Memorandum

Subject: Muddy Creek WWTP Expansion to 0.66 MGD - Project Information Meeting Record and Addendum No. 1 to RFQ

Date: January 12, 2026

To: All Prospective Offerors

From: Water & Sewer Authority of Cabarrus County (WSACC)

Copy: Brown and Caldwell

Project Information Meeting

WSACC held a Project Information Meeting for the Muddy Creek Wastewater Treatment Plant Expansion to 0.66 MGD on January 6, 2026. The meeting agenda and the attendee list are attached for reference.

Addendum No. 1 – Amendment to RFQ Section 2.7.11

This memo serves as Amendment No. 1 to the RFQ and amends Section 2.7.11 ("Projects of Similar Scope and Complexity"). The RFQ required that similar projects have completion dates within the last five (5) years. WSACC confirms that offerors may instead include projects with completion dates within the past ten (10) years. All other characteristics and requirements listed in Section 2.7.11 remain unchanged.

Addendum No. 1 - Minority Business Participation Goals and Submittal Requirements

WSACC has established a 10% Minority Business Participation goal for this project. Because this is a PDB delivery, WSACC will apply this requirement in a phase-appropriate manner, consistent with the level of scope definition available at each phase.

For this PDB procurement, references in the attached forms to "Bid" and "Bidder" shall be interpreted as "SOQ/Offeror" for Phase 1 submittals, and references to "low bidder" or "apparent low bidder" shall be interpreted as the "apparent successful Offeror/Design-Builder" at the applicable later milestone.

1) SOQ Submittal Requirement – Phase 1 (Design & Preconstruction Services)

For purposes of SOQ responsiveness, the Minority Business Participation documentation submitted with the SOQ shall address Phase 1 (Design & Preconstruction Services), which is the portion of the work that can be reasonably identified at the RFQ stage (e.g., design/professional services and other Phase 1 support services).

Offerors shall submit, with the SOQ:

- Affidavit A (Listing of Good Faith Efforts) or Affidavit B (Intent to Perform Contract with Own Workforce), as applicable, and
- the Identification of Minority Business Participation form

This submittal identifies the minority business enterprises proposed for Phase 1 as subcontractors, vendors/suppliers, or providers of professional services. Failure to submit the required documentation with the SOQ may render the SOQ non-responsive.

2) Later Submittal Requirement – Phase 2 (Construction Services)

WSACC recognizes that many Phase 2 (Construction) subcontracting opportunities are not fully defined at the SOQ stage. Accordingly, Phase 2 Minority Business Participation commitments and final participation documentation will be addressed later in the PDB process, when the Phase 2 scope and pricing are sufficiently developed (e.g., prior to execution of a GMP / transition into Phase 2 Construction).

At that time, the apparent successful Offeror/Design-Builder will be required to submit Affidavit C (Portion of Work to be Performed by Minority Firms) or Affidavit D (Good Faith Efforts), as applicable, based on the Phase 2 contract value and the then-available subcontracting plan.

The affidavits and forms referenced above are attached to this Amendment for Offeror use. Except as expressly modified by this Addendum No. 1, all other RFQ requirements remain unchanged.

Request for Technical Memoranda (TM)

WSACC has received a request for select TMs related to the Muddy Creek WWTP expansion effort. The requested TMs include:

TM 4 – Influent Flows and Loads Analysis and Projections for MCWWTP

TM 6 – Biological Process Modeling for MCWWTP

TM 7 – Capacity Analysis for Muddy Creek Wastewater Treatment Plant (MCWWTP)

TM 16 – Expansion Alternatives Analysis for Muddy Creek Wastewater Treatment Plant (MCWWTP)

Relative to TM 16, cost information, cost assumptions, and internal estimating basis contained within TM 16 are informational only and do not constitute a binding project budget. Attachment D (Cost Estimate) is removed from the version of TM 16 included here.

Questions

Further questions can be directed to Thomas Hahn, PE at t.hahn@wsacc.org. The last day to submit questions regarding the RFQ is January 20, 2026.

Attachments:

A. Project Information Meeting Attendee List / Sign-In Sheet (January 6, 2026)
B. Project Information Meeting Agenda (January 6, 2026)
C. MBE Instructions – Affidavits A and B
D. Affidavit A – Listing of Good Faith Efforts
E. Affidavit B – Intent to Perform Contract with Own Workforce
F. Identification of Minority Business Participation Form
G. MBE Instructions – Affidavits C and D
H. Affidavit C – Portion of Work to be Performed by Minority Firms
I. Affidavit D – Good Faith Efforts
J. TM 4 – Influent Flows and Loads Analysis and Projections for MCWWTP
K. TM 6 – Biological Process Modeling for MCWWTP
L. TM 7 – Capacity Analysis for Muddy Creek Wastewater Treatment Plant (MCWWTP)
M. TM 16 – Expansion Alternatives Analysis for Muddy Creek Wastewater Treatment Plant (MCWWTP)

Attachment A

EHS-3010.A.406.4.00

WSACC TRAINING ATTENDANCE FORM

Training Description: MCWWTP Expansion Project Information

Trainer/Instructor:

Company:

Training Date: 01/06/2026

Please sign in below; if credit hour training (by outside company), please include your current certificate #.

~~Signature~~ Name	~~Certificate #~~ Company	~~Signature~~ Name	~~Certificate #~~ Company
1. Mike Osborne	BV	26.	
2. GARY HUNTER	B&V	27.	
3. Lina Herrera	BV	28.	
4. TOM SWARTOUT	BV	29.	
5. Austin McGee	Ironclad Environmental	30.	
6. Chris Heyward	State Utility	31.	
7. Andrew Merritt	State Utility	32.	
8. Kris Hannah	State Utility	33.	
9. Brian Thorsvold	HDR	34.	
10. Mary Kingsby	HDR	35.	
11. Joe DeHart	PC	36.	
12. Alan Parent	PC	37.	
13. Allen J. Anthony	PC	38.	
14. AARON BABSON	HAZEN	39.	
15. Brandon Moretz	Hazen	40.	
16. Mike Parker	Hazen	41.	
17. Zac Walter	Harper	42.	
18. Justin Jones	Harper	43.	
19. Tessa Germond	GHD	44.	
20. BRANDON GOTT	GHD	45.	
21. Will Allen	GHD	46.	
22.		47.	
23.		48.	
24.		49.	
25.		50.	

Attachment B

Brown AND Caldwell

Meeting Agenda

Prepared for: Water and Sewer Authority of Cabarrus County
Project Title: Muddy Creek Wastewater Treatment Plant Expansion to 0.66 MGD

Purpose of Meeting: Project Information Meeting
Meeting Location: 6400 Breezy Lane, Concord, NC 28025

Date: January 6th, 2026
Time: 2:00 PM

Attendees: Thomas Hahn, WSACC
Mayara Arnold, WSACC
George Anipsitakis, BC
Numerous PDB Team Members

Agenda

1. **Welcome and Introductions**
2. **Project Overview**

   Owner: Water and Sewer Authority of Cabarrus County (WSACC)

   Owner's Advisor: Brown and Caldwell

   Location: Muddy Creek Wastewater Treatment Plant, Cabarrus County, NC

   Project Goal: Expand treatment capacity to 0.66 MGD to support projected growth and regulatory requirements

   Project Objectives:

   i. Establish a collaborative relationship between WSACC and the Design-Build Team to deliver high-quality design and construction on time and within WSACC's budget.
   ii. Maintain a safe, injury free work site.
   iii. WSACC desires to have completed the design, permitting, and construction for this project by December 2028.

   Project Performance Outcomes:

   i. Provide continuous wastewater treatment service meeting NPDES permit limit.
   ii. Treat a Maximum Monthly Flow of 0.66 MGD.
   iii. Manage Peak Equalized Flow through the process up to approximately 1.78 MGD.
   iv. Achieve required effluent quality under seasonal conditions.
   v. Maintain uninterrupted operations during construction.
   vi. Allow for future capacity expansion to 1.0 MGD without major reconstruction.

   Project Budget: The estimated budget for the Scope of Work is currently $21,320,000. Budget information is preliminary and subject to refinement through the PDB process.
3. **Planned Facility Improvements**: Based on the Preliminary Engineering Report (PER), the project is anticipated to include:

   i. New influent pumping station hydraulically connected to existing IPS
   ii. Additional headworks screening capacity
   iii. New equalization basin (approximately 180,000 gallons)
   iv. Parallel conventional activated sludge aeration basins with future expansion allowance

v. Additional disk filters and UV disinfection units
vi. Conversion of existing basins for sludge holding and process flexibility
vii. Modifications to secondary clarifiers, RAS/WAS pumping, and supporting systems

(Final scope will be refined collaboratively during PDB Phase 1)

4. Progressive Design-Build (PDB) Approach

Phase 1 - Design & Preconstruction

i. Design development and validation of scope
ii. Cost modeling and pricing assumptions
iii. Schedule development and risk refinement
iv. Development of a Guaranteed Maximum Price (GMP)

Phase 2 - Final Design & Construction

i. Final design completion
ii. Construction and commissioning based on the agreed GMP

5. Procurement Schedule

Date (Eastern Time)	Activity
December 18, 2025	Issue RFQ
January 6, 2026 at 2:00 PM	In-Person Project Information Meeting (optional)
January 20, 2026	Last Date to Submit Questions Regarding the RFQ
January 27, 2026 at 2:00 PM	SOQ Due Date
February 10, 2026	Notification of Short-Listed Offeror
February 24, 2026	Interviews with Short-Listed Offerors
March 3, 2026	Notification of Preferred Offeror

6. Evaluation and Ranking of Offerors

Criteria	Weight
Team Organization	10%
Qualifications and Experience of Key Personnel	40%
Demonstrated Past Performance with Successful Projects of Similar Scope and Complexity	30%
Delivery Approach	20%
Interviews with Short-Listed Offerors	Not Scored

7. Questions, Communications & Next Steps

- Formal questions to be submitted per RFQ instructions
- Owner Contact: Thomas Hahn, PE (t.hahn@wsacc.org)
- Addenda and clarifications will be issued in writing
- Project updates will be posted on WSACC's website

Next Milestone: Questions Deadline, January 20, 2026

MBE INSTRUCTIONS (AFFIDAVITS A & B)

MINORITY BUSINESS PARTICIPATION AFFIDAVITS (A & B), AND IDENTIFICAITON FORM (REQUIRED WITH INITIAL BID)

The Minority Business Participation goal established by under the Water and Sewer Authority of Cabarrus County (WSACC) Outreach Plan is 10%. This goal is applicable for all WSACC construction projects required to have verifiable percentage goals under G.S. 143-128.2(a).

In accordance with Section 143-128.2, General Statutes of North Carolina, all bidders are required to provide information relative to minority business enterprises that will be used as construction subcontractors, vendors, suppliers or providers of professional services for the proposed project. This information must be provided with the bid by completing the "Identification of Minority Business Participation" form that is included with the Bid documents. The total dollar value of the Bid that is to be performed by Minority business contracting must also be included on the form.

Also included with the bid documents is Affidavit A and Affidavit B. Each bidder must complete Affidavit A (Listing of Good Faith Efforts) that outlines the good faith efforts made to comply with the minority business participation requirements for the proposed project. If a bidder intends to perform 100% of the Work with its own forces, then Affidavit B (intent to Perform Contract With Own Workforce) must be completed and submitted instead of Affidavit A.

Requirements for MBE participation is outlined in the "Special Conditions" part of the front-end of these contract documents. Bidder is instructed to read this information carefully prior to completing and submitting the bid.

Please note that submittal and proper completion of the required minority business participation forms must be provided in order for the bid to be considered responsive.

Identification of Minority Business Participation

State of North Carolina AFFIDAVIT A – Listing of Good Faith Efforts

County of Cabarrus

Affidavit of (Name of Bidder)____

I have made a good faith effort to comply under the following areas checked:

Bidders must earn at least 50 points from the good faith efforts listed for their bid to be considered responsive. (1 NC Administrative Code 30 I.0101)

- ❑ **1 – (10 pts)** Contacted minority businesses that reasonably could have been expected to submit a quote and that were known to the contractor, or available on State or local government maintained lists, at least 10 days before the bid date and notified them of the nature and scope of the work to be performed.
- ❑ **2 --(10 pts)** Made the construction plans, specifications and requirements available for review by prospective minority businesses, or providing these documents to them at least 10 days before the bids are due.
- ❑ **3 – (15 pts)** Broken down or combined elements of work into economically feasible units to facilitate minority participation.
- ❑ **4 – (10 pts)** Worked with minority trade, community, or contractor organizations identified by the Office of Historically Underutilized Businesses and included in the bid documents that provide assistance in recruitment of minority businesses.
- ❑ **5 – (10 pts)** Attended prebid meetings scheduled by the public owner.
- ❑ **6 – (20 pts)** Provided assistance in getting required bonding or insurance or provided alternatives to bonding or insurance for subcontractors.
- ❑ **7 – (15 pts)** Negotiated in good faith with interested minority businesses and did not reject them as unqualified without sound reasons based on their capabilities. Any rejection of a minority business based on lack of qualification should have the reasons documented in writing.
- ❑ **8 – (25 pts)** Provided assistance to an otherwise qualified minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letters of credit, including waiving credit that is ordinarily required. Assisted minority businesses in obtaining the same unit pricing with the bidder's suppliers in order to help minority businesses in establishing credit.
- ❑ **9 – (20 pts)** Negotiated joint venture and partnership arrangements with minority businesses in order to increase opportunities for minority business participation on a public construction or repair project when possible.
- ❑ **10 - (20 pts)** Provided quick pay agreements and policies to enable minority contractors and suppliers to meet cash-flow demands.

The undersigned, if apparent low bidder, will enter into a formal agreement with the firms listed in the Identification of Minority Business Participation schedule conditional upon scope of contract to be executed with the Owner. Substitution of contractors must be in accordance with GS143-128.2(d) Failure to abide by this statutory provision will constitute a breach of the contract.

The undersigned hereby certifies that he or she has read the terms of the minority business commitment and is authorized to bind the bidder to the commitment herein set forth.

Date:_______________ Name of Authorized Officer:____

Signature:____

Title:____

SEAL

State of North Carolina, County of_________________________________

Subscribed and sworn to before me this _______day of _____________20_____

Notary Public______________________________

My commission expires _____________________

Identification of Minority Business Participation

State of North Carolina --AFFIDAVIT B-- Intent to Perform Contract with Own Workforce.

County of Cabarrus

Affidavit of____

(Name of Bidder)

I hereby certify that it is our intent to perform 100% of the work required for the ______________

____ contract.

(Name of Project)

In making this certification, the Bidder states that the Bidder does not customarily subcontract elements of this type project, and normally performs and has the capability to perform and will perform all elements of the work on this project with his/her own current work forces; and

The Bidder agrees to provide any additional information or documentation requested by the owner in support of the above statement.

The undersigned hereby certifies that he or she has read this certification and is authorized to bind the Bidder to the commitments herein contained.

Date:_____________ Name of Authorized Officer:____

Signature:____

Title:____

SEAL

State of North Carolina, County of ____
Subscribed and sworn to before me this __________________day of ________20___
Notary Public ________________________________
My commission expires_________________________

Attachment F

Identification of Minority Business Participation

I,____,
(Name of Bidder)

do hereby certify that on this project, we will use the following minority business enterprises as construction subcontractors, vendors, suppliers or providers of professional services.

Firm Name, Address and Phone #	Work type	*Minority Category

*Minority categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) American Indian (**I**), Female (**F**) Socially and Economically Disadvantaged (**D**)

The total value of minority business contracting will be ($)____________.

MBE INSTRUCTIONS (AFFIDAVITS C & D)

MINORITY BUSINESS PARTICIPATION AFFIDAVITS (C & D)
(REQUIRED BY THE APPARENT LOW BIDDER)

Within 72 hours of notification of being the apparent lowest responsible, responsive bidder (time period can be extended by owner if determined to be appropriate), Bidder shall file either Affidavit C or Affidavit D as follows:

If the portion of the Work for the proposed project to be performed by minority business enterprises equals 10% or more of the total contract price, then Affidavit C must be completed and submitted by the Bidder. This affidavit shall give rise to the presumption that the Bidder has made the required good faith effort.

If the portion of the Work for the proposed project to be performed by minority business enterprises is less than 10% of the total contract price, then Affidavit D must be completed and submitted by the Bidder. The document must be supplemented by evidence of all good faith efforts that were implemented, including advertisements, solicitations, and other specific actions taken demonstrating recruitment and selection of minority business enterprises for participation in the contract.

If Affidavit "B" (self-performance of work) was submitted with bid, then sufficient information must be provided to demonstrate that the bidder does not customarily subcontract on this type of project.

Requirements for MBE participation is outlined in the "Special Conditions" part front-end of these contract documents. Bidder is instructed to read this information carefully prior to completing and submitting the bid.

Following contract award, the contractor will be required to provide a finalized listing of the minority business enterprises that will be participating in the project.

Please note that submittal and proper completion of the required minority business participation forms must be provided in order for the bid to be considered responsive.

Attachment H

Not with Bid　　To b submitted by apparent low bidder　　Not with Bid

State of North Carolina - AFFIDAVIT C - Portion of the Work to be Performed by Minority Firms

County of ___________________

(Note this form is to be submitted only by the apparent lowest responsible, responsive bidder.)

If the portion of the work to be executed by minority businesses as defined in GS143-128.2(g) is equal to or greater than 10% of the bidders total contract price, then the bidder must complete this affidavit. This affidavit shall be provided by the apparent lowest responsible, responsive bidder within **72 hours** after notification of being low bidder.

Affidavit of ____ I do hereby certify that on the
(Name of Bidder)

____
(Project Name)

Project ID#______________________________ Amount of Bid $_________________________

I will expend a minimum of _______% of the total dollar amount of the contract with minority business enterprises. Minority businesses will be employed as construction subcontractors, vendors, suppliers or providers of professional services. Such work will be subcontracted to the following firms listed below.

Attach additional sheets if required

Name and Phone Number	*Minority Category	Work description	Dollar Value

*Minority categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) American Indian (**I**), Female (**F**) Socially and Economically Disadvantaged (**D**)

Pursuant to GS143-128.2(d), the undersigned will enter into a formal agreement with Minority Firms for work listed in this schedule conditional upon execution of a contract with the Owner. Failure to fulfill this commitment may constitute a breach of the contract.

The undersigned hereby certifies that he or she has read the terms of this commitment and is authorized to bind the bidder to the commitment herein set forth.

Date:___________ Name of Authorized Officer:____

Signature:____

SEAL

Title:____

State of North Carolina, County of ______________

Subscribed and sworn to before me this __________day of ________20_____

Notary Public______________________________

My commission expires________________

State of North Carolina AFFIDAVIT D – Good Faith Efforts

County of ____________________

If the goal of 10% participation by minority business **is not** achieved, the Bidder shall provide the following documentation to the Owner of his good faith efforts:

(Name of Bidder)

Affidavit of: ____

I do certify the attached documentation as true and accurate representation of my good faith efforts.

(Attach additional sheets if required)

Name and Phone Number	*Minority Category	Work description	Dollar Value

*Minority categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) American Indian (**I**), Female (**F**) Socially and Economically Disadvantaged (**D**)

Documentation of the Bidder's good faith efforts to meet the goals set forth in these provisions. Examples of documentation include, but are not limited to, the following evidence:

A. Copies of solicitations for quotes to at least three (3) minority business firms from the source list provided by the State for each subcontract to be let under this contract (if 3 or more firms are shown on the source list). Each solicitation shall contain a specific description of the work to be subcontracted, location where bid documents can be reviewed, representative of the Prime Bidder to contact, and location, date and time when quotes must be received.

B. Copies of quotes or responses received from each firm responding to the solicitation.

C. A telephone log of follow-up calls to each firm sent a solicitation.

D. For subcontracts where a minority business firm is not considered the lowest responsible sub-bidder, copies of quotes received from all firms submitting quotes for that particular subcontract.

E. Documentation of any contacts or correspondence to minority business, community, or contractor organizations in an attempt to meet the goal.

F. Copy of pre-bid roster.

G. Letter documenting efforts to provide assistance in obtaining required bonding or insurance for minority business.

H. Letter detailing reasons for rejection of minority business due to lack of qualification.

I. Letter documenting proposed assistance offered to minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letter of credit, including waiving credit that is ordinarily required.

Failure to provide the documentation as listed in these provisions may result in rejection of the bid and award to the next lowest responsible and responsive bidder.

Date:______________ Name of Authorized Officer:____________________________________

Signature:____________________________________

Title:____________________________________

SEAL

State of North Carolina, County of _________________________

Subscribed and sworn to before me this __________day of ______________20_____

Notary Public_____________________

Attachment J

Brown AND Caldwell

309 East Morehead Street,
Suite 220
Charlotte, NC 28202

T: 704.358.7204

Technical Memorandum

Prepared for: Water and Sewer Authority of Cabarrus County (WSACC)

Project Title: Wastewater Treatment Facilities Plan and Preliminary Engineering Report

Project No.: 193209.100.001

Technical Memorandum No. 04

Subject: Influent Flows and Loads Analysis and Projections for MCWWTP

Date: November 1, 2024

To: Chad VonCannon, P.E., Executive Director

From: George Anipsitakis, P.E., Project Manager

Copy to: Thomas Hahn, P.E., Engineering Director

Prepared by: ______________________________
Kayla Bauhs, Process Engineer
Mark Miller, Ph.D., P.E., Lead Process Engineer

Reviewed by: ______________________________
Jose Jimenez, Ph.D., P.E., Technical Reviewer
George Anipsitakis, Ph.D., P.E., Project Manager

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 045265 MARK WALLACE MILLER 11-1-24

Limitations:

This document was prepared solely for WSACC in accordance with professional standards at the time the services were performed and in accordance with the contract between WSACC and Brown and Caldwell dated February 28, 2024. This document is governed by the specific scope of work authorized by WSACC; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by WSACC and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

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List of Abbreviations

AADF	Annual Average Daily Flow
BOD_5	5-day Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
d	Day
EQ	Equalization
gpm	Gallons Per Minute
I&I	Inflow and Infiltration
IPS	Influent Pump Station
L	Liter
lb	Pound
MCWWTP	Muddy Creek Wastewater Treatment Plant
MDF	Minimum Day Flow
mg	Milligram
MGD	Million Gallons per Day
mm	Millimeter
MMF	Maximum Month Flow
MWF	Maximum Week Flow
NPDES	National Pollution Discharge Elimination System
PDF	Peak Day Flow
PHF	Peak Hour Flow
RAS	Return Activated Sludge
RRRWWTP	Rocky River Regional Wastewater Treatment Plant
SHT	Sludge Holding Tank
TAN	Total Ammonia Nitrogen
TM	Technical Memorandum
TSS	Total Suspended Solids
UV	Ultraviolet
WAS	Waste Activated Sludge
WSACC	Water and Sewer Authority of Cabarrus County

Executive Summary

This Technical Memorandum (TM) summarizes the analysis of historical flows and loads at the Muddy Creek Wastewater Treatment Plant (MCWWTP). This TM also provides the flow and load projections that were evaluated to determine the basis of designs for expanding the MCWWTP to treat a maximum month flow (MMF) of 0.45 million gallons per day (MGD), 0.6 MGD, and 1 MGD.

Historical flow data for MCWWTP from 2013 to 2023 was analyzed to determine flow peaking factors. Using these peaking factors, peak flow projections were determined based on the MMF of 0.45 MGD, 0.6 MGD, and 1 MGD as shown in Table ES-1.

Table ES-1. Basis of Design Flows at MCWWTP

Flow Condition	Flow Rate (MGD)		
	For 0.45 MGD MMF	For 0.6 MGD MMF	For 1 MGD MMF
Peak Hour Flow (PHF) [a]	2.58	3.04	4.21
Peak Day Flow (PDF) [a]	1.56	1.82	2.47
Maximum Week Flow (MWF)	0.78	1.04	1.73
Maximum Month Flow (MMF)	0.45	0.60	1.00
Annual Average Daily Flow (AADF)	0.28	0.37	0.62
Minimum Day Flow (MDF)	0.10	0.14	0.22

[a] *Based on 2-year storm interval projections (B&V, 2022) instead of using historical peaking factors.*

Flow projections were obtained from the 2022 Master Plan Future Utility Demand and Flow Forecast (Black and Veatch, 2022). These flow projections were used to determine when the annual average daily flow (AADF) would meet or exceed 80% and 90% of the current permitted capacity of 0.3 MGD and the expanded flow capacities of 0.45 MGD, 0.6 MGD, and 1 MGD. Based on flow projections, the AADF of MCWWTP is expected to reach 90% of the permitted hydraulic capacity by 2030, meaning that by 2030 WSACC must have completed the design and permitting of the next expansion and construction must be starting. However, the historical MMF has already reached the hydraulic design capacity of 0.3 MGD and that may be a reason to expand MCWWTP sooner.

Historical pollutant concentrations and loads were analyzed to determine the expected loads at the 0.45 MGD, 0.6 MGD, and 1 MGD design conditions. The flow projections were used along with constant annual average chemical oxygen demand (COD), 5-day biochemical oxygen demand (BOD_5), total suspended solids (TSS), and total ammonia nitrogen (TAN) concentrations to develop load projections for the current permitted capacity of 0.3 MGD and for expanding the plant.

The projected loads for expansion of MCWWTP to 1 MGD are provided in Table ES-2. To determine the annual average loads, the average historical MMF peaking factor of 1.40 was used instead of the maximum historical MMF peaking factor. This provides a more realistic design. The maximum month load peaking factors were then used to calculate the expected maximum month loads and concentrations. These loads will be used as the basis of design for expansion to treat a MMF of 1 MGD.

Table ES-2. 1 MGD Pollutant Loads and Concentrations Basis of Design				
Pollutant	Annual Average Load (lb/d)	Annual Average Concentration (mg/L)	Max Month Load (lb/d)	Max Month Concentration (mg/L)
COD	3,955	664	5,710	685
BOD_5	1,594	268	2,300	276
TSS	1,696	285	2,450	294
TAN	240	40.2	263	31.5

Section 1: Introduction

The Muddy Creek Wastewater Treatment Plant (MCWWTP), owned and operated by the Water and Sewer Authority of Cabarrus County (WSACC), is currently designed, and permitted to treat up to 0.3 MGD on a monthly average basis and has an effluent limits page for 1 MGD already included in its National Pollution Discharge Elimination System (NPDES) operating permit. Funding of up to $11 million was recently secured for capital improvements at MCWWTP. Though this funding may not be sufficient for an expansion to 1 MGD, it may be sufficient for an expansion to 0.45 or 0.6 MGD. In anticipation of growth within its service area, WSACC is looking into expansion alternatives to meet demands beyond 2027 and through 2050.

This TM summarizes the historical flows and pollutant loadings to the MCWWTP. Historical flows and loads were used to develop peaking factors for the facility and influent flows and loads basis of design for expansion up to 1 MGD MMF. Historical influent data from January 1, 2013 through December 21, 2023 was obtained from WSACC and used for this analysis.

1.1 MCWWTP Description

MCWWTP is a nitrifying activated sludge plant that consists of influent pumping, screening, equalization (EQ), aeration basins with secondary clarifiers, filtration, ultraviolet (UV) light disinfection, and cascade aeration. A simplified process flow diagram is provided in Figure 1. Raw influent from the gravity flow collection system is pumped from the influent pump station (IPS) where it passes through a 5-mm rotary drum screen and into the EQ tank. The IPS does not operate continuously but is based on the level in the wet well. The EQ tank is mixed with coarse bubble aeration. Recycle flow from the plant drains is pumped directly into the EQ tank, so the influent sampler, which is located adjacent to the rotary drum screen on the deck of the EQ tank, does not include the recycle flow. Flow is pumped out of the EQ tank, combines with the return activated sludge (RAS) flow, passes through manual bar screens, and is split between four parallel aeration trains, followed by two secondary clarifiers. Secondary effluent passes through disc filters, UV disinfection, effluent cascade aeration, and then is discharged to the Rocky River.

Waste activated sludge (WAS) is sent to four sludge holding tanks (SHTs) that are mixed using coarse bubble aeration. The SHTs are manually decanted several times to thicken the solids and the decant is sent to the plant drains. Thickened sludge is hauled to the RRRWWTP, also owned, and operated by WSACC, for further processing.

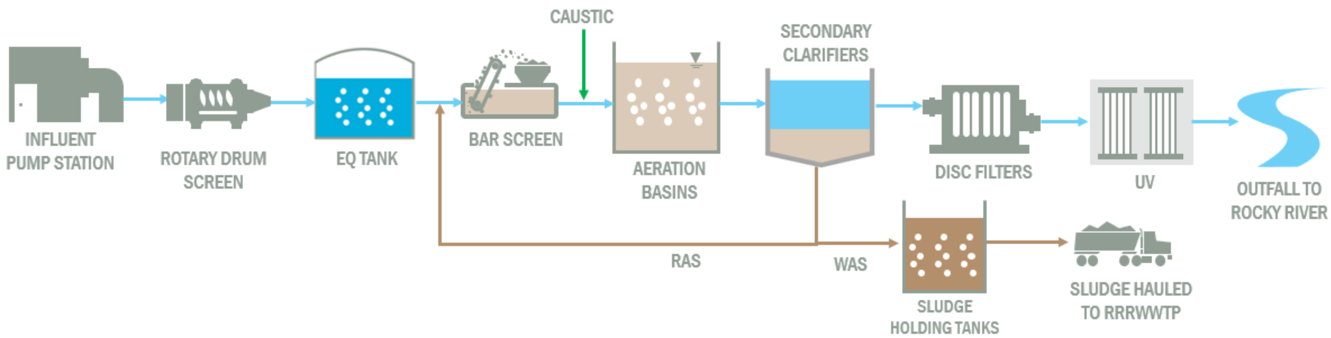

Figure 1. Process flow diagram of the MCWWTP.

Section 2: Historical and Projected Flows

Daily data from January 1, 2013 through December 31, 2023 was analyzed to evaluate historical influent flows to develop influent flow design criteria for expanding the facility. Historical 15-minute data from January 1, 2023 through December 31, 2023 was used to determine hourly flow rates and peaking factors.

2.1 Historical Flows

The IPS flow to the EQ tank is monitored by a magnetic flow meter, but the IPS does not operate continuously and is based on liquid level in the IPS wet well. Effluent flow is measured following cascade aeration using a V-notch weir, and these reported effluent flows are used as the basis for analysis in this TM.

The historical daily, 30-day moving average, and 365-day moving average flows for MCWWTP are presented in Figure 2. The daily flow has increased by 200% overall or 18% on an annual basis from 2013 to 2023. Starting in 2019, the peak flows become much more variable than in the previous years. This may indicate inflow and infiltration (I&I) has increased ever though WSACC continues its efforts to manage it. For example, WSACC completed smoke testing for the WSACC lines in the Muddy Creek service area in March 2022, and replaced 157 cleanout caps and repaired 4 manholes rings and covers noted as needing work during that effort. WSACC is currently working on a system-wide I&I study.

.

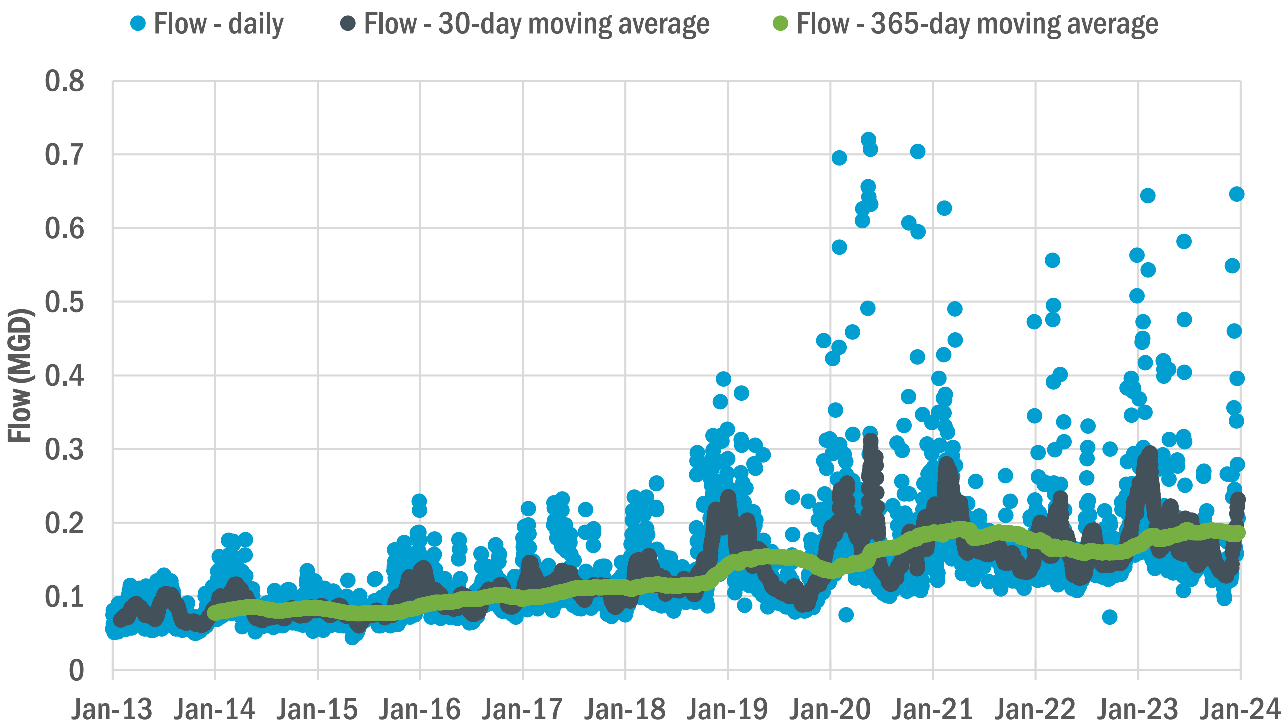

Figure 2. Daily, 30-day moving average, and 365-day moving average flows at MCWWTP.

A summary of peak and minimum flows is provided in Table 1, including the flow peaking factors. All flows in the table were determined using reported daily average effluent flows (2013 – 2023). Peaking factors were initially calculated as the ratio of maximum or minimum flow to AADF. These are based on rolling average flows (i.e., 365-day, 30-day, and 7-day rolling average flows). The peaking factors for MCWWTP were generally higher than typical plants; for example, typical MMF peaking factors for the region are around 1.25 compared to 1.94 for MCWWTP. High peaking factors are not unusual for small collection systems. However, the significantly high values at MCWWTP may be due to the changes in flows starting in 2019 as previously noted. The peaking factor values presented in Table 1 therefore were calculated using the maximum AADF (maximum 365-day rolling average flow from 2019 to 2023) of 0.192 MGD. The resultant MMF peaking factor is 1.62. This MMF peaking factor is similar to the value of 1.63 that was used in the 2022 Master Plan collection system model (Black & Veatch, 2022).

Table 1. Summary of Historical Flows at MCWWTP

Flow Condition	Flow Rate (MGD) [a]	Peaking Factor [b]
Maximum Week Flow (MWF)	0.538	2.80
Maximum Month Flow (MMF)	0.312	1.62
Annual Average Daily Flow (AADF)	0.192	-
Minimum Day Flow (MDF)	0.072	0.38

[a] *Flows are calculated as rolling averages (7-day max week, 30-day max month, 365-day annual average).*

[b] *Peaking Factors are relative to AADF.*

As shown in Table 1, the MMF based on 30-day rolling averages exceeds the 0.3 MGD limit. Similarly, the MMF that has been observed based on calendar months is right at 0.3 MGD. While the AADF is well below the 80/90 rule (15A NCAC 02T .0118) annual average flow triggers, MCWWTP is currently at risk of monthly average flow exceedances.

The peak hour flows were initially calculated using 15-minute intervals from the IPS for 2023. The current firm capacity (one pump) of the IPS is 730 gallons per minute (gpm) (1.05 MGD) and the total capacity (both pumps) is 1,460 gpm (2.10 MGD). The peak hour flow of 1.87 MGD was recorded multiple times, on both April 10 and December 27, 2023. This is well above the firm capacity of the IPS and indicates that the standby pump was brought online. The influent flow meter is scaled from 0 to 1,300 gpm (1.87 MGD), but the pumped flow may have been higher than recorded and closer to the total IPS pumping capacity of 2.10 MGD during these peak flow events. It is also likely that both pumps may have been off and then kicked on in response to high levels in the wet well, and the actual influent flow rate from the collection system may have been lower than the total pump capacity. Therefore, these peak flows were compared to the model-predicted peak hour flow of 1.53 MGD for a 2-year storm and 1.84 MGD for a 5-year storm from the 2022 Master Plan collection system model (Black & Veatch, 2022). The diurnal flows for these storm events are shown in Figure 3. The recorded IPS flows were more similar to the model-predicted 5-year storm event flow than the 2-year event. Future designs would not likely use anything beyond a 5-year storm event. Furthermore, the peaking factors corresponding to the 2-year and 5-year storm events of 7.96 and 9.57 (using the storm event peak hour flow and AADF of 0.192 MGD) are extremely high, and future design would not use these same peaking factors, but rather the collection system model to predict future peak hour flows, as the model has built-in assumptions for system improvements and restrictions (and so would yield a lower peaking factor for future years anyway). The estimation for projected peak hour flow using the collection system model is discussed in Section 2.2.

