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 Kansas City
4800 East 63rd Street
Kansas City, MO 64130

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 14, 2026
Effective Date

August 13, 2028
Expiration Date

Heather S. Peters, Director, Water Protection Program

CONSTRUCTION PERMIT

I. CONSTRUCTION DESCRIPTION

The construction of an Aerobic Granular Sludge (AGS) treatment system serves as Alternative 1. The applicant cites the affordability, the ease of operation, ability to consistently meet performance requirements, and the relatively low footprint as reasons for selecting this option as the preferred alternative. With an estimated 20-year net present value of $114 million, this alternative is considered economically efficient and practicable. This is considered a new technology so the applicant will need to work with the department to ensure that equipment is designed appropriately, as this treatment technology is not covered in 10 CSR 20-8 Minimum Design Standards.

This is a **DEMONSTRATION** project and additional monitoring requirements are included in the operating permit in accordance with the Approval Process for Innovative Technology Factsheet and 10 CSR 20-6.010(5).

A closure plan will need to be submitted to the Kansas City Regional Office for review and approval prior to any closure activites.

This project will also include general site work appropriate to the scope and purpose: abandonment of existing sludge holding cells of the project; demolition of the existing Todd Creek Wastewater Treatment Plant (WWTP) building, tanks, outfall, fencing and structures; abandonment of existing buried structures and utilities; and all necessary appurtenances to make a complete and usable wastewater treatment facility.

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 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.

Cost Analysis for Compliance - The department has made a reasonable search for empirical data indicating the permit is affordable. The search consisted of a review of department records that might contain economic data on the community, a review of information provided by the applicant as part of the application, and public comments received in response to public notices of this draft permit. If the empirical cost data was used by the permit writer, this data may consist of median household income, any other ongoing projects that the department has knowledge, and other demographic financial information that the community provided as contemplated by Section 644. 145.3. See **APPENDIX 3 – COST ANALYSIS FOR COMPLIANCE**.

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 and Addenda Nos. 1 - 7 submitted by Burns & McDonnell on December 29, 2025, January 5, 2026, and February 26, 2026, and signed and sealed December 19, 2025, and February 26, 2026, by the engineers listed below, and approved by the department on August 14, 2026.

   A. Bryce Joseph Dickmeyer, P.E.
   B. Paul E. Ward, P.E.
   C. Cervente D. Sudduth, P.E.
   D. John Tsouflias, P.E.
   E. Rachelle Lynn Lowe, P.E.
   F. Jeremy Ryan Walker, P.E.
   G. Craig Keith Brewster, P.E.
   H. Shawn Taylor, P.E.
   I. Christopher S. Woker, P.E.
   J. Tyler J. McKee, P.E.

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. All changes in contract price or time within the approved scope of work must be by change order in accordance with 10 CSR 20-4.040(19).

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 Kansas City 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 or you may contact the department's Water Protection Program at 573-522-4502 or wpsc401cert@dnr.mo.gov.

9. In accordance with 10 CSR 20-6.010(12), a full closure plan shall be submitted to the department's Kansas City Regional Office for review and approval of any permitted wastewater treatment system being replaced. The closure plan must meet the requirements outlined in Standard Conditions Part III of the Missouri State Operating Permit No. MO-0024961. Closure shall not commence until the submitted closure plan is approved by the department.

10. All construction must adhere to applicable 10 CSR 20-8 (Chapter 8) requirements. Some of the requirements include:
    - Adequate provisions shall be made to effectively protect facility personnel and visitors from hazards. The following shall be provided to fulfill the particular needs of each wastewater treatment facility:
        - Fencing. Enclose the facility site with a fence designed to discourage the entrance of unauthorized persons and animals; 10 CSR 20-8.140 (8) (A)
        - Gratings over appropriate areas of treatment units where access for maintenance is necessary; 10 CSR 20-8.140(8)(B)
        - First aid equipment; 10 CSR 20-8.140(8)(C)
        - Posted "No Smoking" signs in hazardous areas; 10 CSR 20-8.140(8)(D)
        - Appropriate personal protective equipment (PPE); 10 CSR 20-8.140(8)(E)
        - Portable blower and hose sufficient to ventilate accessed confined spaces; 10 CSR 20-8.140(8)(F)
        - 10 CSR 20-8.140(8)(G) Portable lighting equipment complying with NEC requirements. See subsection (7)(B) of this rule;
        - 10 CSR 20-8.140(8)(H) Gas detectors listed and labeled for use in NEC Class I, Division 1, Group D locations. See subsection (7)(B) of this rule;
        - Appropriately-placed warning signs for slippery areas, non-potable water fixtures (see subparagraph (7)(D)3.B. of this rule), low head clearance areas, open service manholes, hazardous chemical storage areas, flammable fuel storage areas, high noise areas, etc.; 10 CSR 20-8.140(8)(I)

- Ventilation shall include the following:
  - Isolate all pumping stations and wastewater treatment components installed in a building where other equipment or offices are located from the rest of the building by an air-tight partition, provide separate outside entrances, and provide separate and independent fresh air supply; 10 CSR 20-8.140(8)(J)1.
  - Force fresh air into enclosed screening device areas or open pits more than 4 feet deep. 10 CSR 20-8.140(8)(J)2.
  - Dampers are not to be used on exhaust or fresh air ducts. Avoid the use of fine screens or other obstructions on exhaust or fresh air ducts to prevent clogging; 10 CSR 20-8.140(8)(J)3.
  - Where continuous ventilation is needed (e.g., housed facilities), provide at least 12 complete air changes per hour. Where continuous ventilation would cause excessive heat loss, provide intermittent ventilation of at least thirty (30) complete air changes per hour when facility personnel enter the area. Base air change demands on 100 percent fresh air; 10 CSR 20-8.140(8)(J)4.
  - Electrical controls. Mark and conveniently locate switches for operation of ventilation equipment outside of the wet well or building. Interconnect all intermittently operated ventilation equipment with the respective wet well, dry well, or building lighting system. The manual lighting/ventilation switch is expected to override the automatic controls. For a 2 speed ventilation system with automatic switch over where gas detection equipment is installed, increase the ventilation rate automatically in response to the detection of hazardous concentrations of gases or vapors; 10 CSR 20-8.140(8)(J)5.
  - Fabricate the fan wheel from non-sparking material. Provide automatic heating and dehumidification equipment in all dry wells and buildings. 10 CSR 20-8.140(8)(J)6.
- Explosion-proof electrical equipment, non-sparking tools, gas detectors, and similar devices, in work areas where hazardous conditions may exist, such as digester vaults and other locations where potentially explosive atmospheres of flammable gas or vapor with air may accumulate. 10 CSR 20-8.140(8)(K)
- Provisions for local lockout/tagout on stop motor controls and other devices; 10 CSR 20-8.140(8)(L)
- Provisions for an arc flash hazard analysis and determination of the flash protection boundary distance and type of PPE to reduce exposure to major electrical hazards shall be in accordance with NFPA 70E *Standard for Electrical Safety in the Workplace* (2018 Edition), as approved and published August 21, 2017. 10 CSR 20-8.140(8)(M)

- Where 2 or more mechanically cleaned bar screens are used, the design shall provide for taking the largest unit out-of-service without sacrificing the capability to handle the average design flow. Where only one mechanically cleaned screen is used, it shall be sized to handle the design peak instantaneous flow. 10 CSR 20-8.150(4)(B)
- Mechanical screening equipment shall have adequate removal enclosures to protect facility personnel against accidental contact with moving parts and to prevent dripping in multi-level installations. 10 CSR 20-8.150(4)(A)3.B.(I)

- Electrical systems and components in raw wastewater or in enclosed or partially enclosed spaces where hazardous concentrations of flammable gases or vapors that are normally present, shall comply with the NFPA 70 *National Electric Code (NEC)* (2017 Edition), as approved and published August 24, 2016, requirements for Class I, Division 1, Group D locations. 10 CSR 20-8.140(7)(B)
- For solids pumping systems, audio-visual alarms shall be provided in accordance with 10 CSR 20-8.140(7)(C) for:
  - Pump failure; 10 CSR 20-8.170(6)(A)
  - Pressure loss; 10 CSR 20-8.170(6)(B) and
  - High pressure. 10 CSR 20-8.170(6)(C)
- Emergency Power. Disinfection and dechlorination processes, when used, shall be provided during all power outages. 10 CSR 20-8.190(2)(A)
- The UV system shall deliver a minimum UV dosage of 30,000 microwatt seconds per centimeters squared (30,000 µW • s/cm^2). 10 CSR 20-8.190(5)(A)4.
- The outfall shall be so constructed and protected against the effects of flood water, ice, or other hazards as to reasonably ensure its structural stability and freedom from stoppage. 10 CSR 20-8.140(6)(A)
- All outfalls shall be posted with a permanent sign indicating the outfall number (i.e., Outfall #001). 10 CSR 20-8.140(6)(C)
- All wastewater treatment facilities shall be provided with an alternate source of electric power or pumping capability to allow continuity of operation during power failures. 10 CSR 20-8.140(7)(A)1.

11. Upon completion of construction:

A. The City of Kansas City 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 Statement of Work Completed form (https://dnr.mo.gov/document-search/wastewater-construction-statement-work-completed-mo-780-2155) 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 existing facility does not have the capacity to operate effectively or meet projected limits without significant improvement to the existing facility. A new facility at a greenfield site will be constructed to address the current aging facility's capacity, floodplain issues, and meet projected water quality requirements and anticipated permit limits through 2042.

2. FACILITY DESCRIPTION

The current Kansas City (KC) Todd Creek WWTP wastewater treatment process consists of mechanical bar screens, raw water pumping, aerated activated sludge, final clarification (three concentric, contact stabilization aeration basin/clarifiers), and ultraviolet (UV) disinfection. Solids wasted from the three biological treatment basins flow by gravity to a common sludge wet well. Sludge is pumped across the plant to 3 sludge detention lagoons. Sludge is periodically dredged and hauled offsite by a 3rd party for disposal. The plant has a design flow of 3.4 million gallons per day (MGD).

The new treatment facility will utilize aerobic granular sludge (AGS) with biological nutrient removal. The treatment process units include influent screening, a pump station, grit removal, one AGS reactor basin, water level correction tank, process water pump station, two UV disinfection systems, parshall flume, cascade aeration, two thin sludge tanks, two rotary drum thickners, two thickened sludge tanks, effluent sampling, outfall, odor control, and solids processing. The sludge will be transported to the Blue River WWTP for digestion and land application. The project includes all the associated structures and buildings needed for the project and an administrative building with an electrical room. The project also includes all necessary appurtenances to complete the project.

The new KC Todd Creek WWTP will located at 14001 NW Interurban Road, Kansas City, Missouri, in Platte County. The facility will have a design average flow of 4.6 MGD and serve a hydraulic population equivalent of approximately 2,700 people.

3. COMPLIANCE PARAMETERS

The proposed project is required to meet final effluent limits as established in the antidegradation review dated January 2023.

The construction is to meet more protective effluent limits. As this is a demonstration project, for the first year of operation following construction, additional monitoring will be required before and after the AGS process.

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

Parameter	Units	Daily Maximum Limit	Monthly Average Limit
Ammonia as N - January	mg/L	8.4	2.4
Ammonia as N - February	mg/L	8.4	2.4
Ammonia as N - March	mg/L	8.4	2.4
Ammonia as N - April	mg/L	6.9	1.9
Ammonia as N - May	mg/L	8.4	1.6
Ammonia as N - June	mg/L	6.9	1.0
Ammonia as N - July	mg/L	6.9	0.8
Ammonia as N - August	mg/L	8.4	1.0
Ammonia as N - September	mg/L	6.9	1.1

Ammonia as N - October	mg/L	6.9	1.8
Ammonia as N - November	mg/L	8.4	2.4
Ammonia as N - December	mg/L	8.4	2.4
Oil & Grease	mg/L	15	10

4. ANTIDEGRADATION

The department has reviewed the antidegradation report for this facility and issued the Water Quality and Antidegradation Review dated January 2023, due to expansion and upgrade of the KC Todd Creek WWTP. See **APPENDIX 2 – ANTIDEGRADATION**.

5. REVIEW OF MAJOR TREATMENT DESIGN CRITERIA

- Mechanical Coarse Screen – Two mechanically cleaned coarse screen with a maximum spacing of 1/4-inch. The screening devices shall be capable of treating a design average flow of 4.6 MGD and a peak hourly flow of 15 MGD.
- Influent Pump Station – Construction of a pentaplex influent pump station with three 150 horsepower (HP) submersible pump capable of operating at 3,810 gallons per minute (gpm) at 90.5 feet of total dynamic head (TDH) and two 50 HP submersible pump capable of operating at 1,490 gpm at 86.2 feet of TDH.
- Mechanical Perforated Plate Screen – Two mechanically-cleaned perforated plate fine screens in dual channels with a maximum spacing of 6-millimeters. The screening devices shall be capable of treating a design average flow of 4.6 MGD and a peak hourly flow of 13.2 MGD. The addition of a second mechanically-cleaned fine screen provides redundancy and improved screening of inorganic materials. The screening structure is followed by grit removal.
- Multi-Tray Vortex Flow Grit Removal – A stacked tray mechanical grit removal system is proposed to handle 13.2 MGD peak flow. The tray diameter is 12 feet (ft) and provides approximately 113 square feet (sf) per tray. The design utilizes 7 trays in sequence, and thus provides 791 sf of surface area for grit removal. The grit cyclone will have a capacity of 200 gpm with 4-inch inlet diameter, which provides an inlet velocity of 2.4 feet per second at the design average daily flow.
- Grit Classifier – Installation of one grit classifier with a grit concentrator with a minimum flow of 200 gpm and grit classifier with a maximum flow capacity from the grit concentrator of 250 gpm. The addition of a 24-inch diameter screw auger to transport grit from the classifier to the disposal unit with a 1/3 HP motor.
- Aerobic Granular Sludge (AGS) – Installation of 4 basins in one AGS reactor train with a hydraulic retention time of 0.45 days and a solids retention time of 19 days per basin. The train consists of 4 AGS basins that operate in parallel, two sludge buffer tanks, and one water level control tank. The average design flow of the basin is 4.59 MGD with a peak daily flow of 12.26 MGD. The AGS basins are designed with a length of 80 ft, width of 75 ft, 2.5 ft of freeboard, an average water depth of 21 ft and a maximum water depth of 22 ft. The basins will operate on 6 cycles per day per reactor, with each cycle duration being 3.7 hours. The water level control tank is

designed with a length of 20 ft, width of 20 ft, a minimum water depth of 1 ft and a maximum water depth of 14.4 ft. The sludge buffer tanks are designed with a length of 28 ft, width of 20 ft, a minimum water depth of 1 ft and a maximum water depth of 14.2 ft. Aeration is provided by fixed fine bubble diffusers providing up to 3,870 standard cubic feet of air per minute per reactor. The actual oxygen requirements are 31,511 pounds per day (lbs/day) for the entire system.

- Open Channel Ultraviolet (UV) – Two open channel, gravity flow, low-pressure low-intensity UV disinfection system capable of treating a peak hourly flow of 12.3 MGD while delivering a minimum UV intensity of 30 mJ/cm^2 with an expected ultraviolet transmissivity of 65 percent or greater. The dual open channel UV system consists of 2 banks in parallel with 10 lamps per bank. The disinfected effluent will flow by gravity through flow measurement equipment and to Outfall No. 001.
- Parshall Flume – A 36-inch throat width effluent parshall flume with ultrasonic flow sensor shall measure the disinfected wastewater flowrate prior to cascade aeration.
- Post Cascade Aeration — To increase dissolved oxygen in the effluent, step cascade aeration will be provided prior to the outfall headwall at Todd Creek.
- Thin Sludge Tanks – Construction of 2 thin sludge holding tanks each with a length of 30 ft, width of 37.5 ft, and 20 ft sidewater depth. Each tank will store and thicken an average of 6,600 lbs of solids per day, with a maximum of 13,200 lbs of solids per day. A medium bubble diffuser system shall include air diffusers, air piping manifolds and laterals, piping supports, anchor bolts, pipe anchors, and accessories as specified herein and as required for a complete working system. Installation of 2 sludge rake arms and 2 scum skimming arms. Supernatant will flow by force main to the polymer feed equipment prior to the rotary drum thickeners. Sludge shall be pumped to the polymer feed and blending by means of the thin sludge pumps.
- Polymer Feed Equipment – Installation of 2 polymer feed systems capable of feeding between 180 gallons per hour (gph) to 1,800 gph and a flocculation tank. Polymer is fed to the 2 rotary drum thickeners.
- Rotary Drum Thickeners – Installation of 2 rotary drum thickeners. The design solids loading is 1,250 dry lbs per hour and the maximum hydraulic loading is 250 gpm. Thickened sludge will discharge at the end of the drum and be directed to an attached sludge hopper. Sludge shall be pumped from the hopper through a 6-inch connection to the thickened sludge tanks by means of the thickened sludge pumps.
- Thickened Sludge Tanks – Construction of 2 thick sludge holding tanks each with a length of 24 ft, width of 37.5 ft, and 20 ft sidewater depth. A large bubble mixing system shall include 2 compressors, a receiver tank, 2 valve control panels, compressed gas mixing system, instrumentation, auxiliary equipment, and accessories as specified herein and as required for a complete working system. Sludge shall be pumped to the loadout by means of the sludge feed pumps.
- Emergency Power – A 30 kW standby generator and automatic transfer switch will be provided to operate the treatment facility in event of power failure.

6. OPERATING PERMIT

Missouri State Operating Permit No. MO-0024961 will require a modification to reflect the construction activities. The modified KC Todd Creek WWTP, MO-0024961, was successfully public noticed from July 10, 2026, to August 10, 2026 with no comments received. When construction has reached substantial completion, 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.

Missouri State Operating Permit No. MO-0024961 will be expiring on September 30, 2026. If you have questions on completing the renewal application, please contact the Water Protection Proram's Operating Permit Section at 573-522-4502.

V. NOTICE OF RIGHT TO APPEAL

If you were adversely affected by this decision, you may be entitled to an appeal before the Administrative Hearing Commission (AHC) pursuant to Section 621.250 RSMo. To appeal, you must file a petition with the AHC within 30 days after the date this decision was mailed or the date it was delivered, whichever date was earlier. If any such petition is sent by registered mail or certified mail, it will be deemed filed on the date it is mailed; if it is sent by any method other than registered mail or certified mail, it will be deemed filed on the date it is received by the AHC. Any appeal should be directed to:

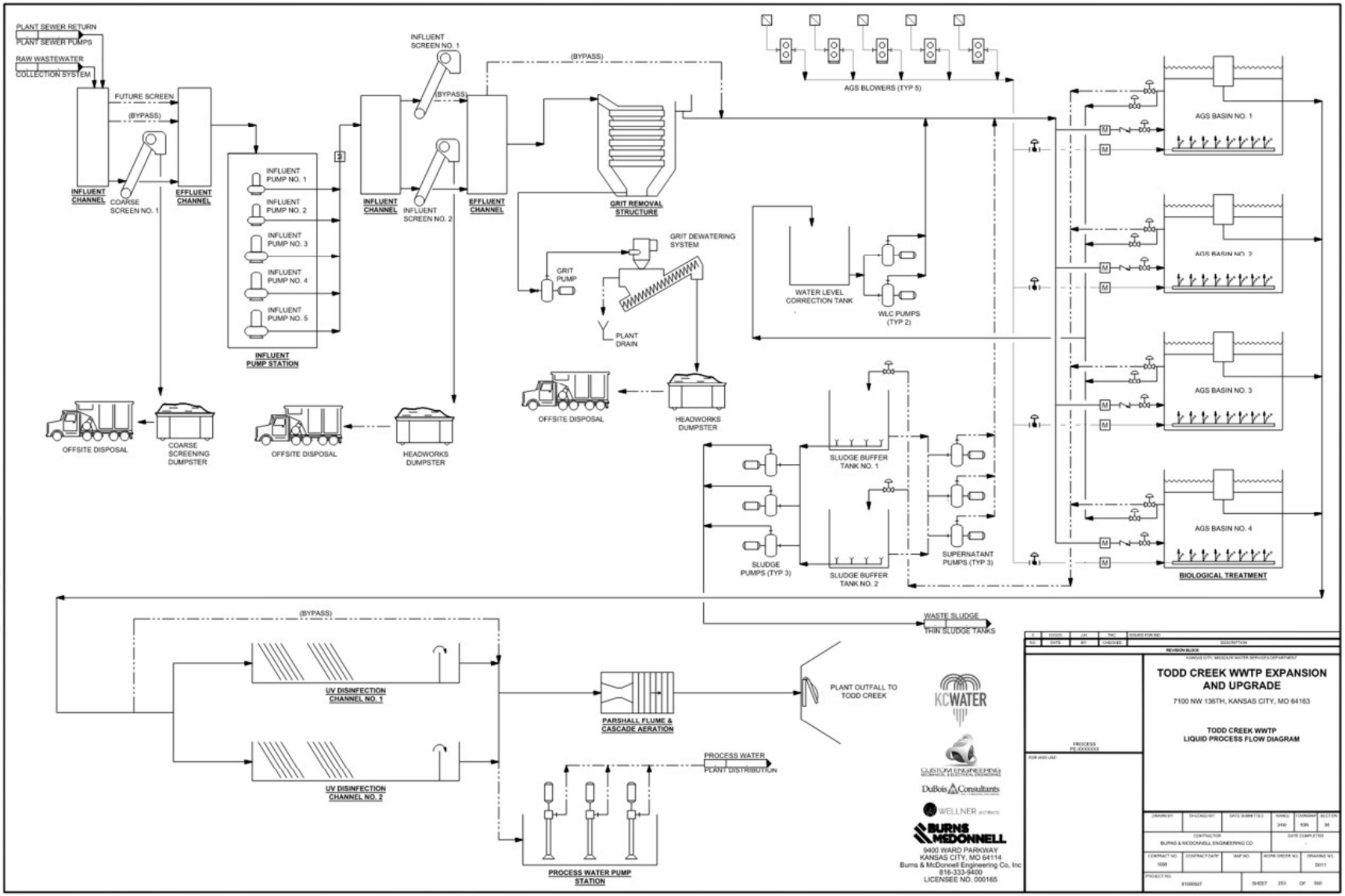
Administrative Hearing Commission
U.S. Post Office Building, Third Floor
131 West High Street, P.O. Box 1557
Jefferson City, MO 65102-1557
Phone: 573-751-2422
Fax: 573-751-5018
Website: https://ahc.mo.gov

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

APPENDICES

APPENDIX 1 – PROCESS FLOW DIAGRAM
APPENDIX 2 – ANTIDEGRADATION
APPENDIX 3 – COST ANALYSIS FOR COMPLIANCE
APPENDIX 4 – SUMMARY OF DESIGN

APPENDIX 1 – PROCESS FLOW DIAGRAM



APPENDIX 2 – ANTIDEGRADATION

Water Quality and Antidegradation Review

For the Protection of Water Quality
and Determination of Effluent Limits for Discharge to

Todd Creek
by the
City of Kansas City
Todd Creek Wastewater Treatment Plant

January 2023

Table of Contents

PERMIT LIMITS AND MONITORING INFORMATION

***Expanded Facility Monitoring Parameters and Effluent Limits

PARAMETER	Unit	Basis for Limits	Daily Maximum	Weekly Average	Monthly Average	Previous Permit Limit	Sampling Frequency	Reporting Frequency	Sample Type
Flow	MGD	FSR	*		*	*/*	once/ weekday	once/ month	24 hr. total
BOD_5	mg/L	TBEL		15	15	15/15	once/ month	once/ month	composite
TSS	mg/L	TBEL		30	20	30/20	once/ month	once/ month	composite
*Escherichia coli***	#/100mL	FSR		1,030	206**	1,030/206	once/week	once/ month	grab
Ammonia as N (January) (February) (March) (April) (May) (June) (July) (August) (September) (October) (November) (December)	mg/L	WQBEL	 8.4 8.4 8.4 6.9 8.4 6.9 6.9 8.4 6.9 6.9 8.4 8.4		 2.4 2.4 2.4 1.9 1.6 1.0 0.8 1.0 1.1 1.8 2.4 2.4	 37.2/5.8 37.2/6.0 35.0/5.1 35.8/4.7 34.0/4.3 28.2/3.5 38.4/3.6 34.8/3.3 */* 37.0/3.9 37.0/4.0 42.0/4.8	once /month	once/ month	composite
Total Phosphorus	mg/L	FSR	*		*	*/*	once/ month	once/ month	composite
Total Kjeldahl Nitrogen	µg/L	FSR	*		*	*/*	once/ month	once/ month	composite
Nitrite + Nitrate	mg/L	FSR	*		*	*/*	once/ month	once/ month	composite
Oil & Grease	mg/L	FSR	15		10	*/*	once/ quarter	once/ quarter	grab
Aluminum, Total Recoverable	µg/L	WQBEL	*		*	*/*	once/ quarter	once/ quarter	composite
Iron, Total Recoverable	µg/L	WQBEL	*		*	*/*	once/ quarter	once/ quarter	composite
Selenium, Total Recoverable	µg/L	WQBEL	*		*	*/*	once/ quarter	once/ quarter	composite

PARAMETER	Unit	Basis for Limits	Minimum		Maximum	Previous Permit Limit	Sampling Frequency	Reporting Frequency	Sample Type
pH	SU	FSR	6.0		9.0	6.0/9.0	once/ month	once/ month	grab

PARAMETER	Unit	Basis for Limits			Monthly Avg. Min	Previous Permit Limit	Sampling Frequency	Reporting Frequency	Sample Type
BOD_5 Percent Removal	%	FSR			85	85	once/ month	once/ month	calculated
TSS Percent Removal	%	FSR			85	85	once/ month	once/ month	calculated

* - Monitoring requirement only

** - #/100mL; the Monthly Average for *E. coli* is a geometric mean.

*** - The limits and monitoring requirements in this table represent anticipated parameters based on the current operating permit and the antidegradation report provided by the applicant. The applicant selected an Aerobic Granular Sludge (AGS) treatment system as their preferred alternative. Because this is a new technology not directly addressed by 10 CSR 20-8 Minimum Design Standards, more

stringent limits or more frequent monitoring may be assigned to ensure a proper level of treatment is attained.

Basis for Limitations Codes:

MDEL – Minimally Degrading Effluent Limit	TBEL – Technology-Based Effluent Limit
NDEL – Non-Degrading Effluent Limit	WQBEL – Water Quality-Based Effluent Limit
PEL – Preferred Effluent Limit	FSR – State or Federal Regulation/Law

PURPOSE OF ANTIDEGRADATION REVIEW REPORT

The Kansas City Todd Creek Wastewater Treatment Plant is a 3.4 million gallons per day (MGD) plant receiving actual flows of about 1.9 MGD based on the current operating permit and Discharge Monitoring Report (DMR) data from the past five years of operation. The facility currently includes a bar screen, an influent pump station, three aeration basins, three final clarifiers, and UV disinfection. Sludge is stored in earthen sludge holding basins before being transported to the Blue River WWTP for digestion and land application. Geosyntec Consultants prepared, on behalf of the City of Kansas City, the *Water Quality and Antidegradation Review Report for the Kansas City Todd Creek Wastewater Treatment Plant Upgrade and Expansion*, which outlines the proposed expansion to the plant. As a result of the expansion, the design flow will be increased to 4.6 MGD. Two non-discharging alternatives and five discharging alternatives were analyzed, and the Aerobic Granular Sludge (AGS) with Biological Nutrient Removal (BNR) alternative was selected as the preferred alternative. For this alternative, treatment includes screening, influent pumping, grit removal, AGS reactors, UV disinfection, and effluent reaeration.

The applicant elected to assume that all pollutants of concern (POC), except ammonia, significantly degrade the receiving stream in the absence of existing water quality. An alternatives analysis was conducted to fulfill the requirements of the Antidegradation Implementation Procedure (AIP). The applicant elected to determine that ammonia is non-degrading in the receiving stream utilizing the Path A: Tier 2 – Non-Degradation Mass Balance form.

FACILITY INFORMATION

Facility Name:	Kansas City Todd Creek WWTP
Address:	7600 NW 144th Street, Kansas City, MO 64130
Permit #:	MO-0024961
County:	Platte
Facility Type:	POTW
Owner:	City of Kansas City
Continuing Authority:	Same as owner
UTM Coordinates:	X = 356605 ; Y = 4357319
Legal Description:	Sec. 1, T52N, R34W, Platte County
Ecological Drainage Unit:	Central Plains/Nishnabotna/Platte

FACILITY HISTORY

The facility was initially constructed in 1968 and discharges to Todd Creek, a tributary of the Little Platte River. The facility was last inspected on May 10th, 2013 by Mr. Matt Arnold. At the time of the inspection, it was determined that the condition and operation of the facility were satisfactory.

