BIOSOLIDS MANAGEMENT PLAN

Madison Metropolitan Sewerage District

DANE COUNTY, WISCONSIN
MARCH 2021

PREPARED BY:
MSA Professional Services, Inc.

PROJECT NUMBER: 01579025

MSA

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TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES

LIST OF APPENDICES

EXECUTIVE SUMMARY

BIOSOLIDS MANAGEMENT PLAN FACT SHEET

MADISON METROPOLITAN SEWERAGE DISTRICT

Since it's inception in 1930, the Madison Metropolitan Sewerage District (MMSD) has established a legacy of sustainable biosolids management. The current Metrogro Program was established over 40 years ago by recycling Class 'B' liquid biosolids through agricultural land application. However, the current program is facing increasing threats to sustainability and resiliency which increases administrative, operational, financial and environmental pressures, including:

- Population growth increases the amount of biosolids and reduces available land application sites.
- Application methods becoming increasingly incompatible with modern agricultural conservation practices
- Reduction in available application days due to climate change
- Concerns over emerging contaminants
- Antiquated data management system

This Biosolids Management Plan provides the District practical steps to make smart investments towards achieving a truly sustainable and resilient biosolids program, both now and into the future. Six products were evaluated as part of the Biosolids Managment Plan. Product information sheets on the following pages provide a summary of the key product aspects, life-cycle costs, and scores in the key driver/goal areas identified for MMSD.

KEY DRIVERS / GOALS

Categories that determine the impacts and score of each biosolids product were identified during the planning process. Four key areas were identified, with criteria identified for each area as follows:

ECONOMICS

Criteria:

- Net Present Value
- Flexibility to Phase Investments
- Operational Costs
- Minimize Investments in Single-Use Assets

ENVIRONMENT

Criteria:

- Synergy with Other Nutrient Management and Runoff Opportunities
- GHG Emissions & Energy Usage
- Resilience to Emerging Containments

OPERATIONS

Criteria:

- Truck Traffic Impacts
- Flexibility in Hauling Hours
- Limit Operational Process Adjustments at Nine Springs Wastewater Treatment Plant (NSWWTP)

CUSTOMERS

Criteria:

- Impact on Field Management
- Flexibility to Match Farming Practices
- Soil Health Improvements
- Regional Collaboration Opportunities

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Created: 2021

CLASS B LIQUID

APPLICATION METRICS

COST PER DRY TON/ YEAR	TOTAL WET TON/YEAR		TOTAL EQUIPMENT
$469	217,300		25 *4 Applicators* *0 Loaders/Tractors* *21 Trucks*
TRIPS PER YEAR	FULL-TIME EMPLOYEES		CONTRACTED HOURS
	OPERATIONS	METROGRO	
9,150	0.5	7	16,500

INFRASTRUCTURE UPGRADES

- 4th Metrogro Tank
- Expanded Load-out Facilities

DRIVER/GOAL SCORE

CUSTOMER	2.8
ECONOMICS	2.0
ENVIRONMENT	1.3
OPERATIONS	2.4

20-Year Life Cycle Cost **$89M**

CLASS B CAKE

APPLICATION METRICS

COST PER DRY TON/ YEAR	TOTAL WET TON/YEAR		TOTAL EQUIPMENT
$395	50,400		12 *2 Applicators* *4 Loaders/Tractors* *6 Trucks*
TRIPS PER YEAR	FULL-TIME EMPLOYEES		CONTRACTED HOURS
	OPERATIONS	METROGRO	
9,150	1	5.5	16,500

INFRASTRUCTURE UPGRADES

- Centrifuge or Belt Filter Press Dewatering Facility
- Cake Storage Barn

DRIVER/GOAL SCORE

CUSTOMER	2.3
ECONOMICS	4.0
ENVIRONMENT	3.0
OPERATIONS	3.3

20-Year Life Cycle Cost **$77M**

COMPOST

APPLICATION METRICS

COST PER DRY TON/ YEAR	TOTAL WET TON/YEAR		TOTAL EQUIPMENT
$580	17,400		8 *2 Applicators* *2 Loaders/Tractors* *4 Trucks*
TRIPS PER YEAR	FULL-TIME EMPLOYEES		CONTRACTED HOURS
	OPERATIONS	METROGRO	
1,000	6	5.5	1,975

INFRASTRUCTURE UPGRADES

- Dewatering Facility
- Aerated Static Pile Composting System. Imported Wood Chips as Bulking Agent
- Compost Storage Barn

DRIVER/GOAL SCORE

CUSTOMER	3.8
ECONOMICS	2.5
ENVIRONMENT	3.7
OPERATIONS	4.0

20-Year Life Cycle Cost **$113M**

THERMALLY-DRIED PRODUCT

APPLICATION METRICS

COST PER DRY TON/ YEAR	TOTAL WET TON/YEAR		TOTAL EQUIPMENT
$748	12,100		7 *2 Applicators* *2 Loaders/Tractors* *3 Trucks*
TRIPS PER YEAR	FULL-TIME EMPLOYEES		CONTRACTED HOURS
	OPERATIONS	METROGRO	
475	5	5.5	1,150

INFRASTRUCTURE UPGRADES

- Dewatering Facility
- Single-train Drum Dryer Facility
- Pellet Storage Silos with Overflow Barn

DRIVER/GOAL SCORE

CUSTOMER	3.8
ECONOMICS	2.3
ENVIRONMENT	3.7
OPERATIONS	4.0

20-Year Life Cycle Cost **$146M**

CLASS A LIQUID

APPLICATION METRICS

COST PER DRY TON/ YEAR	TOTAL WET TON/YEAR		TOTAL EQUIPMENT
$536	79,200		9 *2 Applicators* *0 Loaders/Tractors* *7 Trucks*
TRIPS PER YEAR	FULL-TIME EMPLOYEES		CONTRACTED HOURS
	OPERATIONS	METROGRO	
3,330	1.5	5.5	6,500

INFRASTRUCTURE UPGRADES

- Dewatering Facility
- Thermo-Chemical Hydrolysis Treatment Facility (Lystek™)
- Storage in Existing Metrogro Tanks

DRIVER/GOAL SCORE

CUSTOMER	3.5
ECONOMICS	3.0
ENVIRONMENT	2.7
OPERATIONS	2.7

20-Year Life Cycle Cost **$105M**

CLASS A CAKE

APPLICATION METRICS

COST PER DRY TON/ YEAR	TOTAL WET TON/YEAR		TOTAL EQUIPMENT
$536	79,200		10 *2 Applicators* *2 Loaders/Tractors* *6 Trucks*
TRIPS PER YEAR	FULL-TIME EMPLOYEES		CONTRACTED HOURS
	OPERATIONS	METROGRO	
2,220	1.5	5.5	4,600

INFRASTRUCTURE UPGRADES

- Dewatering Facility
- Expanded Batch Thermophillic Digestion Facility
- Cake Storage Barn

DRIVER/GOAL SCORE

CUSTOMER	3.3
ECONOMICS	2.8
ENVIRONMENT	3.0
OPERATIONS	3.0

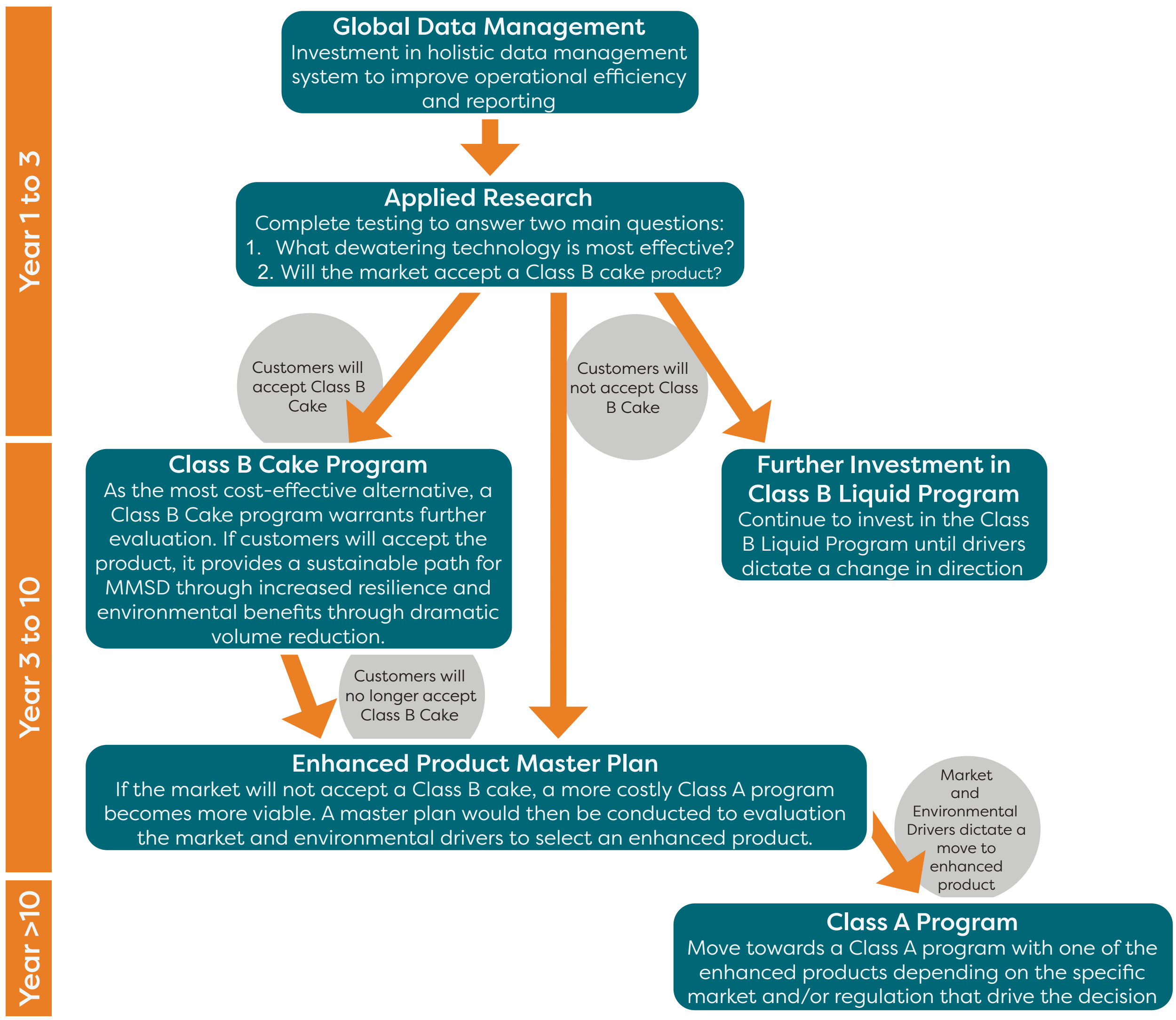
20-Year Life Cycle Cost **$105M**

MMSD • MADISON, WISC. • BIOSOLIDS MANAGEMENT PLAN ROAD MAP

BIOSOLIDS MANAGEMENT PLAN ROAD MAP

Evaluation and analysis of the different biosolids products led to two key insights. First, an enhanced biosolids product, such as compost, provided a high level of customer value and environmental benefits. Second, the economic cost of these enhanced products is likely difficult to justify relative to the cost benefit of Class B cake solids. A Class B cake program would reduce current operating costs by $12 M over a 20-year period as compared to the existing Class B Liquid program. A Class A product program would cost at least $16 M more than the current Class B Liquid program.

The recommended path forward is to focus on two projects in the next three years that will solidify the long-term direction for MMSD. The first project is improvement of data management associated with the Metrogro Program, shown as Global Data Management in the Roadmap. The second project is an applied research program to help understand dewatering to produce a Class B Cake product and completing market research to understand the market for the Class B Cake product. The outcomes of these two projects will finalize the path forward for major infrastructure investment at MMSD. Ultimately, the Roadmap leads to an enhanced biosolids product (Class A cake, liquid, compost, or dried products). The variable is the length of time before the ultimate investment in the Class A product is realized, and iF an intermediate investment in the Class B Cake program is viable with the MMSD customers.



BIOSOLIDS MANAGEMENT PLAN
FACT SHEET

NEXT STEPS

The first two steps on the Metrogro journey for biosolids management involve improving data management for the program, and conducting an applied research program related to cake products. These two steps will lay the foundation for a successful, long-term biosolids management for MMSD.

Execution of an applied research project for biosolids should focus on two aspects: the technologies available to produce a cake product, and the market for that product. For the technology evaluation, MMSD should invest in pilot testing of several dewatering technologies, include belt filter presses, newer centrifuge models, and potential emerging technologies. The focus of the pilot testing should be on potential for regrowth in the biosolids product, achievable cake content, polymer dosing, and general operability. This testing will inform the long-term technology investment decision. In parallel, a market analysis of the Class B Cake product should be completed. If possible, a larger quantify of Class B Cake could be generated using the existing centrifuge equipment. The major negative in terms of driver/goal score for Class B cake was customer acceptance, and therefore the focus of the market analysis should be on the viability of the product with customers. Efforts to expose end users to the handling, application, and quality of the Class B Cake would need to be completed. This would likely entail the rental of application equipment specifically designed for biosolids application, and application on several end-user fields. Given the potential economic savings associated with the Class B Cake program, it is worth the investment to determine if it is a viable product with customers. If the Class B Cake program is not viable, a more rapid move towards an enhanced biosolids product will likely be required.

GLOBAL DATA MANAGEMENT

MMSD's biosolids program needs a major upgrade to their management systems. The existing systems require considerable maintenance to function, while hindering efficient workflows. Significant operational efficiency improvements are likely to be realized through a modern data management system. The following steps are recommended as part of the redesign effort.

1. **Review Identified Issues/Solutions in Context of Global District Asset Management:** Review identified solutions with District Information Technology (IT) and Asset Management Staff and identify synergies with overall District goals.

2. **Review Database Structure Concerns:** Review the known concerns in the Database data structure with IT Staff and determine if updates to the data structure should happen before any redesign efforts.

3. **Select a Database Design:** Identify a database structure that can be supported by MMSD IT into the future. A database rooted in Geographic Information Systems (GIS) is an ideal fit for the biosolids management program.

4. **Develop & Pilot a Prototype Database:** Create a new database structure, leveraging either the live SQL tables or static copies and compare reporting outputs against current database.

5. **Transition to New Database Structure:** Once the prototype has been vetted by the District, continue to utilize until a new database structure is commissioned.

6. **Upgrade Mobile Mapping:** The MMSD GIS staff can prepare mobile mapping solutions in tandem with the redesign effort, ideally linking the new database to the live mapping data.

APPLIED RESEARCH INTO CLASS 'B' CAKE

Execution of an applied research project for biosolids should focus on two aspects: the technologies available to produce a cake product, and the market for that product.

1. **Invest in Dewatering Technology Pilot Tests.** Pilot testing should include several dewatering technologies, include belt filter presses, newer centrifuge models, and potential emerging technologies. The focus of the pilot testing should be on potential for regrowth in the biosolids product, achievable cake content, polymer

dosing, evaluate 'stickiness' of product, and general operability. This testing will inform the long-term technology investment decision.

2. **Conduct a Market Analysis on Class 'B' Cake.** Given the potential economic savings associated with the Class B Cake program, and widespread use nationwide, it warrants investment into further research to determine if it is a viable product with local customers. The District can already create Class B Cake using the existing centrifuge equipment. Therefore, the District can immediately create a product for the market to evaluate with minimal investment. Further, Class B cake could be used as the basis for further composting research. Composting has the highest aggregate score versus all other options when economics was not the primary factor.

   The major negative in terms of driver/goal score for Class B cake was customer acceptance, and therefore the focus of the market analysis should be on the viability of the product with customers. Efforts to expose end users to the handling, application, and quality of the Class B Cake is a critical piece of the analysis. This would likely entail pilot testing various hauling and application equipment specifically designed to address customer concerns and potential benefits with the product, such as:

   a. Evaluate odors and cleanliness of operation if cake is not incorporated

   b. Minimize issues with 'stickiness' through testing various hauling application and equipment

   c. Evaluate benefits of volume reduction to the customers through less compaction and flexibility in application days.

   If the Class B Cake program is not viable, a more rapid move towards an enhanced biosolids product will likely be required.

PLAN OVERVIEW

PLAN OVERVIEW

Since the formation of the Madison Metropolitan Sewerage District (MMSD) in 1930, MMSD has maintained a proactive approach to biosolids handling and management. As the District's service area has expanded, so has the size and level of complexity of their biosolids management program. The current Biosolids Program, which was adopted more than 40 years ago, primarily consists of distribution and application of a liquid Class B product (commonly known as Metrogro) as fertilizer on cropped agricultural fields. The program is becoming increasingly more difficult to manage due to a multitude of factors including increasingly stringent agricultural regulations, changes in farming practices, emerging contaminants, and changes in climate and weather patterns. These factors have caused a reduction in customers, additional travel distance, and a decrease in seasonal application windows, thus increasing numerous administrative, fiscal, and environmental pressures. These drivers triggered MMSD to begin a Biosolids Management Plan in 2020 to identify practical steps to develop solutions for sustained operation of the biosolids management program.

This Final Report summarizes the Biosolids Management Plan developed during a multi-step evaluation process. The steps include:

- Program Assessment
- Evaluation Metrics
- Alternatives Evaluation
- Customer Engagement
- Triple Bottom Line Analysis
- Applied Research

PROGRAM ASSESSMENT:

The main purpose of the first step was to identify management and infrastructure bottlenecks that need to be addressed as part of future investments by the MMSD. Major challenges and/or bottlenecks that need to be addressed during future biosolids projects are:

Program Administration and Data Management

- A careful review of the existing MMSD administrative and data management workflows was conducted as part of this plan by listening to staff, documenting all of the existing datasets used to conduct normal operations and describing the workflow in verbal text and with a visual diagram.
- The existing system has several key limitations that decrease the efficiency of the program. Several key additions to the program administration and data management toolbox were identified to improve efficiency:
    - Improving Reporting Outputs
    - Importing Files
    - Changing Land Ownership/Operation
    - Unique Field Identifier
    - Emulating components of the SnapPlus Database
    - Integrating GPS and SMS from Applicators
    - Real-time Information on Road/Bridge Restrictions
    - Improved Method for Receiving Mailed Permission Slips
    - Preferred Main Interface
    - Mobile Mapping
    - Live Tracking of Contract Work
    - Searchable Scans of Printed Documents
    - Phone Alerts for Contract Employees

Biosolids Infrastructure

- If growth occurs as projected, there will be thickening capacity gaps in the next 10 years.
- Adequate storage volume. Desired minimum storage provides 180 days of storage time; however, the effective use of this storage volume is highly dependent on hauling capacity. Currently, over 75 days of hauling have been required to effectively apply the full year of biosolids. In the past five years, hauling days used has ranged from 70 to 81 days. Additional capacity was required and rented due to unforeseen weather circumstances in 2019.

Biosolids Application & Nutrient Management

- Class A Cake product quality, coliform regrowth, handling, and lack of a cake hauling program are leading to gaps in the market demand for the product
- Hauling days are highly dependent on weather, recent extreme weather events have increased the risk of insufficient hauling windows resulting in a need for greater than 180-days of storage
- Application requirements, for liquid Class B product, limit efficiency of application due to regulatory restrictions and application practices
- Fleet equipment, load-out capacity, and labor availability create challenges for hauling during the shorter, weather-influenced hauling seasons
- Timing and Coordination of load-out, hauling, and application is cumbersome and dependent on streamlining third-party services (regulatory-permitting, soil testing, and contracted hauling)

- From a nutrient management perspective, applying biosolids on a nitrogen-only basis per the minimum requirements of DNR has caused phosphorus overloading on fields. This misaligns with other District nutrient management goals and modern agricultural practices.
- The significant volume and method of application do not align with customers shift to no-till or min-minimum practices and minimal compaction

EVALUATION METRICS:

The second step established project goals to form design metrics for scoring and comparing various identified alternatives. Historically, capital costs and lifecycle were sole metrics for decision making. The follow sections outline the procedure for creating an all-encompassing series of criteria.

MMSD Goals & Drivers

MMSD's strategic organizational goals were reviewed and aligned to the Biosolids Management Plan project goals. In addition, future regulatory and end-use drivers that need to be considered were discussed.

Evaluation Criteria

Various internal and external sources were reviewed to develop a consolidated approach to evaluating the alternatives.

Technology Shortlisting

A wide array of biosolids processing technologies were reviewed and discussed. MMSD and the project team winnowed down the list of technology alternatives to those that will likely score the highest, and best fit with the District's needs.

ALTERNATIVE EVALUATION:

After completing Evaluation Metrics, alternatives were evaluated in the third step, Alternatives Evaluation. This focused on three primary areas of alternatives as noted below:

Biosolids Processing Technology

Various alternatives were selected in order to provide a broad cross section of potential biosolids management strategies and to compare these to the current operation. The biosolids alternatives that were evaluated during the study are organized in the following order:

- Baseline alternative (expansion of current liquid land application operations)
- Alternatives based on Class B biosolids (with prefix 'B')
    - B1 - Dewatering Centrifuges in Existing Building (Reuse Existing Unit)
    - B2 – Dewatering Centrifuges in Existing Building (Replace Existing Unit)
    - B3 – Dewatering Centrifuges in New Building
    - B4 – Dewatering Belt Filter Presses in New Building
- Alternatives based on Class A biosolids (with prefix 'A')
    - A1 – Centrifuge Dewatering and Static Pile Composting
    - A2 – Centrifuge Dewatering and Windrow Composting
    - A3 – Centrifuge Dewatering and Thermal Drying
    - A4 – Centrifuge Dewatering and Class A Liquid Treatment
    - A5 – Thermal Batch Treatment with Belt Filter Press Dewatering

Land Application Comparison

- Land application compared volumes, total solids concentration amounts, and nutrient contents of end products of all alternatives evaluated.
- Equipment required for loadout, transportation, field loading, field application, and incorporation were evaluated, as necessary.
- Labor hours and rates were calculated as a result of the combined alternative and equipment needs.

Data Management & Administration

- A series of recommendations to workflow and data structure that is flexible for the future of MMSD was assembled into a graphical solution.
- An implementation program was created to allow the MMSD IT department to make changes to the system as the Biosolids Program adapts over time.

TRIPLE BOTTOM LINE ANALYSIS:

An evaluation matrix was developed to consider the fiscal, social, and environmental impacts of each alternative. This is commonly called a 'Triple Bottom Line' analysis. Based upon the evaluation metrics developed in Step 2, criteria were developed around four (4) key drivers or goals:

1. Economics
2. Environment
3. Operations
4. Customers

CONCLUSION & NEXT STEPS

The evaluation and analysis of the different biosolids products led to two key insights. **First**, an enhanced biosolids product, such as compost, provided a high level of customer value and environmental benefits. **Second**, the economic cost of these enhanced products is likely difficult to justify relative to the cost benefit of Class B cake solids. A Class B cake program would reduce currently operating costs by $12M over a 20-year period as compared to the existing Class B Liquid program. A Class A cake program would cost approximately $16M more than the current Class B Liquid program.

The recommended path forward is to focus on two projects within the next three (3) years that will solidly the long-term direction for MMSD.

Global Data Management. Investment in holistic data management and mapping system to improve operation efficiency and reporting

Applied Research Plan. Implement research on the equipment and optimization of the creation of Class B cake and conduct further market research to better understand if your customer base will accept it.

Ultimately, the long-term solution is likely an enhanced Class A program. The variable is the length of time before the utilize investment in a Class A program is realized, and if an intermediate investment in the Class B cake program is viable with MMSD's customers.

CHAPTER 1
INTRODUCTION

CHAPTER 1

INTRODUCTION

BACKGROUND

The Madison Metropolitan Sewage District (MMSD) operates the Nine Springs Wastewater Treatment Plant (NSWWTP). The NSWWTP processes an average of 41 million gallons per day (MGD) of wastewater from MMSD's 26 customer communities and septage from around Dane County. The NSWWTP is an advanced activated sludge facility producing highly treated effluent and anaerobically digested biosolids.

A vast majority of the biosolids are recycled to agricultural land as soil conditioner and fertilizer through MMSD's Biosolids Program. Predominately, biosolids are recycled as a liquid (<6% total solids (TS), by weight) product, with the remaining portion as a cake (average 24% total solids) product. These products are commonly known as Class B Liquid and Class A cake and are regulated by the United States Environmental Protection Agency (EPA) and Wisconsin Department of Natural Resources (DNR) to ensure protection of human health and the environment.

