RESOLUTION NO. 2025-15

A RESOLUTION OF THE UPPER MONTGOMERY JOINT AUTHORITY, MONTGOMERY COUNTY, PENNSYLVANIA,

AWARDING OF THE PHASE 1 SERVICES PROPOSAL FOR THE AEROBIC DIGESTER AND BIOSOLIDS IMPROVEMENT PROJECT TO WORTH AND COMPANY AND AUTHORIZING CONTINUED NEGOTIATION BY THE SOLICITOR AND APPROPRIATE OFFICIALS TO FINALIZE CONTRACTUAL TERMS FOR A DESIGN BUILD CONTRACT

WHEREAS, the Upper Montgomery Joint Authority (hereinafter referred to as the "Authority") is a municipal authority organized and existing under the Pennsylvania Municipality Authorities Act of 1945, as amended and supplemented (the "Authorities Act"); and

WHEREAS, Worth & Company, Inc. (hereinafter "Worth") is a duly organized Pennsylvania domestic business corporation with its main business office located at 6363 Keller Church Road, Pipersville, PA 18947; and

WHEREAS, the Authority desires to complete an Aerobic Digester and Biosolids Improvement Project to replace outdated and worn equipment necessary to process and thicken sludge into biosolids; and

WHEREAS, the Authority desires to use a design/build method of contracting to complete the Aerobic Digester and Biosolids Improvement Project using CoStars vendors, material and equipment; and

WHEREAS, the Authority and Worth, a CoStars Vendor, have entered into negotiations and are negotiating the terms of a design/build contract for the completion of the Aerobic Digester and Biosolids Improvement Project (hereinafter the "Project"); and

WHEREAS, the Project is to be designed and constructed in two (2) phases; and

WHEREAS, Phase 1 Services will consist of design, pricing, and other services for the project based on the Owner's project criteria; and

WHEREAS, Phase 2 Services will consist of the completion of design services, permitting, and the construction of the project; and

WHEREAS, the contract currently in negotiation between the parties requires Worth to provide a cost proposal for Phase 1 Services; and

WHEREAS, the Phase 1 Services scope of work requires preliminary design up to a thirty (30%) percent design completion and then design up to a seventy five (75%) percent design milestone; and

WHEREAS, Worth submitted a written proposal for Phase 1 Services to the Authority on or about August 5, 2025 in the amount of $1,811,840.00; and

WHEREAS, in order to lock in certain fixed pricing and reduce the risk of price increases for major pieces of equipment to be incorporated into the Project, Worth proposes to pre-order certain pieces of equipment as directed by the Authority; and

WHEREAS, the Authority desires to accept and approve Worth's Phase 1 Services Proposal and have Worth pre-order equipment in order to avoid any increase in the cost of equipment.

NOW THEREFORE, BE IT RESOLVED AND IT IS HEREBY RESOLVED by the Authority Board of Directors that:

1. Acceptance of Phase 1 Services Proposal. The Authority accepts the Worth & Company Phase 1 Services Proposal received on August 5, 2025, in the amount of $1,811,840.00 subject to the scope of work for the thirty (30%) percent and seventy five (75%) percent design milestones. A true and correct copy of the Worth & Company Proposal for Phase 1 Design/Build

Services is attached as **Exhibit 'A.'** Acceptance of the Worth & Company Phase 1 Services Proposal includes the following exhibits:

A. Exhibit 'A' – Aerobic Digester and Biosolids Improvement Alternatives Evaluation Report dated March 2025.

B. Exhibit 'B' – Scope of Services (Phase 1) prepared by Worth & Company.

D. Exhibit 'D' – List of Job Costed Employees prepared by Worth & Company.

E. Exhibit 'E' – Preliminary Project schedule.

2. Authorization. The Chairman, Vice Chairman, Secretary, Treasurer or any other proper officer of the Authority are authorized to execute and deliver such documents and to do such things as required to commence and complete the Phase 1 Services for the Project.

3. Use of 2025 Sewer Revenue Funds. The Chairman, Vice Chairman, Secretary and Treasurer are authorized to draw upon the 2025 Sewer Revenue Funds to pay for the design and consulting services contained in the Worth Phase 1 Service Proposal, and to advance such funds required to pre-order the equipment listed in the Proposal Overview or, determined during the course of the design necessary to the project, have long lead times and are subject to price increases.

4. Notice to proceed with Phase 1 Services. The Authority is authorized to issue a "Notice To Proceed" to Worth & Company to proceed with, and commence the delivery of, Phase 1 Services for the Project as set forth in their Proposal.

5. Continue Design/Build Contract Negotiations. The Solicitor and proper officers are authorized to continue negotiations and to finalize the Design/Build Contract with Worth & Company based upon the Phase 1 Services to be conducted and costs for Phase 2 Services to be provide to the Authority at the completion of Phase 1 Services. Upon agreement of final

terms and conditions, the Solicitor shall present the final design/build contract, including amendments to account for the costs of Phase 2 Services, to the Board of Directors for final approval and execution.

RESOLVED and **ADOPTED** this 12th day of August 2025.

UPPER MONTGOMERY JOINT AUTHORITY

By:________________________________
(Vice) Chair

Attest:______________________________
Donna Paul, Secretary

AECOM

Aerobic Digester and Biosolids Improvements Alternatives Evaluation

Upper Montgomery Joint Authority

Project number: 60734560

March 2025

Delivering a better world

Quality information

Prepared by	Checked by	Verified by	Approved by
Terry Goss Jocelyn Juliano	M. Elisco	J. McQuarrie	B. Deatrich

Revision History

Revision	Revision date	Details	Authorized	Name	Position

Distribution List

# Hard Copies	PDF Required	Association / Company Name

Prepared for:

Upper Montgomery Joint Authority
Jennifer Leister
Executive Director
Upper Montgomery Joint Authority
110 Mensch Dam Road
Pennsburg, PA 18073

Prepared by:

AECOM
625 West Ridge Pike
Conshohocken, PA 19428
aecom.com

Table of Contents

Figures

Tables

Appendicies

Executive Summary

Upper Montgomery Joint Authority (UMJA) is a 2.0 million gallon per day (MGD) wastewater treatment plant in Pennsburg, Pennsylvania, and is within the Schuylkill River Watershed. Primary sludge and waste activated sludge (WAS) are processed on site using combination of aerobic digestion, dewatering, and sludge drying.

UMJA has historically produced Class B biosolids in the aerobic digesters, but the performance of the digesters has been reduced since the biological nutrient removal (BNR) upgrade changed the characteristics of the solids disrupting the ability to achieve Class B. Currently the aerobic digesters serve as aerated sludge holding tanks upstream of dewatering. In addition, the digester aeration and mixing system is aging and near end of useful service life.

Class A dried biosolids can be produced using a Fenton dryer and is a valued product for beneficial use within the local community and given away in bags directly from the facility. However, the dryer is nearing end of useful life and operation has not been consistent due to equipment outages. When the dryer is offline, the dewatered sludge is landfilled although an option to send dewatered sludge to a regional composting facility is also being considered. In addition, UMJA currently only contains one dewatering centrifuge which is also aging, and lack of dewatering redundancy causes operational issues if the centrifuge is down for extended periods of time for maintenance. As part of the future planning UMJA plans to add a second centrifuge and received a proposal from RDP to retrofit and replace components of their aging Fenton dryer.

UMJA has the goal of returning to Class B biosolids production in their digesters and retrofitting their dewatering and drying facilities to maintain reliable operation. As part of this goal, AECOM was tasked to perform a digester improvement alternatives analysis to determine the best options for upgrading the digesters and documenting additional improvements including adding a second centrifuge and retrofitting and replacing the components of the Fenton dryer.

UMJA has conducted several previous analyses on their biosolids processes including, condition assessments of the existing digester tanks and thickening and dewatering pilot studies. The data and experience with the pilots informed preferred equipment choices that will be associated with the biosolids upgrade. Using historical plant data, a basis of design for future digester upgrades was developed based on permitted capacity. Mass balances for the current and permitted loading for each alternative was developed

Two aerobic digester alternatives were compared to the baseline case of maintaining the digesters as aerated sludge holding tanks. These include retrofitting conventional aerobic digestion to achieve Class B and converting the existing digester tanks to an Autothermal Thermophilic Aerobic Digester (ATAD) with a Simultaneous Nitrification / Denitrification Reactor (SNDR). For both the Class B and ATAD alternatives it was assumed that the waste activated sludge would be mechanically thickened with a Disc Thickener. Overall, three aerobic digester alternatives were compared, and a business case and non-economic evaluation was conducted for

- Alternative 1: In Kind Replacement
- Alternative 2: Class B Digestion
- Alternative 3: ATAD

For Alternative 2 - Class B, multiple options for mixing and aeration were considered including Ovivo (previously Enviroquip), Enviromix diffused aeration system, jet mixing and aeration, and Invent mixing and aeration. For Alternative 3 - ATAD one digester was assumed to be converted to an ATAD tank and the second was assumed to be converted to an SNDR tank. For ATAD options with jet mixing / aeration and Invent mixing / aeration were considered.

The annual operating costs were estimated for each of the three aerobic digestion options. Annual operating costs included polymer, electricity, natural gas, and maintenance. The analysis also considered the impact of and transportation / beneficial use / disposal costs which have a large impact on the analysis particularly if drying is maintained. For management of dewatered cake, options for land application of Class B (when seasonally available) were considered for Class A and B options and compared to options for landfilling or composting offsite.

The analysis showed that upgrading the digesters to Class A (Alternative 3) or Class B (Alternative 2) provides the potential for the lowest operating cost. The potential operating cost savings for Class A cake, however, did not outweigh the significantly higher capital cost for the ATAD alternative (Alternative 3). The operating cost analysis also shows that maintaining drying also offers operating cost savings. A lifecycle cost analysis was conducted for the digester alternatives including the capital and operating costs for additional dewatering and retrofitting the existing drying system.

The results of the lifecycle cost analysis showed that options that include drying provide a higher lifecycle cost mainly because of the increased capital cost. Class B land application (Alternative 2) and landfilling (Alternative 1) without drying has the lowest lifecycle cost, however, these options would be sensitive to hauling and tipping fees which could see increases due to uncertainty with future market and end use regulations. UMJA desires to avoid landfilling and promote beneficial use. Offsite composting provides an alternative beneficial use outlet but is the most expensive option on a lifecycle cost basis.

While ATAD (Alternative 3) provides Class A biosolids at an economical cost when considering the dryer retrofit, there might not be a significant advantage to having Class A cake biosolids product and a more detailed marketing analysis would need to be conducted to determine if there would be alternative options for managing the Class A cake product than a Class B cake product. Available space in the existing digester building is also a concern for the ATAD system.

After completing the analysis, UMJA agreed with the recommendation to proceed with Alternative 2 to upgrade the digesters to achieve Class B, add a second centrifuge and retrofit/replace the components of the existing dryer facility. These options provide UMJA flexibility with multiple beneficial use outlets and maintaining the dryer helps mitigate future impacts to changing regulatory and market conditions. During detailed design it will be important to plan and sequence the improvements to allow for smooth maintenance of plant operations. The Opinion of Probable Construction Cost (OPCC) is estimated to be approximately $8,000,000.

1. Introduction

Upper Montgomery Joint Authority (UMJA) is a municipal authority that owns and operates a wastewater treatment plant in Pennsburg, Pennsylvania, and serves East Greenville, Pennsburg, and Red Hill Boroughs, as well as parts of Upper Hanover Township in Montgomery County, PA.

UMJA processes primary sludge and waste activated sludge (WAS) on site using aerobic digestion, dewatering, and sludge drying as shown in Figure 1-1. UMJA has historically produced Class B biosolids at the plant, but the performance of the digesters has been reduced since the biological nutrient removal (BNR) upgrade changed the characteristics of the solids disrupting the ability to achieve Class B. Currently the aerobic digesters serve as aerated sludge holding tanks upstream of dewatering. In addition, the digester aeration and mixing system originally provided by Enviroquip is aging and near end of useful service life.