FACILITY PERFORMANCE HISTORY:

A review of the past five years of Discharge Monitoring Report data shows that the facility generally performs well, but recorded exceedances in the following parameters: Ammonia as N (10/17, 08/18, 02/20), BOD (05/18-08/18), *E.coli* (06/19, 08/19), pH (11/18, 12/18, 11/19)

RECEIVING WATERBODY INFORMATION

OUTFALL(S) TABLE:

OUTFALL	DESIGN FLOW (CFS)	TREATMENT LEVEL	EFFLUENT TYPE
001	7.13	Secondary	Domestic

RECEIVING STREAM(S) TABLE:

WATER-BODY NAME	CLASS	WBID	DESIGNATED USES*	12-DIGIT HUC	DISTANCE TO CLASSIFIED SEGMENT (MI)
Todd Creek	C	316	AQL, WBC-B, SCR, HHP, IRR, LWW	10240012-0710	0

* Protection of Warm Water Aquatic Life (AQL), Cold Water Fishery (CDF), Cool Water Fishery (CLF), Whole Body Contact Recreation – Category A (WBC-A), Whole Body Contact Recreation – Category B (WBC-B), Secondary Contact Recreation (SCR), Human Health Protection (HHP), Irrigation (IRR), Livestock & Wildlife Watering (LWW), Drinking Water Supply (DWS), Industrial (IND), Groundwater (GRW).

RECEIVING STREAM(S) LOW-FLOW VALUES:

RECEIVING STREAM	LOW-FLOW VALUES (CFS)		
	1Q10	7Q10	30Q10
Todd Creek (C)	0.0	0.0	0.0

Receiving Water Body Segment Outfall #1:		
Upper end segment* UTM coordinates:	X = 356605 ; Y = 4357319	outfall
Lower end segment* UTM coordinates:	X = 357501 ; Y = 4361709	downstream confluence

*Segment is the portion of the stream where discharge occurs. Segment is used to track changes in assimilative capacity and is bound at a minimum by existing sources and confluences with other significant water bodies.

A Geohydrologic Evaluation was submitted with the request and the receiving stream is gaining for discharge purposes (see Appendix B).

EXISTING WATER QUALITY

No existing water quality data was submitted. The facility discharges to Todd Creek, which is not a 303(d) listed stream. Further, there are no applicable impairments downstream of the discharge.

MIXING CONSIDERATIONS

MIXING CONSIDERATIONS
Mixing Zone: Not Allowed [10 CSR 20-7.031(5)(A)4.B.(I)(a)].
Zone of Initial Dilution: Not Allowed [10 CSR 20-7.031(5)(A)4.B.(I)(b)].

RECEIVING WATER MONITORING REQUIREMENTS

Downstream receiving water samples should be taken ~0.2 miles downstream of outfall #001 in Todd Creek. See Special Condition #23 of the current operating permit (MO-0024961).

ANTIDEGRADATION REVIEW INFORMATION

In accordance with Missouri's Water Quality Standard [10 CSR 20-7.031(3)] and federal antidegradation policy at Title 40 Code of Federal Regulation (CFR) Section 131.12 (a), the department developed a statewide antidegradation policy and corresponding procedures to implement the policy. A proposed discharge to a water body will be required to undergo a level of Antidegradation Review, which documents that the use of a water body's available assimilative capacity is justified. Effective August 30, 2008, and revised July 13, 2016, a facility is required to use Missouri's AIP for new and expanded wastewater discharges.

The AIP specifies that if the proposed activity results in significant degradation then a demonstration of necessity (i.e., alternatives analysis) and a determination of social and economic importance are required.

The following is a review of the *Water Quality and Antidegradation Review Report for the Kansas City Todd Creek Wastewater Treatment Plant Upgrade and Expansion* dated May 2022.

A. TIER DETERMINATION

Waterbodies are assigned Tier 1, 2, or 3 protection levels.

Tier 1 protection is applied to a waterbody on a pollutant by pollutant basis for pollutants may cause or contribute to the impairment of a beneficial use or violation of Water Quality Criteria (WQC); and prohibit further degradation of Existing Water Quality (EWQ) where additional pollutants of concern (POCs) would result in the water being included on the 303(d) List.

Tier 2 level protection is assigned to the waterbody on a pollutant by pollutant basis that prohibits the degradation of water quality of a surface water unless a review of reasonable alternatives and social and economic considerations justifies the degradation in accordance with the methods presented in the AIP.

Tier 3 protection prohibits any degradation of water quality of Outstanding National Resource Waters and Outstanding State Resource Waters as identified in Tables D and E of the Water Quality Standards (WQS). Temporary degradation of water receiving Tier 3 protection may be allowed by the department on a case-by-case basis as explained in Section VI of the AIP.

Below is a list of POCs reasonably expected and identified by the permittee in their application to be in the discharge. Pollutants of concern are defined as those pollutants "proposed for discharge that affect beneficial use(s) in waters of the state." They include pollutants that "create conditions unfavorable to beneficial uses in the water body receiving the discharge or proposed to receive the discharge" (AIP, Page 6).

Pollutants of Concern and Tier Determination

Pollutants of Concern	Tier	Degradation	Comment
Biological Oxygen Demand (BOD_5)	2*	Significant	
Total Suspended Solids (TSS)	2*	Significant	
Ammonia as N	2*	Insignificant	
Escherichia coli (E. coli)	2*	N/A	Permit limits applied
Oil & Grease	2*	Significant	Permit limits applied
pH	**	N/A	Permit limits applied
Total Nitrogen	2*	Significant	Permit limits applied
Total Phosphorus	2*	Significant	Permit limits applied
Total Recoverable Metals (Al, Fe, Se)	2*	***	

* Tier assumed.

** Standards for these parameters are ranges

*** Tier determination is not considered applicable as effluent metals quality data are currently being characterized. The department acknowledges that total recoverable metals are below applicable water quality standards in expanded effluent tests. It is not anticipated that the preferred alternative will appreciably alter effluent metals concentrations.

B. NECESSITY OF DEGRADATION

The AIP specifies that if the proposed activity does result in significant degradation then a demonstration of necessity (i.e., alternatives analysis) and a determination of social and economic importance are required. Part of that analysis as shown below is the evaluation of non-degrading alternatives, such as regionalization or no discharge systems.

The applicant has the option of assuming discharge will be significant and proceeding directly to the alternatives analysis, thereby avoiding the determination of the assimilative capacity of the receiving water. The applicant has elected this option.

Regionalization

Discharging to an existing regional system with sufficient capacity would eliminate the need for a discharge permit to be obtained. However, regionalization is not considered a practicable alternative because the Todd Creek WWTP is the regional WWTP within the Todd Creek and lower Little Platte River watersheds.

No Discharge Evaluation

Land application was analyzed as a no discharge alternative, and would involve lagoon storage and treatment prior to application. In order to comply with the requirements of 10 CSR 20-8.200(6)(C)1.C., more than 260 million gallons of storage capacity would be required in the lagoon. Further, over 2,600 acres of suitable land would be necessary in order to meet the proposed irrigation rates. These factors make land application an impracticable alternative.

Alternatives to No discharge

The existing treatment technology, contact stabilization activated sludge, serves as the base case. While this technology has demonstrated the ability to meet proposed effluent limitations, it is not capable of reliably meeting total phosphorus effluent limitations of 1.0 mg/L, which KC Water anticipates will be imposed on the facility by the department by 2030. Because of this consideration, the base case technology is not considered practicable and an estimate of the net present value was not generated for this alternative. The following four less-degrading alternatives were analyzed:

Alternative 1 – Aerobic Granular Sludge (AGS) with Biological Nutrient Removal (BNR) [Preferred Alternative]
The construction of an AGS treatment system serves as Alternative 1. The applicant cites the affordability, the ease of operation, ability to consistently meet performance requirements, and the relatively low footprint as reasons for selecting this option as the preferred alternative. With an estimated 20-year net present value of $114 million, this alternative is considered economically efficient and practicable. This is considered a new technology so the applicant will need to work with the department to ensure that equipment is designed appropriately, as this treatment technology is not covered in 10 CSR 20-8 Minimum Design Standards. A summary of this treatment system as provided by the applicant is listed below:

Influent Pumping → Screening → Grit Removal → Flow Measurement → AGS Reactors → UV Disinfection → Effluent Reaeration

Alternative 2 – Anaerobic/Anoxic/Oxic (A2O)
The construction of an A2O system serves as Alternative 2. KC Water has existing facilities which utilize similar processes and equipment, making this alternative practical from an operations and maintenance standpoint. However, the applicant cites the susceptibility of A2O systems to filamentous bacteria as a reason that the BNR is likely to be less effective for this alternative than the preferred alternative. At a 20-year net present value of $127 million, this alternative is considered economically efficient and practicable. A summary of this treatment system as provided by the applicant is listed below:

Influent Pumping → Screening → Grit Removal → Flow Measurement → A2O Basins → Final Clarifiers → UV Disinfection → Effluent Reaeration

Alternative 3 – Oxidation Ditch with BNR
Alternative 3 involves the construction of an oxidation ditch, a well-established treatment technology. This alternative is considered practicable but is not preferred as the applicant believes the efficacy of the BNR for this technology is less than the preferred alternative for similar reasons as the A2O system. At an estimated net present value of $130 million, this alternative is considered economically efficient. A summary of this treatment system as provided by the applicant is listed below:

Influent Pumping → Screening → Grit Removal → Flow Measurement → Oxidation Ditches → Final Clarifiers → UV Disinfection → Effluent Reaeration

Alternative 4 – Membrane Bioreactor (MBR) with A2O
The fourth less-degrading alternative evaluated was an MBR system with A2O. This alternative consists of a conventional A2O system which is then followed by an aerated MBR tank in lieu of final clarification. The applicant cites the relatively low footprint and enhanced treatment capability as advantages to this alternative, but cites the additional aeration power required, necessity for enhanced screening, and the additional maintenance required as disadvantages. This alternative would be expected to yield lower effluent BOD and TSS concentrations than the base case alternative, but at a 20-year present value of $137 million, this alternative is not considered economically efficient. A summary of this treatment system as provided by the applicant is listed below:

Influent Pumping → Fine Screening → Grit Removal → Flow Measurement → A2O Basins → MBR Tanks → UV Disinfection → Effluent Reaeration

Alternatives Analysis Comparison

Pollutant	Base Case Contact Stabilization AS	Alternative 1 (Preferred Alternative) AGS with BNR	Alternative 2 A2O	Alternative 3 Oxidation Ditch with BNR	Alternative 4 MBR with A2O
BOD_5	≤ 15 mg/L	≤ 15 mg/L	≤ 15 mg/L	≤ 15 mg/L	≤ 5 mg/L
TSS	≤ 20 mg/L	≤ 20 mg/L	≤ 20 mg/L	≤ 20 mg/L	≤ 5 mg/L
Escherichia coli (E. coli)	≤ 206 CFU/100 mL	≤ 206 CFU/100 mL	≤ 206 CFU/100 mL	≤ 206 CFU/100 mL	≤ 206 CFU/100 mL
Ammonia as N					
(January)	≤ 2.4 mg/L	≤ 2.4 mg/L	≤ 2.4 mg/L	≤ 2.4 mg/L	≤ 2.4 mg/L
(February)	≤ 2.4 mg/L	≤ 2.4 mg/L	≤ 2.4 mg/L	≤ 2.4 mg/L	≤ 2.4 mg/L
(March)	≤ 2.4 mg/L	≤ 2.4 mg/L	≤ 2.4 mg/L	≤ 2.4 mg/L	≤ 2.4 mg/L
(April)	≤ 1.9 mg/L	≤ 1.9 mg/L	≤ 1.9 mg/L	≤ 1.9 mg/L	≤ 1.9 mg/L
(May)	≤ 1.6 mg/L	≤ 1.6 mg/L	≤ 1.6 mg/L	≤ 1.6 mg/L	≤ 1.6 mg/L
(June)	≤ 1.0 mg/L	≤ 1.0 mg/L	≤ 1.0 mg/L	≤ 1.0 mg/L	≤ 1.0 mg/L
(July)	≤ 0.8 mg/L	≤ 0.8 mg/L	≤ 0.8 mg/L	≤ 0.8 mg/L	≤ 0.8 mg/L
(August)	≤ 1.0 mg/L	≤ 1.0 mg/L	≤ 1.0 mg/L	≤ 1.0 mg/L	≤ 1.0 mg/L
(September)	≤ 1.1 mg/L	≤ 1.1 mg/L	≤ 1.1 mg/L	≤ 1.1 mg/L	≤ 1.1 mg/L
(October)	≤ 1.8 mg/L	≤ 1.8 mg/L	≤ 1.8 mg/L	≤ 1.8 mg/L	≤ 1.8 mg/L
(November)	≤ 2.4 mg/L	≤ 2.4 mg/L	≤ 2.4 mg/L	≤ 2.4 mg/L	≤ 2.4 mg/L
(December)	≤ 2.4 mg/L	≤ 2.4 mg/L	≤ 2.4 mg/L	≤ 2.4 mg/L	≤ 2.4 mg/L
Total Phosphorus	*	≤ 1.0 mg/L	≤ 1.0 mg/L	≤ 1.0 mg/L	≤ 1.0 mg/L
Total Kjeldahl Nitrogen	*	*	*	*	*
Nitrite + Nitrate	*	*	*	*	*
Oil & Grease	≤ 10 mg/L	≤ 10 mg/L	≤ 10 mg/L	≤ 10 mg/L	≤ 10 mg/L
Total Recoverable Metals (Al, Fe, Se)	*	*	*	*	*
Annual O&M Cost ($M 2021)	***	$34	$37	$38	$40
Net Present Value ($M 2021)**	***	$114	$127	$130	$137
Ratio	***	100%	112%	115%	121%
Economically Efficient?	Y	Y	Y	Y	N
Practicable?	N	Y	Y	Y	Y

* monitoring requirement
**Net present value at 25-year design life and 8% interest
***Cost projection not generated by the applicant due to anticipated future nutrient removal requirements which make this alternative impracticable

C. SOCIAL AND ECONOMIC IMPORTANCE

The affected community consists of visitors and employees of the Kansas City International (KCI) Airport and the residents of the surrounding Todd Creek watershed area. The preferred alternative of upgrading the plant to an AGS system will serve to accommodate the anticipated growth of the KCI Airport and the surrounding developable area while providing biological nutrient removal and improved flood control measures. The applicant provided an estimate of the expected population growth of the service area utilizing information from the Mid-America Regional Council (MARC), the City of Kansas City, MO Planning and Development Department, and historical Google Earth aerial satellite imagery. The Todd

Creek WWTP currently has an estimated service area population of 9,091. Based upon an annual service population growth of 5 percent in the Twin Creeks area, 3.7 percent in the Todd Creek area, as well 2 percent annual growth for the KCI Airport, the service area population is expected to reach 25,920 by 2042. This population growth, along with the fact that KC Water identified an industrial user planning to commission a plant within the next 5 years that would contribute 0.52 MGD, led the applicant to arrive at an estimated average daily flow of 4.6 MGD by 2042.

The expansion of the Todd Creek WWTP will allow the plant to provide the proper treatment capacity in the Todd Creek watershed and the KCI Airport for the next 20 years. This expanded capacity will accommodate a prospective industry that will provide jobs and economic growth to the Kansas City area. Furthermore, the upgrades will improve treatment reliability and flood control, and will provide an increased level of nutrient reduction.

D. NATURAL HERITAGE REVIEW

A Missouri Department of Conservation Natural Heritage Review was obtained by the applicant. Two species of bats, Indiana and Northern Long-Eared may be present in the project area. The following recommendations were made for construction activities:

- Manage construction to minimize sedimentation and run-off to nearby streams.
- At stream and drainage crossings, avoid erosion, silt introduction, petroleum or chemical pollution, and disruption or realignment of stream banks and beds.
- Remove any mud, soil, trash, plants, or animals from equipment before leaving any water body or work area.
- Drain water from boats and machinery that have operated in water, checking motor cavities, live-well, bilge and transom wells, tracks, buckets, and any other water reservoirs.
- When possible, wash and rinse equipment thoroughly with hard spray or hot water and dry in the hot sun before using again.
- If any trees need to be removed for the project, contact the U.S. Fish and Wildlife Service for coordination under the Endangered Species Act.

E. DEMONSTRATION OF INSIGNIFICANCE

The AIP states that a demonstration of insignificance of the discharge requires the applicant to show a reduction, or maintenance of loading, i.e., no change in ambient water quality concentrations in the receiving waters. As demonstrated in the *Water Quality and Antidegradation Review Report for the Kansas City Todd Creek Wastewater Treatment Plant Upgrade and Expansion* dated May 2022, the tables below summarize the results of current loading based on the current permit concentrations and proposed loadings based on the proposed permit concentrations.

Net Change in Loadings Based upon Current and Proposed Daily Permit Limits.

POLLUTANTS OF CONCERN	CURRENT MAXIMUM DAILY LIMIT (MG/L)	PROPOSED MAXIMUM DAILY LIMIT (MG/L)	CURRENT LOADING (LBS/DAY)	PROPOSED LOADING (LBS/DAY)	NET CHANGE (LBS/DAY)
Ammonia – Jan.	37.2	8.4	1054.8	322.3	-732.6
Ammonia – Feb.	37.2	8.4	1054.8	322.3	-732.6
Ammonia – Mar.	35.0	8.4	992.5	322.3	-670.2
Ammonia – Apr.	35.8	6.9	1015.1	264.7	-750.4
Ammonia – May.	34.0	8.4	964.1	322.3	-641.8
Ammonia – Jun.	28.2	6.9	799.6	264.7	-534.9
Ammonia – Jul.	38.4	6.9	1088.9	264.7	-824.2
Ammonia – Aug.	34.8	8.4	986.8	322.3	-664.5
Ammonia – Sep.	28.2*	6.9	799.6	264.7	-534.9
Ammonia – Oct.	37.0	6.9	1049.2	264.7	-784.5
Ammonia – Nov.	37.0	8.4	1049.2	322.3	-726.9
Ammonia – Dec.	42.0	8.4	1191.0	322.3	-868.7

*No limit set by the existing operating permit for this month. The most stringent of the existing daily limits were used to demonstrate non-degradation.

Net Change in Loadings Based upon Current and Proposed Monthly Permit Limits.

POLLUTANTS OF CONCERN	CURRENT AVERAGE MONTHLY LIMIT (MG/L)	PROPOSED AVERAGE MONTHLY LIMIT (MG/L)	CURRENT LOADING (LBS/DAY)	PROPOSED LOADING (LBS/DAY)	NET CHANGE (LBS/DAY)
Ammonia – Jan.	5.8	2.4	164.5	92.1	-72.4
Ammonia – Feb.	6.0	2.4	170.1	92.1	-78.1
Ammonia – Mar.	5.1	2.4	144.6	92.1	-52.5
Ammonia – Apr.	4.7	1.9	133.3	72.9	-60.4
Ammonia – May.	4.3	1.6	121.9	61.4	-60.5
Ammonia – Jun.	3.5	1.0	99.2	38.4	-60.9
Ammonia – Jul.	3.6	0.8	102.1	30.7	-71.4
Ammonia – Aug.	3.3	1.0	93.6	38.4	-55.2
Ammonia – Sep.	3.3*	1.1	93.6	42.2	-51.4
Ammonia – Oct.	3.9	1.8	110.6	69.1	-41.5
Ammonia – Nov.	4.0	2.4	113.4	92.1	-21.4
Ammonia – Dec.	4.8	2.4	136.1	92.1	-44.0

*No limit set by the existing operating permit for this month, The most stringent of the existing daily limits were used to demonstrate non-degradation.

DERIVATION AND DISCUSSION OF PARAMETERS AND LIMITS

Wasteload allocations and limits were calculated using two methods:

A. **Water quality-based** – Using water quality criteria or water quality model results and the dilution equation below:

$$C = \frac{(C_s \times Q_s) + (C_e \times Q_e)}{(Q_e + Q_s)}$$ (EPA/505/2-90-001, Section 4.5.5)

Where C = downstream concentration
C_s = upstream concentration
Q_s = upstream flow
C_e = effluent concentration
Q_e = effluent flow

Chronic wasteload allocations were determined using applicable chronic water quality criteria (CCC: criteria continuous concentration) and stream volume of flow at the edge of the mixing zone (MZ). Acute wasteload allocations were determined using applicable water quality criteria (CMC: criteria maximum concentration) and stream volume of flow at the edge of the zone of initial dilution (ZID).

Water quality-based maximum daily and average monthly effluent limitations were calculated using methods and procedures outlined in USEPA's "Technical Support Document For Water Quality-based Toxics Control" (EPA/505/2-90-001).

B. **Alternative Analysis-based** – Using the preferred alternative's treatment capacity for conventional pollutants such as BOD_5 and TSS that are provided by the consultant as the WLA, the significantly-degrading effluent average monthly and average weekly limits are determined by applying the WLA as the average monthly (AML) and multiplying the AML by 1.5 to derive the average weekly limit (AWL).

Note: Significantly-degrading effluent limits have been based on the authority included in Section I.A. of the AIP. Also under 40 CFR 133.105, permitting authorities shall require more stringent limitations than equivalent to secondary treatment limitations for 1) existing facilities if the permitting authority determines that the 30-day average and 7-day average BOD_5 and TSS effluent values could be achievable through proper operation and maintenance of the treatment works, and 2) new facilities if the

permitting authority determines that the 30-day average and 7-day average BOD_5 and TSS effluent values could be achievable through proper operation and maintenance of the treatment works, considering the design capability of the treatment process.

Outfall #001 – **Main Facility Outfall**

- **Flow.** Though not limited itself, the volume of effluent discharged from each outfall is needed to assure compliance with permitted effluent limitations [40 CFR Part 122.44(i)(1)(ii)]. If the permittee is unable to obtain effluent flow, then it is the responsibility of the permittee to inform the department, which may require the submittal of an operating permit modification. Influent monitoring has been and will be required for this facility in its Missouri State Operating Permit.
- **Biochemical Oxygen Demand (BOD_5).** Effluent limits of 15 mg/L average monthly and 15 mg/L average weekly maximum were established as a result of a discharging technology alternatives analysis conducted by the applicant. These limits are at least as stringent as the minimum effluent regulations established in 10 CSR 20-7.015(8)(A)1.
- **Total Suspended Solids (TSS).** Effluent limits of 20 mg/L average monthly and 30 mg/L average weekly maximum were established as a result of a discharging technology alternatives analysis conducted by the applicant. These limits are at least as stringent as the minimum effluent regulations established in 10 CSR 20-7.015(8)(A)1.
- ***Escherichia coli (E. coli).*** Monthly average of 206 per 100 mL as a geometric mean and Weekly Average of 1,030 per 100 mL as a geometric mean during the recreational season (April 1 – October 31), for discharges within two miles upstream of segments or lakes with Whole Body Contact Recreation (B) designated use of the receiving stream, as per 10 CSR 20-7.015(9)(B). An effluent limit for both monthly average and weekly average is required by 40 CFR 122.45(d).
- **Total Ammonia Nitrogen.** Early Life Stages Present Total Ammonia Nitrogen criteria apply [10 CSR 20-7.031(5)(B)7.C. & Table B3]. Background total ammonia nitrogen = 0.01 mg/L

Month	Temp (°C)*	pH (SU)*	Total Ammonia Nitrogen CCC (mg N/L)	Total Ammonia Nitrogen CMC (mg N/L)
January	2.3	8.0	2.4	8.4
February	2.7	8.0	2.4	8.4
March	9.1	8.0	2.4	8.4
April	15.8	8.1	1.9	6.9
May	20.3	8.0	1.6	8.4
June	26.0	8.1	1.0	6.9
July	28.8	8.1	0.8	6.9
August	28.1	8.0	1.0	8.4
September	23.6	8.1	1.1	6.9
October	16.1	8.1	1.8	6.9
November	10.3	8.0	2.4	8.4
December	4.0	8.0	2.4	8.4

* Ecoregion Data (Western Corn Belt Plains)

WBQEL equation

$C_e = (((Q_e+Q_s)*C) - (Q_s*C_s))/Q_e$

January

Chronic WLA: Ce = ((7.13 + 0.0)2.4 – (0.0 * 0.01)) / 7.13 Ce = 2.4

Acute WLA: Ce = ((7.13 + 0.0)8.4 – (0.0 * 0.01)) / 7.13 Ce = 8.4

AML = WLAc = 2.4 mg/L

MDL = WLAa = 8.4 mg/L

February
Chronic WLA: Ce = ((7.13 + 0.0)2.4 – (0.0 * 0.01)) / 7.13 Ce = 2.4
Acute WLA: Ce = ((7.13 + 0.0)8.4 – (0.0 * 0.01)) / 7.13 Ce = 8.4
AML = WLAc = 2.4 mg/L
MDL = WLAa = 8.4 mg/L

March
Chronic WLA: Ce = ((7.13 + 0.0)2.4 – (0.0 * 0.01)) / 7.13 Ce = 2.4
Acute WLA: Ce = ((7.13 + 0.0)8.4 – (0.0 * 0.01)) / 7.13 Ce = 8.4
AML = WLAc = 2.4 mg/L
MDL = WLAa = 8.4 mg/L

April
Chronic WLA: Ce = ((7.13 + 0.0)1.9 – (0.0 * 0.01)) / 7.13 Ce = 1.9
Acute WLA: Ce = ((7.13 + 0.0)6.9 – (0.0 * 0.01)) / 7.13 Ce = 6.9
AML = WLAc = 1.9 mg/L
MDL = WLAa = 6.9 mg/L

May
Chronic WLA: Ce = ((7.13 + 0.0)1.6 – (0.0 * 0.01)) / 7.13 Ce = 1.6
Acute WLA: Ce = ((7.13 + 0.0)8.4 – (0.0 * 0.01)) / 7.13 Ce = 8.4
AML = WLAc = 1.6 mg/L
MDL = WLAa = 8.4 mg/L

June
Chronic WLA: Ce = ((7.13 + 0.0)1.0 – (0.0 * 0.01)) / 7.13 Ce = 1.0
Acute WLA: Ce = ((7.13 + 0.0)6.9 – (0.0 * 0.01)) / 7.13 Ce = 6.9
AML = WLAc = 1.0 mg/L
MDL = WLAa = 6.9 mg/L

July
Chronic WLA: Ce = ((7.13 + 0.0)0.8 – (0.0 * 0.01)) / 7.13 Ce = 0.8
Acute WLA: Ce = ((7.13 + 0.0)6.9 – (0.0 * 0.01)) / 7.13 Ce = 6.9
AML = WLAc = 0.8 mg/L
MDL = WLAa = 6.9 mg/L

August
Chronic WLA: Ce = ((7.13 + 0.0)1.0 – (0.0 * 0.01)) / 7.13 Ce = 1.0
Acute WLA: Ce = ((7.13 + 0.0)8.4 – (0.0 * 0.01)) / 7.13 Ce = 8.4
AML = WLAc = 1.0 mg/L
MDL = WLAa = 8.4 mg/L

September
Chronic WLA: Ce = ((7.13 + 0.0)1.1 – (0.0 * 0.01)) / 7.13 Ce = 1.1
Acute WLA: Ce = ((7.13 + 0.0)6.9 – (0.0 * 0.01)) / 7.13 Ce = 6.9
AML = WLAc = 1.1 mg/L
MDL = WLAa = 6.9 mg/L

October
Chronic WLA: Ce = ((7.13 + 0.0)1.8 – (0.0 * 0.01)) / 7.13 Ce = 1.8
Acute WLA: Ce = ((7.13 + 0.0)6.9 – (0.0 * 0.01)) / 7.13 Ce = 6.9
AML = WLAc = 1.8 mg/L
MDL = WLAa = 6.9 mg/L

November
Chronic WLA: Ce = ((7.13 + 0.0)2.4 – (0.0 * 0.01)) / 7.13 Ce = 2.4
Acute WLA: Ce = ((7.13 + 0.0)8.4 – (0.0 * 0.01)) / 7.13 Ce = 8.4
AML = WLAc = 2.4 mg/L
MDL = WLAa = 8.4 mg/L

December
Chronic WLA: Ce = ((7.13 + 0.0)2.4 – (0.0 * 0.01)) / 7.13 Ce = 2.4
Acute WLA: Ce = ((7.13 + 0.0)8.4 – (0.0 * 0.01)) / 7.13 Ce = 8.4
AML = WLAc = 2.4 mg/L
MDL = WLAa = 8.4 mg/L

- **Oil & Grease.** Conventional pollutant, [10 CSR 20-7.031(4)(B)]. Waters shall be free from oil, scum, and floating debris in sufficient amounts to be unsightly or prevent full maintenance of designated uses.
- **Total Kjeldahl Nitrogen, Nitrite + Nitrate, and Total Phosphorus.** Effluent monitoring for Total Kjeldahl Nitrogen, Nitrite + Nitrate, and Total Phosphorus are required per 10 CSR 20-7.015(9)(D)8.B.
- **pH.** 6.0-9.0 SU. The permit writer has made a reasonable potential determination based on effluent data submitted to the department and the assimilative capacity of the receiving stream that the discharge will not cause or contribute to the excursion of the water quality standard for pH instream. Therefore, effluent limitations as required by 10 CSR 20-7.015 are substituted for the pH water quality criteria of 6.5-9.0 SU.
- **Biochemical Oxygen Demand (BOD_5) Percent Removal.** In accordance with 40 CFR Part 133, removal efficiency is a method by which the Federal Regulations define Secondary Treatment and Equivalent to Secondary Treatment, which applies to BOD_5 and TSS for Publicly Owned Treatment Works (POTWs)/municipals. This facility is required to meet 85 percent removal efficiency for BOD_5.
- **Total Suspended Solids (TSS) Percent Removal.** In accordance with 40 CFR Part 133, removal efficiency is a method by which the Federal Regulations define Secondary Treatment and Equivalent to Secondary Treatment, which applies to BOD_5 and TSS for Publicly Owned Treatment Works (POTWs)/municipals. This facility is required to meet 85 percent removal efficiency for TSS.