The Biosolids Program has become more difficult to manage in recent years due to a multitude of factors including increasingly stringent agricultural regulations, changes in farming practices, emerging contaminants, and climate change. These factors have caused a reduction in customers and a decrease in available application days, thus increasing the impact of numerous administrative, fiscal, and environmental pressures.

OBJECTIVE & GOALS

The objective of this Biosolids Management Plan was to assess the current Biosolids Program with the following goals:

- Determine what biosolids are most desired by the market and the region.
- Determine what biosolids processes are the easiest for MMSD to integrate into MMSD's current processes.
- Determine which biosolids processes are most complementary in creating resilient, value-added solutions to the MMSD's resource recovery efforts.
- Recommended solutions that can be implemented feasibly with five (5) years.
- Identify a framework for investigating and implementing alternatives beyond five (5) years.

SCOPE

The scope of the Biosolids Management Plan was defined by four (4) major tasks. Each task was a result of significant collaboration between the consulting team and MMSD including workshops and review meetings. Each task was summarized into individual technical memoranda (TM) during the course of the project and assembled together to complete this final report. The technical memoranda that were previously issued are outlined below.

- **TM No. 1 – Program Assessment:** Assessment of the existing Biosolids Program including processing, transfer, transport, application, and administration.
- **TM No. 2 - Establish 'Quadruple Bottom Line' Evaluation Criteria:** Development of metrics that consider economic, environmental, social, and operational criteria that align with the projects goals from which to evaluate alternatives.
- **TM No. 3 – Alternatives Evaluation:** Development and evaluation of alternatives based on the program assessment.

DOCUMENT OVERVIEW

This Final Report is an organization of the previous three Technical Memoranda plus a summary of the Triple Bottom Line Analysis, recommended next steps, and Applied Research Plan it serves as a summary of comprehensive Biosolids Management Plan conducted by the consultant team.

CHAPTER 2
BIOSOLIDS INFRASTRUCTURE ASSESSMENT

BIOSOLIDS INFRASTRUCTURE ASSESSMENT

OVERVIEW

Generation of a quality end-use product as part of biosolids processing is a major focus for operations and maintenance staff at the MMSD. Multi-staged anaerobic digestion, biogas treatment, energy recovery, and fertilizer production are all part of the resource recovery paradigm driven by biosolids for the MMSD. For this assessment, the focus is infrastructure that directly relates to the processing of digested biosolids. This includes the infrastructure required to thicken or dewater the digested biosolids, whether those biosolids be Class B biosolids from mesophilic digestion or Class A biosolids from the thermophilic batching process. Assessment of existing digested biosolids infrastructure includes the following three key areas:

- Existing digested biosolids handling infrastructure
- Digested biosolids production rates
- Infrastructure gaps for digested biosolids handling

EXISTING DIGESTED BIOSOLIDS HANDLING INFRASTRUCTURE

Within the NSWWTP, digested biosolids are produced in two forms by the MMSD: Class B liquid from mesophilic digestion and Class A liquid following thermophilic batch processing. The majority of Class B and Class A liquid is thickened via gravity belt thickeners (GBTs) and is then used as the Metrogro product. A relatively small fraction of the Class A liquid is dewatered by a centrifuge and becomes the Class A cake product. For the purposes of the Biosolids Management Plan, digested biosolids handling infrastructure is defined as the infrastructure downstream of anaerobic digestion that produces the Metrogro products. This includes the following major infrastructure components (also shown in **Figure 2-1)**:

- Digested biosolids transfer pumps
- Digested biosolids gravity belt thickeners
- Gravity belt thickener polymer feed system
- Gravity belt thickener filtrate pumps
- Centrate pump
- Thickened digested biosolids transfer pumps
- Metrogro storage tanks
- Class A digested biosolids transfer pumps
- Class A digested biosolids centrifuge
- Class A cake storage area

The capacities for the major unit processes are summarized below:

Table 2-1: Digested Biosolids Major Equipment Capacity.

Unit Process	Parameter
Thickening	
Equipment	Gravity Belt Thickener
Quantity	2
Belt Width, m	2
Hydraulic Capacity per Unit, gpm	250
Solids Capacity per Unit, lbs./hr.	2,800
Metrogro Storage Tanks	
Quantity	3
Storage Capacity, Total, MG	19.4
Dewatering	
Equipment	Centrifuge
Quantity	1
Hydraulic Capacity, gpm	150
Max Solids Capacity, lbs./hr.	1,250
Sludge Storage Tanks	
Quantity	2
Storage Capacity, Total, MG	0.9

Digested Biosolids Gravity Belt Thickening

Under normal operation, sludge from the Acid Phase Digesters is fed to Mesophilic Digesters Nos. 4-9. The majority of mesophilic digested biosolids (Class B liquid) is pumped directly to the Digested Biosolids GBTs, with the rate of feed varying to maintain levels in the mesophilic digesters. Typically, digested biosolids from Digester No. 7 are transferred to thermophilic batching, and Digesters No. 8 and 9 are also configured to send biosolids to thermophilic batching if necessary. The quantity sent to the thermophilic batching tanks can be driven by Class A biosolids demand, but also by the need to keep the gas holder covers on the Sludge Storage Tanks from freezing in the winter. The majority of the time, biosolids from the thermophilic batching tanks (Class A liquid) are transferred to the GBTs. The transfer of thermophilic biosolids to the GBTs takes place downstream of the storage tanks. Any Class A liquid thickened on the GBTs is classified as Class B biosolids downstream of the process.

Gravity belt thickening is a continuous operation, with one of the two GBTs operating 24 hours a day, 7 days a week. Typically, one GBT runs at a time and is rotated on a weekly basis for power washing. Class B biosolids off the GBTs is generally thickened to 5-6% prior to pumping to the Metrogro Storage Tanks for eventual loadout. As the storage tanks fill, the digested biosolids are pumped thinner to avoid over-pressuring the cake pumps sending sludge to the storage tanks. Ferric chloride is dosed in the GBT feed for struvite control in the downstream filtrate processes. Emulsion polymer is also fed into the GBT feed to promote thickening of the biosolids. GBT filtrate flows to a filtrate well in the GBT Building, where it eventually combines with filtrate off the Thickened Waste Activated Sludge GBTs and is conveyed to the struvite recovery process.

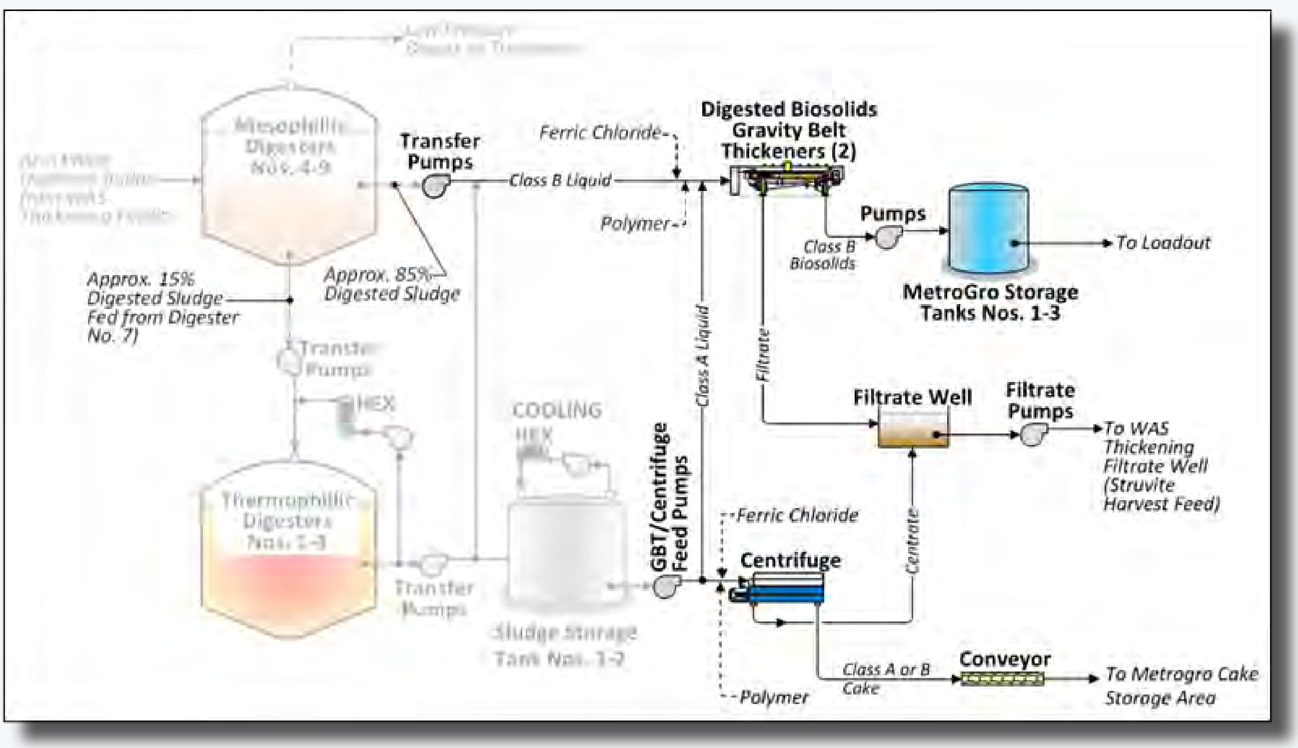
Operations staff have noted several limitations associated with the digested biosolids thickening process. Solids distribution across the GBT belts is a challenge for the plant, due in large part to the manufacturer's equipment design. Operators have rigged temporary devices to spread solids over the belt width to achieve an even distribution. The plant has also experienced issues with the polymer batching systems. If the GBT feed rate is increased suddenly, the ability to deliver sufficient polymer is limited by the polymer feed pump capacity. The plant also experiences issues with struvite accumulations in the filtrate well, pumps, and associated valving. The ferric chloride dosing upstream of the GBTs helps to mitigate this, but there is still sufficient deposition to require periodic cleaning of the well.

Dewatering Operations

Digested biosolids are transferred from the Sludge Storage Tanks to the centrifuge via one of three feed pumps (these pumps can also feed the GBTs). Polymer is dosed upstream of the centrifuge for dewatering. Ferric chloride is also added upstream of the centrifuge to prevent struvite buildup. The trigger for operation of the centrifuge is generally in support of the Class A cake dewatering program. However, there are a number of factors that can influence dewatering operation including the annual polymer budget, storage availability in the end-use building, storage availability in the Metrogro storage tanks, ability to distribute Class A cake, and market demand. Dewatering operations vary throughout the year, with the centrifuge operated an average of 48 days total throughout the year (based on data from 2015 through 2019). When the centrifuge is in operation, it typically operates on a 36-42 hour continuous cycle based on the volume in the Sludge Storage Tanks. Dewatered biosolids (Class A cake) are discharged to a short auger conveyor, which conveys the biosolids to a belt conveyor. The belt conveyor transfers the biosolids outside to a pile in the end-use facility for loadout. Under typical operations, this pile has to be moved using a front-end loader approximately twice every 24 hours.

Although operations staff have not noted any specific concerns with the operation of the centrifuge equipment, there have been challenges associated with the dewatering operations. Fecal

Figure 2-1: Digested Biosolids Process Flow Diagram



coliform regrowth has been an issue in the Class A product. It can take as long as five months in the winter for pile counts to decrease sufficiently for loadout. Extensive testing by the MMSD has confirmed this regrowth limitation. Additional testing is being completed related to Class B product regrowth. The storage in the end-use facility can also be a pinch point in the process. The solids discharged off the conveyor must be manually piled with front end loaders in the storage facility. Availability of operators for biosolids stockpiling is a consideration in operation of the centrifuge. The Class A product can be difficult to work with. The consistency of the product is heterogeneous and sticky unless it is spread out and evenly air-dried before distribution. End users must stockpile the Class A cake in a dry place until it its application, making it more difficult to manage from a storage and handling standpoint and less desirable as compared to the liquid product. The plant also experiences issues with buildup of nuisance material under the belt conveyor downstream of the centrifuge. When in operation, the pan underneath the conveyor must be cleaned during periodic shutdowns to prevent fouling.

DIGESTED BIOSOLIDS PRODUCTION RATES

Understanding current digested biosolids production rates is important to both future projections and sizing of infrastructure for current conditions. There are two sources of data for digested biosolids production: operational data from thickening and digestion facilities and hauled biosolids data. As noted above, the majority of Class B and Class A liquid is thickened via GBTs, which is then distributed as the Metrogro product. A relatively small fraction of the Class A liquid is dewatered by centrifuges, which becomes the Class A cake product. The daily mass processed by the two technologies from 2015 through 2020 is shown in Figure 2-2. The centrifuge can process approximately 25% of the overall biosolids produced but is only operated on average 48 days per year.

Based on the historical operational data for the NSWWTP, the distribution of digested biosolids production rate to thickening and dewatering for the past five (5) full years are shown in Table 2-2. The solids production rates in 2015, 2016, and 2019 are similar. The production rate in 2017 was significantly lower, but this was offset with a higher production rate in 2018. When the full data set is evaluated, the overall average is similar to production rates observed in 2015, 2016, and 2019 (Table 2-3). Evaluating the distributions provides insight into the overall ranges of operation for equipment. Note that the digested biosolids to thickening and the digested biosolids to dewatering would be added over the course of a year to obtain total digested biosolids production rates, but the percentiles should not be added as the GBT feed can decrease when the centrifuge is in operation.

Prior to thickening, the digested biosolids has an average solids concentration of 2.7% TS. Post thickening, the solids concentration is increased to an average of 5.7% TS. For digested biosolids dewatered by the centrifuge, the average TS concentration is 20.5%.

An additional data source for understanding average annual biosolids production rates is the Metrogro hauling data. Annual biosolids hauled should equate closely to annual biosolids produced. As shown in Table 2-4, the average daily solids hauling rates from the Metrogro data provide a similar average biosolids production rate for the majority of years. In 2019, the calculation from Metrogro is significantly below the biosolids production rate based on plant operations data, but this correlates to a unique season where the full capacity of the Metrogro tanks was not land applied due to weather conditions.

The historical digested biosolids production can be compared with future projections from previous projects to develop planning numbers for digested biosolids production rates. The MMSD has three sources for future solids production:

- 11th Addition Design Basis solids production rates
- 2016 Liquids Facility Plan (FP) Influent BOD
- High strength waste (HSW) solids production from the 2014 Energy Baseline and Optimization Roadmap

Currently, MMSD does not accept, and does not have the ability to accept, a significant amount of HSW. Future HSW acceptance

Figure 2-2: Daily Mass Rate of Biosolids Production (dry ppd) via GBTs and Centrifuges

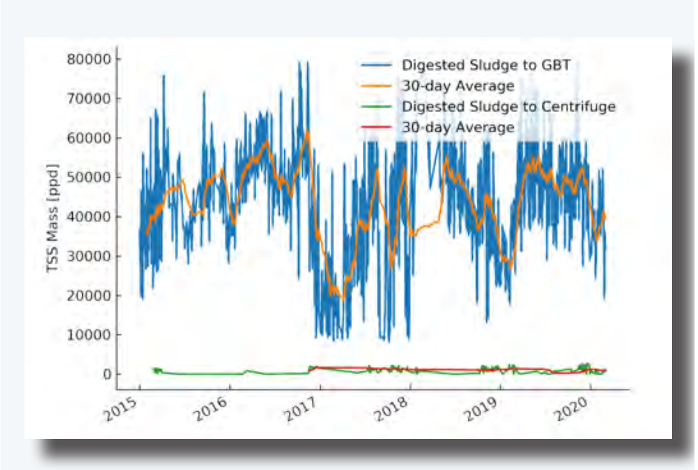


Table 2-2: Distributions of Digested Biosolids Production Rates

PERCENTILE	DIGESTED BIOSOLIDS TO THICKENING (PPD)					DIGESTED BIOSOLIDS TO DEWATERING (PPD)				
	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019
10th	30,859	37,916	3,285	29,890	29,689	12	6,328	2,641	239	7
25th	37,376	43,854	12,807	38,471	37,795	969	10,555	4,899	2,859	339
50th	43,361	50,893	29,789	47,276	46,219	7,301	12,129	7,439	8,175	2,906
75th	49,986	56,937	44,147	63,454	53,845	13,917	12,668	11,073	10,769	7,761
90th	57,064	63,674	56,317	116,461	60,290	16,806	13,411	13,369	15,018	12,627
Average	43,769	49,725	30,332	58,823	45,792	8,046	10,860	8,170	7,614	4,787

Notes:
[1]Average solids concentration of unthickened, digested sludge is 2.7% TS.
[2]Average solids concentration of the thickened, digested sludge is 5.7% TS.
[3]Percentile reflects percentage of days receiving ppd of digested biosolids shown or less

Table 2-3: Distribution of Biosolids Production from 2015 through 2019

PERCENTILE	DIGESTED BIOSOLIDS TO THICKENING (PPD)	DIGESTED BIOSOLIDS TO DEWATERING (PPD)	TOTAL DIGESTED BIOSOLIDS (PPD)
10th	22,274	101	2,296
25th	35,416	2,491	31,037
50th	45,056	8,110	43,107
75th	53,431	12,140	52,286
90th	63,245	13,651	61,774
Average	45,520	7,689	41,426

Notes:
[1]Average solids concentration of unthickened, digested sludge is 2.7% TS.
[2]Average solids concentration of the thickened, digested sludge is 5.7% TS.
[3]Percentile reflects percentage of days receiving ppd of digested biosolids shown or less

Table 2-4: Distribution of Sludge Production from 2015 through 2019

YEAR	METROGRO ANNUAL HAULING (GALLONS)	AVERAGE DAILY SOLIDS PRODUCTION RATE (PPD)[1]
2015	34,259,200	44,620
2016	36,935,400	48,105
2017	34,615,400	45,082
2018	33,558,000	43,706
2019	25,496,600	31,865

Notes:
[1]Average solids concentration of the thickened, digested sludge is 5.7% TS.

and potential impact on biosolids production is uncertain given numerous financial and process factors. As a result, future biosolids production resulting from the acceptance of HSW could range from what is shown, to much less than, or not at all.

While the 2016 Liquid FP did not project solids production, it did provide influent BOD projections, and the growth of biosolids production would be anticipated to mirror any growth in influent BOD loadings. Data from these three sources, as well as the average solids production from 2015 through 2019 based on operation data from the NSWWTP, are presented in Figure 2-3. Key observations from these data sets include:

- The 2020 average digested biosolids production rate from the 11th Addition Basis of Design is 20,000 ppd higher than the average from 2015 through 2019, likely due to the inclusion of Oscar Meyer plant operations which is now closed.
- The growth rate of solids production from the 11th Addition Basis of Design is more than double the growth rate of BOD from the 2016 Liquid FP influent BOD projection.
- The 11th Addition Basis of Design average solids production in 2030 is almost double the current solids production rate.

For biosolids production estimates in the 2020 Energy Master Plan two approaches were used. First, flows going into mesophilic digestion and TS leaving digestion were used to estimate dry ppd of digested solids. Second, flows to the GBT and centrifuge and TS for each flow were used to estimate dry ppd digested solids. These results were then averaged to establish the 2020 dry ppd solids production going to solids processing. The 2040 average production was then estimated by escalating the 2020 value using the 2016 Liquid Facilities Plan TSS/BOD loading increase estimate (18.7%). Finally, the 2040 max month flow was estimated by multiplying by a factor from the 2016 Liquid Facilities Plan (1.17). This projection will be utilized for this Biosolids Management Plan, and is also included in Figure 2-3.

For the Biosolids Management Plan, the overarching goal is to develop near-term solutions for biosolids management while positioning for the future. With this goal in mind, solids capacity will be evaluated for current conditions (2015 through 2019) with expansion requirements for the 2030 and 2040 projections identified.

For future projections, the 11th Addition Basis of Design and the 2020 Energy Master Plan can be viewed as providing an envelope of expansion requirements. Analyses in this plan will be developed using the projections presented in this plan matching the 2020 Energy Master Plan. By showing the envelope of capacities, the expandability of system capacities and triggers for future expansions can be established, rather than focusing on a single set of future design capacity requirements. The range of biosolids production rates are summarized in Table 2 5, with average unthickened digested biosolids flow rates in Table 2 6 and annual thickened digested biosolids volumes in Table 2 7.

Table 2-5: Average Annual Solids Production Rates for use in the Biosolids Management Plan

	DIGESTED BIOSOLIDS PRODUCTION RATE (DRY PPD)					
	2015-2019		2030		2040	
	Average Day	Maximum Month	Average Day	Maximum Month	Average Day	Maximum Month
Historical Data	41,426	61,774	-	-	-	-
11th Addition Growth Rate	-	-	82,966	104,128	102,227	132,602
2016 Facility Plan Growth Rate	-	-	70,597	80,481	76,127	86,785
HSW Solids	-	-	14,640	14,640	14,640	14,640
2016 FP +HSW	-	-	85,237	95,121	90,767	101,425
2020 EP & BMP Projection	-	-	54,000	63,000	58,000	68,000

Figure 2-3: Current Digested Biosolids, Projections for the 11th Addition Basis of Design, a Projected Influent BOD Loading Growth from the 2016 Liquids FP, and Potential HSW Solids for Energy Production.

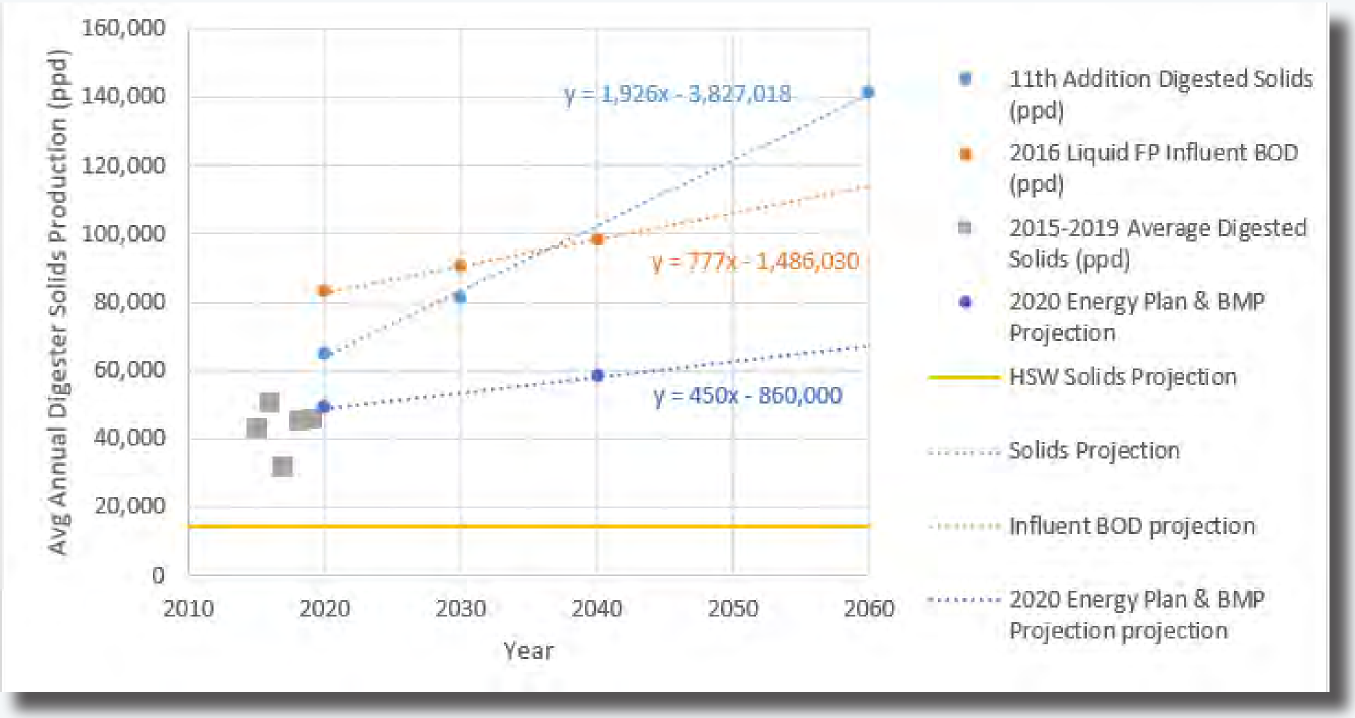


Table 2-6: Solids Production Rate for use in the Biosolids Management Plan (unthickened flow rate)

	DIGESTED BIOSOLIDS PRODUCTION RATE (GPM)[1]					
	2015-2019		2030		2040	
	Average Day	Maximum Month	Average Day	Maximum Month	Average Day	Maximum Month
Historical Data	128	191	-	-	-	-
11th Addition Growth Rate	-	-	256	321	315	409
2016 Facility Plan Growth Rate	-	-	218	248	235	268
2016 FP +HSW	-	-	263	293	280	313
2020 EP & BMP Projection	-	-	165	193	179	210

[1]Average solids concentration of unthickened, digested biosolids is 2.7% total solids

INFRASTRUCTURE GAPS FOR DIGESTED BIOSOLIDS HANDLING

Gaps in infrastructure for the Biosolids Management Plan can exist in three main areas: infrastructure capacity, biosolids hauling capacity, and ability to meet regulatory requirements. For each of these areas, capacity needs for current biosolids production and potential gaps for future production rates will be identified. These gaps will be taken into consideration when developing alternatives for biosolids management.