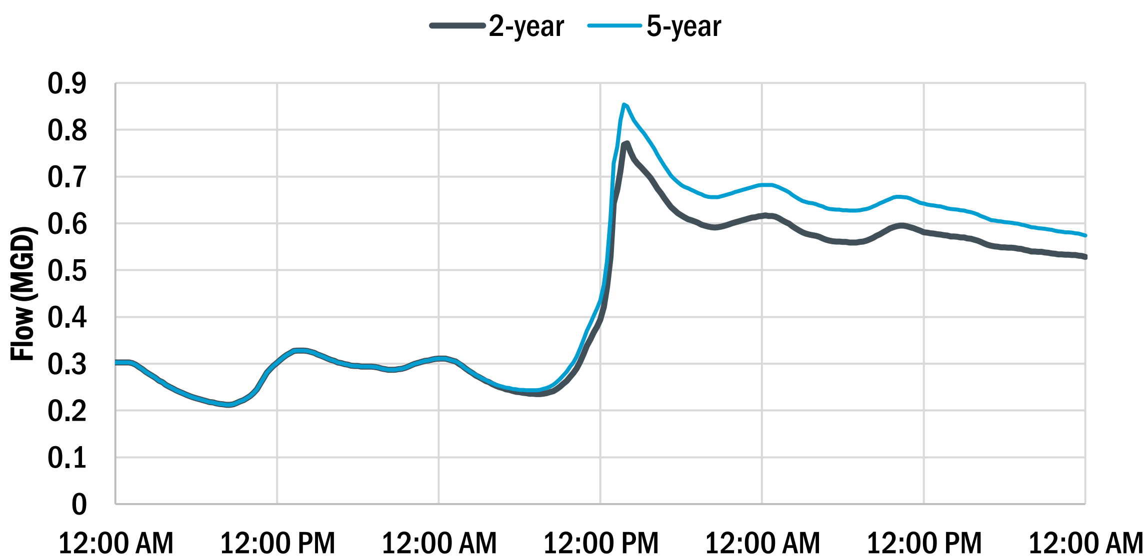

Figure 3. Modeled 2-year and 5-year storm event diurnal flow curves from the Master Plan collection system model (Black & Veatch, 2022).

Similar to the IPS flow meter, the effluent flow meter appeared to have been maxed out. The effluent flow meter is scaled from 0 to 500 gpm (0.72 MGD), and notably the historical peak day flow of 0.72 MGD was recorded sequentially on both May 21 and May 22, 2020. The actual peak day flow for this wet weather event was likely higher. Instead, the historical peak day EQ influent flow was considered, which was recorded as 1.70 MGD on December 27, 2023. However, this corresponded to the same storm event where the maxed-out flow of 1.87 MGD was recorded at the IPS and given the infrequency of the event as noted in the discussion on peak hour flow, it is not recommended to be used for future design. The peak day flows for the

2-year and 5-year storm events modeled by the collection system were 0.98 MGD and 1.20 MGD, respectively, which correspond to peaking factors of 5.10 and 6.24. A summary of peak hour and peak day flows is presented in Table 2. The estimation for projected peak hour and day flow using the collection system model rather than a constant peaking factor is discussed in Section 2.2.

Table 2. Summary of Peak Hour and Peak Day Flows at MCWWTP

Flow Condition and Source	Flow Rate (MGD)	Peaking Factor [a]	Notes
Peak Hour			
IPS flow meter	1.87	9.73	Historical (2013-2023) maximum; flow meter maxed out
IPS total capacity	2.10	10.9	Rated pump capacity (from 2018 expansion reference drawings)
2-year storm event	1.53	7.96	From 2022 Master Plan collection system model
5-year storm event	1.84	9.57	From 2022 Master Plan collection system model
Peak Day			
Effluent flow meter	0.72	3.75	Historical (2013-2023) maximum; flow meter maxed out
EQ Influent flow meter	1.70	8.85	Historical (2013-2023) maximum
2-year storm event	0.98	5.10	From 2022 Master Plan collection system model
5-year storm event	1.20	6.24	From 2022 Master Plan collection system model

[a] *Peaking Factors are relative to AADF of 0.192 MGD.*

To expand the plant capacity the IPS will also need to be expanded. The IPS, screening, and EQ basin should be designed around peak hour flow. However, the EQ basin is used for peak shaving so hourly flows are not necessarily representative of treated/effluent flow, and the processes following EQ should be designed around a peak day flow capacity or lower rather than peak hour. The EQ capacity at future flows will determine the peak flow through the plant.

2.2 Flow Projections

Using the peaking factors provided in Table 1, the flows at the maximum month design capacities of 0.45 MGD, 0.6 MGD, and 1 MGD were calculated and are summarized in Table 3. Given the estimation of the historical peak day and peak hour flows as discussed in the previous section, rather than using a constant peaking factor, these basis of design flows were estimated by interpolating between the baseline (2022) and 2050 collection system model 2-year storm event flows, which results in different peaking factors provided in Table 4. All basis of design flows can be used to evaluate current unit process capacities versus future needs and identify the processes that would need to be expanded to meet 0.45 MGD, 0.6 MGD, and ultimately the 1 MGD design capacity. This will be addressed in a capacity analysis in a future TM.

Table 3. Basis of Design Flows at MCWWTP			
Flow Condition	Flow Rate (MGD)		
	For 0.45 MGD MMF	For 0.6 MGD MMF	For 1 MGD MMF
Peak Hour Flow (PHF) [a]	2.58	3.04	4.21
Peak Day Flow (PDF) [a]	1.56	1.82	2.47
Maximum Week Flow (MWF)	0.78	1.04	1.73
Maximum Month Flow (MMF)	0.45	0.60	1.00
Annual Average Daily Flow (AADF)	0.28	0.37	0.62
Minimum Day Flow (MDF)	0.10	0.14	0.22

[a] *Based on 2-year storm interval projections (B&V, 2022) instead of historical peaking factors.*

Table 4. Peak Hour and Peak Day Flow Peaking Factors			
Flow Condition	Peaking Factor [a]		
	For 0.45 MGD	For 0.6 MGD MMF	For 1 MGD MMF
Peak Hour Flow (PHF)	9.21	8.22	6.79
Peak Day Flow (PDF)	5.57	4.92	3.98

[a] *Peaking Factors are relative to AADF.*

To determine when MCWWTP will exceed the 0.3 MGD, 0.45 MGD, and 0.6 MGD design capacities, the historical MMF peaking factors and the 2022 Master Plan flow projections (Black & Veatch, 2022) were used to project future MMF. The historical and projected flows are shown in Figure 4 through Figure 6 along with the potential range of MMF and the 80 and 90 percent design triggers. The 2022 Master Plan flow projections are based on population projections and are for the AADF. The Master Plan projections slope increases significantly in 2030, due to an anticipated acceleration of growth in the Town of Midland as noted in the Master Plan (Black & Veatch, 2022). In Figure 4 through Figure 6, the solid green line represents the projected AADF and should be compared to the 80/90 rule (15A NCAC 02T .0118) thresholds to establish the year when an expansion or flow reduction process should be initiated. The solid blue line represents the projected average MMF using the historical average peaking factor of 1.40 based on calendar month and year, and the shaded blue area represents the potential range of MMFs. These values should be compared to the black capacity line (i.e., monthly average permit limit). The potential range of MMF was calculated using the historical maximum and minimum MMF:AADF peaking factors of 1.62 and 1.20, respectively, as calculated based on calendar month and year.

The expansion of the plant in 2018 from 0.15 to 0.3 MGD is also reflected in the capacity plots in Figure 4 through Figure 6. The MMF projections indicate that the MCWWTP is already at its design capacity of 0.3 MGD, but the AADF is not expected to reach 90 percent of the permitted hydraulic capacity until 2030, which indicates construction needs to be started by that year according to the 80/90 rule (15A NCAC 02T .0118). While the figures show an immediate step up in capacity when AADF hits this 90 percent design trigger, the actual construction completion and achievement of that increased capacity rating is sometime in the following years, but duration is too variable from project to project and hard to predict.

Intermediate capacities of 0.45 MGD and 0.6 MGD are shown on the capacity projection in Figure 4 and could be phased expansion steps prior to the full expansion to 1 MGD. MMF projections surpass 0.45 MGD by the year 2033 and 0.6 MGD by the year 2037. However, this is only 3 year and 7 years, respectively, after the initial expansion from 0.3 MGD is warranted. If the risk of exceeding the MMF is acceptable, or the peaking factor can be reduced, the AADF does not reach 90% of the 0.45 MGD capacity until 2036, which indicates construction to expand beyond 0.45 MGD could start that year. The acceptance of risk of exceeding the MMF or reduction of peaking factors is assumed for all following scenarios as well. If the expansion were to 0.6 MGD, 90% of the 0.6 MGD capacity would be reached in 2042 and triggers the start of the next expansion to 1 MGD. This expansion in 2042 is not long after the previous expansion in 2036, so Figure 5 shows a progression where the 0.45 MGD step is skipped, and the initial expansion is from 0.3 MGD to 0.6 MGD. Another option would be to expand from 0.3 MGD directly to 1 MGD and skip both intermediate steps to cut down on the number of construction periods, as shown in Figure 6. The 1 MGD design MMF capacity will be exceeded by 2049.

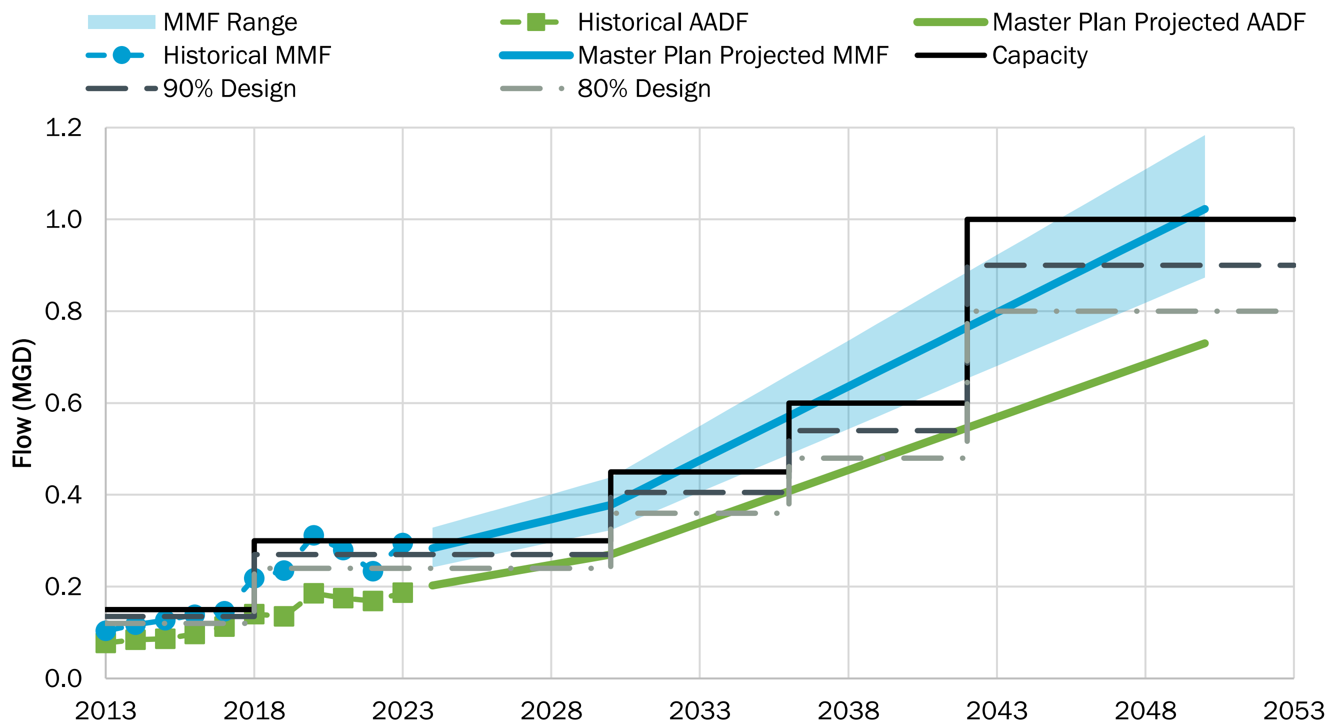

Figure 4. Historical flow data and Master Plan flow projections compared to capacity limits for 0.45 MGD, 0.6 MGD, and 1 MGD expansions.

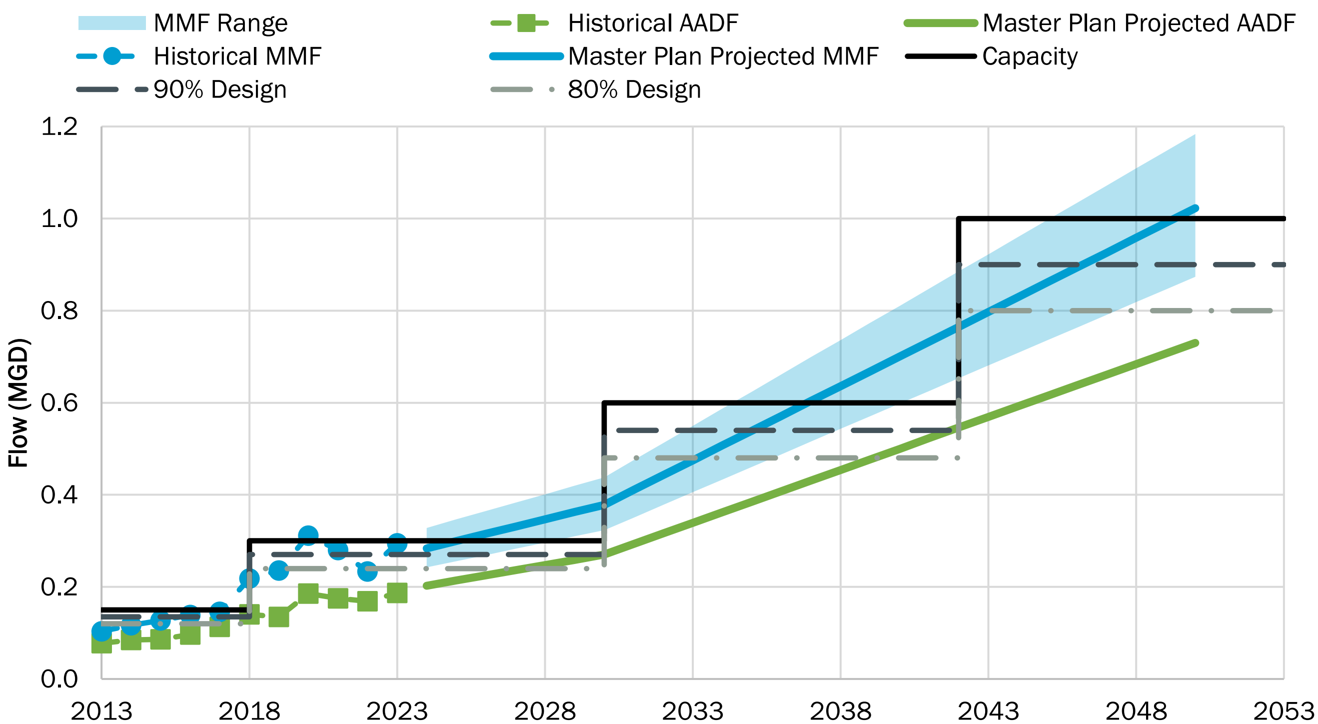

Figure 5. Historical flow data and Master Plan flow projections compared to capacity limits for 0.6 MGD and 1 MGD expansions (skipping the 0.45 MGD capacity expansion level).

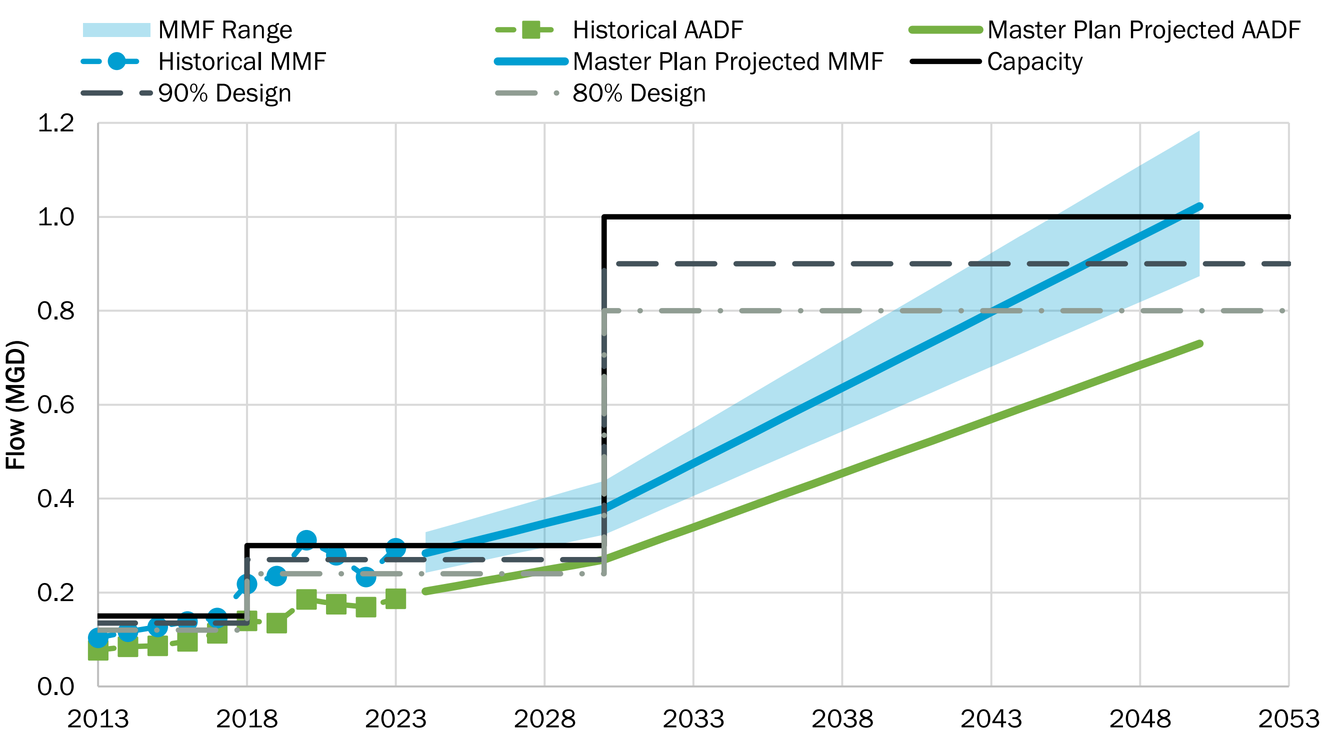

Figure 6. Historical flow data and Master Plan flow projections compared to capacity limits for 1 MGD expansion (skipping the 0.45 MGD and 0.6 MGD capacity expansion levels).

Section 3: Historical and Projected Loads

Daily data from January 1, 2013 through December 31, 2023 was analyzed to estimate historical influent pollutant loadings for developing design criteria and information to support the process modeling. Prior to placement adjacent to the EQ tanks and rotary drum screen in 2019 and commissioning of the plant drains pump station, the influent sampler was located upstream of the IPS. At no point did the influent sampler include recycle flow, as the plant drain pump station pumps directly to EQ and plant drain flow previously went to the IPS (downstream of the original influent sampler location). With the change in influent sampler location, no significant difference in influent concentration data was observed in 2019, so data from the 2013 – 2023 period was used for analysis (with exceptions noted in the following subsections).

3.1 Historical Pollutant Concentrations

Figure 7 through Figure 10 provide the historical annual average influent COD, BOD_5, TSS, and TAN concentrations for the MCWWTP influent. As shown in Figure 7, no COD data was collected in 2014 and 2015. To interpret these figures, referred to as box and whisker plots, the mean is displayed as an X, the median (50th percentile) line divides the box, the top of the box is the third quartile (75th percentile), the bottom of the box is the first quartile (25th percentile), the top whisker is the local maximum, the bottom whisker is the local minimum, and the points are considered outliers.

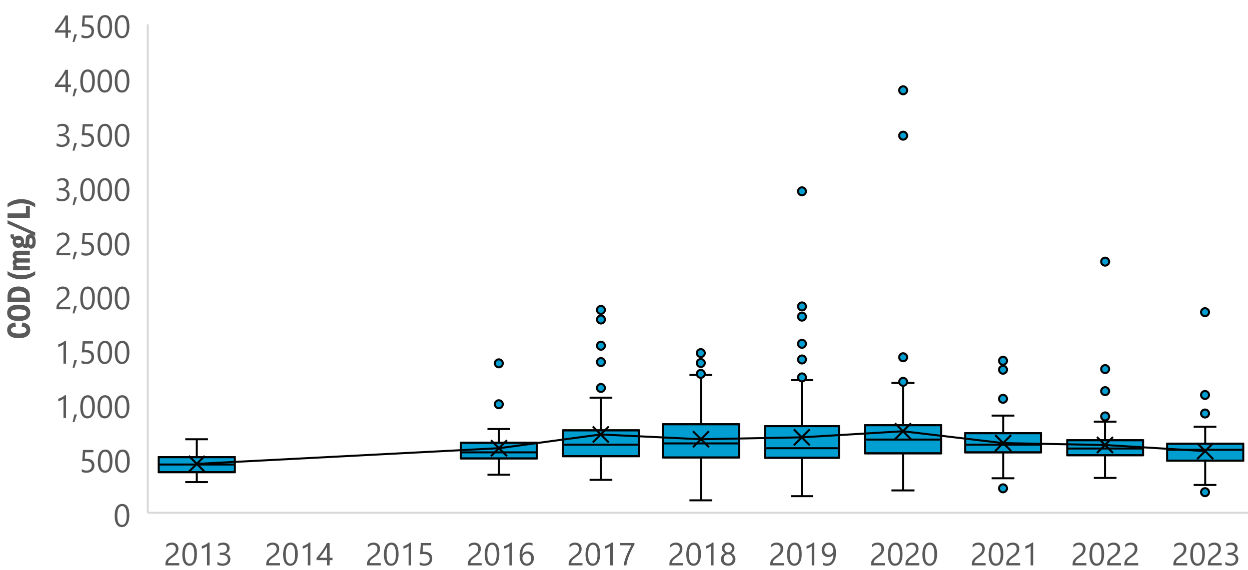

Figure 7. Annual average COD concentration of MCWWTP influent.

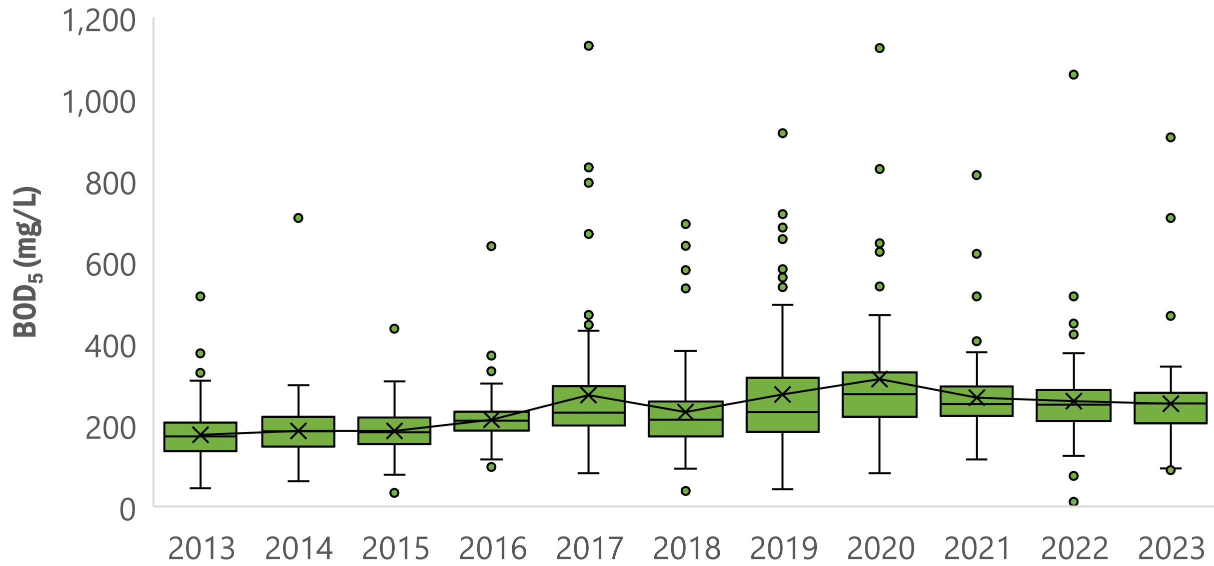

Figure 8. Annual average BOD_5 concentration of MCWWTP influent.

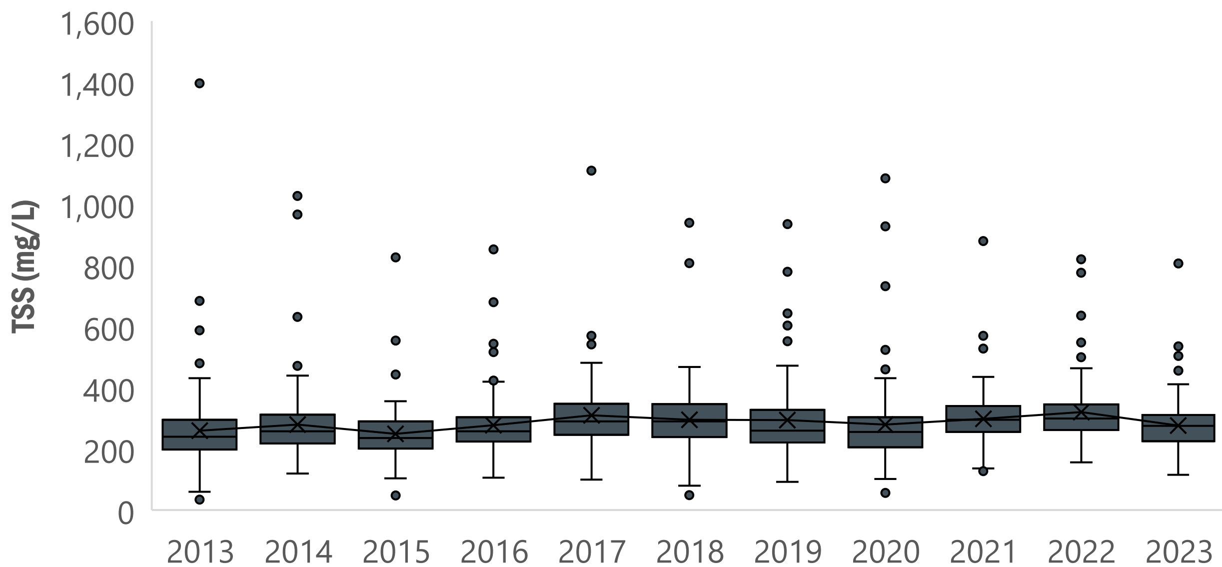

Figure 9. Annual average TSS concentration of MCWWTP influent.

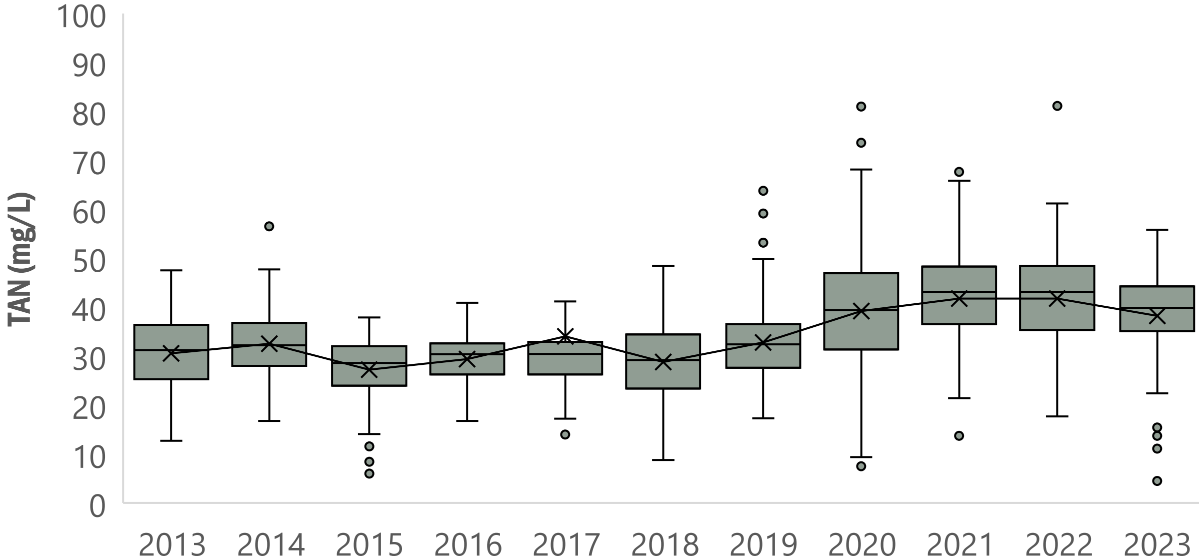

Figure 10. Annual average TAN concentration of MCWWTP influent.

COD and TSS concentrations remained relatively constant (<2% change on average on an annual basis). Based on these observations it is not anticipated that the strength of these pollutants for the influent will change for the foreseeable future. On the other hand, an increase in BOD_5 concentration in 2017 and in TAN concentration in 2020 were observed, after which the annual concentrations generally remained steady. The increase in TAN concentrations was likely due to widespread adoption of water saving features, like low flow toilets. It is not anticipated that BOD_5 or TAN concentrations will increase again as significantly as they did in 2017 and 2020, respectively, due to limitations on the extent of water saving features implementation. Average pollutant concentrations and the period over which the average concentration was calculated are summarized for each pollutant in Table 5.

Table 5. Average Influent Pollutant Concentrations

Pollutant	Concentration (mg/L)	Years for Average
COD	664	2013 - 2023
BOD_5	268	2017 - 2023
TSS	285	2013 - 2023
TAN	40.2	2020 - 2023

3.2 Historical Loads

Historical influent loads for COD, BOD_5, TSS, and TAN are provided in Figure 11 through Figure 14, respectively. The maximum annual average (365-day rolling) influent loads from 2013-2023 were calculated after removal of outliers (by using 99th percentile values). The 30-day rolling average was used to calculate the maximum month loads. The maximum month load peaking factor was calculated as the ratio of the maximum month load to maximum annual average load. Table 6 presents a summary of the historical loads to MCWWTP.

Table 6. Summary of Historical Loads at MCWWTP

Pollutant	Annual Average Load (lb/d)	Max Month Load (lb/d)	Max Month Peaking Factor
COD	977	1,337	1.37
BOD_5	394	564	1.43
TSS	449	687	1.53
TAN	59	64	1.10

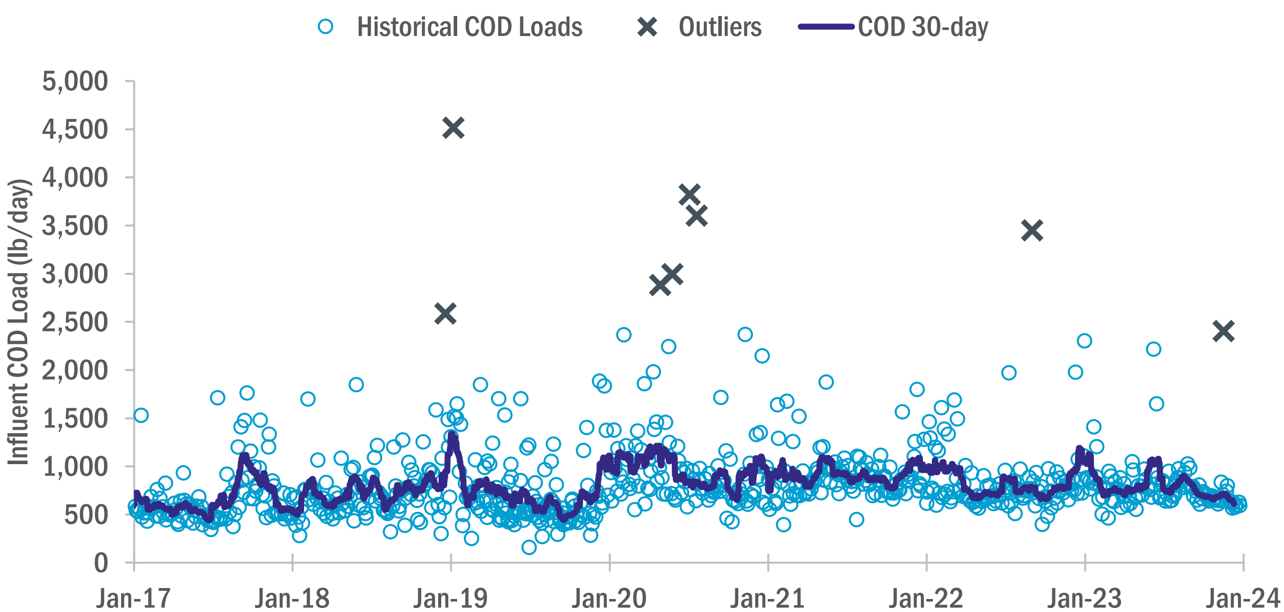

Figure 11. Daily and 30-day moving average influent COD load to MCWWTP.

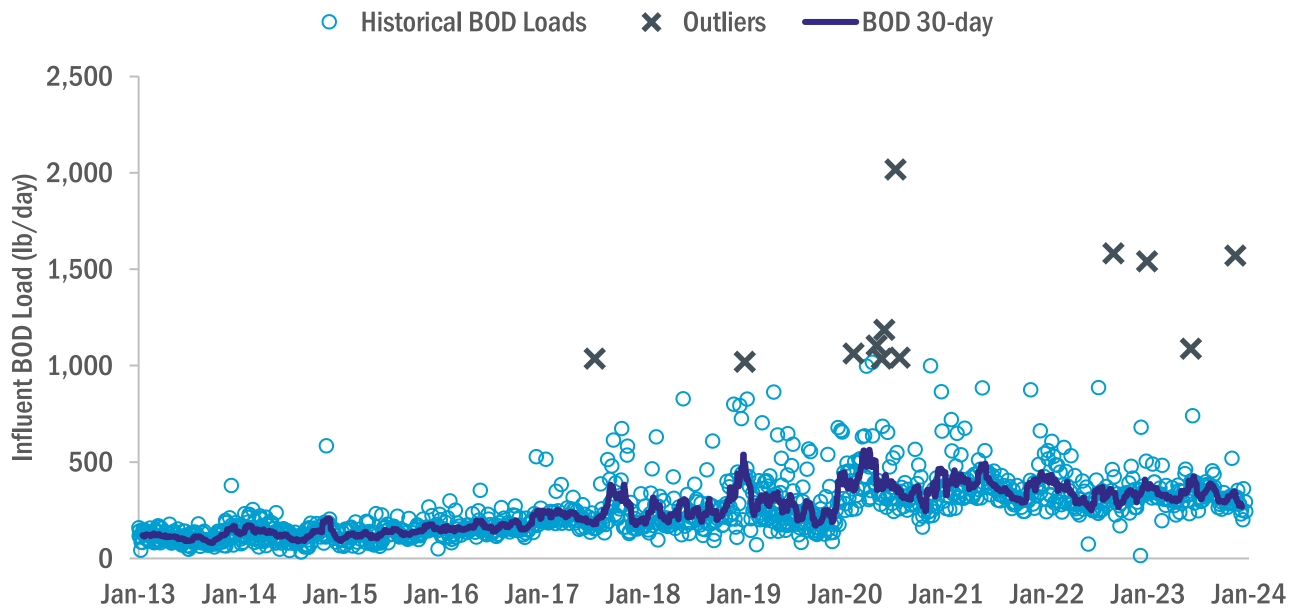

Figure 12. Daily and 30-day moving average influent BOD_5 load to MCWWTP.