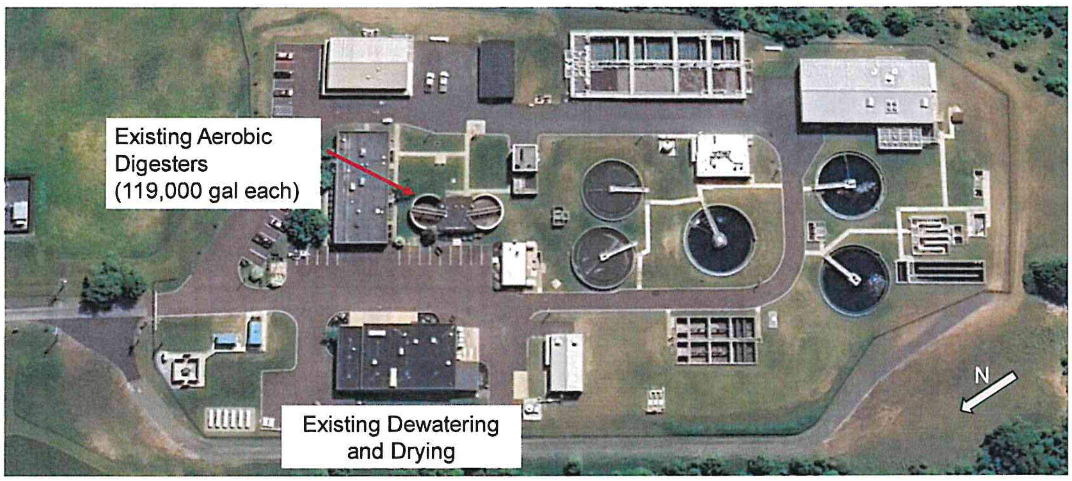


Figure 1-1. Existing Site and Alternatives

Class A dried biosolids product can be produced using the dryer and is a valued product for beneficial use within the local agricultural community. However, due to the aging Fenton dryer, production of Class A has become unreliable and has not been consistent due to equipment outages. When the dryer is offline, the dewatered sludge is landfilled although an option to send dewatered sludge to a regional composting facility is also being considered. In addition, UMJA currently only contains one dewatering centrifuge which is also aging, and lack of dewatering redundancy causes operational issues if the centrifuge is down for extended periods of time for maintenance. As part of the future planning UMJA plans to add a second centrifuge and received a proposal from RDP to retrofit and replace components of their aging Fenton dryer.

UMJA has the goal of returning to at least Class B biosolids production. AECOM has been tasked to perform a digester improvement alternatives analysis to support this goal. This report describes the analysis performed by AECOM and the recommended improvements to meet the UMJA's goal of achieving Class B biosolids or better. The report also documents additional improvements including adding a second centrifuge and retrofitting and replacing the components of the Fenton dryer. Pictures of the exiting digester, centrifuge and dryer are provided in Figure 2.

Figure 1-2. Pictures of Digester (top left), centrifuge (right), dryer (bottom left)

1.1 Background

The plant is currently designed to treat an annual average flow of 2.0 million gallons per day (MGD), with an organic design capacity of 3,481 pounds per day (lbs/day) of 5-day biochemical oxygen demand (BOD_5), as well as a hydraulic design capacity of 2.77 MGD. The treated water outfalls to Green Lane Reservoir. Green Lane Reservoir is a tributary to Perkiomen Creek in the Schuylkill River Watershed and is also a source of potable water downstream.

Based on the most recent NPDES permit renewal obtained by the wastewater treatment plant in 2020, the phosphorus limit is 0.5 mg/l, and the ammonia limit is 10 mg/l, which was reduced from 20 mg/l. Nitrate-nitrogen and nitrite-nitrogen are also monitored since the facility discharges into a potable source of water. The total dissolved solids limit is 1,000 mg/l.

The existing treatment plant consists of two influent screens, an influent pumping station, an aerated grit chamber, two primary clarifiers, two five-stage Bardenpho process BNR tanks, two secondary clarifiers, tertiary filtration, three chlorine contact tanks, three post aeration tanks, and a Parshall flume. The solids management processes consist of two aerobic digesters, a centrifuge, and a sludge dryer. The activated sludge BNR treatment unit processes began operation in 2019 after the completion of the BNR upgrades.

Historically, Class B biosolids produced at the plant were either land applied, or dewatered with a single centrifuge, dried using a Fenton Dryer, and stored in super sacks, which were then provided to farmers and the community for free. UMJA desires to have the flexibility to manage biosolids using Class B land application again as well as maintain Class A thermal drying.

The goals and objectives of UMJA include:

1. Generate Class A or B biosolids.
2. Retrofit the digesters to produce at least Class B biosolids:
    a. Replacing the digester mixing and aeration systems.
    b. Upstream thickening to meet minimum capacity requirements, if necessary.

To assist UMJA in achieving at least Class B biosolids, AECOM was asked to conduct an alternative analysis to retrofit the existing aerobic digesters at UMJA. The first option evaluated includes modifying/upgrading the existing aerobic digesters to improve mixing and aeration. Several options were considered for mixing and aeration including replacing the Enviroquip system with new Enviroquip (now Ovivo) system, Enviromix mixing/aeration, Invent mixing/aeration, and jet mixing/aeration. The second option evaluated considered converting the aerobic digester system to an Autothermal Thermophilic Aerobic Digestion (ATAD) system. This includes converting the first digester to an ATAD tank and converting the second digester to a Simultaneous Nitrification / Denitrification (SNDR) tank. This process would produce Class A biosolid cake. Each option will include additional thickening as needed to allow the existing digesters sufficient capacity to produce at least Class B biosolids. For the evaluation presented herein it was assumed that WAS thickening would be achieved with Huber Disc Thickening Technology, however, a different technology could be considered during detailed design.

To further increase solids handling reliability, UMJA desires to have a second centrifuge for improved performance, increased capacity and redundancy. In addition, UMJA would like to retrofit the existing dryer and replace the components to have a drying system that remains reliable for the foreseeable future.

1.2 Summary of Previous Studies

Prior to starting this study, several previous analyses, condition assessments and thickening and dewatering pilot studies were reviewed which impact design and potential equipment selection.

1.2.1 Digester Reconfiguration Study

RETTEW, an engineering consulting firm, conducted an analysis in June 2020 of the two aerobic digesters at UMJA to determine the most efficient configuration for the digesters to achieve desirable SOUR (Specific Oxygen Uptake Rate) test results. To land apply biosolids, the SOUR test result must be less than 1.5 mg O_2/hr/g VSS. Previously, UMJA utilized a trickling filter system in which SOUR testing results were within the acceptable range to allow for beneficial land application of biosolid. However, when UMJA upgraded from the trickling filter system to a BNR system, along with the addition of new influent screening, operations at the plant were impacted, including SOUR test results. If SOUR requirements are not met, the solids must be dewatered and dried or the dewatered solids are landfilled. To meet the SOUR testing requirements for land application of biosolids, a review of the digester configuration was conducted to achieve SOUR testing goals as often as possible.

The existing configuration includes two 119,000-gallon aerobic digesters set up as a batch process, where one tank is filled with waste solids while the other tank is filled with sludge where it digests, and then the sludge is tested for SOUR requirements. Suspended coarse bubble diffusers are attached to the digesters to supply oxygen, and sludge that has a total solids concentration between 20,000-25,000 mg/L is sent to the centrifuge from the digesters. While this process worked in the past, SOUR requirements and pH requirements are no longer being met.

The goals of reconfiguring the digesters include meeting the oxygen demand and the total solids concentration of 2-2.5% for the sludge. The concept proposed by RETTEW was documented on two different schematics that should be followed during 3 different shifts, each consisting of 8 hours. The 1^{st}

schematic is completed during the 1st shift and includes turning off the aeration to allow for settling for 2-3 hours, followed by collecting a sludge sample for SOUR testing, then sending water to the BNR system while also sending sludge to from the clarifiers to the digesters. At this point, the sludge is sent to the centrifuge if the total solids are >2%. The final step is to turn the aeration back on. The 2nd and 3rd shift follow the 2nd schematic, which only consists of constant aeration cycling based on PLC controls in the aerobic digesters. The 2nd schematic should also be followed for the entire weekend. Overall, RETTEW predicted that SOUR testing and total solids goals will be achieved by following this configuration. The proposed operation, however, was labor intensive and is not currently practiced by UMJA.

1.2.2 Digester Condition Assessments:

Both Digesters A and B were evaluated in 2022 by Spotts, Stevens and McCoy to determine the condition of the structural and steel components of each tank. The tanks are about 30 feet in interior diameter, and 24 feet tall, with a high-water level of 22 feet. The open tanks are made from cast-in-place concrete. The steel structures in the tank that support the catwalks and the air drops have been in use since 2005, with varying levels of damage and corrosion found. The use of ferric chloride in both tanks is a contributing factor to the corrosion of the steel due to its ability to oxidize steel.

Digester A Report Summary: Below is a summary of the conditions assessment on Digester Tank A, conducted on January 5, 2023.

Digester A has moderate structural corrosion to various areas of steel, including the support structures for the catwalk and air drops, as well as the wide flange steel posts and angle bracing that supports the catwalk, standpipe, and the base plate anchoring points. The structural framework in the digester shows signs of corrosion, which could lead to future loading capacity concerns. However, it was found that the stainless-steel anchor bolts are in good condition, along with some of the braced frames and air drop anchors.

Based on the overall inspection of the tank, the recommendations provided in the report suggest replacing portions of the digester periodically, with the goal of fully replacing the structures in the near future before the tank becomes unfit for use. The catwalk is also unsafe for use due to the damage of the supporting structures.

Digester B Report Summary: Below is a summary of the conditions assessment on Digester Tank B, conducted on September 23, 2022.

It was determined that a majority of the structural components in the tank are severely damaged due to the breakdown of steel from chemical use in the tank. The structure of Digester B is unable to support the desired loading safely and is too damaged to reinforce the current structure. The corroded structures in the tank include the structures that support the air drops and catwalk, the air drop anchor connections, portions of the wide flanged steel posts and angle bracing, the steel post flanges, and the base plate anchorage points.

Overall, it has been recommended that the entire framework structure of the digester must be replaced for safety reasons. It was also recommended that the supporting posts and angle braces be replaced as well. Another area of concern is the catwalk and supporting structures. The steel in these systems were also found to be extremely corroded and flaking in certain sections. It was also determined that the catwalk is unsafe and should not be in use.

1.2.3 Huber Disc Thickener Operation

Huber is a manufacturing company specializing in wastewater treatment equipment. From June 9, 2022-July 8, 2022, UMJA operated a pilot Huber S-Disc Thickener. The purpose of the Disc Thickener is to maximize sludge thickening abilities with minimal operations and maintenance costs. The goals for UMJA in this pilot study was to test operations and maintenance, as well as the steady-state operations of this system, and to determine the suitability of the Disc Thickener to meet the plant's needs.

The pilot text used different flow rates to test hydraulic loading rates from 50 to 75 gallons per min (gpm), and various polymer dosages) throughout the testing period. Samples were taken from the sludge feed, filtrate, and discharge by UMJA. Total Suspended Solids (TSS) were tested using the filtrate samples, and Total Solids (TS) were tested using the discharge samples.

Overall, the pilot study performed well. Huber concluded that thickening requirements at UMJA were achieved by using Huber S-Disc Thickener and was able to show steady-state thickening capabilities, appropriate discharge solids concentrations at an average of 5.76% TS, and greater than 96% solids capture rate, while achieving minimal operations and maintenance requirements. Polymer dosing ranged from 15 to 35 lb/dry ton. Based on this piloting experience, UMJA's preferred thickening technology is the disc thickener.

1.2.4 Rotary Drum Thickener Onsite Pilot Test

BDP Industries is a manufacturing company specializing in thickening, dewatering, and composting equipment. From October 24, 2022-October 26, 2022, BDP Industries performed a pilot test at UMJA for the BDP Rotary Drum Thickener (RDT). The purpose of the RDT is to maximize sludge thickening abilities with minimal operations and maintenance costs. The goals for UMJA in this pilot study was to observe the operations and maintenance, as well as the steady-state operations of this system, and to determine the loading rate and RDT size that suits the plant's needs.

This pilot utilized a Model 30x5 RDT. The pilot study used different flow rates to test hydraulic loading rates, and various polymer dosages throughout the testing period. Samples were taken from the sludge feed, filtrate, and discharge by UMJA, as well as the RDT, and results were recorded in the pilot study report. Total Suspended Solids (TSS) were tested using the filtrate samples, and Total Solids (TS) were tested using the discharge samples.

