630	6.110	0.87			1.00	0.0119	0.5119	734.2419	FL at 734.48, HGL from true gravity flow is 734.71
PIPE	PVC_ASTM	79.86	130	SDR 26 (160 PSI)	6.0	6.630	6.110	0.87	3.50	0.0022			0.5141	734.2441	
PLUG VALVE	DIP	79.86	140	CL 52	6.0	6.900	6.280	0.83			0.50	0.0053	0.5194	734.2494	FL at 734.49, HGL from true gravity flow is 734.72
PIPE	DIP	79.86	140	CL 52	6.0	6.900	6.280	0.83	31.00	0.0150			0.5344	734.2644	FL at 734.64, HGL from true gravity flow is 734.87
														734.8700	CONTROLLING HGL at US end of 6" (HGL at 4" x 6" reducer)

Braymer, MO **WWTF**
HYDRAULIC CALCULATIONS FOR peak daily flow (peak flow from HEC-HMS model using SCS rip run)

DESCRIPTION: WWTF outfall from lagoon cell 3 through mag meter and UV to WWTF outfall
FLOW(GPD): 115,000 (peak outflow from cell 2 with 4inch pipe per HEC-HMS – rip run scenario)
FLOW(GPM): 79.86
FLOW(MGD): 0.12

ELEMENT	MATERIAL	FLOW (GPM)	C FACTOR	PIPE CLASS	NOM. DIA (IN)	OUT. DIA (IN)	ID (IN)	VELOCITY (FPS)	LENGTH (FT)	PIPE LOSS	K FACTOR	FIT. LOSS (FT)	CUM. LOSS (FT)	HGL (FT)	COMMENTS
REDUCER	DIP	79.86	140	CL 52	4.0	4.800	4.220	1.83			0.20	0.0104	0.0104	734.8804	
PIPE	DIP	79.86	140	CL 52	4.0	4.800	4.220	1.83	2.00	0.0067			0.0171	734.8871	
90° BEND	DIP	79.86	140	CL 52	4.0	4.800	4.220	1.83			0.30	0.0156	0.0328	734.9028	
PIPE	DIP	79.86	140	CL 52	4.0	4.800	4.220	1.83	4.00	0.0134			0.0462	734.9162	VERTICAL PIPE AT INTAKE
PROJECTING ENTRANCE	DIP	79.86	140	CL 52	4.0	4.800	4.220	1.83			0.80	0.0417	0.0879	734.9579	HGL at cell 2 if outlet controlled CELL 2

Braymer, MO WWTF
HYDRAULIC CALCULATIONS FOR peak daily flow (peak flow from HEC-HMS model using SCS rip run)

DESCRIPTION: Lagoon cell 2 through MBBR to lagoon cell 3
FLOW(GPD): 162,085 (peak outflow from cell 2 with 4inch pipe per HEC-HMS- rip run scenario)
FLOW(GPM): 112.56
FLOW(MGD): 0.16

ELEMENT	MATERIAL	FLOW (GPM)	C FACTOR	PIPE CLASS	NOM. DIA (IN)	OUT. DIA (IN)	ID (IN)	VELOCITY (FPS)	LENGTH (FT)	PIPE LOSS	K FACTOR	FIT. LOSS (FT)	CUM. LOSS (FT)	HGL (FT)	COMMENTS
														735.1900	ELEVATION OVER EXISTING FLOW CONTROL WEIR (LAGOON CELL 3 WSE)
EXIT LOSS	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17			1.00	0.0211	0.0211	735.2111	
PIPE	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17	31.50	0.0288			0.0499	735.2399	
PLUG VALVE	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17			0.50	0.0106	0.0605	735.2505	
PIPE	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17	2.50	0.0023			0.0627	735.2527	
TEE - LINE FLOW	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17			0.30	0.0063	0.0691	735.2591	
PIPE	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17	3.50	0.0032			0.0723	735.2623	
45° BEND	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17			0.15	0.0032	0.0754	735.2654	horizontal bend
PIPE	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17	17.00	0.0155			0.0910	735.2810	
45° BEND	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17			0.15	0.0032	0.0941	735.2841	horizontal bend
PIPE	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17	10.00	0.0091			0.1033	735.2933	
REDUCER	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17			0.20	0.0042	0.1075	735.2975	
PIPE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65	3.50	0.0008			0.1083	735.2983	
90° BEND	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65			0.30	0.0020	0.1103	735.3003	90 deg bend under weir trough
PIPE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65	1.50	0.0003			0.1106	735.3006	vertical pipe to weir trough
														736.9300	HGL per weir trough calcs
EXIT LOSS	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65			1.00	0.0066	0.0066	736.9366	
PIPE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65	4.00	0.0009			0.0075	736.9375	
TEE - BRANCH FLOW	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65			1.80	0.0119	0.0194	736.9494	
PIPE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65	3.00	0.0007			0.0201	736.9501	(common wall)
												0.0833	0.1034	**737.0334**	**PLACE HOLDER FOR MBBR MEDIA RETENTION SEIVE HEADLOSSES - THIS WAS PULLED FROM CLARKSBURG**
RUBBER FLAPPER CHECK: V < 6 FPS												**0.1600**	0.2634	737.1934	this headloss is pulled from duckbill headloss spreadsheet that was built from headlosses provided by vendor - may need to be modified
PIPE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65	1.50	0.0003			0.2638	737.1938	(common wall)
												0.0833	0.3471	**737.2771**	**PLACE HOLDER FOR MBBR RETENTION SEIVE HEADLOSSES - THIS WAS PULLED FROM CLARKSBURG**
RUBBER FLAPPER CHECK: V < 6 FPS												**0.1600**	0.5071	737.4371	this headloss is pulled from duckbill headloss spreadsheet that was built from headlosses provided by vendor - may need to be modified
PIPE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65	3.00	0.0007			0.5078	737.4378	(common wall)
90° BEND	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65			0.30	0.0020	0.5098	737.4398	
PIPE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65	6.00	0.0013			0.5111	737.4411	vertical pipe in air lift structure
PROJECTING ENTRANCE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65			0.80	0.0053	0.5164	**737.4464**	**HGL IN AIR LIFT VERTICAL OUTFALL PIPING**
														733.0800	**FL into airlift at 732.80, HGL from true gravity flow is 733.08**
EXIT LOSS	PVC_ASTM	112.56	130	SDR 26 (160 PSI)	6.0	6.630	6.110	1.23			1.00	0.0236	0.0236	733.1036	
PIPE	PVC_ASTM	112.56	130	SDR 26 (160 PSI)	6.0	6.630	6.110	1.23	5.00	0.0060			0.0295	733.1095	
45° BEND	PVC_ASTM	112.56	130	SDR 26 (160 PSI)	6.0	6.630	6.110	1.23			0.15	0.0035	0.0331	**733.1131**	**FL at 732.82, HGL from true gravity flow is 733.10**
PIPE	PVC_ASTM	112.56	130	SDR 26 (160 PSI)	6.0	6.630	6.110	1.23	15.00	0.0180			0.0511	733.1311	
22.5° BEND	PVC_ASTM	112.56	130	SDR 26 (160 PSI)	6.0	6.630	6.110	1.23			0.08	0.0018	0.0528	733.1328	**FL at 732.90, HGL from true gravity flow is 733.18**
PIPE	PVC_ASTM	112.56	130	SDR 26 (160 PSI)	6.0	6.630	6.110	1.23	27.50	0.0329			0.0858	733.1658	
SHARP-EDGE ENTRANCE	PVC_ASTM	112.56	130	SDR 26 (160 PSI)	6.0	6.630	6.110	1.23			0.50	0.0118	0.0975	**733.1775**	**FL at trash basket structure = 733.03, HGL from true gravity flow is 733.31**
														733.3100	**CONTROLLING HGL at US end of 6" (HGL in trash basket structure)**
														733.7300	**bottom of trash basket, to be confirmed**
			130									**0.5000**	0.5000	734.2300	**PLACE HOLDER FOR TRASH BASKET HEADLOSS**
EXIT LOSS	PVC_ASTM	112.56	130	SDR 26 (160 PSI)	6.0	6.630	6.110	1.23			1.00	0.0236	0.5236	734.2536	**FL at 734.48, HGL from true gravity flow is 734.76**
PIPE	PVC_ASTM	112.56	130	SDR 26 (160 PSI)	6.0	6.630	6.110	1.23	3.50	0.0042			0.5278	734.2578	
PLUG VALVE	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17			0.50	0.0106	0.5383	734.2683	**FL at 734.49, HGL from true gravity flow is 734.77**
PIPE	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17	31.00	0.0283			0.5666	734.2966	**FL at 734.64, HGL from true gravity flow is 734.92**
														734.9200	**CONTROLLING HGL at US end of 6" (HGL at 4" x 6" reducer)**

Braymer, MO **WWTF**
HYDRAULIC CALCULATIONS FOR peak daily flow (peak flow from HEC-HMS model using SCS rip run)

DESCRIPTION: lagoon cell 2 through MBBR to lagoon cell 3
FLOW(GPD): 162,085 (peak outflow from cell 2 with 4inch pipe per HEC-HMS- rip run scenario)
FLOW(GPM): 112.56
FLOW(MGD): 0.16