  Metals
  Effluent limitations for total recoverable metals were developed using methods and procedures outlined in the "Technical Support Document for Water Quality-based Toxic Controls" (EPA/505/2-90-001) and "The Metals Translator: Guidance for Calculating a Total Recoverable Permit Limit from a Dissolved Criterion" (EPA 823-B-96-007). General warm-water fishery criteria apply. Ecoregion water hardness for Western Corn Belt Plains of 240 mg/L is used in the calculation below. This value represents the 50th percentile (median) for all watersheds in-stream hardness values through the Ecoregion.

  Due to the absence of contemporaneous effluent and instream data for total recoverable metals, dissolved metals, hardness, and total suspended solids with which to calculate metals translators, partitioning between the dissolved and absorbed phases was assumed to be minimal (Section 5.7.3, EPA/505/2-90-001). Freshwater criteria conversion factors for dissolved metals were used as the metals translator as recommended in guidance (Section 1.3, 1.5.3, and Table 1, EPA 823-B-96-007). If concurrent site-specific data for total recoverable metals, dissolved metals, hardness, and total suspended solids are provided to the department, partitioning evaluations may be considered and site-specific translators developed.
- **Aluminum, Total Recoverable.** Monitoring requirement only. The permit writer observed Aluminum data provided as part of the Expanded Effluent testing requirements and noted that the four data points, when used in the Reasonable Potential Analysis, showed that a Reasonable Potential existed. However, the permit writer also noted that the maximum value reported was below the Water Quality Standard for Aluminum. Therefore the permit writer decided to add Aluminum as a monitoring-only requirement, to collect additional data during the next permit renewal, to determine if the discharge has a reasonable potential to violate Water Quality Standards.

- **Iron, Total Recoverable.** Monitoring requirement only. The permit writer observed Iron data provided as part of the Expanded Effluent testing requirements and noted that the four data points, when used in the Reasonable Potential Analysis, showed that a Reasonable Potential existed. However, the permit writer also noted that the maximum value reported was below the Water Quality Standard for Iron. Therefore the permit writer decided to add Iron as a monitoring-only requirement, to collect additional data during the next permit renewal, to determine if the discharge has a reasonable potential to violate Water Quality Standards.
- **Selenium, Total Recoverable.** Monitoring requirement only. The permit writer observed Selenium data provided as part of the Expanded Effluent testing requirements and noted that the four data points, when used in the Reasonable Potential Analysis, showed that a Reasonable Potential existed. However, the permit writer also noted that the maximum value reported was below the Water Quality Standard for Selenium. Therefore the permit writer decided to add Selenium as a monitoring-only requirement, to collect additional data during the next permit renewal, to determine if the discharge has a reasonable potential to violate Water Quality Standards.

GENERAL ASSUMPTIONS OF THE WATER QUALITY AND ANTIDEGRADATION REVIEW

A. A Water Quality and Antidegradation Review (WQAR) assumes that [10 CSR 20-6.010(2) Continuing Authorities and 10 CSR 20-6.010(4)(A)5.B., consideration for no discharge] has been or will be addressed in a Missouri State Operating Permit or Construction Permit Application.

B. A WQAR does not indicate approval or disapproval of alternative analysis as per [10 CSR 20-7.015(4) Losing Streams], and/or any section of the effluent regulations.

C. Changes to Federal and State Regulations (FSR) made after the drafting of this WQAR may alter Water Quality Based Effluent Limits (WQBEL).

D. Effluent limitations derived from FSR may be WQBEL or Effluent Limit Guidelines (ELG).

E. WQBEL supersede ELG only when they are more stringent. Mass limits derived from technology based limits are still appropriate.

F. A WQAR does not allow discharges to waters of the State, and shall not be construed as a National Pollution Discharge Elimination System (NPDES) or Missouri State Operating Permit to discharge or a permit to construct, modify, or upgrade.

G. Limitations and other requirements in a WQAR may change as Water Quality Standards (WQS), Methodology, and Implementation procedures change.

H. Nothing in this WQAR removes any obligations to comply with county or other local ordinances or restrictions.

I. If the proposed treatment technology is not covered in 10 CSR 20-8 Design Guides, the treatment process may be considered a new technology. As a new technology, the permittee will need to work with the review engineer to ensure equipment is sized properly. The operating permit may contain additional requirements to evaluate the effectiveness of the technology once the facility is in operation. This Antidegradation Review is based on the information provided by the facility and is not a comprehensive review of the proposed treatment technology. If the review engineer determines the proposed technology will not consistently meet proposed effluent limits, the permittee will be required to revise their Antidegradation Report.

ANTIDEGRADATION REVIEW PRELIMINARY DETERMINATION

The proposed new treatment system will result in insignificant degradation of Todd Creek with respect to ammonia, and will result in significant degradation with respect to all other pollutants of concern. Upgrading the existing treatment technology, which utilizes contact stabilization activated sludge, was determined to be the base case technology (lowest cost alternative that meets technology and water quality based effluent limitations). Four less degrading alternatives were analyzed, and AGS with BNR was selected as the preferred alternative.

Per the requirements of the AIP, the effluent limits in this review were developed to be protective of beneficial uses and to attain the highest statutory and regulatory requirements. The department has determined that the submitted review is sufficient and meets the requirements of the AIP. No further analysis is needed for this discharge.

Reviewer: Thomas Silkwood
Date: January 2023
Unit Chief: Jill Wade, P.E.

Appendix A: Map of Discharge Location

Appendix B: Natural Heritage Review

Missouri Department of Conservation

Missouri Department of Conservation's Mission is to protect and manage the forest, fish, and wildlife resources of the state and to facilitate and provide opportunities for all citizens to use, enjoy and learn about these resources.

Natural Heritage Review Level Two Report: State Listed Endangered Species and/or Missouri Species/Natural Communities of Conservation Concern

There are records for state-listed Endangered Species, or Missouri Species or Natural Communities of Conservation Concern within or near the defined Project Area. Please contact Missouri Department of Conservation for further coordination.

Foreword: Thank you for accessing the Missouri Natural Heritage Review Website developed by the Missouri Department of Conservation with assistance from the U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers, Missouri Department of Transportation and NatureServe. The purpose of this website is to provide information to federal, state and local agencies, organizations, municipalities, corporations and consultants regarding sensitive fish, wildlife, plants, natural communities and habitats to assist in planning, designing and permitting stages of projects.

PROJECT INFORMATION

Project Name and ID Number: Kansas City Todd Creek WWTP Facility Plan #8268
Project Description: Todd Creek WWTP facility plan for future upgrades and potential expansion.
Project Type: Waste Transfer, Treatment, and Disposal, Liquid waste/Effluent, Effluent Discharge, Effluent discharge - renewal or modification of discharge to stream
Contact Person: Cody Luebbering
Contact Information: cluebbering@geosyntec.com or 5734434100

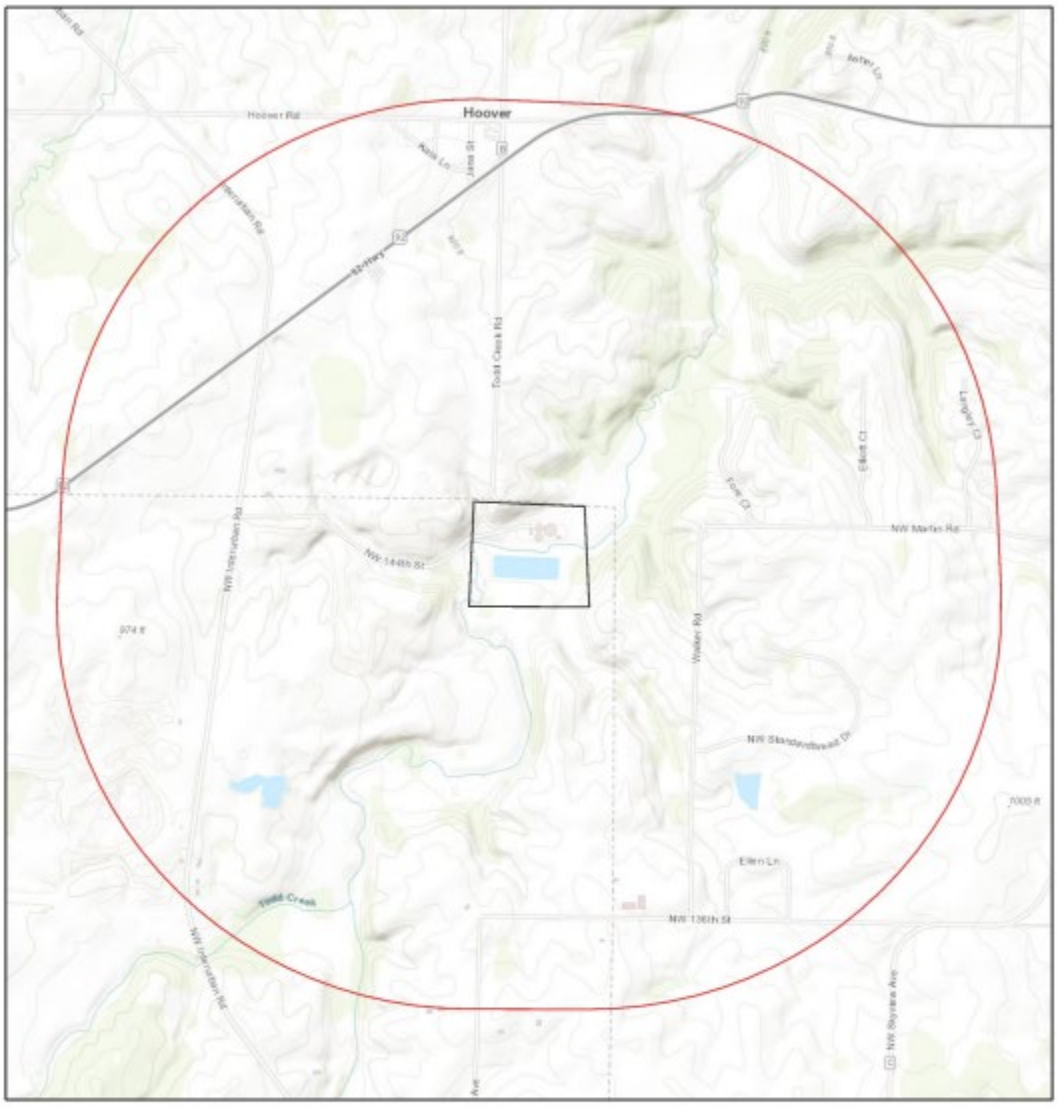
Disclaimer: The NATURAL HERITAGE REVIEW REPORT produced by this website identifies if a species tracked by the Natural Heritage Program is known to occur within or near the area submitted for your project, and shares suggested recommendations on ways to avoid or minimize project impacts to sensitive species or special habitats. If an occurrence record is present, or the proposed project might affect federally listed species, the user must contact the Department of Conservation or U.S. Fish and Wildlife Service for more information. The Natural Heritage Program tracks occurrences of sensitive species and natural communities where the species or natural community has been found. Lack of an occurrence record does not mean that a sensitive plant, animal or natural community is not present on or near the project area. Depending on the project, current habitat conditions, and geographic location in the state, surveys may be necessary. Additionally, because land use conditions change and animals move, the existence of an occurrence record does not mean the species/habitat is still present. Therefore, Reports include information about records near but not necessarily on the project site.

The Natural Heritage Report is not a site clearance letter for the project. It provides an indication of whether or not public lands and sensitive resources are known to be (or are likely to be) located close to the proposed project. Incorporating information from the Natural Heritage Program into project plans is an important step that can help reduce unnecessary impacts to Missouri's sensitive fish, forest and wildlife resources. However, the Natural Heritage Program is only one reference that should be used to evaluate potential adverse project impacts. Other types of information, such as wetland and soils maps and on-site inspections or surveys, should be considered. Reviewing current landscape and habitat information, and species' biological characteristics would additionally ensure that Missouri Species of Conservation Concern are appropriately identified and addressed in planning efforts.

U.S. Fish and Wildlife Service – Endangered Species Act (ESA) Coordination: Lack of a Natural Heritage Program occurrence record for federally listed species in your project area does not mean the species is not present, as the area may never have been surveyed. Presence of a Natural Heritage Program occurrence record does not mean the project will result in negative impacts. The information within this report is not intended to replace Endangered Species Act consultation with the U.S. Fish and Wildlife Service (USFWS) for listed species. Direct contact with the USFWS may be necessary to complete consultation and it is required for actions with a federal connection, such as federal funding or a federal permit; direct contact is also required if ESA concurrence is necessary. Visit the USFWS Information for Planning and Conservation (IPaC) website at https://ecos.fws.gov/ipac/ for further information. This site was developed to help streamline the USFWS environmental review process and is a first step in ESA coordination. The Columbia Missouri Ecological Field Services Office may be reached at 573-234-2132, or by mail at 101 Park Deville Drive, Suite A, Columbia, MO 65203.

Transportation Projects: If the project involves the use of Federal Highway Administration transportation funds, these recommendations may not fulfill all contract requirements. Please contact the Missouri Department of Transportation at 573-526-4778 or www.modot.mo.gov/ehp/index.htm for additional information on recommendations.

Kansas City Todd Creek WWTP Facility Plan



November 4, 2020

1:21,453

0 0.175 0.35 0.7 mi
0 0.275 0.55 1.1 km

Project Boundary

Buffered Project Boundary

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Species or Communities of Conservation Concern within the Area:

There are records for state-listed Endangered Species, or Missouri Species or Natural Communities of Conservation Concern within or near the defined Project Area. Please contact the Missouri Department of Conservation for further coordination.

MDC Natural Heritage Review
Resource Science Division
P.O. Box 180
Jefferson City, MO
65102-0180
Phone: 573-522-4115 ext. 3182
NaturalHeritageReview@mdc.mo.gov

Other Special Search Results:

No results have been identified for this project location.

Project Type Recommendations:
Waste Transfer, Treatment, and Disposal - Liquid Effluent Discharge - New or Renewal of Permit: Clean Water Act permits issued by other agencies regulate both construction and operation of wastewater systems, and provide many important protections for fish and wildlife resources throughout the project area and at some distance downstream. Fish and wildlife almost always benefit when unnatural pollutants are removed from water, and concerns are minimal if construction is managed to minimize erosion and sedimentation/runoff to nearby streams and lakes, including adherence to any "Clean Water Permit" conditions.
Revegetation of disturbed areas is recommended to minimize erosion, as is restoration with of native plant species compatible with the local landscape and for wildlife needs. Annuals like ryegrass may be combined with native perennials for quicker green-up. Avoid aggressive exotic perennials such as crown vetch and sericea lespedeza.

Project Location and/or Species Recommendations:

Endangered Species Act Coordination - Indiana bats *(Myotis sodalis*, federal- and state-listed endangered) and **Northern long-eared bats** (*Myotis septentrionalis*, federal-listed threatened) may occur near the project area. Both of these species of bats hibernate during winter months in caves and mines. During the summer months, they roost and raise young under the bark of trees in wooded areas, often riparian forests and upland forests near perennial streams. During project activities, avoid degrading stream quality and where possible leave snags standing and preserve mature forest canopy. Do not enter caves known to harbor Indiana bats or Northern long-eared bats, especially from September to April. **If any trees need to be removed for your project, please contact the U.S. Fish and Wildlife Service (Ecological Services, 101 Park Deville Drive, Suite A, Columbia, Missouri 65203-0007; Phone 573-234-2132 ext. 100 for Ecological Services) for further coordination under the Endangered Species Act.**

Invasive exotic species are a significant issue for fish, wildlife and agriculture in Missouri. Seeds, eggs, and larvae may be moved to new sites on boats or construction equipment. Please inspect and clean equipment thoroughly before moving between project sites. See http://mdc.mo.gov//9633 for more information.

- Remove any mud, soil, trash, plants or animals from equipment before leaving any water body or work area.
- Drain water from boats and machinery that have operated in water, checking motor cavities, live-well, bilge and transom wells, tracks, buckets, and any other water reservoirs.
- When possible, wash and rinse equipment thoroughly with hard spray or HOT water (?140° F, typically available at do-it-yourself car wash sites), and dry in the hot sun before using again.

Streams and Wetlands – Clean Water Act Permits: Streams and wetlands in the project area should be protected from activities that degrade habitat conditions. For example, soil erosion, water pollution, placement of fill, dredging, in-stream activities, and riparian corridor removal, can modify or diminish aquatic habitats. Streams and wetlands may be protected under the Clean Water Act and require a permit for any activities that result in fill or other modifications to the site. Conditions provided within the U.S. Army Corps of Engineers (USACE) Clean Water Act Section 404 permit (http://www.nwk.usace.army.mil/Missions/RegulatoryBranch.aspx) and the Missouri Department of Natural Resources (DNR) issued Clean Water Act Section 401 Water Quality Certification (http://dnr.mo.gov/env/wpp/401/index.html), if required, should help minimize impacts to the aquatic organisms and aquatic habitat within the area. Depending on your project type, additional permits may be required by the Missouri Department of Natural Resources, such as permits for stormwater, wastewater treatment facilities, and confined animal feeding operations. Visit http://dnr.mo.gov/env/wpp/permits/index.html for more information on DNR permits. Visit both the USACE and DNR for more information on Clean Water Act permitting.

For further coordination with the Missouri Department of Conservation and the U.S. Fish and Wildlife Services, please see the contact information below.

MDC Natural Heritage Review
Resource Science Division
P.O. Box 180
Jefferson City, MO
65102-0180
Phone: 573-522-4115 ext. 3182
NaturalHeritageReview@mdc.mo.gov

U.S. Fish and Wildlife Service
Ecological Service
101 Park Deville Drive
Suite A
Columbia, MO
65203-0007
Phone: 573-234-2132

Miscellaneous Information

FEDERAL Concerns are species/habitats protected under the Federal Endangered Species Act and that have been known near enough to the project site to warrant consideration. For these, project managers must contact the U.S. Fish and Wildlife Service Ecological Services (101 Park Deville Drive Suite A, Columbia, Missouri 65203-0007; Phone 573-234-2132; Fax 573-234-2181) for consultation.

STATE Concerns are species/habitats known to exist near enough to the project site to warrant concern and that are protected under the Wildlife Code of Missouri (RSMo 3 CSR 1 0). "State Endangered Status" is determined by the Missouri Conservation Commission under constitutional authority, with requirements expressed in the Missouri Wildlife Code, rule 3CSR 1 0-4.111. Species tracked by the Natural Heritage Program have a "State Rank" which is a numeric rank of relative rarity. Species tracked by this program and all native Missouri wildlife are protected under rule 3CSR 10-4.110 General Provisions of the Wildlife Code.

Additional information on Missouri's sensitive species may be found at http://mdc.mo.gov/discover-nature/field-guide/endangered-species . Detailed information about the animals and some plants mentioned may be accessed at http://mdc4.mdc.mo.gov/applications/mofwis/mofwis_search1.aspx . If you would like printed copies of best management practices cited as internet URLs, please contact the Missouri Department of Conservation.

Appendix C: Geohydrologic Evaluation

Missouri Department Of Natural Resources
Missouri Geological Survey
Geological Survey Program
Environmental Geology Section

Project ID Number
LWE22101
County
Platte County

Request Details

Project: Kansas City Todd Creek WWTP Upgrade and Expansion

Legal Description: 36 T53N R34W

Quadrangle: FERRELVIEW
Latitude: 39 21 20.6
Longitude: -94 40 12.85

Organization Official
Name: Sherri Irving
Address: 4800 East 63rd Street
City: Kansas City
State: MO Zip: 64130
Phone: 816-513-0601
Email: sherri.irving@kcmo.org

Preparer
Name: Cody Luebbering
Address: 2009 East McCarty St.
City: Jefferson City
State: MO Zip: 65101
Phone: 573-499-5443
Email: cluebbering@geosyntec.com

Project Details

Report Date: 06/27/2022
Date of Field Visit: 06/09/2022

Previous Reports: Not Applicable

Facility Type
- [X] Mechanical treatment plant
- [ ] Recirculating filter bed
- [ ] Land application
- [ ] Lagoon or storage basin
- [ ] Subsurface soil absorption system
- [ ] Lagoon or storage basin W/Land App
- [ ] Lagoon or storage basin W/SSAS
- [ ] Other type of facility

Type of Waste
- [ ] Animal
- [X] Human
- [ ] Process or industrial
- [ ] Leachate
- [ ] Other waste type

Funding Source
- [ ] IWT
- [X] WWL-SRF

Additional Information
- [ ] Plans were submitted
- [ ] Site was investigated by NRCS
- [ ] Soil or geotechnical data were submitted

Geologic Stream Classification: [X] Gaining [ ] Losing [ ] No discharge

Overall Geologic Limitations
- [X] Slight
- [ ] Moderate
- [ ] Severe

Collapse Potential
- [X] Not applicable
- [ ] Slight
- [ ] Moderate
- [ ] Severe

Topography
- [X] <4%
- [ ] 4% to 8%
- [ ] 8% to 15%
- [ ] >15%

Landscape Position
- [X] Broad uplands
- [ ] Floodplain
- [ ] Ridgetop
- [ ] Alluvial plain
- [X] Hillslope
- [ ] Terrace
- [ ] Narrow ravine
- [ ] Sinkhole

Bedrock: Bedrock consists of the low permeable Pennsylvanian-age Lansing Group.

Surficial Materials: Surficial materials consist of low permeable glacial drift.

Missouri Department Of Natural Resources
Missouri Geological Survey
Geological Survey Program
Environmental Geology Section

Project ID Number
LWE22101
County
Platte County

Recommended Construction Procedures for Earthen Facility	Determine Overburden Properties	Determine Hydrologic Conditions
☐ Installation of clay pad and Compaction	☐ Particle size analysis	☐ Groundwater elevation
☐ Diversion of subsurface flow	☐ Atterberg limits	☐ Direction of groundwater flow
☐ Artificial sealing	☐ 95% Max. dry density test method	☐ 25-Year flood level
☐ Rock excavation	☐ Overburden thickness	☐ 100-Year flood level
☐ Limit excavation depth	☐ Permeability coefficient-undisturbed	
	☐ Permeability coefficient-remolded	

Remarks:

On June 9, 2022, a geologist with the Geological Survey Program (GSP) performed a geohydrologic evaluation for a new wastewater treatment plant that will replace the existing Kansas City Todd Creek Wastewater Treatment Plant. The proposed facility will be located approximately 0.25 miles to the northwest of the existing facility on uplands; the existing facility is located in the alluvial plain of Todd Creek. The purpose of this evaluation is to evaluate the geologic and hydrologic characteristics of the site and to determine the potential impact of groundwater contamination to local and regional water resources in the event of treatment failure.

No bedrock was observed on site, but previous mapping indicates that the uppermost bedrock on site consists of alternating layers of shales and limestones of the Pennsylvanian-age Lansing Group. While these bedrock units may exhibit varying permeabilities, they exhibit an overall low vertical permeability. Surficial materials observed on site consist of low permeability glacial till. According to logs of nearby wells, surficial material thickness is approximately 30 to 50 feet.

Surface water from the site will flow south to Todd Creek, which has been classified as a gaining stream for two miles downstream of the existing outfall. The site receives an overall slight geologic limitation rating, primarily due to the presence of low permeability bedrock and surficial materials onsite. In the event of treatment failure, impact to regional groundwater resources would likely be minimal. However, shallow and local groundwater resources, and surface waters of Todd Creek, may be adversely impacted.

Appendix D: Antidegradation Review Summary Attachments

Antidegradation Review Summary / Request

MISSOURI DEPARTMENT OF NATURAL RESOURCES
WATER PROTECTION PROGRAM, WATER POLLUTION CONTROL BRANCH

ANTIDEGRADATION REVIEW SUMMARY / REQUEST

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

1. FACILITY

NAME			COUNTY
KC Todd Creek WWTP			Platte
ADDRESS (PHYSICAL)	CITY	STATE	ZIP CODE
7600 NW 144th St.	Kansas City	MO	64163
PERMIT NUMBER	PROPOSED DESIGN FLOW	SIC / NAICS CODE	
MO-0024961	4.6		

2. OWNER

NAME			
City of Kansas City			
ADDRESS	CITY	STATE	ZIP CODE
4800 East 63rd St.	Kansas City	MO	64130
EMAIL ADDRESS			TELEPHONE NUMBER WITH AREA CODE
shawn.cross@kcmo.org			816-513-0442

3. CONTINUING AUTHORITY The regulatory requirement regarding continuing authority is found in 10 CSR 20-6.010(2).

NAME	SECRETARY OF STATE CHARTER NUMBER		
same as owner			
ADDRESS	CITY	STATE	ZIP CODE
EMAIL ADDRESS			TELEPHONE NUMBER WITH AREA CODE

4. CONSULTANT

PREPARER NAME	COMPANY NAME		
Cody Luebbering	Geosyntec Consultants		
ADDRESS	CITY	STATE	ZIP CODE
2009 E. McCarty St., Suite 1	Jefferson City	MO	65101
EMAIL ADDRESS			TELEPHONE NUMBER WITH AREA CODE
cluebbering@geosyntec.com			573-499-5443

5. RECEIVING WATER BODY SEGMENT #1

NAME: Todd Creek

5.1 Upper end of segment – Location of discharge
UTM: X= 356334, Y= 4357342 OR Lat _____, Long _____

5.2 Lower end of segment –
UTM: X= _____, Y= _____ OR Lat _____, Long _____

Per the Missouri Antidegradation Implementation Procedure (AIP), the definition of a segment, "a segment is a section of water that is bound, at a minimum, by significant existing sources and confluences with other significant water bodies."

6. WATER BODY SEGMENT #2 (IF APPLICABLE, Use another form if a third segment is needed)

NAME:

6.1 Upper end of segment – End of Segment #1
UTM: X= _____, Y= _____ OR Lat _____, Long _____

6.2 Lower end of segment –
UTM: X= _____, Y= _____ OR Lat _____, Long _____

7. DECHLORINATION

If chlorination and dechlorination is the existing or proposed method of disinfection treatment, will the effluent discharged be equal to or less than the Water Quality Standards for Total Residual Chlorine stated in Table A1 of 10 CSR 20-7.031?

☐ Yes ☑ No – What is the proposed method of disinfection? Ultraviolet disinfection

Based on the disinfection treatment system being designed for total removal of Total Residual Chlorine, minimal degradation for Total Residual Chlorine is assumed and the facility will be required to meet the water quality based effluent limits. These compliance limits for Total Residual Chlorine are much less than the method detection limit of 0.13 mg/L.

8. SUMMARIZE THE FEASIBILITY OF CONSTRUCTING A NO-DISCHARGE TREATMENT WASTEWATER FACILITY

According to the Antidegradation Implementation Procedure Sections I.B. and II.B.1., the feasibility of no-discharge alternatives must be considered. No-discharge alternatives may include connection to a regional treatment facility, surface land application, subsurface land application, and recycle or reuse.

No-discharge alternatives were evaluated and deemed not practicable due to the volume of storage and large amount of land for land application, and the Todd Creek WWTP currently serves as the regional wastewater treatment provider.

9. ADDITIONAL REQUIREMENTS

Complete and submit the following with this submittal:

- ☑ Copy of the Geohydrologic Evaluation – Submit request through the Missouri Geological Survey website
- ☑ Copy of the Missouri Natural Heritage from the Missouri Department of Conservation website
- ☑ Attach your Antidegradation Review Report and all supporting documentation as these forms are only a summary.
- ☐ If applicable, submit a copy of any Existing Water Quality data used in this process. Include the date range of the data, source(s) of the data, and location of data collection relative to the outfall. If using your own collected water quality data, submit a copy of the Quality Assurance Project Plan (QAPP) approved by the department's Watershed Protection Section. For more detailed information, see the Missouri Antidegradation Implementation Procedure (AIP), Section II.A.1.