Overall, the pilot study performed well. BDP concluded that thickening requirements at UMJA were achieved by using a 30x5 RDT and was able to show steady-state thickening capabilities, appropriate discharge solids concentrations at an average of 2.87 % TS, and 99.78% solids capture rate, while achieving minimal operations and maintenance requirements, as well as minimal polymer dosage, with an average of 12.9 active lb/dry ton. The thickened sludge concentration achieved by the RDT was lower than what was observed by the disc thickener.

1.2.5 GEA Centrifuge Pilot Test

In July 2024, a centrifuge pilot study was conducted by GEA at UMJA. A pilot test trailer was set up for one week, and the set up included the GEA CF-4000 centrifuge, as well as a variable speed sludge feed pump and a polymer blending unit, with the goal of producing dry biosolids cake. Various flow rates and solids loadings were tested over the course of the pilot study, ranging from 70-110 gpm flows, and 350-550 dry lbs/hour solids loading rates. Steady state conditions were maintained through torque adjustments in the centrifuge, and samples were collected after maintaining steady-state conditions for 45 minutes. Feed sludge, dewatered cake, and centrate were analyzed for each test, with a total of 14 test trials, which analyzed the % TS (total solids) of the feed sludge and biosolids cake, and % TSS (total suspended solids) of the centrate.

The results indicate that polymer dosage had the greatest impact on cake dryness with higher doses leading to dryer cake, and the cake dryness is only slightly impacted by the solids loading rate. The cake dryness decreased as the solids loading rate increased. The overall results show that the cake dryness was between 19% and 22%, based on the varying loading rates and polymer dosages. UMJA currently has an old model of a GEA centrifuge and prefers to maintain a common supplier.

1.2.6 Alfa Laval Centrifuge Pilot Test

Alfa Laval, a manufacturing company that works in various industries specializing in heat transfer, separation, and fluid handling products, conducted a pilot study at UMJA to test a system to dewater sludge produced at the plant, specifically using a 2-phase decanter centrifuge. The pilot study utilized the Alfa Laval ALSYS G3-75 Trailer mounted Centrifuge Dewatering System Demonstration Trailer. The goals of this study were to dewater sludge while capturing at least 95% solids, along with minimizing polymer dosage for polymer to determine the best conditions to meet the needs of the plant and optimize the efficiency of the system. This was determined by analyzing polymer curves from the study using C-6286X polymer. The pilot trailer was set up on April 22, 2024, and the study was conducted from April 23, 2024-April 25, 2024.

During the study, sludge was pumped from the aerobic digesters through a macerator to reduce the particle size, and then to the pilot trailer where the centrifuge system was set up. This is also where the polymer was injected, using the Polycube polymer system. The system automatically regulates polymer dosage and sludge feed. Throughout the pilot study, samples from the sludge feed, cake, and centrate were taken and data was recorded in the report.

Various flow rates and solids loadings were tested over the course of the pilot study, ranging from 75-180 gpm flows and 11.3 to 20.2 active lb/DT of polymer. The results indicated that both polymer dosage and solids loading rates impacted the cake dryness but the range during testing was relatively small ranging from 19.9% to 21.3%. Although the Alfa Laval centrifuge performed well and similar to the GEA centrifuge, UMJA prefers to maintain a common manufacturer for both dewatering units.

2. Regulatory Considerations

2.1 Federal Standards

Biosolids standards are established at the federal level by the United States Environmental Protection Agency (USEPA). The USEPA biosolids regulations were promulgated on February 19, 1993, and are found in Chapter 40 of the Code of Federal Regulations (CFR), Part 503 (Part 503). The federal program has established standards for the beneficial use of biosolids products based on three parameters: pollutants (regulated metals), pathogen reduction (PR), and vector attraction reduction (VAR).

2.1.1 Pollutants

Nine pollutants (metals) are established in Part 503 (Table 2-1). Two sets of pollutant (metals) standards are defined in Part 503: Ceiling Concentration limits (Table 1 of Part 503) and more stringent Monthly Average Pollutant Concentration limits (Table 3 of Part 503), as reported on a dry weight basis (dwb). These standards establish allowable beneficial use practices for biosolids products.

Ceiling Concentration Limits (Table 1 of Part 503) establish maximum concentrations limits for all beneficial use activities. Biosolids products that contain pollutants that exceed Table 1 limits may not be applied to the land or distributed. Biosolids products that do not exceed the Ceiling Concentration Limits

(Table 1 of Part 503) but exceed the Monthly Average Pollutant concentration limits (Table 3 of Part 503) require tracking, monitoring, and reporting of annual and cumulative pollutant loading rates (APLR and CPLR) at beneficial use sites. Biosolids products that do not exceed the more stringent Monthly Average Concentration limits (Table 3 of Part 503) do not require pollutant loading tracking or reporting.

Table 2-1. Part 503 Table 1 and Table 3 Pollutant Limits

Pollutant	Table 1 Part 503 Ceiling Concentrations (mg/kg dwb)	Table 3 Part 503 Monthly Average Concentrations (mg/kg dwb)
Arsenic	75	42
Cadmium	85	39
Chromium	NL	NL
Copper	4,300	1,500
Lead	840	300
Mercury	57	17
Molybdenum	75	NA
Nickel	420	420
Selenium	100	100
Zinc	7,500	2,800

2.1.2 Pathogen Reduction

Pathogen reduction (PR) is a measure of the degree to which biosolids treatment processes reduce pathogens (disease causing organisms). At the federal level, PR is categorized based on level of treatment: Class A or Class B.

Class A PR are Processes to Further Reduce Pathogens (PFRP) to very low limits as defined in Part 503. Class A biosolids are used in a variety of markets with both high public access (i.e., residential, municipal, and commercial) and low public access (i.e., agriculture, alternative daily cover, and mine reclamation). To meet Class A criteria, a process must be used to reduce pathogens. The pathogen reduction limits for Class A are monitored by using either fecal coliform or Salmonella as indicator organisms. For Class A the maximum fecal coliform concentration may not exceed 1,000 most probable number (MPN) per gram of solids (dry weight basis) or the maximum Salmonella concentration may not exceed 3 MPN per 4 grams of solids (dry weight basis). The process must also include a vector attraction reduction step either before or at the same time as the pathogen reduction step to stabilize the biosolids. Currently the EPA defines six alternatives to meet Class A pathogen requirements, as listed below:

1. High temperature treatment based on set time and temperature curves
2. High pH and high temperature processes (alkaline treatment) using specified pH, temperature, and air-drying requirements
    a. Elevating pH to greater than 12 and maintaining pH for more than 72 hours

b. Maintaining the temperature above 126 F for at least 12 hours while pH is greater than 12

c. Air drying the final solids to over 50% after the 72-hour period of elevated pH

3. Extensive pathogen, enteric virus and helminth ova testing
4. Extensive pathogen testing similar to what is required in Alternative 3, targeted for solids that are stockpiled or stored for extended periods in lagoons
5. Processes to further reduce pathogens (PFRP) which include:
   a. Composting (>55 C for 3 days [in-vessel and aerated static pile] or >55 C for 15 days [windrow composting])
   b. Heat drying
   c. Heat treatment
   d. Thermophilic aerobic digestion (i.e.., ATAD)
   e. Beta ray irradiation
   f. Gamma ray irradiation
   g. Pasteurization
6. Other processes to be classified as being equivalent to an existing PFRP not defined in Alternative 5.

The Class A technologies that is being evaluated or used at UMJA include Heat Drying and ATAD. UMJA currently uses heat drying to generate Class A biosolids.

Alternatively, Class B PR includes Processes to Significantly Reduce Pathogens (PSRP) to levels that are unlikely to cause harm to human health or the environment when specific management practices are followed. Class B biosolids are confined by regulation to markets with low public access (generally agriculture), which include site and setback restrictions. The maximum fecal coliform concentration for Class B biosolids may not exceed 2,000,000 colony forming units (CFU) or MPN per gram of solids (dry weight basis). The EPA currently defines threes alternatives to meet Class B:

1. Perform fecal coliform testing to ensure concentration is below the defined threshold.
2. Use a Process to Significantly Reduce Pathogens (PSRP) such as:
   a. Aerobic digestion
   b. Air drying
   c. Anaerobic digestion (greater than 35 C for at least 15 days)
   d. Composting (greater than 40 C for 5 days with 4 hours exceeding)
   e. Lime stabilization (pH to 12 with 2 hours of contact time)
3. Use other processes to be classified as being equivalent to an existing PSRP not defined in Alternative 2.

Aerobic Digestion is the Class B alternative being evaluated for UMJA in this memo. UMJA historically generated Class B biosolids.

2.1.3 Vector Attraction Reduction

Vector attraction reduction (VAR) is also an important component of both Class A and Class B requirements. A vector is defined by the USEPA as "any living organism capable of transmitting a pathogen from one organism to another either mechanically (by simply transporting the pathogen) or biologically by playing a specific role in the life cycle of the pathogen". Vectors for sewage sludge pathogens can include insects, rodents, and birds. VAR is a measure of biosolids ability to attract vectors that may encounter and transport pathogens away from the application site. Vector attraction reduction includes process VAR (PVAR) and barrier methods. Process methods include processes that break down volatile solids and reduce the food source for microbial populations (e.g., digestion) or processes to change the physical or chemical composition to stop microbial activity (e.g., alkaline stabilization). These methods involve biosolids stabilization processes employed at the WWTP. Barrier methods create a physical barrier between the biosolids and potential vectors and are employed at the application site (incorporation or injection). The USEPA defines ten VAR methods as summarized in Table 2-2.

Table 2-2. Vector Attraction Reduction (USEPA 1992)

Requirements	What is required?	Appropriate for:
Option 1 503.33(b)(1)	Greater than 38% VS reduction during biosolids treatment	Anaerobic/aerobic biologically treated or chemically oxidized biosolids
Option 2 503.33(b)(2)	Less than 17% additional VS loss during bench scale anaerobic batch digestion of biosolids for additional 40 d at 86°F to 99°F	Anaerobically digested biosolids
Option 3 503.33(b)(3)	Less than 15% additional VS loss during bench scale aerobic batch digestion of biosolids for additional 30 d at 68°F	Aerobically digested biosolids with solids less than 2% – example: biosolids treated in extended aeration plants
Option 4 503.33(b)(4)	SOUR at 68°F is 1.5 mg O2/h.g. total biosolids	Biosolids from aerobic processes (should not be used for composted sludges) or biosolids that have been deprived of oxygen for longer than 1-2 h
Option 5 503.33(b)(5)	Aerobic treatment of biosolids for at least 14 d at over 104°F with an average temperature of over 113°F	Composted biosolids (Options 3 and 4 are likely to be easier to meet for biosolids from other aerobic processes)
Option 6 503.33(b)(6)	Addition of sufficient alkali to raise the pH to at least 12 at 77°F and maintain a pH of 12 for 2 h and a pH of 11.5 for additional 22 h	Alkali treated biosolids (alkalis include lime, fly ash, kiln dust, and wood ash)
Option 7 503.33(b)(7)	75% solids before mixing with other materials	Biosolids treated by aerobic or anaerobic process (i.e., biosolids that do not contain unstabilized solids generated in primary wastewater treatment)
Option 8 503.33(b)(8)	90% solids before mixing with other materials	Biosolids that contain unstabilized solids generated in primary wastewater treatment like heat dried sludges
Option 9 503.33(b)(9)	Biosolids injected into soil so that no significant amount of biosolids is present on the land surface 1 h after injection, except Class A biosolids which must be	Liquid biosolids applied to the land. Domestic septage applied to agricultural land, a forest, or a reclamation site

Requirements	What is required?	Appropriate for:
	injected within 8 h after pathogen reduction process	
Option 10 503.33(b)(10)	Biosolids is incorporated into the soil within 6 h after application to land. Class A biosolids must be applied to the land surface within 8 h after pathogen reduction process, and must be incorporated within 6 h of application	Biosolids applied to the land. Domestic septage applied to agricultural land, forest, or a reclamation site

Historically UMJA has used Option 4 SOUR testing for showing vector attraction compliance with the aerobic digesters. In the future either this method or Option 1 VSR could be used. The Class A dried biosolids meets vector attraction reduction requirements with Option 8 drying to 90% solids although Option 7 drying to 75% solids could be used if biosolids are considered aerobically stabilized.