Infrastructure Capacity

The first area of biosolids processing infrastructure is the digested biosolids GBTs. There are two GBTs in operation, with one being operated at a time. Refer to Table 2-1 for the capacity of each GBT.

Firm capacity for the GBTs would be defined as the ability to handle the maximum month solids production rate with one unit in operation and one unit in standby. The historical average solids production rate, along with the projected future production rates, are summarized in Figure 2-4 (hydraulic loading basis) and Figure 2-5 (solids loading basis). Current biosolids production rates are not stressing the capacity of the GBTs, and the projected 2030 maximum month solids production rates would not exceed the GBT capacity from a solids loading perspective. If the Class B liquid land application continues, it may still be prudent to include a GBT expansion in 2030 to continue to provide firm capacity at maximum month.

Figure 2-4: Maximum month digester biosolids volumetric production rates (assuming a digested sludge concentration of 2.7% solids) and current GBT firm capacity.

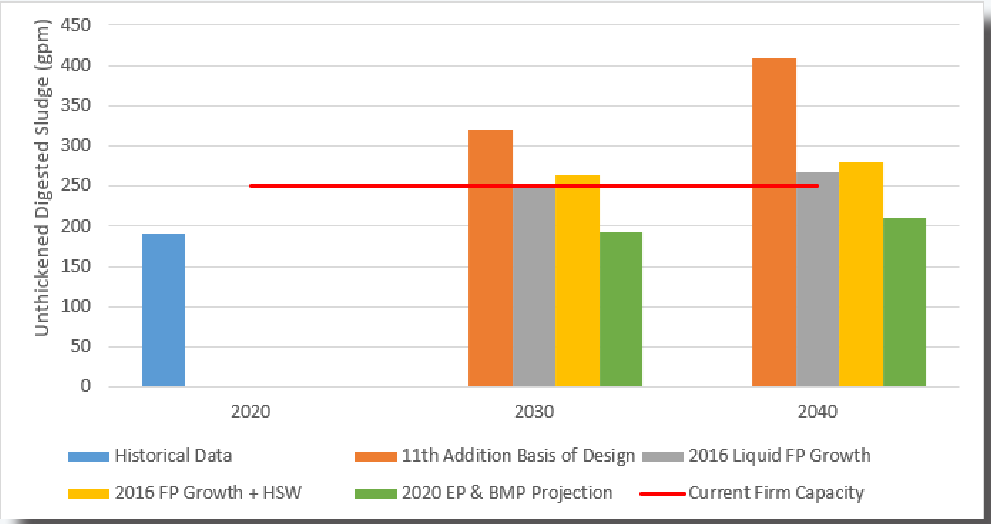


Table 2-7: Solids Production Rates for use in the Biosolids Management Plan (thickened volume per year)

	DIGESTED BIOSOLIDS PRODUCTION RATE (GALLONS PER DAY)[1]					
	2015-2019		2030		2040	
	Average Day	Maximum Month	Average Day	Maximum Month	Average Day	Maximum Month
Historical Data	87,145	129,950	-	-	-	-
11th Addition Growth Rate	-	-	174,530	219,040	215,040	278,940
2016 Facility Plan Growth Rate	-	-	148,510	169,300	160,140	182,560
2016 FP +HSW	-	-	179,300	200,100	190,940	213,360
2020 EP & BMP Projection	-	-	113,590	132,530	122,010	143,040

[1]Average solids concentration of thickened, digested biosolids is 5.7% total solids

No major operational or maintenance limitations were identified for the GBTs. The belts are washed on a weekly basis to reduce scale buildup, but this is manageable given the redundant capacity. Flow distribution was reported as being non-ideal for the digested biosolids feed, which can lead to unbalanced loading of the GBTs and reduced throughput capacity. In addition, efficiency improvement needs were reported for the polymer feed system, including issues with the batching systems. As the maximum month capacity of the GBTs is approached, a project that looks to improve overall efficiency of the GBT operation would likely extend the window for needing a new GBT installed, although significant increases in capacity are not likely to be achieved.

Biosolids processing with the centrifuge operates under different drivers than the GBTs. While the GBTs are required to process 100% of the biosolids produced at the NSWWTP, the centrifuge operates on a side stream of the digested biosolids for a relatively small portion of the year. The single existing centrifuge has a hydraulic capacity of 150 gpm and a solids loading capacity of 1,250 lbs per hour. These capacities are shown relative to biosolids production rates in Figure 2-6 (hydraulic basis) and Figure 2-7 (mass basis). For solids concentrations above 2%, the centrifuge capacity is mass limited. The centrifuge capacity is approximately 50% of the maximum month loading solids production rate if operated on a continuous basis; however, downtime for maintenance would need to be considered. Generally, systems that rely on a centrifuge for dewatering have redundancy to account for this downtime.

Figure 2-5: Maximum month digested biosolids mass production rates and current GBT firm capacity.

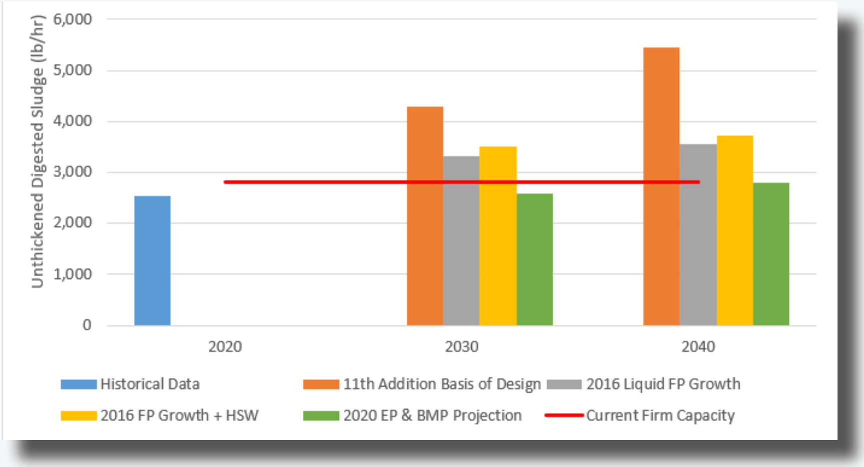
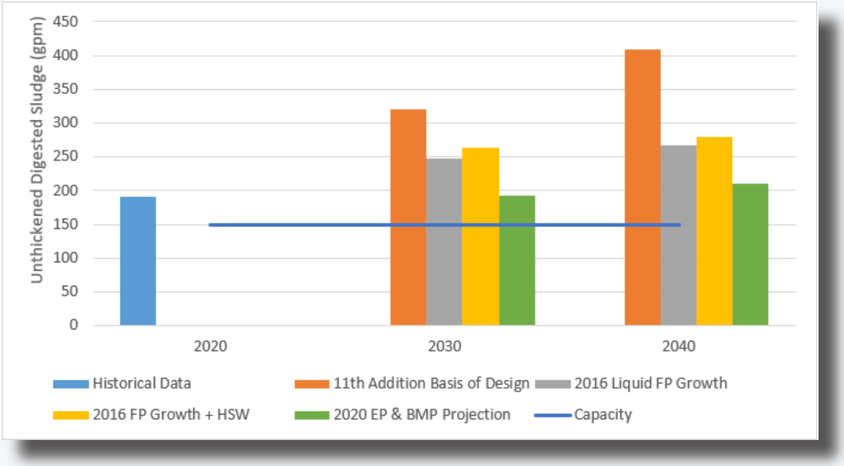


Figure 2-6: Maximum month digested biosolids volumetric production rates (assuming digested sludge concentration of 2.7% solids) and centrifuge capacity



No major maintenance or operational concerns were reported for the centrifuge operation overall, though the centrifuge was out of operation during the late summer and fall of 2019 due to mechanical issues. There is a limitation associated with the dewatered biosolids storage area. While the storage pad area is relatively large at 200 feet by 300 feet, the cake discharged off the conveyor must be manually stockpiled and is stackable to an average height of 8-10 feet.

The majority of biosolids storage for the NSWWTP occurs in the Metrogro tanks. These tanks have a total capacity of approximately 19.4 million gallons. Current average solids production rates would result in approximately 32 million gallons of biosolids at 5.7% TS concentration, which would result in 210 days of storage in the existing tanks (Figure 2-8). At the projected 2030 conditions, the Metrogro tanks would not provide sufficient storage at the current solids concentration of 5.7% TS. No major operational limitations were reported by plant staff.

Hauling Capacity

In addition to understanding the storage capacity for biosolids, it is important to assess the number of hauling days per year, and thus the volume of biosolids that must be moved on each hauling day, to land apply 100% of the digested biosolids. This section is intended to present a summary of the number of hauling days and volume of biosolids hauled in recent years, as well as project future hauling requirements. Further investigation to understand the drivers of changes observed in number of total hauling days and total biosolids hauled in recent years, as well as to understand the potential impacts of those drivers on future hauling requirements

Figure 2-7: Maximum month digested biosolids mass production rates and centrifuge capacity.

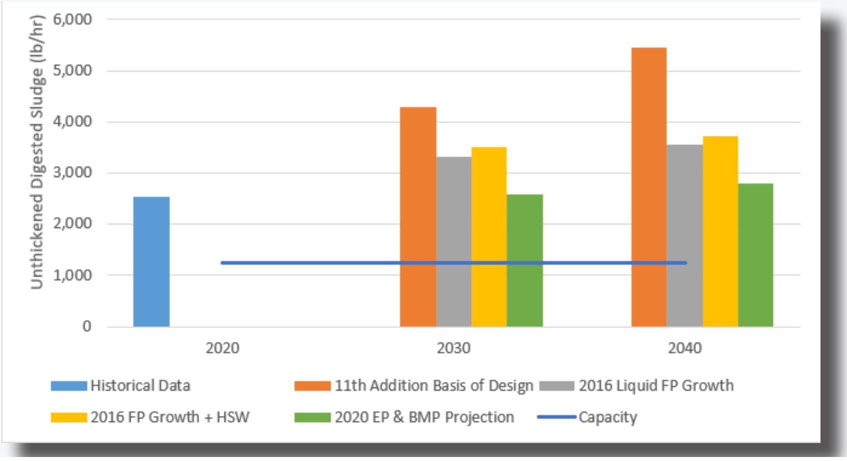
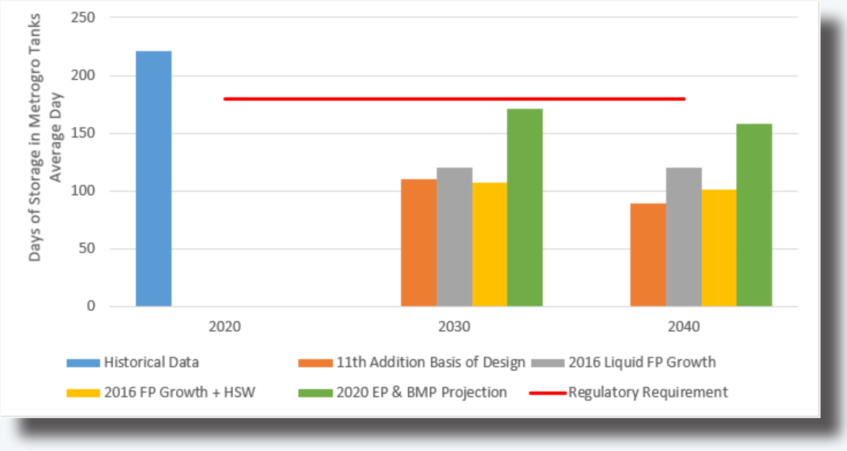


Figure 2-8: Available Days of Storage in Metrogro tanks at Average Day Biosolids Production Rates



will be reviewed in the next phase of the study. The current intent is to document production rates to facilitate this more detailed evaluation and discussion in the future.

Historically, biosolids have been land applied between 70 and 81 days per year (Table 2-8). The number of days for land application has decreased from 2017 through 2019 due to weather and field conditions limiting biosolids application. In addition to a decrease in the number of days for land application over the past three years, the volume applied per day has varied significantly. When evaluating based on average daily rates, the quantity has been decreasing for similar reasons related to weather and field accessibility (Figure 2-9). From 2016 through 2019, the volume of biosolids hauled for land application has decreased from an average of approximately 500,000 gallons per hauling day in 2016 to 364,237 gallons per hauling day in 2019. This is, in part, due to a change made in application rates after 2016. Rates of application to bean and wheat fields were reduced by approximately 25% to match University of Wisconsin recommendations, which requires additional application sites and decreased efficiency.

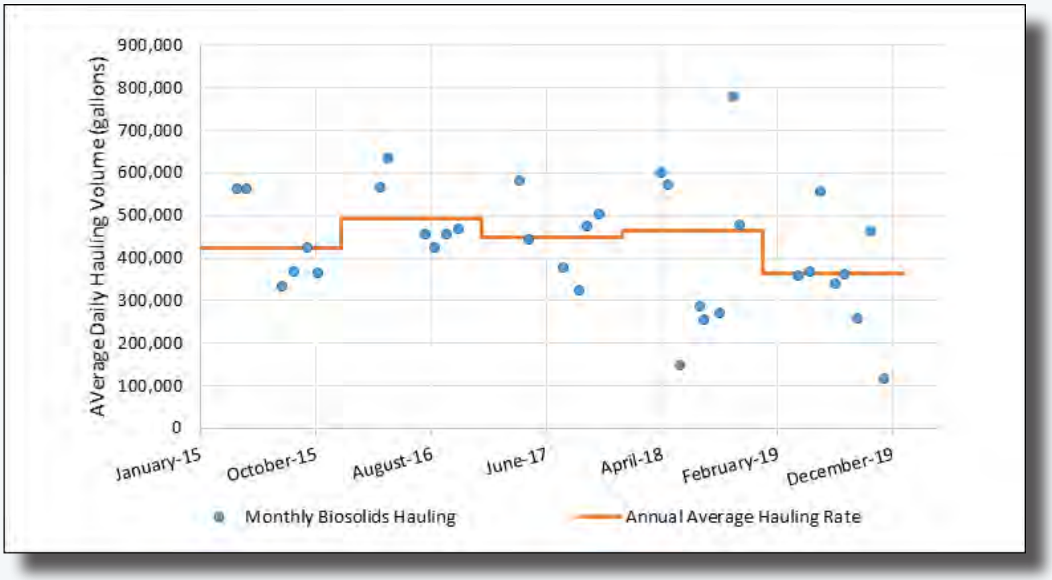
Annual biosolids production rates from historical data and future projections can be analyzed in terms of hauling requirements. For a given number of hauling days in a year, this then dictates the volume of hauling that is required per day. Using the historical annual solids production, and assuming a thickened digested biosolids concentration of 5.7% solids, the daily average hauling requirements were calculated assuming varying numbers of annual hauling days (100, 75, 50, and 25 days). The 5.7% biosolids is the concentration seen from the discharge of the GBTs. Concentration of the biosolids hauled may be lower as there may be additional breakdown in storage, however, this would not impact the volume of biosolids hauled. This can also be calculated for future solids production projections. The daily hauling volume for this range of annual hauling days is summarized in Figure 2-10. If there are 75 days of hauling in a given season, a daily hauling capacity of greater than 400,000 gallons per day would be required to land apply 100% of the yearly generated biosolids under the current average conditions. If a similar daily hauling capacity is available in 2030, it is projected that 100 days of hauling would be required.

A factor considered by MMSD when balancing the number of gallons hauled per day and the number of hauling days is the effect the reduced number of hauling days has on efforts to bring in contract workers. A greater number of hauling days means companies can rely on MMSD for more work and are more accommodating of the

Table 2 8: Number of Days of Biosolids Hauling Per Year

YEAR	BIOSOLIDS HAULED (DAYS)
2014	80
2015	81
2016	75
2017	77
2018	72
2019	70

Figure 2-9: Average Daily Hauling Volume during Biosolids Application



sporadic work schedules and their dependence on the weather. Less consistent work means they may be more likely to find other more stable and steady work.

Regrowth in Class A Biosolids

A full review of future regulatory drivers and considerations will be completed as part of Task B of the Biosolids Management Plan. A significant current regulatory consideration that impacts infrastructure decisions is related to regrowth of organisms in Class A biosolids. Following centrifuge dewatering of Class A digested biosolids, the MMSD has observed regrowth of fecal coliforms, which can be used to demonstrate compliance with the pathogen reduction requirements for land application. Testing will soon begin to determine if similar regrowth issues have been observed with the Class B dewatered product. MMSD completed a test run of Class B dewatering due to unique conditions at the plant that resulted in excess biosolids that were used to create Class B dewatered product. Regrowth has been observed in other facilities following centrifuge dewatering of digested biosolids, although its occurrence is case-specific. There is a significant amount of literature on this subject available, and much of it was summarized as part of a Water Environment Research Foundation project intended to identify research gaps and to investigate management strategies[1].

There is no clear conclusion as to the cause of the regrowth phenomena, however, potential contributing factors include higher shear during centrifugation and/or greater aeration / oxygenation of centrifuged cake (and associated inhibition of competing methanogenic activity combined with favorable conditions for facultative anaerobes such as E. coli). There is evidence that re-growth of E. coli (the predominant contributor to fecal coliform counts) is significantly more pronounced than other bacteria present in digested biosolids. It is suggested that the facultative nature of E. coli (able to grow under aerobic or anaerobic conditions) favors their growth over other bacteria when oxygen is introduced during dewatering[2].

In general, it can be concluded that there is a risk of exceeding a regulatory standard for Class B biosolids of 2 x 106 MPN or CFU of fecal coliforms per gram dry solids due to regrowth after centrifuge dewatering, particularly following post-dewatering cake storage for around two to seven days. The risk diminishes for longer storage periods. The MMSD has determined that with the Class A cake, a minimum of 30 days is needed to allow the fecal coliform levels to drop to acceptable levels, and as long as five months in the winter. Such a risk has not been observed with low-shear dewatering technologies such as belt filter presses.

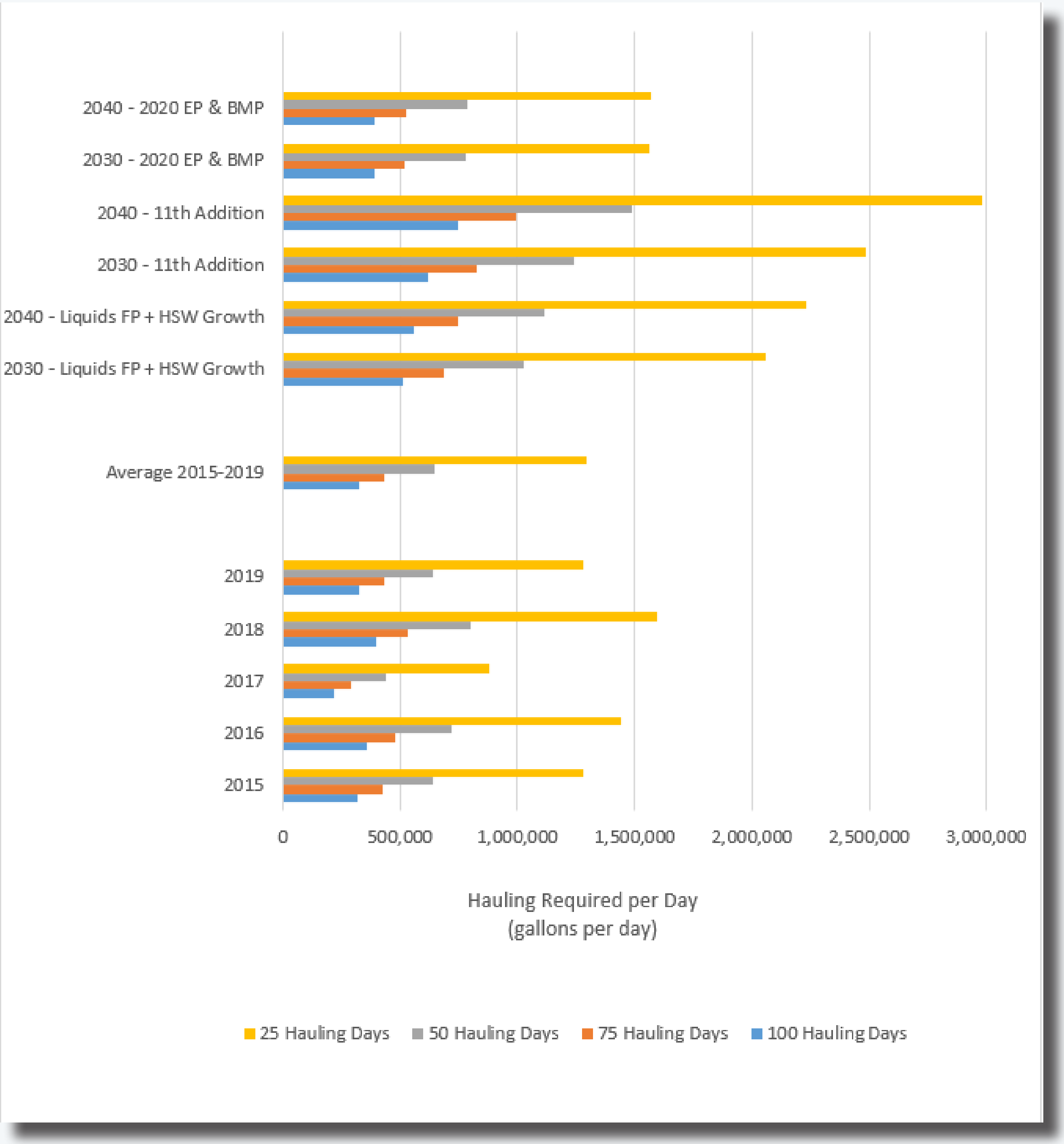
Infrastructure Gap Summary

Infrastructure gaps under current biosolids production rates are mainly tied to biosolids land application risks. Sufficient GBT capacity exists to process the digested biosolids, and the Metrogro tanks provide sufficient capacity to store the liquid biosolids product for more than the required 180 days. The main challenge is associated with hauling and land application of the biosolids product. If there are 75 days a year where biosolids are land applied, the MMSD would need to ensure a hauling capacity of 400,000 gallons per day. If there are fewer than 75 available days for land application, as observed in 2018 and 2019, the available hauling and land application capacity would need to increase or additional storage is necessary. Beginning in 2016, the hauling rates have seen a consistent and significant reduction due to staffing requirements, weather conditions, land availability, and recommended application rates. The uncertainties related to these drivers, and the lack of a safety factor between the required hauling rates and the historically achieved hauling rates, presents a high-risk condition under current biosolids production rates. In addition, regrowth of Class A dewatered cake presents a limitation on the use of this product.

When the potential solids production for the year 2030 is evaluated based on projections, all major infrastructure components present an infrastructure gap. The GBTs will be overloaded from a solids loading rate capacity if operated in a similar paradigm as currently operated (ex. a relatively small amount of centrifuge processing in a year). The Metrogro storage tanks will not provide sufficient storage volume, and the hauling and land application requirements will significantly exceed the achievable hauling and land application capacity seen in the past five (5) years.

1. Higgins, Matthew J.; Murthy, Sudhir N; “Wastewater Treatment Plant Design and Operation Modifications to Improve Management of Biosolids: Regrowth, Odors, and Sudden Increase in Indicator Organisms.” Water Environment Research Foundation, SRSK4T08, 2015.
2. Higgins, Matthew J.; Chen, Yen-Chih; Murthy, Sudhir N.; Hendrickson, Donald; Farrel, Joseph; Schafer, Perry, “Reactivation and growth of non-culturable indicator bacteria in anaerobically digested biosolids after centrifuge dewatering.” Water Research, v 41, n 3, p 665-673, February 2007; ISSN: 00431354; DOI: 10.1016/j.watres.2006.09.017; Publisher: Elsevier Ltd

Figure 2-10: Required biosolids hauling rate per day of hauling for different hauling days in a year



CHAPTER 3
BIOSOLIDS APPLICATION & NUTRIENT MANAGEMENT

BIOSOLIDS APPLICATION & NUTRIENT MANAGEMENT

PRODUCT OVERVIEW

MMSD's Biosolids Program is responsible for distributing all biosolids generated at the NSWWTP. As described in Chapter 2, NSWWTP generates two (2) types of products – Class B liquid (Metrogro) and Class A cake. MMSD's biosolids have been used in numerous applications as a fertilizer that provides nutrients and organic matter. Historically, MMSD's biosolids products have been utilized as fertilizer on arable land typically planted with soybeans, corn, or wheat. Very small quantities of cake and liquid products have been utilized as compost feedstock and used on commercial horticulture acreage.