10. PATH / TIER REVIEW ATTACHMENTS ENCLOSED

Path A: Tier 2 – Non-Degradation Mass Balance	☑ **Yes**	☐ **No**
Path B: Tier 2 – Minimal Degradation	☐ **Yes**	☐ **No**
Path C: Tier 2 – Significant Degradation	☑ **Yes**	☐ **No**
Path D: Tier 1 – Preliminary Review Request	☐ **Yes**	☐ **No**
Path E: Temporary Degradation	☐ **Yes**	☐ **No**

11. APPLICANT PROPOSED ANTIDEGRADATION REVIEW EFFLUENT LIMITS

Preliminary effluent limits for the proposed project are dependent upon the path selected:

Applicable Pollutants of Concern	Concentration* mg/L	Concentration* µg/L	Path / Tier Review Attachment Used for POC Evaluation	Average Monthly Limit	Daily Maximum Limit or Average Weekly Limit
BOD_5	X		Tier 2: Significant	15	15
TSS	X		Tier 2: Significant	20	30
Ammonia (Summer)	X		Tier 2: Non-Degrading	July: 0.8	6.9
Ammonia (Winter)	X		Tier 2: Non-Degrading	October: 1.8	6.9
Total Phosphorus	X		NA	monitor only	monitor only
Total Recoverable Metals (Al, Se, Fe)		X	NA	monitor only	monitor only

* Place an X in appropriate box for the concentration units for each Pollutant of Concern.

12. PROPOSED PROJECT SUMMARY

KC Water is pursuing a Tier 2, both significant degradation and non-degradation WQAR for the TCWWTP upgrade and expansion. BMcD evaluated appropriate non- and less-degrading alternatives that protect the receiving stream designated uses and Geosyntec developed effluent limits for the upgraded and expanded TCWWTP discharge to Todd Creek. A thorough evaluation of each practicable alternative is also provided in the 2021 Facility Plan: Todd Creek WWTP1 where BMcD and KC Water evaluated and scored each alternative based on Environment, Community, Financial and Opertions criteria, which resulted in the Greenfield AGS as the preferred treatment alternative. The proposed TCWWTP upgrade and expansion serves the critical SEI function of accommodating forecasted growth in the area and is the most economical, consistent, and reliable alternative to meet future effluent nutrient targets.

Applicants choosing to use a new wastewater technology that are considered an "unproven technology" in Missouri must comply with the requirements set forth in the *New Technology Definitions and Requirements fact sheet*.

13. CONTINUING AUTHORITY WAIVER (For New Discharges)

In accordance with 10 CSR 20-6.010(2)(C), applicants proposing use of a lower preference continuing authority, when the higher level authority is available, must submit a waiver from the existing higher authority one or other documentation for the department's review, provided it does not conflict with any area-wide management plan approved under section 208 of the Federal Clean Water Act or by the Missouri Clean Water Commission. Is the waiver necessary? ☐ Yes ☑ No
If yes, provide a copy.

14. APPLICATION FEE

☐ CHECK NUMBER ☐ JETPAY CONFIRMATION NUMBER

15. SIGNATURE

I am authorized and hereby certify that I am familiar with the information contained in this document and to the best of my knowledge and belief such information is true, complete and accurate.

SIGNATURE	DATE
Cody Luebbering	05/20/2022
PRINT NAME	TITLE
Cody Luebbering	Senior Scientist

PLEASE IDENTIFY YOUR STATUS FOR THIS PROJECT: ☐ OWNER ☐ CONTINUING AUTHORITY ☑ CONSULTANT

MO 780-2025 (03-19) Page 3

MISSOURI DEPARTMENT OF NATURAL RESOURCES
WATER PROTECTION PROGRAM, WATER POLLUTION CONTROL BRANCH

ANTIDEGRADATION REVIEW SUMMARY
PATH C: TIER 2 – SIGNIFICANT DEGRADATION

1. FACILITY

NAME	COUNTY
KC Todd Creek WWTP	Platte

2. SUMMARY OF THE POLLUTANTS OF CONCERN

Pollutants of Concern to be considered include those pollutants reasonably expected to be present in the discharge per the Antidegradation Implementation Procedure Section II.A. and assumed or demonstrated to cause significant degradation. The tier protection levels are specified and defined in rule at 10 CSR 20-7.031(2).

What are the proposed pollutants of concern and their respective effluent limits that the selected treatment option will comply with:

Pollutants of Concern*	Concentration*		Base Case Limit	Basis (WQS, WLA, ELG, Other)**
	mg/L	µg/L		
BOD_5	X			
TSS	X			
Ammonia (Summer)	X			Non-degrading
Ammonia (Winter)	X			Non-degrading
Total Nitrogen	X			Non-degrading
Total Phosphorus	X			Non-degrading
Total Recoverable Metals (Al, Se, Fe)				

* Place an X in appropriate box for the concentration units for each Pollutant of Concern

** Provide the Basis for the Base Case Limit: WQS – Water Quality Standard, WLA – Wasteload Allocation, ELG – Effluent Limit Guideline, or describe other.

3. IDENTIFYING ALTERNATIVES

Supply a summary of the non-discharging alternatives considered. "For Discharges likely to cause significant degradation, an analysis of non-degrading and less-degrading alternatives must be provided," as stated in the Antidegradation Implementation Procedure Section II.B.1. These alternatives include no-discharge. Attach all supportive documentation in the Antidegradation Review report.

Feasibility of non-discharging alternatives (regionalization, land application, subsurface irrigation, and recycling or reuse):

See WQAR report.

Minimum of three (preferably five or more) discharging alternatives* ranging from less-degrading to degrading including Preferred Alternative (All treatment levels for POCs must at a minimum meet water quality standards):

Discharging Alternative #	Treatment Type	Description
1	MBR with A2O	Membrane bioreactor
2	AGS with BNR	Activated granular sludge with biological nutrient removal
3	Oxidation Ditch with BNR	Oxidation ditch with biological nutrient removal
4	A2O	Anerobic-Anoxic-Oxic with biological nutrient removal
5	Contact Activated Sludge	Base Case, existing Todd Creek WWTP
6		

* Same technology may be multiple alternatives as you have the base unit and add to it with more capacity to provide additional treatment.

4. DETERMINATION OF THE REASONABLE ALTERNATIVE

Per the Antidegradation Implementation Procedure Section II.B.2, "a reasonable alternative is one that is practicable, economically efficient and affordable." Provide basis and supporting documentation in the Antidegradation Review report. **Please do not write "See Report" for any box below.**

Practicability Summary:

"The practicability of an alternative is considered by evaluating the effectiveness, reliability, and potential environmental impacts," according to the Antidegradation Implementation Procedure Section II.B.2.a. Examples of factors to consider, including secondary environmental impacts, are given in the Antidegradation Implementation Procedure Section II.B.2.a.

See WQAR report.

Economic Efficiency Basis:

What is the design life cycle for the comparison?

What interest rate was used in the present worth calculations? 8%

Economic Efficiency Summary:

Alternatives that are deemed practicable must undergo a direct cost comparison in order to determine economic efficiency. Means to determine economic efficiency are provided in the Antidegradation Implementation Procedure Section II.B.2.b.

See WQAR report.

TABLE OF THE ALTERNATIVES EVALUATION (Attach additional page if necessary)

PARAMETERS	Alternatives #					
	1	2	3	4	5	6
BOD_5 – mg/L	5.0	15	15	15	15	
TSS – mg/L	5.0	20	20	20	20	
Ammonia (Summer) – mg/L	NA	NA	NA	NA	NA	
Ammonia (Winter) – mg/L	NA	NA	NA	NA	NA	
E. Coli – #/100 mL	206	206	206	206	206	
Total Nitrogen – mg/L	NA	NA	NA	NA	NA	
Total Phosphorus – mg/L	1.0	1.0	1.0	1.0	8.0	
Construction Cost – $					NA	
Operating Cost – $					NA	
Present Worth – $	93.7 M	76.4 M	84.0 M	82.6 M	NA	
Ratio present worth to base case	123%	100%	110%	108%	Base Case	

Affordability Summary:

Alternatives identified as most practicable and economically efficient are considered affordable if the applicant does not supply an affordability analysis. An affordability analysis per the Antidegradation Implementation Procedure Section II.B.2.c, "may be used to determine if the alternative is too expensive to reasonably implement."

See WQAR report.

Justification for Preferred Alternative:

AGS with BNR is a more robust system capable of handling influent variability with reliable and more consistent effluent quality performance. AGS is a less-degrading alternative from the base case that is more than 20% economically efficient than the least degrading MBR option.

Reasons for Rejecting the other Evaluated Alternatives:

See WQAR report.

Comments/Discussion:

5. SOCIAL AND ECONOMIC IMPORTANCE OF THE PREFERRED ALTERNATIVE

If the preferred alternative will result in significant degradation, then it must be demonstrated that it will allow important economic and social development in accordance to the Antidegradation Implementation Procedure Section II.E. Social and Economic Importance is defined as the social and economic benefits to the community that will occur from any activity involving a new or expanding discharge.

Identify the affected community:

The affected community is defined in 10 CSR 20-7.031(2)(B) as the community "in the geographical area in which the waters are located. Per the Antidegradation Implementation Procedure Section II.E.1, "the affected community should include those living near the site of the proposed project as well as those in the community that are expected to directly or indirectly benefit from the project."

See WQAR report.

Identify relevant factors that characterize the social and economic conditions of the affected community:

Examples of social and economic factors are provided in the Antidegradation Implementation Procedure Section II.E.1., but specific community examples are encouraged.

See WQAR report.

Describe the important social and economic development associated with the project:

Determining benefits for the community and the environment should be site specific and in accordance with the Antidegradation Implementation Procedure Section II.E.1.

See WQAR report.

PROPOSED PROJECT SUMMARY:

The proposed TCWWTP upgrade and expansion serves the critical SEI function of accommodating forecasted growth in the area and is the most economical, consistent, and reliable alternative to meet future effluent nutrient targets.

Attach the Antidegradation Review report and all supporting documentation. This is a technical document, which must be signed, sealed and dated by a registered professional engineer of Missouri.

MO 780-2021 (02-19) Page 4

MISSOURI DEPARTMENT OF NATURAL RESOURCES
WATER PROTECTION PROGRAM, WATER POLLUTION CONTROL BRANCH

ANTIDEGRADATION REVIEW SUMMARY
PATH A: TIER 2 – NON-DEGRADATION MASS BALANCE

1. FACILITY

NAME	COUNTY
KC Todd Creek WWTP	Platte

2. EXISTING LOAD SUMMARY – NET CHANGE

Pollutant of Concern	Type of Limit	Current Permit Limit*	Current Design Flow	Current Load	New Load	New Expanded Design Flow	No-Degradation Expansion Concentration
		mg/L	MGD	lbs/day	lbs/day	MGD	mg/L
Biochemical Oxygen Demand (BOD_5)	AWL						
	AML						
Total Suspended Solids (TSS)	AWL						
	AML						
Ammonia (Summer)	MDL	28.2		800	798		20.8
	AML	3.3	3.4	94	92	4.6	2.4
Ammonia (Winter)	MDL	35.0		993	990		25.8
	AML	3.9		111	107		2.8

* If current facility discharges the pollutant of concern and does not have a current permit limit for this pollutant of concern, the water quality standard should be used in the calculation.

AWL – Average Weekly Limit MDL – Maximum Daily Limit AML – Average Monthly Limit

Equation: Load = Limit (mg/L)* Conversion Factor (8.34 (LBS/MG)/(mg/L))*Design Flow (MGD). Note: New Load must be less than or equal to the Current Load.

Is mass balance non-degradation proposed for all pollutants of concern? ☐ Yes ☑ No
If no, the appropriate additional forms must be used for those pollutants which are degrading.

3. PROPOSED PROJECT SUMMARY

See WQAR report

APPENDIX 3 – COST ANALYSIS FOR COMPLIANCE

Missouri Department of Natural Resources
Water Protection Program
Cost Analysis for Compliance
(In accordance with RSMo 644.145)

KC Todd Creek WWTP, Permit Modification
City of Kansas City
Missouri State Operating Permit #MO-0024961

Section 644.145 RSMo requires the Department of Natural Resources (department) to make a "finding of affordability" when "issuing permits under" or "enforcing provisions of" state or federal clean water laws "pertaining to any portion of a combined or separate sanitary sewer system for publicly-owned treatment works." This cost analysis does not dictate how the permittee will comply with new permit requirements.

New Permit Requirements

The permit requires compliance with proposed demonstration project monitoring requirements for Biochemical Oxygen Demand5, Total Suspended Solids, Volatile Suspended Solids, Ammonia, Total Kjeldahl Nitrogen, Nitrate + Nitrite, Total Phosphorus, Alkalinity, and pH.

Connections
The number of connections was reported by the permittee in the Facility Plan.

Connection Type	Number
Residential	3644
Commercial	0
Industrial	1
Total	**3645**

Data Collection for this Analysis
This cost analysis is based on data available to the department and data obtained from readily available sources. For the most accurate analysis, it is essential that the permittee provides the department with current information about the city's financial and socioeconomic situation. If the financial questionnaire is not submitted with the renewal application, the department sends a request to complete the form with the welcome correspondence. The department has relied heavily on readily available data to complete this analysis. If certain data was not provided by the permittee to the department and the data is not obtainable through readily available sources, this analysis will state that the information is "unknown".

Eight Criteria of 644.145 RSMo
The department must consider the eight (8) criteria presented in subsection 644.145 RSMo to evaluate the cost associated with new permit requirements.

(1) A community's financial capability and ability to raise or secure necessary funding;

Criterion 1 Table. Current Financial Information for the City of Kansas City	
Current Monthly User Rates per 5,000 gallons*	$ 105.37
Median Household Income (MHI)[1]	$ 69,438
Current Annual Operating Costs (excludes depreciation)	N/A

*User Rates were reported by the permittee on to the department's Financial Assistance Center.

(2) Affordability of pollution control options for the individuals or households at or below the median household income level of the community;
The following tables outline the estimated costs of the new permit requirements:

Criterion 2A Table. Estimated Cost Breakdown of New Permit Requirements			
New Requirement	Frequency	Estimated Cost	Estimated Annual Cost

Biochemical Oxygen Demand$_5$ – Influent	Weekly	$46.50	$1,860
Total Suspended Solids – Influent	Biweekly	$16.00	$832
Volatile Suspended Solids – Influent	Weekly	$17.00	$884
Ammonia – Influent	Weekly	$47.00	$1,880
Nitrate – Influent	Weekly	$23.50	$940
Nitrite – Influent	Weekly	$23.50	$940
Total Kjeldahl Nitrogen – Influent	Weekly	$45.00	$1,800
Total Phosphorus – Influent	Weekly	$27.50	$1,100
Alkalinity - Influent	Weekly	$14.00	$728
Total Suspended Solids – AGS Influent	Weekly	$16.00	$832
Volatile Suspended Solids – AGS Influent	Weekly	$17.00	$884
Biochemical Oxygen Demand$_5$ – AGS Influent	Weekly	$46.50	$2,418
Ammonia – AGS Influent	Weekly	$47.00	$2,444
Nitrate – AGS Influent	Weekly	$23.50	$1,222
Nitrite – AGS Influent	Weekly	$23.50	$1,222
Total Kjeldahl Nitrogen – AGS Influent	Weekly	$45.00	$2,340
Total Phosphorus – AGS Influent	Weekly	$27.50	$1,430
Alkalinity – AGS Influent	Weekly	$14.00	$728
Total Suspended Solids – AGS Effluent	Weekly	$16.00	$832
Volatile Suspended Solids – AGS Effluent	Weekly	$17.00	$884
Biochemical Oxygen Demand$_5$ – AGS Effluent	Weekly	$46.50	$2,418
Ammonia – AGS Effluent	Weekly	$47.00	$2,444
Nitrate – AGS Effluent	Weekly	$23.50	$1,222
Nitrite – AGS Effluent	Weekly	$23.50	$1,222
Total Kjeldahl Nitrogen – AGS Effluent	Weekly	$45.00	$2,340
Total Phosphorus – AGS Effluent	Weekly	$27.50	$1,430
Alkalinity – AGS Effluent	Weekly	$14.00	$728
Biochemical Oxygen Demand$_5$ – Effluent	Weekly	$46.50	$1,860
Ammonia – Effluent	Weekly	$47.50	$1,900
Nitrate – Effluent	Weekly	$23.50	$940
Nitrite – Effluent	Weekly	$23.50	$940
Total Kjeldahl Nitrogen - Effluent	Weekly	$45.00	$1,800
Total Phosphorus – Effluent	Weekly	$27.50	$1,100
pH - Effluent	Weekly	$10.00	$400
Alkalinity - Effluent	Weekly	$14.00	$728
Oil & Grease - Effluent	Monthly	$78.50	$628
Total Recoverable, Aluminum	Monthly	$23.50	$188
Total Recoverable, Iron	Monthly	$23.50	$188

Total Recoverable, Selenium	Monthly	$23.50	$188
Total Estimated Annual Cost of New Permit Requirements			$48,116

Criterion 2B Table. Estimated Costs for New Permit Requirements		
(1)	Total Estimated Annual Cost of New Permit Requirements	$48,116
(2)	Estimated Monthly User Cost for New Requirements [2]	$1.10
	Estimated Monthly User Cost for New Requirements as a Percent of MHI [3]	0.019%
(3)	Total Monthly User Cost*	$106.47
	Total Monthly User Cost as a Percent of MHI [4]	1.840%

* Current User Rate + Estimated Monthly Costs of New Sampling Requirements

(3) An evaluation of the overall costs and environmental benefits of the control technologies;

This analysis is being conducted based on new requirements in the permit, which will not require the addition of new control technologies at the facility. However, the new sampling requirements are being established in order to provide data regarding the health of the receiving stream's aquatic life and to ensure that the existing permit limits are providing adequate protection of aquatic life. Improved wastewater provides benefits such as avoided health costs due to water-related illness, enhanced environmental ecosystem quality, and improved natural resources. The preservation of natural resources has been proven to increase the economic value and sustainability of the surrounding communities. Maintaining Missouri's water quality standards fulfills the goal of restoring and maintaining the chemical, physical, and biological integrity of the receiving stream; and, where attainable, it achieves a level of water quality that provides for the protection and propagation of fish, shellfish, wildlife, and recreation in and on the water.

(4) Inclusion of ongoing costs of operating and maintaining the existing wastewater collection and treatment system, including payments on outstanding debts for wastewater collection and treatment systems when calculating projected rates:

The community reported that their outstanding debt for their current wastewater collection and treatment systems is $645,963,458. The community reported that each user pays $105.37 monthly.

As shown in Criterion 2, the user rate plus the amount for the additional sampling requirements is $106.47.

The community did not provide the department with this information, nor could it be found through readily available data.

(5) An inclusion of ways to reduce economic impacts on distressed populations in the community, including but not limited to low and fixed income populations. This requirement includes but is not limited to:

(a) Allowing adequate time in implementation schedules to mitigate potential adverse impacts on distressed populations resulting from the costs of the improvements and taking into consideration local community economic considerations.
(b) Allowing for reasonable accommodations for regulated entities when inflexible standards and fines would impose a disproportionate financial hardship in light of the environmental benefits to be gained.

The following table characterizes the current overall socioeconomic condition of the community as compared to the overall socioeconomic condition of Missouri. The following information was compiled using the latest U.S. Census data.

Criterion 5 Table. Socioeconomic Data [1, 5-9] for the City of Kansas City

No.	Administrative Unit	Kansas City	Missouri State
1	Population (2023)	508,233	6,168,181
2	Percent Change in Population (2000-2023)	15.1%	10.2%
3	2023 Median Household Income (in 2024 Dollars)	$69,438	$70,567
4	Percent Change in Median Household Income (2000-2023)	-0.9%	-1.2%
5	Median Age (2023)	35.7	38.9
6	Change in Median Age in Years (2000-2023)	1.7	2.8
7	Unemployment Rate (2023)	4.7%	4.1%
8	Percent of Population Below Poverty Level (2023)	14.6%	12.6%
9	Percent of Household Received Food Stamps (2023)	10.5%	9.9%
10	(Primary) County Where the Community Is Located	Jackson County	

(6) An assessment of other community investments and operating costs relating to environmental improvements and public health protection;

The community did not report any other investments relating to environmental improvements.

(7) An assessment of factors set forth in the United States Environmental Protection Agency's guidance, including but not limited to the "Combined Sewer Overflow Guidance for Financial Capability Assessment and Schedule Development" that may ease the cost burdens of implementing wet weather control plans, including but not limited to small system considerations, the attainability of water quality standards, and the development of wet weather standards;

The new requirements associated with this permit will not impose a financial burden on the community, nor will they require the City of Kansas City to seek funding from an outside source.

(8) An assessment of any other relevant local community economic conditions.

The department contracted with Wichita State University to complete an assessment tool that would allow for predictions on rural Missouri community populations and future sustainability. The purpose of the study is to use a statistical modeling analysis in order to determine factors associated with each rural Missouri community that would predict the future population changes that could occur in each community. A stepwise regression model was applied to 19 factors which were determined as predictors of rural population change in Missouri. The model established a hierarchy of the predicting factors which allowed the model to place a weighted value on each of the factors. A total of 745 rural towns and villages in Missouri received a weighted value for each of the predicting factors. The weighted values for each town / village were then added together to determine an overall decision score. The overall decision scores were then divided into five categories and each town was assigned to a different categorical group based on the overall decision score. The categorical groups were developed from the range of overall scores across all rural towns and villages within Missouri.

The City of Kansas City was not included in this assessment.

Conclusion and Finding
As a result of new regulations, the department is proposing modifications to the current operating permit that may require the permittee to increase monitoring. The department has considered the eight (8) criteria presented in subsection 644.145 RSMo to evaluate the cost associated with the new permit requirements.

This analysis examined whether the new sampling requirements affect the ability of an individual customer or household to pay a utility bill without undue hardship or unreasonable sacrifice in the essential lifestyle or spending patterns of the individual or household. After reviewing the above criteria, the department finds that the new sampling requirements may result in a low burden with regard to the community's overall financial capability and a low financial impact for most individual customers/households; therefore, the new permit requirements are affordable.

References

1. (A) 2023 MHI in 2023 Dollar: United States Census Bureau. 2019-2023 American Community Survey 5-Year Estimates, Table B19013: Median Household Income in the Past 12 Months (in 2023 Inflation-Adjusted Dollars).
https://data.census.gov/cedsci/table?q=B19013&tid=ACSDT5Y2023.B19013.
(B) 2000 MHI in 1999 Dollar: (1)For United States, United States Census Bureau (2003) 2000 Census of Population and Housing, Summary Social, Economic, and Housing Characteristics, PHC-2-1 Part 1. United States Summary, Table 5. Work Status and Income in 1999: 2000, Washington, DC.
https://www.census.gov/content/dam/Census/library/publications/2003/dec/phc-2-1-pt1.pdf.
(2) For Missouri State, United States Census Bureau (2003) 2000 Census of Population and Housing, Summary Social, Economic, and Housing Characteristics, PHC-2-27, Missouri, Table 10. Work Status and Income in 1999: 2000, Washington, DC.
https://www.census.gov/content/dam/Census/library/publications/2003/dec/phc-2-1-pt1.pdf.
(C) 2024 CPI and 1999 CPI: U.S. Department of Labor Bureau of Labor Statistics (2024) Consumer Price Index - All Urban Consumers, U.S. City Average. All Items. 1982-84=100 (unadjusted) - CUUR0000SAO. https://data.bls.gov/cgi-bin/surveymost?bls.
(D) 2023 MHI in 2024 Dollar = 2023 MHI in 2023 Dollar x 2024 CPI /2024 CPI; 2000 MHI in 2024 Dollar = 2000 MHI in 1999 Dollar x 2024 CPI /1999 CPI.
(E) Percent Change in Median Household Income (2000-2023) = (2023 MHI in 2024 Dollar - 2000 MHI in 2024 Dollar) / (2000 MHI in 2024 Dollar).
2. ($48,116/3,645)/12 = $1.10 (Estimated Monthly User Cost for New Requirements)
3. ($1.10/($69,438/12))100% = 0.019% (New Sampling Only)
4. ($106.47/($69,438/12))100% = 1.84% (Total User Cost)
5. (A) Total Population in 2023: United States Census Bureau. 2019-2023 American Community Survey 5-Year Estimates, Table B01003: Total Population - Universe: Total Population. https://data.census.gov/cedsci/table?q=B01003&tid=ACSDT5Y2023.B01003.
(B) For United States, United States Census Bureau (2002) 2000 Census of Population and Housing, Summary Social, Economic, and Housing Characteristics, PHC-1-1 Part 1. United States Summary, Table 1. Age and Sex: 2000, Washington, DC.
https://www.census.gov/content/dam/Census/library/publications/2003/dec/phc-2-1-pt1.pdf.
(2) For Missouri State, United States Census Bureau (2002) 2000 Census of Population and Housing, Summary Population and Housing Characteristics, PHC-1-27, Missouri, Table 2. Age and Sex: 2000, Washington, DC. https://www2.census.gov/library/publications/2003/dec/phc-2-1-pt2.pdf.
(C) Percent Change in Population (2000-2023) = (Total Population in 2023 - Total Population in 2000) / (Total Population in 2000).
6. Median Age in 2023: United States Census Bureau. 2019-2023 American Community Survey 5-Year Estimates, Table B01002: Median Age by Sex - Universe: Total population. https://data.census.gov/cedsci/table?q=B01002&tid=ACSDT5Y2023.B01002.
(B) For United States, United States Census Bureau (2002) 2000 Census of Population and Housing, Summary Social, Economic, and Housing Characteristics, PHC-1-1 Part 1. United States Summary, Table 1. Age and Sex: 2000, Washington, DC., Page 2.
https://www.census.gov/content/dam/Census/library/publications/2003/dec/phc-2-1-pt1.pdf.
(2) For Missouri State, United States Census Bureau (2002) 2000 Census of Population and Housing, Summary Population and Housing Characteristics, PHC-1-27, Missouri, Table 2. Age and Sex: 2000, Washington, DC., Pages 64-92. https://www2.census.gov/library/publications/2003/dec/phc-2-1-pt2.pdf.
(C) Change in Median Age in Years (2000-2023) = (Median Age in 2023 - Median Age in 2000).
7. United States Census Bureau. 2019-2023 American Community Survey 5-Year Estimates, S2301: Employment Status for the Population 16 Years and Over - Universe: Population 16 years and Over. https://data.census.gov/cedsci/table?q=unemployment&tid=ACSST5Y2023.S2301.
8. United States Census Bureau. 2019-2023 American Community Survey 5-Year Estimates, Table S1701: Poverty Status in the Past 12 Months. https://data.census.gov/cedsci/table?q=S1701&tid=ACSST5Y2023.S1701.
9. United States Census Bureau. 2019-2023 American Community Survey 5-Year Estimates, Table S2201: Food Stamps/Supplemental Nutrition Assistance Program (SNAP) - Universe: Households. https://data.census.gov/cedsci/table?q=S2201&tid=ACSST5Y2023.S2201.

APPENDIX 4 – SUMMARY OF DESIGN

BURNS McDONNELL

Summary of Design: Todd Creek WWTP

KCWATER SERVICES

Water Services Department / City of Kansas City, Missouri

BMCD Project No. 125460
City Project / Contract No. 81000927 / 1587

Issued to MDNR
Revision 1.2
5/19/2026

Summary of Design: Todd Creek WWTP

prepared for

Water Services Department / City of Kansas City, Missouri

Project No. 125460

Issued to MDNR
Revision 1.1
5/19/2026

prepared by

Burns & McDonnell Engineering Company, Inc.
Kansas City, Missouri

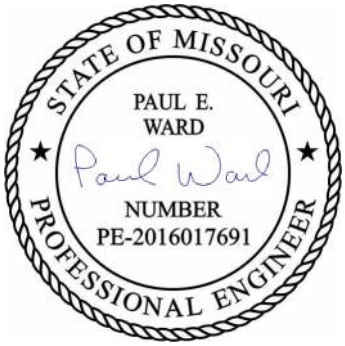
INDEX AND CERTIFICATION

Water Services Department / City of Kansas City, Missouri Summary of Design: Todd Creek WWTP Project No. 125460

Report Index

Certification

I hereby certify, as a Professional Engineer in the state of Missouri, that the information in this document was assembled under my direct personal charge. This report is not intended or represented to be suitable for reuse by the Water Services Department /City of Kansas City, Missouri or others without specific verification or adaptation by the Engineer.



Paul E. Ward, P.E. MO#2016017691

Date: 5/19/2026

TABLE OF CONTENTS

Page No.

LIST OF TABLES

Page No.

LIST OF FIGURES

Page No.

No table of figures entries found.