2.1.4 Exceptional Quality Biosolids

Biosolids products that meet a Class A PR Alternative and PVAR (Option 1-8), and do not exceed Average Monthly pollutant limits are recognized as Exceptional Quality (EQ) biosolids. Biosolids that do not meet one of the three requirements must be managed with setbacks and management practices, limited to low access markets (like agriculture), and/or must calculate the CPLR with each application. While meeting EQ standards will allow these products to be managed in non-agricultural markets, only high-quality products will meet quality criteria demanded by customers and improve sustainability.

2.2 Pennsylvania Department of Environmental Protection

In Pennsylvania, the PA Department of Environmental Protection (PADEP) regulates the land application of biosolids. In addition to meeting federal regulations, facilities in PA must also meet regulations set by the PADEP to land apply biosolids, which is important for the protection of the environment and surrounding communities. A land application of sewage sludge general permit must be obtained by the waste facility. To ensure that biosolids are suitable for land application, vector attraction reduction and pathogen reduction requirements must be met. Along with this, the sewage generator must sample the solids and test for various pollutants to make sure that quality standards are achieved. Monitoring, recordkeeping, and reporting must be completed routinely to ensure that the biosolids are continuing to meet regulatory standards to protect the surrounding environment from possible pollutants that can be found in biosolids. Once land application begins, land application sites are subject to PADEP inspections and sampling.

It is also required to notify the landowners and property owners adjacent to application sites, as well as the DEP, at least 30 days before biosolids land application. Prior to land application, the DEP must evaluate the site to determine if the area meets requirements to land apply biosolids. Strict guidelines are in place to ensure that the area is suitable for land application.

2.3 Future Regulatory Considerations

Emerging contaminants can have the potential to shape biosolids management options in the future. In particular, per- and polyfluoroalkyl substances (PFAS) compounds in biosolids are becoming a concern in the industry and AECOM previous analyzed data and provided recommendations in the PFAS Data

Review and Recommendations TM (November 2024) which is provided in Appendix A. In the future other contaminants such as microplastics may also become a contaminant of concern.

3. Summary of Aerobic Digester Alternatives

Two aerobic digester alternatives were considered for stabilization in this technical memo. These include retrofitting conventional aerobic digestion to achieve Class B, and ATAD. An overview of these processes is provided in this section. Currently the digesters serve as aerated sludge holding tanks and a wide spot upstream of dewatering. Although some digestion is occurring, the process is not able to reliably meet Class B requirements summarized in Section 2.

3.1 Class B Digestion and Drying (Retrofit)

Aerobic digestion is a biological process that takes place in the presence of oxygen. Aerobic digestion uses aerobic microbes to decompose organic matter, stabilize sewage sludge and generate biosolids. Aerobic digestion is most practiced in plants with influent flows of less than 5 MGD. Aerobic digestion typically yields high volatile solids destruction, has a low BOD concentration in the side streams from dewatering, produces a relatively odorless stable product, maintains a high nutrient value in the biosolids, is simple to operate, and involves relatively low capital costs. The aerobic process, however, requires a large amount of aeration which results in a high electrical consumption. Conventional aerobic digestion can produce Class B biosolids but the resulting liquid biosolids can also be difficult to dewater. The process is commonly used for secondary sludge only although it can be applied to plants with primary and WAS like UMJA. Advantages and disadvantages of Aerobic Digestion are summarized in Table 3-1.

Table 3-1. Advantages and Disadvantages of Aerobic Digestion

Advantages	Disadvantages
• Well proven process • Good pathogen inactivation • Operationally stable • Odor potential is low for aerobic digestion with the proper operation • Relatively simple to operate • Produces relatively stable sludge which helps in mass and volume reduction of residual solids for disposition or beneficial use	• Relatively large footprint when compared to alternative stabilization technologies • High operating costs due to electrical consumption • Does not produce useful byproduct (methane) for renewable energy production • Typically, not suitable for plants over 5 MGD

3.2 ATAD

Autothermal Thermophilic Aerobic Digestion (ATAD) is a specific variation of the aerobic digestion process. The process is exothermic, and sludge is subjected to temperatures more than 55°C for a hydraulic retention time of greater than 10 days. The ATAD process such as the one shown in Figure 3-1 requires mechanically thickened sludge up to 4 percent to 6 percent TS before the aerobic digester reactors. Newer ATADs also include a simultaneous nitrification / denitrification reactor (SNDR) prior to dewatering to reduce odors, improve dewaterability and reduce ammonia concentration in the dewatering side streams. The SNDR process operates at mesophilic conditions (35°C) so cooling heat exchangers are required. Advantages and disadvantages of ATAD are summarized in Table 3-1.

Table 3-2. Advantages and Disadvantages of ATAD

Advantages	Disadvantages
• Proven process • Provides good volatile solids destruction which reduces mass and volume for beneficial use or disposal • High reaction rate and low retention time compared to traditional aerobic digestion • Requires no pretreatment of biosolids feed, other than thickening • No boiler or gas-handling combustion steps needed • Fully enclosed reactor • Produces a Class A biosolids	• Foam breakers are required, due to the high degree of foaming in the reactors • Poor dewatering characteristics (low solids, high polymer) of digested biosolids if SNDR is not included • Need for feed sludge to be thickened to a minimum 5 percent solids concentration • System usually requires complete odor control and treatment

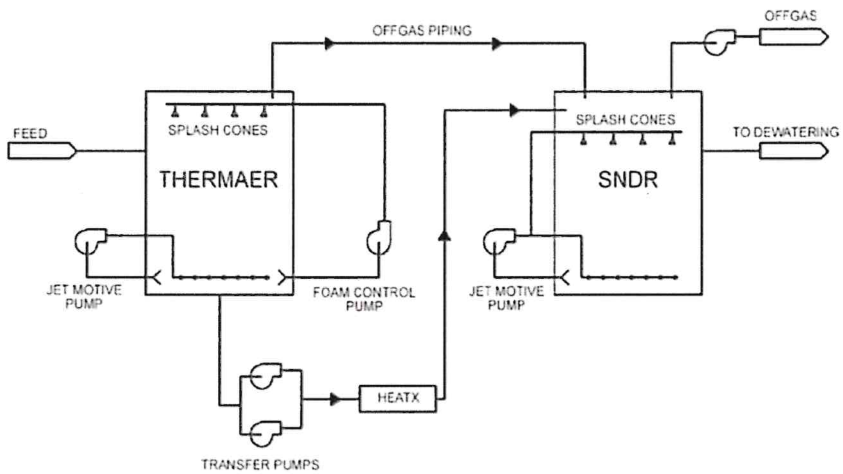


Figure 3-1. Typical ATAD with SNDR Process Schematic

4. Sludge Loading and Design Criteria

To develop sludge loading and design criteria, historical data from January 2021 through June 2024 was analyzed to establish current solid production rates as it compares to influent flow. Future loadings were calculated based on solids handling needs to meet permitted average capacity of 2.0 MGD. Table 4-1 summarizes the average, maximum 30 day and maximum 15-day influent flow averages and Figure 4-1 presents the data graphically.

Table 4-1. Influent Flow Averages at UMJA

Year	Units	Average	Max 30-d	Max 15-d
2021	MGD	1.223	2.513	3.479
2022	MGD	1.214	2.513	3.479
2023	MGD	1.255	1.923	2.536
2024	MGD	1.147	2.309	2.703

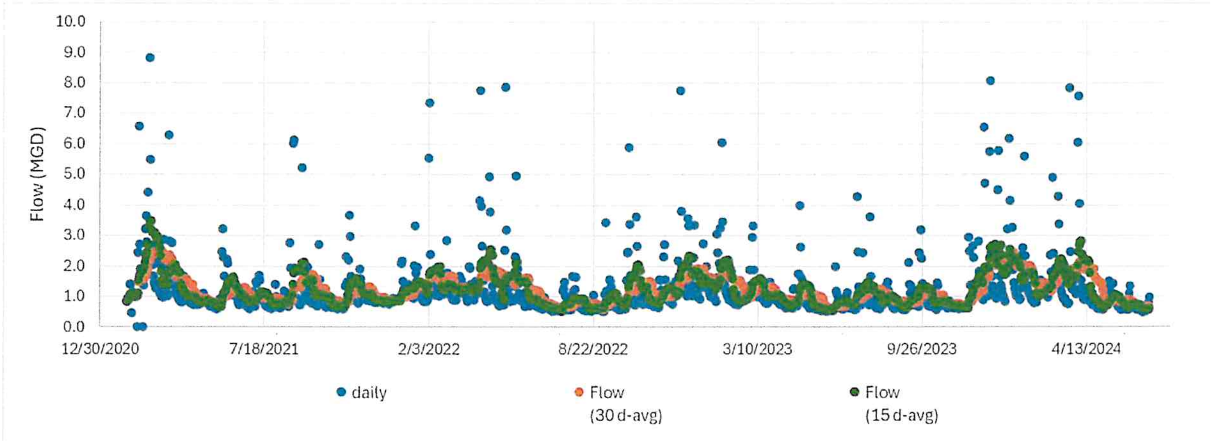


Figure 4-1. Influent Flow Data at UMJA

4.1 Historical Sludge Production

Table 4-2 summarizes the sludge loading projections processed at UMJA from 2021 through 2024. The average, max 30 day, and maximum month peaking factors (MMPF) are shown, and broken down into primary sludge, WAS, and total sludge. Figure 4-2 illustrates the sludge production as compared to the influent flow rates. During this period the primary sludge averaged 2.5 to 2.9% TS and 88% VS/TS and WAS averaged 0.75 to 1.0% TS and 71 to 76% VS/TS.

Table 4-2. Sludge Loading Projections Processed at UMJA

		Primary			WAS			Total		
Year	Units	Average	Max 30-d	MMPF	Average	Max 30-d	MMPF	Average	Max 30-d	MMPF
2021	lb/d	985	1,766	2.6	935	1,514	1.6	1,919	3,148	1.6
2022	lb/d	544	903	1.8	1,126	1,436	1.3	1,670	2,083	1.2
2023	lb/d	539	949	1.7	1,020	1,266	1.2	1,559	1,787	1.1
2024	lb/d	595	940	1.8	1,133	1,343	1.2	1,728	2,283	1.3

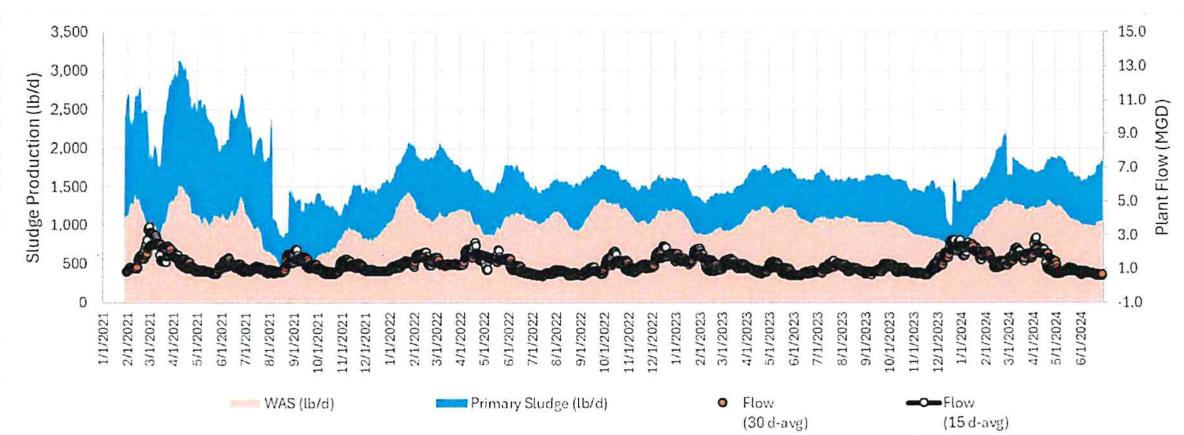


Figure 4-2. Sludge Loading compared to Influent Flow Data

From the aerobic digesters, the sludge is dewatered and either conveyed to a Hopper to feed the Fenton Dryer or conveyed to a Dumpster to haul offsite. Figure 4-3 illustrates the monthly volume of digested sludge that is dewatered and either sent to the dumpster or feed to the hopper feeding the dryer.