Formerly, the District has also experimented with producing various value-added products with limited long-term success. One such product termed 'MetroMix™' was comprised of Class A biosolids, sand, and sawdust. While MetroMix™ performed adequately as a soil amendment, the production was discontinued as the operational cost of the program exceeded the benefit and revenue created.

The vast majority of biosolids currently produced are Metrogro (Class B-designated liquid). The primary task of the program is to land apply Metrogro onto agricultural fields planted with traditional row crops (soybeans, corn, and wheat). Historically, this has occurred within a 35-mile radius of NSWWTP. Biosolids application typically occurs in the spring before planting, late summer after wheat harvest, and/or fall after corn and soybean harvest. The product provides valuable nutrients for the crops and organic matter that improves soil health. MMSD bears all the costs (labor, equipment, fuel, etc.) for the hauling and application.

The quantity of Class A cake is very small compared to Metrogro. Class A cake solids have minimal restrictions on application. Class A cake is made sporadically and, due to fecal coliform regrowth, is stored for approximately 30-90 days prior to distribution. Recently, storage time has even been up to 10 months, carrying production from winter to the following fall after harvest.

OVERVIEW OF APPLIED & DISTRIBUTED PRODUCTS

Annual Volume Applied & Distributed

Table 3-1 summarizes the total annual volume applied and hauling days from 2014-2019. For the timeframe between 2014 and 2018, the average gallons hauled per year was greater than 35 million gallons. The year of 2019 was an anomaly compared to previous application years due to extreme environmental conditions significantly reducing the number of available fields. These conditions included increased total precipitation, more intense rain events, delayed planting, delayed or no harvest, and early snow. This did not significantly reduce the total number of days hauled, but greatly affected the amount hauled daily. In total, there was almost 10 million gallons less hauled during 2019 compared to the previous 5-year average.

In 2019, plant operators had increased the total solids output from the GBTs, which had a detrimental effect on the transfer pumping capacity to the tanker loading sites, which increased the queue times during loadout because of efficiency lost with a higher solids concentration or thicker product. Produced solids concentration, on average, increased from 5.5% (2014) total solids to 5.9% (2020) off the GBT.

Table 3-1: Annual Class B Liquid Application Amounts:

YEAR	ANNUAL GALLONS HAULED	NUMBER OF DAYS HAULING OCCURRED	AVERAGE DAILY GALLONS HAULED
2014	35,898,000	80	448,725
2015	34,259,200	81	422,953
2016	36,935,400	75	492,472
2017	34,615,400	77	449,550
2018	33,558,000	72	466,083
2019	25,496,600	70	364,237

While biosolids production remained steady during this timeframe, MMSD compensated for the reduced hauling in 2019 by commissioning temporary dewatering facilities and disposed of Class B cake in a landfill. In addition, MMSD contracted with a farmer to store liquid biosolids off site. The liquid biosolids were then land applied to that farm's fields in 2020 by a subcontracted applicator, Synagro Technologies. Synagro used a manure tanker to apply directly from the storage tanks to fields.

Characterization of Products

The biosolids produced from MMSD are a valuable nutrient resource. Biosolids have organic matter, nutrients, and other properties similar to manure and commercial fertilizers. The nutrients in biosolids have value to farmers and growers who have land bases that require nutrients to maintain fertility. Table 3-2 shows a comparison of the Metrogro concentrations to those of NR 204 Ceiling concentrations as established by (EPA 40 CFR Part 503).

Table 3-3 summarizes the 2019 analytical data of MMSD's biosolids products in terms of TS concentration and nutrient content. As discussed in previous sections, the main two (2) products produced are Metrogro and Class A cake. Recently, MMSD has been part of some experimental composting efforts in an effort to develop an enhanced fertilizer product. Class A cake has been utilized in four compost recipes through a pilot program. Some of the composting was developed and processed under a roof while others were processed outside. Finished compost was brought back to MMSD while the failed trials were land applied by the farmer due to the windrows being too wet to successfully compost.

The four recipes developed are:

- Class A cake and bedded-pack manure
- Class A cake and grass hay
- Class A cake and corn stalks
- Class A cake, bedded-pack manure, digested solids

The analyses of all four recipes are presented as an average in Table 3-3. Results are displayed in units associated with typical agronomic application to reflect the as-applied nutrient value. Conversion of these units to nutrient percent by dry weight could be misleading due to the moisture content when applied. Further analysis of nitrogen speciation could be beneficial to compare fertilizer value and would benefit the analysis of future production and application alternatives.

OVERVIEW OF EXISTING APPLICATION STRATEGY & METHODS

Review of Application Process

The factors affecting land application vary based on the application season. In the spring, landowners/operators make agreements for biosolids application based on timing, such as when they want the application completed. Summer application of biosolids is dependent on the planted winter wheat the previous fall. Winter wheat planting acres are dependent on several factors such as commodity pricing, available buyers, transportation costs, demand for wheat straw, and time commitment. In the fall, the application plan is based on availability of land after harvest. Overall, the ability to load tankers, work through traffic and roadway congestion, and manage landowner/operator expectations relates greatly to the efficiency and production of the application crews.

As outlined in Chapter 4, Biosolids staff (Resource Recovery Manager and Metrogro Operations Supervisor) develop the daily application plan a day prior. On the day of the event, the Metrogro Operations Supervisor reviews field conditions early in the morning (before 5:00 am) to provide enough time to notify contract haulers to reschedule before they start their day. If fields are in acceptable conditions, loadout typically starts by 6:00 am in two (2) locations if all sites are running – the Metrogro storage tanks (referred to as "The Hill") on the far west side of the NSWWTP, and the Vehicle Loading Bay (VLB) at the Metrogro Loading Station. These locations can be seen in Figure 3-1, Figure 3-2, and Figure 3-3 as follows.

Table 3-2: Metrogro Metal Concentrations

METAL POLLUTANT	UNIT[A]	METROGRO CONCENTRATIONS[B]	NR 204 CEILING CONCENTRATIONS	POLLUTANT CONCENTRATIONS LIMITS (SECTION 503.13)
Arsenic	mg/kg	5.3	75.0	41.0
Cadmium	mg/kg	1.06	85.0	39.0
Copper	mg/kg	574	4,300.0	1,500.0
Lead	mg/kg	25.24	840.0	300.0
Mercury	mg/kg	0.55	57.0	17.0
Molybdenum	mg/kg	20.20	75.0	-
Nickel	mg/kg	27.81	420.0	420.0
Selenium	mg/kg	6.8	100.0	36.0
Zinc	mg/kg	832.0	7,500.0	2,800.0

A. Dry Weight Basis
B. 2019 Average Concentrations

Table 3-3: Total Solids Concentration & Nutrient Summary for Metrogro & Class A Cake

PARAMETER	METROGRO	CLASS A CAKE	CLASS A CAKE (COMPOST)[B]
TS (%)	5.2%	25.0%	54.0%
Nitrogen			
lbs/1000 gal	22.7	-	-
lbs/CY	-	6.9A	-
lbs/ton (wet)	-	11.4	28
Phosphorus (P2O5)			
lbs/1000 gal	22	-	-
lbs/CY	-	16.4	-
lbs/ton (wet)	-	27.0	38
Potash/Potassium (K2O)			
lbs/1000 gal	2	-	-
lbs/CY	-	0.5	-
lbs/ton (wet)	-	0.8	24
Sulfur			
lbs/1000 gal	2	-	-
lbs/CY	-	1.5	-
lbs/ton (wet)	-	2.5	10

A. An average nitrogen value for Class A cake based upon when it was applied and/or incorporated into the soil. Because of the volatility of the nitrogen, it is lost to the atmosphere as it sits on the surface of the ground.

B. MMSD Biosolid compost is an average of four compost mixes. The potash value is reflective of the other feedstock utilized within the composting recipes like dairy manure.

Figure 3-1: NSWWTP Aerial Map Depicting Metrogro Loading Sites

Figure 3-2: The “Hill” Loading Site at NSWWTP

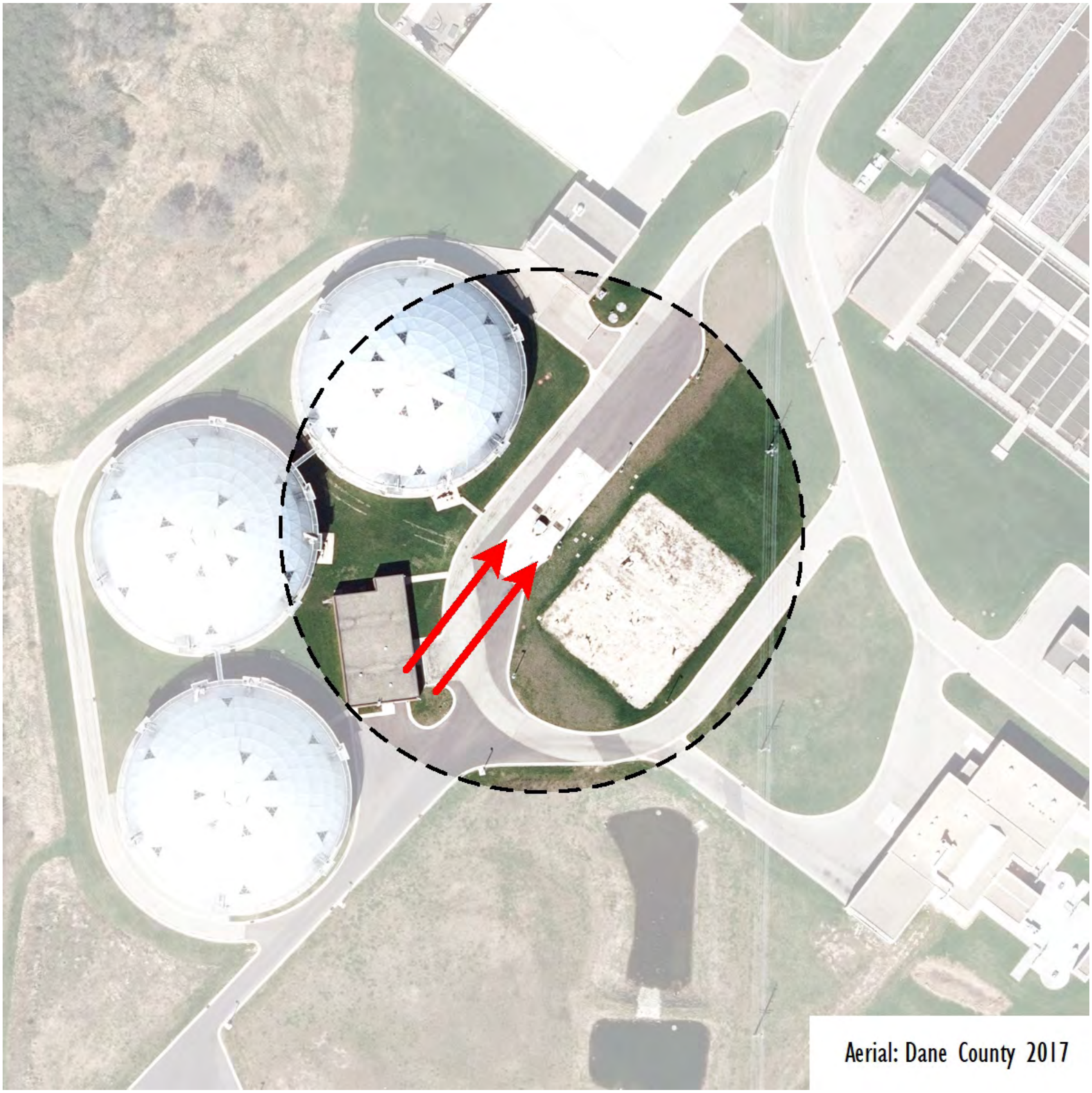
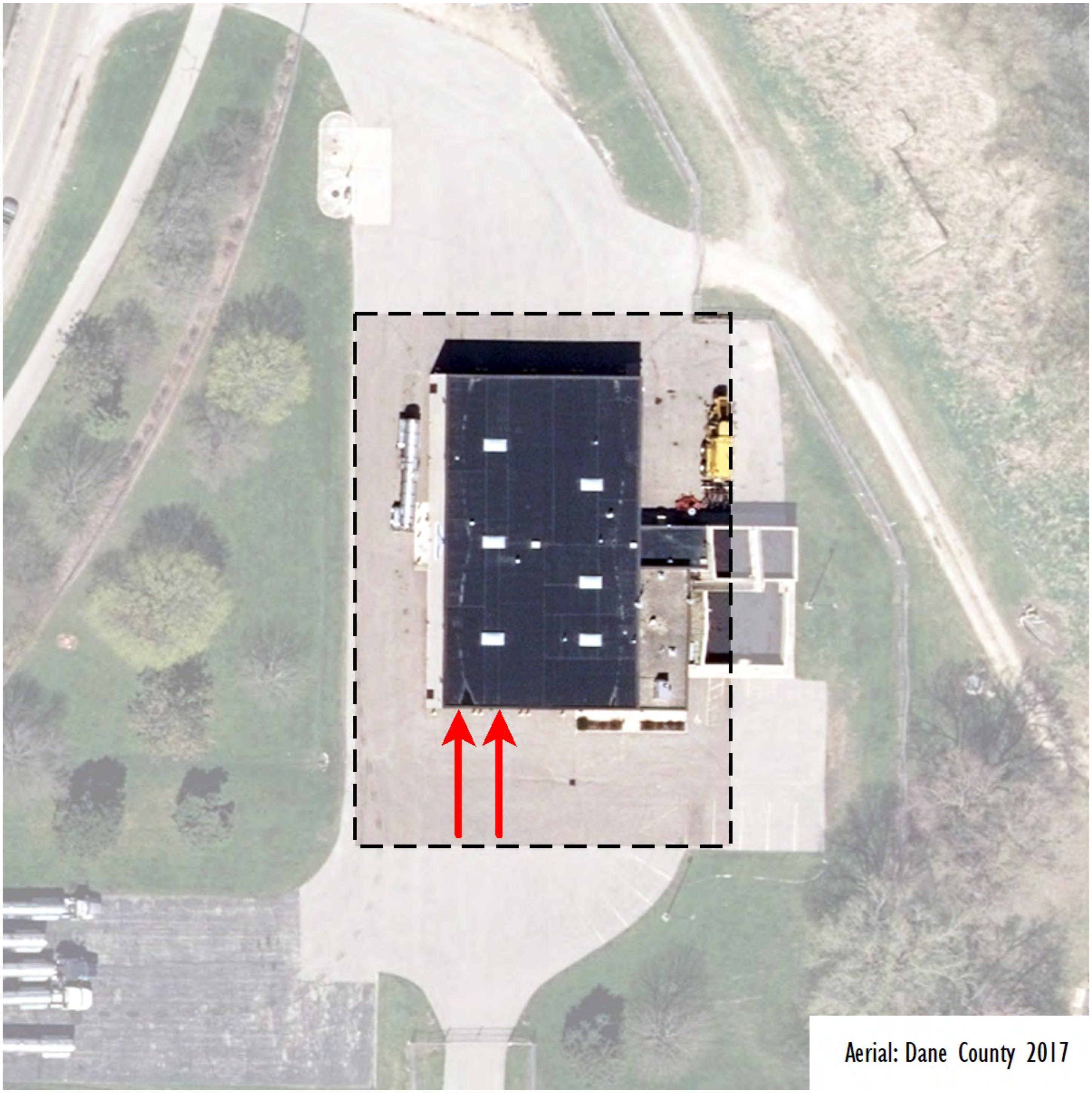
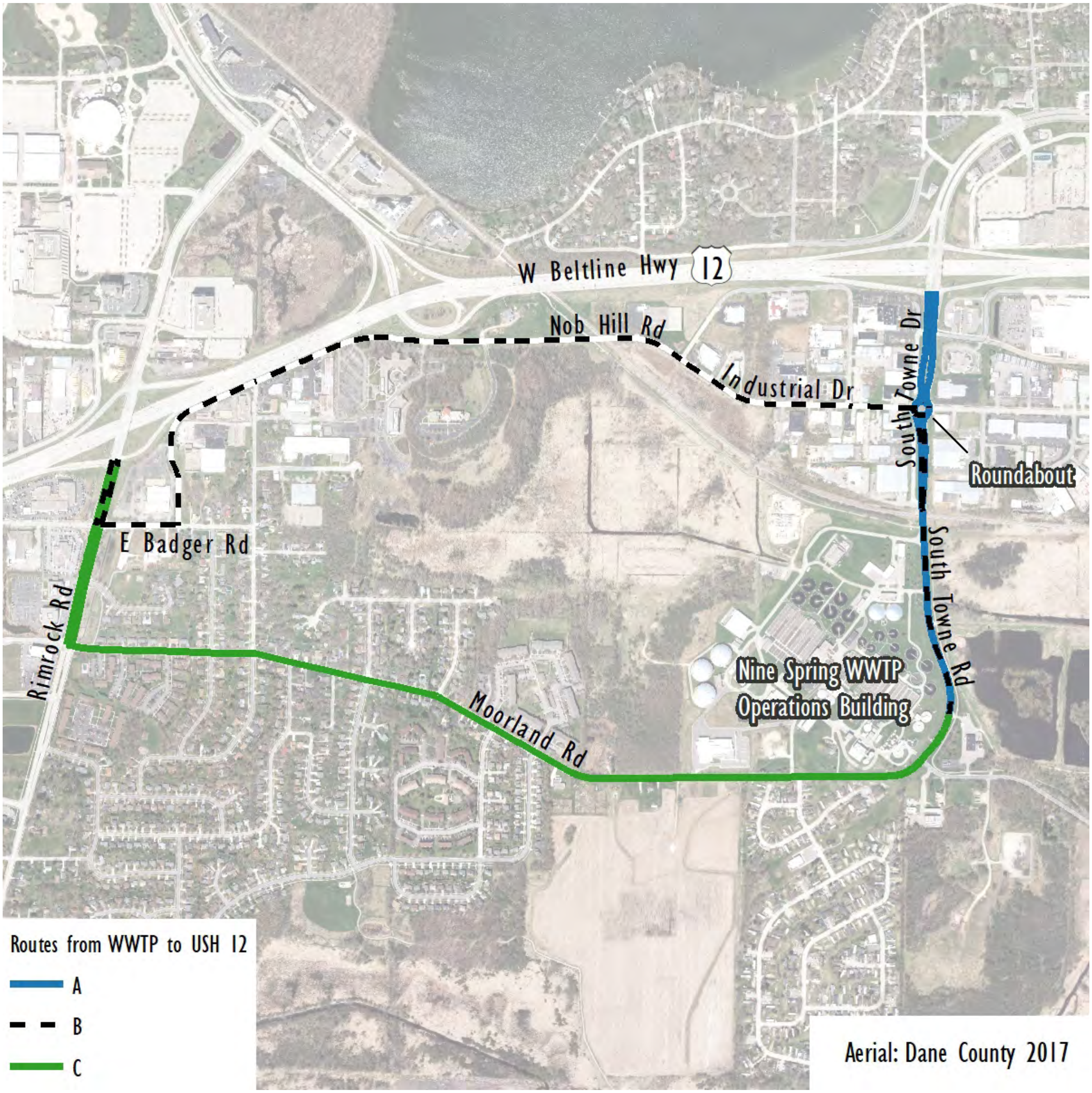


Figure 3-3: VLB Loading Site at the Metrogro Loading Station



At the VLB load-out site, tankers are required to be self-loading, however, not all the fleet has that capability. Based on fleet inventory, as described in more detail in Section 3.4, only semi-tankers #501-508, can do so. Therefore, these larger tankers are sent to the 'Hill' site because they are not vacuum pressure tanks. Once tankers are loaded, they drive to the field location of the assigned applicator. In order to access USH 12/Beltline, the haulers can only utilize designated tanker routes. See Figure 3-4.

Figure 3-4: Aerial of Roadways to Access USH 12



Metrogro semi-tankers can access USH 12 by three routes:

- **Route A -** South Towne Drive to USH 12
- **Route B -** Nob Hill Road to CTH 'MM' (Rimrock Rd) to USH 12
- **Route C -** Moorland Road to CTH 'MM' (Rimrock Rd) to USH 12 (Not a hauling route, City permission is required in order to use)

Route A is the preferred route; however, the time of day of hauling, the local traffic in this area, and congestion can increase hauling times to the fields and back to the loading stations.

Once a semi-tanker arrives at the field, it unloads into the nurse tank. Each nurse tank holds 11,500 – 13,000 gallons or approximately two semi-tanker loads each. Once the semi-tanker is unloaded, it returns to the same loadout location at the NSWWTP.

The applicators are equipped with suction pumps that allow them to self-load from the nurse tanks. The applicators then apply biosolids to the assigned field and return to the nurse tank to reload as needed. With the preferred method, applicators are equipped with an injection toolbar (See Figure 3-11). During colder temperatures, applicators are equipped with a stronger, more aggressive injection bar that can break through frost (See Figure 3-12) to apply. The operation continues throughout the day.

Infrastructure at the NSWWTP facilitates the loading of the semi tankers. At the 'Hill' loadout site, the loadout pump operates at approximately 930 to 990 gpm. The pumps were originally specified at 860 gpm but have received belt and sheave modifications over time. As previously discussed, self-loading tankers load at the VLB loadout site is not equipped with its own loadout pumps.

The VLB loadout site is equipped with 150,000 gallons of storage in two (2) separate tanks (100,000 gallons, and 50,000 gallons, respectively). The VLB tankage is filled from the large Metrogro tanks at the 'Hill' via a 500 gpm pump, but with the increased thickness in 2020, the pump is performing below 500 gpm. The tanks are at different elevations and loading is done preferentially from the upper tank to facilitate faster loading.

Regulatory Overview

40 CFR 503 (EPA Part 503 Biosolids Rule) sets the framework and minimum standards for management of municipal biosolids. The State of Wisconsin, through the DNR, administers and further regulates municipal biosolids through NR204. The regulations for land application are based around essentially four key elements:

- Pollutant (metals) concentrations
- Pathogen reduction requirements
- Vector attraction reduction (VAR) requirements
- Management practices (e.g., nutrient loading limits and site access)

Of these elements, pathogen reduction requirements often have the most significant impact on biosolids processing and management. To meet the criteria, a stabilization process, such as anaerobic digestion, is required. There are two levels of pathogen reduction: Class A, which has the most stringent requirements, and Class B. Both levels equally protect human health and the environment, but Class B relies more on site access restrictions as compared to Class A, which requires treatment to reduce pathogens to below detection level.

Biosolids achieving Class A have few restrictions and can be distributed to the public. The existing cake product is permitted as Class A. Class B-designated biosolids have additional restrictions on end use and reporting requirements to ensure protection of human health and the environment. Many of these restrictions, and resulting administrative requirements, are discussed in the following chapter of this report. Since a vast majority of biosolids managed by the Biosolids Program are designated as Class B, they will be the focus of this report. NR204.07 regulations largely set the application and nutrient management strategy of the Biosolids Program and are discussed in the following sections.

Application Schedule

As discussed in Section 3.2.1, the number of days Metrogro was able to haul are trending down. In order to maintain adequate storage at NSWWTP, Metrogro's benchmark is to land apply approximately 15 days per month during the historical hauling periods of April-May, and August-November. In 2018 and 2019, hauling and application had also occurred in June and July. Both years experienced many rain days and saturated field conditions, reducing days available to work in April through May, and pushing biosolids application into June. Additionally, because of the wet conditions, farmers were not able to plant and fields were left fallow thus allowing biosolids to be applied in July.

Climate change and other factors have either reduced the number of available hauling days, and/or reduced the daily hauling volume. Due to soil type, soil condition, precipitation, and saturation level, MMSD is not able to operate at full hauling and application capacity at most times. Further analysis needs to be completed to determine where efficiencies can be gained. For example, reviewing total mileage traveled (rather than one-way trip mileage) can help determine cycle times and efficiency with making sure applicators are being fed continually.