LIST OF ABBREVIATIONS

Abbreviation	Term/Phrase/Name
AGS	Aerobic Granular Sludge
AML	Average Monthly Limit
AWL	Average Weekly Limit
BOD	Biochemical Oxygen Demand
Burns & McDonnell	Burns & McDonnell Engineering Company, Inc.
COD	Chemical Oxygen Demand
DO	Dissolved Oxygen
FEMA	Federal Emergency Management Agency
FRP	Fiber Reinforced Plastic
IPS	Influent Pump Station
KCI	Kansas City International Airport
MGD	Million Gallons per Day
MLSS	Mixed Liquor Suspended Solids
NH_3-N	Ammonia-Nitrogen
NPDES	National Pollutant Discharge Elimination System
PFD	Process Flow Diagram
PLC	Programmable Logic Controller
RDT	Rotary Drum Thickener
SIU	Significant Industrial Users
SRT	Solids Retention Time
TKN	Total Kjeldahl Nitrogen

Abbreviation	Term/Phrase/Name
TN	Total Nitrogen
TP	Total Phosphorus
TS	Total Solids
TSS	Total Suspended Solids
UV	Ultraviolet
VFD	Variable Frequency Drive
WLC	Water Level Correction
WWTP	Wastewater Treatment Plant

1.0 INTRODUCTION

The Todd Creek Wastewater Treatment Plant (TCWWTP) is in the northern sewershed of Kansas City located in the corridor between interstate I-435 and Highway 92 at 7600 NW 144th St. The TCWWTP is owned and operated by the City of Kansas City Missouri (KC Water) and was built in 1968 and originally consisted of two contact stabilization activated sludge basins and chlorine disinfection. It was upgraded in 1990 with a third, larger aeration basin, and the two smaller contact stabilization basins were continued to be utilized. In 2013, an ultraviolent (UV) disinfection facility was constructed to replace the original chlorine disinfection facility. The TCWWTP is designed to reduce biochemical oxygen demand (BOD), total suspended solids (TSS), ammonia, and E. coli prior to discharge into Todd Creek. The liquid treatment process consists of mechanical bar screens, raw water pumping, aerated activated sludge, final clarification, and UV disinfection. Solids wasted from the three biological treatment basins flow by gravity to a common sludge wet well. Sludge is pumped across Todd Creek to three sludge detention lagoons. Sludge is periodically dredged and hauled offsite by a third party for disposal.

The TCWWTP currently operates under an expired NPDES permit as of 2016. Based on the NPDES permit, the plant is rated for a design flow of 3.4 MGD. It receives domestic, commercial, and industrial flows including seasonal discharges (October-March) of spent aircraft-deicing fluid (SADF) from the Kansas City International Airport (KCI). Current deicing management operations at the KCI is to either haul the collected runoff to Blue River Wastewater Treatment Plant, discharge to the Berlin Reservoir if the chemical oxygen demand (COD) is less than 50 mg/L, or discharge to the sanitary sewer that flows to the TCWWTP.

1.1 Purpose

Due to the condition of the exiting WWTP, anticipated growth in the watershed, and anticipated implementation of limits for ammonia and phosphorus, and the change in the FEMA floodplain in the immediate area of the existing WWTP, a new Todd Creek WWTP will be built immediately NNW of the existing site. The purpose of this report is to summarize the design of this new wastewater treatment process train. The hydraulic and organic loadings are listed followed by descriptions of each individual process unit. Following this, are process flow diagrams of the liquid and solid processes, respectively, and supporting design calculations.

2.0 HYDRAULIC AND ORGANIC LOADINGS

- This plant discharges directly into Todd Creek, so there are no downstream capacity concerns.
- There are five (5) non-categorical significant industrial users (SIUs) that discharge to this treatment facility. All users are subject to an approved pretreatment program.

Table 2-1: Hydraulic and Organic Loading Summary

Parameter	Current	2025	2035	2042
Service Population	9,091	11,530	18,560	25,920
Flow, MGD				
- Average Day	1.79	2.66	3.63	4.59
- Maximum Month	3.27	4.43	6.20	7.96
- Maximum Day	4.51	5.91	8.33	10.77
- Peak	5.16	6.69	9.47	12.26
- Minimum	1.33	1.59	2.30	3.01
TSS, lbs/d				
- Average Day	3,400	4,000	5,800	7,600
- Maximum Month	6,900	8,200	11,800	15,400
- Maximum Day	10,400	12,400	17,900	23,500
- Minimum	1,300	1,600	2,300	3,000
BOD, lbs/d				
- Average Day	2,700	4,300	5,700	7,200
- Maximum Month	5,400	7,500	10,400	13,300
- Maximum Day	7,000	9,400	13,100	16,800
- Minimum	1,300	1,600	2,200	2,900
TKN, lbs/d				
- Average Day	720	860	1,230	1,600
- Maximum Month	1,000	1,190	1,710	2,230
- Maximum Day	1,420	1,700	2,440	3,180
- Minimum	450	530	770	1,000
TP, lbs/d				
- Average Day	120	150	210	270
- Maximum Month	170	200	290	380
- Maximum Day	240	290	410	540
- Minimum	80	90	130	170

3.0 INDIVIDUAL UNIT PROCESSES

3.1 Influent Bar Screening

- A new coarse screening structure includes three (3) screening channels. Two channels contain a 0.25-inch mechanical bar screen, and the third channel is provided as a bypass.
- A chemical feed pad will be included for the dosing of 50% hydrogen peroxide upstream of the screening structure as needed to control odors. The pad is sized to hold a 6,650 gallon double-walled hydrogen peroxide storage tank, a chemical feed metering pump, and pump enclosure.

Table 3-1: Perforated Plate Screening Design Summary

Parameter	Value
No. of Mechanical Bar Screens	2 (1 Duty / 1 Standby)
Opening Size, in	0.25
Capacity ea, MGD	15
Channel Width, ft	3
Channel Depth, ft	42.33
Channel Length, ft	40

3.2 Influent Pump Station (IPS)

- The wet well is divided into two compartments, and the IPS contains five (5) submersible pumps installed with guiderails for removal. A sixth pump can be added in the future.
    - The wet wells will be covered with a reinforced concrete slab with hatches to provide maintenance access for pump removal and replacement.
    - Duty condition: Two (2) high flow pumps and two (2) low flow pumps
    - The wet well has been sized to handle larger replacement pumps in the future.
- Flow is monitored at the Headworks Building.

Table 3-2: Influent Pumping Design Summary

Parameter	Value
Number of Pumps	3 High Flow 2 Low Flow
Pump Capacity at Max Flow	4.54 MGD @ 101.6 ft (High Flow) 1.70 MGD @ 99.6 ft (Low Flow)
Firm Capacity	12.3 MGD (2x High Flow, 2x Low Flow)
Horsepower	150 HP (High Flow) 50 HP (Low Flow)
Type of Pump	Wet-Pit Submersible, Solids Handling

Table 3-3: IPS Wet Well Design Summary

Parameter	Value
Max Water Depth, ft	10.34
Min Water Depth, ft	5.33
Number of Wet Wells	2
Dimensions (each)	16’ W x 16.5’ L x 52.3’ H
Detention Time, min (approximate)	8 @ Avg Flow 3 @ Peak Flow

3.3 Perforated Plate Screening

- Wastewater is pumped from the IPS to the second floor of the Headworks building where it enters a common influent channel before two (2) screening channels, each containing one (1) 6-mm mechanical perforated plate screen. The screens discharge to a common effluent channel.
    - Slide gates included at the influent and effluent of each channel to allow complete isolation of screens for maintenance.
    - Bypass piping is provided to bypass the entire screening system if necessary.
- Channel lengths were designed to allow the screen to pivot out of the channel for maintenance.
- Channels are designed to be 6’ wide to accommodate installation of larger screens in the future but will be filled to a 4’ width initially to fit the current screen units.
- Each perforated plate screen will have one (1) washer/compactor and screenings will be discharged into a dumpster.
- A hot water line is connected to each washer/compactor to help grease build-ups and prevent clogging as needed.
- The screening units are sized to accommodate approximately 0.9 MGD of additional plant sewer recycle.

Table 3-4: Perforated Plate Screening Design Summary

Parameter	Value
No. of Mechanical Perforated Plate Screens	2 (1 Duty / 1 Standby)
Opening Size, mm	6
Capacity ea, MGD	13.2
Channel Width, ft	4
Channel Depth, ft	6
Channel Length, ft	27
No. of Washer/Compactors	2

3.4 Grit Removal

- The grit removal system includes one stacked tray grit removal unit, one Grit Pump, and one grit washing/dewatering system.
- Interior space is provided on the first floor for future addition of an additional grit pump and grit washing/dewatering system. A second grit removal compartment is provided to allow addition of a second stacked tray grit removal assembly in the future.
- Screened effluent gravity flows into a stacked tray grit removal unit adjacent to the headworks building.
    - The structure and hydraulics are designed for the ability to add 2 more trays in the future to increase capacity to approximately 16.0 MGD per grit removal structure.
- The degritted wastewater passes over a weir to an effluent channel, flows to a splitter box, and is sent to the AGS basins. The design includes only one active AGS train, with the ability to add up to 3 additional AGS trains in the future.
- The grit that settles in the concentrator is pumped into a grit washer/classifier located on the first floor of the headworks building, then into the Grit Dewatering Unit that discharges into a dumpster.
    - Grit in the dumpster will contain at least 60% (wt.) total solids and less than 20% volatile solids.

Table 3-5: Grit Removal System Design Summary

Parameter	Value
No. of Stacked Tray Units	1
No. of Trays	7
Stacked Tray Diameter, ft	12
Design Peak Flow Capacity, MGD	13.2
Design Removal, % of particles ≥ 75 µm	95
No. of Grit Dewatering Units	1
Design Removal, % of particles ≥ 75 µm	95
No. of Grit Pumps	1
Maximum Design Capacity, gpm	250
Drive Type	Variable Frequency

3.5 AGS Secondary Treatment System

- The biological treatment system is an Aerobic Granular Sludge (AGS) process that includes four (4) AGS basins. The basins operate in parallel and are fed sequentially, similarly to sequencing

batch reactors. However, treated effluent is discharged concurrently with influent feeding while each basin is in service.

- The concept design provided from Aqua-Aerobics assumed a design equivalent MLSS of 8,000 mg/L and a solids retention time (SRT) of 19 days. AGS systems commonly use a relatively high equivalent MLSS under design conditions. The enhanced settleability of the sludge allows operation at higher biomass concentrations.
- A common header brings wastewater to the AGS system where each basin has a dedicated influent line that branches off the main header,
    - Each dedicated influent line includes two (2) motor-actuated influent valves (duty / standby) and a check valve to prevent backflow / flow between reactors.
    - The header includes tie-in points for recycle streams generated by the AGS process.
- Basins include an influent distribution grid, fine bubble diffuser grid, effluent troughs, process instrumentation, and various piping connections
- Five (5) positive displacement blowers serve the AGS system through a common discharge header, with control valves and air flow meters provided for each basin.
    - Air flow is automatically adjusted by a programmable logic controller (PLC) using ammonia-nitrogen (NH_3-N), dissolved oxygen (DO), or other monitored parameters.
- During the fill/draw cycle, raw wastewater fills the basin from the bottom while treated effluent is discharged into full-span effluent finger weir troughs located across the top of the AGS basin.
    - The effluent pipes from all basins tie together in the yard and flow to UV disinfection.
- The waste solids stream generated during the settle phase of the treatment cycle is drawn from an intermediate point in the tank after the sludge granules have settled below that depth.
- Water Level Correction (WLC) volume is removed from the tank after the fill/discharge cycle to keep the water surface 12 inches below the weir discharge level to prevent solids carryover during the aeration phase.
- Waste solids and WLC volume are discharged through a single connection to the basin, with dedicated motor actuated valves for each service located on the line after leaving the basin.
    - The programming for the entire process is set up to only have one basin discharging waste solids, and one basin discharging WLC volume at any point in time
- The waste solids and WLC volumes are discharged into the Solids Buffer Tanks and WLC Tank, respectively.
- Two (2) Sludge Buffer Tanks are used to store and thicken the waste sludge. Each tank contains a full-floor grid to withdraw sludge evenly across the tank bottom.
    - After thickening, sludge is transferred to solids processing via Sludge Pumps.

  - An inline solids analyzer is used to determine when the sludge layer is completely discharged, and the remaining volume is subsequently pumped back to the AGS Influent Header via Supernatant Pumps.
- One WLC Tank is provided that receives WLC volume from all reactors. The WLC Transfer Pumps return the combined WLC volume to the AGS Influent Header.
- The site footprint and building layouts have been designed to allow the addition of chemical feed and storage systems as needed in the future, including aluminum sulfate and/or supplemental BOD.

Table 3-6: Biological Treatment Basin Design Summary

Parameter	Value
No. of AGS Basins	4
Length, ft	75
Width, ft	80
Normal Operating Level, ft	21
Volume, gal (each)	942,500
No. of WLC Tanks	1
Length, ft	20
Width, ft	20
Max. Water Depth, ft	15
Max. Volume, gal	44,800
No. of Sludge Buffer Tanks	2
Length, ft	28
Width, ft	20
Max. Level, ft	15
Max. Basin Volume, gal	62,800

Table 3-7: Biological Treatment System Design Summary

Parameter	Value
No. of Aeration Blowers	5 (4 Duty / 1 Standby)
Capacity ea, hp	200
Design Capacity ea, scfm	2,430
No. of WLC Transfer Pumps	2 (1 Duty / 1 Standby)
Design Capacity ea, gpm	440
No. of Sludge Wasting Pumps	3 (2 Duty / 1 Standby)
Design Capacity ea, gpm	175
No. of Supernatant Pumps	3 (2 Duty / 1 Standby)
Design Capacity ea, gpm	785

3.6 UV Disinfection

- Effluent from the secondary treatment process is discharged to a new UV Disinfection Facility consisting of a UV Building to house electrical gear and concrete channels to accommodate in-channel UV disinfection equipment.
- The UV Building will also have floor space for storing spare UV lamp assemblies and performing limited maintenance activities.
- The concrete channels include a common influent channel, two parallel channels containing the UV equipment, and a common effluent channel.
    - Influent gates in each UV channel allow one channel to be taken out of service.
    - Full bypass piping included.
- The preliminary design allows for future expansion through the addition of a fourth bank in each channel, as well as incorporation of fixed head adjustable to increase flow capacity.
- Autosampler will pull from the UV effluent channel for daily composite samples.

Table 3-8: UV Facility Design Summary

Parameter	Value
No. of Channels	2
No. of UV Banks per Channel	2 (1 Duty / 1 Standby)
Peak Capacity, MGD	12.3
Minimum UV Transmittance, %	65

3.7 Process Water Pump Station

- A slide gate at the effluent of the UV channels allows treated wastewater to enter a wet well containing three (3) process water pumps.
- The process water pumps will discharge to a common header then pass through a strainer and 1,000 gallon expansion tank, located in the UV Building, to provide a buffer for pressure in the distribution system.
    - Pumps will be controlled with VFDs to meet the variable process water demands.

Table 3-9: Process Water Pump Station Design Summary

Parameter	Value
No. of Process Water Pumps	3 (2 duty / 1 standby)
Type	Vertical Turbine
Capacity ea, gpm	195
Drive Type	Variable Frequency
No. of Strainers	1
No. of Expansion Tanks	1
Volume, gal	1,000

3.8 Aeration and Outfall

- Effluent from the UV Channels will be metered via parshall flume.
- Effluent reaerated via a cascade aeration structure downstream of parshall flume.
    - Cascade aeration structure is made up of 27 steps.
    - Each step is 12 feet wide and six (6) inches in height.
- Treated effluent then flows by gravity through a 30-inch discharge pipe to the outfall structure located along Todd Creek.
    - Outfall structure designed to dissipate energy without causing localized erosion.

3.9 Solids Handling

- Waste sludge from the AGS basins is sent to two Thin Sludge tanks
    - Each tank will contain a medium bubble diffuser grid to keep the WAS mixed and to prevent the sludge from going septic.
    - Air will be supplied to each tank by dedicated variable-speed positive displacement blowers with a swing blower between the two holding tanks.
    - Each tank can be isolated for maintenance activities.

Table 3-10: Thin Sludge Tank System Design Summary

Parameter	Value
Influent Total Solids, %	0.8-1.0
WAS Solids Loadings, lb/d	6,600 (Average)
	13,200 (Max Month)
No. of Thin Sludge Tanks	2
Dimensions	30’ x 37.5’ x 20’
Total Volume, gal	337,000
Retention Time, days	3-4 @ Avg Flow
	1.5-2 @ Peak Flow
No. of Sludge Blowers	3 (2 duty / 1 standby)
Capacity ea, scfm	1,200
Blower Type	Positive Displacement Rotary Lobe
Horsepower	100

- Thin Sludge will be transferred to the mechanical thickening process located in the Solids Processing Building by three (3) Thin Sludge rotary lobe style pumps.
    - Each Rotary Drum Thickener (RDT) has a dedicated Thin Sludge Pump with a third pump acting as a swing pump between the two RDTs.
    - Space has been reserved to add a fourth pump in the future.
- The solids thickening process consists of the three (3) Thin Sludge Pumps, two (2) RDTs, and two (2) Thickened Sludge Pumps.
    - Each RDT is rated to handle the max month solid loadings based on an 80 hr/wk dewatering schedule. Giving full redundancy at max month condition.
    - With each RDT having a dedicated Thin Sludge Feed Pump, both RDTs can be operated simultaneously.
    - Each Rotary Drum Thickener has a dedicated Thickened Sludge progressive cavity style pump.
    - Filtrate from the RDT flows by gravity to the plant sewer pump system.
    - Space in the solids building has been reserved for addition of a third RDT.
- Each RDT is served by a dedicated polymer feed skid to feed diluted emulsion polymer upstream of the RDT system to condition the sludge and allow optimal thickening.

Table 3-11: Sludge Thickening and Storage Design Summary

Parameter	Value
Waste Sludge Solids Loading, lbs/d	6,600 (average) 13,100 (max month)
No. of Thin Sludge Pumps	3 (2 Duty / 1 Standby)
Pump Type	Rotary Lobe
Capacity ea, gpm	250
TDH, ft	35
Horsepower, Hp	7.5
Drive Type	Variable Frequency
No. of Rotary Drum Thickeners	2 (1 Duty / 1 Standby)
Average Operating Schedule, hr/wk	40 (approx.)
Max Month Operating Schedule, hr/wk	80 (approx.)
Solids Loading Capacity, lbs/hr	1,200
Anticipated Outlet Consistency, %TS	4-8%
No. of Thickened Solids Pumps	2 (1 Duty / 1 Standby)
Pump Type	Progressive Cavity
Capacity ea, gpm	100
TDH, ft	208
Horsepower, Hp	15
Drive Type	Variable Frequency
No. of Thickened Solids Holding Tanks	2
Total Volume, gallons	269,000
Retention Time, days	17 (average) 8.5 (max month)
No. of Solids Loadout Pumps	2 (1 Duty per Tank)
Pump Type	Progressive Cavity
Capacity ea, gpm	500
TDH,ft	115
Horsepower, Hp	40
Drive Type	Constant

- Thickened sludge is discharged from each RDT into a discharge hopper and transferred to two (2) Thickened Sludge Tanks
    - The Thickened Sludge Tanks will be mixed with a large-bubble mixing system to mitigate sludge bridging, served by two (2) air compressors in a one duty, one standby arrangement.

- Each Thickened Sludge Tank has one (1) duty Sludge Loadout Pump to transfer the sludge from the holdings tanks to tanker trucks for hauling off-site. There are two locations provided for sludge haul-off on the North and South sides of the Solids Handling Building.
- Each tank can be isolated for maintenance activities.

3.10 Odor Control

- The coarse screening structure includes a chemical feed system to allow the dosing of 50 % hydrogen peroxide solution via a peristaltic chemical metering pump.
  - Chemical storage will include bulk storage of 6,650 gallons of hydrogen peroxide in a double-walled storage tank.
- Odor control system at the Coarse Screening Building includes a hydroxyl radical mist odor control system.
  - The odor control system combines water, air, and ozone via nozzles to create the hydroxyl radical mist.
- Odor control system at the Thickened Sludge Storage Tanks includes fiber-reinforced plastic (FRP) flat panel covers to fully enclose the tanks and a hydroxyl radical mist odor control system to treat the foul air.
  - The odor control system combines water, air, and ozone via nozzles to create the hydroxyl radical mist.

3.11 Plant Sewer

- The plant sewer system is designed to collect return streams from various unit processes and other miscellaneous waste flows from floor drains and the Administration Building.
- The plant sewer terminates at the Plant Sewer Pump Station located near the UV Building.
- Based on anticipated operating conditions, these processes may routinely generate up to approximately 750 gpm during sludge thickening and grit dewatering activities.
- The Plant Sewer Pump Station consists of a wet well with associated isolation valves located in the yard adjacent to the wet well. A flow meter is located in the interior of the Headworks Building. The wet well contains two (2) 750 gpm submersible pumps in a duty/standby arrangement. The pump station forcemain discharges into the plant influent line.

4.0 ANTICIPATED EFFLUENT QUALITY

Table 4-1: Anticipated Pollutant Removal Rates

Pollutant of Concern	Units	Average Influent Conc.	Removal by Process			Overall Removal
			Screening & Grit Removal	AGS	UV Disinfection	
BOD_5	mg/l	185	-	170	-	91%
TSS	mg/l	196	-	176	-	90%
E. Coli	#/100 ml	*	-	-	*	126 # / 100 mL
NH_3-N						
Nov-Mar	mg/l	26.1	-	23.7	-	91%
Apr	mg/l	26.1	-	24.2	-	93%
May	mg/l	26.1	-	24.5	-	94%
June	mg/l	26.1	-	25.1	-	96%
July	mg/l	26.1	-	25.3	-	97%
Aug	mg/l	26.1	-	25.1	-	96%
Sept	mg/l	26.1	-	25.0	-	96%
Oct	mg/l	26.1	-	24.3	-	93%

*Influent E. Coli concentrations are not monitored. Required effluent concentrations were given to manufacturers to meet standards.

Table 4-2: Anticipated Average Monthly Effluent Concentrations, mg/L

Parameter	Value
BOD_5	15
TSS	20
NH3-N	2.4 (Nov-Mar) 1.9 (Apr) 1.6 (May) 1.0 (June) 0.8 (July) 1.0 (Aug) 1.1 (Sept) 1.8 (Oct)
TN	8.0
Total P	1.0
Oil and Grease	10

5.0 PROCESS FLOW DIAGRAMS

Process flow diagrams (PFDs) were developed for the liquid and solids processes. The liquid PFD and solids PFD are shown in Appendix B.

6.0 DESIGN CALCULATIONS

6.1 Influent Pump Station Hydraulics

See Appendix C.

6.2 AGS System

The design conditions listed in Table 6-1 were used by Aqua-Nereda to design the AGS system to meet the effluent requirements given in Table 4-2. See Appendix A for a full process design report from Aqua-Nereda.

Table 6-1: Biological Treatment System Design Conditions

Parameter	Value
Max Month Design Flow, MGD	7.96
Peak Design Flow, MGD	12.26
Cycle Duration, hr/cycle	3.7
Hydraulic Retention Time, days	0.45
SRT, days	19
Equivalent MLSS, mg/L	8,000
Food/Mass (F/M) Ratio, lbs BOD / lb MLSS-d	0.055
Sludge Yield, lbs WAS / lb BOD	0.91
Oxygen Demand, lbs O_2 / lb BOD	1.50
Oxygen Demand, lbs O_2 / lb TKN	4.60
Actual Oxygen Required (AOR), lbs/d	31,511
Airflow per Basin, scfm	3,870

6.3 Aeration

CASCADE AERATOR CALCS

	Site Elevation	910	ft			
		277.55	m			
	Plant Flow	4.6	MGD			

$$r = \frac{C_s - C_u}{C_s - C_d} = 1 + 0.38abh(1 - 0.11h)(1 + 0.046T)$$

*from p. 446 Chapter 5-11 in Metcalf & Eddy v. 5, *change 0.38 to 0.11 for US units

	Cs at Elev	7.99	mg/L	*interpolated from Metcalf & Eddy App E		
	Cu	0.5	mg/L			
	Cd	6	mg/L			
	r	3.77				
	a	0.8		*0.8 for WWTP eff		
	b	1.1		*1.1 for steps		
	T	25	C			
				Typical Values		
	h	13.30	ft	Cascade height	6-16	ft
		14.00	ft			
	Step height	6	in	Step height	6-12	in
		0.5	ft			
	Step length	12	in	Step length	12-24	in
		1	ft			
	# steps	27				
	Cascade length	27	ft			
	Step width	12	ft			
				HLR at avg design flow		
CHECK:	HLR	383,333	gpd/ft	100,000-500,000	gpd/ft	
		OK				
	Peak Flow	12.3	MGD			
	Peaking Factor	2.67				
	Future Peak Flow	30	MGD			
	Future Flow	11.2	MGD			
CHECK:	HLR at future flow	934,959	gpd/ft			
		NOT OK				
	Additional aerators needed	1				

6.4 Process Water Pump Hydraulics

See Appendix D.

6.5 Process Water Flow and Pressure

Process Water Needs						
Service	Min Flow (gpm)	Max Flow (gpm)	Min Pressure (psi)	Max Pressure (psi)	Time	Building
Influent screens	31	62	50	75	continuous	Headworks
Grit tray system	20	20	50	50	continuous	Outside of Headworks
Grit classifier	20	30	50	50	intermittent	Headworks
Grit dewatering	5	5	50	50	intermittent	Headworks
Thickened WAS odor control	6	6	30	75	intermittent	Outside of Solids Handling
RDT	40	120	40	40	intermittent	Solids Handling
Polymer	10	30	45	70	intermittent	Solids Handling

PW Min	51	gpm	50	psi	
PW Max		273	gpm	75	psi

6.6 Process Water Connection Sizes

SUMMARY

Equipment	Pipe Size
Influent Screens	2
Headcell	1.25
Grit classifier	1.5
Grit dewatering	1

CALCULATIONS

	Min Flow [gpm]	Max Flow [gpm]	Pipe Size [in.]	Min Velocity [ft/s]	Max Velocity [ft/s]	Pipe Size as Listed in Quotes [in.]
Influent Screens	31	62	2	3.17	6.33	1.5 or 1.25
Headcell	20	20	1.25	5.23	5.23	1
Grit classifier	20	30	1.5	3.63	5.45	1.5
Grit dewatering	5	5	1	2.04	2.04	1

6.7 Solids Handling

See the example calculation used for thin sludge holding detention time below :

$$Max\ Month\ Flow\ (MGD) = \frac{Solids\ Loaings\ \left(\frac{lbs}{day}\right)}{8.34\ (Conversion\ Factor)\ (\ TS\ \% * 10{,}000\frac{mg}{L})}$$

$$= \frac{13{,}200\ lbs/day}{8.34 * (1\% * 10{,}000\frac{mg}{L})} = 0.158\ MGD$$

$$Detention\ Time\ (days) = \frac{Total\ Tank\ Volume\ (gallons)}{Max\ Month\ Flow\ (MGD) * \frac{10^6\ gallons}{MG}}$$

$$= \frac{337{,}000\ gallons}{0.158\ MGD * \frac{10^6\ gallons}{MG}} = 2.1\ Days$$

See the example calculation for rotary drum thickener sizing below:

$$Solids\ Loading\ Rate\ \left(\frac{lbs}{hr}\right)$$
$$= Max\ Month\ Solids\frac{lbs}{day} * 7\ days\ per\ week * \frac{Week}{Dewatering\ Hours}$$

$$= 13{,}200\frac{lbs}{day} * \frac{7\ days}{1\ Week} * \frac{1\ Week}{80\ Hours} = 1{,}155\frac{lbs}{hr}$$

APPENDIX A – AQUA-NEREDA PROCESS DESIGN REPORT

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

Process Design Report

TODD CREEK WWTP MO

Design# 167429
Option: Revised P&S Design

AquaNereda®

Aerobic Granular Sludge Technology

January 20, 2023
Designed By: Tatiana Mazzei

6306 N. Alpine Rd Loves Park, IL 61111 (815) 654-2501 www.aqua-aerobic.com

Upstream Recommendations

- 1/4 inch (6 mm) screening (perforated plate-style preferred) and grit removal (95% removal at 140 mesh) is required (by others) ahead of the AquaNereda system.

- Neutralization is required ahead of the biological system if the pH is expected to fall outside of 6.5-8.5 for significant durations.

- Coarse screening and grit removal is recommended (by others) ahead of the biological system.

- Elevated concentration of hydrogen sulfide can be detrimental to both civil and mechanical structures. If anaerobic conditions exist in the collection system, steps should be taken to eliminate hydrogen sulfide prior to the treatment system.

Flow Considerations

- The maximum flow, as shown on the design, has been assumed as an organic maximum that represents an increased organic load. An oxygen peaking factor has been included to accommodate this additional load while maintaining a residual DO concentration of 2 mg/l for the design of the aeration system only.

Aeration

- The aeration system has been designed to provide 1.5 lbs. O2/lb. BOD5 applied and 4.6 lbs. O2/lb. TKN applied at the design average loading conditions, while maintaining a residual DO concentration of 2 mg/l.

- A common standby blower will be shared among the biological reactors.