ELEMENT	MATERIAL	FLOW (GPM)	C FACTOR	PIPE CLASS	NOM. DIA (IN)	OUT. DIA (IN)	ID (IN)	VELOCITY (FPS)	LENGTH (FT)	PIPE LOSS	K FACTOR	FIT. LOSS (FT)	CUM. LOSS (FT)	HGL (FT)	COMMENTS
REDUCER	DIP	112.56	140	CL 52	4.0	4.800	4.220	2.58			0.20	0.0207	0.0207	734.9407	
PIPE	DIP	112.56	140	CL 52	4.0	4.800	4.220	2.58	2.00	0.0126			0.0334	734.9534	
90° BEND	DIP	112.56	140	CL 52	4.0	4.800	4.220	2.58			0.30	0.0311	0.0644	734.9844	
PIPE	DIP	112.56	140	CL 52	4.0	4.800	4.220	2.58	4.00	0.0253			0.0897	735.0097	**VERTICAL PIPE AT INTAKE**
PROJECTING ENTRANCE	DIP	112.56	140	CL 52	4.0	4.800	4.220	2.58			0.80	0.0828	0.1725	735.0925	**HGL at cell 2 if outlet controlled CELL 2**

Braymer, MO WWTF

HYDRAULIC CALCULATIONS FOR peak daily flow (peak flow from HEC-HMS model using SCS rip run plus RECIRCULATED 1XQ FOR FUTURE RETURN)

DESCRIPTION:	**lagoon cell 2 through MBBR to lagoon cell 3**			
FLOW(GPD):	**162,085**	(peak outflow from cell 2 with 4inch pipe per HEC-HMS- **rip** run scenario)	Recirc. Flow:	277,083 GPD
FLOW(GPM):	**112.56**			192.42gpm
FLOW(MGD):	**0.16**			0.28MGD

ELEMENT	MATERIAL	FLOW (GPM)	C FACTOR	PIPE CLASS	NOM. DIA (IN)	OUT. DIA (IN)	ID (IN)	VELOCITY (FPS)	LENGTH (FT)	PIPE LOSS	K FACTOR	FIT. LOSS (FT)	CUM. LOSS (FT)	HGL (FT)	COMMENTS
														735.1900	**ELEVATION OVER EXISTING FLOW CONTROL WEIR (LAGOON CELL 3 WSE)**
EXIT LOSS	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17			1.00	0.0211	0.0211	735.2111	
PIPE	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17	31.50	0.0288			0.0499	735.2399	
PLUG VALVE	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17			0.50	0.0106	0.0605	735.2505	
PIPE	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17	2.50	0.0023			0.0627	735.2527	
TEE - LINE FLOW	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17			0.30	0.0063	0.0691	735.2591	
PIPE	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17	3.50	0.0032			0.0723	735.2623	
45° BEND	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17			0.15	0.0032	0.0754	735.2654	horizontal bend
PIPE	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17	17.00	0.0155			0.0910	735.2810	
45° BEND	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17			0.15	0.0032	0.0941	735.2841	horizontal bend
PIPE	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17	10.00	0.0091			0.1033	735.2933	
REDUCER	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17			0.20	0.0042	0.1075	735.2975	
PIPE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65	3.50	0.0008			0.1083	735.2983	
90° BEND	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65			0.30	0.0020	0.1103	735.3003	90 deg bend under weir trough
PIPE	DIP	112.56	140	CL 52	8.0	9.050	8.390	0.65	1.50	0.0003			0.1106	735.3006	vertical pipe to weir trough
														736.9300	HGL per weir trough calcs
EXIT LOSS	DIP	192.42	140	CL 52	8.0	9.050	8.390	1.12			1.00	0.0194	0.0194	736.9494	
PIPE	DIP	192.42	140	CL 52	8.0	9.050	8.390	1.12	4.00	0.0024			0.0218	736.9518	
TEE - BRANCH FLOW	DIP	192.42	140	CL 52	8.0	9.050	8.390	1.12			1.80	0.0349	0.0566	736.9866	
PIPE	DIP	192.42	140	CL 52	8.0	9.050	8.390	1.12	3.00	0.0018			0.0584	736.9884	(common wall)
		192.42										**0.0833**	0.1418	737.0718	**PLACE HOLDER FOR MBBR MEDIA RETENTION SEIVE HEADLOSSES - THIS WAS PULLED FROM CLARKSBURG**
RUBBER FLAPPER CHECK: V < 6 FPS		192.42										**0.2700**	0.4118	737.3418	this headloss is pulled from duckbill headloss spreadsheet that was built from headlosses provided by vendor - may need to be modified
PIPE	DIP	192.42	140	CL 52	8.0	9.050	8.390	1.12	1.50	0.0009			0.4127	737.3427	(common wall)
		192.42										**0.0833**	0.4960	737.4260	**PLACE HOLDER FOR MBBR RETENTION SEIVE HEADLOSSES - THIS WAS PULLED FROM CLARKSBURG**
RUBBER FLAPPER CHECK: V < 6 FPS		192.42										**0.2700**	0.7660	737.6960	this headloss is pulled from duckbill headloss spreadsheet that was built from headlosses provided by vendor - may need to be modified
PIPE	DIP	192.42	140	CL 52	8.0	9.050	8.390	1.12	3.00	0.0018			0.7678	737.6978	(common wall)
90° BEND	DIP	192.42	140	CL 52	8.0	9.050	8.390	1.12			0.30	0.0058	0.7736	737.7036	
PIPE	DIP	192.42	140	CL 52	8.0	9.050	8.390	1.12	6.00	0.0036			0.7772	737.7072	vertical pipe in air lift structure
PROJECTING ENTRANCE	DIP	192.42	140	CL 52	8.0	9.050	8.390	1.12			0.80	0.0155	0.7927	737.7227	**HGL IN AIR LIFT VERTICAL OUTFALL PIPING**
		192.42												**733.0800**	**FL into airlift at 732.80, HGL from true gravity flow is 733.18**
EXIT LOSS	PVC_ASTM	192.42	130	SDR 26 (160 PSI)	6.0	6.630	6.110	2.11			1.00	0.0688	0.0688	733.1488	
PIPE	PVC_ASTM	192.42	130	SDR 26 (160 PSI)	6.0	6.630	6.110	2.11	5.00	0.0162			0.0850	733.1650	
45° BEND	PVC_ASTM	192.42	130	SDR 26 (160 PSI)	6.0	6.630	6.110	2.11			0.15	0.0103	0.0953	**733.1753**	**FL at 732.82, HGL from true gravity flow is 733.20**
PIPE	PVC_ASTM	192.42	130	SDR 26 (160 PSI)	6.0	6.630	6.110	2.11	15.00	0.0485			0.1438	733.2238	
22.5° BEND	PVC_ASTM	192.42	130	SDR 26 (160 PSI)	6.0	6.630	6.110	2.11			0.08	0.0052	0.1490	733.2290	**FL at 732.90, HGL from true gravity flow is 733.28**
PIPE	PVC_ASTM	192.42	130	SDR 26 (160 PSI)	6.0	6.630	6.110	2.11	27.50	0.0888			0.2378	733.3178	
SHARP-EDGE ENTRANCE	PVC_ASTM	192.42	130	SDR 26 (160 PSI)	6.0	6.630	6.110	2.11			0.50	0.0344	0.2722	**733.3522**	**FL at trash basket structure = 733.03, HGL from true gravity flow is 733.41**
		192.42												**733.4100**	**CONTROLLING HGL at US end of 6" (HGL in trash basket structure)**
		192.42												**733.7300**	**bottom of trash basket, to be confirmed**
		192.42	130									**0.5000**	0.5000	734.2300	**PLACE HOLDER FOR TRASH BASKET HEADLOSS**
EXIT LOSS	PVC_ASTM	192.42	130	SDR 26 (160 PSI)	6.0	6.630	6.110	2.11			1.00	0.0688	0.5688	734.2988	**FL at 734.48, HGL from true gravity flow is 734.86**
PIPE	PVC_ASTM	192.42	130	SDR 26 (160 PSI)	6.0	6.630	6.110	2.11	3.50	0.0113			0.5802	734.3102	
PLUG VALVE	DIP	192.42	140	CL 52	6.0	6.900	6.280	1.99			0.50	0.0308	0.6110	734.3410	**FL at 734.49, HGL from true gravity flow is 734.87**
PIPE	DIP	192.42	140	CL 52	6.0	6.900	6.280	1.99	31.00	0.0764			0.6874	734.4174	**FL at 734.64, HGL from true gravity flow is 735.02**
		192.42												**735.0200**	**CONTROLLING HGL at US end of 6" (HGL at 4" x 6" reducer)**

Braymer, MO **WWTF**
HYDRAULIC CALCULATIONS FOR peak daily flow (peak flow from HEC-HMS model using SCS rip run plus RECIRCULATED 1XQ FOR FUTURE RETURN)

DESCRIPTION:	lagoon cell 2 through MBBR to lagoon cell 3			
FLOW(GPD):	162,085	(peak outflow from cell 2 with 4inch pipe per HEC-HMS- rip run scenario)	Recirc.Flow:	277,085GPD
FLOW(GPM):	**112.56**			192.42gpm
FLOW(MGD):	**0.16**			0.28MGD

ELEMENT	MATERIAL	FLOW (GPM)	C FACTOR	PIPE CLASS	NOM. DIA (IN)	OUT. DIA (IN)	ID (IN)	VELOCITY (FPS)	LENGTH (FT)	PIPE LOSS	K FACTOR	FIT. LOSS (FT)	CUM. LOSS (FT)	HGL (FT)	COMMENTS
REDUCER	DIP	192.42	140	CL 52	4.0	4.800	4.220	4.41			0.20	0.0605	0.0605	735.0805	
PIPE	DIP	192.42	140	CL 52	4.0	4.800	4.220	4.41	2.00	0.0341			0.0946	735.1146	
90° BEND	DIP	192.42	140	CL 52	4.0	4.800	4.220	4.41			0.30	0.0908	0.1854	735.2054	
PIPE	DIP	192.42	140	CL 52	4.0	4.800	4.220	4.41	4.00	0.0682			0.2536	735.2736	**VERTICAL PIPE AT INTAKE**
PROJECTING ENTRANCE	DIP	192.42	140	CL 52	4.0	4.800	4.220	4.41			0.80	0.2420	0.4956	735.5156	**HGL at cell 2 if outlet controlled CELL 2**