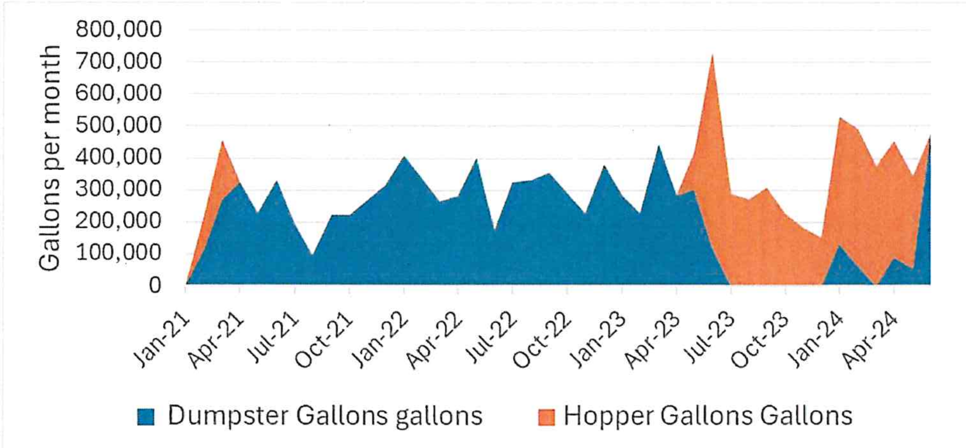


Figure 4-3. Monthly Volumes of Digested Sludge Dewatered

Table 4-3 shows the annualized average digested sludge production.

Table 4-3. Digested Sludge Production Estimates

Year	Digested Sludge Production (lb/d)	Digested Sludge TS	Dewatered TS
2021	1,098	1.5%	21.0%
2022	1,276	1.5%	20.0%
2023	1,031	1.2%	21.4%
2024	1,286	1.0%	19.6%

Using this information a historical mass balance for the digestion and dewatering system at UMJA as developed which is presented in Table 4-4.

Table 4-4. Historical Solids Mass Balance at UMJA

Year	Units	2021	2022	2023	2024
Digester Feed (PS+WAS)	lb/d	1,919	1,670	1,559	1,728
Digester Feed (PS+WAS)	VS/TS	79.5%	77.9%	79.9%	77.4%
Digester Feed (PS+WAS)	gal/d	15,114	15,887	15,235	20,951
Digester Feed TS	TS	1.5%	1.3%	1.2%	1.0%
Digested Sludge	lb/d	1,098	1,276	1,031	1,286
Digested Sludge*	VS/TS	64%	71%	70%	70%
Digested Sludge	gal/d	8,669	10,378	10,513	14,853
Digested Sludge TS	TS	1.5%	1.5%	1.2%	1.0%

Year	Units	2021	2022	2023	2024
Dewatered Sludge TS	TS	21.0%	20.0%	21.4%	19.6%
VS Reduction*	VSR	34%	18%	27%	20%

* Calculated Value

4.2 Basis of Design for Evaluation

Using the historical information a basis of design was developed, Table 4-5, to solicit proposals from vendors for new mixing and aeration equipment for the aerobic digesters. The loadings at the permitted average capacity of 2.0 MGD were calculated proportionally based on the historical loadings.

Table 4-5. Basis of Design for Aerobic Digestion System

	Current	Design
Flow, MGD	1.2	2.0
Primary, lb/d	540	900
Primary, VS/TS	88%	88%
Primary, TS	2.6%	2.6%
Primary, gal/d	2,500	4,100
WAS, lb/d	1,060	1,770
WAS, VS/TS	73%	73%
WAS, TS (Assumed, new thickening)	6%	6%
WAS, gal/d	2,100	3,500
Total, lb/d	1,600	2,670
Total, VS/TS	78%	78%
Total, TS	4.2%	4.2%
Total, gal/d	4,590	7,660
Max Month, lb/d*	2,080	3,470

* Calculated based on a 1.3 peaking factor or total sludge production

4.3 Mass Balance for Alternatives

Mass balances for the three alternatives being considered are presented in Table 4-6 for current conditions and Table 4-7 for the permitted average loading.

Table 4-6. Mass Balances Based on Current Loading

Parameter		Alt 1 In-kind replace	Alt 2 Class B Aerobic Digestion	Alt 3 ATAD (Class A)	Units
Primary	Mass	540	540	540	lb/d
	TS	2.6%	2.6%	2.6%	
	VS/TS	88%	88%	88%	
	Volume	2,490	2,490	2,490	gal/d
WAS	Mass	1,060	1,007	1,007	lb/d
	TS	1.0%	4.5%	6.0%	
	VS/TS	73%	73%	73%	
	Volume	12,710	2,683	2,012	gal/d
Total	Mass	1,600	1,547	1,547	lb/d
	TS	1.3%	3.6%	4.1%	
	VS/TS	78.1%	78.2%	78.2%	
	Volume	15,200	5,174	4,503	gal/d
Digester	VSR	25%	45%	60%	
	HRT*	12.2	36.0	20.7	days
Digested Sludge	Mass	1,288	1,002	821	lb/d
	TS	1.3%	2.4%	2.2%	
	VS/TS	72.7%	66.4%	59.0%	
	Volume	11,877	5,108	4,416	gal/d
Dewatered Sludge	Mass	1,223	952	780	lb/d
	TS	20%	22%	25%	
	wet ton/wk	21.4	15.1	10.9	wet tons/wk

* HRT for Alternatives 1 and 2 are based on both tanks being in service. HRT for Alternative 3 ATAD is for one tank being used as the ATAD tank

Table 4-7. Mass Balances Based on Permitted Average Loading

Parameter		Alt 1 In-kind replace	Alt 2 Class B Aerobic Digestion	Alt 3 ATAD (Class A)	Units
Primary	Mass	900	900	900	lb/d
	TS	2.6%	2.6%	2.6%	
	VS/TS	88%	88%	88%	
	Volume	4,151	4,151	4,151	gal/d
WAS	Mass	1,770	1,682	1,682	lb/d
	TS	1.0%	4.5%	6.0%	
	VS/TS	73%	73%	73%	
	Volume	21,223	4,480	3,360	gal/d
Total	Mass	2,670	2,582	2,582	lb/d
	TS	1.3%	3.6%	4.1%	
	VS/TS	78.1%	78.2%	78.2%	
	Volume	25,374	8,631	7,511	gal/d
Digester	VSR	25%	45%	60%	
	HRT[1]	7.3	21.6	12.4	days
Digested Sludge	Mass	2,149	1,673	1,370	lb/d
	TS	1.3%	2.4%	2.2%	
	VS/TS	72.7%	66.4%	59.0%	
	Volume	19,821	8,522	7,366	gal/d
Dewatered Sludge	Mass	2,042	1,589	1,301	lb/d
	TS	20%	22%	25%	
	wet ton/wk	35.7	25.3	18.2	wet tons/wk

* HRT for Alternatives 1 and 2 are based on both tanks being in service. HRT for Alternative 3 ATAD is for one tank being used as the ATAD tank

5. Aerobic Digester Alternatives

Historically, UMJA used aerobic digesters to generate Class B biosolids. However, since upgrading to BNR UMJA has not been able to meet regulatory requirements for Class B biosolids. Some of the issues include mixing and maintaining inadequate dissolved oxygen (DO) levels, as well as issues meeting the SOUR requirements. Due to this, UMJA has been utilizing their aging Fenton Dryer to produce Class A biosolids or sending dewatered sludge to the landfill. The digesters are currently being used as sludge holding tanks prior to dewatering and needs to remain in service. The existing mixing and aeration system in the aerobic digesters, however, are near end of useful life and require replacement.

Cost estimates for the three aerobic digester options are presented in Appendix B and proposals are presented in Appendix C.

5.1 Alternative 1: In Kind Replacement

Alternative 1 for in kind replacement assumes that only the mixing and aeration equipment inside the two digesters will be replaced. The mixing and aeration system is based the same Enviroquip design (now OVIVO). The system assumed is the same as what is proposed for the OVIVO option in Alternative 2 but does not include additional mechanical thickening or covers on the digesters. The Opinion of probable construction cost (OPCC) for Alternative 1 is $2,700,000 to $2,900,000. Details of this cost estimate are provided in Appendix B and vendor proposals are included in Appendix C.1.

Although this option is among the least expensive, it might not be a sustainable option for the future as it relies on maintaining drying or offsite processing (landfilling or 3rd party composting). Landfilling is subject to price increases, so the costs of this alternative could change significantly over time.

5.2 Alternative 2: Class B Digestion

Alternative 2 includes upgrading the digester system to be able to achieve Class B biosolids. UMJA desires to have this flexibility, particularly during warmer months when there is demand for Class B biosolids. Class B pathogen reduction would be met by monitoring fecal coliform and vector attraction reduction would be met by either SOUR tests or VSR. In addition to replacing the aerobic digester mixing and aeration system, this option also includes adding mechanical thickening for the WAS to increase solids retention time in the digesters and options to cover the digesters are also considered. For the evaluation it was assumed that a single Huber Disc Thickener would be located in the basement of the digester building. The Huber Disc Thickener for WAS will fit in the existing building; however, it will be a tight fit with the polymer system and pumps. The installation details and layout will be examined in more detail during detailed design.

Multiple options for mixing and aeration were considered for this alternative including Ovivo (same as existing), Enviromix diffused aeration system and Invent hyperboloid mixing and aeration. The OPCC for Alternative 2 ranged from $2,600,000 to $4,000,000. The lower costs options were for the Invent and Enviromix options without covers included. The higher cost option was for the OVIVO system with a covers. For the Ovivo and Invent system, it was assumed that the existing walkways over the digesters would be replaced and used to help support the aeration equipment. The additional walkways were not included in the Enviromix estimate. In addition, Thermal Process Systems proposed two alternative using jet mixing/aeration and invent mixers, but their costs were the highest with an OPCC ranging from $4,300,000 to $5,000,000. Pictures of the different mixing and aeration alternatives are shown in Figure 5-1.

Thermal Process System (TPS) with Jet Mixer/Aerators

Thermal Process System with Invent Mixer/Aerators

Ovivo - MTAD

Enviromix

Figure 5-1. Pictures of Mixing / Aeration Alternatives Evaluated

Proposals by Invent and Ovivo recommended operating the two digesters in series mode while the Enviromix and Thermal Process Systems proposals were based on parallel operation. Having the ability to operate in both scenarios would be desired to maintain operational flexibility. The option from Invent was preferred by UMJA based on experience with this equipment at other parts of the facility followed by the system proposed by Enviromix. Also since it is only necessary to achieve Class B seasonally, the option to provide covers on the digesters can be deferred and potentially not needed. Currently UMJA's preference is Alternative 2 using Invent Mixers without covers and the OPCC for this option is estimated to be $2,910,000. Details of this cost estimate are provided in Appendix B and vendor proposals are included in Appendix C.1.

5.3 Alternative 3: ATAD

Alternative 3 includes upgrading the existing digesters to an ATAD system that would have the ability to generate Class A biosolids in the digesters. The existing aerobic digesters at UMJA are the right size for conversion to an ATAD with SNDR process. Options for ATAD conversion were provided by Thermal Process Systems and proposals can be found in Appendix C.1.

Converting the existing digesters to ATAD requires mechanical thickening which was assumed to be a disc thickener located in the digester building basement similar to Alternative 3. One existing digester would be converted to an ATAD (ThermAer) Reactor with floor-mounted jet mixing/aeration, level and foam control, and instrumentation for online monitoring (ORP, Temperature, and level monitoring). The second digester tank would be converted to a SNDR also with floor-mounted jet mixing/aeration, level and foam control, and instrumentation for online monitoring (ORP, Temperature, and level monitoring). Alternatives using Invent mixers / aerators in lieu of jet mixing aeration where also proposed.

The thermophilic ATAD reactors do not achieve nitrification so the digested biosolids leaving that reactor have a relatively high ammonia concentration. The addition of the mesophilic SNDR reactor requires an additional pump and heat exchanger to cool the sludge to mesophilic conditions. The SNDR provides nitrification and denitrification which reduces the ammonia concentration and literature from Thermal Process Systems suggest that the SNDR provides up to 70% ammonia reduction. Managing cyclic aeration with dewatering is important to help minimize any additional polyphosphate release which could impact sidestream management. Addition of alum could also be considered in the future to mitigate phosphorus release in dewatering.