- Depending on the actual yard piping from the blowers to the diffuser system and the heat losses associated with the yard piping, additional provisions for cooling of the air (i.e. incorporating heat exchangers) and/or modification of in-basin piping and/or diffuser sleeve material may be required. Aqua-Aerobic Systems, Inc. may need to modify the following equipment offering to ensure compatibility of all in-basin components with actual air temperatures.

Process/Site

- The following parameters have been assumed, as displayed on the design (engineer to verify): Elevation.

- The anticipated effluent nitrogen requirement is predicated upon an influent waste temperature of 10 °C or greater in the winter and 20 °C in the summer. While lower temperatures may be acceptable for a short-term duration, nitrification and (if required) denitrification below 10 °C can be unpredictable, requiring special operator attention.

- Sufficient alkalinity is required for nitrification, as approximately 7.1 mg alkalinity (as CaCO3) is required for every mg of NH3-N nitrified. If the raw water alkalinity cannot support this consumption, while maintaining a residual concentration of 50 mg/l, supplemental alkalinity shall be provided (by others).

- Influent to the biological system is a typical municipal wastewater application. Influent TP shall be either in a particle associated form or in a reactive soluble phosphate form or in a soluble form that can be converted to reactive phosphorus in the biological system. Soluble hydrolyzable and organic phosphates are not removable by chemical precipitation with metal salts. A water quality analysis is required to determine the phosphorus speciation with respect to soluble and insoluble reactive, acid hydrolyzable and total phosphorus at the system Influent, point(s) of chemical addition, and final effluent.

- Chemical feed lines (i.e. metal salts) shall be furnished to each reactor, aerobic digester and dewatering supernatant streams as necessary.

- pH monitoring 6.5-8.5 of the biological reactor is required when adding metal salts.

- The average and maximum design flow and loading conditions, shown within the report, are based on maximum month average and peak sustained flow conditions, respectively.

Equipment

- Changes in basin geometry may require alterations in the equipment recommendation.

- The basins are not included and shall be provided by others.

- The influent enters the basin near the reactor floor. Adequate hydraulic capacity shall be made in the headworks to prevent backflow from one reactor to the other during transition of influent.

- Based on the process requirements and selected equipment, the reactor wall height should be at least 23.5 feet in the biological reactors, at least 17.5 feet in the sludge buffer tanks, and at least 16.5 feet in the water level correction tank.

- Each ancillary basin include a stand by pump.

- Scope of supply includes freight, installation supervision and start-up services.

- Equipment selection is based upon the use of Aqua-Aerobic Systems' standard materials of construction and electrical components, suitable for non-classified electrical environments.

- The basin dimensions reported on the design have been assumed based upon the required volumes and assumed basin geometry. Actual basin geometry may be circular, square or rectangular with construction materials including concrete or steel.

- The control panel does not include motor starters or VFDs, which should be provided in a separate MCC (by others).

- Provisions should be made, by others, for overflows in each of the recommended basins.

WATER LEVEL CORRECTION TANK DESIGN VALUES

No./Basin Geometry:	= 1 Rectangular Basin(s)	
Minimum Level:	= 1.0 ft	= (0.3 m)
Max. Water Depth:	= 14.4 ft	= (4.4 m)
Max. Basin Volume (Total):	= 42,267.5 gallons	= (120 m^3)
Length of Basin:	= 20.0 ft	= (6.1 m)
Width of Basin:	= 20.0 ft	= (6.1 m)

WATER LEVEL CORRECTION VOLUME DETERMINATION

The water correction tank volume has been determined based on the required level drop in the AquaNereda reactors. The water from this tank will be pumped back to the head of the plant.

WATER LEVEL CORRECTION EQUIPMENT CRITERIA

Max. Capacity per Pump:	= 440.3gpm	= 100.0 m3/hr
Number of Duty Pumps:	= 1	
Avg. Power Required:	= 82.9 kW-hr/day	

Project: Option: **TODD CREEK WWTP MO**
Revised P&S Design

Designed by Tatiana Mazzei on Friday, January 20, 2023

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DESIGN INFLUENT CONDITIONS

Avg. Design Flow	= 7.96 MGD	= 30,132 m3/day
Max Design Flow	= 12.26 MGD	= 46,409 m3/day

DESIGN PARAMETERS	Influent	mg/l	Effluent Required	<= mg/l	Effluent Anticipated	<= mg/l
Bio/Chem Oxygen Demand:	BOD5	200	BOD5	10	BOD5	10
Total Suspended Solids:	TSS	232	TSS	20	TSS	20
Total Kjeldahl Nitrogen:	TKN	34	TKN	--	TKN	--
NH3-N	--	--	NH3-N	1.8	NH3-N	1.8
Total Nitrogen:	--	--	TN	8.0	TN	8.0
Phosphorus:	Total P	6	Total P	1.0	Total P	1.0

SITE CONDITIONS	Maximum		Minimum		Elevation (MSL)
Ambient Air Temperatures:	95 F	35.0 C	20 F	-7.0 C	500 ft
Influent Waste Temperatures:	68 F	20.0 C	50 F	10.0 C	152.0 m

AGS BASIN DESIGN VALUES			Water Depth			Basin Vol./Basin	
No./Basin Geometry:	4 Rectangular Basin(s)		**Process Level (PWL):**	21.0 ft	(6.4 m)	0.94 MG	(3,568 m³)
Freeboard (from PWL):	2.5 ft	(0.8 m)	**Discharge Level (DWL):**	22.0 ft	(6.7 m)		
Length of Basin:	80.0 ft	(24.4 m)	**Top of Wall (TOW):**				
Width of Basin:	75.0 ft	(22.9 m)					

PROCESS DETAILS

Cycle Duration:	= 3.7 Hours/Cycle	
Food/Mass (F/M) ratio:	= 0.055 lbs. BOD5/lb. MLSS-Day	
MLSS Concentration:	= 8000 mg/l	
Hydraulic Retention Time:	= 0.45 Days	
Solids Retention Time:	= 19.00 Days	
Est. Net Sludge Yield:	= 0.91 Lbs. WAS/lb. BOD5	
Est. Dry Solids Produced:	= 12018.0 lbs. WAS/Day	= (5451.3 kg/Day)

AERATION DETAILS

Lbs. O2/lb. BOD5	= 1.50	
Lbs. O2/lb. TKN	= 4.60	
Peak O2 Factor:	= 1.04	
Actual Oxygen Required:	= 31511 lbs./Day	= (14293.3 kg/Day)
Air Flowrate/Basin:	= 3869 SCFM	= (109.6 Sm3/min)
Max. Discharge Pressure:	= 10.89 PSIG	= (75 KPA)

POWER CONSUMPTION

Average Aeration Power Consumption: = 3334 kWh/day (at 80% design load)

DESIGN INFLUENT CONDITIONS

Avg. Design Flow = 7.96 MGD = 30,132 m³/day =

Max Design Flow = 12.26 MGD 46,409 m³/day

		Conc. mg/l	Mass lb/day	kg/day
Bio/Chemical Oxygen Demand:	BOD5	200	13,285.9	6,026.4
Total Suspended Solids: Total	TSS	232	15,411.6	6,990.6
Kjeldahl Nitrogen:	TKN	34	2,258.6	1,024.5
Total Phosphorus:	Total P	6	398.6	180.8

SITE CONDITIONS

	Maximum		Minimum	
Ambient Air Temperatures:	95 F	35 C	19.94 F	-6.7 C
Influent Waste Temperatures:	68 F	20 C	50 F	10.0 C
Elevation (Mean Sea Level):	1,000 ft	304.8 m		

EFFLUENT OBJECTIVES

		Conc. mg/l	Mass lb/day	kg/day
Bio/Chemical Oxygen Demand:	BOD5	10	663.9	301.1
Total Suspended Solids:	TSS	20	1,327.7	602.1
Ammonia Nitrogen:	NH3-N	1.8	119.5	54.2
Total Nitrogen:	Total N	8	531.1	240.9
Total Phosphorus:	Total P	1.0	66.4	30.1

BASIN SIZING CALCULATIONS

1. **Mass of Bio-Solids necessary for treatment (lbs MLSS)**

   Based upon an F/M ratio of 0.053 lbs BOD5/lbs MLSS-day, the mass of mixed liquor suspended solids (MLSS) is:

   lb MLSS = (lb BOD5/day) / (F/M) = 250,677.4 lb MLSS = (113,705.3 kg)

2. **Total Reactor Volume at Process Level (Vpro-T)**

   Based upon an MLSS concentration of 8,000 mg/l measured at the process water level, the total React Volume at process level is:

   Vpro-T = lb MLSS/(MLSS mg/l x 8.34 lb/gal) = 3.76 MG-Total = 502,258.6 ft³-Total = (14,272.0 m³-Total)

3. **Reactor Volume for each Basin at Process Level (Vpro/basin)**

   The AquaNereda shall utilize a 4 reactor system. The resultant unit volume for each reactor at the process depth is:

   Vpro/basin = (Vpro-T)/(Number of Reactors) = 0.94 MG/basin = 125,565.1 ft³/basin = (3,568.0 m³/basin)

4. **Process Sidewater Depth (Proc. SWD)**

   The process sidewater depth (Proc. SWD) is based on providing sufficient volume to achieve design MLSS mass at 8,000 mg concentration:

   Proc. SWD = 21.0 ft = (6.4 m)

5. **Selection of reactor geometry and dimensional requirements**

   The AquaNereda can be configured for a variety of reactor geometries, quantities, and materials of construction. Typical construction may employ circular, square, or rectangular tanks in concrete or steel basins. The following has been either assumed by Aqua or designated based upon supplied information:

Number of Basins (Nb): Selected Reactor	= 4	
Geometry:	= Rectangular	
Length of Reactor:	= 80.0 ft	= (24.4 m)
Width of Reactor:	= 75.0 ft	= (22.9 m)
Process Water Depth:	= 21.0 ft	= (6.4 m)
Discharge Depth (nappe over V-notch weir):	= 22.0 ft	= (6.7 m)
Process Reactor Volume/Basin:	= 0.940 MG	= (3,568.0 m³)

SLUDGE CALCULATIONS

1. **Net Sludge Yield (Yn)**

   Based upon the design MLSS concentration, influent loading, and volume requirements stated above, the AquaNereda shall produce a certain quantity of sludge, as is typical of Activated Sludge Processes. The sludge yield factor, Yn is:

   Yn = 0.905 lb Waste Activated Sludge/lb BOD5/Day

   Please note that the calculated sludge yield, Yn, was estimated via a kinetic model which accounts for the influent organic and inorganic TSS as well as the developed Active, Endogenous, Inert-Organic, and Inert-Inorganic fractions of the MLSS.

2. **Net Sludge Production (lb WAS/Day)**

   The net sludge production (dry solids basis) is:

   lb WAS/Day = lb BOD5/Day x Yn = 12,023.7 lb WAS/day = (5,453.9 kg/day)

3. **Sludge Volume (Vs)**

   The volume of sludge produced, assuming a waste sludge concentration of 0.2% is:

   Vs = lb WAS/Day/(Sludge Conc. x 8.34) = 0.721 MGD = (2,728.7 m³/day)

4. **Mean Cell Retention Time (Ts)**
   The mean cell retention time (sludge age, Ts) of the proposed system necessary to attain the specified effluent objectives is:

   Ts = lb MLSS/(lb WAS/Day + lb TSSe/Day) = 18.8 days

BIOREACTOR OXYGEN REQUIREMENT

Oxygen Requirement

1. **Oxygen Utilization Rates for Synthesis, Oxidation & Nitrification**

   Based upon a kinetic evaluation of the influent data with respect to the proposed design considerations, the estimated oxygen uptake rate (OUR) at average conditions is 52.0 mg/l/Hour.
   The process oxygen required is:
   OUR lbs./hour = OUR mg/l/hour x Vol/Basin x 8.34 = 408.6 lbs. O2/Hour/Basin = (185.3 KG/Hour/Basin)

2. **Oxygen Required For Organic Reduction (Rb)**

   The aeration system shall be designed to provide 1.50 lbs. O2 for each lb. BOD5, as influent to the system. This oxygen provision shall account for the oxygen utilization for synthesis, as well as endogenous respiration.
   Rb = lbs. O2/lb. BOD5 x lbs. BOD5 Applied/Day = 19,928.8 lbs. O2/Day = (9,038.0 KG/Day)

3. **Oxygen Required For Nitrification (Rn)**

   Additional oxygen may be necessary for Nitrification of TKN to NO3-N. While an effluent requirement may or may not exist, it may be difficult to prevent Nitrification from exerting an oxygen demand (when nitrogen is present in the influent).
   Nitrification requires 4.6 lbs. O2 to oxidize each lb. of TKN to NO3-N.

   Rn = lbs. O2/lb. TKN x lbs. TKN Applied/Day = 10,389.5 lbs. O2/Day = (4,711.8 KG/Day)

4. **Carbon Stabilized via Denitrification (Rd)**

   When complete mixing occurs in the absence of aeration and the presence of organic substrate (and NO3-N), denitrification of NO3-N to N2 (gas) can occur. Denitrification makes 2.86 lbs. O2 available from each lb. NO3-N that is converted.

   Rd =lbs. NO3-N converted/Day x lbs. O2/lb. NO3-N converted/Day = 0 lbs O2/Day = (0 KG/Day)

5. **Total Oxygen Requirement (ORt)**

   The total oxygen demand under process (field) conditions is with a peaking factor of 1.36 is:
   ORt = (Rb + Rn – Rd) x Peaking Factor = 41,233 lbs. O2/Day (total) = (18,699.8 KG/Day)

6. **Hourly Oxygen Requirement (ORh)**

   Based on 2.06 hours of aeration per cycle, 5.05 Cycles/Day/Basin, and 3 Basin(s), the hourly ORh is:
   ORh = 944 lbs. O2/Hour/Basin = (428.1 KG/Hour/Basin)

7. **Actual Aeration Time Required To Meet Average Demand (At)**

   The aeration system has been designed to meet the design maximum oxygen requirement in 1.82 Hours/Cycle/Basin. Since average conditions will not require as much oxygen, the actual aeration time shall be adjusted to generate a power draw reflective of average conditions. The aeration time required at average conditions is:

   At = OURh/ORh*Aerobic Hours/Cycle = 0.79 Hours/Basin/Cycle

Process Wastewater Conditions - FIXED FINE BUBBLE DIFFUSERS

1. Field Oxygen Transfer Factor (FTF)

While the Oxygen Requirement quantifies the necessary oxygen to satisfy the biochemical reactions, the process water possesses inherent characteristics that typically inhibit oxygen transfer, as it compares to tap (clean) water. The FTF coefficient adjusts the oxygen transfer requirements in Field (dirty) conditions to Standard (clean) water conditions as follows:

FTF = Alpha x Theta^(T-20) x [(Beta x Csm) – Cr]/Cstm = 0.53

Where:

Alpha = Ratio of mass transfer rate of O2 in process water to clean water = 0.7

Beta = Ratio of saturation of O2 in process water to clean water = 0.95

Theta = Temperature correction factor for O2 transfer = 1.024

T = Design Reactor Temperature = 20 C

Cstm = Saturation DO at Mid-Depth and Standard Conditions = 11.8 mg/l

Csm = Cstm corrected for site Elevation and Temperature = 11.5 mg/l

Cr = Residual Dissolved Oxygen concentration = 2 mg/l

AERATION SYSTEM

Standard Conditions

1. Standard Oxygen Requirement (SORh)

The oxygen transferred at Standard conditions necessary to satisfy the required process oxygen demand at Field conditions is: SORh = ORh / FTF = 1,780.2 lbs. O2/Hour/Basin = (807.3 KG/Hour/Basin)

2. Standard Cubic Feet of Air per Minute (SCFM)

The ability to transfer oxygen into the water under standardized conditions is:
SCFM = (SOR lbs./Hour/Basin)/(60 x 0.0175 x SOTE/FT x Dsub) = 4,835 SCFM = (137.0 CMM)

Where:

0.0175 = lbs. O2 per cubic foot of air at standard conditions

SOTE/FT = Standard Oxygen Transfer Efficiency per foot submergence = 1.71%/FT = (5.61%/M)

Dsub= Average Diffuser Submergence = 20.5 FT = (6.3 M)

Blower Inlet Conditions

1. Actual Inlet Pressure (Pa, due to elevation, and inlet filter/silencer/piping losses)

Note: An assumed inlet loss due to blower fittings/piping of 0.25 PSIG has been assumed.
Pa = 14.696 – (Elevation_FT/2116.3) – 0.25 = 14.22 P.S.I.A. = (98.09 KPA)

2. Blower Inlet Air Temperature in Degrees Rankine

Ta = Ambient Air Temp (Deg F) + 460 = 555.0 Degrees R = (308.3 K)

3. Inlet Cubic Feet of Air per Minute (ICFM)

From the perfect gas law, the universal gas constant (MR) can relate standard conditions to inlet conditions, as: ICFM = SCFM x (14.696 x Ta)/(Pa x 528) = 5,250.6 ICFM/Basin = (148.7 CMM/Basin)

Blower Discharge Conditions

1. Discharge Pressure (Pd)

The discharge pressure includes the static pressure above the diffusers and dynamic losses from the blower discharge, through the diffusers expressed by:

Pd = (0.4333 x Diffuser Submergence, ft) + System Losses, PSIG

Where the assumed system losses account for 0.20 PSIG blower discharge losses, 0.50 PSIG piping losses from blower to diffuser and 1.30 PSIG diffuser losses.

Discharge Pressure (Pda) = 10.89 PSIG = (75.1 KPA)

Average Blower Power Estimate

1. Estimated Average Power Draw (BHP)

The following is a general equation that estimates the power draw of the blower at the average oxygen demand, and average pressure. While the actual blower selection shall be made from manufacturer supplied curves, programs or recommendations at maximum conditions, this equation shall be used to estimate the annual average aeration power. Unless stated otherwise, the blower efficiency (e) of 0.70 shall be used (typical range 0.60 to 0.70).

BHP = 0.227 x ICFM x [((Pa + Pda)/Pa)^0.283 – 1]/e = 297.1 BHP** = (221.6 KW)

**Note: Power draw may differ from actual BHP installed as actual blowers are designed based on providing oxygen on an applied basis.

2. Estimated Daily Power Required for Blowers (Pwa)

Pwa = (BHP x 0.7457 x At x Ncdb x Nb) = 4,189.4 KW-Hours/Day at Max Month Loading Conditions Estimated power at annual average loading conditions = 3,478.3 KW-Hours/Day

Designed by Tatiana Mazzei on Friday, January 20, 2023

SLUDGE BUFFER DESIGN VALUES

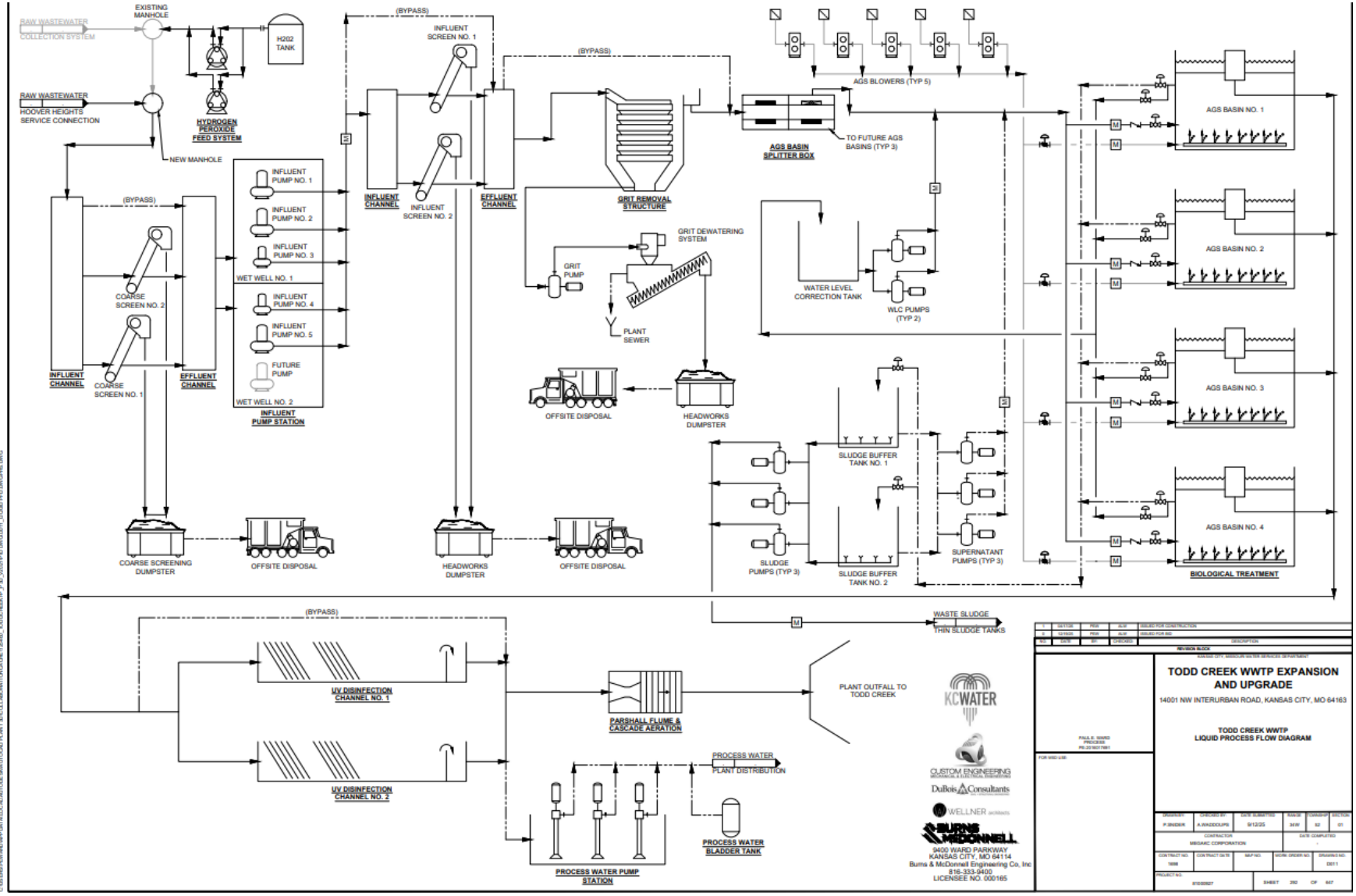
No./Basins Geometry:	= 2 Rectangular Basin(s)	
Minimum Level:	= 1.0 ft	= (0.3 m)
Max. Level:	= 14.8 ft	= (4.5 m)
Max. Basin Volume:	= 57,866 gallons	= (219.0 m³)
Length of Basin:	= 28.0 ft	= (8.5 m)
Width of Basin:	= 20.0 ft	= (6.1 m)

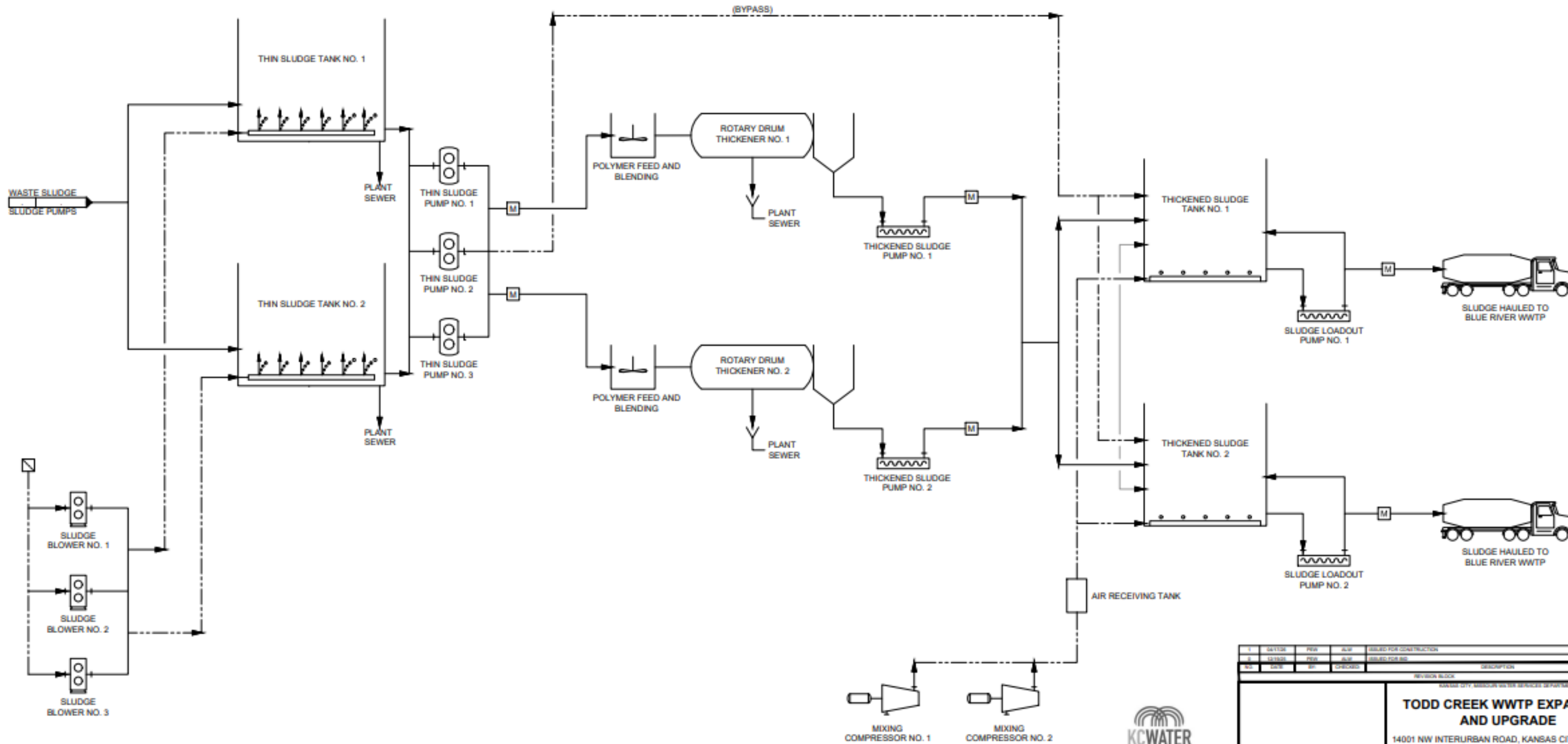
SLUDGE BUFFER VOLUME DETERMINATION

The sludge buffer volume has been determined based on the sludge production and the concentration of sludge from the AquaNereda reactors. The Sludge from this basin will be pumped to the sludge handling system, and the supernatant back to the head of the plant.