Braymer, MO WWTF

HYDRAULIC CALCULATIONS FOR peak daily flow (peak flow from HEC-HMS model using SCS rip run)

DESCRIPTION: **UV to Clarifier (bypass around cell 3)**
FLOW(GPDJ: **162,085** (peak outflow from cell 2 per HEC-HMS- rip run scenario)
FLOW(GPM)· **112.56**
FLOW(MGD): **0:16**

ELEMENT	MATERIAL	FLOW (GPM)	C FACTOR	PIPE CLASS	NOM. DIA (IN)	OUT. DIA (IN)	ID (IN)	VELOCITY (FPS)	LENGTH (FT)	PIPE LOSS	K FACTOR	FIT. LOSS (FT)	CUM. LOSS (FT)	HGL (FT)	COMMENTS
					6.0									734.1200	HGL at tee upstream of mag meter vault - see results here: "W:\Proj\20000\20114\20114.003\Documents\DesignCalcs\Hydraulic Calcs\hydraulics for yard piping-cell 3 through UV and mag meter to outfall.xlsx"
PIPE	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17	7.00	0.0064			0.0064	734.1264	pipe just upstream of UV unit
45° BEND	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17			0.15	0.0032	0.0096	734.1296	90 deg vertical bend US of UV above slab
PIPE	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17	10.00	0.0091			0.0187	734.1387	vertical pipe length, to be verified with pdf plan set
22.5° BEND	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17			0.08	0.0016	0.0203	734.1403	90 deg vertical bend US of UV under slab
PIPE	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17	23.19	0.0212			0.0415	734.1615	
22.5° BEND	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17			0.08	0.0016	0.0431	734.1631	8" x 6" tee connection to pipe between cell 3 and UV
PIPE	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17	40.30	0.0368			0.0799	734.1999	
22.5° BEND	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17			0.08	0.0016	0.0815	734.2015	
PIPE	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17	20.00	0.0183			0.0998	734.2198	
45° BEND	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17			0.15	0.0032	0.1029	734.2229	
PIPE	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17	15.15	0.0138			0.1168	734.2368	
PIPE	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17	431.00	0.3939			0.5107	734.6307	
TEE - BRANCH FLOW	DIP	112.56	140	CL 52	6.0	6.900	6.280	1.17			1.80	0.0380	0.5487	**734.6687**	tee connection to line from Clarifier to cell 3, less than 735.2480 so 6" is OK (i.e. this run doesn't control)

EXISTING CELL 3 FLOW CONTROL STRUCTURE

Weir calculations using the Kindsvater-Shen equation

V-NOTCH WEIR:

Inputs:

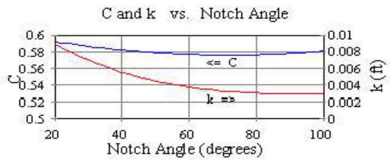
Qmin (GPD):	0
Qmax (GPD):	162085.00
0 (degrees):	90
Total Height of weir (in):	5
Total Height of weir **(ft)**:	0.42
Elevation of bottom of v-notch:	734.79

Outputs:

C:	0.577904885
k (ft):	0.002902517

$$Q = 4.28\ C\ \tan\left(\frac{\theta}{2}\right)(h+k)^{5/2}$$

where Q = Discharge (cfs)
C = Discharge Coefficient
θ = Notch Angle
h = Head (ft)
k=Head Correction Factor (ft)



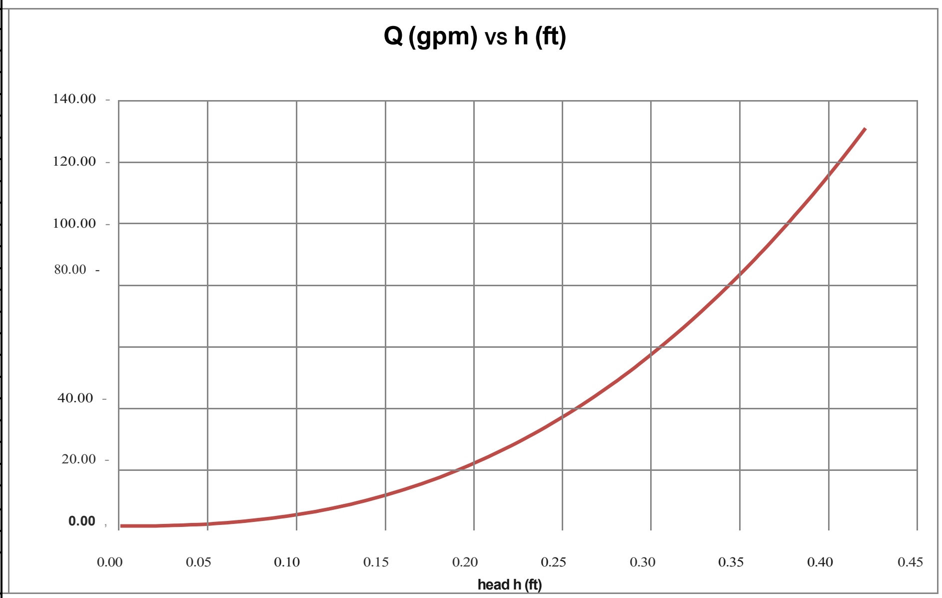
$C = 0.607165052 - 0.000874466963\ Ø + 6.10393334 \times 10^{-6}\ Ø^2$

$k\ (ft.) = 0.0144902648 - 0.00033955535\ Ø + 3.29819003 \times 10^{-6}\ Ø^2 - 1.06215442 \times 10^{-8}\ Ø^3$

where Ø is the notch angle in degrees

h vs Q table:

h (ft)	Q (GPD)	Q(gpm)	WSE	
0.00	0.73	0.00	734.79	
0.01	30.23	0.02	734.80	
0.02	126.89	0.09	734.81	
0.03	313.90	0.22	734.82	
0.04	609.43	0.42	734.83	
0.05	1,028.98	0.71	734.84	
0.06	1,586.30	1.10	734.85	
0.07	2,293.89	1.59	734.86	
0.08	3,163.26	2.20	734.87	
0.09	4,205.18	2.92	734.88	
0.10	5,429.76	3.77	734.89	
0.11	6,846.59	4.75	734.90	
0.12	8,464.81	5.88	734.91	
0.13	10,293.15	7.15	734.92	
0.14	12,340.00	8.57	734.93	
0.15	14,613.43	10.15	734.94	
0.16	17,121.23	11.89	734.95	
0.17	19,870.96	13.80	734.96	
0.18	22,869.92	15.88	734.97	
0.19	26,125.24	18.14	734.98	
0.20	29,643.81	20.59	734.99	
0.21	33,432.39	23.22	735.00	
0.22	37,497.55	26.04	735.01	
0.23	41,845.71	29.06	735.02	
0.24	46,483.15	32.28	735.03	
0.25	51,416.01	35.71	735.04	
0.26	56,650.32	39.34	735.05	
0.27	62,191.97	43.19	735.06	
0.28	68,046.77	47.25	735.07	
0.29	74,220.39	51.54	735.08	
0.30	80,718.43	56.05	735.09	
0.31	87,546.36	60.80	735.10	
0.32	94,709.61	65.77	735.11	
0.33	102,213.48	70.98	735.12	
0.34	110,063.21	76.43	735.13	
0.35	118,263.95	82.13	735.14	ADF
0.36	126,820.78	88.07	735.15	
0.37	135,738.72	94.26	735.16	
0.38	145,022.71	100.71	735.17	max month ADF/permitted flow
0.39	154,677.63	107.42	735.18	
0.40	164,708.28	114.38	735.19	anticipated peak from HEC-HMS
0.41	175,119.42	121.61	735.20	
0.42	185,915.74	129.11	735.21	



Bartlett & West

Project No. 20114.003
Project: Braymer Wastewater System Improvements
Subject: Lagoon Storage and Flow Control Structures
Location: Braymer, MO

Cell 2 Discharge Calculations

Orifice calcs:

Structure between Cell 2 and Cell 3 has two pipes leaving Cell 2 at an upward angle (elevation of pipes in Cell 2 is unknown and elevation of pipes when enter structure is also known) and has 1 discharge pipe leaving structure to enter Cell 3. All pipes are 8" DI.