The type of crop greatly impacts Metrogro's land application program. Locally, soybeans and corn are the predominant crops. Therefore, farmers require that most application occurs in the spring prior to planting, or in the fall after harvest. In addition, some wheat acres are available mid-growing season creating more flexibility and a greater window throughout the year to apply biosolids. However, in general, wheat acres are trending down within Dane County.

MMSD has incentive programs for farmers with the intent of increasing the amount of land available, particularly during the spring and late summer. A Yield Loss Guarantee program incentivizes farmers to delay planting and in return be compensated for the yield loss for planting the crop later than an ideal time. The intent is to increase the number of spring hauling days. A Wheat Yield guarantee program is designed to incentivize farmers to plant more wheat, and thus increase the amount of late-summer acreage. The Wheat Yield program was initiated in 2019 to begin in 2020, so performance of the program has not been evaluated. The late, and wet, 2019 harvest season did not allow for much wheat to be planted (preferred planting is between September 15th and October 1st), so interest and signups were low. As evident by the continual decrease in hauling days and daily volume, both incentive programs must offset the decrease in hauling days and daily volume hauled experienced in recent years.

Figure 3-5 summarizes monthly application volumes, application days, and one-way average trip mileage for the semi-tankers from 2014-2019. All three (3) parameters are trending down year-to-year. Certainly, reducing mileage is advantageous because it reduces wear and tear and operational costs on equipment. However, this is more a reflection of the reduced operational days than proximity of fields to the facility.

Application Setbacks

NR204.07 provides the restrictions for the land application of Class B biosolids in order to maintain adequate protection for human health and environmental protection. Restrictions for incorporation and injection methods of application are listed in Table 3-4.

Figure 3-5: Monthly application volumes, the number of days applications were being done in one month, and one-way average trip mileage for the semi-tanker per month from 2014 through 2019

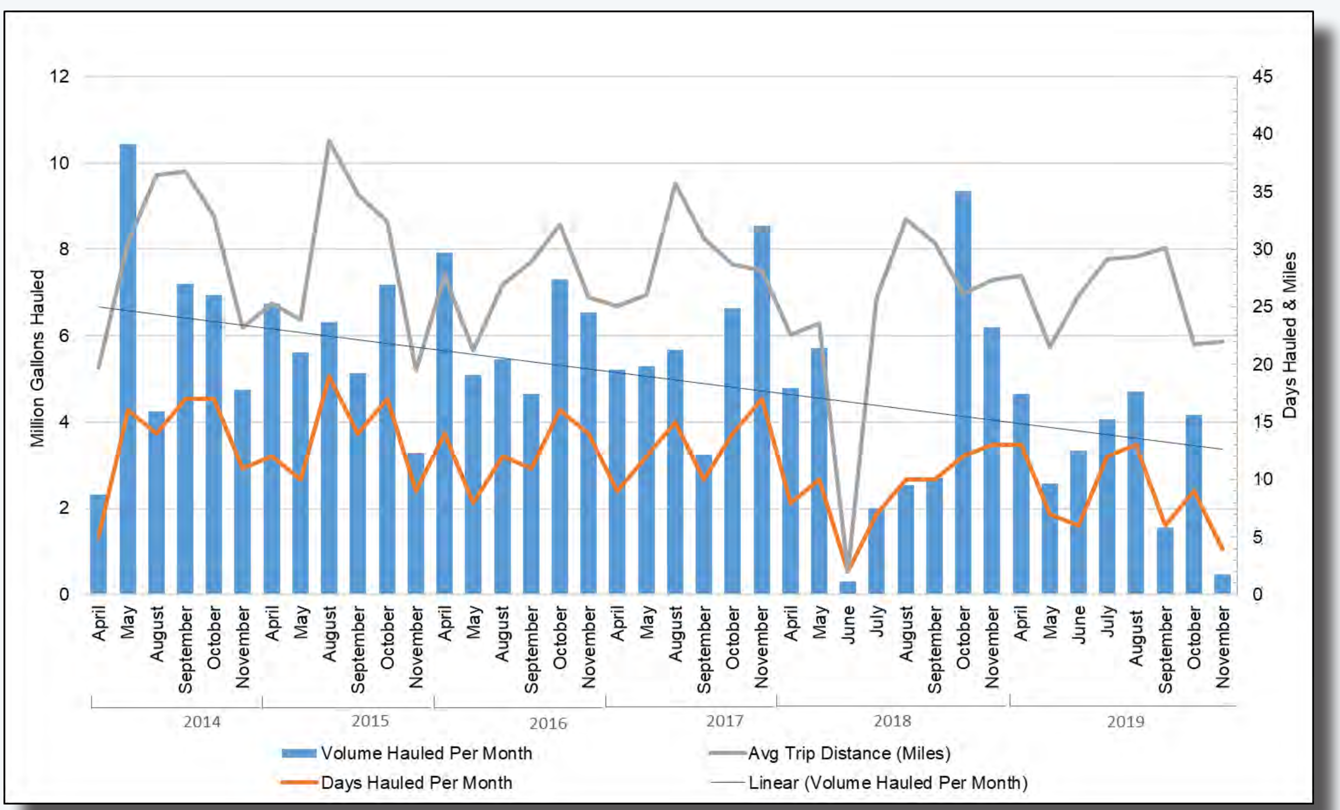


Table 3-4: Summary of Wisconsin Admin Code 204.07 Restrictions for Class B

SITE CRITERIA	INCORPORATION	INJECTION
Depth to bedrock	3 ft	3 ft
Depth to high groundwater	3 ft	3 ft
Allowable slopes	0 – 12%	0 – 12%
Distance to community water supply or school	1,000 ft	1,000 ft
Distance to other wells	250 ft*	250 ft*
Minimum distance to residence, business or recreation area	200 ft	200 ft
Distance to rural schools or businesses with permission	100 ft	100 ft
Distance to rural schools and health care facilities	1,000 ft	1,000 ft
Distance to property line	25 ft**	25 ft**
Minimum distance to streams, lakes, ponds, wetlands or channelized waterways connected to a stream, lake, pond or wetland.		
Slope 0 to <6%	150 ft	100 ft
Slope 6 to <12%	200 ft	150 ft
Minimum distance to grass waterways, or dry run with a 50 ft range grass strip.***		
Slope 0 to <6%	50 ft	25 ft
Slope 6 to <12%	100 ft	50 ft
Soil Permeability Range (in/hr.)	0-6.0	0-6.0
pH	5.5 or greater	5.5 or greater

* Separation distances to non-potable wells used for irrigation or monitoring may be reduced to 50 feet if the sludge is incorporated or injected and the department does not determine that a greater distance to the wells is required to protect the groundwater.
** The distances to a property lines may be reduced with the written permission of both property owners.
*** Separation distances not required if grass waterway or dry run with grass strip is contained within a site or field for the purpose of erosion control.

These setbacks, listed in Table 3-4, greatly affect the number of acres that Class B biosolids can be applied. Setbacks may reduce the available acreage up to 10%, whereas restrictions on the application of agricultural manure and Class A biosolids are less. This allows for more solids to be applied on the field and better fertilizer coverage for the farmers. The Class B restrictions affect the growers, as they have to still apply nutrients (typically commercial fertilizer) to maximize yield on all acreage and balance the field fertility.

Application Rates

The amount of biosolids applied to fields is driven by the previous crop (especially a legume), the organic matter percentage, and the available nitrogen in the biosolids. For example, its respective yield potential, rotational crop benefit, amount of nitrogen credits in the field prior to planting, and pounds of available nitrogen per gallon of biosolids are used to determine the quantity of biosolids that can be applied per acre. A loamy soil with a high yield potential would have a recommended crop (corn) need from 0 to 190 lb. N per acre based on previous crop and soil test organic matter. From Table 3-3, the nitrogen concentration for the Metrogro liquid in 2019 was 22.7 lb. per 1000 gal., resulting in an application rate of 8,370 gal. per acre for a corn on corn field. Limiting the amount of nutrients on a field is important because over application can lead to leaching.

The inherent challenge with applying biosolids only per nitrogen need is the compounding of phosphorus. With the same example above, 8,370 gallons per acre were applied and Table 3-3 notes 22 lb. P2O5 per 1,000 gal. results in 184 lb. of P2O5 to be applied to each acre. A grain corn crop yielding 90-210 bushels per acre will utilize about 40 lb. of P2O5 per acre thus allowing 144 lb. of P2O5 per acre to remain in the field. This equates to an additional 3.6 years' worth of additional phosphorus in the field. In general, approximately 18 lb. of P2O5 per acre will raise the soil concentration 1 ppm. Therefore, phosphorus in the field would be increased up to 8 ppm in one application. This is a significant increase per application if applied annually and does not take long to reach the maximum limit—of 30 ppm (NRCS Standard 590). According to the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP), the average phosphorus level in tested agricultural fields is 53 ppm of P2O5. In the future, this issue may become the most challenging issue for MMSD's land application program.

In order to maintain a successful program, the Resource Recovery Manager spends a large amount of time permitting fields in order to provide the program more flexibility. This is done solely to manage availability for spring, summer and fall applications.

Spring application presents multiple challenges. The time between when the fields are suitable and when the farmer wants to plant is short, and thus the application window is small. Further the particular tillage practices, such as no-till or strip-till do not allow for biosolids application, and spring application causes a great deal of compaction.

In summary, for MMSD to maintain a successful Class B liquid biosolid program, a large, available acreage base is critical. The restrictions for Class B products require more acreage than if Class A products were to be applied. Also, it is imperative that MMSD and Metrogro expand hauling and application capabilities to match or exceed the necessary acreage base.

Application Labor

Metrogro is setup as a supervisory and management operation relying on contracted semi tractors, drivers, and equipment operators to handle the actual transportation and application.

Metrogro staff includes five (5) people:

- Resource Recovery Manager
- Metrogro Operations Supervisor
- Biosolids Program Assistant
- Two (2) Mechanics

It is clear these staff are the primary reason farmers are willing to work with MMSD and accept biosolids. Positive feedback was received from customers about their working relationship with Metrogro staff.

Since 2017, the Metrogro staff (including contracted workers) have significantly increased the efficient use of available hauling days. As shown in Table 3-1, the number of actual hauled days has remained steady. However, prior to 2017, Metrogro staff did not need to use all the available hauling days. Therefore, daily schedules were reasonable, and minimal weekend work was required. Conversely in the later three years, nearly every available day was used to haul and/or administer the program. Daily hours increased with minimal days off during the hauling periods. This was due to implementing more stringent application standards based on the growing crop, and increased precipitation. These factors reduced the amount of available days, and the amount that could be hauled daily, and greatly increased the burden on staff.

To maximize efficiency, four (4) application groups are running simultaneously, requiring four (4) applicator operators and 15 tanker drivers. Operators and tanker drivers are farm staff from the application sites. This is common, as biosolids application typically occurs when farm staff has available time. The tanker drivers are typically retired individuals, but in 2020 with the pandemic, retirees were not willing to work. In order to get all semi-tankers operating, MMSD hires contractors for labor and tankers (MMSD owns six (6) semi-tractors, see Table 3-5).

Using contractor labor can be challenging. Particularly in the fall, drivers typically prioritize harvesting work over biosolids application. Therefore, scheduling drivers can be difficult for Metrogro staff and require them to frequently reschedule hauling at the last minute.

Another challenge of a large contract workforce is their inattention to some of the details required for the program, such as the record keeping. Metrogro staff tend to rework records, resulting in inefficiencies for Metrogro staff.

Metrogro is limited in operation to four (4) field application sites simultaneously because of only having 4 nurse tanks. Additional pieces of equipment reduces downtime in the case of mechanical problems or delay in getting parts. It is estimated more tankers will be needed to keep nurse tanks with a quantity of biosolids to create better cycle times and increase the amount of biosolids applied per day.

OVERVIEW OF EXISTING APPLICATION EQUIPMENT

The existing fleet of equipment is designed to serve a liquid application program. The major components of the fleet include 15 semi-tankers, four (4) nurse tanks, six (6) applicators, and six (6) semi tractors. All remaining equipment is provided through the contracted haulers. The Metrogro program does not have any dedicated equipment for the transport and hauling of Class A cake. Farmers and others interested in Class A cake must pick it up from the NSWWTP.

Liquid Handling Equipment

Metrogro's fleet is set up for injection or surface application with incorporation per the requirements of NR204.07. In general, the fleet is in good operational. A complete list of Metrogro equipment is listed in Table 3-5. All equipment listed is owned and maintained by MMSD. Each piece of equipment receives a 1-10 ranking from Metrogro staff. The ranking system is a subjective system developed by Metrogro staff to rank the overall condition and maintenance needs of the equipment. A more detailed and comprehensive evaluation of all major equipment assigned to the Biosolids Program is included in MMSD's asset registry. Based on the age and rank, further investment is needed for newer equipment to meet near- and long-term demand. In addition, modern agricultural practices require equipment that maximizes efficiency and automation, minimizes compaction, complies with minimum or no-tillage practices, and reduces emissions.

Table 3-5: Metrogro's Liquid Application Fleet List

FLEET NUMBER	YEAR	DESCRIPTION	RANK (1-10)	CAPACITY
501	1980	IME Semi-tanker	5	5,000 gal
502	1980	IME Semi-tanker	6	5,000 gal
503	1980	IME Semi-tanker	6	5,000 gal
504	1980	IME Semi-tanker	5	5,000 gal
505	1980	IME Semi-tanker	6	5,000 gal
506	1980	IME Semi-tanker	6	5,000 gal
507	1996	Pressure Vac System Semi-tanker	7	5,000 gal
508	1997	Pressure Vac System Semi-tanker	7	5,000 gal
509	1999	STE Semi-tanker	9	5,700 gal
510	1999	STE Semi-tanker	9	5,700 gal
511	2000	STE Semi-tanker	9	5,700 gal
512	2000	STE Semi-tanker	8	5,700 gal
513	2004	STE Semi-tanker	8	5,700 gal
514	2004	STE Semi-tanker	9	5,700 gal
515	2010	Brenner Semi-tanker	10	5,700 gal
302	1998	Nurse Tank	6	11,500 gal
302	1997	Nurse Tank	6	11,500 gal
303	1997	Nurse Tank	9	11,500 gal
304	1997	Nurse Tank	7	13,000 gal
209	2004	9105 Terra-Gator	7	4,300 gal
210	2005	9105 Terra-Gator	8	4,300 gal
211	2006	9105 Terra-Gator	8	4,300 gal
212	2005	9105 Terra-Gator	9	4,300 gal
213	2008	9105 Terra-Gator	7	5,300 gal
214	2019	Oxbo LNMS AT5105	10	6,600 gal
401	1995	Ford Semi Tractor, air ride	8	NA
402	1993	Ford Semi Tractor, spring ride	5	NA
403	1993	Ford Semi Tractor, spring ride	5	NA
404	1995	Ford Semi Tractor, air ride	8	NA
405	1994	International Semi-Tractor, air ride	8	NA
406	1994	International Semi-Tractor, air ride	7	NA

FIGURE 3-6 THROUGH 3-12 PROVIDE PHOTOS OF A REPRESENTATIVE SAMPLE OF THE METROGRO FLEET.

Figure 3-6: Photo of a two of Metrogro's semi tractors. The near tractor is connected to one of the nurse tanks. (Courtesy of Metrogro staff)

Figure 3-7: Photo of several of Metrogro's semi tanks. Specifically, this tanker is a vacuum pressure tanker. (Courtesy of Metrogro staff)

Figure 3-8: Photo of three of Metrogro's nurse tanks. (Courtesy of Metrogro staff)

Figure 3-9: Photo of Several of Metrogro Terra-Gator Applicators. (Courtesy of Metrogro staff)

Figure 3-10: Newest addition to the fleet, an Oxbo applicator equipped with GPS. (Courtesy of Metrogro staff)

Figure 3-11: Photo of Kongskilde injector with discs. Most common applicator used by Metrogro and this one is mounted on the Oxbo.

Figure 3-12: Photo of Brillian shank toolbar with surface applicator. Primarily used in winter because it can handle shallow frozen ground. (Courtesy of Metrogro staff)

Within the semi-tanker fleet of Metrogro there are two basic types of tankers. Tankers #509-515, only have the ability to unload. Tankers #501-508 are equipped with a pump on the tanker, which allows for self-loading and unloading. This is important because of the two types of loadout sites at the facilities. The “Hill” has pumps to load tankers, but VLB does not have this ability. Therefore, only the tankers equipped with suction-lift pumps can utilize this site. To improve efficiency, Metrogro has retrofitted five (5) tankers with top loading valves for the 2020 season.

Solids Handling Equipment

The Biosolids Program is dedicated to liquid land application and owns a minimal amount of solids handling equipment. The dewatering operation operates very sporadically, and therefore, has not justified investment into this type of equipment. There is a 2002 John Deere Wheel Loader shared between all departments at the NSWWTP. The shared loader is undersized for managing cake biosolids because the lift height does not make loading these taller trailers easy. It is likely the Biosolids Program would need to rent or purchase additional equipment to handle any increased demand.

SUMMARY OF CHALLENGES & INFRASTRUCTURE GAPS

- In the last five (5) years, the annual number of hauling days and average daily hauling volume has decreased, primarily due to weather constraints. Reduced available acreage in the spring is attributabled to weather and more. This has significantly increased strain on staffing, loadout infrastructure, and the hauling fleet. In 2019, the Biosolids Program was unable to empty tanks and apply the required amount of biosolids. This added significant cost to the program, as MMSD had to contract out for temporary storage, land application, dewatering, and landfilling.
- Setback restrictions cause a loss of Class B liquid land application efficiency because biosolids cannot be spread within the setbacks and commercial fertilizer must be purchased and applied to said acreage.
- Applying biosolids based on nitrogen only per NR204.07 could impact land availability, due to phosphorus overloading.
- Additional demands on the Metrogro labor force during the fall harvest cause a shortage of contracted operators and drivers. In addition, the existing subcontracted labor force does not want to work the necessary hours and days required for application.
- Metrogro’s application fleet does not align with the preferred no-tillage or minimum-tillage practices. Older and heavier equipment is not attractive to farmers due to the added compaction in the fields.
- Only one applicator, the 2019 Oxbo, has GPS applicator capabilities and the ability to work within precision agricultural applications. GPS capabilities minimize the current manual data entry process (Ch. 4). Additional technologically-advanced equipment will create additional operator training and data management.
- Maximizing efficiency during the available hauling days is critical to meet annual application volume requirements. Currently, field applicators are queued at the nurse tanks waiting for the semi-tankers to arrive with more product. More semi-tankers are necessary as well as an increase in capacity of the load-out infrastructure.
- Metrogro developed the Trucking Cost Program to pay customers to pick up Class A cake and to incentivize with equipment/labor to load transport vehicles. However, Class A cake lacks uniformity and is ‘sticky/gluey’ which makes application very difficult. In addition, the cake is not worth the value of the transportation and spreading costs. This has led to near-zero demand for cake biosolids.
- As discussed in the previous chapter, Class A cake regrowth presents numerous logistical and storage concerns. The cake is not ready for application/distribution until mid-summer, which is a time of low demand. This further increases the amount of time Class A cake must be stored on site.

CHAPTER 4
PROGRAM ADMINISTRATION & DATA MANAGEMENT ASSESSMENT

PROGRAM ADMINISTRATION & DATA MANAGEMENT ASSESSMENT

PROGRAM INTRODUCTION

Data management impacts the daily workflow for staff and can increase/decrease the efficiencies of regular operations at MMSD. The Metrogro staff are tasked with managing the necessary permits for biosolids application, proper communication with participating farmers, determining application rates, coordinating trucking and application to fields, maintaining soil testing information, coordinating with nutrient/bacteria/heavy metal testing of biosolids, and annual reporting to the DNR about program-wide applications.

The current data management system was designed in the mid-1990s, and while it served the needs of MMSD at the time, it has since become outdated. Changes to permitting requirements and Metrogro internal processing, as well as staffing transitions (e.g. a new Resource Recovery Manager, new IT staff managing databases, hiring of contract workers for hauling and field application, etc.) has resulted in noticeable inefficiencies. Therefore, as part of the Biosolids Management Plan, a comprehensive review of the current data management procedures was requested to identify goals and provide a list of potential alternatives that can improve processes and staff efficiency.

MSA staff met with MMSD staff on March 10th, 2020, to review daily management operations, which vary throughout the course of the year. The goal of the meeting was to document workflows, identify challenges, and to create a list of data management goals. The following individuals were in attendance:

- Kim Meyer, Resource Recovery Manager, MMSD
- Martye Griffin, Director of Ecosystem Services, MMSD
- Drew Linton, Programmer Analyst, MMSD
- Amber Converse, Senior GIS Analyst, MSA
- Andy Skwor, Team Leader, MSA
- Andrew Skog, Project Engineer, MSA

Martin Griffin, Director of Ecosystem Services, oversees the Metrogro program providing strategic direction to meet the programs overall goals and assure customer satisfaction. Kim Meyer, Resource Recovery Manager (RRM), handles much of the administration for the Metrogro program. She coordinates with farmers/landowners, organizes soil testing, records when fields are limed, reports hours to pay contract employees, receives biosolids testing for nutrient content, bacteria and heavy metals, rolls up the yearly documentation required to submit to the DNR and reports nutrient application information back to the farmer.

Ross Hollfelder, Metrogro Operations Supervisor (MOS), manages the logistical components of the Metrogro program. His role entails determining haul routes, staying abreast of spring road closures, scheduling contractor employees for hauling and application to fields, tracking tanks and trucks throughout the application season, collecting trip tickets from haulers, organizing daily logs by the applicators, installing and monitoring rain gauges at field sites, and conducting site visits to confirm soil conditions and oversee field application. The MOS was not present at the meeting, but the RRM summarized his general role within Metrogro.

Drew Linton, Programming Analyst, is the main contact for making changes to the Metrogro Microsoft Access database. He is versed in the SQL Server database that houses the bulk of the data used for the program and makes changes to the Access database front end, modifying the data entry and reporting capabilities that are available to the RRM.

EXISTING DATASETS

The following subsections detail the various data sources that were referenced and discussed during the March meeting and later correspondences to better understand existing workflows.

Examples of database screenshots or forms, where applicable, are included within Appendix A.

Metrogro Access Database

The Metrogro Access database is linked to SQL Server tables. MSA was provided with a static copy of the existing database with copies of the data tables for review. The database is housed on the MMSD server and potentially could be accessed by others at MMSD. The RRM is the primary user of the database, with support from the IT department primarily through programmer analyst.

This database contains information associated with:

- Metrogro customer farms and fields
- Participating farmers
- Permitted acres available for biosolids application
- Contractor information
- Contractor hours worked
- Application information
- Hauling information
- Soil testing results
- Biosolids testing results
- Contractor hours

This database was the original solution developed in the 1990s and has been maintained with coordination of the MMSD IT department. It was expressed that the data is relatively complete, although the usability, importing capabilities, and reporting outputs could be improved. Some of the existing functionality was created with different user needs and may no longer be required by the Metrogro staff.

Annual Field List

The Annual Field List is a Microsoft Excel table maintained by the RRM. This Excel file was created by the RRM for ease-of-use and she creates a new list annually.

The Excel file is organized by spring and summer/fall application and by unique field ID. It includes duplicative information from the Metrogro Access database (See Section 4.2.1), such as:

- Farm ID
- Field ID
- DNR ID
- Number of acres
- Number of approved acres
- Date of the most recent soil test
- Soil test pH
- Total gallons of biosolids applied to the fields (based on Daily Logs)
- Biosolids application rate (a calculation, the total volume applied divided by the total number of available acres)

Unique data for each field includes:

- Cropping information for the previous crop year (determined from talking with the farmer or other means)
- Yield potential (determined based on the field's predominant soil type)
- Target Nitrogen application rate (lb N/acre, determined based on yield potential and the recommended maximum return to nitrogen [MRTN] rate for the planted crop)
- Maximum Nitrogen application rate (lb N/acre, the high range of the MRTN rate)
- Estimated application rate (gal/acre, based on historical biosolids nutrient concentrations and target Nitrogen application rate)
- Estimated total gallons of biosolids (based on approved acres and estimated application rate)

Some additional fields are added to assist in the RRM's workflow, including:

- A checkbox indicating if the maps have been created/reviewed
- A column for follow-up notes
- A checkbox for whether or not the farmer has a yield guarantee
- The completion date of work for that field.

Spreading Log

The Spreading Log is a Microsoft Excel table maintained by the RRM. This Excel file was created by the RRM for ease-of-use and she creates a new list annually.