SLUDGE BUFFER EQUIPMENT CRITERIA

Max. Sludge Flow Rate Required:	**=** 159 gpm	= (36 m^3/hr)
Max. Supernatant Flow Rate Required:	= 159 gpm	= (178 m^3/hr)
Average Power Consumption:	**=** 92 kWh/day (at 80% design load)	


EXISTING MANHOLE
RAW WASTEWATER COLLECTION SYSTEM
RAW WASTEWATER HOOVER HEIGHTS SERVICE CONNECTION
NEW MANHOLE
H202 TANK
HYDROGEN PEROXIDE FEED SYSTEM
(BYPASS)
INFLUENT SCREEN NO. 1
INFLUENT SCREEN NO. 2
INFLUENT CHANNEL
EFFLUENT CHANNEL
GRIT REMOVAL STRUCTURE
AGS BLOWERS (TYP 5)
AGS BASIN SPLITTER BOX
TO FUTURE AGS BASINS (TYP 3)
AGS BASIN NO. 1
AGS BASIN NO. 2
AGS BASIN NO. 3
AGS BASIN NO. 4
BIOLOGICAL TREATMENT
INFLUENT PUMP NO. 1
INFLUENT PUMP NO. 2
INFLUENT PUMP NO. 3
WET WELL NO. 1
INFLUENT PUMP NO. 4
INFLUENT PUMP NO. 5
FUTURE PUMP
WET WELL NO. 2
INFLUENT PUMP STATION
COARSE SCREEN NO. 2
COARSE SCREEN NO. 1
GRIT PUMP
GRIT DEWATERING SYSTEM
PLANT SEWER
WATER LEVEL CORRECTION TANK
WLC PUMPS (TYP 2)
OFFSITE DISPOSAL
HEADWORKS DUMPSTER
COARSE SCREENING DUMPSTER
SLUDGE BUFFER TANK NO. 1
SLUDGE BUFFER TANK NO. 2
SLUDGE PUMPS (TYP 3)
SUPERNATANT PUMPS (TYP 3)
WASTE SLUDGE THIN SLUDGE TANKS
UV DISINFECTION CHANNEL NO. 1
UV DISINFECTION CHANNEL NO. 2
PARSHALL FLUME & CASCADE AERATION
PLANT OUTFALL TO TODD CREEK
PROCESS WATER PLANT DISTRIBUTION
PROCESS WATER BLADDER TANK
PROCESS WATER PUMP STATION
KCWATER
CUSTOM ENGINEERING
DuBois Consultants
WELLNER
BURNS McDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
Burns & McDonnell Engineering Co, Inc
816-333-9400
LICENSEE NO. 000165
REVISION BLOCK
TODD CREEK WWTP EXPANSION AND UPGRADE
14001 NW INTERURBAN ROAD, KANSAS CITY, MO 64163
TODD CREEK WWTP
LIQUID PROCESS FLOW DIAGRAM



9400 WARD PARKWAY
KANSAS CITY, MO 64114
Burns & McDonnell Engineering Co, Inc
816-333-9400
LICENSEE NO. 000165

TODD CREEK WWTP EXPANSION AND UPGRADE

14001 NW INTERURBAN ROAD, KANSAS CITY, MO 64163

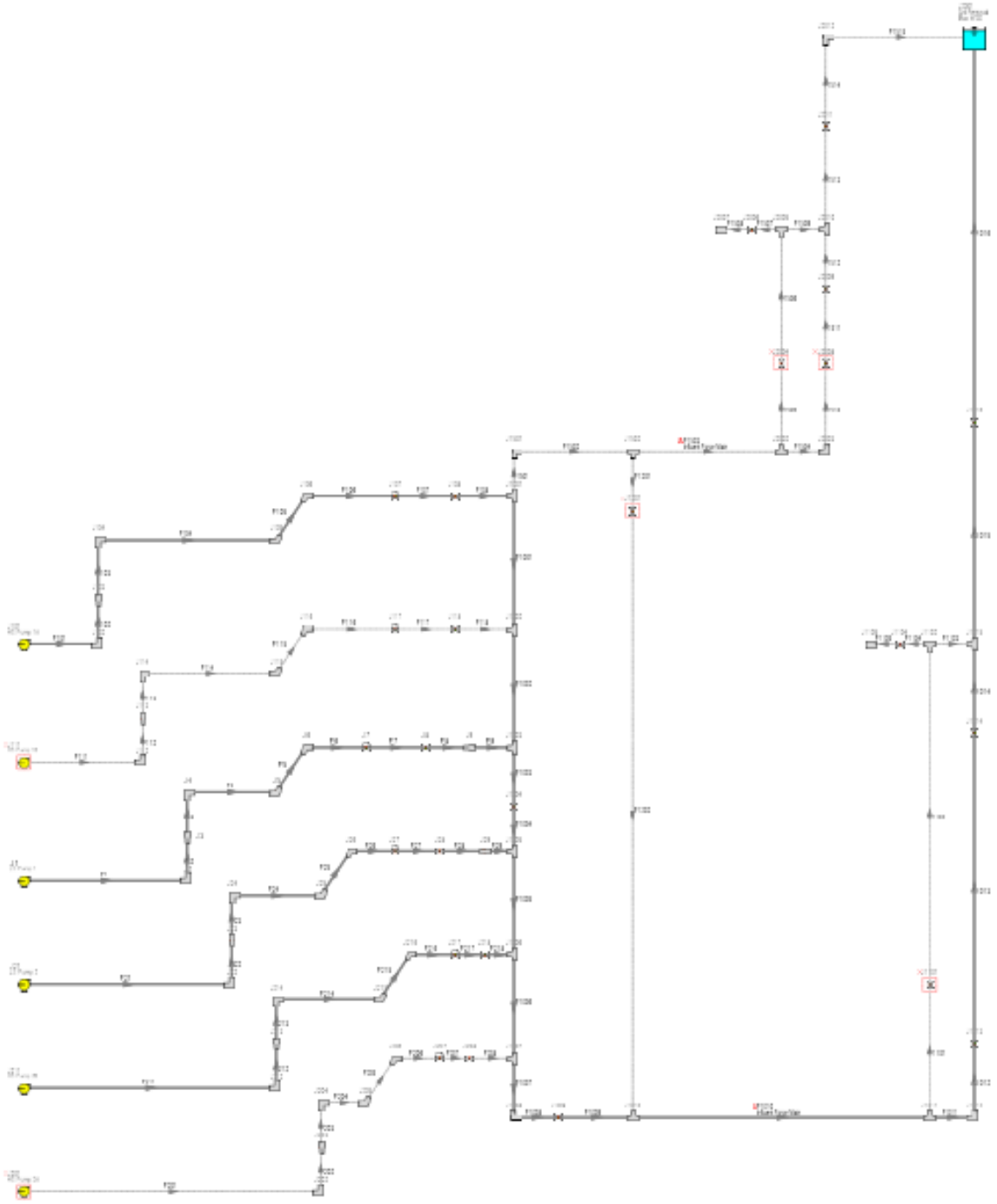
TODD CREEK WWTP SOLIDS PROCESS FLOW DIAGRAM

DRAWN BY	CHECKED BY	DATE SUBMITTED	RANGE	TOWNSHIP	SECTION
C. JENSEN	A. WADDOUPS	9/12/25	34W	52	01

CONTRACTOR: MEGAKC CORPORATION

DRAWING NO.: D012

APPENDIX C – INFLUENT PUMP STATION HYDRAULICS



AFT Fathom 12 (Workspace) 5/19/2026 Page 1 of 1	AFT Fathom Model Todd Creek WWTP Influent Pumping Design	

AFT Fathom Model

Todd Creek WWTP
Influent Pumping Design

Model Reference Information

General

Title: AFT Fathom Model
Analysis run on: 5/19/2026 10:43:54 AM
Application version: AFT Fathom Version 12 (2022.04.12)
Input File: Z:\Clients\WTR\KCMO\125460_ToddCreekFP\Design\Proc\Design Calculations\Fathom Models\Redesign\125460_TC IPS Final Design_FLYGT_New Site_Short FM.fth
Scenario: Base Scenario
Output File: Z:\Clients\WTR\KCMO\125460_ToddCreekFP\Design\Proc\Design Calculations\Fathom Models\Redesign\125460_TC IPS Final Design_FLYGT_New Site_Short FM_F1.out

Execution Time= 1.72 seconds
Total Number Of Head/Pressure Iterations= 1706
Total Number Of Flow Iterations= 178
Total Number Of Temperature Iterations= 0
Number Of Pipes= 88
Number Of Junctions= 85
Matrix Method= Gaussian Elimination

Pressure/Head Tolerance= 0.0001 relative change
Flow Rate Tolerance= 0.0001 relative change
Temperature Tolerance= 0.0001 relative change
Flow Relaxation= (Automatic)
Pressure Relaxation= (Automatic)

Constant Fluid Property Model
Fluid Library: ASME Steam/Water Tables
Fluid: ASME '97 Water
Temperature= 45 deg. F
Pressure= 14.7 psia
Max Fluid Temperature Data= 211.9676 deg. F
Min Fluid Temperature Data= 32.00002 deg. F
Density= 62.42131 lbm/ft3
Viscosity= 3.428892 lbm/hr-ft
Vapor Pressure= 0.1475722 psia
Viscosity Model= Newtonian
Apply laminar and non-Newtonian correction to: Pipe Fittings & Losses, Junction K factors, Junction Special Losses, Junction Polynomials
Corrections applied to the following junctions: Branch, Reservoir, Assigned Flow, Assigned Pressure, Area Change, Bend, Tee or Wye, Spray Discharge, Relief Valve

Ambient Pressure (constant)= 1 atm
Gravitational Acceleration= 1 g
Turbulent Flow Above Reynolds Number= 4000
Laminar Flow Below Reynolds Number= 2300
Total Inflow= 8,749 gal/min
Total Outflow= 8,749 gal/min
Maximum Static Pressure is 61.36 psia at Pipe 103 Inlet
Minimum Static Pressure is 17.30 psia at Pipe 1016 Outlet

Warnings

No Warnings

Design Alerts

No Design Alerts Defined

Pump Summary

Jct	Results Diagram	Name	Vol. Flow (gal/min)	Mass Flow (lbm/sec)	dP (psid)	dH (feet)	Overall Efficiency (Percent)	Speed (Percent)	Overall Power (hp)	Ideal Power (hp)	BEP (gal/min)
1	Show	LS Pump 1	1,178	163.9	43.18	99.62	71.92	100.0	41.26	29.67	1,267
21	Show	LS Pump 2	1,187	165.1	43.02	99.24	72.00	100.0	41.38	29.79	1,267
101	Show	HS Pump 1A	3,152	438.3	44.04	101.59	82.38	100.0	98.26	80.95	3,449
X111	Show	HS Pump 1B	0	0.0	N/A	N/A	N/A	0.0	N/A	N/A	N/A
X201	Show	HS Pump 2A	0	0.0	N/A	N/A	N/A	0.0	N/A	N/A	N/A
211	Show	HS Pump 2B	3,232	449.5	43.49	100.33	82.59	100.0	99.26	81.98	3,449

Jct	% of BEP (Percent)	NPSHA (feet)	NPSHR (feet)
1	92.96	41.23	17.36
21	93.68	41.23	17.42
101	91.38	41.23	12.88
X111	N/A	N/A	N/A
X201	N/A	N/A	N/A
211	93.70	41.23	13.26

Valve Summary

Jct	Name	Valve Type	Vol. Flow (gal/min)	Mass Flow (lbm/sec)	dP Stag. (psid)	dH (feet)	P Static In (psig)	Cv	K	Valve State
8	Valve	REGULAR	1,178	163.9	0.08105	0.1870	31.113	4,140	1.2280	Open
28	Valve	REGULAR	1,187	165.1	0.08231	0.1899	30.931	4,140	1.2280	Open
108	Valve	REGULAR	3,152	438.3	0.32862	0.7581	31.505	5,500	1.2866	Open
118	Valve	REGULAR	0	0.0	N/A	N/A	31.118	N/A	N/A	Open
208	Valve	REGULAR	0	0.0	N/A	N/A	30.574	N/A	N/A	Open
218	Valve	REGULAR	3,232	449.5	0.34553	0.7971	30.881	5,500	1.2866	Open
1004	Valve	REGULAR	4,330	602.2	0.11102	0.2561	30.958	13,000	0.9672	Open
1009	Valve	REGULAR	8,749	1,216.8	0.45326	1.0456	29.973	13,000	0.9672	Open
1013	Valve	REGULAR	8,749	1,216.8	0.45326	1.0456	10.104	13,000	0.9672	Open
1014	Valve	REGULAR	8,749	1,216.8	0.45326	1.0456	5.275	13,000	0.9672	Open
1016	Valve	REGULAR	8,749	1,216.8	0.45326	1.0456	3.933	13,000	0.9672	Open
X1101	Valve	REGULAR	0	0.0	N/A	N/A	8.579	N/A	N/A	Closed By User
1104	Valve	REGULAR	0	0.0	N/A	N/A	5.277	N/A	N/A	Open
X1201	Valve	REGULAR	0	0.0	N/A	N/A	31.427	N/A	N/A	Closed By User
X2004	Valve	REGULAR	0	0.0	N/A	N/A	12.354	N/A	N/A	Closed By User

Jct	Name	Valve Type	Vol. Flow (gal/min)	Mass Flow (lbm/sec)	dP Stag. (psid)	dH (feet)	P Static In (psig)	Cv	K	Valve State
2006	Valve	REGULAR	0	0.0	N/A	N/A	4.335	N/A	N/A	Open
X2008	Valve	REGULAR	0	0.0	N/A	N/A	14.521	N/A	N/A	Closed By User
2009	Valve	REGULAR	0	0.0	N/A	N/A	5.635	N/A	N/A	Open
2011	Valve	REGULAR	0	0.0	N/A	N/A	3.468	N/A	N/A	Open
7	Check Valve	CHECK	1,178	163.9	0.11946	0.2756	31.234	3,410	1.8100	Open
27	Check Valve	CHECK	1,187	165.1	0.12132	0.2799	31.054	3,410	1.8100	Open
107	Check Valve	CHECK	3,152	438.3	0.46172	1.0652	31.972	4,640	1.8078	Open
117	Check Valve	CHECK	0	0.0	N/A	N/A	31.118	N/A	N/A	Open
207	Check Valve	CHECK	0	0.0	N/A	N/A	30.574	N/A	N/A	Open
217	Check Valve	CHECK	3,232	449.5	0.48548	1.1200	31.372	4,640	1.8078	Open

Reservoir Summary

Jct	Name	Type	Liq. Height (feet)	Liq. Elevation (feet)	Surface Pressure (psig)	Liquid Volume (feet3)	Liquid Mass (lbm)	Net Vol. Flow (gal/min)	Net Mass Flow (lbm/sec)
2001	Grit Removal Max WSE	Infinite	N/A	893.0	0	N/A	N/A	8,749	1,217

Pipe Output Table

Pipe	Name	Vol. Flow Rate (MGD)	Velocity (feet/sec)	dP/dx (psi/100 ft)	P Static Max (psig)	P Static Min (psig)	Elevation Inlet (feet)	Elevation Outlet (feet)	dP Static Total (psid)
1	Pipe	1.697	12.440	3.87738	45.465	45.445	801.0	801.0	0.0193869
2	Pipe	1.697	12.440	3.87738	45.135	45.131	801.0	801.0	0.0038774
3	Pipe	1.697	3.130	0.11565	45.651	31.307	801.0	834.0	14.3442039
4	Pipe	1.697	3.130	0.11565	31.290	31.267	834.0	834.0	0.0231297
5	Pipe	1.697	3.130	0.11565	31.256	31.253	834.0	834.0	0.0028912
6	Pipe	1.697	3.130	0.11565	31.243	31.234	834.0	834.0	0.0092519
7	Pipe	1.697	3.130	0.11565	31.115	31.113	834.0	834.0	0.0011565
8	Pipe	1.697	3.130	0.11565	31.032	31.031	834.0	834.0	0.0011565
9	Pipe	1.697	2.302	0.29662	31.060	31.059	834.0	834.0	0.0014831
21	Pipe	1.710	12.536	3.93658	45.283	45.264	801.0	801.0	0.0196829
22	Pipe	1.710	12.536	3.93658	44.948	44.944	801.0	801.0	0.0039366
23	Pipe	1.710	3.154	0.11736	45.473	31.128	801.0	834.0	14.3447847
24	Pipe	1.710	3.154	0.11736	31.110	31.087	834.0	834.0	0.0234717
25	Pipe	1.710	3.154	0.11736	31.077	31.074	834.0	834.0	0.0029340
26	Pipe	1.710	3.154	0.11736	31.063	31.054	834.0	834.0	0.0093887
27	Pipe	1.710	3.154	0.11736	30.932	30.931	834.0	834.0	0.0011736
28	Pipe	1.710	3.154	0.11736	30.849	30.848	834.0	834.0	0.0011736
29	Pipe	1.710	2.320	0.08320	30.878	30.878	834.0	834.0	0.0004160

AFT Fathom Model

Todd Creek WWTP
Influent Pumping Design

Pipe	dP Stag. Total (psid)	dP Gravity (psid)	dH (feet)	P Static In (psig)	P Static Out (psig)	P Stag. In (psig)	P Stag. Out (psig)	HGL Inlet (feet)
1	0.0193869	0.0000	0.0447238	45.465	45.445	46.507	46.488	905.9
2	0.0038774	0.0000	0.0089448	45.135	45.131	46.177	46.174	905.1
3	14.3442039	14.3049	0.0907087	45.651	31.307	45.717	31.373	906.3
4	0.0231297	0.0000	0.0533581	31.290	31.267	31.356	31.333	906.2
5	0.0028912	0.0000	0.0066698	31.256	31.253	31.322	31.319	906.1
6	0.0092519	0.0000	0.0213432	31.243	31.234	31.309	31.300	906.1
7	0.0011565	0.0000	0.0026679	31.115	31.113	31.181	31.179	905.8
8	0.0011565	0.0000	0.0026679	31.032	31.031	31.098	31.097	905.6
9	0.0014831	0.0000	0.0034214	31.060	31.059	31.096	31.095	905.7
21	0.0196829	0.0000	0.0454065	45.283	45.264	46.342	46.322	905.5
22	0.0039366	0.0000	0.0090813	44.948	44.944	46.007	46.003	904.7
23	14.3447847	14.3049	0.0920499	45.473	31.128	45.540	31.195	905.9
24	0.0234717	0.0000	0.0541470	31.110	31.087	31.177	31.154	905.8
25	0.0029340	0.0000	0.0067684	31.077	31.074	31.144	31.141	905.7
26	0.0093887	0.0000	0.0216588	31.063	31.054	31.130	31.121	905.7
27	0.0011736	0.0000	0.0027073	30.932	30.931	31.000	30.998	905.4
28	0.0011736	0.0000	0.0027073	30.849	30.848	30.916	30.915	905.2
29	0.0004160	0.0000	0.0009597	30.878	30.878	30.914	30.914	905.2

Pipe	Name	Vol. Flow Rate (MGD)	Velocity (feet/sec)	dP/dx (psi/100 ft)	P Static Max (psig)	P Static Min (psig)	Elevation Inlet (feet)	Elevation Outlet (feet)	dP Static Total (psid)
101	Pipe	4.538	12.042	1.94754	46.384	46.374	801.0	801.0	0.0097377
102	Pipe	4.538	12.042	1.94754	46.104	46.102	801.0	801.0	0.0019475
103	Pipe	4.538	6.157	0.35064	46.667	32.243	801.0	834.0	14.4240999
104	Pipe	4.538	6.157	0.35064	32.176	32.106	834.0	834.0	0.0701278
105	Pipe	4.538	6.157	0.35064	32.058	32.049	834.0	834.0	0.0087660
106	Pipe	4.538	6.157	0.35064	32.000	31.972	834.0	834.0	0.0280511
107	Pipe	4.538	6.157	0.35064	31.510	31.505	834.0	834.0	0.0052596
108	Pipe	4.538	6.157	0.35064	31.177	31.171	834.0	834.0	0.0052596
111	Pipe	0.000	0.000	0.00000	45.423	45.423	801.0	801.0	0.0000000
112	Pipe	0.000	0.000	0.00000	45.423	45.423	801.0	801.0	0.0000000
113	Pipe	0.000	0.000	0.00000	45.423	31.118	801.0	834.0	14.3048830
114	Pipe	0.000	0.000	0.00000	31.118	31.118	834.0	834.0	0.0000000
115	Pipe	0.000	0.000	0.00000	31.118	31.118	834.0	834.0	0.0000000
116	Pipe	0.000	0.000	0.00000	31.118	31.118	834.0	834.0	0.0000000
117	Pipe	0.000	0.000	0.00000	31.118	31.118	834.0	834.0	0.0000000
118	Pipe	0.000	0.000	0.00000	31.118	31.118	834.0	834.0	0.0000000
201	Pipe	0.000	0.000	0.00000	44.879	44.879	801.0	801.0	0.0000000
202	Pipe	0.000	0.000	0.00000	44.879	44.879	801.0	801.0	0.0000000
203	Pipe	0.000	0.000	0.00000	44.879	30.574	801.0	834.0	14.3048830
204	Pipe	0.000	0.000	0.00000	30.574	30.574	834.0	834.0	0.0000000

Pipe	dP Stag. Total (psid)	dP Gravity (psid)	dH (feet)	P Static In (psig)	P Static Out (psig)	P Stag. In (psig)	P Stag. Out (psig)	HGL Inlet (feet)
101	0.0097377	0.0000	0.0224639	46.384	46.374	47.361	47.351	908.0
102	0.0019475	0.0000	0.0044928	46.104	46.102	47.081	47.079	907.4
103	14.4240999	14.3049	0.2750229	46.667	32.243	46.922	32.498	908.7
104	0.0701278	0.0000	0.1617782	32.176	32.106	32.432	32.361	908.2
105	0.0087660	0.0000	0.0202223	32.058	32.049	32.313	32.304	908.0
106	0.0280511	0.0000	0.0647113	32.000	31.972	32.256	32.228	907.8
107	0.0052596	0.0000	0.0121334	31.510	31.505	31.766	31.761	906.7
108	0.0052596	0.0000	0.0121334	31.177	31.171	31.432	31.427	905.9
111	0.0000000	0.0000	0.0000000	45.423	45.423	45.423	45.423	905.8
112	0.0000000	0.0000	0.0000000	45.423	45.423	45.423	45.423	905.8
113	14.3048830	14.3049	0.0000000	45.423	31.118	45.423	31.118	905.8
114	0.0000000	0.0000	0.0000000	31.118	31.118	31.118	31.118	905.8
115	0.0000000	0.0000	0.0000000	31.118	31.118	31.118	31.118	905.8
116	0.0000000	0.0000	0.0000000	31.118	31.118	31.118	31.118	905.8
117	0.0000000	0.0000	0.0000000	31.118	31.118	31.118	31.118	905.8
118	0.0000000	0.0000	0.0000000	31.118	31.118	31.118	31.118	905.8
201	0.0000000	0.0000	0.0000000	44.879	44.879	44.879	44.879	904.5
202	0.0000000	0.0000	0.0000000	44.879	44.879	44.879	44.879	904.5
203	14.3048830	14.3049	0.0000000	44.879	30.574	44.879	30.574	904.5
204	0.0000000	0.0000	0.0000000	30.574	30.574	30.574	30.574	904.5

Pipe	Name	Vol. Flow Rate (MGD)	Velocity (feet/sec)	dP/dx (psi/100 ft)	P Static Max (psig)	P Static Min (psig)	Elevation Inlet (feet)	Elevation Outlet (feet)	dP Static Total (psid)
205	Pipe	0.000	0.000	0.00000	30.574	30.574	834.0	834.0	0.0000000
206	Pipe	0.000	0.000	0.00000	30.574	30.574	834.0	834.0	0.0000000
207	Pipe	0.000	0.000	0.00000	30.574	30.574	834.0	834.0	0.0000000
208	Pipe	0.000	0.000	0.00000	30.574	30.574	834.0	834.0	0.0000000
211	Pipe	4.654	12.348	2.04565	45.789	45.778	801.0	801.0	0.0102282
212	Pipe	4.654	12.348	2.04565	45.494	45.492	801.0	801.0	0.0020456
213	Pipe	4.654	6.314	0.36806	46.086	31.656	801.0	834.0	14.4300251
214	Pipe	4.654	6.314	0.36806	31.586	31.512	834.0	834.0	0.0736129
215	Pipe	4.654	6.314	0.36806	31.461	31.452	834.0	834.0	0.0092016
216	Pipe	4.654	6.314	0.36806	31.401	31.372	834.0	834.0	0.0294452
217	Pipe	4.654	6.314	0.36806	30.886	30.881	834.0	834.0	0.0055210
218	Pipe	4.654	6.314	0.36680	30.535	30.530	834.0	834.0	0.0055020
1001	Pipe	4.538	3.005	0.05739	31.059	31.057	834.0	834.0	0.0022955
1002	Pipe	4.538	3.005	0.05607	31.057	31.055	834.0	834.0	0.0022427
1003	Pipe	6.235	4.128	0.10515	30.961	30.958	834.0	834.0	0.0031545
1004	Pipe	6.235	4.128	0.10376	30.847	30.844	834.0	834.0	0.0031127
1005	Pipe	7.945	5.260	0.16736	30.616	30.609	834.0	834.0	0.0066943
1006	Pipe	12.599	8.341	0.40904	30.123	30.106	834.0	834.0	0.0163617

Pipe	dP Stag. Total (psid)	dP Gravity (psid)	dH (feet)	P Static In (psig)	P Static Out (psig)	P Stag. In (psig)	P Stag. Out (psig)	HGL Inlet (feet)
205	0.0000000	0.0000	0.0000000	30.574	30.574	30.574	30.574	904.5
206	0.0000000	0.0000	0.0000000	30.574	30.574	30.574	30.574	904.5
207	0.0000000	0.0000	0.0000000	30.574	30.574	30.574	30.574	904.5
208	0.0000000	0.0000	0.0000000	30.574	30.574	30.574	30.574	904.5
211	0.0102282	0.0000	0.0235956	45.789	45.778	46.816	46.805	906.6
212	0.0020456	0.0000	0.0047191	45.494	45.492	46.521	46.519	906.0
213	14.4300251	14.3049	0.2886907	46.086	31.656	46.354	31.924	907.3
214	0.0736129	0.0000	0.1698180	31.586	31.512	31.854	31.781	906.9
215	0.0092016	0.0000	0.0212273	31.461	31.452	31.730	31.721	906.6
216	0.0294452	0.0000	0.0679272	31.401	31.372	31.670	31.640	906.4
217	0.0055210	0.0000	0.0127364	30.886	30.881	31.155	31.149	905.3
218	0.0055020	0.0000	0.0126926	30.535	30.530	30.804	30.798	904.4
1001	0.0022955	0.0000	0.0052954	31.059	31.057	31.120	31.118	905.7
1002	0.0022427	0.0000	0.0051736	31.057	31.055	31.118	31.116	905.6
1003	0.0031545	0.0000	0.0072772	30.961	30.958	31.076	31.073	905.4
1004	0.0031127	0.0000	0.0071807	30.847	30.844	30.962	30.958	905.2
1005	0.0066943	0.0000	0.0154432	30.616	30.609	30.802	30.796	904.6
1006	0.0163617	0.0000	0.0377449	30.123	30.106	30.591	30.575	903.5

Pipe	Name	Vol. Flow Rate (MGD)	Velocity (feet/sec)	dP/dx (psi/100 ft)	P Static Max (psig)	P Static Min (psig)	Elevation Inlet (feet)	Elevation Outlet (feet)	dP Static Total (psid)
1007	Pipe	12.599	8.341	0.40904	30.105	30.093	834.0	834.0	0.0122713
1008	Pipe	12.599	8.341	0.40904	29.981	29.973	834.0	834.0	0.0081808
1009	Pipe	12.599	8.341	0.40904	29.519	29.507	834.0	834.0	0.0122713
1010	Influent Force Main	12.599	8.341	0.58092	29.507	14.612	834.0	863.0	14.8946390
1011	Pipe	12.599	8.341	0.40904	14.612	14.592	863.0	863.0	0.0204521
1012	Pipe	12.599	8.341	0.40904	14.479	10.104	863.0	873.0	4.3757172
1013	Pipe	12.599	8.341	0.40904	9.650	5.275	873.0	883.0	4.3757172
1014	Pipe	12.599	8.341	0.40904	4.822	4.809	883.0	883.0	0.0122713
1015	Pipe	12.599	8.341	0.40904	4.809	3.933	883.0	885.0	0.8751435
1016	Pipe	12.599	8.341	0.40855	3.480	2.601	885.0	887.0	0.8792190
1101	Pipe	0.000	0.000	0.00000	15.081	8.579	863.0	878.0	6.5022197
1102	Pipe	0.000	0.000	0.00000	7.445	5.277	878.0	883.0	2.1674066
1103	Pipe	0.000	0.000	0.00000	5.277	5.277	883.0	883.0	0.0000000
1104	Pipe	0.000	0.000	0.00000	5.277	5.277	883.0	883.0	0.0000000
1105	Pipe	0.000	0.000	0.00000	5.277	5.277	883.0	883.0	0.0000000
1201	Pipe	0.000	0.000	0.00000	31.427	31.427	834.0	834.0	0.0000000
1202	Pipe	0.000	0.000	0.00000	29.976	29.976	834.0	834.0	0.0000000
1501	Pipe	0.000	0.000	0.00000	31.427	31.427	834.0	834.0	0.0000000
1502	Pipe	0.000	0.000	0.00000	31.427	31.427	834.0	834.0	0.0000000
1503	Influent Force Main	0.000	0.000	0.00000	31.427	18.856	834.0	863.0	12.5709581

Pipe	dP Stag. Total (psid)	dP Gravity (psid)	dH (feet)	P Static In (psig)	P Static Out (psig)	P Stag. In (psig)	P Stag. Out (psig)	HGL Inlet (feet)
1007	0.0122713	0.0000	0.0283086	30.105	30.093	30.574	30.562	903.5
1008	0.0081808	0.0000	0.0188724	29.981	29.973	30.449	30.441	903.2
1009	0.0122713	0.0000	0.0283086	29.519	29.507	29.988	29.976	902.1
1010	14.8946390	12.5710	5.3605100	29.507	14.612	29.976	15.081	902.1
1011	0.0204521	0.0000	0.0471811	14.612	14.592	15.081	15.061	896.7
1012	4.3757172	4.3348	0.0943621	14.479	10.104	14.948	10.572	896.4
1013	4.3757172	4.3348	0.0943621	9.650	5.275	10.119	5.743	895.3
1014	0.0122713	0.0000	0.0283086	4.822	4.809	5.290	5.278	894.1
1015	0.8751435	0.8670	0.0188724	4.809	3.933	5.277	4.402	894.1
1016	0.8792190	0.8670	0.0282743	3.480	2.601	3.949	3.070	893.0
1101	6.5022197	6.5022	0.0000000	15.081	8.579	15.081	8.579	897.8
1102	2.1674066	2.1674	0.0000000	7.445	5.277	7.445	5.277	895.2
1103	0.0000000	0.0000	0.0000000	5.277	5.277	5.277	5.277	895.2
1104	0.0000000	0.0000	0.0000000	5.277	5.277	5.277	5.277	895.2
1105	0.0000000	0.0000	0.0000000	5.277	5.277	5.277	5.277	895.2
1201	0.0000000	0.0000	0.0000000	31.427	31.427	31.427	31.427	906.5
1202	0.0000000	0.0000	0.0000000	29.976	29.976	29.976	29.976	903.2
1501	0.0000000	0.0000	0.0000000	31.427	31.427	31.427	31.427	906.5
1502	0.0000000	0.0000	0.0000000	31.427	31.427	31.427	31.427	906.5
1503	12.5709581	12.5710	0.0000000	31.427	18.856	31.427	18.856	906.5