Equations Used:

$$Q_o = C_o A_o \sqrt{2g(H - E_o)}$$

Q_o = orifice outflow
C_o = orifice discharge coefficient
g = acceleration due to gravity 32.2 ft/s²
A_o = net opening area = $\pi d^2/4$
H = water Elevation
E_o = elevation of orifice

C_o = 0.62

	#1:	#2:	#3:
FL orifice =	734.64 ft	735.82 ft	ft
Number of orifices =	1	1	
Diameter of Orifice =	4 in	8 in	in

Bottom Cell 2

Water Elevation (ft)	H (ft)	Q (cfs)	Q (gpd)	H (ft)	Q (cfs)	Q (gpd)	H (ft)	Q (cfs)	Q (gpd)	Total Q (cfs)	Total Q (gpd)
727.97	-6.84	0.00	0	-8.18	0.00	0	727.97	0.00	0	0.00	0
728.07	-6.74	0.00	0	-8.08	0.00	0	728.07	0.00	0	0.00	0
728.17	-6.64	0.00	0	-7.98	0.00	0	728.17	0.00	0	0.00	0
728.27	-6.54	0.00	0	-7.88	0.00	0	728.27	0.00	0	0.00	0
728.37	-6.44	0.00	0	-7.78	0.00	0	728.37	0.00	0	0.00	0
728.47	-6.34	0.00	0	-7.68	0.00	0	728.47	0.00	0	0.00	0
728.57	-6.24	0.00	0	-7.58	0.00	0	728.57	0.00	0	0.00	0
728.67	-6.14	0.00	0	-7.48	0.00	0	728.67	0.00	0	0.00	0
728.77	-6.04	0.00	0	-7.38	0.00	0	728.77	0.00	0	0.00	0
728.87	-5.94	0.00	0	-7.28	0.00	0	728.87	0.00	0	0.00	0
728.97	-5.84	0.00	0	-7.18	0.00	0	728.97	0.00	0	0.00	0
729.07	-5.74	0.00	0	-7.08	0.00	0	729.07	0.00	0	0.00	0
729.17	-5.64	0.00	0	-6.98	0.00	0	729.17	0.00	0	0.00	0
729.27	-5.54	0.00	0	-6.88	0.00	0	729.27	0.00	0	0.00	0
729.37	-5.44	0.00	0	-6.78	0.00	0	729.37	0.00	0	0.00	0
729.47	-5.34	0.00	0	-6.68	0.00	0	729.47	0.00	0	0.00	0
729.57	-5.24	0.00	0	-6.58	0.00	0	729.57	0.00	0	0.00	0
729.67	-5.14	0.00	0	-6.48	0.00	0	729.67	0.00	0	0.00	0
729.77	-5.04	0.00	0	-6.38	0.00	0	729.77	0.00	0	0.00	0
729.87	-4.94	0.00	0	-6.28	0.00	0	729.87	0.00	0	0.00	0
729.97	-4.84	0.00	0	-6.18	0.00	0	729.97	0.00	0	0.00	0
730.07	-4.74	0.00	0	-6.08	0.00	0	730.07	0.00	0	0.00	0
730.17	-4.64	0.00	0	-5.98	0.00	0	730.17	0.00	0	0.00	0
730.27	-4.54	0.00	0	-5.88	0.00	0	730.27	0.00	0	0.00	0
730.37	-4.44	0.00	0	-5.78	0.00	0	730.37	0.00	0	0.00	0
730.47	-4.34	0.00	0	-5.68	0.00	0	730.47	0.00	0	0.00	0
730.57	-4.24	0.00	0	-5.58	0.00	0	730.57	0.00	0	0.00	0
730.67	-4.14	0.00	0	-5.48	0.00	0	730.67	0.00	0	0.00	0
730.77	-4.04	0.00	0	-5.38	0.00	0	730.77	0.00	0	0.00	0
730.87	-3.94	0.00	0	-5.28	0.00	0	730.87	0.00	0	0.00	0
730.97	-3.84	0.00	0	-5.18	0.00	0	730.97	0.00	0	0.00	0
731.07	-3.74	0.00	0	-5.08	0.00	0	731.07	0.00	0	0.00	0
731.17	-3.64	0.00	0	-4.98	0.00	0	731.17	0.00	0	0.00	0
731.27	-3.54	0.00	0	-4.88	0.00	0	731.27	0.00	0	0.00	0
731.37	-3.44	0.00	0	-4.78	0.00	0	731.37	0.00	0	0.00	0
731.47	-3.34	0.00	0	-4.68	0.00	0	731.47	0.00	0	0.00	0
731.57	-3.24	0.00	0	-4.58	0.00	0	731.57	0.00	0	0.00	0
731.67	-3.14	0.00	0	-4.48	0.00	0	731.67	0.00	0	0.00	0
731.77	-3.04	0.00	0	-4.38	0.00	0	731.77	0.00	0	0.00	0
731.87	-2.94	0.00	0	-4.28	0.00	0	731.87	0.00	0	0.00	0
731.97	-2.84	0.00	0	-4.18	0.00	0	731.97	0.00	0	0.00	0

Project No. 20114.003
Project: Braymer Wastewater System Improvements Subject: Lagoon Storage and Flow Control Structures Location: Braymer, MO

732.07	-2.74	0.00	0
732.17	-2.64	0.00	0
732.27	-2.54	0.00	0
732.37	-2.44	0.00	0
732.47	-2.34	0.00	0
732.57	-2.24	0.00	0
732.67	-2.14	0.00	0
732.77	-2.04	0.00	0
732.87	-1.94	0.00	0
732.97	-1.84	0.00	0
733.07	-1.74	0.00	0
733.17	-1.64	0.00	0
733.27	-1.54	0.00	0
733.37	-1.44	0.00	0
733.47	-1.34	0.00	0
733.57	-1.24	0.00	0
733.67	-1.14	0.00	0
733.77	-1.04	0.00	**0**
733.87	-0.94	0.00	0
733.97	-0.84	0.00	0
734.07	-0.74	0.00	0
734.17	-0.64	0.00	0
734.27	-0.54	0.00	0
734.37	-0.44	0.00	0
734.46	-0.35	0.00	0
734.47	-0.34	0.00	0
734.57	-0.24	0.00	**0**
734.64	-0.17	0.00	0
734.67	-0.14	*0.01*	*9,211*
734.77	-0.04	*0.06*	*39,914*
734.87	0.06	0.11	70,618
734.97	0.16	0.18	113,406
735.07	0.26	0.22	143,996
735.12	0.31	0.24	157,073
735.14	**0.33**	**0.25**	**162,251**
735.17	0.36	0.26	169,141
735.18	0.37	0.27	171,453
735.28	0.47	0.30	193,055
735.38	0.57	0.33	212,472
735.48	0.67	0.36	230,257
735.53	0.72	0.37	238,653
735.58	0.77	0.38	246,763
735.68	0.87	0.41	262,233
735.78	**0.97**	**0.43**	**276,840**
735.82	1.01	0.44	282,471
735.88	1.07	0.45	290,713
735.98	1.17	0.47	303,954
736.08	1.27	0.49	316,642
736.18	1.37	0.51	328,841
736.28	1.47	0.53	340,603
736.38	1.57	0.54	351,972
736.48	1.67	0.56	362,985
736.58	1.77	0.58	373,674
736.68	1.87	0.59	384,065
736.78	1.97	0.61	394,183
736.88	2.07	0.63	404,047
736.98	2.17	0.64	413,676
737.08	2.27	0.65	423,086
737.18	2.37	0.67	432,292
737.28	2.47	0.68	441,305

-4.08	0.00	0
-3.98	0.00	0
-3.88	0.00	0
-3.78	0.00	0
-3.68	0.00	0
-3.58	0.00	0
-3.48	0.00	0
-3.38	0.00	0
-3.28	0.00	0
-3.18	0.00	0
-3.08	0.00	0
-2.98	0.00	0
-2.88	0.00	0
-2.78	0.00	0
-2.68	0.00	0
-2.58	0.00	0
-2.48	0.00	0
-2.38	0.00	0
-2.28	0.00	0
-2.18	0.00	0
-2.08	0.00	0
-1.98	0.00	0
-1.88	0.00	0
-1.78	0.00	0
-1.69	0.00	0
-1.68	0.00	0
-1.58	0.00	0
-1.51	0.00	0
-1.48	0.00	0
-1.38	0.00	0
-1.28	0.00	0
-1.18	0.00	0
-1.08	0.00	0
-1.03	0.00	0
-1.01	**0.00**	**0**
-0.98	0.00	0
-0.97	0.00	0
-0.87	0.00	0
-0.77	0.00	0
-0.67	0.00	0
-0.62	0.00	0
-0.57	0.00	0
-0.47	0.00	0
-0.37	**0.00**	**0**
-0.33	0.00	0
-0.27	*0.05*	*30,549*
-0.17	*0.13*	*81,463*
-0.07	*0.20*	*132,377*
0.03	0.28	183,291
0.13	0.62	399,474
0.23	0.83	534,381
0.33	0.99	641,519
0.43	1.13	733,165
0.53	1.26	814,564
0.63	1.37	888,537
0.73	1.48	956,808
0.83	1.58	1,020,522
0.93	1.67	1,080,486
1.03	1.76	1,137,292
1.13	1.84	1,191,393