The Excel file is organized by spring and summer/fall application and by unique field ID. Data is recorded here to clean up and ultimately is then manually entered into the Metrogro Access database (See Section 4.2.1). Some of this information is also saved within the Annual Field List (See Section 4.2.2). The Spreading Log is modeled after the CAFO style spreading log used in SnapPlus and contains the following information:

- Application date
- Driver ID
- Field ID
- Manure/process wastewater source (always biosolids)
- Spreader volume
- Number of loads (based on Daily Logs)
- Total volume (calculation based on spreader volume and number of loads)
- Total volume per field (calculation based on all of the application days)
- Number of acres applied
- Rate per acre (calculation based on total volume applied per field and number of acres)
- Application type (e.g. injection)

Metrogro Map

The Metrogro Map is a compilation of GIS datasets and an ArcGIS Online (AGO) web map created and maintained by MMSD GIS staff. The RRM operates in ArcGIS Desktop to view the data and make edits.

Farm and field boundaries are mapped and maintained for the Biosolids Program. Boundaries are digitized in GIS by the RRM when a new farmer asks to be involved in the program. Each field is traced based on aerial imagery (USDA-NAIP images or whatever aerial is most current) and then grouped into a farm area. The farm ID, field ID, and field number is assigned by MMSD staff when it is digitized, and a DNR ID is added later once the permit for biosolids is processed and approved by the DNR. All of this information is present within the Metrogro database, except for the shape of the mapped boundaries.

Field boundaries also contain the GIS acres, the retired status, the permission status, the State ID, the Parcel ID, the Parcel Date, the Tax Roll Year and associated ownership information (likely derived from the parcel information), and a Latitude/Longitude.

The map also contains data layers used for determining setbacks and exclusion areas for biosolids applications, including mapped WDNR wetland/water features and USDA-SSURGO Soils, a subset of the SSURGO soils that are classified as unsuitable for biosolids (e.g. shallow groundwater, steep slopes). Maps also contain wells that are part of the sampling program and estimated well locations with buffers for any well along field boundaries.

The current Biosolids Program operates in five (5) counties, including Dane, Columbia, Rock, Jefferson and Green. All of the GIS data is therefore limited to these counties.

Approved DNR Permits

The Approved DNR Permits are a set of paper copies for all the farm fields approved to receive biosolids through the Biosolids Program. These files are currently stored in hard copy format in the Metrogro office, but there are plans to scan in the documents into an online system, OneBase.

Each farm (or field) that is included within the Biosolids Program must receive DNR approval prior to applying biosolids. Metrogro staff facilitate the application process by completing the necessary paperwork: Land Application Site Request Form 3400-053. This also includes mapping the fields with the necessary setbacks to determine the approved acres available for biosolids, documenting the results of soil testing (nutrients, pH and organic matter information), completing soil borings, and answering additional questions from the DNR staff.

Each season, the hard copies of approved fields are referenced when a farmer requests to participate in the program. MMSD staff review if documentation is up to date, confirm if additional soil testing is required, for potentially re-submit individual permits if additional land area is to be included within the program. Approximately 40% of the annual paperwork is associated with re-permitting fields.

FORMS/DOCUMENTS USED BY THE BIOSOLIDS PROGRAM

The following data sources are used to populate the datasets described in Section 4.2. Some are documents prepared by contractors, others are other databases within MMSD.

Examples of forms or documents, where applicable, are included within Appendix A.

Soil Test Reports

Soil Test Reports are Excel or PDF copies provided by Soil Testing Operators. Soil testing reports are provided by the farmer or from the cooperatives/fertilizer company the completed the test originally. If a soil test is not available, MMSD will contract a lab to complete the test for a field.

Ideally, all of the soil testing reports would come in Excel in a format compatible with SnapPlus. However, these are often received as a PDF and not in a unified fashion, particularly from cooperatives/fertilizer companies. Soil test results are imported by hand into the Metrogro database (See Section 4.2.1).

Lime Records

Lime Reports are PDF invoices from private companies providing lime to fields. Fields with a pH of 5.5 or lower are required to have a lime application to increase the pH levels prior to a biosolids application per NR204.07(3)(e). Lime invoices are not saved within the Metrogro database. Instead, they are saved to the individual farmer's folder on the MMSD server. The RRM saves these files and submits them to the DNR via email prior to the annual report deadline.

Signed Permission Slips

Signed Permission Slips are a form created by MMSD and signed by all landowners within the Biosolids Program. All landowners must provide written approval to be part of the Biosolids Program. Landowners are not often on site (i.e. not farming the land themselves, instead renting it out) and historically have been slow to respond when a signature is requested. Typically, the RRM communicates with the farmer, then the landowner is called and emailed/mailed a copy of the form to be completed. Follow up contact with the landowner is often necessary.

Preliminary Trip Tickets

Contractors arrive at the MMSD facility in the early morning and are required to complete a Preliminary Trip Ticket Form (with carbon copy). This records their activity for the day and is also used for preparing and paying invoices for their work. The form includes:

- Tanker ID
- Applicator ID
- Date
- Start/end times
- Total hours worked
- Vehicle inspected/greased status
- ETM quitting (a field that is no longer needed)
- Status of road restriction signs

- Status of field flagged
- Farm(s) ID
- Field(s) ID
- Number of semi loads
- Driver name

It has been noted that the contracted drivers are not vigilant at completing this form in its entirety and there are sometimes data integrity issues with individual entries. For example, the start/end times might not add up to the total hours worked, the farm ID or field ID is not populated, etc. The MOS has to call individuals to rectify this information with drivers/others who were onsite. Hours worked are added to the added to the Metrogro database (See Section 4.2.1), to facilitate invoicing and payment.

The remainder of the information recorded on this form is outdates and therefore not added to the Metrogro database (See Section 4.2.1). Instead, it is a quality control check against the submitted Daily Logs (See Section 4.3.5).

Daily Logs for Application of Biosolids

Daily Logs are recorded on a paper form completed by contract staff responsible for applying biosolids to fields. Contract applicators arrive to the field sites in the morning and are required to complete a Daily Log form. This records their activity of the day and is also used for preparing and paying invoices for their work. The form includes:

- Applicator ID
- Date
- Driver name
- One row for each unique field ID

Since the applicator equipment only records cumulative amounts for the number of acres covered, the operate needs to also record the acres on the equipment at the start of the day and at the end of the day, to determine the number of total acres completed. They also record:

- Volume of the tanker
- Number of loads delivered to the field
- Total gallons applied (a calculation, based on the tanker volume and number of loads)
- Daily summation from all of the fields (based on the tanker volume and number of loads) as the applicator's recorded gallons delivered (this should be very close to the calculated total gallons applied)
- Total number of hours worked

It has been noted that the contracted applicators are not vigilant at completing this form in its entirety and there are sometimes data integrity issues with individual entries. For example, the field ID is not populated, the calculated gallons applied is grossly different from the recorded gallons applied, etc. The MOS has to call individuals to rectify this information with drivers/others who were onsite. Hours worked are also added to the Metrogro database (See Section 4.2.1), to facilitate invoicing and payment.

Some of this information is manually put into the Metrogro database (See Section 4.2.1) by the RRM on a daily basis using the "Alternate Trip Ticket" interface. This includes:

- Tanker ID
- Applicator ID
- Driver ID
- Date
- Hours worked
- Farm(s) ID
- Field(s) ID
- Number of applicator loads

Additional items included into Metrogro database (but not on the Trip Ticket) are the source of the biosolids (e.g. Metrogro Biosolids), the crop year and the application method (e.g. injection).

Data Acquisition & Reporting Center (DARC)

The Data Acquisition and Reporting Center (DARC) is a separate MMSD database used for storing analytical testing results for all of MMSD, including the testing of biosolids for nutrients, bacteria and heavy metal content.

Laboratory testing of biosolids are completed regularly by MMSD and recorded into the DARC database. Concentrations of nutrients, bacteria and heavy metals are sampled daily and are automatically added to the Metrogro database (See Section 4.2.1) daily using an automated SQL script. This information is used for manually calculating application rates by the RRM in the Annual Field List spreadsheet (See Section 4.2.2).

OUTPUT REPORTS REQUIRED

The following forms are required for permitting of the Biosolids Program. PDF copies of the completed forms are saved on the MMSD server.

Examples of output reports, where applicable, are included within Appendix A.

Annual Land Application Report

The Annual Land Application Report is submitted to the DNR by MMSD and documents biosolids application records.

This annual form is completed in January, recording the application of biosolids from the prior year. It includes the WPDES Permit Number and name, the FID number, the year for submittal, the county, the total amount of municipal sludge generated, and the total amount of municipal sludge land applied. A single row of data is provided for each field where biosolids are applied recording the following:

- Field DNR number
- Facility site ID
- Field number
- Landowner name
- Acres where biosolids were applied
- Outfall number (uniform for all Metrogro sites)
- Total amount of waste applied in gallons
- Nitrogen rate supplied from waste (lbs./acre)
- Additional sources of nitrogen applied
- Crop code
- Crop year
- Recommended nitrogen rate (lbs./acre)
- Method of application

All of this information is stored within the Metrogro database (See Section 4.2.1) and/or the Annual Field List (See Section 4.2.2). However, the current database design does not allow for an easy review of this information for creation of the annual report.

Characteristic Report

The Characteristic Report is an annual submittal to the DNR recording annual analysis results of heavy metal testing within the biosolids.

This annual form is completed in January, recording all the measured heavy metal concentrations within MMSD's biosolids over the previous year. Metal info is extracted from the weekly samples as one monthly composite. Bacteria samples are taken seven (7) times per month during application months and are reported as an average. Reported information includes:

- Permit number and name
- Reporting period
- Due date
- If biosolids were land applied
- Class of the biosolids
- If pathogen requirements were satisfied
- If vector control requirements were satisfied

A single row of data is provided for each heavy metal, for each month including the following information:

- Parameter number
- Name of the parameter (the heavy metal)
- Sample point number
- Date of the sample
- Sample type
- Analysis results with units
- Limit
- High quality limit
- Lab certification number

Land Application Site Request

The Land Application Site Request is a form required for submittal to the DNR for new land areas to be included within the Biosolids Program. This must be submitted to the DNR and approved prior to the application of biosolids. A hard copy of the completed forms is saved in file cabinets in the Metrogro office (See Section 4.2.5)

Any landowners that wish to participate in the Biosolids Program must have a completed application form, which documents the permittee (MMSD), basic information about the application site (e.g. section/town/range, soil characteristics, historical agricultural use, etc.) and a map showing the site with setback limitations (e.g. wetlands, depth to bedrock). New soil tests need to be conducted every four (4) years for the permit to be valid. A soil boring is required for regions with shallow bedrock and the boring is required annually for wet soils. Much of this information is stored within the Metrogro database (See Section 4.2.1) and the map is generated from the Metrogro map (See Section 4.2.4).

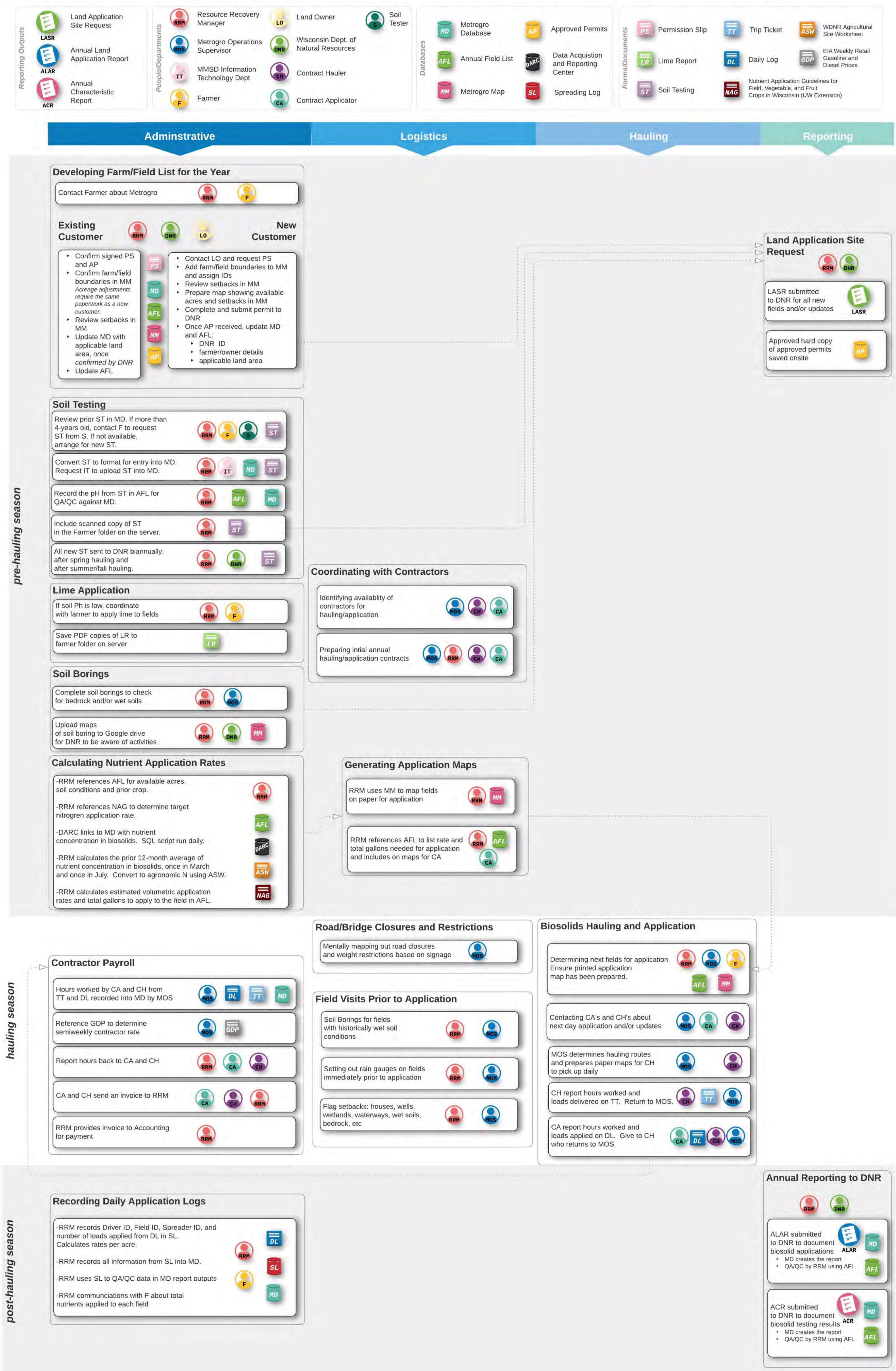
ADMINISTRATIVE LIQUID BIOSOLIDS WORKFLOW

The following is a brief description of the Resource Recovery Manager's (RRM) regular data management efforts to administer the liquid biosolids portion of Metrogro. This description is not intended to be exhaustive, but to instead provide basic insights into how certain data processing can be effective, while others can be time intensive.

Figure 4-1 is a visual illustration of this same workflow, displayed by type of process (Administrative, Logistics, Hauling, and Reporting) and by season (Pre-hauling, Hauling, and Post-hauling). Individual icons are displayed by type: Reporting Outputs, People/Departments, Databases, and Forms/Documents. This graphic was created to more easily identify where data management challenges are incurred and to see how it can slow/impact other parts of the program.

Figure 4-1: Existing Workflows, Liquid Biosolids Administration and Data Management.

Figure 4-1: Existing Workflows, Liquid Biosolids Administration and Data Management



At the beginning of each season, the RRM reaches out to farmers to gauge interest in the program, and farmers also reach out to indicate which fields they would like to include within the biosolids application program that upcoming year. Farmers indicate either spring application (generally not preferred by farmers due to soil conditions) or a summer/fall application (more common). The RRM will start with an initial GIS search to identify the farm and the specific fields. Two different procedures are followed, depending on if the field is already a customer with the Biosolids Program as outlined in the following subsections.

New Customer

The RRM will initiate a DNR permit application process. The first step is receiving a signed permission slip (See Section 4.3.3) from the landowner (who may or may not be the individual farming the land). The then RRM digitizes the farm and field(s) into GIS and assigns a farm ID and field ID. Basic information about the site are included on the DNR form, as well as a map showing the land area and excluded areas from biosolids application. The RRM will commonly visit the farm for a field check, complete the soil borings, and record the findings with the coordinates on a copy of the map. Once the permit is approved by the DNR, a new DNR ID for the site is assigned and entered into the Metrogro database (See Section 4.2.1) and the Annual Field List (See Section 4.2.2). The rest of the workflow is identical to an existing customer.

Existing Customer

The RRM will then refer to the Metrogro database (See Section 4.2.1) to find that farm/field and to see the available acres for biosolids application. If the acreage is less the total area of the field, the RRM will reference the paper copy of the approved permit (See Section 4.2.5) to see any setback restrictions on the site (e.g. wetlands, steep slopes, private wells, etc.). The RRM will also review the most recent soil test information (e.g. pH, nutrients, etc.), which must have been completed within four (4) years. Soil test information should be included with the paper copy of the permit. The RRM will reach out to the land owner or farmer to obtain a copy of the more recent soil test information, and record this manually into the Metrogro database (See Section 4.2.1). A soil boring is completed once for fields whose soils indicated that shallow bedrock could be present and annually for fields with high water table potential. Much of this basic information is recorded in the Annual Field List (See Section 4.2.2), including the farmer's name, farm ID, field ID, DNR ID, the total acres, the amount of acres approved, the date of the most recent soil test, the recorded pH, and the previous crop (provided by the farmer).

The RRM or MOS conduct the onsite soil borings prior to biosolids applications within a field. The RRM prints a paper map showing the field boundaries and competes the necessary soil borings at the site, marking up details and notes about the site all of which is included within the DNR permit application. The soil boring map is added to the permit application file for that specific farm/field. If time is available, the RRM also posts a copy of the notes to a Google Dropbox site for viewing by DNR staff. This is not a permit requirement or regulation; it is a common courtesy to the DNR so that staff could reference the data if someone called with a question and to reduce the number of emails sent to the DNR. However, the RRM often does not have time to record this information to the Google Dropbox site, and therefore, the records held there are incomplete.

The RRM then references the "Nutrient Application Guidelines for Field, Vegetable, and Fruit Crops in Wisconsin" (publication by the UW Extension) using the previous year's crop and soil type to determine the yield potential of the fields available for biosolids application. Then the RRM references the "Nutrient Management Fast Facts Worksheet" to determine the range of recommended Nitrogen application rates for each field. This is a publication by the Nutrient and Pest Management (NPM) Program, which is a summary of the larger document "A2809 Nutrient Application Guidelines for Field, Vegetable and Fruit Crops in Wisconsin" published by UW Extension (2012). This information can also be referenced using the SnapPlus software if desired. Using the target Nitrogen application rate for each field and an estimated concentration of nutrients within last year's biosolids, the RRM calculates the estimated volumetric application rate and total gallons of biosolids to be applied to each field.

The final step (prior to hauling) is the creation of a Field Application Map for each of the sites. The RRM will prepare a paper map using the Metrogro map (See Section 4.2.4) that shows the farm/field boundaries, and any setbacks. The RRM references the Annual Field List spreadsheet (See Section 4.2.2) for the total gallons needed for application. The Field Application Maps are used by the MOS and the Contract Applicators on the day of application.

Once the application season begins, the sites are reviewed for logistics (e.g. road closures, bridge limitations, etc.) to determine hauling routes. This is not personally done by the RRM, but they are kept informed by MOS. Contract halers and applicators are contacted by the MOS, and the RRM and MOS together prepare the preliminary hauling contracts for the year.

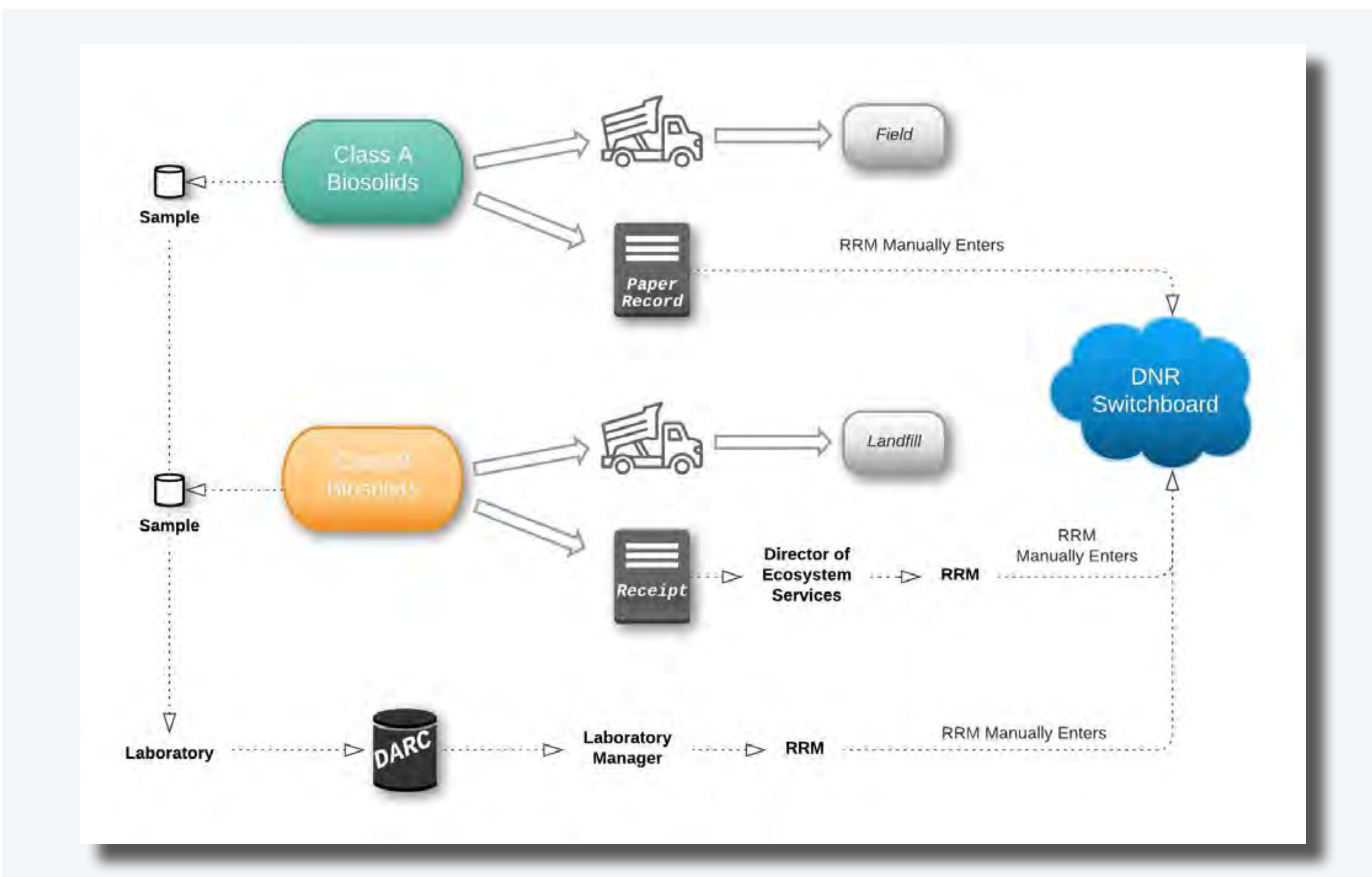
Rain gauges are installed at the sites prior to application, to ensure that the fields are viable for biosolids application. If precipitation occurs, but it is below a certain threshold, the MOS or Biosolids Program Assistant (BPA) will drive to the site to assess soil conditions. If too much precipitation occurs, the site will not receive biosolids until more favorable conditions occur to meet the requirements of the customer and NR204.07(3)(h). The contract employees would be texted that work would be canceled due to rain. If weather conditions are favorable, a daily plan is written on a marker board by the MOS and reviewed with the driver contract employees when they arrive at the Metrogro building (VLB) to inform them on their work plan for the day.

Contract tanker drivers arrive at MMSD to pick up their assigned tanker and drive on designated haul routes to the field(s) for the day. Contract applicators arrive at the field, without first stopping at MMSD and begin their work, coordinating with the MOS and referencing both the flagged setbacks and the paper Field Application Map when applying the liquid biosolids. The contracted tanker drivers complete their Daily Trip Tickets and the contracted applicators complete their Daily Logs. The contracted tanker drivers return both the Trip Tickets and the Daily Logs to MMSD (as the applicators do not need to return to MMSD at the end of their day).