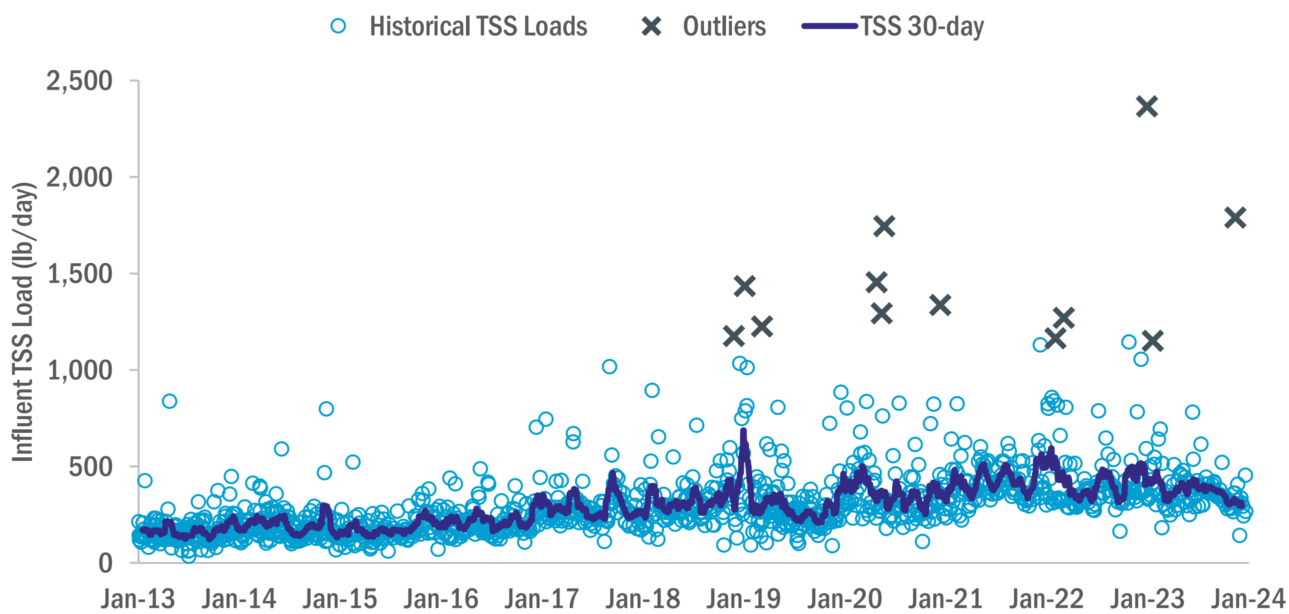

Figure 13. Daily and 30-day moving average influent TSS load to MCWWTP.

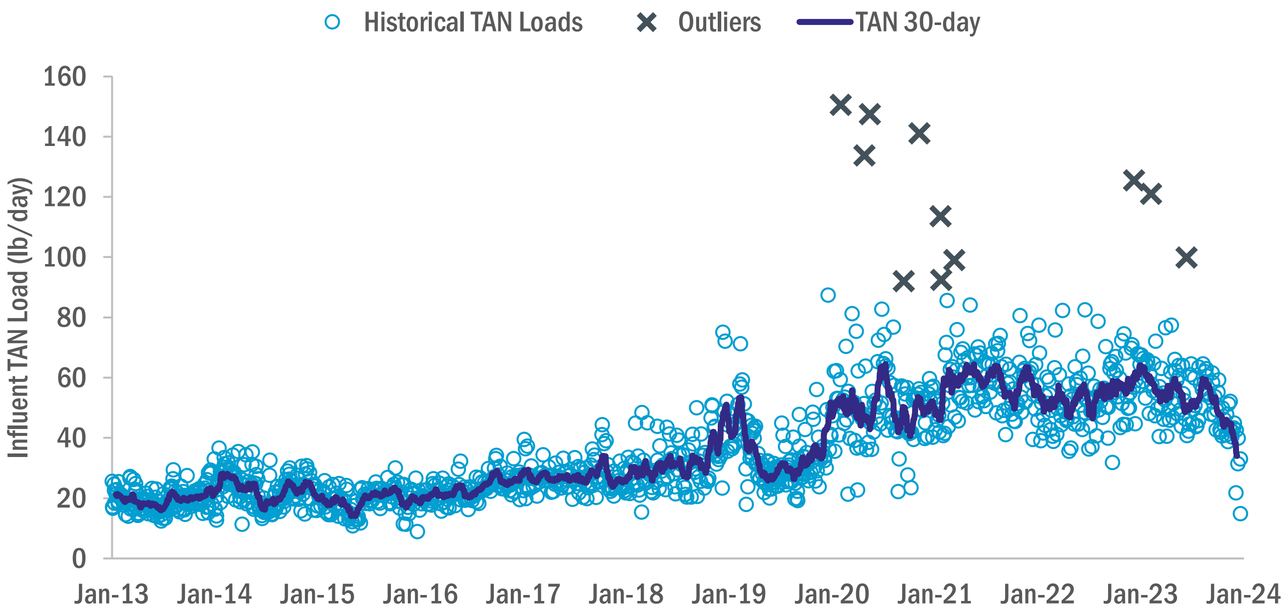

Figure 14. Daily and 30-day moving average influent TAN load to MCWWTP.

3.3 Load Projections

Load projections were calculated based on the Master Plan flow projections (discussed in Section 2.2) assuming the average pollutant concentration (Table 5) remain constant. These projections, along with the historical annual average loads, are presented in Figure 15 through Figure 18 for COD, BOD_5, TSS, and TAN, respectively. The slope of the Master Plan projections increases significantly following 2030.

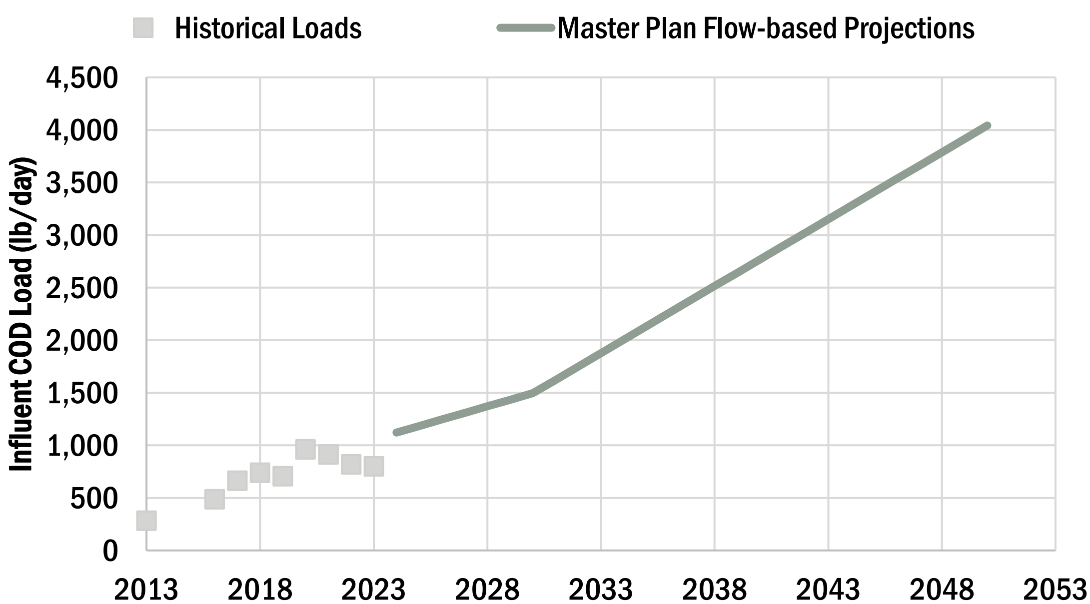

Figure 15. COD load projections to MCWWTP.

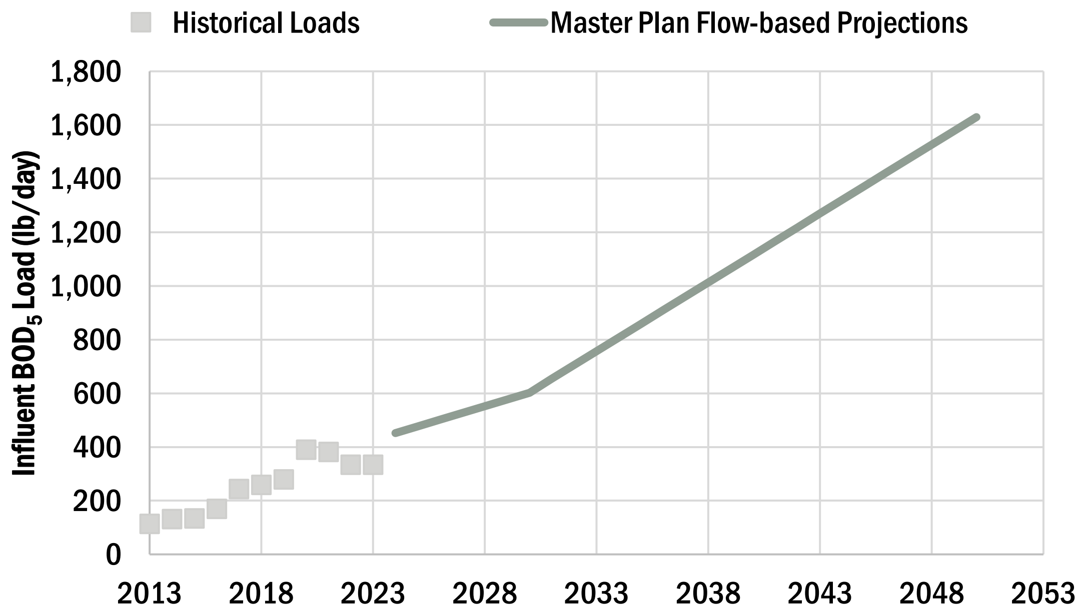

Figure 16. BOD_5 load projections to MCWWTP.

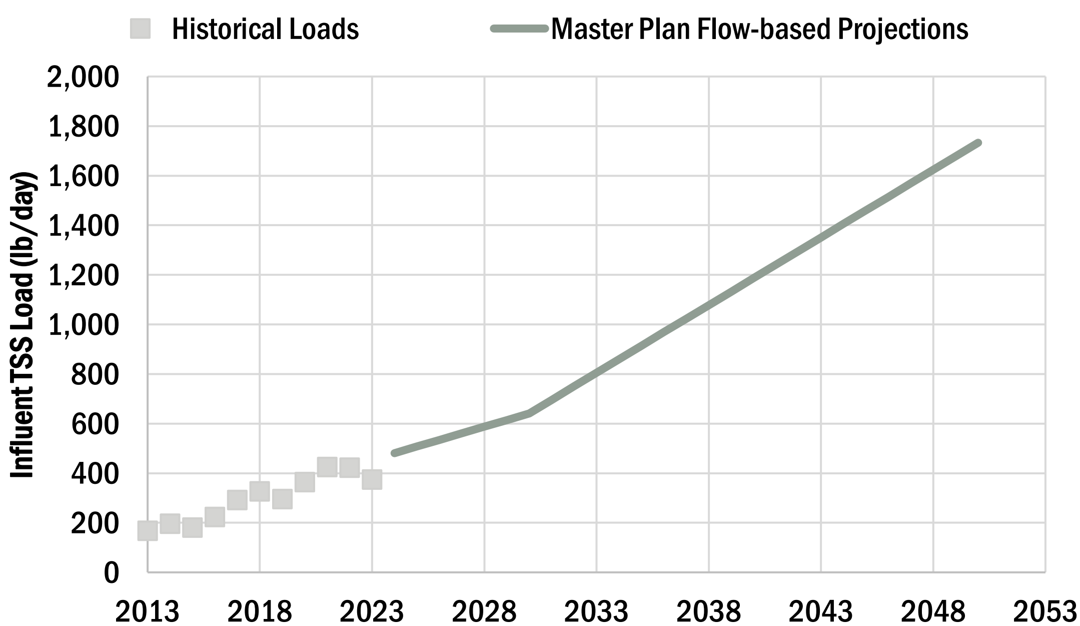

Figure 17. TSS load projections to MCWWTP.

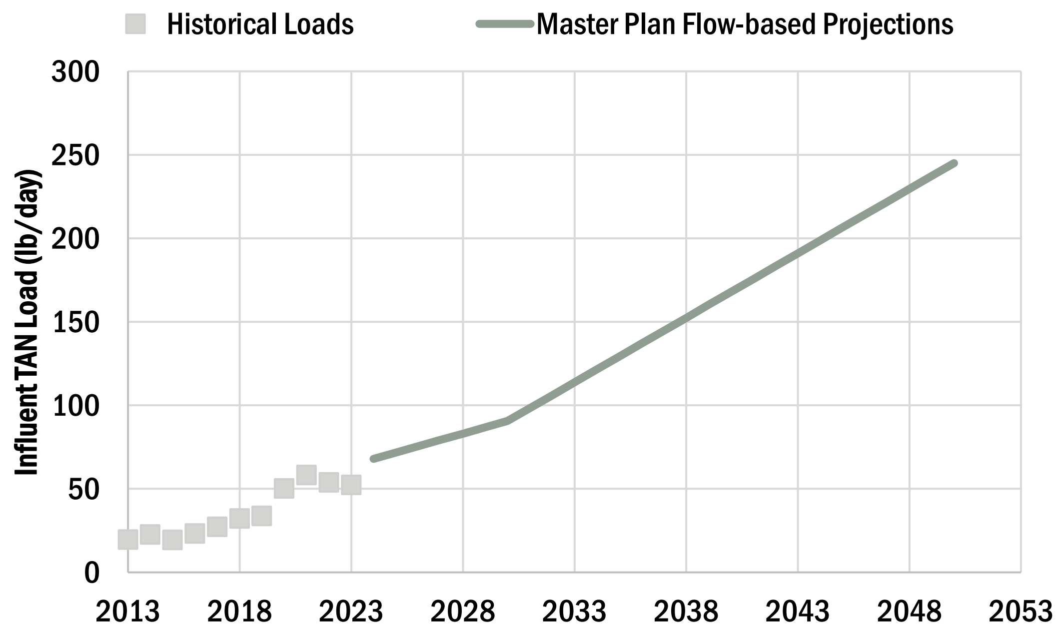

Figure 18. TAN load projections to MCWWTP.

Section 4: Summary and Recommendations

The 2022 Master Plan flow projections, based on population projections, were used to develop the basis of design. The MMF has already reached the hydraulic design capacity of 0.3 MGD. However, the MMF peaking factor of 1.40 (historical average of MMF peaking factors based on calendar month and year) is significantly higher than typically seen at other treatment plants, and the AADF of 0.21 MGD is only around 71% of the permitted hydraulic capacity (i.e., 0.3 MGD) and well below the 80/90 rule (15A NCAC 02T .0118) annual average flow triggers. Based on flow projections, the AADF of MCWWTP is expected to reach 90% of the permitted hydraulic capacity by 2030, which indicates construction needs to be started by that year. However, because the Master Plan flow projections appear to be conservative, flows and loads should be tracked against the projections to better determine when expansions should occur. Since wet weather equalization is already utilized at MCWWTP, I&I reduction should be evaluated to lower this peaking factor and reduce the risk of maximum month flow exceedances.

Using the Master Plan flow projections and assuming constant annual average COD, BOD_5, and TSS concentrations, load projections were developed for the current permitted capacity of 0.3 MGD and for expanding the plant to 0.45 MGD, 0.6 MGD, and 1 MGD. The projected loads for the current permitted capacity are provided in Table 7 and the projected loads for the expansion to 0.45 MGD, 0.6 MGD, and 1 MGD are provided in Table 8 through Table 10. The MMF peaking factor of 1.40 was used to calculate the average flow for the specific design capacity flow (0.3 MGD, 0.45 MGD, 0.6 MGD, or 1 MGD), and thus the associated average loads (assuming the constant annual average pollutant concentrations as noted above).

The average of the maximum month load peaking factors provided in Section 3.2 for COD, BOD_5, and TSS of 1.44 was used to calculate the expected maximum month loads based on the average loads for those parameters. For TAN the maximum month load peaking factor of 1.10 (as provided in Section 3.2) was used. The maximum month concentrations were calculated from these loads and the MMF peaking factor of 1.40. Note the concentrations and loads presented are higher than the original 0.3 MGD basis of design developed for the 2018 plant expansion (Willis Engineers, 2016), where the BOD_5, TSS, and TAN concentrations were 250 mg/L, 250 mg/L, and 31 mg-N/L, respectively. Concentrations used in this TM were based on historical data as described in Section 3.1 and include data from years after the expansion, particularly when there has been widespread adoption of water saving features as previously discussed. These updated concentrations and loads will be used as the basis of design for evaluating current treatment capacity and expansion to treat a maximum month flow of 0.45 MGD, 0.6 MGD, and ultimately 1 MGD.

Table 7. 0.3 MGD Pollutant Loads and Concentrations (Current)

Pollutant	Annual Average Load (lb/d)	Annual Average Concentration (mg/L)	Max Month Load (lb/d)	Max Month Concentration (mg/L)
COD	1,187	664	1,710	683
BOD_5	478	268	691	276
TSS	509	285	735	294
TAN	72	40.2	79	31.6

Table 8. 0.45 MGD Pollutant Loads and Concentrations

Pollutant	Annual Average Load (lb/d)	Annual Average Concentration (mg/L)	Max Month Load (lb/d)	Max Month Concentration (mg/L)
COD	1,780	664	2,570	685
BOD_5	717	268	1,036	276
TSS	763	285	1,102	294
TAN	108	40.2	118	31.4

Table 9. 0.6 MGD Pollutant Loads and Concentrations

Pollutant	Annual Average Load (lb/d)	Annual Average Concentration (mg/L)	Max Month Load (lb/d)	Max Month Concentration (mg/L)
COD	2,373	664	3,430	685
BOD_5	957	268	1,381	276
TSS	1,017	285	1,469	294
TAN	144	40.2	158	31.6

Table 10. 1 MGD Pollutant Loads and Concentrations

Pollutant	Annual Average Load (lb/d)	Annual Average Concentration (mg/L)	Max Month Load (lb/d)	Max Month Concentration (mg/L)
COD	3,955	664	5,710	685
BOD_5	1,594	268	2,300	276
TSS	1,696	285	2,450	294
TAN	240	40.2	263	31.5

References

Black & Veatch, 2022. WSACC FY 2022 Master Plan. Future Utility Demand and Flow Forecast Technical Memorandum, January 4.

Willis Engineers, 2016. Contract 7.0 – Muddy Creek WWTP 0.3 MGD Expansion Design Calculations, September 2.

Attachment K

Brown AND Caldwell

309 East Morehead Street,
Suite 220
Charlotte, NC 28202

T: 704.358.7204

Technical Memorandum

Prepared for: Water and Sewer Authority of Cabarrus County (WSACC)

Project Title: Wastewater Treatment Facilities Plan and Preliminary Engineering Report

Project No.: 193209.200.004

Technical Memorandum No. 6

Subject: Biological Process Modeling for MCWWTP

Date: February 12, 2025

To: Chad VonCannon, P.E., Executive Director

From: George Anipsitakis, P.E., Project Manager

Copy to: Thomas Hahn, P.E., Engineering Director

Prepared by: Kayla Bauhs Mark Miller

Kayla Bauhs, Process Engineer
Mark Miller, Ph.D., P.E., Lead Process Engineer

Reviewed by:

Jose Jimenez, Ph.D., P.E., Technical Reviewer
George Anipsitakis, Ph.D., P.E., Project Manager

NORTH CAROLINA PROFESSIONAL SEAL 045265 ENGINEER MARK WALLACE MILLER 2/12/25

Limitations:

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List of Abbreviations

BC	Brown and Caldwell
BOD_5	5-day Biochemical Oxygen Demand
$CBOD_5$	Carbonaceous 5-day Biochemical Oxygen Demand
CO_2	Carbon Dioxide
COD	Chemical Oxygen Demand
d	day
DO	Dissolved Oxygen
EQ	Equalization
ft	Foot/Feet
Fup	Fraction of Unbiodegradable Particulate COD
Fus	Fraction of Unbiodegradable Soluble COD
gal	Gallon
gpd	Gallons per Day
IPS	Influent Pump Station
ISS	Inert Suspended Solids
L	Liter
lb	pound
MCWWTP	Muddy Creek Wastewater Treatment Plant
mg	Milligram
MGD	Million Gallons per Day
MLSS	Mixed Liquor Suspended Solids
MMF	Maximum Month Flow
mmol	millimole
RAS	Return Activated Sludge
RRRWWTP	Rocky River Regional Wastewater Treatment Plant
SC	Secondary Clarifier
scfm	Standard Cubic Feet per Minute
SHT	Sludge Holding Tank
SRT	Solids Retention Time
TAN	Total Ammonia Nitrogen
TKN	Total Kjeldahl Nitrogen
TM	Technical Memorandum
TSS	Total Suspended Solids
TWAS	Thickened Waste Activated Sludge
UV	Ultraviolet
VSS	Volatile Suspended Solids
WAS	Waste Activated Sludge
WSACC	Water and Sewer Authority of Cabarrus County

Executive Summary

This Technical Memorandum No. 6 (TM-6) summarizes the BioWin™ biological process modeling of the Muddy Creek Wastewater Treatment Plant (MCWWTP). MCWWTP is a nitrifying activated sludge plant with a permitted capacity of 0.3 million gallons per day (MGD) maximum month flow (MMF) that discharges to the Rocky River.

Historical daily average influent, operating, and effluent data from January 2013 through December 2023 was collected, reviewed, and analyzed. Brown and Caldwell (BC) developed a calibrated BioWin model using historical data from the most recent three years of historical data from 2021 through 2023. Certain assumptions had to be made for fine tuning the model. The key observations based on the modeling efforts were as follows:

- Chemical addition (caustic) was used to match effluent quality (pH and alkalinity) rather than matching historical chemical addition, for which data is limited.
- Elevated MLSS (approximately 6,000 mg/L on average) due to the long solids retention time (SRT) (> 40 days) may limit secondary clarifier capacity at peak flows and in the future.
- Model-predicted airflows were approximately 7 percent higher than historical daily average airflow and should be considered in evaluation of aeration system capacity moving forward.

Overall, the calibrated model predicts plant performance to an acceptable level given the limitations and assumptions discussed in this TM. The calibrated model will be used to evaluate treatment capacity and future expansion alternatives.

Section 1: Background and Scope of Work

The Water and Sewer Authority of Cabarrus County (WSACC) owns and operates the Muddy Creek Wastewater Treatment Plant (MCWWTP), a 0.3 million gallons per day (MGD) maximum monthly flow (MMF), nitrifying activated sludge wastewater treatment facility. Treated water is discharged to the Rocky River. The MCWWTP provides sewage treatment for the Town of Midland. WSACC also owns and operates the Rocky River Regional Wastewater Treatment Plant (RRRWWTP) that serves the Cities of Concord and Kannapolis, the Towns of Harrisburg and Mt. Pleasant, and Cabarrus County. In anticipation of growth within its service area, WSACC is planning to expand MCWWTP.

There have been major upgrades to the plant, specifically in 2011 (from 0.075 MGD to 0.15 MGD) and 2018 (from 0.15 MGD to 0.3 MGD). The current aerial map of the plant identifying major unit processes is presented in Figure 1. This Technical Memorandum covers the calibration of the BioWin™ (EnviroSim Associates Ltd.) process model for MCWWTP that will be used to assess the current biological treatment capacity and for sizing future expansions.

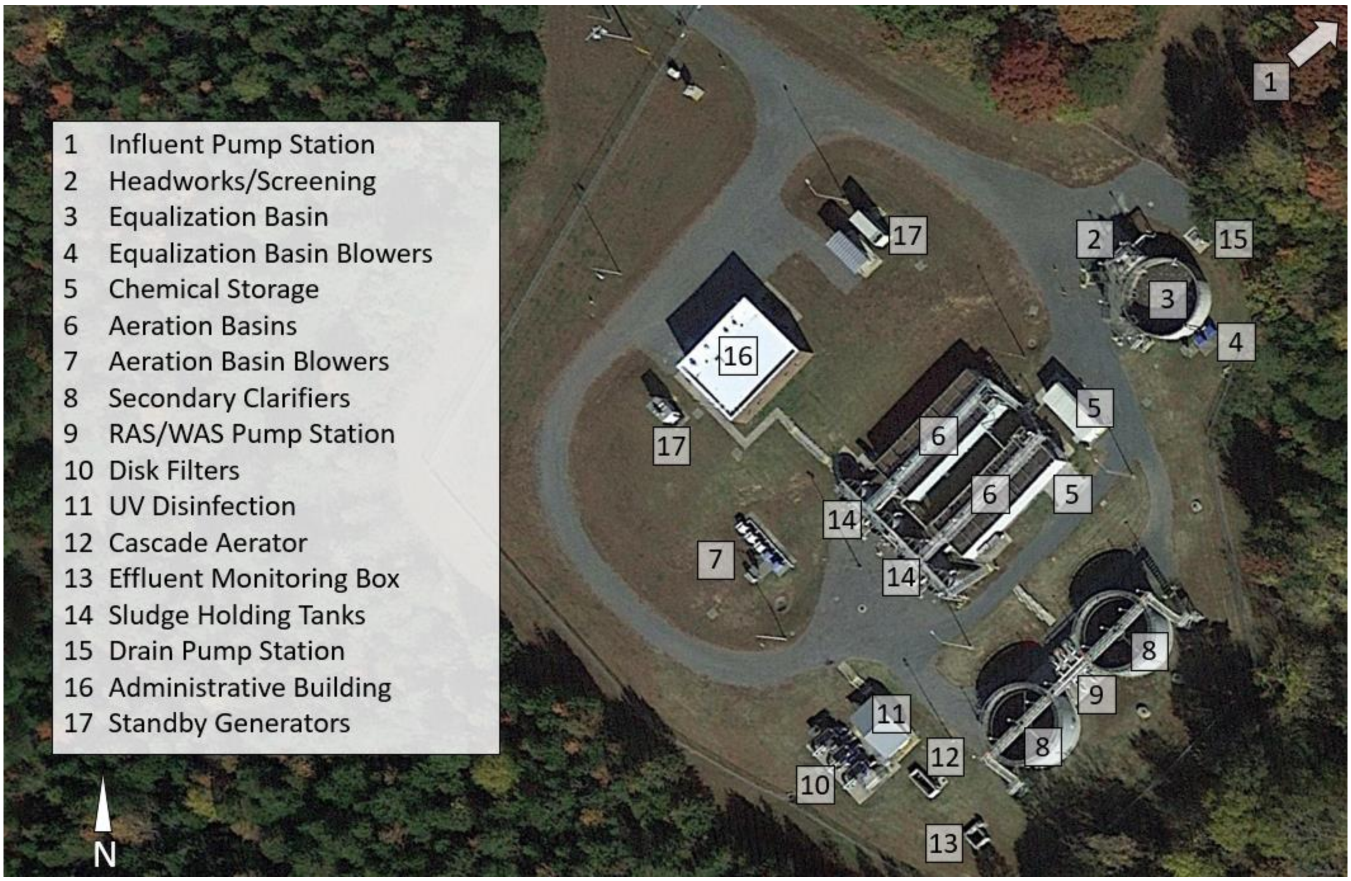

Figure 1. Aerial of MCWWTP identifying major unit processes.

Section 2: MCWWTP Process Configuration

The process flow diagram of MCWWTP is depicted in Figure 2.

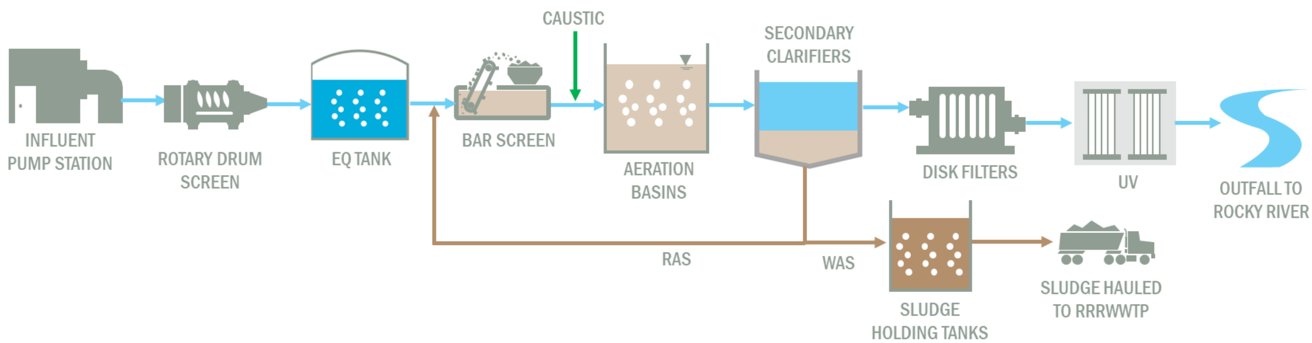

Figure 2. MCWWTP process diagram with key unit processes.

2.1 Liquid Stream Configuration

Raw influent from the gravity flow collection system is pumped from the influent pump station (IPS) where it passes through a 6-mm rotary drum screen and into the equalization (EQ) tank. The IPS operates based on wet well level setpoints. The EQ tank has a 75,000-gallon capacity and is mixed with coarse bubble aeration. The parameters used in BioWin to represent the EQ basin are provided in Table 1. Recycle flow from the plant drains is pumped directly into the EQ tank, so the influent sampler, which is located adjacent to the rotary drum screen on the deck of the EQ tank, does not include the recycle flow.

Table 1. Equalization Basin Parameters Used in BioWin Modeling

Parameter	Value
Volume, gal	75,000
Depth, ft	12 [a]
Average Operating Level, % full	36%
DO, mg/L	2

[a] *Sidewater depth is 12 ft but minimum depth for pumps is 3 ft, so 9 ft of operating level.*

2.1.1 Secondary Treatment

Flow is pumped out of the EQ tank, combines with the return activated sludge (RAS) flow, passes through manual bar screens, and is split between four parallel aeration trains, followed by two secondary clarifiers (SCs). The aeration basins are aerated with coarse bubble diffusers. Airflow is manually balanced between all trains, and historical dissolved oxygen (DO) sensor data indicates an average DO above 2 mg/L is maintained. Caustic soda is added at the head of each train. Typically, caustic is used but sometimes lime is also used. Dosing is at a constant speed with on/off control based on aeration basin influent pumps on/off operation. The basis for modeling secondary treatment in BioWin is presented in Table 2.

Table 2. Basis for Modeling Secondary Treatment in BioWin	
Parameter	**Value**
Aeration Basins	
Number of Basins	4
Volume per basin, gal	62,500
Sidewater Depth, ft	10.4
DO, mg/L	2
Blower Capacity, scfm	1,850 [a]
Average Airflow, scfm	750
Diffuser Type	Mooers Flexcap (4-inch diameter)
Caustic, Strength	25%
Secondary Clarifiers	
Number of Clarifiers	2
Diameter, ft	40
Sidewater Depth, ft	12
RAS Flow, Fraction of Influent	66%

[a] *Two at 250 scfm each; three at 450 scfm each*

Following secondary treatment, effluent passes through disk filters, ultraviolet (UV) disinfection, effluent cascade aeration, and then is discharged to the Rocky River.

2.2 Solids Stream Configuration

Waste activated sludge (WAS) is sent to four sludge holding tanks (SHTs) that are mixed using coarse bubble aeration. The SHTs are manually decanted several times to thicken the solids and the decant is sent to the plant drain. Thickened WAS (TWAS) is hauled to the RRRWWTP for further processing. Approximately 4 truckloads of 3,500 gal each of TWAS is hauled to RRRWWP every 2 to 2.5 weeks, which equates to an average TWAS production of 800 to 1,000 gallons per day (gpd). The SHTs were represented in BioWin as aerobic digesters followed by solids separation to represent manual decanting. Details are provided in Table 3. Even though no data was available, a low DO of 0.2 mg/L was used in the SHTs, given the coarse bubble aeration and intermittent decanting periods when aeration is shut off entirely. Total suspended solids (TSS) samples are not collected for the decant stream, so the thickening performance and flow split was adjusted in BioWin to help match mixed liquor suspended solids (MLSS) in the aeration basins and typical hauled sludge volumes.

Table 3. Basis for Modeling Sludge Thickening in BioWin	
Parameter	**Value**
Number of Sludge Holding Tanks	4
Volume per Tank, gal	7,600
Diameter, ft	12.2
Sidewater Depth, ft	8.7
DO, mg/L	0.2

Section 3: Historical Data Review

The most recent three years of historical influent data from 2021 through 2023 was used to establish the BioWin model influent. This period is after the influent sampler was moved adjacent to the EQ tanks and rotary drum screen and commissioning of the plant drain pump station in 2019. The same three years of effluent data (2021-2023) were analyzed to evaluate the current treatment performance and establish the model calibration.

3.1 Influent Data

The average influent concentrations based on historical data from 2021 through 2023 and used for the BioWin model influent are summarized in Table 4.

Table 4. Average Influent Pollutant Concentrations

Pollutant	Concentration (mg/L)
Chemical Oxygen Demands (COD)	612
Biochemical Oxygen Demands (BOD_5)	259
Total Suspended Solids (TSS)	299
Total Ammonia Nitrogen (TAN)	40.6

The average influent flows by year are shown in Figure 3. Influent flow increases each year until 2020. The average influent flow of 0.177 MGD for the three most recent years (2021-2023) was used for the BioWin model influent to represent current conditions.

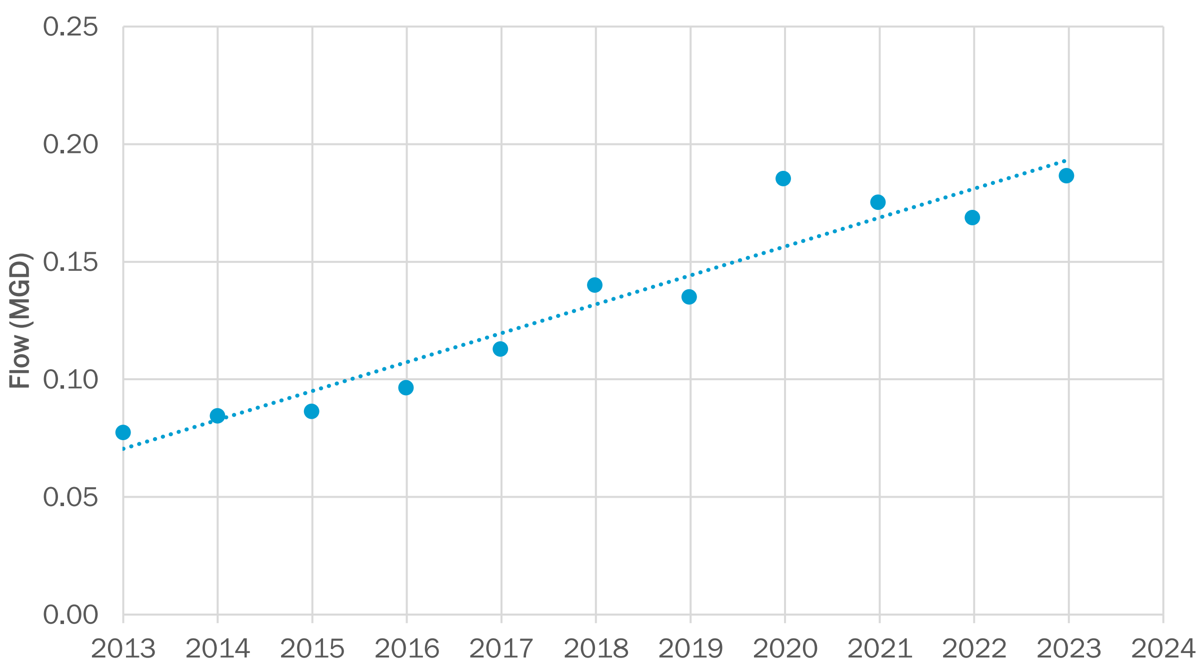

Figure 3. Yearly average influent flows.

3.2 Effluent Data

Historical data from 2021 through 2023 was analyzed and used for the BioWin calibration. This period follows the plant improvements completed in 2018 and coincides with years when more consistent process data was collected that was also used to inform the BioWin model. The results for the key effluent parameters are presented in Table 5.

Table 5. Historical Effluent Characteristics

Year	TSS (mg/L) [a]	COD (mg/L)	BOD_5 (mg/L) [b]	TAN (mg-N/L)	pH (S.U.)	Alkalinity (mg-$CaCO_3$/L)
2021	3.86	27.6	2.84	0.17	6.83	49.5
2022	3.03	34.7	2.06	0.11	6.53	48.0
2023	2.52	29.9	1.53	0.07	6.61	53.5
Average	3.14	30.7	2.14	0.12	6.65	50.5

[a] *Many values were below the minimum reporting limit of 2.5 mg/L, so values were assumed to be approximately half (1.25 mg/L) for those data points.*
[b] *Many values were below the minimum reporting limit of 2 mg/L, so values were assumed to be approximately half (1 mg/L) for those data points.*

Section 4: Process Model Calibration

Process model calibration involves combining the operational or controllable aspects of the treatment plant with the input wastewater characteristics and adjusting selected parameters to fit a set of plant performance data. Process models are considered calibrated when the model predictions can mimic measured performance data.

This section summarizes the process model calibration for the MCWWTP. Steady state modeling was used which represents average conditions. BioWin Version 6.3 was used for the wastewater treatment plant model calibration. The process flow diagram employed in BioWin to simulate the current process operations at the MCWWTP is presented in Figure 4. The BioWin configuration and calibration are based on the influent and effluent data as described in Section 3, as well as historical plant operational data from 2021-2023. While there are multiple parallel unit processes at MCWWTP these were combined in BioWin into single units with a total volume and surface area equal to the individual units.