732.07	0.00	0	0.00	0	
732.17	0.00	0	0.00	0	
732.27	0.00	0	0.00	0	
732.37	0.00	0	0.00	0	
732.47	0.00	0	0.00	**0**	
732.57	0.00	0	0.00	0	
732.67	0.00	0	0.00	0	
732.77	0.00	0	0.00	0	
732.87	0.00	0	0.00	0	
732.97	0.00	0	0.00	0	
733.07	0.00	0	0.00	0	
733.17	0.00	0	0.00	0	
733.27	0.00	0	0.00	0	
733.37	0.00	0	0.00	0	
733.47	0.00	0	0.00	0	
733.57	0.00	0	0.00	0	
733.67	0.00	0	0.00	**0**	
733.77	0.00	0	0.00	0	
733.87	0.00	0	0.00	0	
733.97	0.00	0	0.00	0	
734.07	0.00	0	0.00	0	
734.17	0.00	0	0.00	0	
734.27	0.00	0	0.00	0	
734.37	0.00	0	0.00	0	
734.46	0.00	0	0.00	0	
734.47	0.00	0	0.00	0	
734.57	0.00	0	0.00	**0**	
734.64	0.00	0	0.00	0	FL4"
734.67	0.00	0	*0.01*	*9,211*	
734.77	0.00	0	*0.06*	*39,914*	
734.87	0.00	0	0.11	70,618	
734.97	0.00	0	0.18	113,406	
735.07	0.00	0	0.22	143,996	
735.12	0.00	0	0.24	157,073	
735.14	**0.00**	**0**	**0.25**	**162,251**	**HGL from inlet c,**
735.17	0.00	0	0.26	169,141	
735.18	0.00	0	0.27	171,453	
735.28	0.00	0	0.30	193,055	
735.38	0.00	0	0.33	212,472	
735.48	0.00	0	0.36	230,257	
735.53	0.00	0	0.37	238,653	WSE
735.58	0.00	0	0.38	246,763	
735.68	0.00	0	0.41	262,233	
735.78	**0.00**	**0**	**0.43**	**276,840**	**HGL from inlet c,**
735.82	0.00	0	0.44	282,471	FL 8"
735.88	0.00	0	*0.50*	*321,262*	
735.98	0.00	0	*0.60*	*385,417*	
736.08	0.00	0	*0.69*	*449,019*	
736.18	0.00	0	0.79	512,132	
736.28	0.00	0	1.15	740,076	
736.38	0.00	0	1.37	886,353	
736.48	0.00	0	1.55	1,004,504	
736.58	0.00	0	1.71	1,106,839	
736.68	0.00	0	1.85	1,198,629	
736.78	0.00	0	1.98	1,282,720	
736.88	0.00	0	2.11	1,360,855	
736.98	0.00	0	2.22	1,434,199	
737.08	0.00	0	2.33	1,503,572	
737.18	0.00	0	2.43	1,569,584	top of berm
737.28	0.00	0	2.53	1,632,698	

italized print indicates cells calculated by linear interpolation for flows less than ½ full as the orifice calculation is based on the centroid of the orifice

(linear interpolation between FL of orifice and first non-zero flow)

Cell 1 Elevation-Area Table for HEC-HMS: (water depth at time of survey= 4.76)

Elev (ft.)	Area (ac.)	Area (ft^2)		
730.99	7.108	309,604.35 (lagoon bottom)		
731	7.109	309687.695		
732	7.301	318048.843		
733	7.495	326467.737		
734	7.689	334944.377		
735	7.885	343478.762		
735.75	8.029	349752.070 {WSE)		
736	8.108	353164.439		
736.68	8.255	359,604.54 (2 ft freeboard)	5.69	
737	8.325	362635.174		
738	8.560	372877.666		
738.68	9.443	411340.686 {TOP OF BERM)	lowest top of berm elevation	738.68
			highest top of berm elevation	744.92

Cell 2 Elevation-Area Table for HEC-HMS: (water depth at time of survey= 7.56)

Elev (ft.)	Area (ac.)	Area (ft^2)		
727.97	3.402	148,184.97 (lagoon bottom)		
728	3.405	148321.351		
729	3.511	152924.456		
730	3.618	157586.785		
731	3.726	162308.336		
732	3.836	167089.110		
733	3.947	171929.107		
734	4.059	176828.327		
735	4.173	181786.769		
735.53	4.235	184465.260 {WSE)		
735.18	4.189	182,464.15 (2 ft freeboard)	7.21	
736	4.296	187152.470		
737	4.445	193604.250		
737.18	4.650	202571.667 {TOP OF BERM)	lowest top of berm elevation	737.18
			highest top of berm elevation	740.93

Cell 3 Elevation-Area Table: (water depth at time of survey= 7.12)

Elev (ft.)	Area (ac.)	Area (ft^2)		
727.47	0.876368	38,174.61 (lagoon bottom)		
728	0.904485	39399.3844		
729	0.958546	41754.2537		
730	1.013938	44167.1414		
731	1.070662	46638.0473		
732	1.128718	49166.9714		
733	1.188106	51753.9139		
734	1.248826	54398.8746		
734.59	1.285845	56011.41 (WSE)		
734.79	1.300038	56,629.65 {2 ft freeboard)		
735	1.31494	57278.7958		
736	1.374122	59856.7422		
736.79	1.485904	64725.9727 {TOP OF BERM)	lowest top of berm elevation	736.79
			highest top of berm elevation	737.92

SCS 1 in 10 year synthetic storm event for HEC-HMS

SCS Type 2 Storm - 24hour, 10year

Date Range	4/10/2023 12:00	
	4/12/2023 10:45	

Date & Time (time ending)	Storm Flow (CFS)	ADF Dry weather (CFS)	Total Flow (CFS)
2023-04-10 12:00:00	0.2	0.175	0.375
2023-04-10 12:15:00	0.2	0.175	0.375
2023-04-10 12:30:00	0.2	0.175	0.375
2023-04-10 12:45:00	0.2	0.175	0.375
2023-04-10 13:00:00	0.18	0.17	0.35
2023-04-10 13:15:00	0.19	0.17	0.36
2023-04-10 13:30:00	0.2	0.17	0.37
2023-04-10 13:45:00	0.22	0.17	0.39
2023-04-10 14:00:00	0.23	0.165	0.395
2023-04-10 14:15:00	0.25	0.165	0.415
2023-04-10 14:30:00	0.28	0.165	0.445
2023-04-10 14:45:00	0.3	0.165	0.465
2023-04-10 15:00:00	0.31	0.1775	0.4875
2023-04-10 15:15:00	0.33	0.1775	0.5075
2023-04-10 15:30:00	0.36	0.1775	0.5375
2023-04-10 15:45:00	0.38	0.1775	0.5575
2023-04-10 16:00:00	0.4	0.1775	0.5775
2023-04-10 16:15:00	0.43	0.1775	0.6075
2023-04-10 16:30:00	0.45	0.1775	0.6275
2023-04-10 16:45:00	0.47	0.1775	0.6475
2023-04-10 17:00:00	0.5	0.19	0.69
2023-04-10 17:15:00	0.51	0.19	0.7
2023-04-10 17:30:00	0.53	0.19	0.72
2023-04-10 17:45:00	0.55	0.19	0.74
2023-04-10 18:00:00	0.6	0.1925	0.7925
2023-04-10 18:15:00	0.62	0.1925	0.8125
2023-04-10 18:30:00	0.63	0.1925	0.8225
2023-04-10 18:45:00	0.65	0.1925	0.8425
2023-04-10 19:00:00	0.66	0.1875	0.8475
2023-04-10 19:15:00	0.68	0.1875	0.8675
2023-04-10 19:30:00	0.7	0.1875	0.8875
2023-04-10 19:45:00	0.72	0.1875	0.9075
2023-04-10 20:00:00	0.71	0.175	0.885
2023-04-10 20:15:00	0.73	0.175	0.905
2023-04-10 20:30:00	0.75	0.175	0.925
2023-04-10 20:45:00	0.77	0.175	0.945
2023-04-10 21:00:00	0.8	0.1775	0.9775
2023-04-10 21:15:00	0.83	0.1775	1.0075
2023-04-10 21:30:00	0.85	0.1775	1.0275
2023-04-10 21:45:00	0.88	0.1775	1.0575
2023-04-10 22:00:00	0.91	0.1825	1.0925
2023-04-10 22:15:00	0.95	0.1825	1.1325
2023-04-10 22:30:00	0.98	0.1825	1.1625
2023-04-10 22:45:00	1.02	0.1825	1.2025
2023-04-10 23:00:00	1.08	0.2175	1.2975
2023-04-10 23:15:00	1.13	0.2175	1.3475
2023-04-10 23:30:00	1.19	0.2175	1.4075
2023-04-10 23:45:00	1.27	0.2175	1.4875
2023-04-11 0:00:00	1.38	0.2	1.58
2023-04-11 0:15:00	1.71	0.2	1.91
2023-04-11 0:30:00	2.25	0.2	2.45
2023-04-11 0:45:00	3	0.2	3.2
2023-04-111:00:00	3.86	0.18	4.04
2023-04-111:15:00	4.55	0.18	4.73
2023-04-111:30:00	5.04	0.18	5.22
2023-04-111:45:00	5.32	0.18	5.5