The MOS collects and reviews the Trip Tickets and Daily Logs and rectifies any visible errors by communicating back with the contractors. The appropriate information from these logs are added to the Metrogro database (See Section 4.2.1). Every two weeks, the RRM tallies each contracted employee's hours-worked to develop an invoice for their associated paychecks; rates vary by biweekly according to the price of diesel, which is determined using the U.S. Energy Information Administration *Weekly Retail and Gasoline and Diesel Prices for the Midwest*. The RRM creates an Excel file with the contractor hours, calculates the recent average cost of diesel over the period in question and submits a draft document to contracted employees, who then formally submit an invoice to MMSD for payment.

The total number of number of gallons applied to each field are reported on the Daily Logs by the Contract Applications, and ultimately these values are recorded in to the Metrogro database. However, data entry into Metrogro database interface is completed by entering the number of loads delivered by a single employee on each individual data, rather than showing the entire hauling season

Figure 4-2: Existing Workflows, Class A and Class B Cake Biosolids



(all contract applicators, all fields), which makes it challenging to QA/QC entries at the end of the year. Therefore, the RRM keeps a Spreading Log (See Section 4.2.3), which contains all of the required entries for the season in a single Excel document. This document is used for more easy record keeping and as a comparison against the Metrogro reporting outputs to catch any potential errors in data entry.

At the end of the fall application season (typically November) the RRM reviews the annual list of fields where biosolids were applied. All of the necessary documentation is reviewed for accuracy. Then the RRM transitions to preparing the DNR's annual reports, Annual Land Application Report (See Section 4.4.1) and Characteristic Report (See Section 4.4.2). Although much of this information is contained within the Metrogro database, it can be difficult to extract in the correct format or conduct proper quality control. Due to this, the RRM typically extracts the data into Excel and reviews information individually to confirm that the reporting is complete and accurate. The reporting needs to be completed by mid-January for signatures and submittal to the DNR.

ADMINISTRATIVE CLASS A AND B CAKE BIOSOLIDS WORKFLOW

Although the majority of the Metrogro biosolids are liquid, some Class A and Class B cake are also produced and distributed. This is only a small fraction of the Biosolids Program, and therefore it will only be discussed briefly. Figure 4-2 is a simple visual illustration of this same workflow.

Class A cake biosolids can be collected and self-applied by the farmer. The farmer arranges for a dump truck to collect the cake material, and the amount loaded is recorded in a paper binder (not within the Metrogro database). At the end of the year, the RRM collects all of the recorded loads, and manually enters the information into the DNR's switchboard with the biosolid nutrient information taken from DARC (See Section 4.3.6). The RRM will also convert the nutrient information taken from the DARC database into agronomy units and relay that information back to the farmer for their records.

Class B cake biosolids can be taken to a landfill. MMSD arranges for a dump truck to carry the cake material to the landfill and the Director of Ecosystem Services is provided a receipt for the total volume. At the end of the year, the RRM collects all of receipts, and manually enters the information into the DNR's switchboard with the biosolid nutrient information taken from DARC (See Section 4.3.6).

DATA MANAGEMENT CHALLENGES & INFRASTRUCTURE GAPS

Throughout the March 10th meeting, MMSD staff offered their ideas for potential improvements to the existing data management workflows. Some ideas were identified as a higher priority and are indicated below with a (§). The remaining were considered as potentially beneficial improvements, but of a lesser priority.

More information about data management challenges and infrastructure gaps will be addressed in the Technical Memorandum #2 (Confirm Goals & Develop Evaluation Metrics).

(§) **Improving Reporting Outputs:** Reduce time requirements for DNR annual reporting. The Metrogro database currently exports this report into a format that can be loaded into the DNR website, but within the past two years has required some modifications from the IT department for it to load properly. A larger concern is that it is challenging to review the report outputs and to ensure that all of the data was properly recorded into the database based on the Daily Trip Tickets. Improvements could be made to the data entry process, with options for some automated quality control measures to flag the users of potential data errors.

(§) **Importing Files:** Reduce time recording forms into the existing Metrogro database. For example, it could be possible to load soils testing information in a more automated fashion, as is done in the SnapPlus program. Daily Logs for applicators and hours worked by contractors could be directly imported into the system. Frankly, importing all files in an automated fashion when possible. This might require a change in how the data is initially collected, prior to entry into the Metrogro database.

(§) **Changing Land Ownership/Operation:** Provide the ability to break apart farms/fields by landowner/renter. The system currently does not allow a farm field to change hands (e.g. owner divides the field amongst his/her children or rents a portion of the farm to another operator). Due to this issue, farmer contact information cannot currently be stored in the database; instead contact information is saved by the RRM in a stand-alone excel spreadsheet. SnapPlus has a method for completing this task that could be emulated.

Unique Identifier: Farm IDs/field IDs/site IDs/ DNR IDs simplified. It would be ideal to just use the DNR ID, however a temporary internal ID would still need to be created prior to DNR approval of new land application sites.

(§) **Emulating components of the SnapPlus Database:** SnapPlus is an industry standard for determining nutrient application rates to fields. Current methods recommended by the state/NRCS are coded into the software to complete calculations for the user in a thoughtful, easy to use system. Staff would like to either use SnapPlus directly (with some modifications) OR to emulate components of this system in future database designs.

Integrating GPS and SMS from Applicators: Integrating SMS outputs from newer applicators. This information could be used to map out field boundaries, accurately record application rates, and review the spread of the biosolids. Currently just one applicator is equipped with this system, and MMSD does not have the appropriate software to read the SMS files.

Road/Bridge Restrictions: Mapping out road restrictions and bridge limitations on a live map, where closures are updated by staff in a centralized location to assist in logistical planning. Currently, Ross maintains a working knowledge of road closures by mentally noting road closure signs and communicating with townships. He then works with the contracted tanker drivers to designate their hauling routes to reach each field. A central local to view this information would be beneficial for staff and in those periods where the MOS is unavailable.

Improved Method for Receiving Mailed Permission Slips: Increase the response time from landowners. Historically it has been challenging to get landowners to return a signed document indicating that a farm/field can be added to the Biosolids Program. A method for improving the response rate would be ideal. One option considered was creating a Delegation of Authority form, where the individual who farms the land could have the ability to apply to be part of the Biosolids Program directly, reducing the time required to contact the landowner.Additionally, an online application, accessible via smartphone, may be a solution.

(§) **Preferred Main Interface:** A single location to reference all of the Metrogro datasets. A map based interface that is linked to the underlying datasets is preferred and Forms/Reports/Tables could be exported from this single location. The data is entered (only once) through this same portal. It would have the ability to maintain current records, while also keeping historical records of prior years of application.

(§) **Mobile Mapping:** Real-time mobile mapping within applicators or on a smart device for use in the field. Ideally, it could be used offline in locations with minimal cell phone coverage. Data would include mapped farms, field boundaries, setbacks, and potentially other data layers that could assist with real-time decision making. This could also include collection of simple datasets using the GPS capabilities of a handheld device (smart phone or tablet) such as soil test locations and site notes.

Live Tracking of Contract Work: The ability to see the location of hauling tankers and applicators to assist with logistic planning. It can help Metrogro staff anticipate changes in the workflow, if contractors are delayed/available to move to another site.

Searchable Scans of Printed Documents: Digital copies of the approved DNR permits saved into OneBase. Metrogro permits are currently saved in a paper format but storage has become limited. Scanning of the permit materials is underway, and a solution has already been identified. This effort is currently ongoing, as time/staffing allows. Ideally, this solution could be integrated into any future database design efforts (e.g. hyperlink from a map to the saved PDF of the permit).

Phone Alerts for Contract Employees: A phone-based option for alerting contractors of schedule changes. The current process entails texting to alert contractors if they are scheduled to work that day or if weather is impacting their scheduling. Metrogro staff have a dry erase board with a table that is updated daily to keep track of contractors and the work plan for the day. Not all of the contracted employees have access to internet, therefore a web based option is not feasible. It would be desirable to have a dial-in-phone service that contractors could phone into and hear a verbal message of their planned work schedule. However, it was noted that this option might not be viable, since often changes are specific to one individual field and/or contract worker, so direct communication is required.

Class A and B Cake not in Metrogro Database: Integrating the cake distribution information into the Metrogro database. All the cake products that are distributed to farmers and/or a landfill are only recorded in paper copies and are not saved within the Metrogro database. A method for recording all of the cake product distribution information within the database would assist with annual reporting and provide an authoritative dataset for reviewing historic trends and support future decision-making efforts.

CHAPTER 5
EVALUATION METRICS, GOALS & DRIVERS

EVALUATION METRICS, GOALS & DRIVERS

EVALUATION METRICS

An important aspect of the planning process is to establish project goals and then utilize the goals to design metrics for scoring and comparing the alternatives. Historically, capital and lifecycle costs have been the sole metrics for making decisions. However, while those are important, organizations are now looking to evaluate alternatives based on how they align with to sustainability and resilience goals. Sustainability and resilience are not easily monetized during the planning phase, and only realized long term. Therefore, it is necessary to develop qualitative based metrics to assist in the evaluation of alternatives. Commonly, this is termed a 'Triple Bottom Line' approach to assess the fiscal, social, and environmental impacts of each alternative.

The Madison Metropolitan Sewage District (MMSD) and the project team is taking this approach for the Biosolids Management Plan. In order to develop these metrics, MMSD and the project team conducted three virtual workshops. The goal of the workshops was to ensure that MMSD and the project team align with what is driving improvements, and how alternatives will be evaluated. The three workshops focused on the following areas and are discussed in more detail in the following chapters.

- **MMSD Goals & Drivers:** MMSD's strategic organizational goals were reviewed and aligned to the Biosolids Management Plan project goals. In addition, future regulatory and end-use drivers that need to be considered were discussed.
- **Evaluation Criteria:** Various internal and external sources were reviewed to develop a consolidated approach to evaluating the alternatives.
- **Technology Shortlisting:** A wide array of biosolids processing technologies were reviewed and discussed. MMSD and the project team winnowed down the list of technology alternatives to those that will likely score the highest, and best fit with the District's needs.

The first virtual workshop consisted of reviewing the establish project goals from the scope document, the known regulatory drivers, and MMSD's strategic organizational goals. The purpose was to come to a consensus on what are the most important and how to align the evaluation metrics around those priorities. The presentation and supporting documents are included in Appendix B. A summary of the three key areas of discussion is as follows.

PROJECT GOALS

- Determine what biosolids products are most desired by market in our area and region
- Determine what biosolids processes are the easiest for MMSD to integrate into MMSD's current processes
- Determine which biosolids processes are most complementary in creating resilient, value-added solutions to the District's resource recovery efforts

REGULATORY & END-USE DRIVERS

The workshop included a robust discussion on a range of drivers that generally fit into the following seven (7) categories. Included with each category is a brief summary of the main takeaways from the discussion. More information is included in Appendix B.

Nutrient Management

- Consideration of not only WPDES permit requirements, but the permit agronomic requirements of the agricultural customer community
- Consideration of processes change that would affect balance of macronutrients (N-P-K) per wet ton of biosolids
- Position for future end-product development
- Conduct applied research (e.g. test plots) for test plots to re-prove nutrient/soil amendment value and share-out to customer community
- Consider synergies with the District's other nutrient management goals (e.g. Yahara WINs program)

Emerging contaminants

- The primary focus is on per- and polyfluoroalkyl substances (PFAS)
- Focus should be on monitoring and source elimination as the least-cost alternative
- Limited differentiation in treatment capability between feasible technologies
- Create resilient products that position the District for the future and diversified end use locations

Hauling & Application

- Considerations of Class A vs. Class B in terms of application, method of distribution, and regulatory requirements
- End-user concern about consistency and homogeneous application of cake vs. liquid
- Liquid program creates excessive truck traffic and access issues
- Acknowledgment of cost, labor, and energy intensive requirements of the Class B Biosolids program

- Lake of any infrastructure (processing and fleet) to manage a cake program
- Need to reduce queue and cycle times of fleet operation to maximize daily hauling capacity

Climate Change

- Change in weather patterns are stressing the liquid application program. Need for expanded fleet and staffing to handle variability
- Consideration of products (e.g. cake/dried, Class A) to reduce volume, and therefore, be more resilient to decreased hauling days and diversity end users

Marketability

- Desire to focus on the bulk agricultural market due to established relationships and develop a local nutrient cycle
- Identify products that could create a diversified portfolio of end-users over the long term. Considerations of future value and potential sale of products
- A branding campaign would be necessary to market products beyond bulk agriculture
- Need for applied research (as mentioned above) to prove value and build end-user market

Labor Cost & Availability

- Labor needs (administrative, hauling, application, maintenance) is a key consideration
- Critical to determine the labor requirements to effectively operate the current program, and the various alternatives being considered
- Program relies heavily on contract labor which leads to an inherent lack of control in availability of a qualified workforce

Aging Infrastructure

- Consider how alternatives may address aging infrastructure that is nearing the end of its design life and needs to be replaced

STRATEGIC PLAN

MMSD has developed a Strategic Plan (April 2020) to serve as guiding organizational document. Excerpts from the plan are included in Appendix B. The purpose of reviewing this document was to discuss how the District's Biosolids Program can meet the various strategic goals of the organization, and how can we incorporate the document into how we evaluate the alternatives.

The project team determined it was effective is to group the identified project goals and drivers into the three strategic plan categories of *Priorities, Strategies, and Influencing Factors*. This helps the team understand the relative time horizon in which the drivers can be impacted, and how to prioritize the drivers in the scope of the 3-5 year implementation timeframe identified in the scope. Table 5-1 below summarizes the drivers and how it interfaces with the District's strategic plan

Table 5-1: Project Drivers & Categories

Driver	Type of Driver		Madison MSD Strategic Plan Categories
	Regulatory	End Use	
Nutrient Management	●	●	Influencing Factors
Emerging Contaminants	●	●	Influencing Factors
Hauling/Application		●	Strategies
Climate Change	●		Strategies
Marketability	●	●	Strategies
Labor Cost and Availability	●		Priorities
Aging Infrastructure	●	●	Priorities

CHAPTER 6
EVALUATION CRITERIA

EVALUATION CRITERIA

The key focus area for the second visioning session (Appendix C). When developing evaluation criteria, it is important to identify the non-negotiable criteria for alternative development, as well as the evaluation criteria to help identify the most desirable option to advance as part of the Biosolids Management Plan. Non-negotiable criteria are essentially the drivers for the project, as summarized Chapter 2. For the evaluation criteria, the Biosolids Management Plan can draw from several sources to develop evaluation criteria to develop a consolidated approach for alternatives evaluation.

During visioning session two, evaluation criteria developed based on the requirements in the original request for proposals (RFP), Envision criteria, the MMSD Sustainable Action Map, and the overall Strategic Plan for the district were discussed in detail. For the non-economic criteria, a matrix of key evaluation criteria and Envision Categories of benefits was developed. For each criteria and category, it was identified which Envision Category is impacted by the criterion. The final evaluation criteria and Envision categories are summarized in Table 6-1, with additional discussion and example outputs included in Appendix C. The evaluation criteria will be used to evaluate the alternatives, and weighting of the criteria can be developed based on the number of Envision Categories impacted by the criteria.

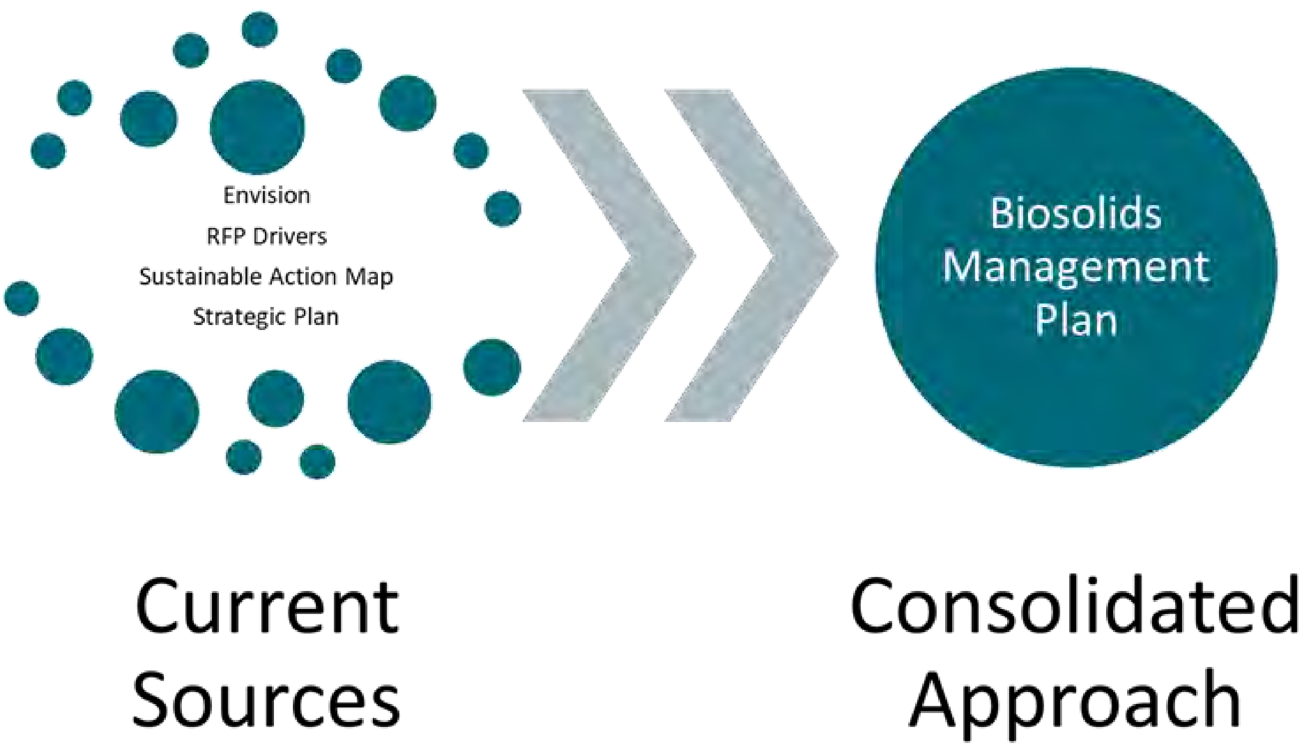


Table 6-1: Evaluation criteria connection to Envision categories

EVALUATION CRITERIA CUSTOMER/USER BENEFITS		ENVISION CATEGORIES IMPACTED									
		Customer/user Benefits	Quality of Life – Wellbeing	Leadership – Collaboration	Leadership - Economy	Resource Allocation – Energy	Natural World - Ecology	Natural World - Protect Surface and Groundwater Quality	Natural World - Protect Soil Health	Climate and Resilience – Emissions	Climate and Resilience – Resilience
OPERATIONS	Truck traffic Impacts	X	X			X	X			X	
	Increases flexibility in hauling days				X	X	X			X	X
	Approach limits business process adjustments needed from other units of the District				X						X
ECONOMICS	NPV within 15% of lowest value	X	X		X						
	Ability to phase capital investment over time	X			X						
	Operational cost within 15% of lowest value	X			X	X					
	Approach limits spending on single-use assets with low salvage value				X						X
ENVIRONMENTAL/ REGULATORY	Product improves nutrient management and runoff opportunities	X	X	X			X	X	X	X	X
	Processing provides resilience to changing regulations	X	X				X	X	X	X	X
END-PRODUCTS/ CUSTOMER CONCERNS	Approach limits business process adjustments needed from end product users/customers	X	X	X					X		X
	Flexibility for different farming approaches	X	X	X					X		X
	Product improves soil health management opportunities	X	X	X			X	X	X	X	X
	End-product provides regional collaboration opportunities	X	X	X			X				

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For the comparison of alternatives, the following analyses will be completed to provide a triple bottom line style evaluation of potential paths forward for biosolids management at MMSD:

- Infrastructure requirements, both at the Nine Springs WWTP and for hauling and application
- Capital cost requirements
- Phasing potential and capital cost cash flow
- Operations and maintenance costs, at the Nine Springs WWTP and for hauling and application
- Non-economic criteria established in Table 6-1

When evaluating different alternative products, it is important to have guidance on scoring for each evaluation criteria. Preliminary scoring guidance for each criterion is provided in Table 6-2. For each criterion scored for an alternative, it will be critical to provide both the score as well as notes related to how the score was developed. Weighting criteria will be evaluated using as sensitivity analysis and will be finalized during the technology evaluation. Weighting will be influent by the number of Envision categories impacted as well as Madison MSD input.

Table 6-2: Preliminary scoring guidance for each criterion

EVALUATION CRITERIA		SCORING GUIDANCE	ALTERNATIVE N
Operations	Truck traffic Impacts	5 - fewest truck 4 - within 15% of lowest value 1 - most trucks	Score: Notes:
	Increases flexibility in hauling days	5 - fewest hauling days 4 - within 15% of lowest value 1 - most hauling days	Score: Notes:
	Approach limits business process adjustments needed from other units of the district	5 - high flexibility 1 - low flexibility	Score: Notes:
Economics	NPV within 15% of lowest value	5 - lowest NPV 4 - within 15% of lowest value 1 - highest NPV	Score: Notes:
	Ability to phase capital investment over time	5 - high flexibility 1 - low flexibility	Score: Notes:
	Operational cost within 15% of lowest value	5 - lowest operational cost 4 - within 15% of lowest value 1 - highest operational cost	Score: Notes:
	Approach limits spending on single-use assets with low salvage value	5 - high flexibility 1 - low flexibility	Score: Notes:
Environmental/ Regulatory	Product improves nutrient management and runoff opportunities	5 - lowest impact 1 - high impact	Score: Notes:
	Processing provides resilience to changing regulations	5 - high resilience 1- low resilience	Score: Notes:
End-Products/ Customer Concerns	Approach limits business process adjustments needed from end product users/customers	5 - high flexibility 1 - low flexibility	Score: Notes:
	Flexibility for different farming approaches	5 - high flexibility 1 - low flexibility	Score: Notes:
	Product improves soil health management opportunities	5 - high benefit to soil health 1 - low benefit to soil health	Score: Notes:
	End-product provides regional collaboration opportunities	5 - high regional value 1 - low regional value	Score: Notes:

CHAPTER 7
TECHOLOGY SHORTLIST

TECHNOLOGY SHORTLIST

During the third visioning session (Appendix D), the focus shifted from discussing drivers and evaluation metrics to identifying a shortlist of technologies for consideration for the MMSD Biosolids Program. One of the goals of the Biosolids Management Plan is to identify a path forward for different biosolids products, which will likely require a transition from the current liquids hauling program. The goal is to develop information around a bracket of possible biosolids products that would provide environmental and economic benefit for MMSD. The focus is on the feasibility of the different biosolids products from a market perspective, and then developing a preliminary evaluation of technologies to identify feasibility level capital and operating cost estimates to enable capital improvements planning.

The types of biosolids products were a large focus of discussions in the visioning sessions. MMSD is a critical part of nutrient cycling in southcentral Wisconsin, and the types of biosolids products have a large impact on sustainable nutrient and soil management. This focus is evident in the metrics developed for alternative evaluation shown in Table 6-2. Producing a product that is of value to the regional agricultural marketplace is a focus for MMSD, and the project team identified five potential biosolids products that have potential value to the southcentral Wisconsin agricultural field:

- Liquid product (Class B)
- Cake product (Class B)
- Cake product (Class A)
- Compost product (Class A)
- Dried biosolids product (Class A)
- Alkaline stabilized product (Class A)

Class B products (liquid and cake) were included to provide the full bracket of products. The viability and environmental impacts of these products will be assessed during the alternative development phase of the project. The Class B products may also provide a bridge product while a full Class A program is developed.

Identifying the value proposition for different enhanced biosolids products is the main goal of the Biosolids Management Plan. By understanding the market drivers and operational costs for the production of different enhanced products, MMSD can identify the future direction for the Biosolids Program. The capital and operating cost to generate these products is a key consideration. The approach for the Biosolids Management Plan is to develop a feasible processing technology to produce the list of potential biosolids products. Several technologies were discussed in the third visioning session, with benefits and drawbacks of technologies reviewed. A final list of feasible processing technologies tied to biosolids products is shown in Table 7-1. The goal of these processing technology alternatives is to develop a potential means to produce the identified product to determine if the product is a viable option for MMSD in the future. For the product, or products, that appear viable for MMSD, future evaluations related to different alternatives to generate the product and applied research activities will be required to identify a final plan.