The ATAD and SNDR reactors include foam and odor control. Foam suppression is required to ensure effective oxygen transfer and enhance biological activity. High temperatures in the ATAD reactor release ammonia and sulfur compounds so off gas from these reactors are treated in a two-stage odor control system with a wet scrubber followed by a biofilter.

For this option, the existing two aerobic digesters will be converted to ATAD and SNDR reactors. The estimated OPCC is $6,000,000 to $6,900,000. Details of this cost estimate are provided in Appendix B and vendor proposals are included in Appendix C.1.

An important factor to consider with the ATAD option is the availability of space for the new equipment needed to convert to an ATAD system. The system would require additional pumps and equipment, which would be located in the existing thickening building. Based on preliminary investigations, there is concern that the all of the required ATAD equipment will not fit in the current building. Considering that a new building is not within the scope of the current project, it would impact the cost because a new building or a new solution would need to be implemented. Since the conversion to ATAD is already the most expensive, the benefits of Class A biosolids might not outweigh the costs.

5.4 Operating Cost

The annual operating costs were estimated for each of the three aerobic digestion options. Annual operating costs included polymer, electricity, natural gas, and maintenance. Labor was assumed to be the same for all options, so this parameter was not included in the analysis. The analysis also considered the impact of and transportation / beneficial use / disposal costs which have a large impact on the analysis particularly if drying is maintained. For management of dewatered cake options for land application of Class B were considered for Class B options and compared to options for landfilling or composting offsite. The operating cost options considered include:

Alternative 1 - Landfilling all cake – partial digestion

Alternative 1 – Offsite composting – partial digestion

Alternative 1 – Drying all cake – partial digestion

Alternative 1 – Landfilling and drying – partial digestion

Alternative 1 – Composting and drying – partial digestion

Alternative 2 – Class B Digestion and drying

Alternative 3 – ATAD (Class A)

The operating costs were based on the mass balances presented in Table 4-6 based on the unit costs presented below in 2024 dollars. An annual operating cost comparison is presented in Figure 5-2. For Alternative 2, it was assumed that 50% of the biosolids generated were land applied and that 50% of the biosolids generated were thermally dried.

- Polymer - $3.94/lb
- Electrical - $0.0602/lb
- Propane - $16.18/MMBtu
- Transportation/Landfill (Cake) - $90.00/ton
- Transportation/Composting (Cake) - $157/ton
- Transportation/Beneficial Use (Cake Class B) - $24.75/ton
- Transportation/Beneficial Use (Cake Class A) - $24.75/ton
- Transportation/Beneficial Use (Class A dry) - $0.00/ton

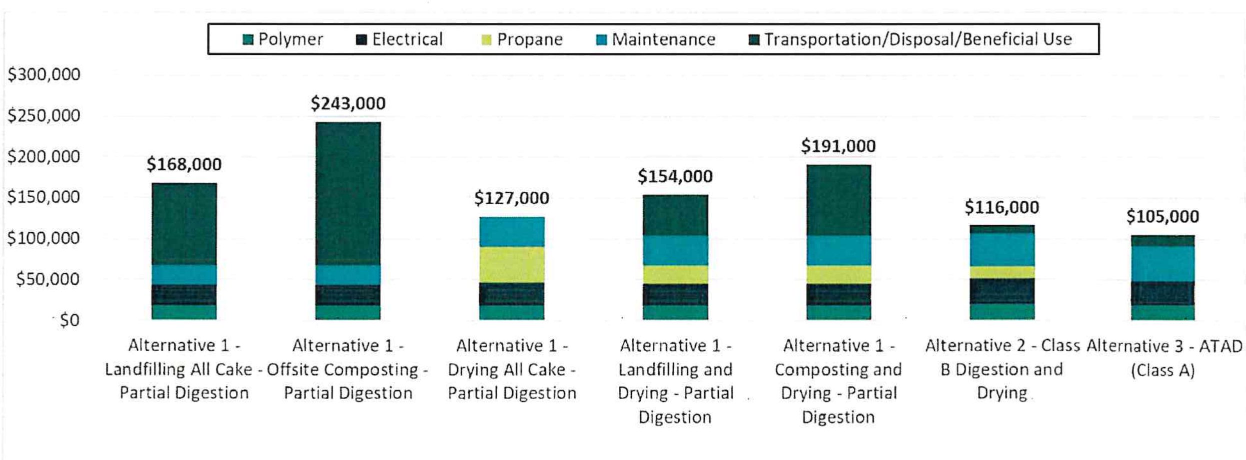


Figure 5-2. Annual Operating Cost Estimates

The analysis shows that upgrading the digesters to Class A (Alternative 3) or Class B (Alternative 2) provides the potential for the lowest operating cost. The potential operating cost saving for Class A, however, do not outweigh the significantly higher capital cost for that alternative. Thus the recommendation for aerobic digester upgrade is to proceed with Alternative 2.

The operating cost analysis also shows that maintaining drying also offers operating cost savings. The dryer, however, is near end of useful life so a significant investment is required to maintain drying, and the impact of this cost needs to be considered in the overall lifecycle cost analysis.

6. Dewatering and Drying Upgrades

In addition to the aerobic digesters, the existing dewatering and drying facilities are also aging and require refurbishment or replacement. The impact of these upgrades needs to be considered before evaluating the whole lifecycle cost for the project.

6.1 Dewatering

UMJA currently operates a Westfalia model CC450-00-32 centrifuge that is approximately 20 years old. The centrifuge is rated for a hydraulic capacity of 85 gpm but the plant can only reliably operate the centrifuge at 50 to 60 gpm. The centrifuge still generally works well but is aging and the facility does not have redundancy to deal with extended downtime if a major overhaul is needed.

The dewatering building does include a spot to add a second centrifuge. Westfalia is now known as GEA and has proposed a newer model centrifuge CF4000 which has a larger length to diameter ratio than the existing centrifuge and would provide increased dewatering capacity when compared to the current unit. This increased capacity was shown during the pilot test (see Section 1.2.5). The GEA proposal also included replacing the existing control panel which is at the end of useful life.

The overall OPCC for installing the second centrifuge inclusive of new polymer, replacement feed pumps and outlet conveyor is approximately $1,180,000. The details of the cost estimate are provided in Appendix B and the GEA proposal is provide in Appendix C.2.

6.2 Drying

UMJA's Fenton dryer has provided benefits for UMJA for approximately 20 years producing a dried Class A biosolids that is in demand by the local community. The dryer components, however, need to be replaced and retrofitted to allow for reliable operation in the future. RDP who now supplies the Fenton drying equipment conducted an inspection of the dryer facility and provided a proposal for replacing the major components of the drying system. The proposal would retain the existing dewatered cake hopper and existing dried product conveyor discharge but replace the dryer with a new RDP-Fenton dryer, new fill auger, new discharge conveyor, new thermal fluid heater, new condenser with new condenser duct, and new drying system control panel. The new fluid heater would reuse the existing stack location. The details of the RDP proposal are provided in Appendix C.3.

The overall OPCC for retrofit and replacement of the drying facility is $3,730,000. Details of the cost estimates are provided in Appendix B. It should be noted that the cost estimate does not include any HVAC or plumbing upgrades that may be desired as part of the project.

6.3 Overall Cost Impacts with dewatering and drying

The future project will need to account for digester and dewatering upgrades to maintain reliable future operation. The drying system also provides UMJA many benefits and is desired to remain in service. The total estimated OPCC's for the three digestion alternatives with dewatering and with dewatering and drying upgrades are presented in Table 6-1.

Table 6-1. Total OPCC estimates including impacts of Dewatering and Drying

Option	OPCC* + Dewatering	OPCC + Dewatering + Drying
Alternative 1 - In Kind Replacement	$3,900,000 - $4,100,000	$7,600,000 - $7,800,000
Alternative 2 - Class B Digestion	$3,800,000 - $5,300,000	$7,500,000 - $9,000,000
Alternative 3 - Class A Digestion (ATAD)	$7,200,000 - $8,000,00	--

7. Lifecycle Cost Estimates

Overall lifecycle costs were estimated using the total project costs with dewatering and drying and accounting for the annual operating costs over a 20 year life. The lifecycle cost analysis was based on a 20-year operations period, beginning at completion of project construction, and a conventional 1.5 percent discount rate, discounting all values to 2024 dollars. Inflation factors used in the lifecycle are presented in Table 7-1.

Table 7-1. Assumed Inflation Factors

Parameter	Inflation Factor
Polymer Inflation	2%
Electrical Inflation	2%
Propane Inflation	2%
Labor Inflation	2%
Maintenance Inflation	2%
Transportation/Landfill Inflation	3%
Transportation/Beneficial Use Inflation	3%
Discount Factor	1.5%

The results of the lifecycle cost analysis are shown in Figure 7-1. The results show that options that include drying provide a higher lifecycle cost mainly because of the increased capital cost. Class B land application (Alternative 2) and landfilling (Alternative 1) without drying has the lowest lifecycle cost, however, these options would be sensitive to hauling and tipping fees which could see increases due to uncertainty with future market and end use regulations. If landfilling costs increase drastically and faster than the rate for the beneficial use options, then landfilling would become less desirable on an economic basis. UMJA desires to avoid landfilling and promote beneficial use. Offsite composting provides an alternative beneficial use outlet but is the most expensive option. Based on this it is recommended to use composting as a preferred back up to land application or drying instead of the main outlet.

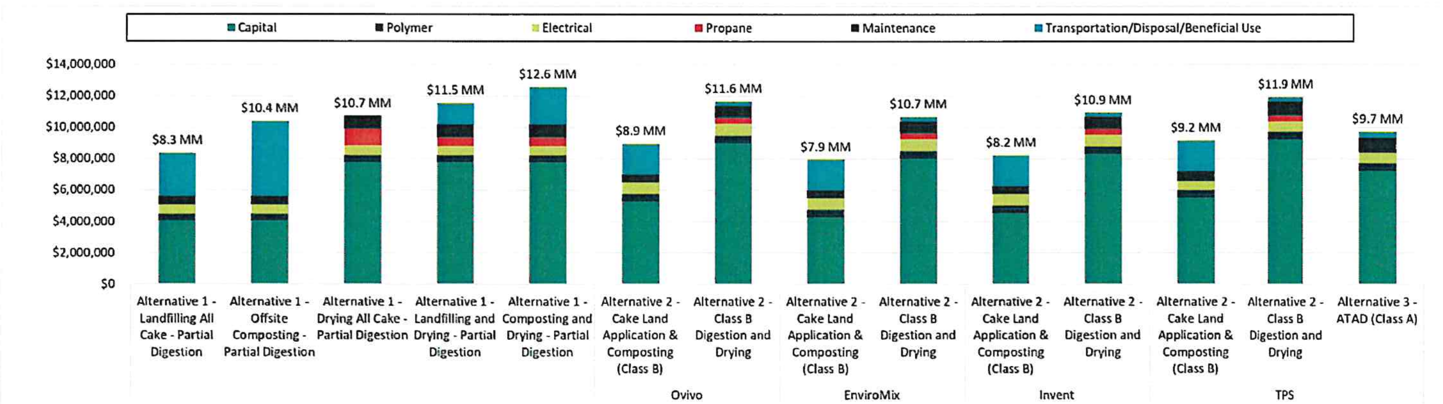


Figure 7-1. UMJA Biosolids Options 20-year Lifecycle Cost Analysis

8. Non-Economic Comparison

While it is important to understand the economic impacts of each of the alternatives, it is also important to look at the advantages and disadvantages of each alternative to see which option makes the most sense. While Alternative 1 is among the least expensive option, there are concerns about the sustainability and reliability of utilizing the landfill or offsite processing (such as composting) long-term. There is uncertainty as to whether the landfill will continue to be a viable option, as well as unknowns surrounding the long-term costs of landfilling due to the possibility for price increases for landfilling. There are also less opportunities for the beneficial use of biosolids with this alternative.