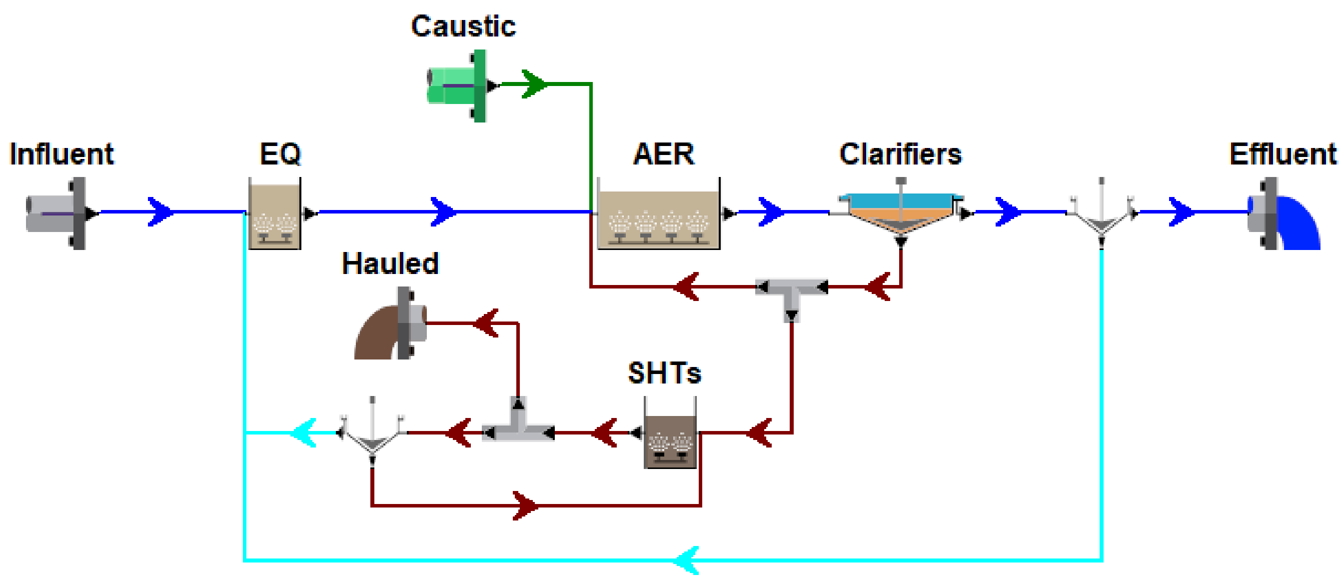

Figure 4. MCWWTP BioWin calibration flow schematic.

The simplifications and assumptions employed in the BioWin model are summarized below:

- All four aeration basins were in service.
- All facility recycles are returned to the EQ basin.
- EQ is a variable volume tank, but the level is constant when modeling steady state (36% full based on 2021 – 2023 historical average depth).
- Diffuser parameters and density were not available. To model approximate airflow, BioWin default diffuser parameters for coarse bubble diffusers were used with an alpha-F of 0.85 (typical for coarse bubble diffusers). The fractional effective saturation depth of 0.29 was based on a diffuser submergence of 9.4 ft (sidewater depth of 10.4 ft and assumed diffuser mounting height of 1 ft). The total blower capacity (1,850 scfm), historical average capacity of blowers in service (970 scfm), and daily average reported airflow (750 scfm) for 2021 – 2023 were used for reference for model-predicted airflows.
- The SHTs were modeled as an aerobic digester with volume and depth equivalent to all four tanks, followed by a splitter for TWAS discharge (hauled to RRRWTP) and a volume-less point separator unit to represent manual decanting. Since solids are held within the SHTs between TWAS discharge loads, the point separator underflow was directed back to the SHTs. Solids capture was adjusted to help match aeration basin MLSS.
- The SHTs DO was assumed to be 0.2 mg/L given the coarse bubble aeration and intermittent decanting when aeration is turned off.
- MCWWTP uses caustic or lime for pH adjustment. This was represented as 25 percent strength caustic in BioWin, and the addition rate was adjusted to match effluent pH and alkalinity as they do not record actual dosage rates. The gas phase was modeled in the aeration basin to determine the dissolved concentration of gases, including carbon dioxide (CO_2), rather than manually setting the off-gas content of CO_2, as this affects the reactor pH and therefore the caustic addition rate required to match the target effluent quality.
- Secondary clarifiers were modeled as ideal clarifiers with user-defined solids removal percentage at 99.85 percent and no biological or chemical reactions to occur in the sludge blanket.

- The solids capture in the secondary clarifiers was adjusted to target approximately 15 mg/L TSS in the secondary effluent (assumed).
- The filters were represented as a volume-less point separator in the model and the solids capture was adjusted to match effluent TSS, with backwash flow set at 5 percent of influent flow. Backwash flow is sent to the plant drain pump station, that is, returned to the EQ basin in the model.
- Rotary drum and manual bar screens, UV disinfection, and effluent cascade aeration were not included in the model.

4.1 Model Inputs

Historical influent data as described in Section 3 was used to develop the influent model inputs provided in Table 6. The table also incorporates assumptions that were made when data was not available. For instance, the carbonaceous biological oxygen demand ($CBOD_5$) was assumed to be 84 percent of BOD_5. Total Kjeldahl nitrogen (TKN) was calculated based on measured TAN and the BioWin default fraction of TAN:TKN of 66 percent. The inert suspended solids (ISS) concentration was adjusted to help match influent TSS, and assumes an influent VSS:TSS fraction of 85 percent.

The operational parameters are summarized in Table 7 along with any assumptions.

Table 6. MCWWTP BioWin Model Inputs – Influent

Parameter	Value	Comments
Flow, MGD	0.177	Historical average
Chemical Oxygen Demand (COD), mg/L	612	Historical average
TKN, mg-N/L	61.5	Based on historical average TAN
TP, mg-P/L	6.5	BioWin default
Total Sulfur, mg-S/L	10	BioWin default
Nitrate, mg-N/L	0	BioWin default
pH, S.U.	7.3	BioWin default
Alkalinity, mg-$CaCO_3$/L	189	Historical average
ISS, mg/L	45	Adjusted to match historical average TSS
Calcium, mg/L	80	BioWin default
Magnesium, mg/L	15	BioWin default
DO, mg/L	0	BioWin default
Temperature, °C	20	Historical average

Table 7. MCWWTP BioWin Model Inputs – Operation		
Parameter	Value	Comments
RAS Flow, MGD	0.117	Historical average (66% of influent flow)
EQ Basin DO, mg/L	2.0	Assumed
EQ Basin % Full	36%	Historical average
Aeration Basin DO, mg/L	2.0	Historical average sensor DO > 2 mg/L
Filter Solids Capture, %	80%	Adjusted to match historical average effluent TSS
Caustic Flow, gpd	65	Adjust to match historical average effluent pH and alkalinity
WAS Flow, MGD	0.0023	Adjusted to target 6 g/L MLSS in aeration tanks
Sludge Holding Tank DO, mg/L	0.2	Assumed based on intermittent coarse bubble aeration
Hauled TWAS Splitter Flow, gpd	920	Adjusted to target 3% solids in TWAS and reported hauled TWAS truckloads
Sludge Holding Tank Solids Capture, %	99.96%	Adjusted to target 500-1,000 mg/L TSS in decant
Sludge Holding Tank Underflow, MGD	0.1	Adjusted to target 3% solids in TWAS

4.2 Calibration Results

A steady-state simulation of the plant operation was performed using the influent data discussed in previous sections. Model calibration was achieved by matching the predicted plant performance with the historical plant performance data.

Several modifications and assumptions were made during the calibration regarding model parameters. A summary of the adjusted parameters is provided in Table 8. Two influent wastewater fractions were modified: the fraction of unbiodegradable soluble COD (Fus) and the fraction of unbiodegradable particulate COD (Fup). Fus was decreased to match effluent COD. The $CBOD_5$ calculation rate constants for non-colloidal and colloidal slowly biodegradable COD were also reduced to achieve agreement with the influent $CBOD_5$ and TSS. The selected fractions are within values often found in similar applications.

Table 8. MCWWTP BioWin Calibration Parameters			
Parameter	Default Value	Adopted Value	Comments
Fus - Unbiodegradable soluble COD (g/g)	0.05	0.042	Adjusted to match effluent COD
Fup – Unbiodegradable particulate COD (g/g)	0.13	0.2	Adjusted to obtain influent CBOD/TSS and match MLSS
BOD calculation rate constant for Xsc degradation (1/d)	0.5	0.22	Adjusted to obtain influent CBOD/TSS ratio
BOD calculation rate constant for Xsp degradation (1/d)	0.5	0.22	Adjusted to obtain influent CBOD/TSS ratio

A comparison of the historical measured data to steady-state model predictions and the percent difference is summarized in Table 9. Overall, a good match between parameters was achieved. Differences in predicted values and measured values for parameters such as effluent ammonia and $CBOD_5$ were insignificant for effluent quality, even if a relatively large percentage. The predicted/measured effluent TAN and $CBOD_5$ are also well below the seasonal-low permit limits of 4.0 mg-N/L and 10.0 mg/L, respectively.

Matching predicted MLSS to measured was priority for the calibration, and to achieve this match the predicted SRT and WAS flow rate were each 17 percent different from measured values. The difference in SRT is relatively insignificant for process performance, as it is already long at over 40 days. However, the difference in WAS flow rate and mass rate were likely related to an overestimation of RAS TSS concentration, as suggested by a mass balance around the secondary clarifiers with the given flows and MLSS (around 6,000 mg/L) indicates the average concentration is likely closer to approximately 15,000 mg/L as shown by the model. The predicted MLSS ultimately was within 1 percent of the measured value.

Beyond the assumptions described at the beginning of Section 4 regarding the aeration system, the k2 diffuser parameter value was adjusted so the model-predicted airflow was within 10% of the average reported airflow of 750 scfm, but slightly higher to be conservative. The k2 value was increased from the default of 0.38 for coarse bubble diffusers to 0.45, effectively making the diffusers more efficient. While the model of diffusers at MCWWTP are coarse bubble, they are marketed by the manufacturer as “medium” bubble, or more efficient coarse bubble diffusers, so this parameter change was justified.

At the end of this task, the BioWin model was considered calibrated and acceptable for use to evaluate high-level expansion concepts.

Table 9. MCWWTP BioWin Model Predictions

Parameter	Measured Value	Model Predicted Value	Difference	Comments
Aeration Basins				
SRT, days	50	41.5	-17%	
MLSS, mg/L	5,940	5,960	0.3%	
RAS TSS, mg/L	19,873	15,374	-23%	Historical values likely overestimated; closer to 15,000 mg/L
Airflow, scfm	750	800	7%	Consider BioWin prediction is slightly conservative in future analysis
Plant Effluent				
TSS, mg/L	3.14	3.06	-2.5%	
COD, mg/L	30.7	30.3	-1.2%	
BOD_5, mg/L [a]	2.14	1.10	-49%	Larger difference of very small number (most historical data also below measuring range)
TAN, mg-N/L	0.12	0.22	83%	Larger difference of very small number
pH, S.U.	6.65	6.63	-0.3%	
Alkalinity, mg-$CaCO_3$/L	50.5	44.9	-12%	
Sludge Production				
WAS, lb/d	334	295	-12%	Historical value likely overestimated due to high RAS TSS
WAS Flow, gpd	1,967	2,300	17%	Increased to match MLSS
TWAS, gpd	900	920	2.2%	Measured value is the median of the typical range (800 – 1,000 gpd)

[a] *Measured value is reported as BOD_5 while BioWin reports as $CBOD_5$; in the effluent of a fully nitrifying system these can be considered equal.*

Section 5: Summary and Observations

A biological process model was developed and calibrated for MCWWTP using historical plant data. The model appeared to under-predict WAS mass rate and SRT, but this is likely related to over-estimation of the

RAS TSS value in historical measurements. These measurements can be highly variable with location and time of day for the sample collection. The SRT is extremely long and the difference in predicted and measured is insignificant for plant performance. Considering the limited data with respect to the thickening in the SHTs and hauling of thickened solids off-site for treatment, as well as the close match in MLSS (within 1 percent), the differences in WAS are considered acceptable.

The predicted plant effluent matches closely with the measured effluent quality. Chemical addition (caustic) was used to match effluent quality (pH and alkalinity) rather than matching historical chemical addition, for which data is limited.

BioWin default coarse bubble diffuser parameters were used along with many assumptions about the aeration system. Model-predicted airflows were approximately 7 percent higher than historical daily average airflow. If possible, aeration parameters should be refined moving forward, or the conservativism of the existing calibrated model airflows should at least be considered if using BioWin for the evaluation of the aeration system capacity.

Overall, the calibrated model predicts plant performance to an acceptable level given the limitations and assumptions discussed in this TM. The calibrated model will be used to evaluate treatment capacity and future expansion alternatives. A key observation to note moving forward is the elevated MLSS (approximately 6,000 mg/L on average) due to the long SRT may limit secondary clarifier capacity at peak flows and in the future. However, this analysis has not been performed.

Attachment L

Brown AND Caldwell

309 East Morehead Street
Suite 220
Charlotte, NC 28202

Phone: 704-358-7204

Technical Memorandum

Prepared for: Water and Sewer Authority of Cabarrus County (WSACC)

Project Title: Wastewater Treatment Facilities Plan and Preliminary Engineering Report (PER)

Project No.: 193209

Technical Memorandum No. 7

Subject: Capacity Analysis for Muddy Creek Wastewater Treatment Plant (MCWWTP)

Date: April 24, 2025

To: Chad VonCannon, PE, Executive Director

From: George Anipsitakis, PhD, PE, Project Manager

Copy to: Thomas Hahn, PE, Engineering Director

Chris Carpenter, Wastewater Operations Director

Prepared by: Duncan Lozinski

Duncan Lozinski, PE, Senior Associate

NORTH CAROLINA PROFESSIONAL SEAL 036485 ENGINEER GEORGIOS P. ANIPSITAKIS

4/24/2025

Reviewed by: ______________________________

George Anipsitakis, PhD, PE# 036485, Exp. 12/31/2025

Limitations:

This document was prepared solely for WSACC in accordance with professional standards at the time the services were performed and in accordance with the contract between WSACC and Brown and Caldwell dated February 28, 2024. This document is governed by the specific scope of work authorized by WSACC; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by WSACC and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

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List of Abbreviations

AADF	Annual Average Daily Flow
BC	Brown and Caldwell
cfm	cubic feet per minute
d	day
DO	dissolved oxygen
EQ	equalization
ES	executive summary
fps	feet per second
ft	feet
gal	gallons
gpd	gallons per day
gph	gallons per hour
gpm	gallons per minute
HRT	hydraulic retention time
HP	horsepower
icfm	inlet cubic feet per minute
In	inches
IPS	influent pump station
MCWWTP	Muddy Creek Wastewater Treatment Plant
MDF	minimum daily flow
MG	million gallons
mg	milligram
MGD	million gallons per day
MLSS	mixed liquor suspended solids
mm	millimeters
MMF	maximum monthly flow
MWF	maximum weekly flow
NA	not applicable
NC	North Carolina
NPDES	National Pollutant Discharge Elimination System
PDF	peak daily flow
PER	preliminary engineering report
PHF	peak hourly flow
PS	pump station
psi	pounds per square inch
RAS	return activated sludge
RRRWWTP	Rocky River Regional Wastewater Treatment Plant
scfm	standard cubic feet per minute
SLR	solids loading rate
SOR	surface overflow rate
SRT	solids retention time
TBD	to be determined
TDH	total dynamic head
TM	technical memorandum
TWAS	thickened waste activated sludge
WAS	waste activated sludge
WSACC	Water and Sewer Authority of Cabarrus County
WWTP	wastewater treatment plant

Executive Summary

This Technical Memorandum No. 7 describes the existing facilities at the Muddy Creek Wastewater Treatment Plant (MCWWTP) and evaluates their capacity to handle future flows associated with possible expansions to 0.45, 0.6, and 1.0 million gallons per day (MGD) maximum monthly flow (MMF). This TM provides a high-level summary of which processes will need upgrades and additions. This TM is the first step in assessing the capacity needs at the MCWWTP and will be supplemented and updated by the currently underway biological process modeling effort. Table ES-1 summarizes the unit process capacities and compares them against future flow needs.

Table ES-1. Existing Unit Process Capacity versus Future Capacity Needs

	Firm	Total	Units	Capacity Needed per Flow Rate		Sufficient? (Y/N)	
				0.45 MGD	0.6 MGD	0.45 MGD	0.6 MGD
IPS Pumps	1.05	2.1	MGD	2.58 PHF	3.04 PHF	N	N
Rotary Drum Screen	1.85		MGD	2.58 PHF	3.04 PHF	N	N
Equalization Basin		75,000	gal	133,000	155,000	N	N
EQ Basin Pumps	1.81	2.86	MGD	1.56 PDF	1.82 PDF	Y	N
Chemical Feed		396	gpd	143	190	Y	Y
Aeration Basins		250,000	gal	375,000	500,000	N	N
Aeration Blowers	1,400	1,850	scfm	TBD	TBD	N	N
Secondary Clarifiers (SOR of 1,000 gpd/ft^2)		2.5	MGD	1.56 PDF	1.82 PDF	Y	Y
Secondary Clarifiers (SLR of 35 lbs/day/ft^2)		2.56 (0.45) 2.41 (0.6)	MGD	1.56 PDF	1.82 PDF	Y	Y
RAS Pumping (100% of MMF assumed)	0.6	0.9	MGD	0.45 MGD	0.60 MGD	Y	Y
WAS Pumping	100	200	gpm	15.8	21.1	Y	Y
Cloth Disc Filters	0.8	1.2	MGD	1.56 PDF	1.82 PDF	N	N
UV Disinfection	1.05	2.1	MGD	1.56 PDF	1.82 PDF	N	N
Cascade Aerator	See Section 3.1.10					Y	Y
Effluent Weir		0.93	MGD	1.56 PDF	1.82 PDF	N	N
Sludge Holding Tanks	22,800	30,400	gal	Dependent on hauling frequency		Y	N
Plant Drainage Pumping		0.3	MGD	0.3 MGD	0.3 MGD	Y	Y

Notable take aways from this analysis are as follows:

- If a new headworks is constructed for the next expansion, consideration should be given to including grit removal facilities.
- The secondary clarifiers, RAS pumps, and WAS pumps have sufficient capacity for a plant expansion to 0.45 and 0.6 MGD.
- WAS pumps appear significantly oversized.
- The cascade aerator has sufficient capacity for a plant expansion to 1 MGD.

Section 1: Scope of Work

The Water and Sewer Authority of Cabarrus County (WSACC) owns and operates the Muddy Creek Wastewater Treatment Plant (MCWWTP) located at 14655 Hopewell Church Road, Midland, NC 28107. The current facility is permitted to treat 0.3 million gallons per day (MGD) of wastewater generated on a maximum monthly flow (MMF) basis and has an effluent limits page for 1 MGD already included in its National Pollution Discharge Elimination System (NPDES) operating permit. In this TM, BC assesses the treatment capacity of each unit process versus future flow and parameter loadings and identifies improvement needs. All unit processes are assessed based on design information found in record documents and reports of operating performance to date.

Section 2: Basis of Design Flows

TM No. 4 titled Influent Flows and Loads Analysis and Projections for MCWWTP summarizes the analysis of historical and projected flows and loads at the MCWWTP to determine the basis of designs for expanding the MCWWTP beyond the current capacity of 0.3 MGD MMF. Expansions to 0.45 MGD, 0.6 MGD, and 1 MGD were evaluated.

Historical daily flow data for MCWWTP from 2013 to 2023 was analyzed to determine flow peaking factors for maximum week and maximum month. Flows at 15-minute intervals from the influent pump station (IPS) and daily flows from the effluent flow meter were initially used to estimate peak hour and peak day flows, respectively. However, the flow meter signals were maxed out during repeated high flow events. Therefore, rather than a constant peaking factor from the historical flow meter data, projected peak hour and day flows used the collection system model (Black & Veatch, 2022), as described in TM No. 4. The results from this analysis are summarized in Table 1, which also constitutes the basis of design flows for the future expansions to 0.45 MGD, 0.6 MGD, and 1 MGD.

Table 1. Basis of Design Flows at MCWWTP

Flow Condition	Flow Rate (MGD)			
	For 0.3 MGD MMF	For 0.45 MGD MMF	For 0.6 MGD MMF	For 1 MGD MMF
Peak Hour Flow (PHF) [a]	1.53	2.58	3.04	4.21
Peak Day Flow (PDF) [a]	0.98	1.56	1.82	2.47
Maximum Week Flow (MWF)	0.52	0.78	1.04	1.73
Maximum Month Flow (MMF)	0.30	0.45	0.60	1.00
Annual Average Daily Flow (AADF)	0.19	0.28	0.37	0.62
Minimum Day Flow (MDF)	0.07	0.10	0.14	0.22

[a] *Based on 2-year storm interval projections (B&V, 2022) instead of using historical peaking factors.*

The 0.3 MGD MMF basis of design flows derived from the recent collection system model are listed for comparison purposes. The original basis of design for the 2018 expansion to 0.3 MGD used a calculated peaking factor of 3.5 following the Ten-State Standards formula based on service population, for a peak flow of 1.05 MGD, whereas the recent model predicts a PHF of 1.53 MGD instead.

Section 3: Existing Facilities and Capacity Assessment

This section evaluates the capacity of each unit process and determines if additional capacity is needed to treat flows of 0.45, 0.6 MGD, and 1.0 MGD MMF. An aerial photo of the MCWWTP with major unit processes identified is provided in Figure 1 and a process flow diagram is provided in Figure 2.

The MCWWTP was originally built as a 75,000 gallon per day (gpd) modular WWTP. Major upgrades to the MCWWTP have been as follows:

- 2011: Duplication of the modular treatment system, addition of a 75,000-gallon equalization basin, and installation of two cloth disk filters. The plant capacity was increased to 0.15 MGD.
- 2018: Addition of new IPS and EQ pumps, two 40-ft diameter clarifiers, new aeration blowers, new chemical feed enclosure, a third filter, replacement of UV system, new generator, conversion of existing clarifiers to sludge holding tanks and conversion of existing sludge holding zones to additional aeration capacity. The plant capacity was increased to 0.3 MGD.

Figure 1. Aerial of MCWWTP identifying major unit processes.

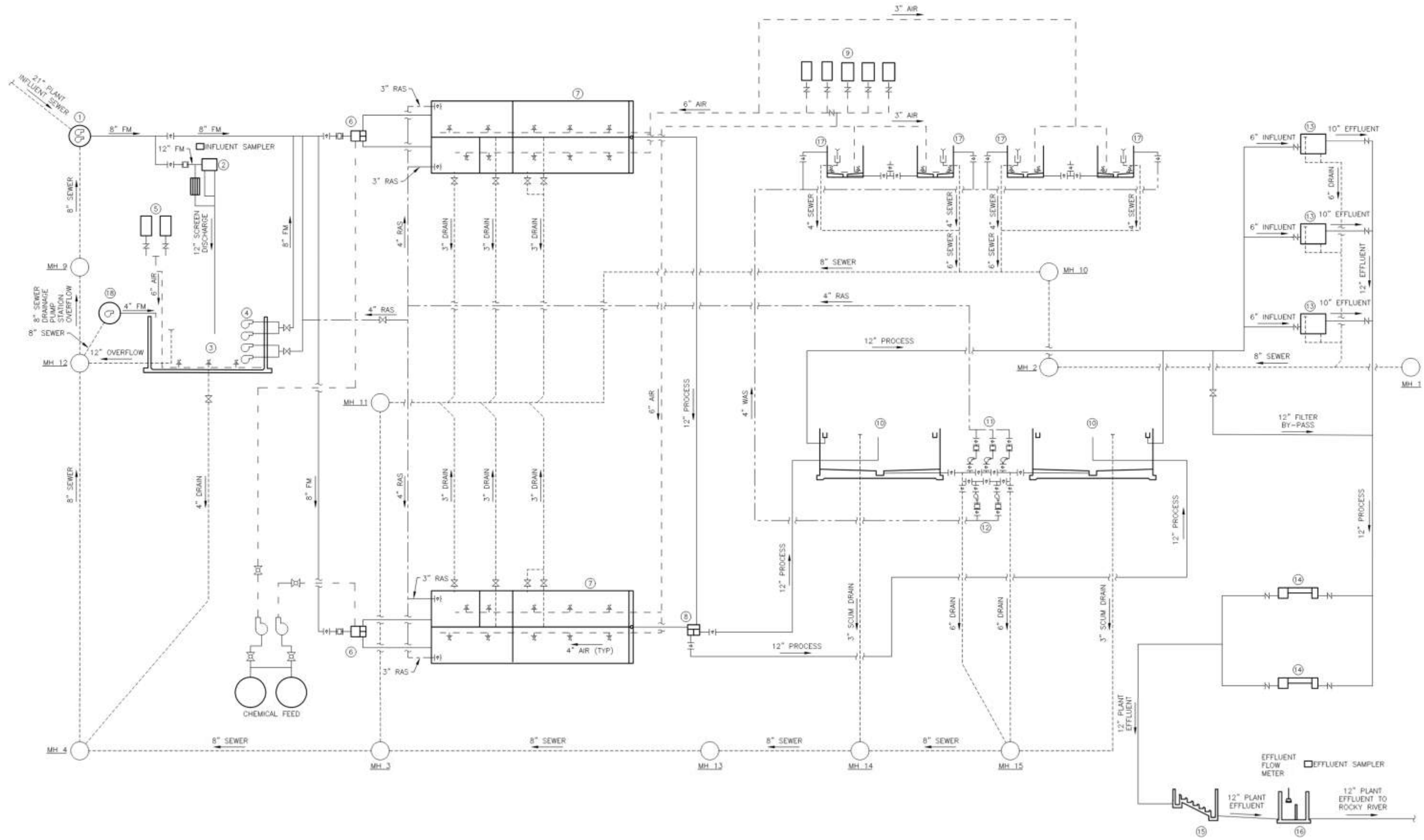


Figure 2. MCWWTP process flow diagram.

(taken from the 2019 Reference Drawings of Contract 7.0 Muddy Creek WWTP 0.3 MGD Expansion by Willis Engineers)

3.1 Liquid Stream Configuration

Raw influent is pumped from the IPS through a 6-mm rotary drum screen and into the equalization (EQ) tank. Recycle flow from the plant drains is pumped into the EQ tank. Flow out of the EQ tank is split between four parallel aeration trains, followed by two secondary clarifiers. Secondary effluent passes through disc filters, ultraviolet (UV) disinfection, effluent cascade aeration, before it is discharged to the Rocky River. Note that the MCWWTP does not include grit removal.

3.1.1 Influent Pump Station

The IPS is a duplex submersible pump station that receives flow from a 21-inch sewer and pumps it to MCWWTP. The pump station consists of two wet pit submersible pumps that were installed in 2018 and operate based on level setpoints in the wet well. Flow from the IPS to the headworks is conveyed via an 8-inch 470-ft long force main. Design attributes of the IPS pumps are summarized in Table 2.

Table 2. Influent Pump Station Capacity

Equipment	Type	Size	Rated Capacity	Rated Head	Motor	Drive Speed
Influent Pump No. 1	Wet pit submersible	4 in	1.05 MGD	76 ft TDH	30 HP	Variable
Influent Pump No. 2	Wet pit submersible	4 in	1.05 MGD	76 ft TDH	30 HP	Variable

Per Table ES-1, the pumping capacity of the IPS will have to be increased to accommodate any increase in plant rating. The firm capacity of the IPS must be greater than or equal to the expected peak hourly flow.

The 8-inch force main may not need upsizing when plant capacity increases to 0.45 or 0.6 MGD. At 0.6 MGD MMF, the PHF is 3.04 MGD which corresponds to a fluid velocity of approximately 13.5 feet per second (fps). This is within acceptable ranges for maximum velocity.

3.1.2 Headworks

Flow enters MCWWTP at the headworks, which consists of an automatic rotary drum screen with manual bar screen bypass. The drum screen was installed in the 2019 expansion project and has a capacity of 1.85 MGD. Screenings are collected in an adjacent dumpster for disposal. An influent sampler and flowmeter are also located at the headworks. Table 3 summarizes the design attributes of the headworks equipment.

Table 3. Headworks Capacity

Parameter	Value
Rotary Drum Screen	
Number of Units	1
Screen Type	Perforated Plate
Opening Size	6 mm
Hydraulic Capacity	1.85 MGD @ 300 mg/L TSS
Drive Size	1.5 HP
Manual Bar Screen Bypass	
Number of Units	1
Width	24 in
Bar Spacing	1 in

Screening and (automatic) bypass screening each need to be able to pass the PHF to the plant. Since screening capacity is currently only 1.85 MGD, screening will have to be upgraded to accommodate any increase in plant rating.

Figure 3. MCWWTP headworks adjacent to EQ basin.

3.1.3 Equalization

A 75,000-gallon equalization basin was constructed as part of the 2011 plant upgrade. All incoming plant flow is routed through the EQ basin before progressing to secondary treatment. Plant drain flow also typically discharges into the EQ basin via the plant drainage pumping station. However, if required for maintenance purposes, all plant flow can bypass the EQ basin and headworks and be sent directly from the IPS to secondary treatment.

The basin itself is a circular concrete tank with a 38-ft diameter and 14-ft high walls. The basin features coarse bubble aeration to maintain acceptable oxygen levels and prevent solids deposition. Aeration air is provided by two positive displacement blowers. EQ Basin characteristics are summarized in Table 4.

Table 4. Influent Flow Equalization Capacity

Parameter	Value
Equalization Basin	
Number of Units	1
Diameter	38 feet
Sidewater Depth	12 feet
Total Volume	100,000 gal
Usable Volume	75,000 gal

Table 4. Influent Flow Equalization Capacity	
Parameter	**Value**
Diffuser Type	Coarse bubble
EQ Blowers	
Number of Units	2
Type	Positive displacement
Capacity, each	454 ICFM
Drive Size, each	10 HP

It seems the recent design by Willis did not necessarily use the EQ volume for reducing peak flows to downstream processes since the hydraulic profile from the 2017 Reference Drawings by Willis Engineers maintains a peak flow of 1.05 MGD all the way through the entire liquid treatment train. This peak appears to be low as discussed in Section 2, but using the EQ volume for peak shaving (reduce PHF down to PDF) as part of the basis of design discussed herein it would produce a value close to the 1.05 MGD peak flow appearing in the hydraulic profile.

To be used for peak shaving at the 0.3 MGD rated capacity (peak hour of 1.53 MGD and peak day flow 0.98 MGD, from Table 1), the EQ basin requires at least 83,000 gallons of storage volume. Due to minimum sidewater depth requirements for the pumps, the effective volume is currently only 75% of the total volume, or 75,000 gallons. Therefore, assuming the same effective ratio, a total volume of 111,000 gallons is needed to accommodate an 83,000-gallon usable volume and peak shaving for the current 0.3 MGD capacity. Table ES-1 summarizes the required usable EQ volume at 0.45 and 0.6 MGD plant ratings that are 133,000 and 155,000 gallons, respectively. For the 1.0 MGD plant rating, the required usable volume is 210,000 gallons.

The Ten States Standards discuss the need to maintain a minimum concentration of 1.0 milligram per liter (mg/L) of dissolved oxygen (DO) by aeration. Air supply rates should be a minimum of 1.25 cubic feet per minute (cfm)/1000 gallons, so for a 75,000-gallon tank that would be 94 cfm. Instead, 454 inlet cubic feet per minute (icfm) or 6 icfm of air per 1000 gallons are provided by a single blower, which is more than sufficient to keep the DO greater than 1.0 mg/L.

Wastewater is transferred from the EQ basin by four submersible pumps that rest on the tank floor. Two smaller pumps were installed in 2011 each with a rated capacity of 0.38 MGD. Two larger pumps were installed in the 2018 expansion, each with a capacity of 1.05 MGD. Each pair of pumps discharges to a dedicated header that combine into a single 8-inch force main leading to secondary treatment. Equalization pumping capacity is summarized in Table 5.

Table 5. Equalization Basin Pump Capacity

Equipment	Type	Rated Capacity	Rated Head	Motor	Drive Speed
EQ Basin Discharge Pump No. 1	Submersible, non-clog	0.38 MGD	NA	5 HP	Variable
EQ Basin Discharge Pump No. 2	Submersible, non-clog	0.38 MGD	NA	5 HP	Variable
EQ Basin Discharge Pump No. 3	Submersible, non-clog	1.05 MGD	25 ft	10 HP	Variable
EQ Basin Discharge Pump No. 4	Submersible, non-clog	1.05 MGD	25 ft	10 HP	Variable

Whereas equipment upstream of the equalization basin is sized for PHF, equipment downstream including the EQ transfer pumps should be sized for peak daily flow. Per Table ES-1, the EQ discharge pumps currently have a total capacity of 2.86 MGD and firm capacity of 1.81 MGD. This is adequate capacity to increase the plant rating up to 0.6 MGD if the EQ volume is expanded to reduce the peak hourly flows to the peak day flow.

Post EQ, flow travels in an 8-inch influent force main to the aeration influent splitter boxes where it is equally distributed in four aeration basins.

Figure 4. Equalization basin.

3.1.4 Chemical Storage and Feed for Alkalinity Control

The chemical storage and feed area is located on the northeast side of the aeration basins. The only chemical addition at MCWWTP is for alkalinity control and the chemical used is caustic soda (sodium hydroxide), dosed at the upstream end of the aeration basins. Sodium hydroxide is received at 25% strength and stored in a 6,600-gallon tank.

Based on the calibrated biological process model at increased flows of 0.45 and 0.6 MGD with maximum month loadings, the required caustic addition is 143 and 190 gpd, respectively. This equates to an approximate storage capacity of 46 and 35 days, respectively.

The current chemical feed pumps (Table 6) have sufficient capacity to meet the increased chemical addition requirements. However, if new aeration basins are added, they may require new dedicated feed pumps for simplicity and reliability.

Table 6. Chemical Storage and Feed Capacity	
Parameter	**Value**
Storage Volume	6600 gallons
Number of Feed Pumps	2
Pump Type	Peristaltic
Capacity, total	16.5 gph
Capacity, total	396 gpd
Maximum Discharge Pressure	110 psi

Figure 5. Chemical storage room showing metering pumps and old (abandoned) day tanks. Larger 6,600-gallon storage tank is located outside this building.

3.1.5 Aeration Basins

Secondary treatment at MCWWTP is a single stage nitrification process. Treatment occurs in two modular units that each contain two activated sludge aeration trains. The first modular unit was installed as a packaged plant at the commissioning of MCWWTP, and a second identical one was installed as part of the 2011 expansion project. Flow is split evenly between the four aeration trains at the two aeration influent splitter boxes.

The two modular units were modified in 2018 to increase aeration volume. This was done by eliminating the surge components, moving the sludge processing components out of the units, and converting the leftover space to aeration capacity. The basins function as plug flow reactors, with wastewater and RAS introduced at the upstream end and effluent discharging over a downstream launder. Each of the trains is currently rated for 75,000 gpd, for a total capacity of 0.3 MGD MMF. Aeration effluent is combined in the aeration effluent splitter box before travelling in parallel 12-inch lines to the two secondary clarifiers.

Five blowers provide air to the aeration basins and sludge holding tanks. Two blowers were installed in 2011 whereas three are newer blowers that were installed in 2018. All five blowers combined have a total capacity of 1,850 standard cubic feet per minute (scfm). Diffusers are coarse bubble Flexcap diffusers by Mooers. Preliminary calculations performed in the MCWWTP biological process modeling indicate that the existing blowers do not have any extra capacity for the next plant expansions. Aeration basin design attributes are summarized in Table 7.

Table 7. Aeration Basin Capacity

Parameter	Value
Aeration Basins	
Number of Units	4
Volume, each	62,500 gal
SWD	10 ft
Capacity, total	0.3 MGD MMF
Diffuser Type	Coarse bubble, Mooers Flexcap
Blowers	
Number of Units	5
Type	Positive displacement
Capacity, each	3 @ 450 SCFM 2 @ 250 SCFM
Capacity, total (Firm)	1,850 SCFM (1,400 SCFM)

A biological process model was developed and calibrated using plant historical data as described in TM No. 6, Biological Process Modeling for MCWWTP. Model simulations were used to determine the additional tanks and system configuration needed to meet future flows and loads. The critical aerobic solids retention time (SRT) was determined based on maintaining nitrification during cold weather (minimum month temperature of 12°C) and applying a safety factor of 2. This yielded a recommended minimum aerobic SRT of 16 days, compared to the 2018 design minimum and maximum of 20 and 30 days, respectively. Modeling at the selected SRT and maximum month loadings for 0.3 MGD resulted in a mixed liquor suspended solids (MLSS) concentration of 5,010 mg/L. At 0.45 MGD, the model-predicted MLSS increased to 7,470 mg/L for the existing bioreactor volume to work. These concentrations are much higher than typical design MLSS concentrations of approximately 3,500 mg/L, which generally provides a good balance between aeration tank volume and secondary clarifier volume. The secondary clarifier capacity at the model-predicted and typical design MLSS concentrations are assessed in the following section. Additional aeration basins would be required if a design MLSS of 3,500 mg/L were to be used.

Figure 6. Aeration basin number 3.

3.1.6 Secondary Clarifiers

MCWWTP has two center-fed circular secondary clarifiers. Scraper and skimmer arm assemblies are powered by a central clarifier drive. Both clarifiers are identical in construction and were installed in the 2018 plant expansion. RAS from the clarifiers is returned to the head of the aeration basins by three 4-inch recessed impeller RAS pumps.