SCS 1 in 10 year synthetic storm event for HEC-HMS

Date & Time (time ending)	Storm Flow (CFS)	ADF Dry weather (CFS)	Total Flow (CFS)
2023-04-11 2:00:00	5.42	0.165	5.585
2023-04-11 2:15:00	5.48	0.165	5.645
2023-04-11 2:30:00	5.49	0.165	5.655
2023-04-11 2:45:00	5.43	0.165	5.595
2023-04-11 3:00:00	5.32	0.15	5.47
2023-04-11 3:15:00	5.15	0.15	5.3
2023-04-11 3:30:00	4.94	0.15	5.09
2023-04-11 3:45:00	4.71	0.15	4.86
2023-04-114:00:00	4.48	0.1475	4.6275
2023-04-114:15:00	4.23	0.1475	4.3775
2023-04-114:30:00	3.97	0.1475	4.1175
2023-04-114:45:00	3.71	0.1475	3.8575
2023-04-115:00:00	3.48	0.16	3.64
2023-04-11 5:15:00	3.26	0.16	3.42
2023-04-115:30:00	3.09	0.16	3.25
2023-04-11 5:45:00	2.96	0.16	3.12
2023-04-11 6:00:00	2.86	0.195	3.055
2023-04-11 6:15:00	2.77	0.195	2.965
2023-04-11 6:30:00	2.69	0.195	2.885
2023-04-11 6:45:00	2.62	0.195	2.815
2023-04-11 7:00:00	2.55	0.1875	2.7375
2023-04-11 7:15:00	2.48	0.1875	2.6675
2023-04-11 7:30:00	2.42	0.1875	2.6075
2023-04-11 7:45:00	2.35	0.1875	2.5375
2023-04-118:00:00	2.28	0.1625	2.4425
2023-04-118:15:00	2.22	0.1625	2.3825
2023-04-118:30:00	2.16	0.1625	2.3225
2023-04-118:45:00	2.1	0.1625	2.2625
2023-04-11 9:00:00	2.04	0.17	2.21
2023-04-11 9:15:00	1.98	0.17	2.15
2023-04-11 9:30:00	1.92	0.17	2.09
2023-04-11 9:45:00	1.86	0.17	2.03
2023-04-1110:00:00	1.8	0.1725	1.9725
2023-04-1110:15:00	1.74	0.1725	1.9125
2023-04-1110:30:00	1.69	0.1725	1.8625
2023-04-1110:45:00	1.63	0.1725	1.8025
2023-04-1111:00:00	1.61	0.1825	1.7925
2023-04-1111:15:00	1.55	0.1825	1.7325
2023-04-1111:30:00	1.5	0.1825	1.6825
2023-04-1111:45:00	1.44	0.1825	1.6225
2023-04-1112:00:00	1.37	0.175	1.545
2023-04-1112:15:00	1.32	0.175	1.495
2023-04-1112:30:00	1.27	0.175	1.445
2023-04-1112:45:00	1.23	0.175	1.405
2023-04-1113:00:00	1.17	0.17	1.34
2023-04-1113:15:00	1.14	0.17	1.31
2023-04-1113:30:00	1.1	0.17	1.27
2023-04-1113:45:00	1.06	0.17	1.23
2023-04-1114:00:00	1	0.165	1.165
2023-04-1114:15:00	0.96	0.165	1.125
2023-04-1114:30:00	0.92	0.165	1.085
2023-04-1114:45:00	0.88	0.165	1.045
2023-04-1115:00:00	0.83	0.1775	1.0075
2023-04-1115:15:00	0.8	0.1775	0.9775
2023-04-1115:30:00	0.76	0.1775	0.9375
2023-04-1115:45:00	0.73	0.1775	0.9075

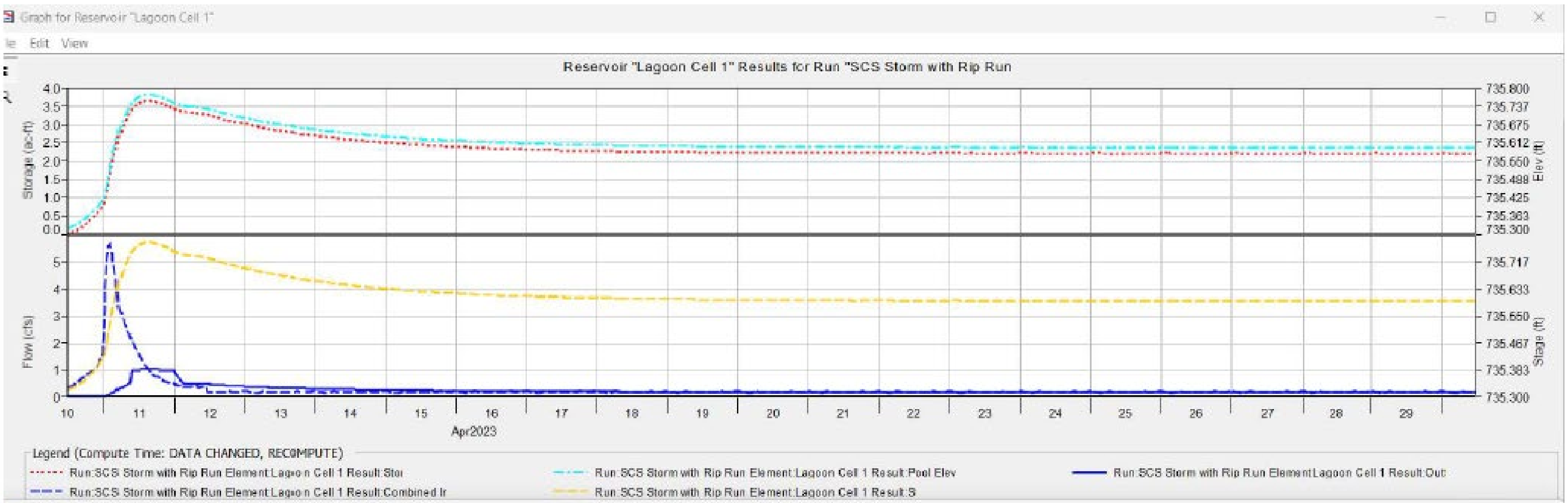
SCS 1 in 10 year synthetic storm event for HEC-HMS

Date & Time (time ending)	Storm Flow (CFS)	ADF Dry weather (CFS)	Total Flow (CFS)
2023-04-11 16:00:00	0.7	0.1775	0.8775
2023-04-11 16:15:00	0.67	0.1775	0.8475
2023-04-11 16:30:00	0.65	0.1775	0.8275
2023-04-11 16:45:00	0.62	0.1775	0.7975
2023-04-11 17:00:00	0.61	0.19	0.8
2023-04-11 17:15:00	0.59	0.19	0.78
2023-04-11 17:30:00	0.57	0.19	0.76
2023-04-11 17:45:00	0.55	0.19	0.74
2023-04-11 18:00:00	0.57	0.1925	0.7625
2023-04-11 18:15:00	0.56	0.1925	0.7525
2023-04-11 18:30:00	0.54	0.1925	0.7325
2023-04-11 18:45:00	0.53	0.1925	0.7225
2023-04-11 19:00:00	0.5	0.1875	0.6875
2023-04-11 19:15:00	0.49	0.1875	0.6775
2023-04-11 19:30:00	0.48	0.1875	0.6675
2023-04-11 19:45:00	0.46	0.1875	0.6475
2023-04-11 20:00:00	0.42	0.175	0.595
2023-04-11 20:15:00	0.41	0.175	0.585
2023-04-11 20:30:00	0.4	0.175	0.575
2023-04-11 20:45:00	0.39	0.175	0.565
2023-04-11 21:00:00	0.38	0.1775	0.5575
2023-04-11 21:15:00	0.37	0.1775	0.5475
2023-04-11 21:30:00	0.36	0.1775	0.5375
2023-04-11 21:45:00	0.35	0.1775	0.5275
2023-04-11 22:00:00	0.34	0.1825	0.5225
2023-04-11 22:15:00	0.33	0.1825	0.5125
2023-04-11 22:30:00	0.32	0.1825	0.5025
2023-04-11 22:45:00	0.31	0.1825	0.4925
2023-04-11 23:00:00	0.31	0.2175	0.5275
2023-04-11 23:15:00	0.3	0.2175	0.5175
2023-04-11 23:30:00	0.29	0.2175	0.5075
2023-04-11 23:45:00	0.28	0.2175	0.4975
2023-04-12 0:00:00	0.27	0.2	0.47
2023-04-12 0:15:00	0.26	0.2	0.46
2023-04-12 0:30:00	0.25	0.2	0.45
2023-04-12 0:45:00	0.24	0.2	0.44
2023-04-12 1:00:00	0.23	0.18	0.41
2023-04-12 1:15:00	0.22	0.18	0.4
2023-04-12 1:30:00	0.22	0.18	0.4
2023-04-12 1:45:00	0.22	0.18	0.4
2023-04-12 2:00:00	0.21	0.165	0.375
2023-04-12 2:15:00	0.2	0.165	0.365
2023-04-12 2:30:00	0.2	0.165	0.365
2023-04-12 2:45:00	0.2	0.165	0.365
2023-04-12 3:00:00	0.21	0.15	0.36
2023-04-12 3:15:00	0.21	0.15	0.36
2023-04-12 3:30:00	0.21	0.15	0.36
2023-04-12 3:45:00	0.2	0.15	0.35
2023-04-12 4:00:00	0.2	0.1475	0.3475
2023-04-12 4:15:00	0.2	0.1475	0.3475
2023-04-12 4:30:00	0.2	0.1475	0.3475
2023-04-12 4:45:00	0.2	0.1475	0.3475
2023-04-12 5:00:00	0.21	0.16	0.37
2023-04-12 5:15:00	0.21	0.16	0.37
2023-04-12 5:30:00	0.21	0.16	0.37
2023-04-12 5:45:00	0.21	0.16	0.37

SCS 1 in 10 year synthetic storm event for HEC-HMS

Date & Time (time ending)	Storm Flow (CFS)	ADF Dry weather (CFS)	Total Flow (CFS)
2023-04-12 6:00:00	0.21	0.195	0.405
2023-04-12 6:15:00	0.21	0.195	0.405
2023-04-12 6:30:00	0.2	0.195	0.395
2023-04-12 6:45:00	0.2	0.195	0.395
2023-04-12 7:00:00	0.2	0.1875	0.3875
2023-04-12 7:15:00	0.2	0.1875	0.3875
2023-04-12 7:30:00	0.2	0.1875	0.3875
2023-04-12 7:45:00	0.2	0.1875	0.3875
2023-04-12 8:00:00	0.18	0.1625	0.3425
2023-04-12 8:15:00	0.18	0.1625	0.3425
2023-04-12 8:30:00	0.18	0.1625	0.3425
2023-04-12 8:45:00	0.18	0.1625	0.3425
2023-04-12 9:00:00	0.18	0.17	0.35
2023-04-12 9:15:00	0.18	0.17	0.35
2023-04-12 9:30:00	0.18	0.17	0.35
2023-04-12 9:45:00	0.18	0.17	0.35
2023-04-12 10:00:00	0.19	0.1725	0.3625
2023-04-12 10:15:00	0.19	0.1725	0.3625
2023-04-12 10:30:00	0.19	0.1725	0.3625
2023-04-12 10:45:00	0.19	0.1725	0.3625