Alternative 2 - Class B digestion offers a more complex system than Alternative 1, which also allows for more options for the beneficial use of biosolids. It is also relatively simple to maintain compared to Alternative 3 - ATAD and poses lower concern for the availability of space at the plant. While Alternative 3 produces Class A biosolids in the ATAD process, there might not be a significant advantage to having Class A cake biosolids compared to Class B biosolids and a more detailed market analysis would need to be conducted to determine this. Furthermore, the Class A cake may not be able to be used year-round so additional storage would likely be required if desired for 100% beneficial use. If there was space for storage and the Class A cake could be stored and further air dried it could produce a "cured" product which may have more beneficial use opportunities, however, there is not currently sufficient space onsite to implement this. Space is a concern for Alternative 3 and there may not be ample space for the ATAD equipment to fit in the existing building. Alternative 3 is also the most complicated in terms of operations and maintenance.

The non-economic comparison helps to breakdown the pros and cons of each alternative, which can be found in Table 8-1.

Table 8-1. Advantages and Disadvantages

	Alternative 1 - Do Nothing (Replace in-kind)	Alternative 2 - Class B Digestion	Alternative 3 - Class A Digestion (ATAD)
Project Summary	• Replace blowers and aeration system	• Add mechanical thickening • Replace blowers and aeration system • Add covers to digesters (optional)	• Add mechanical thickening • Retrofit digester tanks to ATAD and SNDR • Add covers to digesters • Requires heat exchanger for cooling from ATAD to SNDR • Biofilter for odor control • System package with controls
Advantages	• Low Cost	• Provides more pathways for beneficial use • Reduces and potentially eliminates need for landfilling • Improved solids reduction • Low to Medium Cost	• Potentially more pathways for beneficial use (Class A) • Reduces and potentially eliminates need for landfilling • Best solids reduction • Potential to eliminate need for drying?

	Alternative 1 - Do Nothing (Replace in-kind)	Alternative 2 - Class B Digestion	Alternative 3 - Class A Digestion (ATAD)
Disadvantages	• Requires dryer for beneficial use • Requires continued use of landfill for back up	• More complex than existing system • Dryer may still be required when biosolids Class B land application is not available	• Challenging to fit all thickening and ATAD equipment in existing building • Highest Cost • Requires a biofilter • More complex system • Class A cake may not be more marketable than Class B cake

The advantages and disadvantages for the different options are further quantified with non-economic scoring in Table 8-2. In the table "+" represents positive attributes and "-" represents negative attributes, and "O" represent neutral (neither positive or negative). The use of double pluses or minuses represent either very positive or very negative attributes.

Table 8-2. Non-Economic Scoring

Criteria	Alternative 1				Alternative 2		Alternative 3	
	Landfill Only	Compost Only	Drying	Drying/ Compost	Class B/Compost	Class B/Drying	Class A ATAD	Comment
Ability to meet Regulatory Requirements	-	O	O	+	+	++	+	Long-term landfilling uncertain,
Complexity / Operability	++	++	O	O	O	-	-	ATAD is more complicated
Technology Maturity	++	++	++	++		+	+	All proven processes
End Use Reliability	- -	-	+	++	+	+++	++	ATAD generates Class A, compost potential back-up for Class B or Class A.
Site / Footprint Constraints	++	++	+	+	+	+	-	ATAD equipment difficult to fit in existing building
Flexibility with Regulatory Uncertainty	- -	-	O	++	O	+++	+	Most resilient with drying
Ease of Maintenance	++	++	O	O	+	O	-	ATAD is new process
Public Impacts	-	O	O	+	+	++	+	Benefits with dry product.

The result of the analysis shows that Alternative 2 with drying provides the most positive attributes and least negative attributes. This alternative provides UMJA with maximum flexibility to allow for Class B land application, dry Class A biosolids and 3rd party composting can be used as a backup alternative. The system uses proven technologies that can readily fit onsite and uses processes UMJA is familiar with. Being able to generate a dry biosolids also provides flexibility and resiliency to deal with future regulatory and market uncertainty.

9. Conclusion

UMJA has the goal of returning to Class B biosolids production in their digesters and retrofitting their dewatering and drying facilities to maintain reliable operation. AECOM analyzed various aerobic digestion scenarios based on cost, as well as non-economic factors, to provide recommendations on the path forward for upgrades at UMJA. The three main aerobic digester alternatives that were looked at in detail include Alternative 1 replace in-kind option which replaces the mixing and aeration equipment, Alternative 2 which retrofits the current digester system along with the mixing and aeration system to produce Class B, and Alternative 3 for converting the entire system to ATAD with SNDR.

The analysis showed that upgrading the digesters to Class A (Alternative 3) or Class B (Alternative 2) provides the potential for the lowest operating cost. The potential operating cost savings for Class A cake, however, did not outweigh the significantly higher capital cost for the ATAD alternative. The operating cost analysis also shows that maintain drying also offers operating cost savings. A lifecycle cost analysis was conducted for the digester alternatives including the capital and operating costs for additional dewatering and retrofitting the existing drying system.

The results of the lifecycle cost analysis showed that options that include drying provide a higher lifecycle cost mainly because of the increased capital cost. Class B land application (Alternative 2) and landfilling (Alternative 1) without drying has the lowest lifecycle cost, however, these options would be sensitive to hauling and tipping fees which could see increases due to uncertainty with future market and end use regulations. UMJA desires to avoid landfilling and promote beneficial use. Offsite composting provides an alternative beneficial use outlet but is the most expensive option on a lifecycle cost basis.

While ATAD (Alternative 3) provides Class A biosolids at an economical cost when considering the dryer retrofit, there might not be a significant advantage to having Class A cake biosolids product and a more detailed marketing analysis would need to be conducted to determine if there would be alternative options for managing the Class A cake product than a Class B cake product. Available space in the existing digester building is also a concern for the ATAD system.

After completing the analysis, UMJA agreed with the recommendation to proceed with Alternative 2 to upgrade the digesters to achieve Class B, add a second centrifuge and retrofit/replace the components of the existing dryer facility. These options provide UMJA flexibility with multiple beneficial use outlets and maintaining the dryer helps mitigate future impacts to changing regulatory and market conditions. During detailed design it will be important to plan and sequence the improvements to allow for smooth maintenance of plant operations. The total OPCC for the project are summarized in Table 9-1. Overall, the OPCC is estimated to be approximately $8,000,000.

Table 9-1. Total Project OPCC

Component	OPCC
Aerobic Digester (Alt 2, Invent without covers)	$2,910,000
Dewatering (New GEA centrifuge, updated controls)	$1,180,000
Drying (Retrofit/replace existing Fenton dryer)	$3,740,000
Total	**$7,830,000**

10. References

4. RETTEW. June 24, 2020. UMJA Aerobic Sludge Digester. "Proposed Waste Sludge Digestion Operating Mode Update".
5. Spotts, Stevens and McCoy. January 23, 2022. "Digester Assessment" Memorandum.
6. Spotts, Stevens and McCoy. September 30, 2022. "Digester Assessment" Memorandum.
7. BDP Industries. October 2022. "Rotary Drum Thickener Onsite Pilot Test".
8. Alfa Laval Inc. April 2024. "Alfa Laval ALSYS G3-75 Trailer Mounted Centrifuge Dewatering System: Pilot Test Report".
9. GEA. Trionfetti, Robert. July 2024. "Pilot Test Report".

WORTH & COMPANY, INC

Upper Montgomery Joint Authority Biosolids

Proposal Overview:

We are pleased to submit for your consideration our Proposal for the General Construction work for the above referenced project. All work on this project will be performed in strict accordance with OSHA Safety requirements. This proposal is based upon our understanding of the proposed Upper Montgomery Joint Authority Improvements Project to include the:

- Replacement of the existing blowers and aeration system with Aerzen Blowers and Advent Mixers
- Add WAS Thickening in the basement of the Digester Building with a Huber Thickener
- Replace two existing sludge pumps in the basement of the Digester Building with Penn Valley Sludge Pumps
- Add a Velodyne Polymer System on the first floor of the Digester Building for the new Huber Thickener
- Add additional GEA Westfalia Centrifuge on the Mezzanine of the Dryer Building
- Replace existing Fenton Dryer with a new BDP Dryer

Preliminary 30% Design and long lead Equipment Procurement:

Worth & Co. and AECOM will develop a 30% design (basis of design) based on the agreed upon recommended improvements with the input of the Authority. A draft of technical specifications for the identified long lead item equipment will be developed to expedite procurement/ delivery of identified equipment. Collaboration between Worth, AECOM, and the Authority can develop a quicker decision-making process that will allow the construction to begin much earlier, and the authority will have beneficial use of the renovated facilities earlier than the traditional construction process.

Worth & Co. and AECOM will need to develop an understanding of the existing site conditions to develop plans and specifications to meet the criteria for the project, if as-built drawings for the Digester Building and Dryer Building are not readily available or reproducible we will include 3D scans of the buildings to meet any required local codes for permitting. Once this is completed the Basis of Design documents will be developed along with a detailed scope of work for review and comment with Worth, AECOM, and the Authority in a working session for review. Deliverables will be:

- Preliminary Schedule to include long lead time equipment
- Half sized drawings
- Draft of Design memo
- List of anticipated drawings and specifications

The 75% Design Process and GMP:

Development will be an ongoing process to progress the 30% Basis of Design while incorporating feedback from all parties to the level where the GMP can be prepared for the design build implementation. The key understanding is to deliver the planned improvements within the Authority's budget with minimal interruptions to plant operations which may include working sessions for budget and schedule review. The deliverables will be:

- Half size drawings
- Specifications
- Detailed scope of work
- GMP proposal

WORTH & COMPANY, INC

Upper Montgomery Joint Authority Biosolids

Assumptions:

- The proposed improvements will not require the construction of any new buildings. Site civil work has not been included in the scope of work.
- The scope of work will not require new or modified fire suppression or fire alarm systems.
- Existing structures do require upgrades to accommodate egress code issues. Specifically, no additional means of egress will need to be added.
- The digester building will not require new roof modifications or any other significant structural modifications to accommodate new HVAC units.
- The existing electrical systems have the capacity to accommodate the new work. No service upgrades will be required for the facility or specific structures. No upgrades will be required to existing standby power systems.
- Existing electrical equipment does not require any modifications or additions to meet code requirements.
- New equipment and instrumentation will be tied into the existing SCADA system. No upgrades to the existing PLCs or cabinets are included.
- HVAC modifications to the digester building will be required to provide the required air changes per NFPA. HVAC work within the solids handling building will be limited to the area around the new centrifuge and electrical room.
- The scope of work does not include any modifications or additions to odor control systems.
- The digester building will be laser scanned and drafted in a 3D model for design purposes. Work in the solids building will be drafted in 2D based on record drawings and field measurements.

Permitting:

Worth & AECOM will work with the Authority to file the required local and Commonwealth permits necessary for the construction and operation of the project.

The project aims to rehabilitate existing processes with all the work taking place within existing structures. As a result, AECOM expects the permitting to be limited to a PaDEP Water Quality Management Part II Permit and the Building/Construction Permit from Upper Hanover Township.

Worth and AECOM assume that the following permits will not be required:

- Storm Water Management
- ACT 537 Planning
- Planning or Zoning Commission Approvals

AECOM expects to attend up to two meeting with regulatory agencies.

Project Schedule:

Worth and AECOM have developed the Phase I design build schedule. The following provides the summary of deliverables to be completed after the issuance of the NTP.