Current (2014) recommended standards for wastewater treatment facilities suggest sizing secondary clarifiers in single-stage nitrification systems for a PHF surface overflow rate (SOR) of 1,000 gpd/ft^2. Because all influent flow to MCWWTP is passed through the equalization basin, the PHF to the secondary treatment process is assumed will be reduced and be equal to the PDF. Therefore, the secondary clarifier's capacities will be evaluated against MCWWTP's PDF assuming the equalization process is expanded as discussed earlier. Design attributes with capacity values for the secondary clarifiers are provided in Table 8.

Table 8. Secondary Clarifier Capacity Based on SOR

Clarifier Characteristics	
Parameter	**Value**
Number of Units	2
Tank Inner Diameter	40 ft
Side Water Depth (SWD)	12 ft
Weir length (each)	116 ft

Table 8. Secondary Clarifier Capacity Based on SOR	
Clarifier Characteristics	
Parameter	Value
Surface area (each)	1,257 ft^2
Peak Hourly Capacity (each)	1.26 MGD
Peak Hourly Capacity (total)	2.51 MGD
Drive (each)	
Size	0.5 HP
Phase	3
Voltage	460 Volts

At a maximum SOR of 1,000 gpd/ft^2, the secondary clarifiers have a total capacity of 2.5 MGD. As shown in Table ES-1, this is adequate capacity to treat plant flows up to a 0.6 MGD rating. However, in addition to SOR, secondary clarifiers must also be sized for solids loading rate (SLR). Current design standards suggest that secondary clarifiers in single-stage nitrification systems be designed for PDF solids loading rates of no more than 35 pounds per day per square foot (lb/day/ft^2) of surface settling area. Table 9 shows that the secondary clarifiers have sufficient capacity at the current permitted capacity of 0.3 MGD whether that flow is equalized or not. Also shown in Table 9, if the design MLSS can be decreased to 3,500 mg/L by building additional aeration basins, the existing clarifiers can pass the equalized PHF (same as PDF upstream of EQ) for 0.45 MGD and 0.6 MGD.

Table 9. Secondary Clarifier Capacity Evaluation Based on SLR			
Max Month Flow (MGD)	Basis of Design Peak Flow (MGD)	MLSS (mg/L)	Peak Overflow Flow (MGD) [a]
Current Design			
0.3	1.05	5,000	1.81
Future Design with Assumed Design MLSS			
0.45	1.56	3,500	2.56
0.6	1.82	3,500	2.41

[a] *RAS flow of 100% of MMF assumed*

Figure 7. Secondary clarifier 1.

3.1.7 RAS Pumping Station

The RAS pumping station consists of three 208 gpm (0.3 MGD) RAS pumps and is situated between the two secondary clarifiers and draws from their sumps. The pump station was installed with the secondary clarifiers during the 2018 plant expansion.

Each RAS pump has a magnetic flow meter on its discharge piping. RAS is pumped through a 4-inch recycle main to either the EQ basin discharge piping (preferred location for better flow distribution) or to the head of the aeration basins. Table 10 summarizes the design attributes of the RAS pumping station.

Table 10. RAS Pumping

Parameter	Value
Number	3
Type	Horizontal, Recessed Impeller
Suction Size	4 in
Discharge Size	3 in
Capacity, each	208 gpm
Capacity, each	0.3 MGD
TDH	27 ft

Table 10. RAS Pumping	
Parameter	Value
Drive size, each	10 HP
Drive speed	Variable

For single-stage systems, the RAS pumping rate is recommended to be adjustable over the range of 50-150% of the design average daily flow. Typically, RAS pumping is sized for at least 100% of the MMF. On paper, the current RAS pumping at MCWWTP has adequate capacity to pump the needed flow (see Table ES-1) at the expanded plant capacities of 0.45 and 0.6 MGD. Historically however, it has been observed that the RAS pumps cannot pump at their rated capacity of 208 gpm, particularly if two pumps are in service. Therefore, for the 0.6 MGD scenario, the RAS pumping system will have to be modeled to identify and address any potential bottlenecks. Additionally, the 4-inch RAS force main appears adequately sized to convey projected peak RAS flows (projected maximum velocities of 7.5 and 10.0 fps at 0.45 and 0.6 MGD ratings, respectively), but this will also be verified as part of the hydraulic modeling of the RAS pumping system.

Figure 8. RAS pumping station between secondary clarifiers.

3.1.8 Tertiary Filtration

Secondary effluent flows by gravity to three parallel disk filter units via a 12-inch filter influent pipe. Two of the units were installed in the 2011 plant expansion while the third was installed in 2018. Each unit contains four cloth filter disks made of fiber pile with a polyester backing. Disks are backwashed intermittently by water from a backwash pump. Design attributes of the filtration system are summarized in Table 11.

Table 11. Filtration Capacity	
Parameter	**Value**
Cloth Disk Filtration Units	
Number of Units	3
Number of Disks per Unit	4
Filter Pore Size	10 microns
Drive Size, each Unit	0.33 HP
Hydraulic Capacity	
Average (each)	0.2 MGD
Peak (each)	0.4 MGD
Total (peak, combined)	1.2 MGD
Backwash Pumps	
Number	3
Type	Horizontal, Self-Priming
Suction Size	2 in
Discharge Size	2 in
Capacity, each	130 gpm
TDH	23.2 ft
Drive size, each	2 HP
Drive speed	Variable

Like other processes downstream of the EQ basin, filtration will be sized to treat the plant's projected PHF that will equal the PDF assuming sufficient influent flow equalization is constructed. In addition, with one unit offline the system shall hydraulically pass the PHF (for 0.3 MGD refer to the hydraulic profile in the 2017 Reference Drawings by Willis Engineers) and process-wise handle 50% of the design flow (50% x 1.05 MGD = 0.525 MGD). Filtration at MCWWTP currently has a firm capacity of 0.8 MGD (see Table ES-1). For the 0.45 MGD flow tier, one more unit will be needed to bring the system's total capacity to 1.6 MGD (need 1.56 MGD) and for the 0.6 MGD flow tier another two units will be needed to bring the system's total capacity to 2.2 MGD (need 1.82 MGD). Additional conditions as dictated by the North Carolina Minimum Design Criteria and Class II Reliability Standards will also be met with these additions. For the 1 MGD design, a completely reconfigured and redesigned filtration system may be needed unless a reconfigured system is undertaken at the 0.6 MGD flow tier.

Figure 9. Filters number 1 and 2.

3.1.9 Ultraviolet (UV) Disinfection

After filtration the wastewater undergoes UV disinfection. UV disinfection is provided by a two-channel unit that was installed in 2018, replacing the previous UV disinfection facilities. Per Table ES-1, UV disinfection capacity will have to be increased in future expansions. Adding a third parallel channel with a single bank will raise the firm capacity of the system to 2.1 MGD and will satisfy the capacity needs for both the 0.45 and 0.6 MGD flow tiers that are 1.56 and 1.82 MGD, respectively, with two banks/channels online and the third bank/channel as standby. UV disinfection design attributes are summarized in Table 12.

Table 12. Disinfection Capacity	
UV Disinfection System	
Parameter	Value
Number of Channels	2
Banks per Channel	1
UV Transmission @ 253.6 nm	65%
Hydraulic Capacity	
Average (each)	1.05 MGD
Total (combined units)	2.1 MGD

Figure 10. UV disinfection facility.

3.1.10 Cascade Aerator

Flow from the two UV channels recombines and is routed in a 12-inch UV effluent pipe to a concrete step cascade aerator with weirs. The width and height of the aerator were evaluated to determine capacity. Width was evaluated against typical design parameters given in *Metcalf & Eddy* (2013). According to the text, the typical range of hydraulic loading for cascade aerators is 100,000 – 500,000 gal/ft of width-day at average design flow. The existing cascade aerator is 4 feet wide. At a 1 MGD plant rating, the annual average daily flow is 0.62 MGD – this corresponds to 155,000 gal/ft of width-day, which is in the acceptable design range. Therefore, the existing cascade aerator is wide enough to accommodate the planned increases in plant rating.

Cascade height was evaluated using the standard formula developed by Barrett (1960) and referenced in *Metcalf & Eddy* (2013):

$$H = \frac{R-1}{0.11ab(1+0.046T)}$$

where

H = height through which water falls (ft)

R = deficit ratio = $\frac{C_s - C_0}{C_s - C}$

where

C_s = wastewater dissolved oxygen saturation concentration at temperature T (mg/L)

C_0 = post-aeration influent dissolved oxygen concentration (mg/L)

C = required final dissolved oxygen concentration after cascade

T = water temperature (°C)

a = water quality parameter = 0.8 for effluent wastewater

b = weir geometry parameter = 1.3 for step weirs

Using conservative values of C_0 = 0 mg/L, T = 31°C (the warmest temperature measurement from plant historical data for the least oxygen solubility), C = 5 mg/L from the plant's NPDES permit, and C_s = 7.6 mg/L, the required height *H* is 7.35 feet. The actual height of the existing cascade aerator is 7.5 feet. Therefore, the existing cascade aerator has sufficient height and width, and does not need to be upgraded.

Figure 11. Cascade Aerator.

3.1.11 Effluent Flowmeter

Flow from the cascade aerator is routed through a 12-inch pipe to an effluent flowmeter structure which houses an effluent sampler and a 60-degree sharp-crested V-notch effluent weir with a maximum capacity of 0.93 MGD. An ultrasonic level sensor measures the height of water over the weir to determine the total effluent flow rate. Flow discharges from the effluent flowmeter structure into the Rocky River. The effluent weir is undersized to measure current and future peak daily flows, so effluent flow measurement will have to be upgraded in any plant expansion project. For the 0.45 and 0.6 MGD scenarios, the existing weir could be replaced with another 60-degree weir plate that will have a higher notch and thereby increase the range of flows measured. The existing weir is only 1 foot high whereas the maximum height allowed is 2 feet The developed headloss and therefore the necessary v-notch height to measure future peak equalized flows are as follows:

- At 1.58 MGD (0.45 MGD), the 60-degree v-notch will develop a headloss of approximately 1.24 feet.
- At 1.82 MGD (0.6 MGD), the 60-degree v-notch will develop a headloss of approximately 1.31 feet.
- At 2.47 MGD (1.0 MGD), the 60-degree v-notch will develop a headloss of approximately 1.48 feet.

Figure 12. V-notch weir inside effluent monitoring box.

3.1.12 Plant Drainage Pumping Station

Various plant drainage flows including filter backwash water, sludge holding tank supernatant, clarifier scum, and tank drainage are routed in an 8-inch sewer to the plant drain pumping station, which discharges to the EQ basin. Excess flow to the plant drain pumping station overflows back to the IPS. The station consists of a single 208 GPM (0.3 MGD) pump. The size of the plant drain pump at 0.3 MGD seems large as it equals the plant's permitted MMF capacity. The station currently lacks redundancy with only a single pump installed but the overflow protection provided by the IPS adds reliability to the process. Plant drain pumping station design attributes are summarized in Table 13.

Table 13. Plant Drainage Pumping Station Capacity

Parameter	Value
Number of Pumps	1
Type	Submersible Chopper
Discharge Diameter	4 in
Capacity	208 gpm @ 33 ft TDH
Motor Size	5 HP

Of all the plant drain streams, the filter backwash is expected to contribute the most flow and most continuous. For the type of filters used at MCWWTP, the maximum backwash should not exceed three percent of the filter forward flow so for a maximum forward flow of 1.2 MGD the maximum expected backwash flowrate should not exceed 0.036 MGD or 25 gpm. Using the plant's PHF and a 15 percent overall plant drainage flow (not just backwash) for a more conservative calculation, the following maximum plant drain flows are expected:

- At 1.05 MGD (0.3 MGD), expect a maximum of 109 gpm of plant drainage flow.
- At 1.58 MGD (0.45 MGD), expect a maximum of 164 gpm.
- At 1.82 MGD (0.6 MGD), expect a maximum of 189 gpm.

Therefore, the single plant drain pump rated at 208 gpm appears sufficiently sized for up to 0.6 MGD MMF. For the 1.0 MGD alternative, consideration should be given to upgrading this pump station into a duplex or triplex system designed for duty/standby operation.

3.2 Solids Stream Treatment Facilities

The solids treatment train at MCWWTP consists of a WAS pumping station and aerated sludge holding tanks. Decanted thickened solids are trucked from the holding tanks to nearby Rocky River Regional Wastewater Treatment Plant (RRRWWTP) for final thickening, dewatering, and incineration.

3.2.1 WAS Pumping Station

The WAS pumping station consists of two 100 gpm (0.144 MGD) pumps. Just like the RAS pumps, the WAS pumps are situated between the two secondary clarifiers. The two sets of pumps (WAS and RAS) share a suction manifold and draw activated sludge from the bottom of the clarifiers. The WAS pump station was installed with the secondary clarifiers during the 2018 plant expansion.

Each WAS pump has a magnetic flow meter on its discharge piping. WAS is pumped in a 4-inch force main to the four aerated sludge holding tanks. Design attributes of the WAS pumping station are summarized in Table 14.

Table 14. WAS Pumping

Parameter	Value
Number of Pumps	2
Type	Horizontal, Recessed Impeller
Suction Size	3 in

Table 14. WAS Pumping	
Parameter	**Value**
Discharge Size	2 in
Capacity, each	100 gpm
Capacity, each	0.144 MGD
TDH	20 ft
Drive size, each	5 HP
Drive speed	Variable

The calibrated biological process model was used to estimate the solids production rates at the different flow conditions. Using the projected max month WAS loads (2,111 lb/MG), maximum and minimum WAS pump flows were calculated assuming a minimum and maximum WAS TSS concentration of 5,000 and 12,000 mg/L, respectively. The estimated WAS flows and loads are provided in Table 15. The existing WAS pumps appear oversized for the current plant rating and are sufficiently large for the 0.45 and 0.6 MGD plant upgrades. The oversized pumps may have issues with turndown and to compensate for that wasting may be short and at high rates instead of continuous and slow that is preferred.

Table 15. Projected WAS Production Rates and Flows			
Parameter	**0.3 MGD MMF**	**0.45 MGD MMF**	**0.6 MGD MMF**
WAS (lb/d)	630	950	1,270
Max WAS Flow at 0.5% TSS (gpd)	15,200	22,730	30,410
Min WAS Flow at 1.2% TSS (gpd)	6,340	9,470	12,670

3.2.2 Sludge Holding Tanks

WAS is sent to four 7,600-gallon aerated sludge holding tanks located at the end of the aeration basins. Originally installed as secondary clarifiers, these were converted to holding tanks in the 2018 plant expansion. Coarse bubble aeration, provided by the same blowers supplying air to the aeration basins, maintains the necessary DO concentration in the sludge and keeps solids in suspension. After filling, the sludge is decanted via a telescoping valve and the supernatant is routed to the plant drain pumping station. Approximately four loads of thickened WAS (TWAS) are transported to the RRRWWTP in a contracted 4,000-gal truck every two weeks.

The design attributes of the sludge holding tanks are summarized in Table 16. The minimum and maximum hydraulic retention time (HRT) for the 0.3, 0.45, and 0.6 MGD flow/load conditions were determined by the model-predicted WAS production (mass) and assuming a range of potential TWAS TSS concentrations to get a range of TWAS flows. The minimum TWAS concentration of 8 g/L (0.8%) assumes there is no manual decant, such as if the plant drain is out of service, while the maximum TWAS concentration of 30 g/L (3%) is typical for TWAS. If thickening performance is maintained (30 g/L) and a hauling frequency of every two weeks is the goal, additional storage volume is required for 0.45 and 0.6 MGD conditions.

In terms of aeration, Ten-State Standards describe the need to maintain DO between 1 and 2 mg/L with a minimum air supply of 30 cfm/1000 ft^3.

Table 16. Sludge Holding Tanks	
Parameter	**Value**
Number	4
Volume (each)	7,600 gal
Volume (each)	1,015 ft^3
Tank Diameter	12 ft
Tank Height	10.5 ft
Air Requirement	30 SCFM/1000 ft^3
Total Air Requirement	122 SCFM
Min/Max HRT at 0.3 MGD	3.2 / 12.0 days
Min/Max HRT at 0.45 MGD	2.1 / 8.0 days
Min/Max HRT at 0.6 MGD	1.6 / 6.0 days

Figure 13. Sludge holding tank number 2.

3.3 Backup Power Generation

Backup power is provided by two engine generators. One generator was installed in 2010 whereas the second generator was installed in 2018. The equipment (generators and associated generator switchgear) provides a total standby capacity of 425 kW to the plant (Table 17). The switchgear detects any loss of normal utility power and activates the generator to provide standby power to the entire plant. Backup power generator capacity will be evaluated in more detail during preliminary design of the next expansion.

Table 17. Generator Design Criteria	
Parameter	Value
Number of Generators	2
Genset 1 Rating	150 kW (277/480 VAC)
Genset 2 Rating	275 kW (480 VAC)

Section 4: North Carolina Minimum Design Criteria and Reliability Requirements

North Carolina has published minimum design criteria for the design of wastewater treatment plants. In addition, an important factor in design and operation of any WWTP is reliability. Reliability refers to the ability to provide uninterrupted service while continuing to meet discharge requirements. Achieving reliability is usually accomplished by installing standby process units in addition to the active process units. The standby unit can be put into operation while another unit is taken offline for maintenance and/or inspection purposes. It is also very typical to have standby units available during dry weather or low flow conditions. Based on the 1974 EPA publication "Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability" BC feels that MCWWTP would fall under Reliability Class II which is for treatment works 'which discharge into navigable waters that would not be permanently or unacceptably damaged by short-term effluent quality degradations but could be damaged by continued (on the order of several days) effluent quality degradation'. Due to MCWWTP's small size, and the fact that Muddy Creek and Rocky River are not highly protected bodies of water (Class C), MCWWTP should be considered a Reliability Class II treatment works. Table 18 lists the NC minimum design standards side by side with the unit process reliability and redundancy criteria for Class II.

Table 18. North Carolina Minimum Design Criteria and Class II Reliability Standards for WWTP

Process Unit	NC Minimum Design Criteria	Class II Reliability Standards	
		Backup Unit Required?	Firm Capacity with Largest Unit Out of Service
Screens	Hydraulically pass the PHF w/ 1 component (unit) out of service; manual bar screen counts if an automatic bypass is provided.	Yes, can be manual	100% of peak flow
Influent Pumps	PHF w/ largest pump out of service (firm)	Yes. Backup pump can serve more than one set of pumps.	100% of peak flow
Aeration Basins	Hydraulically pass the PHF w/ 1 component (unit) out of service	No, but provide at least two equal volume basins.	
Aeration Basin Blowers	Meet air demand for max month load. For bioreactors, the firm capacity must allow maintaining solids suspension and aerobic conditions.	Yes. Backup unit can be un-installed if easily replaced.	100% of design O_2 transfer
Secondary Clarifiers	Hydraulically pass the PHF w/ 1 component (unit) out of service	Yes	50% of design flow

Table 18. North Carolina Minimum Design Criteria and Class II Reliability Standards for WWTP			
Process Unit	NC Minimum Design Criteria	Class II Reliability Standards	
		Backup Unit Required?	Firm Capacity with Largest Unit Out of Service
RAS Pumps	PHF w/ largest pump out of service (firm)	Yes. Backup pump can serve more than one set of pumps.	100% of peak flow
Filtration	Hydraulically pass the PHF w/1 component (unit) out of service	Yes	50% of design flow
UV Disinfection	100% PHF w/1 bank out of service, minimum of 2 banks	Yes	50% of design flow
WAS Pumps	PHF w/largest pump out of service (firm)	Yes	100% of peak flow
Plant Drainage Pumping Station	PHF w/largest pump out of service (firm)	Yes	100% of peak flow
Sludge Blowers	Meet air demand for max month load.		

Design of future improvements that will be undertaken in response to addressing expanded capacity needs will consider the above state and reliability criteria as minimum measures to reduce operational risks.

Attachment A: MCWWTP Equipment List

Liquid Train

IPS Pumps

Number of Units	2
Type	Submersible Chopper
Manufacturer	Vaughan
Discharge Diameter	4 inches
Capacity, each	730 gpm @ 76 feet TDH
Motor Size	30 HP
Type of Drive	Variable speed
Force main Diameter	8 inch

Rotary Drum Screen

Number of Units	1
Screen Type	Perforated Plate
Manufacturer / Model	Huber / Rotamat Ro9
Opening Size	6 mm
Hydraulic Capacity	1.85 MGD @ 300 mg/L TSS
Motor Size	1.5 HP

Manual Bar Screen Bypass

Number of Units	1
Width	24 inches
Bar Spacing	1 inch

Equalization Basin

Number of Units	1
Volume	75,000 gallons
Diffusers	52 10" Dura-Disc Coarse bubble diffusers
Diffuser Capacity	7.88 SCFM each

Equalization Blowers

Number of Units	2
Type	Positive displacement
Manufacturer	Robuschi Robox
Capacity, each	454 ICFM
Motor Size	10 HP

Equalization Transfer Pumps

Number of Units	4
Type	Submersible, non-clog
Manufacturer	Wilo (pumps 1 and 2); Flygt (pumps 3 and 4)
Capacity, each	264 gpm @ 14 feet TDH (pumps 1 and 2); 730 gpm @ 25 feet TDH (pumps 3 and 4)
Motor Size	5 HP (pumps 1 and 2); 10 HP (pumps 3 and 4)

Type of Drive	Variable Speed
Chemical storage and Feed	
Storage volume	6600 gallons
Number of feed pumps	2
Pump Type	Peristaltic metering pump
Manufacturer / Model	Blue-White Industries / ProSeries-M M-2
Maximum metering rate (total)	16.5 gph
Maximum discharge pressure	110 psi
Aeration	
Type of Process	Conventional activated sludge - Single-stage nitrification
Number of Basins	4
Volume, each	62,500 gal
Side Water Depth	10 feet
Capacity, total	0.3 MGD
Diffusers	62 4" Mooers FlexCap Coarse bubble diffusers per train
Diffuser Capacity	5.0 SCFM each
Aeration Blowers	
Number of Units	5
Type	Positive Displacement
Manufacturer	Robuschi
Capacity, each	450 SCFM @ 6 psig discharge pressure (blowers 1-3); 250 SCFM @ 6psig discharge pressure (blowers 4-5)
Motor Size	25 HP (blowers 1-3); 10 HP (blowers 4-5)
Secondary Clarifiers	
Number of Units	2
Manufacturer	Evoqua
Type	Circular steel tank, Center-fed, inboard effluent launder
Tank Inner Diameter	40 feet
Side Water Depth	12 feet
Surface Area, each	1,257 square feet
Motor Size	0.5 hp
Filtration	
Number of Units	3
Manufacturer / Model	Aqua-Aerobic / MiniDisk
Filter Disks	4 Aqua MiniDisks per unit
Filter Area (per unit)	48 square feet
Filter Pore Size	10 microns
Motor size, each unit	0.33 HP
Hydraulic capacity, average (each)	0.2 MGD

Hydraulic capacity, peak (each)	0.4 MGD
Filter Backwash Pumps	
Number of Units	3
Type	Horizontal, Self-priming
Manufacturer / Model	Gorman-Rupp
Suction Size	2 inch
Discharge Size	2 inch
Capacity, each	130 gpm
Capacity, each	0.187 MGD
TDH	23.2 ft
Drive size, each	2 HP
Drive speed	Variable
Disinfection	
Type	Ultraviolet
Manufacturer	Trojan
Number of Channels	2
Number of UV Modules	16; 4 UV lamps per module
UV Transmission @253.6 nm	65%
Design flow (per channel)	1.05 MGD
Effluent Flow Measurement	
Type	60° V-notch weir, 1-ft high
Capacity	0.93 MGD
Plant Drainage Pumping Station	
Number of Units	1
Type	Submersible Chopper
Manufacturer	Vaughan
Discharge Diameter	4 inches
Capacity	208 GPM @ 33 feet TDH
Motor Size	5 HP
Solids Train	
RAS Pumps	
Number of Units	3
Type	Horizontal, Recessed Impeller
Manufacturer / Model	Hayward Gordon / Torus
Suction Size	4 inch
Discharge Size	3 inch
Capacity, each	208 gpm
Capacity, each	0.3 MGD
TDH	27 ft
Drive size, each	10 HP

Drive speed	Variable

WAS Pumps

Number of Units	2
Type	Horizontal, Recessed Impeller
Manufacturer / Model	Hayward Gordon / Torus
Suction Size	3 inch
Discharge Size	2 inch
Capacity, each	100 gpm
Capacity, each	0.144 MGD
TDH	20 feet
Drive size, each	5 HP
Drive speed	Variable

Sludge Holding Tanks

Number of Units	4
Volume (each)	7,600 gallons
Volume (each)	1,015 cubic feet
Tank Diameter	12 feet
Tank Height	10.5 feet
Diffusers	8 4" Mooers FlexCap course bubble diffusers per tank
Diffuser Capacity	5.0 SCFM each

General

Electrical Generator 1

Manufacturer / Model	Cummins/ Gen-set DSGAC
Genset Rating	150 kW
Line Voltage	277/480 VAC, 3 Phase, 60 Hz

Electrical Generator 2

Manufacturer / Model	Cummins/ Gen-set DQDAB
Genset Rating	275 kW
Line Voltage	480 VAC, 3 Phase, 60 Hz

Attachment M

Technical Memorandum

309 East Morehead Street
Suite 220
Charlotte, NC 28202

Phone: 704-358-7204

Prepared for: Water and Sewer Authority of Cabarrus County (WSACC)

Project Title: Wastewater Treatment Facilities Plan and Preliminary Engineering Report (PER)

Project No.: 193209

Technical Memorandum No. 16

Subject: Expansion Alternatives Analysis for Muddy Creek Wastewater Treatment Plant (MCWWTP)

Date: December 4, 2025

To: Chad VonCannon, Executive Director

From: George Anipsitakis, Project Manager

Copy to: Thomas Hahn, Engineering Director

Chris Carpenter, Wastewater Operations Director

Prepared by: Duncan Lozinski

Duncan Lozinski, P.E

2025-12-4

Reviewed by: G. Anipsitakis

George Anipsitakis, PhD, PE, Project Manager

Limitations:

This document was prepared solely for WSACC in accordance with professional standards at the time the services were performed and in accordance with the contract between WSACC and Brown and Caldwell dated February 28, 2024. This document is governed by the specific scope of work authorized by WSACC; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by WSACC and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

Table of Contents

List of Tables

List of Abbreviations

AACE	Association for the Advancement of Cost Engineering
AADF	annual average daily flow
AE	aerobic
AGS	aerobic granular sludge
AX	anoxic
BC	Brown and Caldwell
BNR	biological nutrient removal
BOD_5	biological oxygen demand, 5-day
CAS	conventional activated sludge
CFU	colony forming units
cm	centimeter
COD	chemical oxygen demand
D	depth
DO	dissolved oxygen
EQ	equalization
ft	feet
gal	gallons
gpd	gallons per day
gph	gallons per hour
gpm	gallons per minute
HP	horsepower
hr	hour
ICFM	inlet cubic feet per minute
IMLR	internal mixed liquor recycle
in	inches
IPS	Influent Pump Station
kWh	Kilowatt-hour
L	length
lb/d	pounds per day
MCWWTP	Muddy Creek Wastewater Treatment Plant
MDF	minimum daily flow
mg	milligrams
mg/L	milligrams per liter
MG	million gallons
MGD	million gallons per day
mJ/cm^2	millijoules per square centimeter
MLE	Modified Ludzack-Ettinger
MLSS	mixed liquor suspended solids
mm	millimeters
MMF	maximum monthly flow
MWF	maximum weekly flow
NCDEQ	North Carolina Department of Environmental Quality
No.	Number
NPDES	National Pollutant Discharge Elimination System
NPV	net present value
nm	nanometer
O&M	Operation and Maintenance
PDF	peak daily flow
PEF	peak equalized flow
PHF	peak hourly flow
PS	pump station
psig	pounds per square inch gauge
RAS	return activated sludge
RPM	revolutions per minute
RRRWWTP	Rocky River Regional Wastewater Treatment Plant
SCFDB	secondary clarifier flow diversion box
SCFM	standard cubic feet per minute
SHT	sludge holding tank
TDH	total dynamic head
TM	Technical Memorandum
TRC	total residual chlorine
TSS	total suspended solids
UV	ultraviolet
VFD	variable frequency drive
W	width
WAS	waste activated sludge
WSACC	Water and Sewer Authority of Cabarrus County
WWTP	Wastewater Treatment Plant
yd	yard

Executive Summary

This Technical Memorandum (TM) evaluates six different treatment alternatives for the expansion of the Muddy Creek Wastewater Treatment Plant (MCWWTP) beyond 0.3 million gallons per day (MGD) on a maximum monthly flow (MMF) basis. The alternatives are flow based and include expansions to 0.6 and 1.0 MGD. Of these, one alternative was selected as the most suitable in meeting the project objectives and will be developed further to a 15-percent level conceptual design as part of the next phase of this project.

Process capacities and alternative expansion concepts discussed in this TM were developed in previous TMs and workshops as part of this project and in collaboration with Water and Sewer Authority of Cabarrus County (WSACC) staff.

Process Areas and Options

Expansion of the MCWWTP beyond 0.3 MGD will for the most part follow the existing liquid and solids treatment train as follows:

- Influent pumping with expansion of the Influent Pump Station (IPS) as needed
- Headworks screening and grit removal (grit removal for 1 MGD alternatives)
- Flow equalization with sufficient storage volume to reduce the peak hourly flow (PHF) down to the peak daily flow (PDF)
- Secondary treatment expansion with either a new conventional activated sludge (CAS) system, oxidation ditch, or aerobic granular sludge (AGS)
- Filtration with cloth disk filters
- Ultraviolet (UV) disinfection
- Effluent flow measurement with V-notch weir or Parshall flume
- Plant Drain Pump Station improvements

Six expansion alternatives are presented in this TM, mainly based around the secondary treatment process technologies (sub alternatives a, b, and c). They are organized by flow rating, where Alternative #1 corresponds to the 0.6 MGD expansion and Alternative #2 corresponds to the 1.0 MGD expansion. The list of alternatives is as follows:

- Alternative #1a – 0.6 MGD, Conventional Activated Sludge
- Alternative #1b – 0.6 MGD, Oxidation Ditch
- Alternative #1c – 0.6 MGD, Aerobic Granular Sludge
- Alternative #2a – 1.0 MGD, Conventional Activated Sludge
- Alternative #2b – 1.0 MGD, Oxidation Ditch
- Alternative #2c – 1.0 MGD, Aerobic Granular Sludge

Table 1 summarizes the expansion alternatives and lists construction costs, Operation and Maintenance (O&M) costs, and net present value (NPV) for each. Construction costs are escalated to the midpoint of construction year 2027. Engineering costs for permitting, design, and construction administration are included. NPV analysis assumes a 20-year analysis period and 4% discount rate.

Table 1. Summary of Alternatives for Expansion of MCWWTP to 0.6 or 1.0 MGD

Process Area	Alternative #1a	Alternative #1b	Alternative #1c	Alternative #2a	Alternative #2b	Alternative #2c
Influent Pump Station	Duplicate existing IPS			New IPS with coarse screens		
Headworks	Duplicate existing rotary drum screen			New headworks with fine screens and grit removal		
Flow Equalization (EQ)	Add 2nd EQ tank with 80,000-gal capacity	Add 2nd EQ tank with 80,000-gal capacity	Add 2nd EQ tank with 80,000-gal capacity	Add 2nd EQ tank with 135,000-gal capacity	Add 2nd EQ tank with 135,000-gal capacity	Add 2nd EQ tank with 135,000-gal capacity
Chemical Feed (Alkalinity)	No improvements			No improvements		
Biological Process	New conventional activated sludge	New oxidation ditch	New aerobic granular sludge	New conventional activated sludge	New oxidation ditch	New aerobic granular sludge
Secondary Clarifiers	No improvements	No improvements	Repurpose SCs as post-EQ	Add 3rd secondary clarifier	Add 3rd secondary clarifier	Repurpose SCs as post-EQ
Return Activated Sludge (RAS) Pumping	No improvements	No improvements	Not required	Add fourth RAS pump	Add fourth RAS pump	Not required
Waste Activated Sludge (WAS) Pumping	No improvements	No improvements	New sludge transfer pump included with AGS package	No improvements	No improvements	New sludge transfer pumps included with AGS package
Filtration	Add fourth and fifth identical filter units			Demolish three existing units, install two new 3 MGD 6-disk units		
UV Disinfection	Add 3rd identical parallel bank			Demolish existing, install new two channel system supplying dose of 90 mJ/cm^2		
Effluent Flow Measurement	Add 2nd identical V-notch weir in parallel			Abandon existing effluent box and weir, install new 9-in Parshall flume		
Cascade Aerator	No improvements			No improvements		
Sludge Holding Tanks (SHTs)	Utilize existing ABs as additional sludge holding	Utilize existing ABs as additional sludge holding	Utilize existing ABs as sludge buffer tanks. Repurpose SHTs as sludge buffer tanks.	Utilize existing ABs as additional sludge holding	Utilize existing ABs as additional sludge holding	Utilize existing ABs as sludge buffer tanks. Repurpose SHTs as sludge buffer tanks.
Plant Drain Pump Station	No improvements			Add 2nd duplicate pump		
Backup Power Generator	Replace existing (2) generators with single new generator of the same total capacity of 425 kW			Add a 2nd 425 kW engine generator		
Construction Cost	$18,845,000	$20,320,000	$22,767,000	$40,346,000	$45,254,000	$46,357,000
Annual Electricity and Caustic Soda Cost	$167,624	$178,055	$167,037	$242,530	$273,412	$246,893
20-year NPV Cost (in year 2025)	$18,770,000	$20,203,000	$22,193,000	$38,605,000	$43,302,000	$43,924,000

Preliminary site plans and process flow diagrams were developed for these alternatives to better define the scope of work and facilitate cost estimating. These are provided as attachments to this TM.

Table 2 summarizes the advantages and disadvantages of the MCWWTP expansion alternatives.

Table 2. Advantages and Disadvantages of the Different MCWWTP Expansion Alternatives

Alternative	Advantages	Disadvantages
#1a. 0.6 MGD and #2a. 1.0 MGD Conventional Activated Sludge	• Status quo (similar to operation at RRRWWTP) • Some nitrogen removal	• Internal mixed liquor recycle pumping • New biological nutrient removal (BNR) basin and aeration system • Diffuser maintenance required
#1b. 0.6 MGD and #2b. 1.0 MGD Oxidation Ditch	• Some nitrogen removal • Simple operation and maintenance • internal mixed liquor recycle (IMLR) is passive within oxidation ditch, controlled by gate (no pumping)	• Sludge settleability is not as good as CAS • Aeration not as efficient as fine bubble • Highest footprint
#1c. 0.6 MGD and #2c. 1.0 MGD Aerobic Granular Sludge	• Nitrogen and phosphorus removal • Small footprint • No secondary clarifiers or RAS pumping	• Newer technology • Requires retrofit of existing Secondary Clarifiers • Batch fed system

Recommended Alternative

WSACC and Brown and Caldwell met multiple times in May and June 2025 to discuss these alternatives before selecting Alternative #1a with some variations as the recommended alternative to be further developed in a Preliminary Engineering Report. The main reasons for selection are economic and WSACC's familiarity with the CAS technology that is currently implemented at the MCWWTP and RRRWWTP. This alternative will be rated for 0.66 MGD MMF since the biological process will be sized for this flow. The equalization basin will be sized for the volume needed for the 1 MGD MMF alternative to make it easier and less costly to expand to 1 MGD in the future. The return activated sludge (RAS) pumping needs to be investigated further since recent feedback suggests that the existing pumps have difficulty meeting current capacity demands.

Section 1: Project Introduction and Background

1.1 Background

The Water and Sewer Authority of Cabarrus County (WSACC) owns and operates the Muddy Creek Wastewater Treatment Plant (MCWWTP) located at 14655 Hopewell Church Road, Midland, North Carolina 28107. The facility is currently permitted to treat 0.3 million gallons per day (MGD) of wastewater generated on a maximum monthly flow (MMF) basis and has an effluent limits page for 1 MGD already included in its National Pollution Discharge Elimination System (NPDES) operating permit. Effluent permit limits are summarized in Table and Table 4. Due to increasing flows, the plant requires expansion, and its capacity will be increased to either 0.6 or 1.0 MGD.

Technical Memorandum (TM) No. 7 Capacity Analysis for Muddy Creek Wastewater Treatment Plant by Brown and Caldwell (BC) dated February 2025 discusses the existing facility capacities and sets the premise for the expansion alternatives presented in this TM.