HEC-HMS output - Lagoon Cells 1 and 2 storage-elevation-discharge results for SCS 1 in 10 year wet weather event



Project#: 20114.003
Project: Braymer MO Wastewater Treatment Improvements
Subject: Runoff to NW Ditch for Ditch Design and Check on Existing 30" Culvert
By: MJV

Composite C Calculations

Land Cover Description	Runoff Coefficient	% of Total Runoff Area
Residential Lot Size 1, D Soils, 0-2%	0.31	2.26%
Cultivated Land, D Soils, 0-2%	0.24	97.74%

Composite C: 0.24 100.00%

Project#: 20114.003
Project: Braymer MO Wastewater Treatment Improvements
Subject: Runoff to NW Ditch for Ditch Design and Check on Existing 30" Culvert

Peak Runoff Calculations

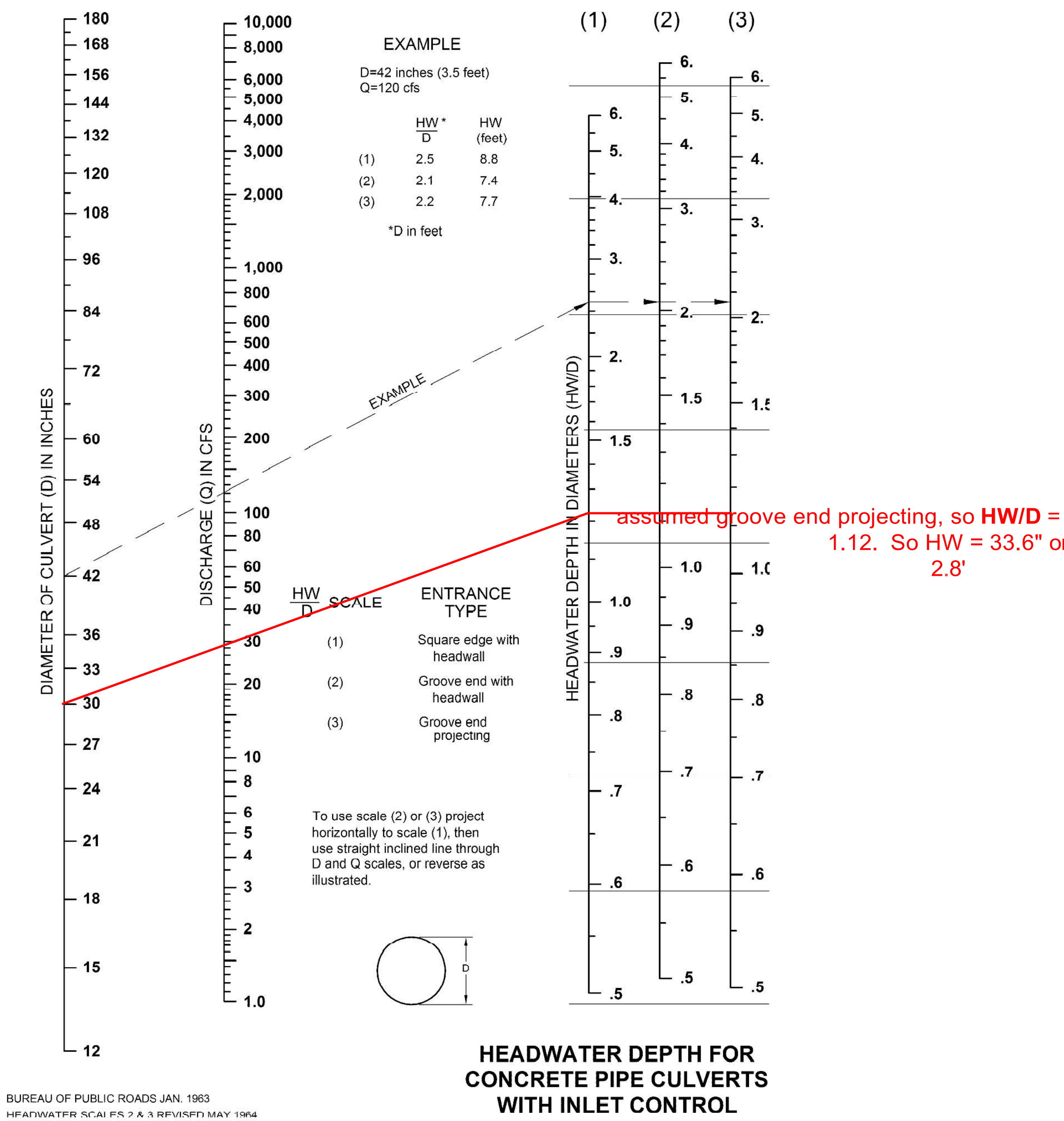
Drainage Area = Runoff to Northwest Ditch

MODOT District= Northwest
Drainage Area (ac) = 16.13
Drainage Length (ft) = 2,453
Change in Elev. (ft)= 35
Soil Type= D
Composite Runoff Coefficient (C) = 0.24

Kirpich Time of Concentration (min)= 16.37
Drainage Slope (ft/ft)= 0.014

MODOT District Rainfall Intensity (in/hr)	Peak Flow (cfs)
$i_{2yr} = 3.27$	$Q_{2yr} = 12.7$
$i_{5yr} = 4.09$	$Q_{5yr} = 16.0$
$i_{10yr} = 4.72$	$Q_{10yr} = 18.4$
$i_{25yr} = 5.77$	$Q_{25yr} = 22.5$
$i_{50yr} = 6.66$	$Q_{50yr} = 25.9$
$i_{100yr} = 7.40$	$Q_{100yr} = 28.8$

Figure 3.1.2.2


DIAMETER OF CULVERT (D) IN INCHES
180
168
156
144
132
120
108
96
84
72
60
54
48
42
36
33
30
27
24
21
18
15
12
DISCHARGE (Q) IN CFS
10,000
8,000
6,000
5,000
4,000
3,000
2,000
1,000
800
600
500
400
300
200
100
80
60
50
40
30
20
10
8
6
5
4
3
2
1.0
EXAMPLE
D=42 inches (3.5 feet)
Q=120 cfs
HW* / D
HW (feet)
(1) 2.5 8.8
(2) 2.1 7.4
(3) 2.2 7.7
*D in feet
EXAMPLE
HW/D SCALE
ENTRANCE TYPE
(1) Square edge with headwall
(2) Groove end with headwall
(3) Groove end projecting
To use scale (2) or (3) project horizontally to scale (1), then use straight inclined line through D and Q scales, or reverse as illustrated.
D
HEADWATER DEPTH IN DIAMETERS (HW/D)
(1)
(2)
(3)
assumed groove end projecting, so **HW/D** = 1.12. So HW = 33.6" or 2.8'
HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL
BUREAU OF PUBLIC ROADS JAN. 1963
HEADWATER SCALES 2 & 3 REVISED MAY 1964

Manning's Equation (for open channels)

Location: northwest ditch sizing

input:

Channel Length (ft):	810
Channel Slope (ft/ft):	0.007
Bottom Width (ft):	3.5
Left Side Slope (X:1):	3
Right Side Slope (X:1):	3
Depth (ft):	1.3
Ditch Conditions:	Natural Channels With Stones and Weeds

output:

Storm Drain Length (ft):	812.83
A (ft^2):	9.62
P (ft):	11.72
R (ft):	0.820684532
n:	0.035
Q (ft^3/s):	30.03
V (ft/s):	3.12
time in ditch (min):	4.34

MISSOURI DEPARTMENT OF NATURAL RESOURCES
WATER PROTECTION PROGRAM

APPLICATION FOR CONSTRUCTION PERMIT – WASTEWATER TREATMENT FACILITY

FOR DEPARTMENT USE ONLY	
APP NO.	CP NO.
FEE RECEIVED	CHECK NO.
DATE RECEIVED	

APPLICATION OVERVIEW

The Application for Construction Permit – Wastewater Treatment Facility form has been developed in a modular format and consists of Part A and B. **All applicants must complete Part A.** Part B should be completed for applicants who currently land-apply wastewater or propose land application for wastewater treatment. **Please read the accompanying instructions before completing this form. Submittal of an incomplete application may result in the application being returned.**

PART A – BASIC INFORMATION

1.0 APPLICATION INFORMATION (Note – If any of the questions in this section are answered NO, this application may be considered incomplete and returned.)

1.1 Is this a Federal/State funded project? ☑ YES ☐ N/A Funding Agency: SRF/CDBG Project #: C295888-01

1.2 Has the Missouri Department of Natural Resources approved the proposed project's antidegradation review?
☐ YES Date of Approval: ______ ☑ N/A

1.3 Has the department approved the proposed project's facility plan*?
☐ YES Date of Approval: ______ ☑ NO (If No, complete No. 1.4.)

1.4 [Complete only if answered No on No. 1.3.] Is a copy of the facility plan* for wastewater treatment facilities included with this application?
☐ YES ☑ NO ☐ Exempt because DNR already has a copy of the Facility Plan

1.5 Is a copy of the appropriate plans* and specifications* included with this application?
☑ YES Denote which form is submitted: ☐ Hard copy ☑ Electronic copy (See instructions.) ☐ NO

1.6 Is a summary of design* included with this application? ☑ YES ☐ NO

1.7 Has the appropriate operating permit application (A, B, or B2) been submitted to the department?
☐ YES Date of submittal: ______
☑ Enclosed is the appropriate operating permit application and fee submittal. Denote which form: ☐ A ☐ B ☑ B2
☐ N/A: However, In the event the department believes that my operating permit requires revision to permit limitation such as changing equivalent to secondary limits to secondary limits or adding total residual chlorine limits, please share a draft copy prior to public notice? ☐ YES ☐ NO

1.8 Is the facility currently under enforcement with the department or the Environmental Protection Agency? ☐ YES ☑ NO

1.9 Is the appropriate fee or JetPay confirmation included with this application? ☑ YES ☐ NO
See Section 7.0

* Must be affixed with a Missouri registered professional engineer's seal, signature and date.