Pipe	Name	Vol. Flow Rate (MGD)	Velocity (feet/sec)	dP/dx (psi/100 ft)	P Static Max (psig)	P Static Min (psig)	Elevation Inlet (feet)	Elevation Outlet (feet)	dP Static Total (psid)
1504	Pipe	0.000	0.000	0.00000	18.856	18.856	863.0	863.0	0.0000000
1505	Pipe	0.000	0.000	0.00000	18.856	12.354	863.0	878.0	6.5022197
1506	Pipe	0.000	0.000	0.00000	6.502	4.335	878.0	883.0	2.1674066
1507	Pipe	0.000	0.000	0.00000	4.335	4.335	883.0	883.0	0.0000000
1508	Pipe	0.000	0.000	0.00000	4.335	4.335	883.0	883.0	0.0000000
1509	Pipe	0.000	0.000	0.00000	4.335	4.335	883.0	883.0	0.0000000
1510	Pipe	0.000	0.000	0.00000	18.856	14.521	863.0	873.0	4.3348131
1511	Pipe	0.000	0.000	0.00000	8.670	5.635	873.0	880.0	3.0343692
1512	Pipe	0.000	0.000	0.00000	5.635	4.335	880.0	883.0	1.3004439
1513	Pipe	0.000	0.000	0.00000	4.335	3.468	883.0	885.0	0.8669626
1514	Pipe	0.000	0.000	0.00000	3.468	3.468	885.0	885.0	0.0000000
1515	Pipe	0.000	0.000	0.00000	3.468	2.601	885.0	887.0	0.8669626

Pipe	dP Stag. Total (psid)	dP Gravity (psid)	dH (feet)	P Static In (psig)	P Static Out (psig)	P Stag. In (psig)	P Stag. Out (psig)	HGL Inlet (feet)
1504	0.0000000	0.0000	0.0000000	18.856	18.856	18.856	18.856	906.5
1505	6.5022197	6.5022	0.0000000	18.856	12.354	18.856	12.354	906.5
1506	2.1674066	2.1674	0.0000000	6.502	4.335	6.502	4.335	893.0
1507	0.0000000	0.0000	0.0000000	4.335	4.335	4.335	4.335	893.0
1508	0.0000000	0.0000	0.0000000	4.335	4.335	4.335	4.335	893.0
1509	0.0000000	0.0000	0.0000000	4.335	4.335	4.335	4.335	893.0
1510	4.3348131	4.3348	0.0000000	18.856	14.521	18.856	14.521	906.5
1511	3.0343692	3.0344	0.0000000	8.670	5.635	8.670	5.635	893.0
1512	1.3004439	1.3004	0.0000000	5.635	4.335	5.635	4.335	893.0
1513	0.8669626	0.8670	0.0000000	4.335	3.468	4.335	3.468	893.0
1514	0.0000000	0.0000	0.0000000	3.468	3.468	3.468	3.468	893.0
1515	0.8669626	0.8670	0.0000000	3.468	2.601	3.468	2.601	893.0

All Junction Table

Jct	Name	P Static In (psig)	P Static Out (psig)	P Stag. In (psig)	P Stag. Out (psig)	Vol. Flow Rate Thru Jct (gal/min)	Loss Factor (K)	HGL Inlet (feet)
1	LS Pump 1	2.282	45.465	3.325	46.507	1,178	0.00000	806.3
2	Bend	45.445	45.135	46.488	46.177	1,178	0.29780	905.8
3	Area Change	45.131	45.651	46.174	45.717	1,178	0.43789	905.1
4	Bend	31.307	31.290	31.373	31.356	1,178	0.26000	906.2
5	Bend	31.267	31.256	31.333	31.322	1,178	0.15484	906.1
6	Bend	31.253	31.243	31.319	31.309	1,178	0.15484	906.1
7	Check Valve	31.234	31.115	31.300	31.181	1,178	1.81003	906.1
8	Valve	31.113	31.032	31.179	31.098	1,178	1.22799	905.8
9	Area Change	31.031	31.060	31.097	31.096	1,178	0.01587	905.6
21	LS Pump 2	2.266	45.283	3.325	46.342	1,187	0.00000	806.2
22	Bend	45.264	44.948	46.322	46.007	1,187	0.29780	905.4
23	Area Change	44.944	45.473	46.003	45.540	1,187	0.43789	904.7
24	Bend	31.128	31.110	31.195	31.177	1,187	0.26000	905.8
25	Bend	31.087	31.077	31.154	31.144	1,187	0.15484	905.7
26	Bend	31.074	31.063	31.141	31.130	1,187	0.15484	905.7
27	Check Valve	31.054	30.932	31.121	31.000	1,187	1.81003	905.6
28	Valve	30.931	30.849	30.998	30.916	1,187	1.22799	905.4
29	Area Change	30.848	30.878	30.915	30.914	1,187	0.01587	905.2
101	HS Pump 1A	2.348	46.384	3.325	47.361	3,152	0.00000	806.4
102	Bend	46.374	46.104	47.351	47.081	3,152	0.27660	908.0
103	Area Change	46.102	46.667	47.079	46.922	3,152	0.16069	907.4
104	Bend	32.243	32.176	32.498	32.432	3,152	0.26000	908.4
105	Bend	32.106	32.058	32.361	32.313	3,152	0.18989	908.1

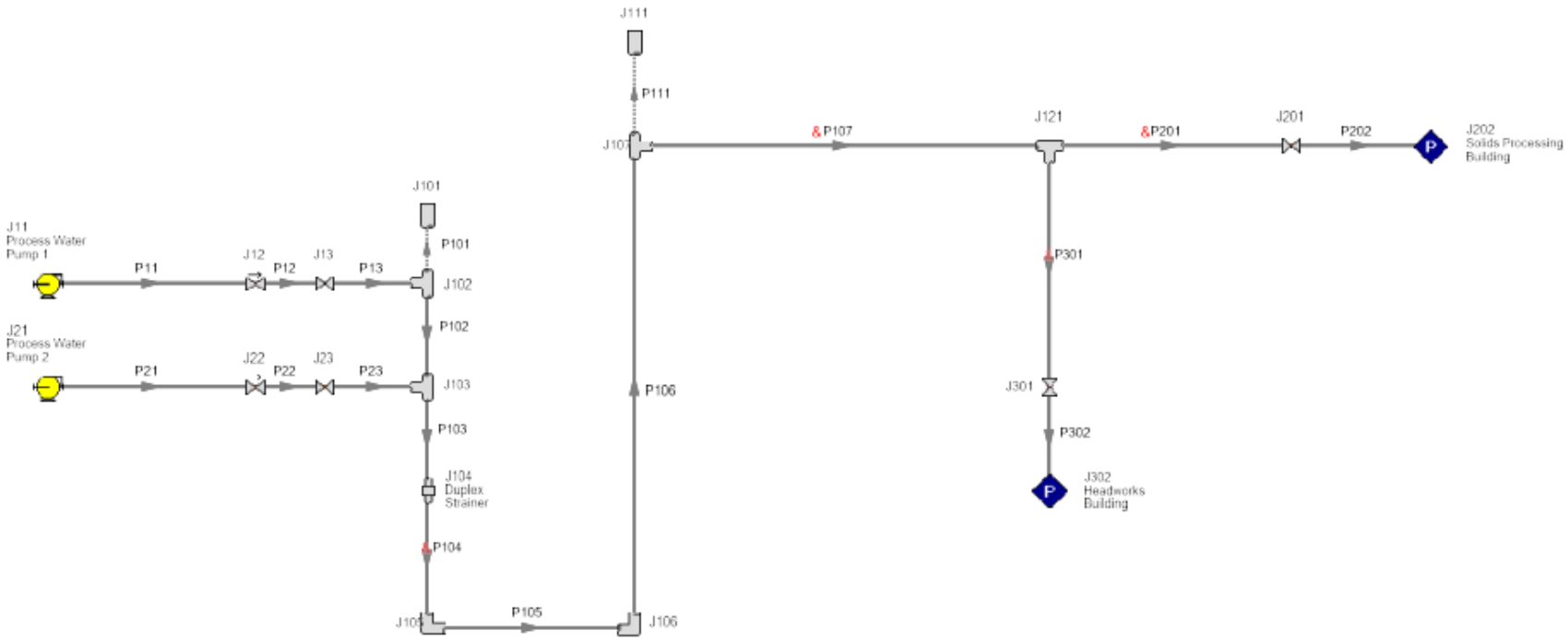
Jct	Name	P Static In (psig)	P Static Out (psig)	P Stag. In (psig)	P Stag. Out (psig)	Vol. Flow Rate Thru Jct (gal/min)	Loss Factor (K)	HGL Inlet (feet)
106	Bend	32.049	32.000	32.304	32.256	3,152	0.18989	907.9
107	Check Valve	31.972	31.510	32.228	31.766	3,152	1.80778	907.8
108	Valve	31.505	31.177	31.761	31.432	3,152	1.28664	906.7
X111	HS Pump 1B	3.325	45.423	3.325	45.423	0	0.00000	808.7
112	Bend	45.423	45.423	45.423	45.423	0	0.00000	905.8
113	Area Change	45.423	45.423	45.423	45.423	0	0.00000	905.8
114	Bend	31.118	31.118	31.118	31.118	0	0.00000	905.8
115	Bend	31.118	31.118	31.118	31.118	0	0.00000	905.8
116	Bend	31.118	31.118	31.118	31.118	0	0.00000	905.8
117	Check Valve	31.118	31.118	31.118	31.118	0	0.00000	905.8
118	Valve	31.118	31.118	31.118	31.118	0	0.00000	905.8
X201	HS Pump 2A	3.325	44.879	3.325	44.879	0	0.00000	808.7
202	Bend	44.879	44.879	44.879	44.879	0	0.00000	904.5
203	Area Change	44.879	44.879	44.879	44.879	0	0.00000	904.5
204	Bend	30.574	30.574	30.574	30.574	0	0.00000	904.5
205	Bend	30.574	30.574	30.574	30.574	0	0.00000	904.5
206	Bend	30.574	30.574	30.574	30.574	0	0.00000	904.5
207	Check Valve	30.574	30.574	30.574	30.574	0	0.00000	904.5
208	Valve	30.574	30.574	30.574	30.574	0	0.00000	904.5
211	HS Pump 2B	2.298	45.789	3.325	46.816	3,232	0.00000	806.3
212	Bend	45.778	45.494	46.805	46.521	3,232	0.27660	906.6
213	Area Change	45.492	46.086	46.519	46.354	3,232	0.16069	905.9
214	Bend	31.656	31.586	31.924	31.854	3,232	0.26000	907.0
215	Bend	31.512	31.461	31.781	31.730	3,232	0.18989	906.7
216	Bend	31.452	31.401	31.721	31.670	3,232	0.18989	906.6
217	Check Valve	31.372	30.886	31.640	31.155	3,232	1.80778	906.4
218	Valve	30.881	30.535	31.149	30.804	3,232	1.28664	905.2
1001	Tee or Wye	31.364	31.364	31.427	31.427	N/A	See Mult. Losses	906.4
1002	Tee or Wye	31.091	31.091	31.118	31.118	N/A	See Mult. Losses	905.7
1003	Tee or Wye	31.009	31.009	31.076	31.076	N/A	See Mult. Losses	905.5
1004	Valve	30.958	30.847	31.073	30.962	4,330	0.96717	905.4
1005	Tee or Wye	30.700	30.700	30.802	30.802	N/A	See Mult. Losses	904.8
1006	Tee or Wye	30.294	30.294	30.591	30.591	N/A	See Mult. Losses	903.9
1007	Tee or Wye	30.366	30.366	30.574	30.574	N/A	See Mult. Losses	904.1
1008	Bend	30.093	29.981	30.562	30.449	8,749	0.24000	903.4
1009	Valve	29.973	29.519	30.441	29.988	8,749	0.96717	903.1
1010	Tee or Wye	29.767	29.767	29.976	29.976	N/A	0.00000	902.7
1011	Tee or Wye	14.873	14.873	15.081	15.081	N/A	See Mult. Losses	897.3
1012	Bend	14.592	14.479	15.061	14.948	8,749	0.24000	896.7
1013	Valve	10.104	9.650	10.572	10.119	8,749	0.96717	896.3
1014	Valve	5.275	4.822	5.743	5.290	8,749	0.96717	895.2

AFT Fathom Model

Todd Creek WWTP
Influent Pumping Design

Jct	Name	P Static In (psig)	P Static Out (psig)	P Stag. In (psig)	P Stag. Out (psig)	Vol. Flow Rate Thru Jct (gal/min)	Loss Factor (K)	HGL Inlet (feet)
1015	Tee or Wye	5.069	5.069	5.277	5.277	N/A	See Mult. Losses	894.7
1016	Valve	3.933	3.480	4.402	3.949	8,749	0.96717	894.1
X1101	Valve	8.579	7.445	8.579	7.445	0	0.00000	897.8
1102	Tee or Wye	5.277	5.277	5.277	5.277	N/A	See Mult. Losses	895.2
1104	Valve	5.277	5.277	5.277	5.277	0	0.00000	895.2
1105	Dead End	5.277	5.277	5.277	5.277	0	0.00000	895.2
X1201	Valve	31.427	29.976	31.427	29.976	0	0.00000	906.5
1501	Bend	31.427	31.427	31.427	31.427	0	0.00000	906.5
1502	Tee or Wye	31.427	31.427	31.427	31.427	N/A	See Mult. Losses	906.5
2001	Grit Removal Max WSE	0.000	2.601	0.000	2.601	N/A	See Mult. Losses	893.0
2002	Tee or Wye	18.856	18.856	18.856	18.856	N/A	See Mult. Losses	906.5
2003	Bend	18.856	18.856	18.856	18.856	0	0.00000	906.5
X2004	Valve	12.354	6.502	12.354	6.502	0	0.00000	906.5
2005	Tee or Wye	4.335	4.335	4.335	4.335	N/A	See Mult. Losses	893.0
2006	Valve	4.335	4.335	4.335	4.335	0	0.00000	893.0
2007	Dead End	4.335	4.335	4.335	4.335	0	0.00000	893.0
X2008	Valve	14.521	8.670	14.521	8.670	0	0.00000	906.5
2009	Valve	5.635	5.635	5.635	5.635	0	0.00000	893.0
2010	Tee or Wye	4.335	4.335	4.335	4.335	N/A	See Mult. Losses	893.0
2011	Valve	3.468	3.468	3.468	3.468	0	0.00000	893.0
2012	Bend	3.468	3.468	3.468	3.468	0	0.00000	893.0

APPENDIX D – PROCESS WATER PUMP STATION HYDRAULICS


J111
P111
J101
&P107
J121
&P201
J201
P202
J202
Solids Processing
Building
J11
Process Water
Pump 1
P11
J12
P12
J13
P13
J102
P101
P102
J21
Process Water
Pump 2
P21
J22
P22
J23
P23
J103
P103
J104
Duplex
Strainer
P104
P106
P301
J301
P302
J302
Headworks
Building
P105
J105
J106

Model Reference Information

General

Title: AFT Fathom Model
Analysis run on: 5/19/2026 11:34:33 AM
Application version: AFT Fathom Version 12 (2022.04.12)
Input File: Z:\Clients\WTR\KCMO\125460_ToddCreekFP\Design\Proc\Design Calculations\Fathom Models\Redesign\Todd Creek Process Water PS.fth
Scenario: Base Scenario
Output File: Z:\Clients\WTR\KCMO\125460_ToddCreekFP\Design\Proc\Design Calculations\Fathom Models\Redesign\Todd Creek Process Water PS_F1.out

Execution Time= 2.55 seconds
Total Number Of Head/Pressure Iterations= 7974
Total Number Of Flow Iterations= 465
Total Number Of Temperature Iterations= 0
Number Of Pipes= 18
Number Of Junctions= 19
Matrix Method= Gaussian Elimination

Pressure/Head Tolerance= 0.0001 relative change
Flow Rate Tolerance= 0.0001 relative change
Temperature Tolerance= 0.0001 relative change
Flow Relaxation= (Automatic)
Flow relaxation automatically lowered to 0.01
Pressure Relaxation= (Automatic)

Constant Fluid Property Model
Fluid Library: ASME Steam/Water Tables
Fluid: ASME '97 Water
Temperature= 50 deg. F
Pressure= 14.7 psia
Max Fluid Temperature Data= 211.9676 deg. F
Min Fluid Temperature Data= 32.00002 deg. F
Density= 62.40933 lbm/ft3
Viscosity= 3.159029 lbm/hr-ft
Vapor Pressure= 0.1781329 psia
Viscosity Model= Newtonian
Apply laminar and non-Newtonian correction to: Pipe Fittings & Losses, Junction K factors, Junction Special Losses, Junction Polynomials
Corrections applied to the following junctions: Branch, Reservoir, Assigned Flow, Assigned Pressure, Area Change, Bend, Tee or Wye, Spray Discharge, Relief Valve

Ambient Pressure (constant)= 1 atm
Gravitational Acceleration= 1 g
Turbulent Flow Above Reynolds Number= 4000
Laminar Flow Below Reynolds Number= 2300
Total Inflow= 390.1 gal/min
Total Outflow= 390.1 gal/min
Maximum Static Pressure is 157.8 psia at Pipe 11 Inlet
Minimum Static Pressure is 94.33 psia at Pipe 202 Outlet

Warnings

No Warnings

Design Alerts

No Design Alerts Defined

Pump Summary

Jct	Results Diagram	Name	Vol. Flow (gal/min)	Mass Flow (lbm/sec)	dP (psid)	dH (feet)	Overall Efficiency (Percent)	Speed (Percent)	Overall Power (hp)	BEP (gal/min)
11	Show	Process Water Pump 1	194.6	27.06	147.2	339.6	72.27	100.0	23.12	161.3
21	Show	Process Water Pump 2	195.5	27.18	146.9	338.9	73.80	100.0	22.69	148.3

Jct	% of BEP (Percent)	NPSHA (feet)	NPSHR (feet)
11	120.7	37.50	N/A
21	131.8	37.50	N/A

Valve Summary

Jct	Name	Valve Type	Vol. Flow (gal/min)	Mass Flow (lbm/sec)	dP Stag. (psid)	dH (feet)	P Static In (psia)	Cv	K	Valve State
13	Valve	REGULAR	194.63	27.06	0.1220	0.2814	157.41	557.4	0.7632	Open
23	Valve	REGULAR	195.51	27.18	0.1231	0.2840	157.10	557.4	0.7632	Open
201	Valve	REGULAR	296.45	41.22	2.0924	4.8278	98.03	205.0	5.6432	Open
301	Valve	REGULAR	93.69	13.03	0.2090	0.4822	97.07	205.0	5.6432	Open
12	Check Valve	CHECK	194.63	27.06	0.2625	0.6056	157.69	380.0	1.6424	Open
22	Check Valve	CHECK	195.51	27.18	0.2648	0.6111	157.39	380.0	1.6424	Open

Pipe Output Table

Pipe	Name	Vol. Flow Rate (gal/min)	Velocity (feet/sec)	P Static Max (psia)	P Static Min (psia)	Elevation Inlet (feet)	Elevation Outlet (feet)	dP Stag. Total (psid)	dP Static Total (psid)	dP Gravity (psid)	dH (feet)
11	Pipe	194.63	4.871	157.81	157.69	860.0	860.0	0.11746	0.11746	0.000	0.27102
12	Pipe	194.63	4.871	157.43	157.41	860.0	860.0	0.02136	0.02136	0.000	0.04928
13	Pipe	194.63	4.871	157.29	157.25	860.0	860.0	0.03203	0.03203	0.000	0.07391
21	Pipe	195.51	4.893	157.51	157.39	860.0	860.0	0.11847	0.11847	0.000	0.27336
22	Pipe	195.51	4.893	157.12	157.10	860.0	860.0	0.02154	0.02154	0.000	0.04970
23	Pipe	195.51	4.893	156.98	156.95	860.0	860.0	0.03196	0.03196	0.000	0.07375
101	Pipe	0.00	0.000	157.41	157.41	860.0	860.0	0.00000	0.00000	0.000	0.00000
102	Pipe	194.63	4.871	157.06	157.02	860.0	860.0	0.04288	0.04288	0.000	0.09893
103	Pipe	390.14	9.764	156.20	156.18	860.0	860.0	0.02056	0.02056	0.000	0.04744
104	Pipe	390.14	9.764	148.05	147.52	860.0	860.0	0.53122	0.53122	0.000	1.22570

Pipe	P Static In (psia)	P Static Out (psia)	P Stag. In (psia)	P Stag. Out (psia)
11	157.81	157.69	157.97	157.85
12	157.43	157.41	157.59	157.57
13	157.29	157.25	157.45	157.41
21	157.51	157.39	157.67	157.55
22	157.12	157.10	157.29	157.26
23	156.98	156.95	157.14	157.11
101	157.41	157.41	157.41	157.41
102	157.06	157.02	157.22	157.18
103	156.20	156.18	156.84	156.82
104	148.05	147.52	148.69	148.16

Pipe	Name	Vol. Flow Rate (gal/min)	Velocity (feet/sec)	P Static Max (psia)	P Static Min (psia)	Elevation Inlet (feet)	Elevation Outlet (feet)	dP Stag. Total (psid)	dP Static Total (psid)	dP Gravity (psid)	dH (feet)
105	Pipe	390.14	9.764	147.30	147.28	860.0	860.0	0.02056	0.02056	0.000	0.04744
106	Pipe	390.14	9.764	147.06	142.11	860.0	870.0	4.95074	4.95074	4.334	1.42308
107	Pipe	390.14	9.764	141.34	106.02	870.0	870.0	35.32500	35.32500	0.000	81.50704
111	Pipe	0.00	0.000	142.75	142.75	870.0	870.0	0.00000	0.00000	0.000	0.00000
201	Pipe	296.45	7.420	106.33	98.03	870.0	875.0	8.29859	8.29859	2.167	14.14773
202	Pipe	296.45	7.420	95.93	94.33	875.0	878.5	1.60892	1.60892	1.517	0.21233
301	Pipe	93.69	2.345	106.04	97.07	870.0	890.0	8.96901	8.96901	8.668	0.69461
302	Pipe	93.69	2.345	96.86	94.66	890.0	895.0	2.20207	2.20207	2.167	0.08093

Pipe	P Static In (psia)	P Static Out (psia)	P Stag. In (psia)	P Stag. Out (psia)
105	147.30	147.28	147.94	147.92
106	147.06	142.11	147.70	142.75
107	141.34	106.02	141.98	106.66
111	142.75	142.75	142.75	142.75
201	106.33	98.03	106.70	98.40
202	95.93	94.33	96.30	94.70
301	106.04	97.07	106.08	97.11
302	96.86	94.66	96.90	94.70

All Junction Table

Jct	Name	P Static In (psia)	P Static Out (psia)	P Stag. In (psia)	P Stag. Out (psia)	Vol. Flow Rate Thru Jct (gal/min)	Mass Flow Rate Thru Jct (lbm/sec)	Loss Factor (K)
11	Process Water Pump 1	16.27	157.81	16.43	157.97	194.63	27.06	0.0000
12	Check Valve	157.69	157.43	157.85	157.59	194.63	27.06	1.6424
13	Valve	157.41	157.29	157.57	157.45	194.63	27.06	0.7632

Jct	Name	P Static In (psia)	P Static Out (psia)	P Stag. In (psia)	P Stag. Out (psia)	Vol. Flow Rate Thru Jct (gal/min)	Mass Flow Rate Thru Jct (lbm/sec)	Loss Factor (K)
21	Process Water Pump 2	16.27	157.51	16.43	157.67	195.51	27.18	0.0000
22	Check Valve	157.39	157.12	157.55	157.29	195.51	27.18	1.6424
23	Valve	157.10	156.98	157.26	157.14	195.51	27.18	0.7632
101	Dead End	157.41	157.41	157.41	157.41	0.00	0.00	0.0000
102	Tee or Wye	157.34	157.34	157.41	157.41	N/A	N/A	See Mult. Losses
103	Tee or Wye	156.56	156.56	156.84	156.84	N/A	N/A	See Mult. Losses
104	Duplex Strainer	156.18	148.05	156.82	148.69	390.14	54.25	8.4411
105	Bend	147.52	147.30	148.16	147.94	390.14	54.25	0.3392
106	Bend	147.28	147.06	147.92	147.70	390.14	54.25	0.3392
107	Tee or Wye	142.47	142.47	142.75	142.75	N/A	N/A	See Mult. Losses
111	Dead End	142.75	142.75	142.75	142.75	0.00	0.00	0.0000
121	Tee or Wye	106.37	106.37	106.66	106.66	N/A	N/A	See Mult. Losses
201	Valve	98.03	95.93	98.40	96.30	296.45	41.22	5.6432
202	Solids Processing Building	94.33	94.33	94.70	94.70	296.45	41.22	0.0000
301	Valve	97.07	96.86	97.11	96.90	93.69	13.03	5.6432
302	Headworks Building	94.66	94.66	94.70	94.70	93.69	13.03	0.0000

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 Project #: C295840-02

1.2 Has the Missouri Department of Natural Resources approved the proposed project's antidegradation review?
☑ YES Date of Approval: 1/31/23 ☐ 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 FP addendum previously submitted for approval process with updated op permit

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: 2/4/26
☐ 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: Todd Creek Wastewater Treatment Plant

2.2 ESTIMATED PROJECT CONSTRUCTION COST: $ 143,800,000

2.3 PROJECT DESCRIPTION

This project will provide a new wastewater treatment facility that includes coarse bar screening, perforated plate screening, biological treatment with activated granular sludge, UV disinfection, and aeration prior to release into Todd Creek. There is a grit removal system and a solids handling building that thickens and stores the waste sludge prior to transport to another facility.

2.4 SLUDGE HANDLING, USE AND DISPOSAL DESCRIPTION

The thickened sludge will be hauled to Blue River WWTP.

2.5 DESIGN INFORMATION

A. Current population: 9100 ; Design population: 27,000

B. Actual Flow: 1,790,(gpd; Design Average Flow: 4,600,(gpd;
Actual Peak Daily Flow: 5,160,(gpd; Design Maximum Daily Flow: 11,590 gpd; Design Wet Weather Event: 12,300

2.6 ADDITIONAL INFORMATION

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

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

3.0 WASTEWATER TREATMENT FACILITY

NAME	TELEPHONE NUMBER WITH AREA CODE	E-MAIL ADDRESS
KC Todd Creek WWTP	816-532-4075	brent.herring@kcmo.org

ADDRESS (PHYSICAL)	CITY	STATE	ZIP CODE	COUNTY
14001 NW Interurban Rd	Kansas City	MO	64163	Platte

Wastewater Treatment Facility: Mo- 0024961 (Outfall 1 Of 1)

3.1 Legal Description: ____ ¼, NW ¼, NE ¼, Sec. 1, T 52N, R 34W
(Use additional pages if construction of more than one outfall is proposed.)

3.2 UTM Coordinates Easting (X): 356291 Northing (Y): 4356942
For Universal Transverse Mercator (UTM), Zone 15 North referenced to North American Datum 1983 (NAD83)

3.3 Name of receiving streams: Todd Creek

4.0 PROJECT OWNER

NAME	TELEPHONE NUMBER WITH AREA CODE	E-MAIL ADDRESS
City of Kansas City	816-513-1313	brent.herring@kcmo.org

ADDRESS	CITY	STATE	ZIP CODE
4800 E 63rd St.	Kansas City	MO	64130

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
Same as above		

ADDRESS	CITY	STATE	ZIP CODE

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
Burns & McDonnell Engineering Company Inc.	816-333-9400	bdickmeyer@burnsmcd.com

ADDRESS	CITY	STATE	ZIP CODE
9400 Ward Pkwy	Kansas City	MO	64114

7.0 APPLICATION FEE

☐ CHECK NUMBER ☑ JETPAY CONFIRMATION NUMBER 20079848

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 Signed by: 27763FE37FD1450...

PRINTED NAME David Poirier

DATE 7/7/2026

TITLE OR CORPORATE POSITION	TELEPHONE NUMBER WITH AREA CODE	E-MAIL ADDRESS
KC Water - Deputy Director	**816-513-0217**	david.poirier@kcmo.org

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