Table 3. Final Effluent Discharge Permit Limits at 0.3 MGD MMF			
Parameter	Monthly Average	Weekly Average	Daily Grab
Flow, MGD	0.3		
Biological Oxygen Demand 5-day (BOD_5), milligrams per liter (mg/L), (April 1 – October 31)	10	15	
BOD_5, mg/L, (November 1 – March 31)	20	30	
Total Suspended Solids (TSS), mg/L	30	45	
TAN, mg/L, (April 1 – October 31)	4	12	
TAN, mg/L, (November 1 – March 31)	8	24	
Minimum Dissolved Oxygen (DO), mg/L			5.0
Fecal Coliform (geometric mean), Colony Forming Units (CFU)/100 mL	200	400	
Maximum Total Residual Chlorine (TRC), μg/L			28
Minimum pH			6.0
Maximum pH			9.0

Table 4. Final Effluent Discharge Permit Limits at 1 MGD MMF			
Parameter	Monthly Average	Weekly Average	Daily Grab
Flow, MGD	1.0		
BOD_5, mg/L, (April 1 – October 31)	5	7.5	
BOD_5, mg/L, (November 1 – March 31)	10	15	
TSS, mg/L	30	45	
TAN, mg/L, (April 1 – October 31)	1	3	
TAN, mg/L, (November 1 – March 31)	2	6	
Minimum Dissolved Oxygen (DO), mg/L			5.0
Fecal Coliform (geometric mean), CFU/100 mL	200	400	
Maximum TRC, μg/L			28
Minimum pH			6.0
Maximum pH			9.0

1.2 Basis of Design Flows and Loads

The basis of design flows and loads for future expansion are discussed in BC's *TM No. 4 Influent Flows and Loads Analysis and Projections for MCWWTP* dated November 1, 2024 and are summarized in the following Table 5 through Table 7..

Table 5. Basis of Design Flows at MCWWTP		
Flow Condition	Flow Rate (MGD)	
	For 0.6 MGD MMF	For 1 MGD MMF
Peak Hourly Flow (PHF) [a]	3.04	4.21
Peak Daily Flow (PDF) [a]	1.82	2.47
Maximum Weekly Flow (MWF)	1.04	1.73
Maximum Monthly Flow (MMF)	0.60	1.00
Annual Average Daily Flow (AADF)	0.37	0.62
Minimum Daily Flow (MDF)	0.14	0.22

[a] *Based on 2-year storm interval projections (B&V, 2022) instead of using historical peaking factors.*

Table 6. 0.6 MGD Pollutant Loads and Concentrations Basis of Design

Pollutant	Annual Average Load (lb/d)	Annual Average Concentration (mg/L)	Max Month Load (lb/d)	Max Month Concentration (mg/L)
COD	2,373	664	3,430	685
BOD_5	957	268	1,381	276
TSS	1,017	285	1,469	294
TAN	144	40.2	158	31.6

COD = chemical oxygen demand

lb/d = pounds per day

Table 7. 1 MGD Pollutant Loads and Concentrations Basis of Design

Pollutant	Annual Average Load (lb/d)	Annual Average Concentration (mg/L)	Max Month Load (lb/d)	Max Month Concentration (mg/L)
COD	3,955	664	5,710	685
BOD_5	1,594	268	2,300	276
TSS	1,696	285	2,450	294
TAN	240	40.2	263	31.5

Section 2: Alternative #1 Expansion to 0.6 MGD

Alternative #1 involves doubling the plant capacity from the current 0.3 MGD MMF to 0.6 MGD MMF. This would require expanding most process areas at the plant, including influent pumping, headworks, equalization (EQ), biological treatment, filtration, and disinfection. Three sub-alternatives for secondary treatment expansion are presented: 1a) construction of a new conventional activated sludge (CAS) system; 1b) construction of a new oxidation ditch system; and 1c) construction of a new aerobic granular sludge (AGS) system. The following sections discuss the proposed improvements associated with Alternative #1 by process area.

2.1 Influent Pump Station

The existing Influent Pump Station (IPS) pumps all raw influent from the collection system into the MCWWTP. The pump station features two 30-horsepower (HP) wet submersible pumps each rated for 1.05 MGD at 76 feet total dynamic head (TDH). As discussed in *Technical Memorandum (TM) No. 07 Capacity Analysis for MCWWTP*, at a future permitted capacity of 0.6 MGD MMF the IPS must handle a PHF of 3.04 MGD. A duplicate IPS and 8-inch forcemain will be constructed, adjacent to and hydraulically connected with the existing IPS to accommodate higher flows. The influent pumping firm capacity of the IPS will be increased from 1.05 to 3.15 MGD. Alternative #1 IPS design criteria are presented in Table 8.

Table 8. Alternative #1 IPS Design Criteria

Parameter	Value
Number of Pumps	4
Type	Wet pit submersible
Pump Power	30 HP
Pump Operating Point	1.05 MGD @ 76 ft TDH
IPS Firm Capacity	3.15 MGD
Dual Forcemain Diameters	8 inches

2.2 Headworks

The existing headworks consists of a single 6-mm rotary drum screen with manual bar screen bypass on an elevated metal platform adjacent to the EQ basin. The hydraulic capacity of the screen is 1.85 MGD. Like the IPS, the headworks must handle a PHF of 3.04 MGD at the 0.6 MGD MMF rating. Therefore, current screening capacity is inadequate. The existing metal platform will be extended, and a duplicate drum screen will be installed to double screening capacity. The new drum screen will receive flow via the new parallel 8-inch forcemain directly from the new IPS pumps. There will be upstream isolation and cross connection valves to balance flow between the two screens. Alternative #1 headworks design criteria are presented in Table 9.

Table 9. Alternative #1 Headworks Design Criteria

Parameter	Value
Rotary Drum Screen	
Number of Units	2
Screen Type	Perforated Plate
Opening Size	6 mm

Table 9. Alternative #1 Headworks Design Criteria	
Parameter	Value
Hydraulic Capacity, each	1.85 MGD @ 300 mg/L TSS
Drive Size	1.5 HP
Manual Bar Screen Bypass	
Number of Units	2 (one per bar screen)
Width	24 in
Bar Spacing	1 in

2.3 Flow Equalization

All flow from the headworks currently flows by gravity to the 75,000-gallon flow EQ basin. Per *TM 07,* the current EQ basin is undersized for the goal of reducing the PHF of 3.04 MGD to the PDF of 1.82 MGD. A new 80,000-gallon capacity EQ basin, hydraulically connected to the existing, will be constructed adjacent to the Administration Building bringing the total EQ capacity to 155,000 gallons. Flow will normally be conveyed from the headworks to the new EQ Tank where it will be hydraulically connected to the existing. The existing Aeration Basin blowers will be repurposed to provide mixing air for the new EQ Tank 2. Design criteria for the EQ Basins are presented in Table 10.

Table 10. Alternative #1 EQ Design Criteria	
Parameter	Value
Equalization Basin No. 1 (EXISTING)	
Diameter	38 ft
Sidewater Depth	12 ft
Total Volume	100,000 gal
Usable Volume	75,000 gal
Diffuser Type	Coarse bubble
Number of Blowers	2
Blower Type	Positive displacement
Capacity, each	454 ICFM
Drive Size, each	10 HP
Equalization Basin No. 2 (NEW)	
Diameter	39 ft
Sidewater Depth	12 ft
Total Volume	107,000 gal
Usable Volume	80,000 gal
Diffuser Type	Coarse bubble
Blowers	Mixing air will be supplied by the existing Aeration Basin blowers.

ICFM = inlet cubic feet per minute

EQ Pumps No. 3 and 4, each rated for 1.05 MGD, will remain but the impeller will be increased by one size to account for increased head on the pumps from a longer pumping distance to the new secondary treatment process. A third identical pump to EQ Pump Nos. 3 and 4 will also be installed, while existing EQ Pump Nos. 1 and 2 (capacity 0.38 MGD, each) will be removed. See Table 11 for EQ pump design criteria. The firm capacity of the pumping arrangement will be 2.1 MGD, compared to maximum required flow of 1.82 MGD PDF.

Table 11. Alternative #1 EQ Pumps Design Criteria

Parameter	Value
Number of Pumps	3
Type	Submersible, non-clog
Capacity, each	1.05 MGD @ 30 ft TDH
Motor Size	10 HP

2.4 Secondary Treatment

For all secondary treatment alternatives (biological process) BC recommends abandoning use of the existing steel package plant aeration basins and converting them to sludge holding tank (SHT) Nos. 5 and 6 to supplement the four existing SHTs. Proposed piping modifications to make use of existing pipe where possible and interconnecting SHT Nos. 5 and 6 to the existing SHT Nos. 1 through 4 are shown in the process flow diagrams and site plans included in the Attachments.

New secondary treatment tanks will be constructed for each of the biological process technologies presented and will be located to the southwest of the disk filters in the wooded area. Site plans are included in Attachment B.

2.4.1 Alternative #1a Conventional Activated Sludge

The CAS process is the most similar to the existing MCWWTP and Rocky River Regional Wastewater Treatment Plant (RRRWWTP) configurations, which WSACC is familiar with. The proposed process is a Modified Ludzack-Ettinger (MLE) with two anoxic zones preceding three aerated zones, which is the same as the process configuration at the RRRWWTP installed as part of the Phase 3/4 Expansion.

Each of the three aerated zones will have fine bubble membrane disc diffuser grids installed on the basin slabs. The diffusers will be in a tapered configuration where zone 1 will have the highest diffuser density as the highest oxygen demand is at the front end of the train. The diffuser density will decrease through cells 2 and 3. It is recommended to construct two parallel treatment trains each capable of handling 0.33 MGD (0.66 MGD total) so that in the future a third train can be added to bring the plant capacity to 1 MGD. The design mixed liquor suspended solids (MLSS) concentration for this alternative is 3,500 mg/L and the aerobic solids retention time is 10 days. Other aeration basin design criteria are presented in Table 12.

Internal mixed liquor recycle (IMLR) will be returned from the end of the aerated zones to the anoxic zones to promote denitrification. Typically, in an MLE process configuration IMLR is recycled at a rate of 250 percent of the MMF. For the 0.6 MGD MMF alternative this equates to 1.5 MGD. IMLR pumping for Alternative #1a will be provided by two wet-pit submersible pumps. Preliminary design criteria are presented in Table 12.

Table 12. Alternative #1a Aeration Basin Design Criteria					
Aeration Basins					
Parameter	Anoxic Zone 1	Anoxic Zone 2	Aerobic Zone 1	Aerobic Zone 2	Aerobic Zone 3
Number of Trains	2				
Zone Volume per Train (MG)	0.09	0.09	0.09	0.09	0.09
Average Airflow per Train (scfm)	N/A		177		
Max Month Airflow per Train (scfm)	N/A		261		
Proposed Number of Diffusers per Zone	N/A		134	74	74
Number of Mixers per Zone	1		N/A		
Number of Blowers	N/A		3 (2 duty + 1 standby)		
Blower Design Operating Point	N/A		290 scfm @ 9 psig		
Blower Power (HP)	N/A		15		
Mixer Power (HP)	4.7		N/A		
IMLR Pumps					
Number	2				
Type	Wet-pit submersible				
Rated Capacity, each	0.75 MGD				
TDH	10 ft				
Drive size, each	5 HP				
Drive speed	Variable				

scfm = standard cubic feet per minute

psig = pounds per square inch gauge

2.4.2 Alternative #1b Oxidation Ditch

Alternative #1b involves construction of a new oxidation ditch. Similar to the CAS process, an oxidation ditch is a suspended growth biological treatment where instead of using diffusers and blowers to introduce air into the tank, mechanical aerators agitate the water surface to promote oxygen transfer into the liquid. An oxidation ditch is sometimes referred to as a 'carrousel' or 'racetrack' due to its unique geometry where two aerators on either end of the tank keep liquid moving in a circular motion.

Oxidation ditches come in multiple configurations for different treatment objectives. Similar to the MLE configuration for Alternative #1c, the oxidation ditch will have anoxic zones to promote denitrification. Gates within the tank are utilized to passively recycle nitrified mixed liquor (IMLR flow) from the aerated carrousel zone to the anoxic zones. Oxidation ditch vendors (namely Ovivo which was used as the basis of design for this alternatives analysis) utilize 'large bubble' mixing for the anoxic zones. However, BC recommends against use of this technology as it has multiple moving parts (solenoid valves) that require maintenance and a compressor to deliver air. Instead, BC recommends mixers in the anoxic zones.

Oxidation ditches are typically sold as all-inclusive packages where aerators, gates, variable frequency drive (VFD) panels, and instrumentation are provided, and locations are optimized for performance of the oxidation ditch as intended by the vendor. Preliminary design criteria for the oxidation ditch for Alternative #1b are presented in Table 13.

Table 13. Oxidation Ditch Process Design Criteria for Alternative #1b

Parameter	Value
Number of Oxidation Ditches	1
Number of Aerators per Ditch	2
Aerator Power	40 hp
Side Water Depth	10.5 ft
Total Aerobic Volume	0.423 MG
Total Anoxic Volume	0.154 MG
MLSS Concentration	4,000 mg/L
Solids Retention Time	10 days

2.4.3 Alternative #1c Aerobic Granular Sludge

Alternative #1c involves construction of a new AGS process. AGS is a batch process in which the reactors (tanks) cycle through three phases of operation, including 1) fill/empty, 2) react, and 3) settle. The operation favors the formation of dense granular biomass which has anaerobic centers (phosphorus removal), anoxic middle layers (denitrification), and aerobic outer layers (nitrification). As influent enters the bottom of each reactor, supernatant is displaced towards the top and exits through the effluent weirs. Once the fill/empty phase is complete, the react phase is started by air being introduced to the reactor via diffusers at the bottom of the tank. During the settling phase, the granular biomass settles quickly forming stratified layers of treated supernatant at the top and settled biomass at the bottom of each reactor. Lighter and less dense biomass is wasted as waste activated sludge (WAS) from the top layer of the settled biomass.

Since the AGS alternative is a batch process, the existing secondary clarifiers will be modified to provide post equalization for effluent from the AGS reactors prior to filtration and disinfection. Coarse bubble diffusers and blowers will be installed to provide mixing/aeration in the modified secondary clarifiers. AGS does not require return activated sludge (RAS), therefore, the existing RAS pumps will be demolished. WAS pumps will be provided by the AGS vendor and will be located at the AGS tanks, therefore, the existing WAS pumps will be demolished. Diffusers, blowers, pumps, effluent weirs, control valves, and instrumentation equipment will be provided by the AGS vendor. Preliminary design criteria for the AGS process for Alternative #1c are presented in Table 14.

Table 14. AGS Process Design Criteria for Alternative #1c

Parameter	Value
Number of AGS Tanks	2
Tank Length	39.5 ft
Tank Width	26.5 ft
Side Water Depth	21 ft
Tank Volume	0.16 MG
Cycle Duration	5.5 hr
MLSS Concentration	8,000 mg/L
Solids Retention Time	19 days
Air Flowrate per Basin	431 scfm
Maximum Simultaneous Air Flowrate	648 scfm

Table 14. AGS Process Design Criteria for Alternative #1c	
Parameter	**Value**
Number of AGS Blowers	3
AGS Blower Discharge Pressure	10.67 psig
AGS Blower Power	40 HP
Influent Buffer Tank Volume Required (min-max)	8,882 - 85,492 gal
Post EQ Tank Volume Required (min-max)	3,852 – 50,336 gal
Sludge Buffer Tank Volume Required	15,239 gal

2.4.4 Chemical Storage and Feed for Alkalinity Control

The only chemical addition at MCWWTP is for alkalinity control and the chemical used is caustic soda (sodium hydroxide), which will continue to be dosed upstream of the aeration basins. Sodium hydroxide is received at 25 percent strength and stored in a 6,600-gallon tank. Future average demand for Alternatives #1a through #1c will not exceed 110 gallons per day (gpd). This equates to an approximate storage capacity of 60 days using the existing tank. The existing pumps have a capacity of 16.5 gallons per hour (gph) or 396 gpd each, which is more than triple the average future demand at 0.6 MGD. As a result, no additional chemical storage and feed facilities are needed for this group of alternatives.

2.5 Filtration

Secondary effluent flows by gravity to three parallel disk filter units via a 12-inch filter influent pipe. Like all processes downstream of EQ, the filters must be sized to handle the peak daily flow (PDF). Per *TM 07*, the projected PDF at 0.6 MGD MMF is 1.82 MGD. For Alternative #1, two new identical disk filter units will be added, bringing the total peak capacity to 2.24 MGD. Per North Carolina reliability standards, the filters must be able to hydraulically pass the design peak flow with one unit out of service. The maximum hydraulic capacity of each filter is 0.553 MGD. Therefore, with one unit out of service, the filters can hydraulically pass 2.21 MGD, which is larger than the design peak flow of 1.82 MGD. See Table 15 for preliminary design criteria for the filters.

Table 15. Alternative #1 Filtration Design Criteria	
Parameter	**Value**
Cloth Disk Filtration Units	
Number of Units	5
Number of Disks per Unit	4
Filter Pore Size	10 microns
Drive Size, each Unit	0.33 HP
Peak Hydraulic Capacity, each	0.553 MGD
Peak Hydraulic Capacity, total (firm)	2.21 MGD
Backwash Pumps	
Number	5
Type	Horizontal, Self-Priming
Suction Size	2 in
Discharge Size	2 in

Table 15. Alternative #1 Filtration Design Criteria	
Parameter	**Value**
Capacity, each	130 gpm
TDH	23.2 ft
Drive size, each	2 HP
Drive speed	Variable

gpm = gallons per minute

2.6 UV Disinfection

Disinfection at MCWWTP is provided by a UV system with two parallel stainless-steel channels. Each channel has a capacity of 1.05 MGD, for a peak capacity of 2.1 MGD. UV disinfection requires N+1 redundancy, and since the current 1.05 MGD firm capacity is lower than the 1.82 MGD PDF, the UV disinfection system will be expanded. For Alternative #1, a third UV channel identical to the existing two will be added, increasing the firm capacity to 2.1 MGD, satisfying the 1.82 MGD peak flow. UV disinfection design criteria are presented in Table 16.

Table 16. Alternative #1 UV Disinfection Design Criteria	
Parameter	**Value**
Number of Channels	3
Banks per Channel	1
UV Transmission @ 253.6 nm	65%
Hydraulic Capacity	
Average (each)	1.05 MGD
Firm (combined units)	2.1 MGD

2.7 Effluent Flow Measurement

Plant effluent flow is currently measured by a 60-degree V-notch weir and level sensor in a concrete effluent monitoring box. The maximum measurable head over the weir is 1 foot, corresponding to a maximum measurable flow of 0.93 MGD. Since this is lower than the PDF of 1.82 MGD at the 0.6 MGD plant rating, effluent flow measuring requires expansion.

Due to channel width requirements of larger V-notch weirs, it is not feasible to replace the existing v-notch weir with a larger weir in the existing monitoring box. Instead, a new identical effluent structure with identical 60-degree V-notch weir will be built adjacent to the existing one. The two will share a wall and be hydraulically connected so they each receive half of the effluent flow and operate in parallel. Design criteria for the new effluent flow measurement are shown in Table 17.

Table 17. Alternative #1 Effluent Flow Measurement Design Criteria	
Parameter	**Value**
Number of Weirs	2
Type	60° V-notch weir
Capacity, each	0.93 MGD
Capacity, total	1.86 MGD

2.8 Plant Drain Pump Station

The existing Plant Drain Pump Station consists of a single submersible pump rated for 208 gpm. Various plant drainage flows are routed to the pump station including filter backwash water, sludge holding supernatant, clarifier scum, and tank drainage, with filter backwash water dominating. Per *TM 07 – MCWWTP Capacity Analysis*, a conservative estimate for maximum flow to the Plant Drain Pump Station (15 percent of PDF) at the 0.6 MGD plant rating is 189 gpm.

While the pump station lacks redundancy and would typically require a second pump for this purpose, redundancy is not required here because of a passive overflow from the Plant Drain Pump Station back to the IPS. Additionally, WSACC owns a shelf spare that can be installed if the current pump fails. Therefore, for the 0.6 MGD scenario there will be no upgrade to the Plant Drain Pump Station.

Section 3: Alternative #2 Expansion to 1.0 MGD

Alternative #2 involves expanding the plant capacity from the current 0.3 MGD MMF to 1 MGD MMF. Similar to Alternative #1, this would require expanding most process areas at the plant, including influent pumping, headworks, EQ, biological treatment, filtration, and disinfection. The same sub-alternatives for secondary treatment as presented for Alternative #1 were developed for Alternative #2. The following sections discuss the proposed improvements associated with Alternative #2 by process area.

3.1 Influent Pump Station

A new IPS will be constructed adjacent to the existing IPS while it remains in operation. The new IPS will feature two coarse mechanical screens, two trench style self-cleaning wet wells, and four submersible pumps to convey wastewater up the hill to the new Headworks. Screens and pumps will be sized for 4.21 MGD PHF.

The screening portion of the new IPS will contain three parallel channels, two with coarse mechanical screens and one for bypass. The screens will be sized to each pass the PHF providing full redundancy. Screen opening size will be 1.5 inches and angle of installation will be 30 degrees from vertical. Channels will be 2 feet wide by 5 feet deep, with a surface operating deck roughly 40 feet above channel invert.

The screen channels will feed into two parallel wet wells, each containing two submersible pumps, where each pump will be rated for 1.5 MGD, providing a firm pump station capacity of 4.5 MGD. IPS design criteria are presented in Table 18.

Table 18. Alternative #2 IPS Design Criteria

Parameter	Value
Mechanical Screens	
Number of Units	2 (+1 bypass channel)
Screen Type	Front cleaned, front returned, link driven bar screen
Bar Spacing	1 ½ in
Channel Width, each	2 ft
Motor Power, each	1 HP
Peak Capacity, each	4.5 MGD

Table 18. Alternative #2 IPS Design Criteria	
Parameter	**Value**
Influent Pumps	
Number of Units	4
Pump type	Submersible
Discharge Diameter	4 in
Rated capacity, each	1.5 MGD
Rated head, each	80 ft TDH
Motor power, each	33.5 HP
Max pump speed, each	1,200 RPM

3.2 Headworks

A new above-ground headworks structure will be constructed adjacent to the existing EQ Tank No. 1 and existing headworks. The new headworks will feature two fine mechanical screens, a vortex style grit removal basin, and grit washer, all sized for peak flow of 4.21 MGD. Screens will have ¼-inch bar spacing and will be situated in parallel channels 2 feet wide by 5 feet deep. A third empty channel will be included for bypass. Like in the IPS, each screen will be sized to convey the PHF, providing full redundancy.

Following screening, wastewater will enter a vortex grit removal basin. The basin will be baffled for increased grit capture, with a minimum capture percentage of 95 percent for all particles greater than 105 microns. Grit slurry will be pumped by a flooded suction grit pump to an adjacent grit concentrator and screw washer. Design criteria for Alternative #2 headworks are presented in Table 19.

Table 19. Alternative #2 Headworks Design Criteria	
Parameter	**Value**
Mechanical Screens	
Number of Units	2 (+1 bypass channel)
Screen Type	Front cleaned, front returned, link driven bar screen
Bar Spacing	¼-inch
Channel Width, each	2 ft
Motor Power, each	1 HP
Peak capacity, each	4.5 MGD
Vortex Grit Basin	
Number of Units	1
Capacity	7 MGD
Motor power, drive mechanism	1 HP
Grit Pump	
Number of Units	1
Design flow	250 gpm
Motor power	10 HP

Table 19. Alternative #2 Headworks Design Criteria	
Parameter	**Value**
Grit Concentrator	
Number of Units	1
Design flow	250 gpm
Pipe Size	4 inches
Grit Washer	
Number of Units	1
Design flow	250 gpm
Motor Power, Auger	3 HP

3.3 Flow Equalization

Per *TM 07,* the current EQ basin is undersized for the goal of reducing peak hourly flow to peak daily flow downstream. To be used for peak shaving at the 1.0 MGD rated capacity (PHF of 4.21 MGD and PDF of 2.47 MGD), an EQ capacity of 210,000 gallons is required. A new EQ basin with 135,000 gallons capacity will be installed. The existing Aeration Basin blowers will be repurposed to provide mixing air for the new EQ Tank 2. Design criteria for the EQ Basins are presented in Table 20.

Table 20. Alternative #2 EQ Design Criteria	
Parameter	**Value**
Equalization Basin No. 1 (EXISTING)	
Diameter	38 ft
Sidewater Depth	12 ft
Total Volume	100,000 gal
Usable Volume	75,000 gal
Diffuser Type	Coarse bubble
Number of Blowers	2
Blower Type	Positive displacement
Capacity, each	454 ICFM
Drive Size, each	10 HP
Equalization Basin No. 2 (NEW)	
Diameter	51 ft
Sidewater Depth	12 ft
Total Volume	180,000 gal
Usable Volume	135,000 gal
Diffuser Type	Coarse bubble
Blowers	Mixing air will be supplied by the existing Aeration Basin blowers.

All four pumps in EQ Basin No. 1 will be replaced or upgraded. Pump Nos. 3 and 4 will remain but the impeller will be increased by one size to account for increased head on the pumps from a longer pumping distance to the new secondary treatment process. Existing EQ Pump Nos. 1 and 2 will be replaced with models identical to pump Nos. 3 and 4. See Table 21 for EQ pump design criteria. The firm capacity of the pump arrangement will be 3.15 MGD, compared to maximum required flow of 2.47 MGD PDF.

Table 21. Alternative #2 EQ Pumps Design Criteria

Parameter	Value
Number of Pumps	4
Type	Submersible, non-clog
Capacity, each	1.05 MGD @ 30 ft TDH
Motor Size	10 HP

3.4 Secondary Treatment

See section 2.4 for the description of secondary treatment which will be similar between Alternatives #1 and #2.

3.4.1 Alternative #2a Conventional Activated Sludge

See Section 2.4.1 for a description of the CAS process which is the same for Alternatives #1a and #2a. Design criteria for Alternative #2a are in most part the same as those presented in Alternative #1a except that one additional train will be added adjacent to the existing two. Preliminary design criteria for the CAS process for Alternative #2a are presented in Table 22.

Table 22. Alternative #2a Aeration Basin Design Criteria

Aeration Basins					
Parameter	Anoxic Zone 1	Anoxic Zone 2	Aerobic Zone 1	Aerobic Zone 2	Aerobic Zone 3
Number of Trains	3				
Zone Volume per Train (MG)	0.09	0.09	0.09	0.09	0.09
Average Airflow per Train (scfm)	N/A		174		
Max Month Airflow per Train (scfm)	N/A		290		
Proposed Number of Diffusers per Zone	N/A		134	74	74
Number of Mixers per Zone	1		N/A	N/A	N/A
Number of Blowers	N/A		4 (3 duty + 1 standby)		
Blower Design Operating Point	N/A		290 scfm @ 9 psig		
Blower Power (HP)	N/A		15		
Mixer Power (HP)	4.7		N/A		
IMLR Pumps					
Number	3				
Type	Wet-pit submersible				
Rated Capacity, each	0.83 MGD				

Table 22. Alternative #2a Aeration Basin Design Criteria					
Aeration Basins					
Parameter	Anoxic Zone 1	Anoxic Zone 2	Aerobic Zone 1	Aerobic Zone 2	Aerobic Zone 3
TDH		10 ft			
Drive size, each		5 HP			
Drive speed		Variable			

3.4.2 Alternative #2b Oxidation Ditch

See Section 2.4.2 for a description of the oxidation ditch process which is the same for Alternatives #1b and #2b. Design criteria for Alternative 2b are in most part the same as those presented in Alternative #1b except that one additional oxidation ditch will be added adjacent to the existing one. Preliminary design criteria for the oxidation ditch process for Alternative #2b are presented in Table 23.

Table 23. Oxidation Ditch Process Design Criteria for Alternative #2b	
Parameter	Value
Number of Oxidation Ditches	2
Number of Aerators per Ditch	2
Aerator Power	40 hp
Side Water Depth	10.5 ft
Total Aerobic Volume	0.846 MG
Total Anoxic Volume	0.307 MG
Mixed Liquor Concentration	4,000 mg/L
Solids Retention Time	10 days

3.4.3 Alternative #2c Aerobic Granular Sludge

See Section 2.4.3 for a description of the AGS process which is the same for Alternatives #1c and #2c. Design criteria for Alternative #2c are in most part the same as those presented in Alternative #1c except that one additional AGS basin and associated appurtenances are required. In the event Alternative #1c is chosen, this will make expanding from 0.6 MGD to 1 MGD simple in the future. Preliminary design criteria for the AGS process for Alternative #2c are presented in Table 24.

Table 24. AGS Process Design Criteria for Alternative #2c	
Parameter	Value
Number of AGS Tanks	3
Tank Length	39.5 ft
Tank Width	26.5 ft
Side Water Depth	21 ft
Tank Volume	0.16 MG
Cycle Duration	4 hr
Mixed Liquor Concentration	8,000 mg/L
Solids Retention Time	17.12 days

Table 24. AGS Process Design Criteria for Alternative #2c	
Parameter	**Value**
Air Flowrate per Basin	556 scfm
Maximum Simultaneous Air Flowrate	1,117 scfm
Number of AGS Blowers	4
AGS Blower Discharge Pressure	10.67 psig
AGS Blower Power	40 HP
Influent Buffer Tank Volume Required (min-max)	8,882 - 85,492 gal
Post EQ Tank Volume Required (min-max)	3,852 – 50,336 gal
Sludge Buffer Tank Volume Required	30,478 gal

3.4.4 Chemical Storage and Feed for Alkalinity Control

Future average demand for sodium hydroxide for Alternatives #2a through #2c will not exceed 175 gpd. This equates to an approximate storage capacity of 38 days using the existing tank. The existing pumps have a capacity of 16.5 gph or 396 gpd each, which is more than double the average future demand at 1.0 MGD. As a result, no additional chemical storage and feed facilities are needed for this group of alternatives.

3.5 Filtration

Currently, three 0.449 MGD cloth-disk filter units provide filtration for MCWWTP. For Alternative #2, these three filter units will be demolished, and in their place two larger cloth-disk filter units will be installed. Each of these larger units will be capable of treating up to 3 MGD. Since peak flow to this process for Alternative #2 is 2.47 MGD, this gives full redundancy to the filtration system. Even with one unit offline, the other can still treat the 2.47 MGD peak flow. See Table 25 for preliminary design criteria.

Table 25. Alternative #2 Filtration Design Criteria	
Parameter	**Value**
Cloth Disk Filtration Units	
Number of Units	2
Number of Disks per Unit	6
Filter Pore Size	10 microns
Drive Size, each Unit	0.5 HP
Peak Capacity, each	3.0 MGD
Backwash Pumps	
Number	2
Type	Horizontal, Self-Priming
Suction Size	4 in
Discharge Size	4 in
Capacity, each	700 gpm
TDH	23.2 ft
Drive size, each	25 HP
Drive speed	Variable

3.6 UV Disinfection

Disinfection at MCWWTP is provided by a UV system with two parallel stainless-steel channels. Each channel has a capacity of 1.05 MGD, for a total capacity of 2.1 MGD. Since this is lower than the PDF of 2.47 MGD associated with the 1.0 MGD plant rating, UV disinfection will be expanded. Additionally for this alternative, BC is increasing design UV dosage from the current 30 millijoules per square centimeter (mJ/cm^2) used in Alternative #1 to 90 mJ/cm^2. This is to account for the expected tightening of effluent limits in the future to require inactivation of viruses along with bacteria. This requirement is being included in Alternative #2 because it is the more 'forward-looking' alternative of the two.

Existing UV equipment will be demolished. Concrete channels will be poured and a new larger two channel system will be installed, with two banks of 48 lamps in each channel. UV dosage supplied is 90 mJ/cm^2 and peak treatable flow is 5.2 MGD with both channels online. Full redundancy is provided so that if one channel is offline, the remaining channel can still treat the peak flow of 2.47 MGD. See Table 26 for preliminary design criteria.

Table 26. Alternative #2 UV Disinfection Design Criteria

Parameter	Value
Number of Channels	2
Channel Size	25'-4" L x 2' W x 5'-2" D
Banks per Channel	2
Lamps per bank	48
UV Dosage	90 mJ/cm^2
UV Transmission @ 253.6 nm	65%
Capacity, each channel	2.6 MGD
Capacity, combined	5.2 MGD

3.7 Effluent Flow Measurement

Plant effluent flow is currently measured by a 60-degree V-notch weir and level sensor in a concrete effluent monitoring box. The maximum measurable head over the weir is 1 foot, corresponding to a maximum measurable flow of 0.93 MGD. Since this is lower than the PDF of 2.47 MGD at the 1.0 MGD plant rating, effluent monitoring will be expanded.

For Alternative #2, the V-notch weir in the effluent monitoring box will be abandoned. A new concrete channel with a 9-inch Parshall flume will be constructed adjacent to the monitoring box. Flow from the cascade aerator will be redirected from the effluent monitoring box to the flume channel. Effluent from the flume channel will be sent to the downstream side of the effluent monitoring box. Note that for a 9-inch Parshall flume, a minimum 15 feet of upstream straight channel length is required. See Table 27 for preliminary design criteria.

Table 27. Alternative #2 Effluent Flow Measurement Design Criteria

Parameter	Value
Number of Flumes	1
Type	Parshall
Throat size	9 inches
Capacity	5.7 MGD

3.8 Plant Drain Pump Station

Using the methodology described in section 3.1.12 of *TM 07 – MCWWTP Capacity Analysis* (15% of PDF), a conservative estimate for maximum flow to the Plant Drain Pump Station at the 1.0 MGD plant rating is 258 gpm. This is larger than the 208-gpm capacity of the single existing submersible pump. Since the wet well is sized to accommodate two pumps, a second identical submersible pump will be added to meet capacity requirements. It will be manifolded with the existing pump to share a common discharge line. The existing passive overflow back to the IPS will continue to provide redundancy for the system, along with the shelf spare owned by WSACC. See Table 28 for preliminary design criteria.

Table 28. Alternative #2 Plant Drainage Pumping Station Design Criteria

Parameter	Value
Number of Pumps	2
Type	Submersible Chopper
Discharge Diameter	4 in
Capacity, each	208 gpm @ 33 ft TDH
Motor Size	5 HP

Section 4: Comparison of Alternatives

Table 29 summarizes the advantages and disadvantages of the different MCWWTP expansion alternatives.

Table 29. Advantages and Disadvantages of the Different RRRWWTP Expansions Alternatives

Alternative	Advantages	Disadvantages
#1a. 0.6 MGD and #2a. 1.0 MGD Conventional Activated Sludge	• Status quo (similar to operation at RRRWWTP) • Some nitrogen removal	• Internal mixed liquor recycle pumping • New biological nutrient removal (BNR) basin and aeration system • Diffuser maintenance required
#1b. 0.6 MGD and #2b. 1.0 MGD Oxidation Ditch	• Some nitrogen removal • Simple operation and maintenance • IMLR is passive within oxidation ditch, controlled by gate (no pumping)	• Sludge settleability is not as good as CAS • Aeration not as efficient as fine bubble • Highest footprint
#1c. 0.6 MGD and #2c. 1.0 MGD Aerobic Granular Sludge	• Nitrogen and phosphorus removal • Small footprint • No secondary clarifiers or RAS pumping	• Newer technology • Requires retrofit of existing Secondary Clarifiers • Batch fed system

Section 5: Non-Cost Factor Evaluation and Scoring

Similar to what was performed for *TM No. 7 Expansion Alternatives Analysis* for the RRRWWTP dated January 2021, the team agreed on certain non-cost factors as criteria that are important in the comparison of the different alternatives. These criteria provide another layer of evaluation in addition to the comparison provided in the previous section and the comparison to occur later on that is based on costs. Table 30 summarizes the non-cost factors or criteria that were found to be important to WSACC. Using these criteria and a simple rating system (3 points for excellent, 2 points for average, and 1 point for poor) as presented in

Table 31, the different expansion alternatives were compared and scored. The outcome of the side-by-side comparison based on these non-cost factors and the overall scoring per alternative is summarized in Table 32.

Table 30. Non-Cost Factor Criteria Definitions

Criteria	Definition/Applicability
Performance Reliability	Reliable and robust process. Process has a demonstrated history of reliably achieving performance standards or will enhance the ability of the existing process to do so under the range of anticipated flows and influent characteristics.
Permitting Uncertainty	Permittable. The process application is proven and has little uncertainty that requires unprecedented approval by North Carolina Department of Environmental Quality (NCDEQ).
Expandability	Ability to meet future water quality regulations. Ability to intensify treatment (i.e., high-rate). Can be implemented modularly and expanded when required.
Implementation Risk	Not first full-scale installation in the US. Characteristics and/or requirements that pose potential risk to successful implementation.
Operation and Maintenance (O&M) Simplicity	Good spare parts availability. Ability to outsource non-core functions. Process is simple to operate and maintain.
Integration Ease	The alternative integrates with and leverages use of existing process trains. It also integrates well into future processes (e.g., nutrient limits). Small footprint.
Automation Ease	User friendly automation. The process may be readily automated to maintain targeted and reliable performance during unstaffed operation.