2.0 PROJECT INFORMATION

2.1 NAME OF PROJECT	2.2 ESTIMATED PROJECT CONSTRUCTION COST
Braymer Wastewater Treatment Facility Improvements	$ 3,158,958

2.3 PROJECT DESCRIPTION

Project consists of the installation of Triplepoint's Nitrox Ammonia Removal System, sludge removal in the lagoons (if bids come in under budget), new lagoon outfall piping, new yard piping, new outfall piping through mag meter vault, and new UV system

2.4 SLUDGE HANDLING, USE AND DISPOSAL DESCRIPTION

Solids handling will be accomplished with a clarifier on the downstream side of the ammonia removal Nitrox tanks with recirculation to lagoon cell 1.

2.5 DESIGN INFORMATION

A. Current population: 737; Design population: 1450

B. Actual Flow: 43,108 gpd; Design Average Flow: 145,000 gpd;
Actual Peak Daily Flow: N/A gpd; Design Maximum Daily Flow: 165,085 gpd; Design Wet Weather Event: 1,450,000 GPD

2.6 ADDITIONAL INFORMATION

A. Is a topographic map attached? ☑ YES ☐ NO

B. Is a process flow diagram attached? ☐ YES ☑ NO see plans

design factored in lagoon attenuation based on wet weather event, and limits throughput flow to the design maximum daily flow based on peak theoretical wet weather event (modeled as 10-year design storm).

3.0 WASTEWATER TREATMENT FACILITY

NAME	TELEPHONE NUMBER WITH AREA CODE	E-MAIL ADDRESS		
Braymer WWTF	(660) 645-2355	braymerclerk@gmail.com		
ADDRESS (PHYSICAL)	CITY	STATE	ZIP CODE	COUNTY
13510 Southeast Hwy N	Braymer	MO	64624	Caldwell

Wastewater Treatment Facility: Mo- 0028061 (Outfall 001 Of 001)

3.1 Legal Description: _____ ¼, NE ¼, NW ¼, Sec. 11, T 55N, R 26W
(Use additional pages if construction of more than one outfall is proposed.)

3.2 UTM Coordinates Easting (X): 432618 Northing (Y): 4383356
For Universal Transverse Mercator (UTM), Zone 15 North referenced to North American Datum 1983 (NAD83)

3.3 Name of receiving streams: Tributary to Mud Creek

4.0 PROJECT OWNER

NAME	TELEPHONE NUMBER WITH AREA CODE	E-MAIL ADDRESS	
City of Braymer, MO	(660) 645-2355	braymerclerk@gmail.com	
ADDRESS	CITY	STATE	ZIP CODE
108 E. 2nd St.	Braymer	MO	64624

5.0 CONTINUING AUTHORITY: A continuing authority is a company, business, entity or person(s) that will be operating the facility and/or ensuring compliance with the permit requirements.

NAME	TELEPHONE NUMBER WITH AREA CODE	E-MAIL ADDRESS	
City of Braymer, MO	(660) 645-2355	braymerclerk@gmail.com	
ADDRESS	CITY	STATE	ZIP CODE
108 E. 2nd St.	Braymer	MO	64624

5.1 A letter from the continuing authority, if different than the owner, is included with this application. ☐ YES ☐ NO ☑ N/A

5.2 COMPLETE THE FOLLOWING IF THE CONTINUING AUTHORITY IS A MISSOURI PUBLIC SERVICE COMMISSION REGULATED ENTITY.

A. Is a copy of the certificate of convenience and necessity included with this application? ☐ YES ☑ NO

5.3 COMPLETE THE FOLLOWING IF THE CONTINUING AUTHORITY IS A PROPERTY OWNERS ASSOCIATION.

A. Is a copy of the as-filed restrictions and covenants included with this application? ☐ YES ☐ NO

B. Is a copy of the as-filed warranty deed, quitclaim deed or other legal instrument which transfers ownership of the land for the wastewater treatment facility to the association included with this application? ☐ YES ☐ NO

C. Is a copy of the as-filed legal instrument (typically the plat) that provides the association with valid easements for all sewers included with this application? ☐ YES ☐ NO

D. Is a copy of the Missouri Secretary of State's nonprofit corporation certificate included with this application? ☐ YES ☐ NO

6.0 ENGINEER

ENGINEER NAME / COMPANY NAME	TELEPHONE NUMBER WITH AREA CODE	E-MAIL ADDRESS	
Kyle J. Landwehr, PE, ENV SP / Bartlett & West, Inc.	(573) 659-6727	kyle.landwehr@bartwest.com	
ADDRESS	CITY	STATE	ZIP CODE
601 Monroe Street, Suite 201	Jefferson City	MO	65101

7.0 APPLICATION FEE

☐ CHECK NUMBER ☑ JETPAY CONFIRMATION NUMBER 20062631

8.0 PROJECT OWNER: I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

PROJECT OWNER SIGNATURE		
PRINTED NAME: Dennis Batchelar (signature)		DATE: 2-28-2025
TITLE OR CORPORATE POSITION: Mayor	TELEPHONE NUMBER WITH AREA CODE: (660) 645-2355	E-MAIL ADDRESS: braymerclerk@gmail.com

Mail completed copy to: MISSOURI DEPARTMENT OF NATURAL RESOURCES
WATER PROTECTION PROGRAM
P.O. BOX 176
JEFFERSON CITY, MO 65102-0176

END OF PART A.
REFER TO THE APPLICATION OVERVIEW TO DETERMINE WHETHER PART B NEEDS TO BE COMPLETE.

PART B – LAND APPLICATION ONLY
(Submit only if the proposed construction project includes land application of wastewater.)

8.0 FACILITY INFORMATION

8.1 Type of wastewater to be irrigated: ☐ Domestic ☐ State/National Park ☐ Seasonal business
☐ Municipal ☐ Municipal with a pretreatment program or significant industrial users
☐ Other (explain) ______

8.2 Months when the business or enterprise will operate or generate wastewater:
☐ 12 months per year ☐ Part of the year (list months): ______

8.3 This system is designed for:
☐ No-discharge.
☐ Partial irrigation when feasible and discharge rest of time.
☐ Irrigation during recreational season, April – October, and discharge during November – March.
☐ Other (explain) ______.

9.0 STORAGE BASINS

9.1 Number of storage basins: ______ (Use additional pages if greater than three basins.)

9.2 Type of basins: ☐ Steel ☐ Concrete ☐ Fiberglass ☐ Earthen ☐ Earthen with membrane liner

9.3 Storage basin dimensions at inside top of berm (feet). Report freeboard as feet from top of berm to emergency spillway or overflow pipe.
Basin #1: Length ______ Width ______ Depth ______ Freeboard ______ Depth ______ Safety ______ % Slope ______
Basin #2: Length ______ Width ______ Depth ______ Freeboard ______ Depth ______ Safety ______ % Slope ______
Basin #3: Length ______ Width ______ Depth ______ Freeboard ______ Depth ______ Safety ______ % Slope ______

9.4 Storage Basin operating levels (report as feet below emergency overflow level).
Basin #1: Maximum operating water level ______ ft Minimum operating water level ______ ft
Basin #2: Maximum operating water level ______ ft Minimum operating water level ______ ft
Basin #3: Maximum operating water level ______ ft Minimum operating water level ______ ft

9.5 Design depth of sludge in storage basins.
Basin #1: ______ ft Basin #2: ______ ft Basin #3: ______ ft

9.6 Existing sludge depth, if the basins are currently in operation.
Basin #1: ______ ft Basin #2: ______ ft Basin #3: ______ ft

9.7 Total design sludge storage: ______ dry tons and ______ cubic feet

10.0 LAND APPLICATION SYSTEM

10.1 Number of irrigation sites ______ Total Acres ______ Maximum % field slopes ______
Location: ______ ¼, ______ ¼, ______ ¼, ______ Sec. ______ T ______ R ______ County ______ Acres
Location: ______ ¼, ______ ¼, ______ ¼, ______ Sec. ______ T ______ R ______ County ______ Acres
Location: ______ ¼, ______ ¼, ______ ¼, ______ Sec. ______ T ______ R ______ County ______ Acres
(Use additional pages if greater than three irrigation sites.)

10.2 Type of vegetation: ☐ Grass hay ☐ Pasture ☐ Timber ☐ Row crops
☐ Other (describe) ______

10.3 Wastewater flow (dry weather) gallons per day: Average annual ______ Seasonal ______ Off-season ______

10.4 Land application rate (design flow including 1-in-10 year storm water flows):
Design: ______ inches/year ______ inches/hour ______ inches/day ______ inches/week
Actual: ______ inches/year ______ inches/hour ______ inches/day ______ inches/week

10.5 Total irrigation per year (gallons): Design: ______ gal Actual: ______ gal

10.6 Actual months used for irrigation (check all that apply):
☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec

10.7 Land application rate is based on:
☐ Hydraulic Loading ☐ Other (describe) ______
☐ Nutrient Management Plan (N&P) If N&P is selected, is the plan included? ☐ YES ☐ NO