- 30% Design: 8 weeks after NTP
- Long Lead Equipment Specifications: 10 weeks after NTP
- 75% design: 18 weeks after NTP

Exclusions:

- Phase 2 proposal for engineering, design, management services after GMP is established
- Allowances

WORTH & COMPANY, INC

Upper Montgomery Joint Authority Biosolids

Exclusions (continued):

- Demo/Construction/Installation
- Costs associated with redesigning due to selection of equipment other than what was recommended in the alternatives analysis.
- Bond
- Sales Tax
- Permit fees

Phase I Preconstruction Price

$1,811,840.00

Sincerely,

Steve Miller

VP – Industrial

WORTH & COMPANY, INC

Upper Montgomery Joint Authority Biosolids

Exhibit B- Scope of Services (Phase 1):

- Onsite kick off meeting attended by Design Builder representatives
- Site assessment
- Provide management of the initial design process, to prepare a preliminary 30% design package, including major equipment, initial design drawings and technical specs (as needed) for the following major pieces of equipment:
    a) Aerzen Blowers
    b) Invent Mixers
    c) Huber Thickener
    d) Penn Valley Pumps
    e) Velodyne Polymer
    f) GEA Centrifuge
- Building scans for design coordination along with the initial effort to review available record drawings.
- Provide a basis of design memo which will formalize scope for the project, provide the capabilities of key equipment, identify required permits and authorizations.
- Facilitate Coordination meetings and working sessions as necessary to review basis of design.
- Prepare Technical specs (as needed) for long lead equipment selected during the 30% design. Specifications necessary for the early procurement will include the disc thickener, digester mixer, positive displacement blowers, centrifuge and major electrical equipment including VFD's and electrical gear components. We assume the vendors to be used in the long lead equipment procurement will be those evaluated and recommended during the alternatives analysis conducted by AECOM.
- Facilitate onsite 30% design review meetings with Owner for input on design decisions
- Provide budgetary pricing on 30% design, including budget pricing from key trade partners (vendors and subcontractors). The deliverables will be:
    a) Five half-size sets of drawings
    b) Three copies of the Basis of Design memo (including the list of anticipated technical specifications)
    c) One memory stick containing PDF files of documents provided
    d) A list of anticipated drawings will be provided as an attachment
- Provide initial project schedule as well as monthly schedule updates
- Facilitate budget and schedule review meetings and descope sessions with Owner
- All work to be taking place to rehabilitate existing processes in existing buildings and structures. As a result, Worth expects the permitting to be limited to a PaDEP Water Quality Management Part II Permit and the Building/ Construction Permit from Upper Hanover Township. Worth assumes the following permits will not be required:
    a) Stormwater Management
    b) ACT 537 Planning
    c) Planning or Zoning Commission Approvals

- Provide management of 75% design process (Includes in person working sessions) between Design Builder and Owner. The design will consider any significant construction staging or temporary facilities required to maintain operations at the WWTP so that they can be incorporated in the preparation of the GMP. The deliverables will be:
    a) Five half size sets of design drawings
    b) Five sets of specifications
    c) One memory stick containing PDF files of documents provided
- Facilitate 75% design review with Owner
- Provide Guaranteed Maximum Price of the project to Owner after 75% design approval

WORTH & COMPANY, INC

Upper Montgomery Joint Authority Biosolids

Job Costed Employees

Preconstruction

Mark Haskell – Chief Estimator

Jason Burke – Senior Estimator

Seth Welsh – Estimator

Deborah Ihedioha – Associate Estimator

Operations

Adam Kleckner – Senior Project Manager

Sean Harrison – Senior Project Engineer

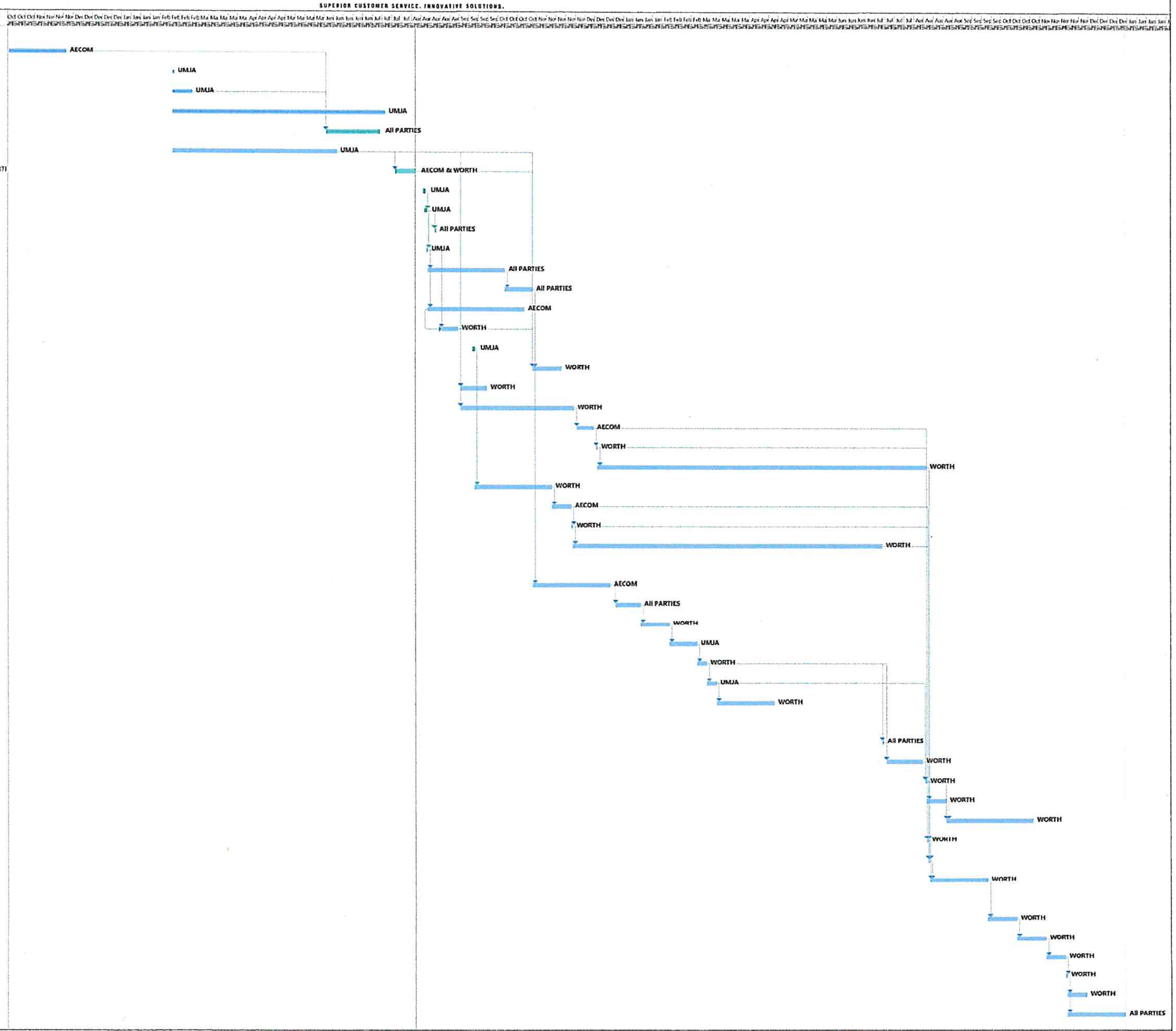
Sarah Baez – Project Coordinator

Exhibit 'D'

WORTH & COMPANY, INC

SUPERIOR CUSTOMER SERVICE. INNOVATIVE SOLUTIONS.

ID	Task Name	Duration	Start	Finish	Predecessors	Resource Names
1	Preconstruction - Pha					
2	Digester Study Compl	30 days	Tue 10/15/2	Mon 11/25/2		AECOM
3	UMJA Board Meeting	1 day	Tue 2/11/25	Tue 2/11/25		UMJA
4	Development of Own	10 days	Tue 2/11/25	Mon 2/24/25		UMJA
5	DBIA Contract Metho	110 days	Tue 2/11/25	Mon 7/14/25		UMJA
6	Contract Terms and C	28 days	Tue 6/3/25	Thu 7/10/25	2,4	All PARTIES
7	Owner Financing Sec	85 days	Tue 2/11/25	Mon 6/9/25		UMJA
8	30%/75% Design Proj	10 days	Wed 7/23/25	Tue 8/5/25	7	AECOM & WORTI
9	UMJA Board Meeting	1 day	Tue 8/12/25	Tue 8/12/25		UMJA
10	Execute Contract for	1 day	Wed 8/13/25	Wed 8/13/25	9	UMJA
11	Working Session (Ow	1 day	Wed 8/20/25	Wed 8/20/25	10FS+2 days	All PARTIES
12	Notice to Proceed	1 day	Thu 8/14/25	Thu 8/14/25	10	UMJA
13	30% Design Complete	40 days	Fri 8/15/25	Thu 10/9/25	12	All PARTIES
14	30% Design Review (I	14 days	Fri 10/10/25	Wed 10/29/2	13	All PARTIES
15	Long Lead Equipment	50 days	Fri 8/15/25	Thu 10/23/2	12	AECOM
16	30% Early Procureme	10 days	Mon 8/25/25	Fri 9/5/25	12,15SS+6 days	WORTH
17	Centrifuge Purchase (	1 day	Wed 9/17/25	Wed 9/17/25		UMJA
18	Early Procurement Bi	15 days	Thu 10/30/2	Wed 11/19/2	7,8,14,16	WORTH
19	Equipment Deposits (	15 days	Mon 9/8/25	Fri 9/26/25	7,8,16	WORTH
20	Dryer Equipment Sub	60 days	Mon 9/8/25	Fri 11/28/25	16	WORTH
21	Dryer Equipment Sub	10 days	Mon 12/1/25	Fri 12/12/25	20	AECOM
22	Dryer Equipment Rel	1 day	Mon 12/15/2	Mon 12/15/2	21	WORTH
23	Dryer Equipment Ma	170 days	Tue 12/16/2	Mon 8/10/2	22	WORTH
24	Centrifuge Equipmen	40 days	Thu 9/18/25	Wed 11/12/2	17	WORTH
25	Centrifuge Equipmen	10 days	Thu 11/13/2	Wed 11/26/2	24	AECOM
26	Centrifuge Equipmen	1 day	Thu 11/27/2	Thu 11/27/2	25	WORTH
27	Centrifuge Equipmen	160 days	Fri 11/28/25	Thu 7/9/26	26	WORTH
28	Preconstruction - Pha					
29	75% Design Complete	40 days	Thu 10/30/2	Wed 12/24/2	14	AECOM
30	75% Design Review (I	14 days	Mon 12/29/2	Thu 1/15/26	29FS+2 days	All PARTIES
31	Submit Phase 2 Prop	15 days	Fri 1/16/26	Thu 2/5/26	30	WORTH
32	Owner to Review Pha	14 days	Fri 2/6/26	Wed 2/25/2	31	UMJA
33	Contract Amendment	5 days	Thu 2/26/26	Wed 3/4/26	32	WORTH
34	Phase 2 Notice to Pro	5 days	Thu 3/5/26	Wed 3/11/2	33	UMJA
35	75% Procurement of	30 days	Thu 3/12/26	Wed 4/22/2	34	WORTH
36	Construction - Phase					
37	Preconstruction Mee	1 day	Fri 7/10/26	Fri 7/10/26	33	All PARTIES
38	Submittals	20 days	Mon 7/13/2	Fri 8/7/26	33,37	WORTH
39	Mobilization	1 day	Mon 8/10/2	Mon 8/10/2	34,38	WORTH
40	Demo	10 days	Tue 8/11/26	Mon 8/24/2	39	WORTH
41	Equipment & Mechar	45 days	Tue 8/25/26	Mon 10/26/2	39,40	WORTH
42	Dryer Installation	1 day	Tue 8/11/26	Tue 8/11/26	21,22,23,39	WORTH
43	Centrifuge Installatio	1 day	Wed 8/12/2	Wed 8/12/2	25,26,27,39,42	
44	Mechanical and Elect	20 days	Thu 8/13/26	Wed 9/23/2	42,43	WORTH
45	Project Closeout - Ph					
46	Start Up	15 days	Thu 9/24/26	Wed 10/14/2	44	WORTH
47	Testing	15 days	Thu 10/15/2	Wed 11/4/2	46	WORTH
48	Commissioning	10 days	Thu 11/5/26	Wed 11/18/2	47	WORTH
49	Substantial Completic	1 day	Thu 11/19/2	Thu 11/19/2	48	WORTH
50	Punchlist	10 days	Fri 11/20/26	Thu 12/3/26	49	WORTH
51	Performance Review	30 days	Fri 11/20/26	Thu 12/31/2	49	All PARTIES



Project: UMJA_Biosolids_Projec
Date: Wed 8/6/25

Task | Split | Milestone | Summary | Project Summary | Inactive Task | Inactive Milestone | Inactive Summary | Manual Task | Duration-only | Manual Summary Rollup | Manual Summary | Start-only | Finish-only | External Tasks | External Milestone | Deadline | Progress | Manual Progress

Exhibit 'E'