Table 31. Non-Cost Factor Criteria Rating

Criteria	Excellent Rating	Average Rating	Poor Rating
Performance Reliability	Highly reliable treatment	Some variability in treatment	Frequent variability in treatment
Permitting Uncertainty	Numerous full-scale installations	A few full-scale installations	Limited or no full-scale installations
Expandability	High modularity and flexibility	Typical expansions required	Limited ability to expand
Implementation Risk	Long standing implementation record	Mature technology	Limited installations
O&M Simplicity	Easy to operate and maintain	Typical O&M requirements	Frequent maintenance
Integration Ease	Easily integrated into exiting processes	Moderate process modifications required	Major process modifications required
Automation Ease	Easy to fully automate process	Some process automation possible	Limited process automation possible

Table 32. Non-Cost Factor Alternative Evaluation Matrix

Criteria	Alternative #1a and Alternative #2a	Alternative #1b and Alternative #2b	Alternative #1c and Alternative #2c
Performance Reliability	Excellent	Excellent	Excellent
Permitting Uncertainty	Excellent	Excellent	Poor
Expandability	Average	Excellent	Excellent
Implementation Risk	Excellent	Excellent	Average
O&M Simplicity	Average	Excellent	Average
Integration Ease	Excellent	Excellent	Average
Automation Ease	Excellent	Average	Excellent
Overall Non-Cost Ranking	19	20	17

Scoring: 1 for poor, 2 for average, 3 for excellent

Section 6: Cost Estimate and NPV Analysis

6.1 Preliminary Opinion of Probable Construction Cost

In accordance with the Association for the Advancement of Cost Engineering International (AACE) criteria, this is a Class 5 estimate. A Class 5 estimate is defined as a Conceptual Level or Project Viability Estimate. Typically, engineering is from 0 to 2 percent complete. Class 5 estimates are used to prepare planning level cost scopes or evaluation of alternative schemes, long-range capital outlay planning and can also form the base work for the Class 4 Planning Level or Design Technical Feasibility Estimate.

Expected accuracy for Class 5 estimates typically ranges from -50 to +100 percent, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. In unusual circumstances, ranges could exceed those shown.

Table 33 summarizes the construction costs for each alternative. A detailed cost breakdown of each alternative can be found in Attachment D.

Table 33. Construction Costs (2027-dollar values)

Estimator	Alternative #1a	Alternative #1b	Alternative #1c	Alternative #2a	Alternative #2b	Alternative #2c
Total Cost (BC Estimator's Detailed Estimate) w/ Engineering	$18,845,000	$20,320,000	$22,767,000	$40,346,000	$45,254,000	$46,357,000

6.2 Operation and Maintenance (O&M) Costs

O&M cost comparison includes comparing the different alternatives in terms of power costs associated with equipment power loads and caustic soda costs used for pH and alkalinity control. All other O&M costs are considered to be equal among the different alternatives. Table 34 presents the changes to the total connected load, duty load, and power costs for each alternative. The duty load is the connected electrical load less the load from equipment that is redundant and typically on standby. Since the power draw to equipment is not always 100 percent of the duty load and not all equipment is running continuously, it was assumed that the operating duty load is 59 percent of the full duty load. This was determined based on the electrical duty load of 149 HP of the existing treatment plant and the most recent annual cost for electricity which was approximately $51,000 (87 HP or 65 kW). Using a power cost of 8.92 cents per kilowatt hour (kWh), the percentage of the full duty load of 149 HP was calculated to be 59 percent. This percentage was applied to the duty load of each alternative for comparison. Annual power costs for each alternative are presented in Table 34.

Table 34. Annual Power Costs Comparison to Baseline Operation in Year 2025

Parameter	Baseline	Alternative #1a	Alternative #1b	Alternative #1c	Alternative #2a	Alternative #2b	Alternative #2c
Connected Load (HP)	249	+150	+166	+175	+283	+359	+314
Duty Load (HP)	149	+135	+166	+143	+232	+323	+245
Duty Load (kW)	111	+101	+123	+106	+173	+241	+183
59% Duty Load (kW)	65	+59	+72	+62	+101	+141	+107
Power Cost Addition to Baseline	0	+$46,004	+$56,434	+$48,628	+$79,153	+$110,036	+$83,516
Total Annual Power Cost	$50,956	$96,960	$107,391	$99,585	$130,110	$160,992	$134,473

Chemical costs among alternatives are largely attributed to caustic dosing for pH control. The current caustic consumption is approximately 65 gpd. Costs associated with caustic dosing for each alternative are presented in Table 35.

Table 35. Annual Chemical Costs (Caustic Soda) for pH Control Comparison to Baseline Operation

Parameter	Baseline	Alternative #1a	Alternative #1b	Alternative #1c	Alternative #2a	Alternative #2b	Alternative #2c
Caustic Consumption (gpd)	65	110	110	105	175	175	175
Difference from Baseline (gpd)	0	+45	+45	+40	+110	+110	+110
Chemical Cost Addition to Baseline	0	+$28,908	+$28,908	+$25,696	+$70,664	+$70,664	+$70,664
Total Annual Chemical Cost	$41,756	$70,664	$70,664	$67,452	$112,420	$112,420	$112,420

Total annual O&M costs for power and chemicals (caustic) are presented in Table 36.

Table 36. Total Annual O&M Costs

Parameter	Baseline	Alternative #1a	Alternative #1b	Alternative #1c	Alternative #2a	Alternative #2b	Alternative #2c
Total Annual Power Cost	$50,956	$96,960	$107,391	$99,585	$130,110	$160,992	$134,473
Total Annual Chemical Cost	$41,756	$70,664	$70,664	$67,452	$112,420	$112,420	$112,420
Total Annual O&M Cost	$92,712	$167,624	$178,055	$167,037	$242,530	$273,412	$246,893

6.3 Net Present Value (NPV) Analysis

The net present value (NPV) analysis entails a 20-year partial lifecycle cost analysis on capital construction costs and O&M costs. Assumptions used for the analysis are as follows:

- Present year = 2025
- Discount rate (r) = 4%
- Number of periods (N) = 20 years
- Does not include equipment maintenance costs
- Table 37 presents the results of the NPV analysis. The NPV analysis shows Alternatives #1a and #2a (CAS) as the most cost-effective options in their respective flow tiers (0.6 MGD vs. 1 MGD).

Table 37. NPV Analysis in Present Year of 2025

Parameter	Alternative #1a	Alternative #1b	Alternative #1c	Alternative #2a	Alternative #2b	Alternative #2c
Capital Cost (2027 dollars from Table 33)	$18,845,000	$20,320,000	$22,767,000	$40,346,000	$45,254,000	$46,357,000
Capital Cost (2025 dollars)	$16,492,000	$17,783,000	$19,924,000	$35,309,000	$39,587,000	$40,569,000
Total Annual O&M Cost (from Table 36)	$167,624	$178,055	$167,037	$242,530	$273,412	$246,893
Total O&M Cost over 20 Years	$2,278,000	$2,420,000	$2,270,000	$3,296,000	$3,716,000	$3,355,000
NPV in Year 2025 (capital cost + total O&M)	$18,770,000	$20,203,000	$22,193,000	$38,605,000	$43,302,000	$43,924,000

Section 7: Recommendations and Next Steps

Of the expansion alternatives evaluated in this TM, Alternative #1a is recommended to be further developed to a 15-percent conceptual design level with some modifications. The reasons for this selection are economic combined with WSACC's familiarity with the CAS technology. This alternative will be rated for 0.66 MGD MMF since the biological process will be sized for this flow. The EQ basin will be sized for the volume needed for the 1 MGD MMF alternative to make it easier and less costly to expand to 1 MGD in the future. The RAS pumping needs to be investigated further since recent feedback suggests that the existing pumps have difficulty meeting current capacity demands. Additional analysis suggests that the existing effluent metering structure could be maintained and the only change there would be modifying the weir plate. See Table 38 for basis of design flow for the 0.66 MGD MMF condition, including peak equalized flow (PEF) to processes downstream of EQ.

Table 38. Basis of Design Flow for 0.66 MGD MMF

Flow Condition	Value
Peak Hour Flow (PHF) [a]	3.16
Peak Day Flow (PDF) [a]	1.89
Peak Equalized Flow (PEF)	1.78
Maximum Week Flow (MWF)	1.15
Maximum Month Flow (MMF)	0.66
Annual Average Daily Flow (AADF)	0.41
Minimum Day Flow (MDF)	0.15

[a] *Based on 2-year storm interval projections (B&V, 2022) instead of using historical peaking factors.*

The estimated construction cost for Alternative #1a is approximately $15 million. An abbreviated scope of work is as follows:

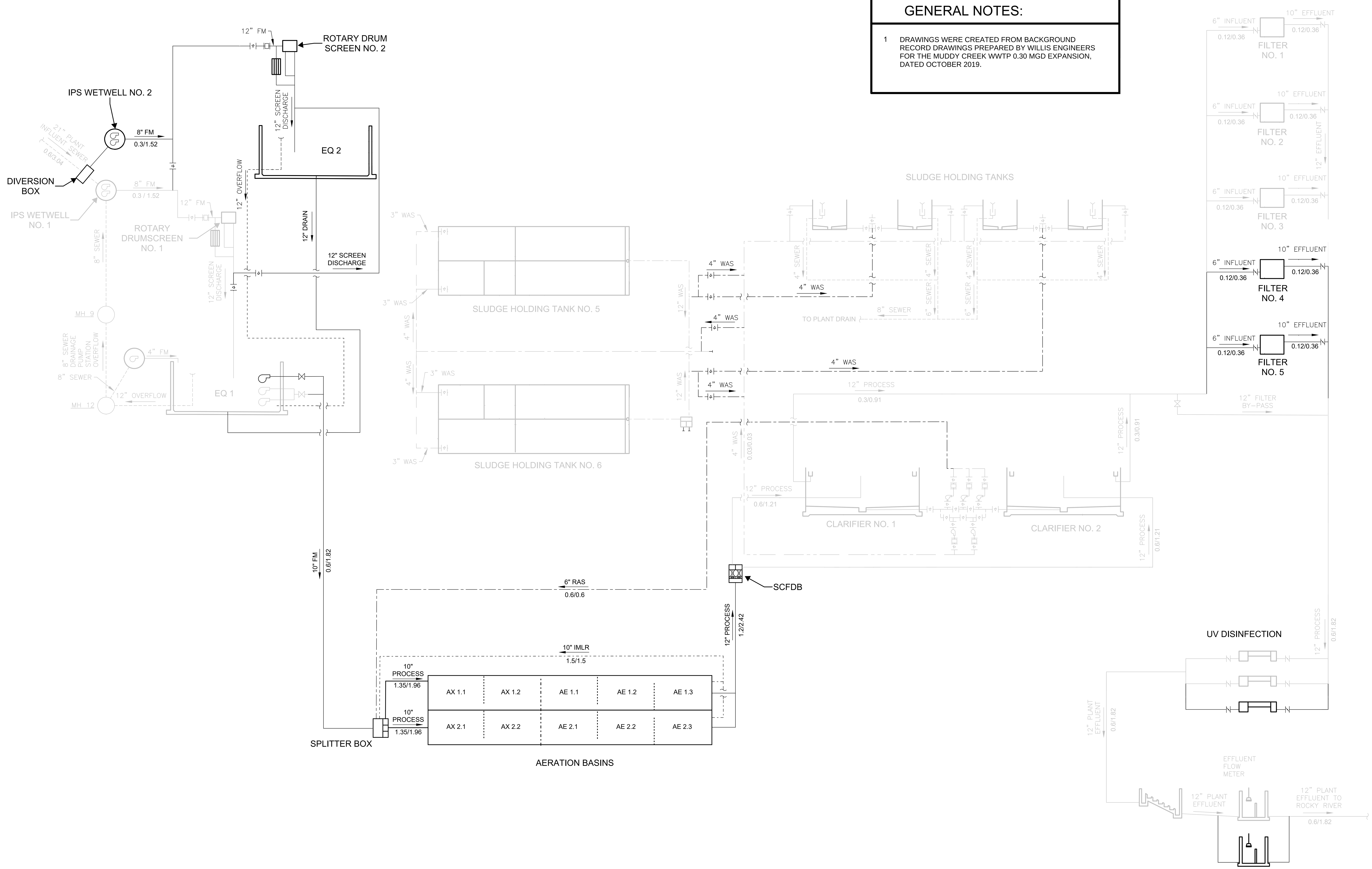
- **IPS:** Construct a new duplicate IPS adjacent to and hydraulically connected with the existing IPS. Install 8-inch forcemain to the headworks parallel to the existing one. Future expansion to 1 MGD may require a complete reconstruction of the IPS system or just upgrading the pumps installed as part of the 0.66-MGD expansion.
- **Headworks:** Install second rotary drum screen next to the existing one. Future expansion to 1 MGD will require the construction of new headworks with new screens and grit removal.
- **Flow Equalization:** Construct a second EQ tank with 135,000-gallon capacity and coarse bubble diffusers for mixing. This additional capacity should be sufficient for the future expansion to 1 MGD. Mixing air will be supplied by the existing aeration blowers. EQ Pump Nos. 3 and 4 will be maintained and their impellers replaced with larger diameter impellers. EQ Pump Nos. 1 and 2 will be removed and replaced with a third pump identical to EQ Pump Nos. 3 and 4. A connector pipe to the future headworks site to EQ 2 will be constructed with a blind flange on the upstream end.
- **Biological Process:** Construct two parallel aeration basins to the west of the existing disk filters, with space for a future third basin for the expansion to 1 MGD. Construct an upstream splitter box with cutthroat flumes and three effluent channels. The aeration basins will be configured to operate in an MLE format. Install three new hybrid blowers for aeration.
- **Secondary Clarifiers:** Construct a secondary clarifier flow diversion box (SCFDB) with three cutthroat flumes for flow splitting. Note the two existing secondary clarifiers have adequate capacity, so no additional clarifiers are required for this upgrade. A third clarifier will be built when the plant is expanded to 1 MGD.

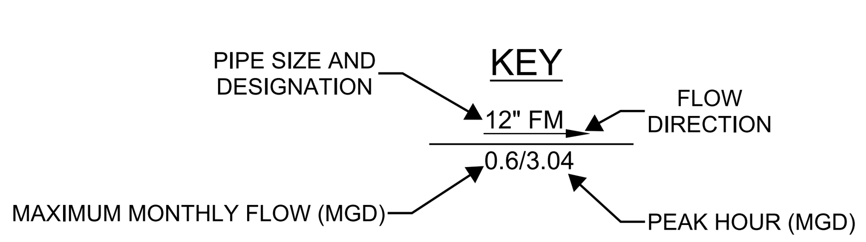
- **RAS Pumping:** Recent feedback suggests that the existing RAS pumps may need to be modified to provide a maximum firm capacity of 0.66 MGD. The existing pumps will be evaluated in more detail in the PER. For the future expansion to 1 MGD, a fourth RAS pump will be needed.
- **WAS Pumping:** No additional WAS pumps are required for the expansion to 0.66 MGD or a future expansion to 1 MGD.
- **Filtration:** Install two new disk filter units identical to the existing three. Future expansion to 1 MGD will require re-evaluation of the design for this process area.
- **UV Disinfection**: Install a third parallel UV bank identical to the existing two. Future expansion to 1 MGD will require re-evaluation of the design for this process area.
- **Effluent Flow Measurement:** The existing weir plate will be removed and upsized, but unlike previous analysis, it is believed that the existing concrete structure could be maintained. The new weir plate will be a 90-degree v-notch weir capable of measuring over 2.47 MGD, providing adequate capacity for the future 1 MGD rating upgrade as well. Due to the effluent box dimensions, the weir will operate under partially contracted conditions at higher flows, but this will have minimal effect on measurement accuracy.
- **Sludge Holding Tanks:** Convert the existing aeration basins to sludge holding tanks (SHT No. 5 and No. 6). This added sludge storage capacity should be sufficient for a future expansion to 1 MGD.
- **Plant Drainage Pump Station:** No changes for the expansion to 0.66 MGD. For the future expansion to 1 MGD, a second plant drain pump will be needed to be installed in the existing wet well.

Attachment A: Process Flow Diagrams

GENERAL NOTES:

1 DRAWINGS WERE CREATED FROM BACKGROUND RECORD DRAWINGS PREPARED BY WILLIS ENGINEERS FOR THE MUDDY CREEK WWTP 0.30 MGD EXPANSION, DATED OCTOBER 2019.





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ALTERNATIVE #1A PROCESS FLOW DIAGRAM

DRAWING NUMBER

GENERAL NOTES:

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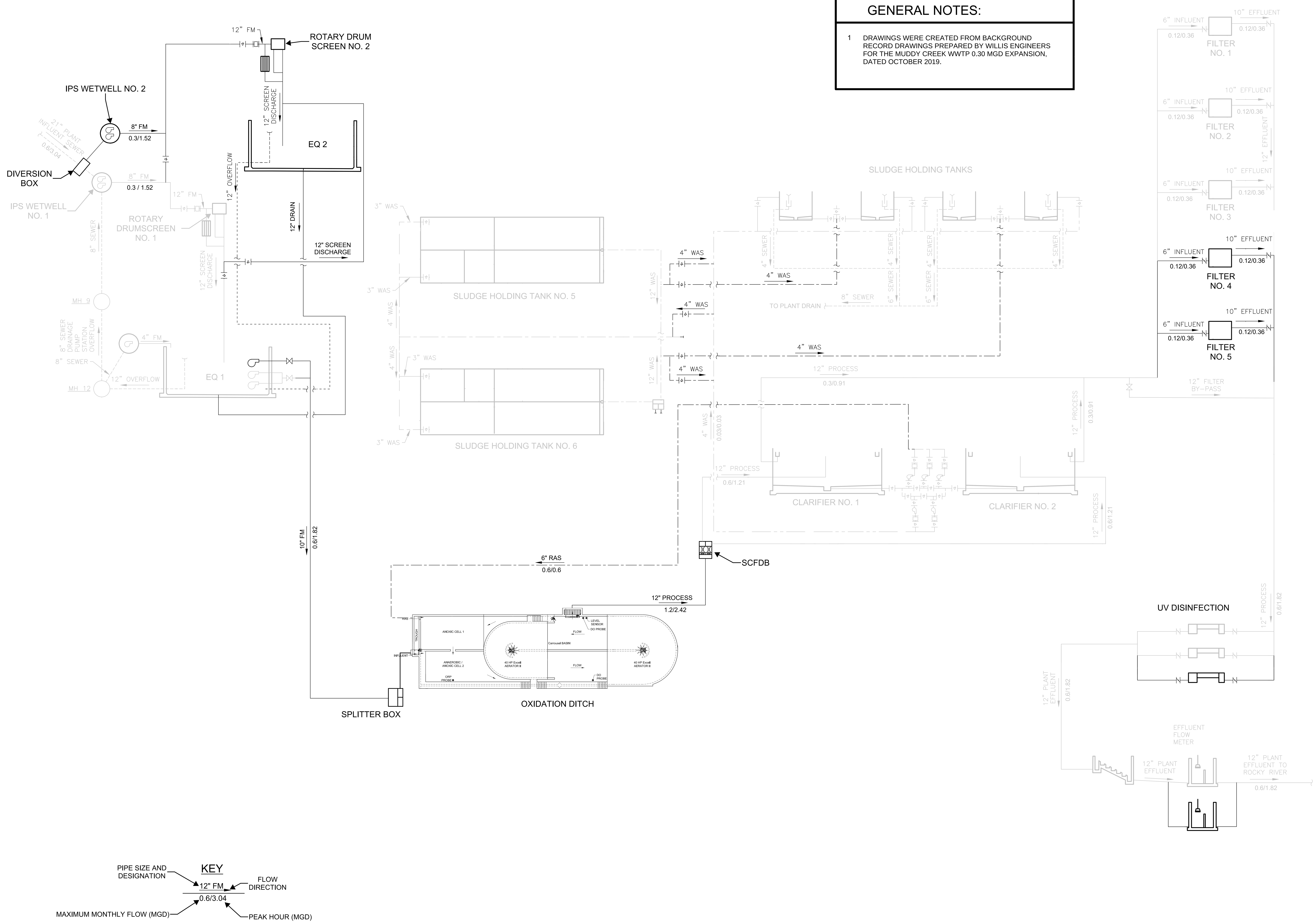

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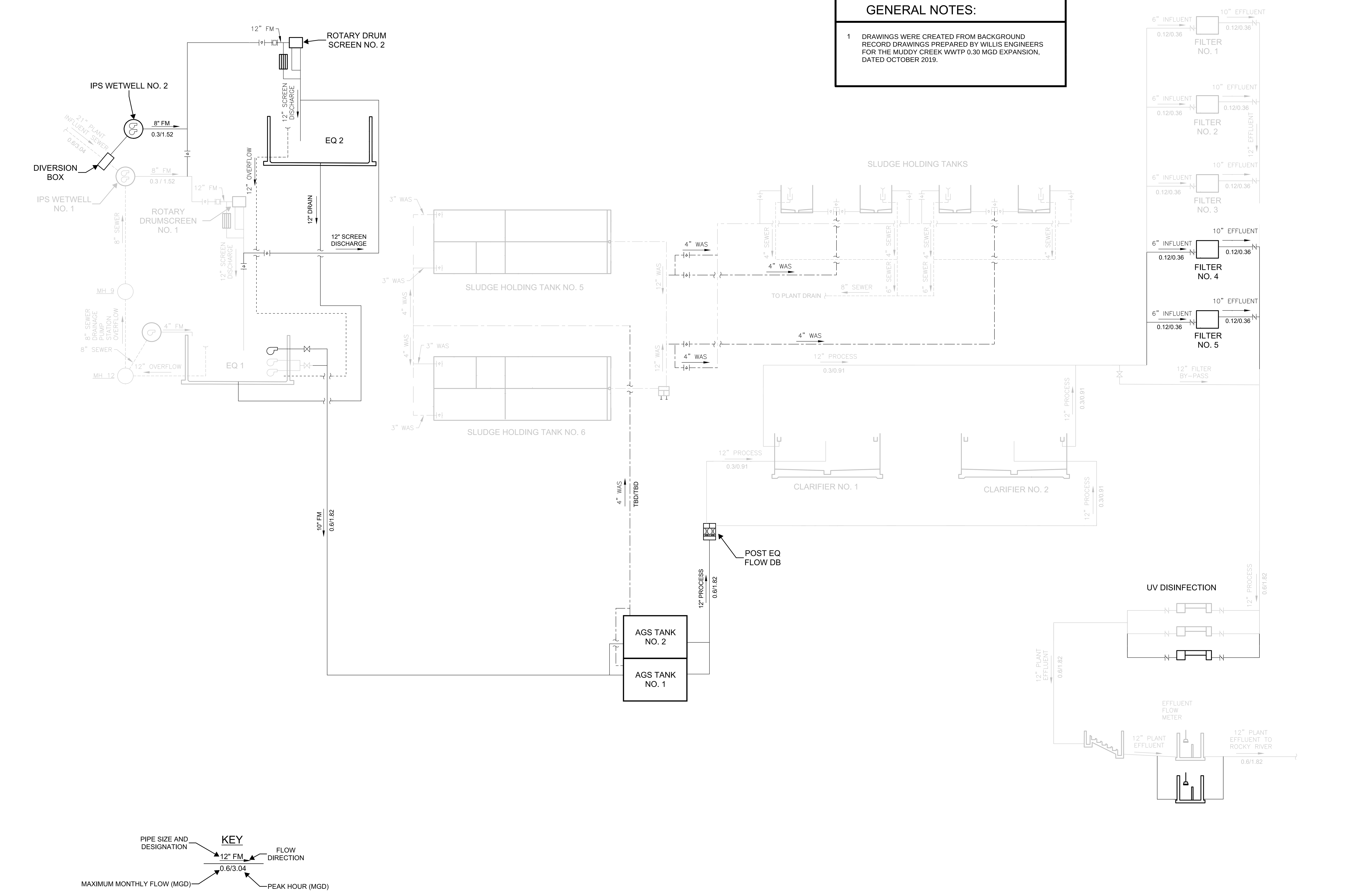
ALTERNATIVE #1B PROCESS FLOW DIAGRAM

DRAWING NUMBER

GENERAL NOTES:

1. DRAWINGS WERE CREATED FROM BACKGROUND RECORD DRAWINGS PREPARED BY WILLIS ENGINEERS FOR THE MUDDY CREEK WWTP 0.30 MGD EXPANSION, DATED OCTOBER 2019.



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ALTERNATIVE #1C PROCESS FLOW DIAGRAM

DRAWING NUMBER

GENERAL NOTES:

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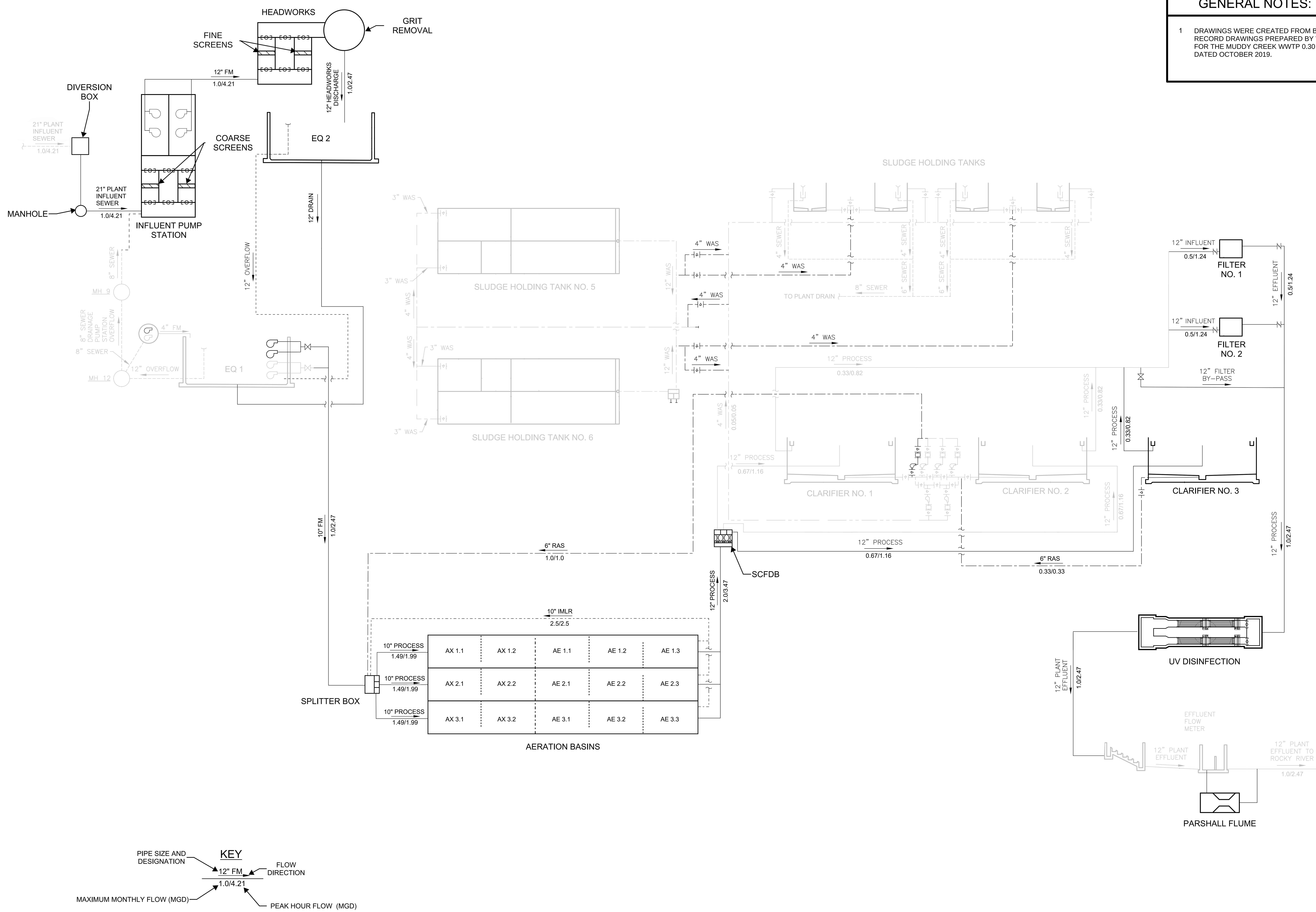

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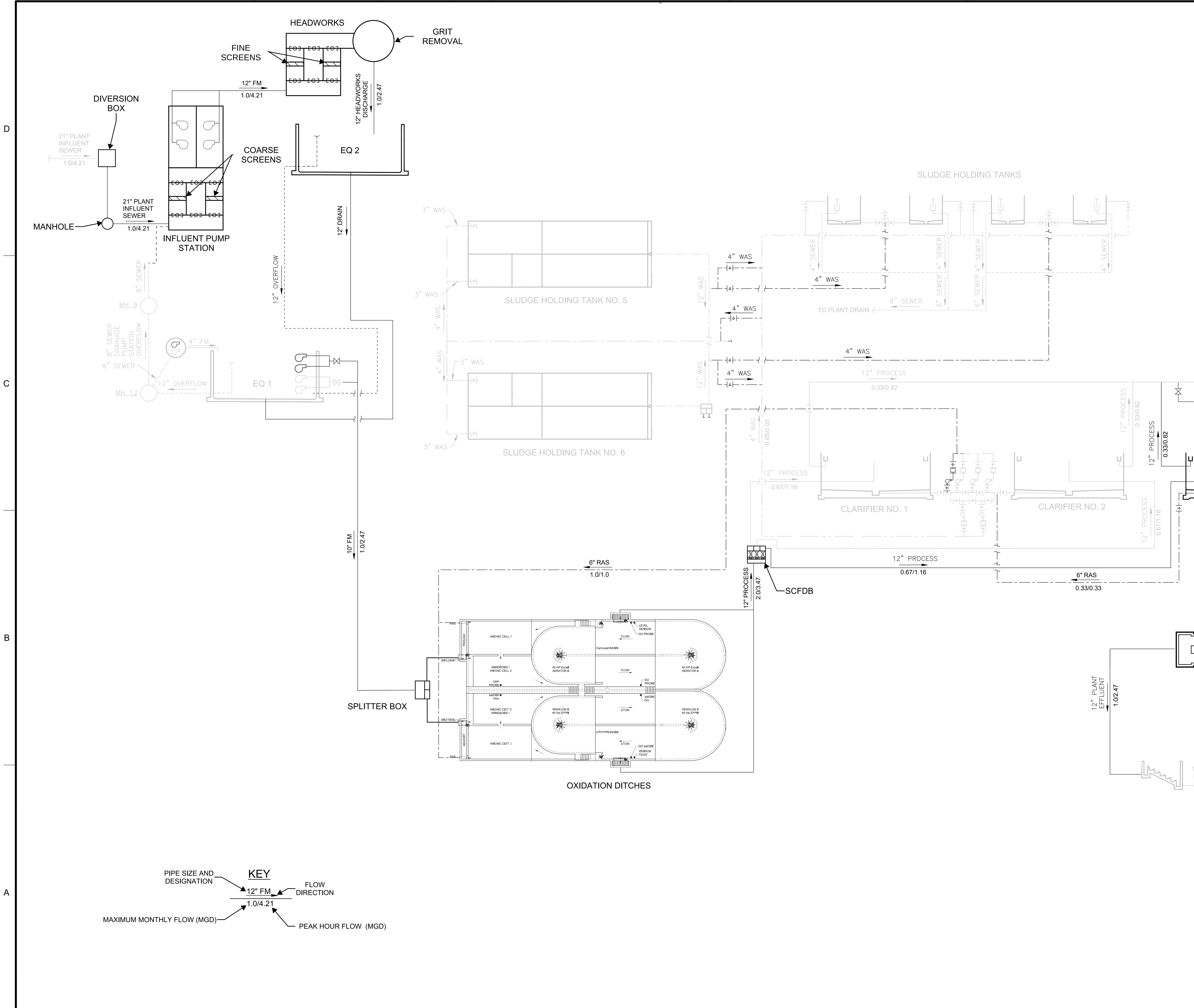
ALTERNATIVE #2A PROCESS FLOW DIAGRAM

DRAWING NUMBER



GENERAL NOTES:

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GENERAL

ALTERNATIVE #2B PROCESS FLOW DIAGRAM

DRAWING NUMBER

GENERAL NOTES:

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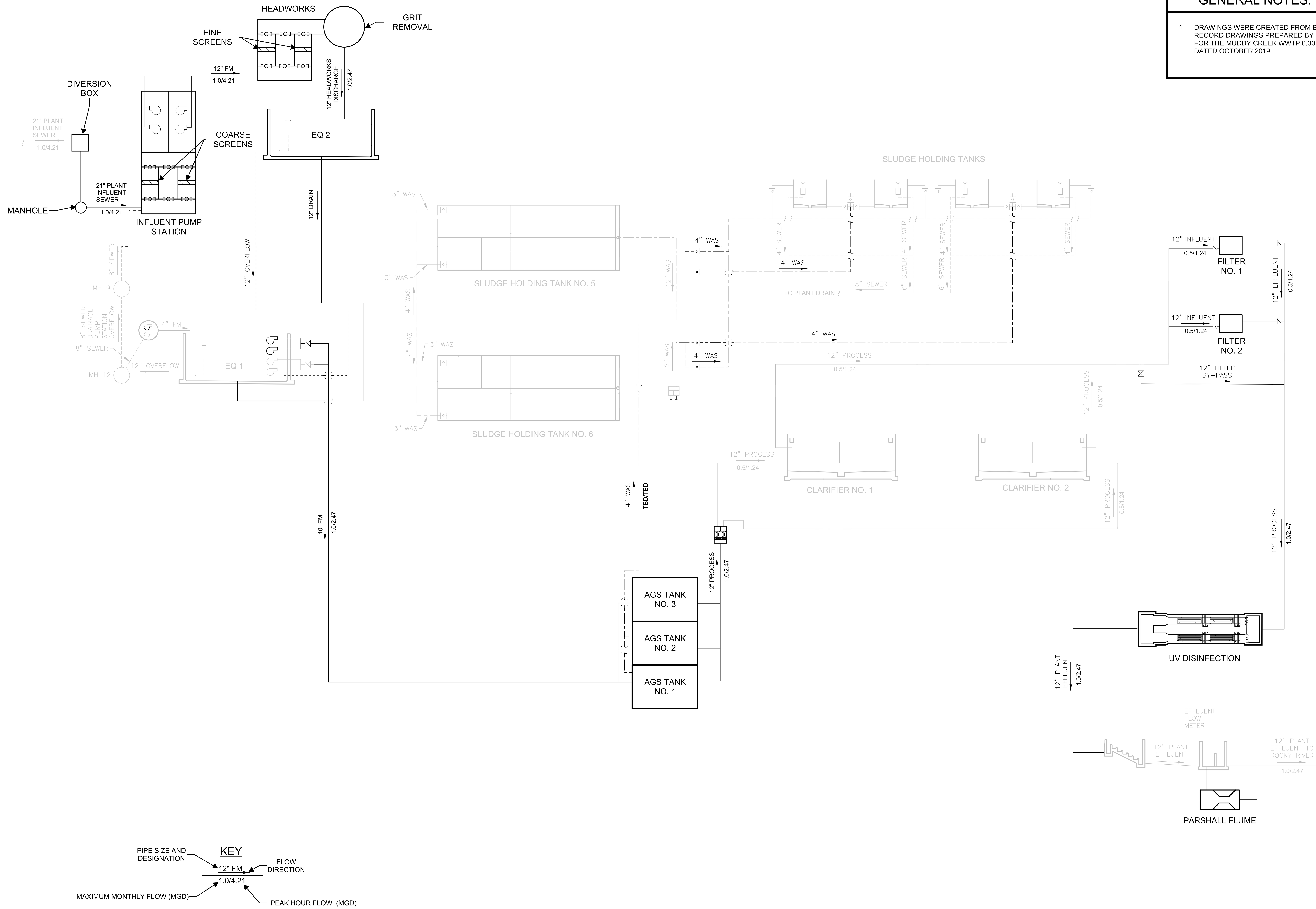

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ALTERNATIVE #2C PROCESS FLOW DIAGRAM

DRAWING NUMBER

Attachment B: Site Plans

GENERAL NOTES:

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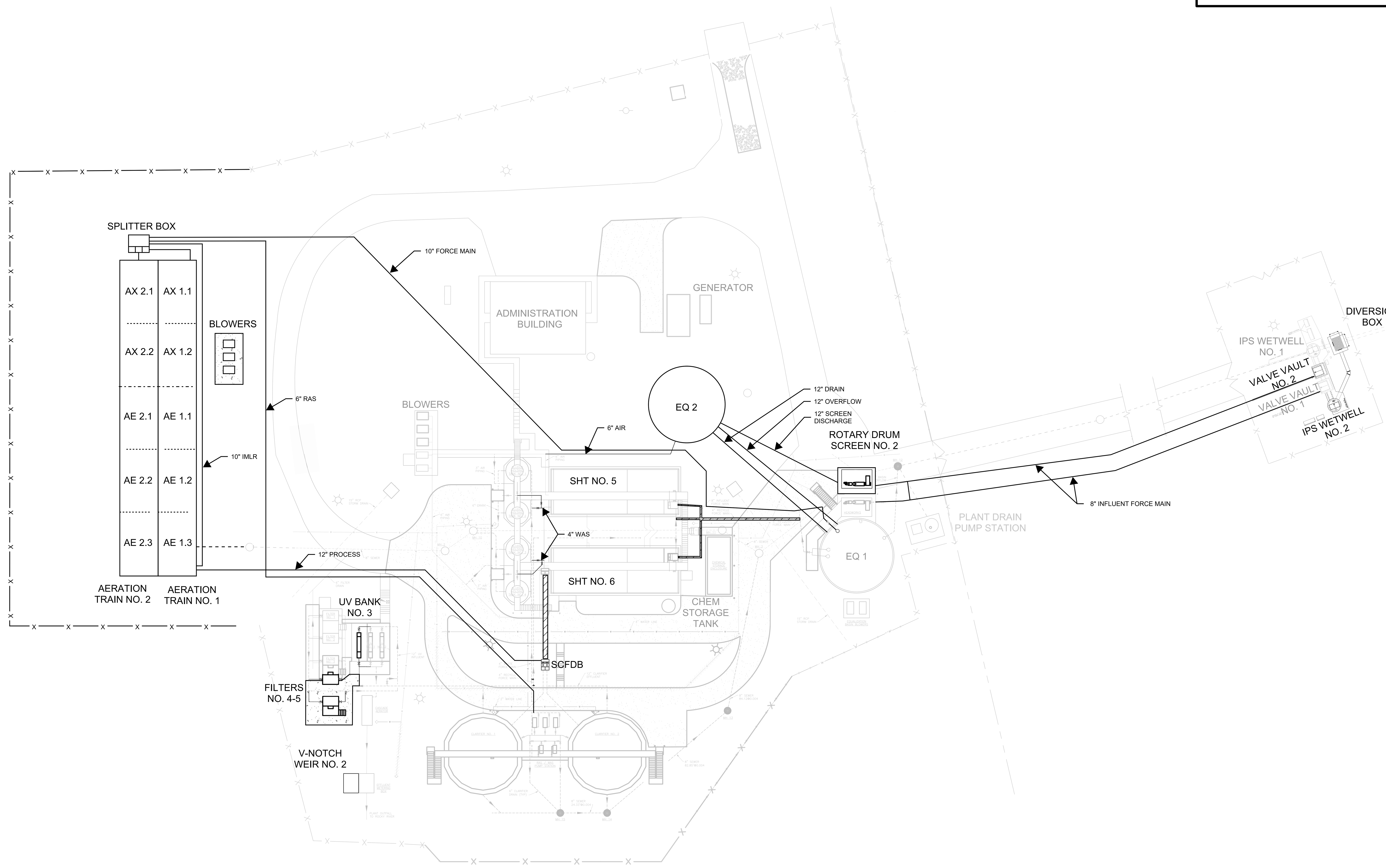

SITE PLAN
SCALE: 1" = 30'

PLAN NORTH

0 30' 60'

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BC PROJECT NUMBER

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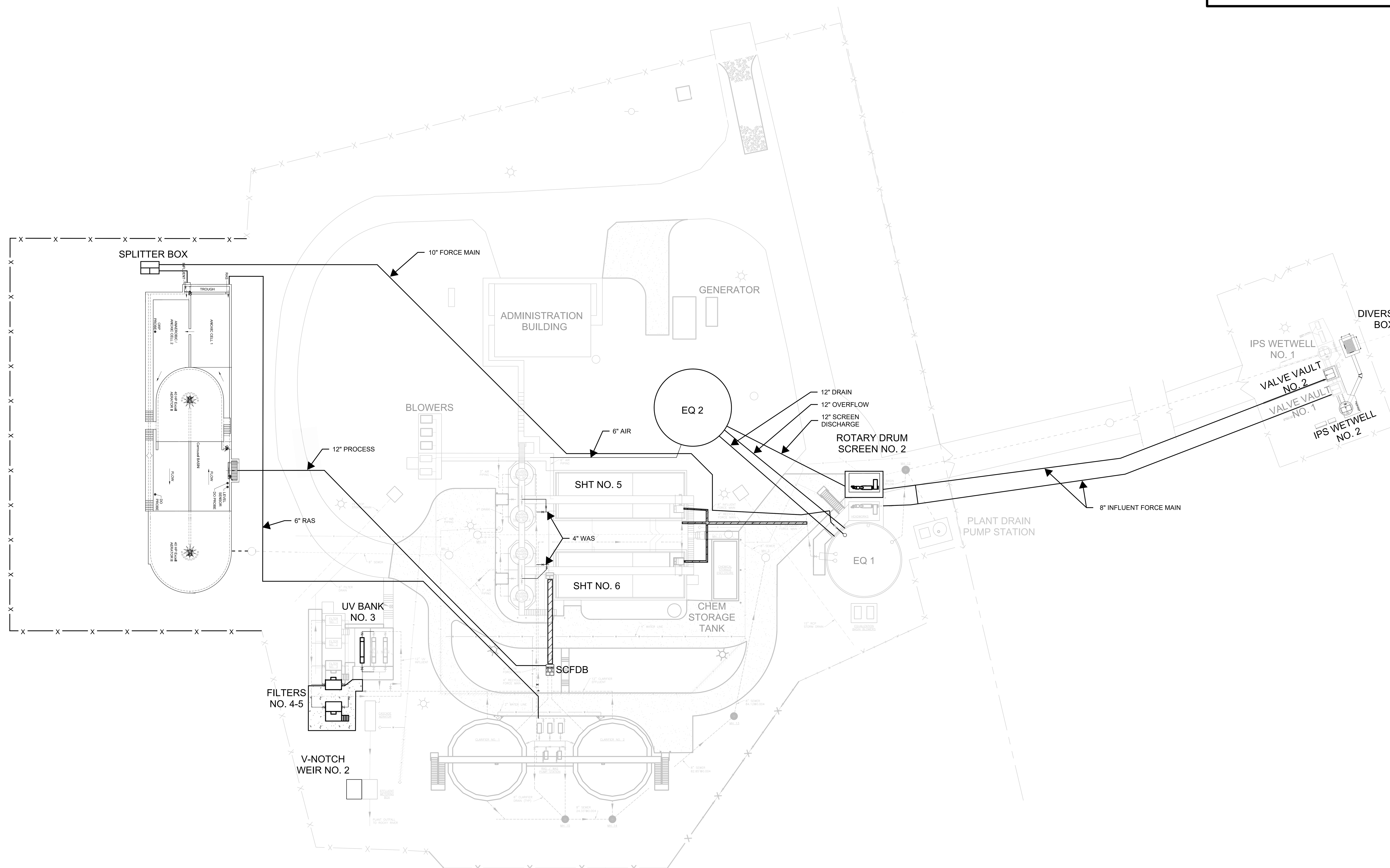
ALTERNATIVE #1A
SITE PLAN

DRAWING NUMBER

GENERAL NOTES:

1 DRAWINGS WERE CREATED FROM BACKGROUND RECORD DRAWINGS PREPARED BY WILLIS ENGINEERS FOR THE MUDDY CREEK WWTP 0.30 MGD EXPANSION, DATED OCTOBER 2019.



SITE PLAN
SCALE: 1" = 30'

PLAN NORTH

0 30' 60'

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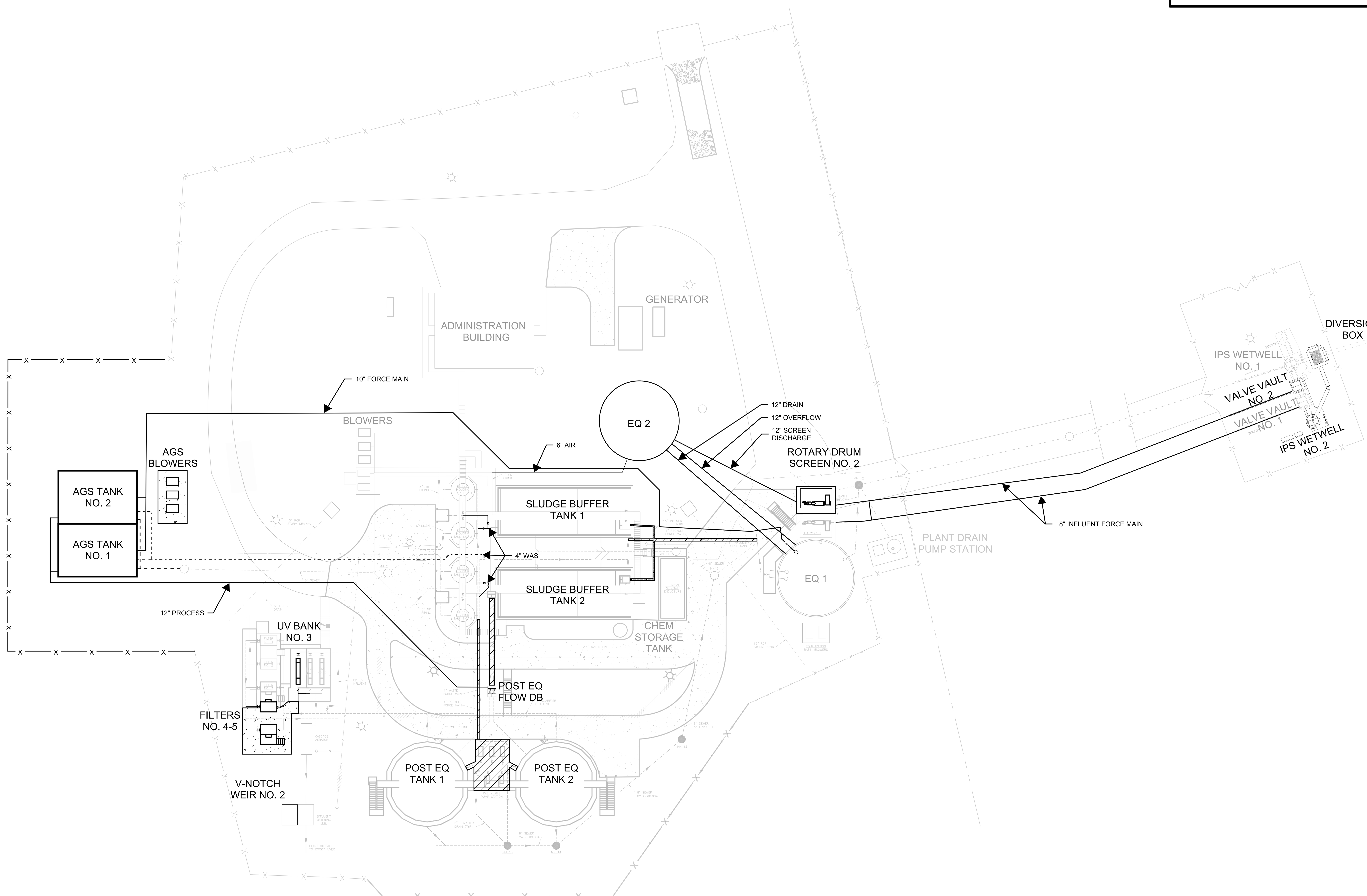
ALTERNATIVE #1B
SITE PLAN

DRAWING NUMBER

GENERAL NOTES:

1. DRAWINGS WERE CREATED FROM BACKGROUND RECORD DRAWINGS PREPARED BY WILLIS ENGINEERS FOR THE MUDDY CREEK WWTP 0.30 MGD EXPANSION, DATED OCTOBER 2019.



SITE PLAN
SCALE: 1" = 30'

PLAN NORTH

0 30' 60'

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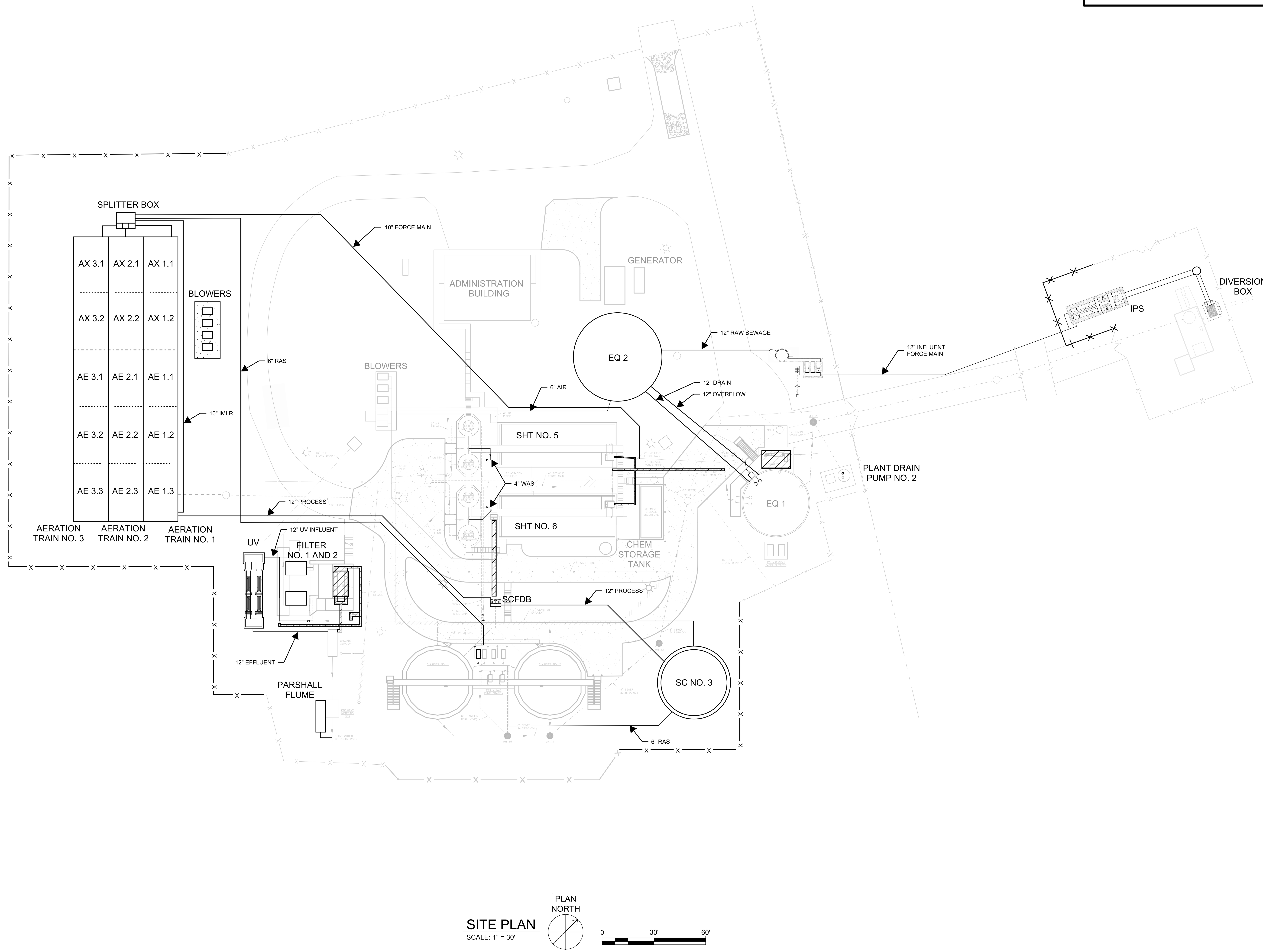
ALTERNATIVE #1C
SITE PLAN

DRAWING NUMBER



SITE PLAN
SCALE: 1" = 30'

GENERAL NOTES:

1. DRAWINGS WERE CREATED FROM BACKGROUND RECORD DRAWINGS PREPARED BY WILLIS ENGINEERS FOR THE MUDDY CREEK WWTP 0.30 MGD EXPANSION, DATED OCTOBER 2019.

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CIVIL

ALTERNATIVE #2A
SITE PLAN

DRAWING NUMBER

Attachment C: Equipment List

PROJECT NAME: WSACC Facilities Plan and PER, MCWWTP Alternatives Analysis					
ALTERNATIVE #1A MAJOR EQUIPMENT LIST					
Equipment	**Process Area**	**Existing/Replace/New**	**Connected Load (HP)**	**Duty Load (HP)**	**Duty/ Stby**
Influent Pump Station					
IPS Pump No. 1	Influent Pump Station	Existing	30	30	Duty
IPS Pump No. 2	Influent Pump Station	Existing	30	30	Duty
IPS Pump No. 3	Influent Pump Station	New	30	30	Duty
IPS Pump No. 4	Influent Pump Station	New	30		Standby
Headworks					
Rotary Drum Screen No. 1	Headworks	Existing	1.5	1.5	Duty
Rotary Drum Screen No. 2	Headworks	New	1.5	1.5	Duty
Equalization					
EQ Blower No. 1	Equalization	Existing	10	10	Duty
EQ Blower No. 2	Equalization	Existing	10		Standby
EQ Pump No. 2	Equalization	New	10	10	Duty
EQ Pump No. 3	Equalization	Existing	10	10	Duty
EQ Pump No. 4	Equalization	Existing	10		Standby
Biological Process					
Aeration Blower No. 1	Biological Process	New	15	15	Duty
Aeration Blower No. 2	Biological Process	New	15	15	Duty
Aeration Blower No. 3	Biological Process	New	15		Standby
Anoxic Zone Mixer No. 1	Biological Process	New	4.7	4.7	Duty
Anoxic Zone Mixer No. 2	Biological Process	New	4.7	4.7	Duty
Anoxic Zone Mixer No. 3	Biological Process	New	4.7	4.7	Duty
Anoxic Zone Mixer No. 4	Biological Process	New	4.7	4.7	Duty
IMLR Pump No. 1	Biological Process	New	5	5	Duty
IMLR Pump No. 2	Biological Process	New	5	5	Duty
Secondary Clarifiers					
SC No. 1 Mechanism	Secondary Clarifiers	Existing	0.5	0.5	Duty
SC No. 2 Mechanism	Secondary Clarifiers	Existing	0.5	0.5	Duty
RAS Pumping					
RAS Pump No. 1	RAS Pumping	Existing	10	10	Duty
RAS Pump No. 2	RAS Pumping	Existing	10	10	Duty
RAS Pump No. 3	RAS Pumping	Existing	10		Standby
WAS Pumping					
WAS Pump No. 1	WAS Pumping	Existing	5	5	Duty
WAS Pump No. 2	WAS Pumping	Existing	5		Standby
Filtration					
Filter Unit No. 1	Filtration	Existing	0.33	0.33	Duty
Filter Unit No. 2	Filtration	Existing	0.33	0.33	Duty
Filter Unit No. 3	Filtration	Existing	0.33	0.33	Duty
Filter Unit No. 4	Filtration	New	0.33	0.33	Duty
Filter Unit No. 5	Filtration	New	0.33	0.33	Duty
Filter No. 1 Backwash Pump	Filtration	Existing	2	2	Duty
Filter No. 2 Backwash Pump	Filtration	Existing	2	2	Duty
Filter No. 3 Backwash Pump	Filtration	Existing	2	2	Duty
Filter No. 4 Backwash Pump	Filtration	New	2	2	Duty
Filter No. 5 Backwash Pump	Filtration	New	2	2	Duty
Sludge Holding					
Existing Blower No. 1	Sludge Holding	Existing	25	25	Duty
Existing Blower No. 2	Sludge Holding	Existing	25	25	Duty
Existing Blower No. 3	Sludge Holding	Existing	25		Standy
Existing Blower No. 4	Sludge Holding	Existing	10	10	Duty
Existing Blower No. 5	Sludge Holding	Existing	10		Standby
Plant Drainage Pumping					
Plant Drainage Pump No. 1	Plant Drainage Pumping	Existing	5	5	Duty

PROJECT NAME: WSACC Facilities Plan and PER, MCWWTP Alternatives Analysis					
ALTERNATIVE #1B MAJOR EQUIPMENT LIST					
Equipment	**Process Area**	**Existing/Replace/New**	**Connected Load (HP)**	**Duty Load (HP)**	**Duty/ Stby**
Influent Pump Station					
IPS Pump No. 1	Influent Pump Station	Existing	30	30	Duty
IPS Pump No. 2	Influent Pump Station	Existing	30	30	Duty
IPS Pump No. 3	Influent Pump Station	New	30	30	Duty
IPS Pump No. 4	Influent Pump Station	New	30		Standby
Headworks					
Rotary Drum Screen No. 1	Headworks	Existing	1.5	1.5	Duty
Rotary Drum Screen No. 2	Headworks	New	1.5	1.5	Duty
Equalization					
EQ Blower No. 1	Equalization	Existing	10	10	Duty
EQ Blower No. 2	Equalization	Existing	10		Standby
EQ Pump No. 2	Equalization	New	10	10	Duty
EQ Pump No. 3	Equalization	Existing	10	10	Duty
EQ Pump No. 4	Equalization	Existing	10		Standby
Biological Process					
Aerator No. 1	Biological Process	New	40	40	Duty
Aerator No. 2	Biological Process	New	40	40	Duty
Anoxic Mixer No. 1	Biological Process	New	4.7	4.7	Duty
Anoxic Mixer No. 2	Biological Process	New	4.7	4.7	Duty
Secondary Clarifiers					
SC No. 1 Mechanism	Secondary Clarifiers	Existing	0.5	0.5	Duty
SC No. 2 Mechanism	Secondary Clarifiers	Existing	0.5	0.5	Duty
RAS Pumping					
RAS Pump No. 1	RAS Pumping	Existing	10	10	Duty
RAS Pump No. 2	RAS Pumping	Existing	10	10	Duty
RAS Pump No. 3	RAS Pumping	Existing	10		Standby
WAS Pumping					
WAS Pump No. 1	WAS Pumping	Existing	5	5	Duty
WAS Pump No. 2	WAS Pumping	Existing	5		Standby
Filtration					
Filter Unit No. 1	Filtration	Existing	0.33	0.33	Duty
Filter Unit No. 2	Filtration	Existing	0.33	0.33	Duty
Filter Unit No. 3	Filtration	Existing	0.33	0.33	Duty
Filter Unit No. 4	Filtration	New	0.33	0.33	Duty
Filter Unit No. 5	Filtration	New	0.33	0.33	Duty
Filter No. 1 Backwash Pump	Filtration	Existing	2	2	Duty
Filter No. 2 Backwash Pump	Filtration	Existing	2	2	Duty
Filter No. 3 Backwash Pump	Filtration	Existing	2	2	Duty
Filter No. 4 Backwash Pump	Filtration	New	2	2	Duty
Filter No. 5 Backwash Pump	Filtration	New	2	2	Duty
Sludge Holding					
Existing Blower No. 1	Sludge Holding	Existing	25	25	Duty
Existing Blower No. 2	Sludge Holding	Existing	25	25	Duty
Existing Blower No. 3	Sludge Holding	Existing	25		Standy
Existing Blower No. 4	Sludge Holding	Existing	10	10	Duty
Existing Blower No. 5	Sludge Holding	Existing	10		Standby
Plant Drainage Pumping					
Plant Drainage Pump No. 1	Plant Drainage Pumping	Existing	5	5	Duty

PROJECT NAME: WSACC Facilities Plan and PER, MCWWTP Alternatives Analysis					
ALTERNATIVE #1C MAJOR EQUIPMENT LIST					
Equipment	**Process Area**	**Existing/Replace/New**	**Connected Load (HP)**	**Duty Load (HP)**	**Duty/ Stby**
Influent Pump Station					
IPS Pump No. 1	Influent Pump Station	Existing	30	30	Duty
IPS Pump No. 2	Influent Pump Station	Existing	30	30	Duty
IPS Pump No. 3	Influent Pump Station	New	30	30	Duty
IPS Pump No. 4	Influent Pump Station	New	30		Standby
Headworks					
Rotary Drum Screen No. 1	Headworks	Existing	1.5	1.5	Duty
Rotary Drum Screen No. 2	Headworks	New	1.5	1.5	Duty
Equalization					
EQ Blower No. 1	Equalization	Existing	10	10	Duty
EQ Blower No. 2	Equalization	Existing	10		Standby
EQ Pump No. 2	Equalization	New	10	10	Duty
EQ Pump No. 3	Equalization	Existing	10	10	Duty
EQ Pump No. 4	Equalization	Existing	10		Standby
Biological Process					
Blower No. 1	Biological Process	New	40	40	Duty
Blower No. 2	Biological Process	New	40	40	Duty
Blower No. 3	Biological Process	New	40		Standby
Secondary Clarifiers / Post EQ					
Post EQ Blower No. 1	Secondary Clarifiers / Post EQ	New	7.5	7.5	Duty
Post EQ Blower No. 2	Secondary Clarifiers / Post EQ	New	7.5		Standby
WAS Pumping					
Sludge Buffer Transfer Pump	WAS Pumping	New	5	5	Duty
Filtration					
Filter Unit No. 1	Filtration	Existing	0.33	0.33	Duty
Filter Unit No. 2	Filtration	Existing	0.33	0.33	Duty
Filter Unit No. 3	Filtration	Existing	0.33	0.33	Duty
Filter Unit No. 4	Filtration	New	0.33	0.33	Duty
Filter Unit No. 5	Filtration	New	0.33	0.33	Duty
Filter No. 1 Backwash Pump	Filtration	Existing	2	2	Duty
Filter No. 2 Backwash Pump	Filtration	Existing	2	2	Duty
Filter No. 3 Backwash Pump	Filtration	Existing	2	2	Duty
Filter No. 4 Backwash Pump	Filtration	New	2	2	Duty
Filter No. 5 Backwash Pump	Filtration	New	2	2	Duty
Sludge Holding					
Existing Blower No. 1	Sludge Holding	Existing	25	25	Duty
Existing Blower No. 2	Sludge Holding	Existing	25	25	Duty
Existing Blower No. 3	Sludge Holding	Existing	25		Standy
Existing Blower No. 4	Sludge Holding	Existing	10	10	Duty
Existing Blower No. 5	Sludge Holding	Existing	10		Standby
Plant Drainage Pumping					
Plant Drainage Pump No. 1	Plant Drainage Pumping	Existing	5	5	Duty

PROJECT NAME: WSACC Facilities Plan and PER, MCWWTP Alternatives Analysis					
ALTERNATIVE #2A MAJOR EQUIPMENT LIST					
Equipment	**Process Area**	**Existing/Replace/New**	**Connected Load (HP)**	**Duty Load (HP)**	**Duty/ Stby**
Influent Pump Station					
IPS Screen No. 1	Influent Pump Station	New	1	1	Duty
IPS Screen No. 2	Influent Pump Station	New	1		Standby
IPS Pump No. 1	Influent Pump Station	New	33.5	33.5	Duty
IPS Pump No. 2	Influent Pump Station	New	33.5	33.5	Duty
IPS Pump No. 3	Influent Pump Station	New	33.5	33.5	Duty
IPS Pump No. 4	Influent Pump Station	New	33.5		Standby
IPS Screenings Conveyor	Influent Pump Station	New	2	2	Duty
Headworks					
Headworks Screen No. 1	Headworks	New	1	1	Duty
Headworks Screen No. 2	Headworks	New	1		Standby
Vortex Grit Basin Drive	Headworks	New	1	1	Duty
Grit Pump	Headworks	New	10	10	Duty
Grit Washer Auger	Headworks	New	3	3	Duty
Headworks Screenings Conveyor	Headworks	New	2	2	Duty
Equalization					
EQ Blower No. 1	Equalization	Existing	10	10	Duty
EQ Blower No. 2	Equalization	Existing	10		Standby
EQ Pump No. 1	Equalization	New	10	10	Duty
EQ Pump No. 2	Equalization	New	10	10	Duty
EQ Pump No. 3	Equalization	Existing	10	10	Duty
EQ Pump No. 4	Equalization	Existing	10		Standby
Biological Process					
Aeration Blower No. 1	Biological Process	New	15	15	Duty
Aeration Blower No. 2	Biological Process	New	15	15	Duty
Aeration Blower No. 3	Biological Process	New	15	15	Duty
Aeration Blower No. 4	Biological Process	New	15		Standby
Anoxic Zone Mixer No. 1	Biological Process	New	4.7	4.7	Duty
Anoxic Zone Mixer No. 2	Biological Process	New	4.7	4.7	Duty
Anoxic Zone Mixer No. 3	Biological Process	New	4.7	4.7	Duty
Anoxic Zone Mixer No. 4	Biological Process	New	4.7	4.7	Duty
Anoxic Zone Mixer No. 5	Biological Process	New	4.7	4.7	Duty
Anoxic Zone Mixer No. 6	Biological Process	New	4.7	4.7	Duty
IMLR Pump No. 1	Biological Process	New	5	5	Duty
IMLR Pump No. 2	Biological Process	New	5	5	Duty
IMLR Pump No. 3	Biological Process	New	5	5	Duty
Secondary Clarifiers					
SC No. 1 Mechanism	Secondary Clarifiers	Existing	0.5	0.5	Duty
SC No. 2 Mechanism	Secondary Clarifiers	Existing	0.5	0.5	Duty
SC No. 2 Mechanism	Secondary Clarifiers	New	0.5	0.5	Duty
RAS Pumping					
RAS Pump No. 1	RAS Pumping	Existing	10	10	Duty
RAS Pump No. 2	RAS Pumping	Existing	10	10	Duty
RAS Pump No. 3	RAS Pumping	Existing	10	10	Duty
RAS Pump No. 4	RAS Pumping	New	10		Standby
WAS Pumping					
WAS Pump No. 1	WAS Pumping	Existing	5	5	Duty
WAS Pump No. 2	WAS Pumping	Existing	5		Standby
Filtration					
Filter Unit No. 1	Filtration	New	0.5	0.5	Duty
Filter Unit No. 2	Filtration	New	0.5		Standby
Filter No. 1 Backwash Pump	Filtration	New	25	25	Duty
Filter No. 2 Backwash Pump	Filtration	New	25		Standby
Sludge Holding					
Existing Blower No. 1	Sludge Holding	Existing	25	25	Duty
Existing Blower No. 2	Sludge Holding	Existing	25	25	Duty
Existing Blower No. 3	Sludge Holding	Existing	25		Standy
Existing Blower No. 4	Sludge Holding	Existing	10	10	Duty
Existing Blower No. 5	Sludge Holding	Existing	10		Standby
Plant Drainage Pumping					
Plant Drainage Pump No. 1	Plant Drainage Pumping	Existing	5	5	Duty
Plant Drainage Pump No. 2	Plant Drainage Pumping	New	5		Standby

PROJECT NAME: WSACC Facilities Plan and PER, MCWWTP Alternatives Analysis					
ALTERNATIVE #2B MAJOR EQUIPMENT LIST					
Equipment	**Process Area**	**Existing/Replace/New**	**Connected Load (HP)**	**Duty Load (HP)**	**Duty/ Stby**
Influent Pump Station	**Influent Pump Station**				
IPS Screen No. 1	Influent Pump Station	New	1	1	Duty
IPS Screen No. 2	Influent Pump Station	New	1		Standby
IPS Pump No. 1	Influent Pump Station	New	33.5	33.5	Duty
IPS Pump No. 2	Influent Pump Station	New	33.5	33.5	Duty
IPS Pump No. 3	Influent Pump Station	New	33.5	33.5	Duty
IPS Pump No. 4	Influent Pump Station	New	33.5		Standby
IPS Screenings Conveyor	Influent Pump Station	New	2	2	Duty
Headworks					
Headworks Screen No. 1	Headworks	New	1	1	Duty
Headworks Screen No. 2	Headworks	New	1		Standby
Vortex Grit Basin Drive	Headworks	New	1	1	Duty
Grit Pump	Headworks	New	10	10	Duty
Grit Washer Auger	Headworks	New	3	3	Duty
Headworks Screenings Conveyor	Headworks	New	2	2	Duty
Equalization					
EQ Blower No. 1	Equalization	Existing	10	10	Duty
EQ Blower No. 2	Equalization	Existing	10		Standby
EQ Pump No. 1	Equalization	New	10	10	Duty
EQ Pump No. 2	Equalization	New	10	10	Duty
EQ Pump No. 3	Equalization	Existing	10	10	Duty
EQ Pump No. 4	Equalization	Existing	10		Standby
Biological Process					
Aerator No. 1	Biological Process	New	40	40	Duty
Aerator No. 2	Biological Process	New	40	40	Duty
Aerator No. 3	Biological Process	New	40	40	Duty
Aerator No. 4	Biological Process	New	40	40	Duty
Anoxic Mixer No. 1	Biological Process	New	4.7	4.7	Duty
Anoxic Mixer No. 2	Biological Process	New	4.7	4.7	Duty
Anoxic Mixer No. 3	Biological Process	New	4.7	4.7	Duty
Anoxic Mixer No. 4	Biological Process	New	4.7	4.7	Duty
Secondary Clarifiers					
SC No. 1 Mechanism	Secondary Clarifiers	Existing	0.5	0.5	Duty
SC No. 2 Mechanism	Secondary Clarifiers	Existing	0.5	0.5	Duty
SC No. 2 Mechanism	Secondary Clarifiers	New	0.5	0.5	Duty
RAS Pumping					
RAS Pump No. 1	RAS Pumping	Existing	10	10	Duty
RAS Pump No. 2	RAS Pumping	Existing	10	10	Duty
RAS Pump No. 3	RAS Pumping	Existing	10	10	Duty
RAS Pump No. 4	RAS Pumping	New	10		Standby
WAS Pumping					
WAS Pump No. 1	WAS Pumping	Existing	5	5	Duty
WAS Pump No. 2	WAS Pumping	Existing	5		Standby
Filtration					
Filter Unit No. 1	Filtration	New	0.5	0.5	Duty
Filter Unit No. 2	Filtration	New	0.5		Standby
Filter No. 1 Backwash Pump	Filtration	New	25	25	Duty
Filter No. 2 Backwash Pump	Filtration	New	25		Standby
Sludge Holding					
Existing Blower No. 1	Sludge Holding	Existing	25	25	Duty
Existing Blower No. 2	Sludge Holding	Existing	25	25	Duty
Existing Blower No. 3	Sludge Holding	Existing	25		Standy
Existing Blower No. 4	Sludge Holding	Existing	10	10	Duty
Existing Blower No. 5	Sludge Holding	Existing	10		Standby
Plant Drainage Pumping					
Plant Drainage Pump No. 1	Plant Drainage Pumping	Existing	5	5	Duty
Plant Drainage Pump No. 2	Plant Drainage Pumping	New	5		Standby

PROJECT NAME: WSACC Facilities Plan and PER, MCWWTP Alternatives Analysis					
ALTERNATIVE #2C MAJOR EQUIPMENT LIST					
Equipment	**Process Area**	**Existing/Replace/New**	**Connected Load (HP)**	**Duty Load (HP)**	**Duty/ Stby**
Influent Pump Station					
IPS Screen No. 1	Influent Pump Station	New	1	1	Duty
IPS Screen No. 2	Influent Pump Station	New	1		Standby
IPS Pump No. 1	Influent Pump Station	New	33.5	33.5	Duty
IPS Pump No. 2	Influent Pump Station	New	33.5	33.5	Duty
IPS Pump No. 3	Influent Pump Station	New	33.5	33.5	Duty
IPS Pump No. 4	Influent Pump Station	New	33.5		Standby
IPS Screenings Conveyor	Influent Pump Station	New	2	2	Duty
Headworks					
Headworks Screen No. 1	Headworks	New	1	1	Duty
Headworks Screen No. 2	Headworks	New	1		Standby
Vortex Grit Basin Drive	Headworks	New	1	1	Duty
Grit Pump	Headworks	New	10	10	Duty
Grit Washer Auger	Headworks	New	3	3	Duty
Headworks Screenings Conveyor	Headworks	New	2	2	Duty
Equalization					
EQ Blower No. 1	Equalization	Existing	10	10	Duty
EQ Blower No. 2	Equalization	Existing	10		Standby
EQ Pump No. 1	Equalization	New	10	10	Duty
EQ Pump No. 2	Equalization	New	10	10	Duty
EQ Pump No. 3	Equalization	Existing	10	10	Duty
EQ Pump No. 4	Equalization	Existing	10		Standby
Biological Process					
Blower No. 1	Biological Process	New	40	40	Duty
Blower No. 2	Biological Process	New	40	40	Duty
Blower No. 3	Biological Process	New	40	40	Duty
Blower No. 4	Biological Process	New	40		Standby
Secondary Clarifiers / Post EQ					
Post EQ Blower No. 1	Secondary Clarifiers / Post EQ	New	7.5	7.5	Duty
Post EQ Blower No. 2	Secondary Clarifiers / Post EQ	New	7.5		Standby
WAS Pumping					
Sludge Buffer Transfer Pump No. 1	WAS Pumping	New	5	5	Duty
Sludge Buffer Transfer Pump No. 2	WAS Pumping	New	5	5	Duty
Filtration					
Filter Unit No. 1	Filtration	New	0.5	0.5	Duty
Filter Unit No. 2	Filtration	New	0.5		Standby
Filter No. 1 Backwash Pump	Filtration	New	25	25	Duty
Filter No. 2 Backwash Pump	Filtration	New	25		Standby
Sludge Holding					
Existing Blower No. 1	Sludge Holding	Existing	25	25	Duty
Existing Blower No. 2	Sludge Holding	Existing	25	25	Duty
Existing Blower No. 3	Sludge Holding	Existing	25		Standy
Existing Blower No. 4	Sludge Holding	Existing	10	10	Duty
Existing Blower No. 5	Sludge Holding	Existing	10		Standby
Plant Drainage Pumping					
Plant Drainage Pump No. 1	Plant Drainage Pumping	Existing	5	5	Duty
Plant Drainage Pump No. 2	Plant Drainage Pumping	New	5		Standby