Table 7-1: Processing technologies required

BIOSOLIDS PRODUCT	FEASIBLE PROCESSING TECHNOLOGY	NOTES
Liquid product (Class B)	• Improved hauling and handling	• Improve existing program to meet infrastructure gaps
Cake product (Class B)	• Expanded dewatering facilities • Cake storage expansion	• Evaluate both centrifuge expansion and belt filter presses • Provide 180 days of onsite cake storage
Cake product (Class A)	• Thermophilic batching expansion for full biosolids flow • Expanded dewatering facilities • Cake storage expansion	• Evaluate both centrifuge expansion and belt filter presses • Provide 180 days of onsite cake storage
Compost product (Class A)	• Expanded dewatering facilities • Composting facility offsite on MMSD property • Aerated static pile and windrow facilities to be evaluated	• Two technology alternatives to be evaluated • Average amendment to be considered
Dried Biosolids Product (Class A)	• Expanded dewatering facilities • Drum dryer facility • Dried product storage	• Drum dryers provide highest quality product • Initial assumption natural gas driven drying
Alkaline stabilized product (Class A)	• Expanded dewatering facilities • Lystek system for high solids liquid Class A product	• Lystek chosen for alkaline stabilized product that can be stored in the existing liquid storage • Lystek product is between 12 and 16% solids

CHAPTER 8
EVALUATION OF BIOSOLIDS ALTERNATIVES

EVALUATION OF BIOSOLIDS ALTERNATIVES

INTRODUCTION

The previous chapters provided a summary of the biosolids management goals and drivers, along with evaluation criteria that was used to produce a technology and end-product shortlist.

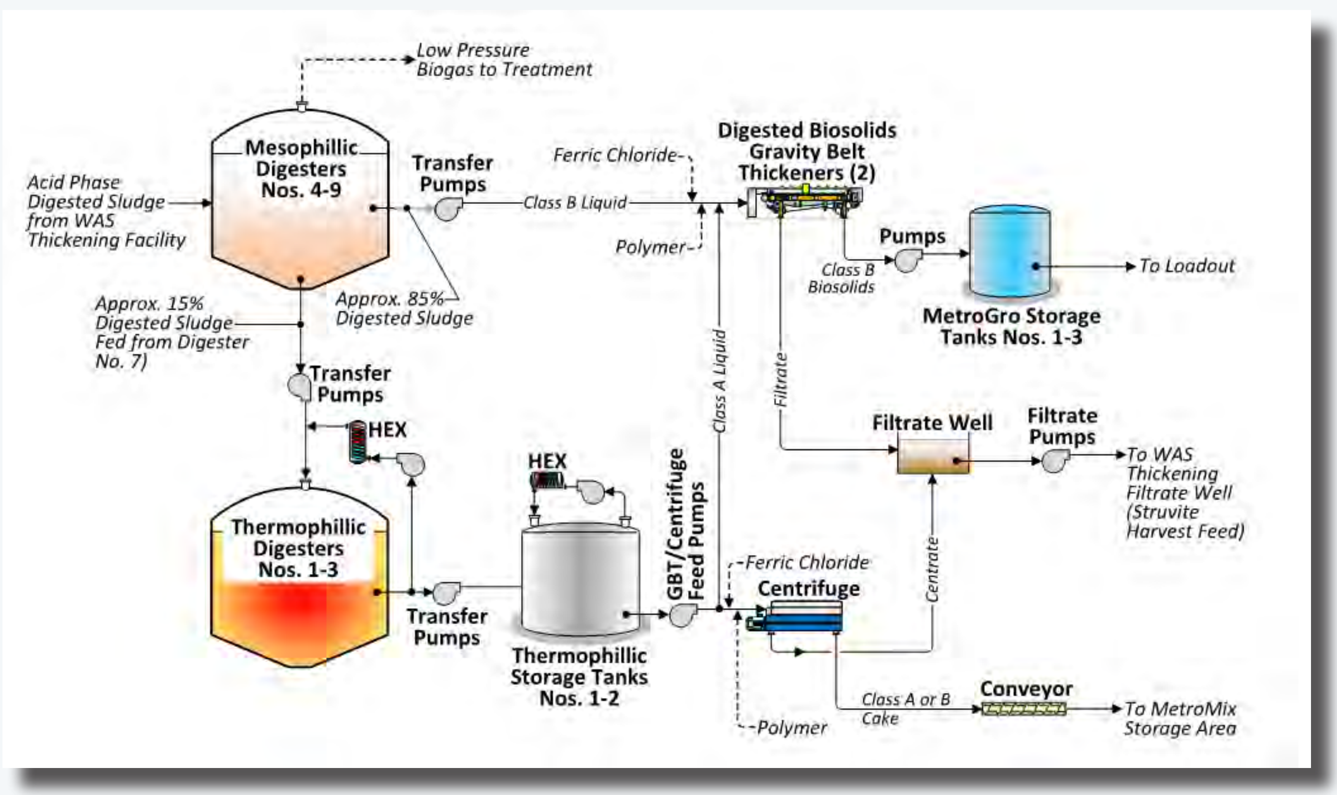
This chapter and the remaining of the report focuses in on selected Biosolids Management Plan alternatives for further evaluation and detail. Each of the alternatives considered were evaluated as integrable into the existing treatment system.

EXISTING OPERATION

The Madison Metropolitan Sewerage District (MMSD) owns and operates the Nine Springs Wastewater Treatment Plant (NSWWTP). The NSWWTP currently treats biosolids using the treatment process identified in Figure 8-1. Thickened waste activated sludge (TWAS) is digested in six mesophilic digesters. Currently, most of the sludge is then transferred to gravity belt thickeners where it is thickened, with the end-product being a Class B liquid biosolids product that is land applied under the trade name "Metrogro." The remaining mesophilic digested biosolids is transferred to three thermophilic digesters where it is batch treated at thermophilic temperatures, cooled in two storage tanks and then dewatered to produce a Class A biosolids cake. MMSD currently processes approximately 2% of the solids through the thermophilic and dewatering systems.

The management of the liquid land application program has become much more challenging in recent years due to a reduction in local land availability for application of the biosolids (which has increased the trucking distance to suitable application sites) as well as a reduction in available hauling days due to changing weather patterns (which increases the quantity of liquid sludge storage required to manage the product). For this reason, MMSD is interested in evaluating alternative biosolids treatment strategies that may address these management issues and reduce the risk associated with land application.

Figure 8-1: Digested Biosolids Process Flow Diagram



This study is primarily concerned with the equipment downstream of the mesophilic digesters and potential alternatives to the current treatment approach including transportation and application alternatives. Equipment details for the existing equipment under consideration are summarized in Table 8-1. The following list identifies the major unit process units and equipment evaluated in this study.

- Thermophilic batch digesters
- Digested biosolids transfer pumps
- Digested biosolids gravity belt thickeners
- Gravity belt thickener polymer feed system
- Centrifuge polymer feed system
- Thickened digested biosolids transfer pumps
- Metrogro storage tanks
- Class A digested biosolids transfer pumps
- Class A digested biosolids centrifuge dewatering system, including polymer feed system
- Class A cake storage area

The capacities for the major unit processes are summarized in Table 8-1.

PURPOSE

The purpose of this work is to evaluate alternative biosolids treatment strategies for potential implementation at the NSWWTP to address the current management issues and reduce the risks associated with land application.

Table 8-1: Digested Biosolids Existing Major Equipment Capacity

UNIT PROCESS	PARAMETER
Digested Biosolids Gravity Belt Thickeners	
Quantity	2
Belt Width, m	2
Hydraulic Capacity per Unit, gpm	250
Solids Capacity per Unit, lbs/hr	2,800
Thermophilic Digesters	
Quantity	3
Volume each (MG)	0.639
Batch hold time (days)	1
Typical Batch hold temperature (deg F)	137
Metrogro Storage Tanks	
Quantity	3
Storage Capacity, Total, MG	19.4
Centrifuge	
Quantity	1
Hydraulic Capacity, gpm	150
Max Solids Capacity, lbs/hr	1,250
Sludge Storage Tanks	
Quantity	2
Storage Capacity, Total, MG	0.9

BIOSOLIDS ALTERNATIVES

Various alternatives were selected in order to provide a broad cross section of potential biosolids management strategies and to compare these to the current operation. The sections below describe the biosolids alternatives that were evaluated during the study. These are organized in the following order:

- Baseline alternative (expansion of current liquid land application operations)
- Alternatives based on Class B biosolids (with prefix 'B')
    - B1 - Dewatering Centrifuges in Existing Building (Reuse Existing Unit)
    - B2 – Dewatering Centrifuges in Existing Building (Replace Existing Unit)
    - B3 – Dewatering Centrifuges in New Building
    - B4 – Dewatering Belt Filter Presses in New Building
- Alternatives based on Class A biosolids (with prefix 'A')
    - A1 – Centrifuge Dewatering and Static Pile Composting
    - A2 – Centrifuge Dewatering and Windrow Composting
    - A3 – Centrifuge Dewatering and Thermal Drying
    - A4 – Centrifuge Dewatering and Class A Liquid Treatment
    - A5 – Thermal Batch Treatment with Belt Filter Press Dewatering

For the purposes of this preliminary evaluation, a 100% capture rate for thickening and dewatering has been assumed for all mass balances presented. Additionally, dewatering alternatives are based on operating up to 24 hours per day, 7 days per week.

BASELINE ALTERNATIVE

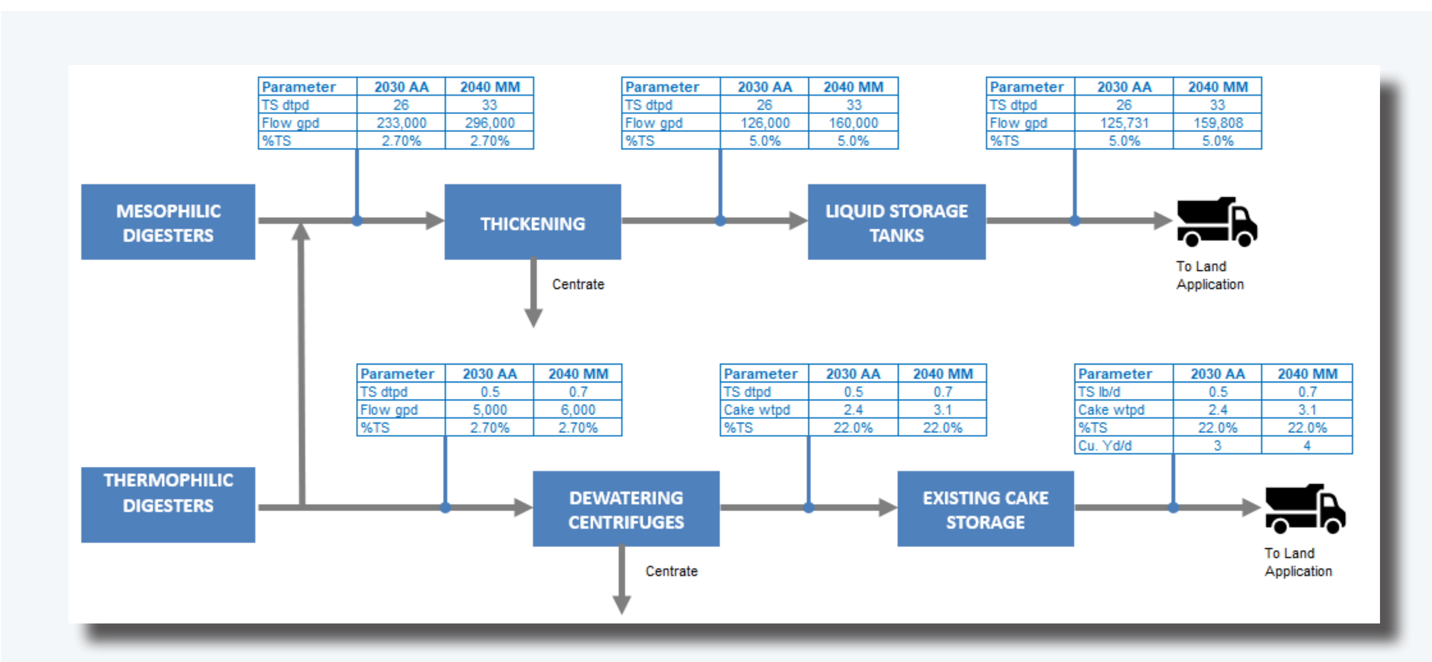
Processing Technology

The baseline alternative involves continuation of the current biosolids management approach with most of the biosolids being thickened and distributed as a Class B liquid product and the remaining being dewatered following thermal treatment to produce a Class A cake. Available data shows that approximately 2% of the annual solids production has been handled as a dewatered cake. This alternative was developed assuming continued diversion of approximately 2% of the annual solids production to dewatering. The thermophilic system was originally designed to treat 25% of the solids loads given future solids projections. A schematic and mass balance is provided in Figure 8-2. See Appendix H for a larger view of each mass balance figure.

Class B Liquid End Use

The baseline alternative including maintaining and expanding the loadout, hauling and application systems and equipment for Class B liquid biosolids (Metrogro). Based on historical analysis outlined in Technical Memorandum #1, the average number of days hauled from 2014-2019 was 75 days. To be conservative, it was assumed that a maximum of 70 days would be available

Figure 8-2: Schematic and Mass Balance for Baseline Alternative (Existing System).



for hauling product to the field in the future due to recent changes in weather, permitted field availability, and seasonality of crops. The days available establishes the minimum number of gallons of Class B biosolids to be applied per day. Additional hauling days could be made available through pursuit of summer crops such as wheat; however, due to the risks associated with various crop programs year-to-year, it was not included in the selection of equipment for application to meet target hauling days.

The number of applicators required is dependent on the minimum gallons applied per day based on historical and projected application rates. Discussion with current Metrogro operations staff led to the selection of the Oxbo 5105 as the preferred applicator. Assumed modifications to the current loading infrastructure and hauling fleet were tailored to the Oxbo 5105 functionality and capacity.

Due to the limited filling capacity at the current Vehicle Loading Bay (VLB) of the Metrogro, it was assumed that 'the Hill' loading station would be expanded to accommodate all tanker loading and that the VLB site could be modified into an expanded and upgraded maintenance facility for the Metrogro program (not included in this study). A layout of the expanded 'Hill' loading station is shown in Appendix E. This upgrade would include the following items:

- Designated truck entry at Gate 4
- Designated truck exit at Gate 1
- Ability for the NSWWTP to be securely gated with separate truck entrance
- Six (6) new loadout pumps
- Two new loadout lanes to west of existing storage tanks
- Top-load capabilities on all four loadout stations
- New Metrogro Storage Tank #4
- 160' inside diameter with 41' exterior walls
- Four sump construction
- Six (6) new mixers
- Geodesic Dome

The application fleet would need to be upgraded from one (1) Oxbo to four (4) total Oxbo 5105 applicators. With four applicators running at full capacity, a total of 21 tankers would be required to achieve the maximum application rate of four (4) applicators running. The total application days could be as low as 55 days. This provides the flexibility of running less applicators and trucks and still achieving the less than 70-day application target window. Further investigation should be made on truck traffic considerations and impact to local communities. Equipment summaries per alternative are provided in Chapter 10.

Based on discussions with Metrogro staff, there are logistical inefficiencies with the hauling and loadout application process (e.g. transporting field application staff from field-to-field). Therefore, one (1) additional Full Time Equivalent (FTE) position is recommended to help manage loadout and field operations. This adds 2,296 annual labor hours to the current annual budget amount of 11,445 labor hours based on the years 2019-2020.

ALTERNATIVE B1 – DEWATERING CENTRIFUGES IN EXISTING BUILDING (REUSE EXISTING UNIT)

This alternative involves the installation of an additional dewatering centrifuge to supplement the existing dewatering centrifuge in the existing dewatering building. The existing centrifuge would have a new control system installed to match the new unit and provide a common control system. Since the existing unit was manufactured by Centrisys, they were contacted for cost and size information. This would provide sufficient capacity to dewater all of the solids produced by the facility. The dewatering would operate either on digestate from the mesophilic digesters (with the thermal batch tanks not used or used only for emergency storage) or on a blend of mesophilic and thermophilic digestate. With either option the cake product would be a Class B product unless additional thermal batch tank capacity is added in the future.

Additional cake storage would be provided to give a total of 180 days' storage as required by the WDNR requirements.

It was assumed that for the dewatering operation, current staff would operate the dewatering equipment. To facilitate comparison to the Baseline Alternative, it was assumed that a 0.5 full time equivalent (FTE) operator would be engaged in the dewatering operations.

A schematic and mass balance for this alternative is provided in Figure 8-2. See Appendix H for a larger view of each mass balance figure.

The following major cost items are included in this alternative:

- A new centrifuge with the same capacity as the existing unit (2,000 lb/hr)
- A new control system for the existing centrifuge
- A spare rotating assembly to be kept on site
- New pumps and conveyors
- A new polymer system to support both units
- A new cake storage barn with capacity for 180 days' storage of cake

It is important to note that this alternative would not provide redundancy and both centrifuges would need to run on a continuous basis in order to process the projected solids loads. Continuous operation would allow for a consistent return of centrate to the headworks to minimize impacts on the liquid treatment processes. Downtime for maintenance would need to be managed through storage of liquid biosolids on site combined and keeping a spare rotating assembly for the centrifuges on site as a contingency measure.

Alternative B1, B2, and B3 End Use

The end use for Alternatives B1, B2, B3 all revolve around the application of a Class B cake product. It was assumed that the loadout, hauling and application capacity required would need to match the same available application window each year. Based on historical analysis outlined in Technical Memorandum #1, the average number of days hauled from 2014-2019 was 75 days. To be conservative, it was assumed that the district would not have any more than 70 days available for hauling in future years due to weather, permitted availability, and seasonality of crops. The days available establishes the minimum number of cubic yards of Class B cake to be applied per day.

The Oxbo 5105 was again assumed as the equipment to land apply cake to the fields; however, it would be fitted with the Tebbe 30-ton box capacity. The current Oxbo applicators would not be retrofitted and would rather be salvaged and new applicators would be purchased. Filling of the Oxbo Tebbe box would be done via a field located front-end loader or loader tractor. Cake can be pre-delivered and stacked in fields prior to the applicator arriving, which eliminates the applicator dependency direct loading from tankers as seen in liquid application scenarios. However, since the Class B cake would still require incorporation and the Oxbo unit would not be outfitted with this capability, the applicator would be followed by a tillage tractor for final incorporation. Equipment summaries per alternative are provided in Chapter 10.

With the reduction in volume hauled, it was assumed the current Metrogro staffing would be sufficient for this alternative. Thus, the labor hours were maintained equivalent to the annual total of 11,445 labor hours, based on the average of years 2019 – 2020.

The following major fleet cost items are included in this alternative:

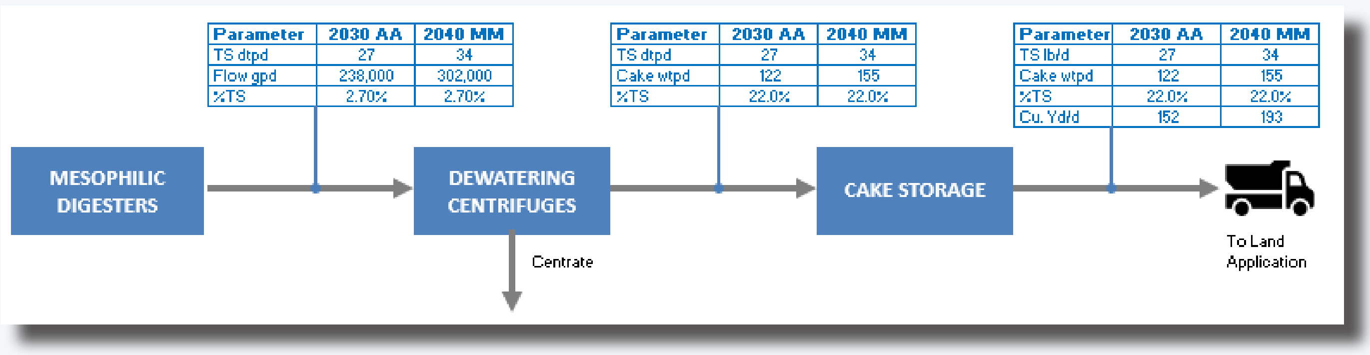
- Two (2) new Oxbo 5105 applicators with 30-ton Tebbe Box
- Six (6) new 65-cubic yard belt trailers for hauling cake
- One John Deere 644L for NSWTTP trailer filling
- Two (2) new John Deere 8230R front-end loaders for field loading
- Two (2) new tractors and tillage implements for field incorporation

ALTERNATIVE B2 – DEWATERING CENTRIFUGES IN EXISTING BUILDING (REPLACE EXISTING UNIT)

This alternative is similar to Alternative B1; however, it assumes complete replacement of the existing centrifuge in the existing dewatering building with two new larger capacity machines. This would provide sufficient capacity to allow a single unit to be taken out of service under future maximum monthly loading conditions. It was assumed that dewatering would be operated on a continuous basis to minimize impacts of centrate return on the liquid treatment process. The space available is restricted for these larger machines; however, discussions with the manufacturer suggests that the space is sufficient. A layout showing the new machines in the existing space is provided in Appendix E.

It was assumed that for the dewatering operation, current staff would operate the dewatering equipment. To facilitate comparison to the Baseline Alternative, it was assumed that a 0.5 FTE operator would be engaged in the dewatering operations.

Figure 8-3: Schematic and Mass Balance for Alternatives B1, B2, and B3 (centrifuge dewatering to produce Class B cake)



The following major cost items are included in this alternative:

- Two new centrifuges sized at 3,825 lb/hr per machine
- New centrifuge control systems for both machines
- New pumps and conveyors
- A new polymer system to support both units
- A new cake storage barn with capacity for 180 days' storage of cake

The mass balance for this alternative is the same as Alternative B1 (shown in Figure 8-3). See Appendix H for a larger view of each mass balance figure.

Alternative B1, B2, and B3 End Use

The end use for Alternatives B1, B2, B3 remain the same, including staffing requirements.

ALTERNATIVE B3– DEWATERING CENTRIFUGES IN NEW BUILDING

This alternative assumes that a completely new dewatering building is provided to house two new centrifuges using the same sized units as Alternative B2. A new building is provided to provide better access for maintenance and operation of the equipment, as access to the new equipment in the existing building as presented in Alternative B2 would be difficult. It was assumed that dewatering would be operated on a continuous basis to minimize impacts of centrate return on the liquid treatment process. This alternative was also assumed as the basis for the development of subsequent Class A alternatives (A1 through A4) that require cake processing to produce a Class A cake. This assumption was made because a new dewatering facility could be more easily configured to support the additional downstream processes. In addition, centrifuges will provide higher cake total solids concentrations than belt filter presses, which will help reduce costs for downstream processing for the Class A processes in each of these alternatives.However, Alternatives B1 and B2 could also be used as the basis for developing Alternatives A1 through A4 with additional equipment and building modifications.

It was assumed that for the dewatering operation, current staff would operate the dewatering equipment. To facilitate comparison to the Baseline Alternative, it was assumed that a 0.5 FTE operator would be engaged in the dewatering operations.

Major cost items included in this alternative are:

- Two new centrifuges sized at 3,825 lb/hr per machine
- New centrifuge control systems for both machines
- New pumps and conveyors
- A new centrate pumping system
- A new polymer system to support both units
- A new dewatering building
- A new cake storage barn with capacity for 180 days storage of cake

The mass balance for this alternative is the same as Alternative B1 (shown in Figure 8-3). An indicative layout for the new building is provided in Appendix E. See Appendix H for a larger view of each mass balance figure.

Alternative B1, B2, and B3 End Use

The end use for Alternatives B1, B2, B3 remain the same, including staffing requirements.

ALTERNATIVE B4 – DEWATERING BELT FILTER PRESSES IN NEW BUILDING

This alternative is based on a completely new dewatering building with belt filter presses rather than centrifuges. It was assumed that dewatering would be operated on a continuous basis to minimize impacts of filtrate return on the liquid treatment process. Typically, belt filter presses produce cake with a lower total solids content than centrifuges, which has an impact on the sizing of the cake barn. Belt filter presses have demonstrated a reduced potential for activating re-growth of fecal coliforms in the dewatered cake than centrifuges. For this reason, this scenario was also used as the basis for dewatering of thermophilic digested biosolids as described in Alternative A5.

Belt filter presses are also more amenable to on-site maintenance than centrifuges which typically require occasional manufacturer overhaul of the rotating assembly.

It was assumed that for the dewatering operation, current staff would operate the dewatering equipment. To facilitate comparison to the Baseline Alternative, it was assumed that a 0.5 FTE operator would be engaged in the dewatering operations.

A schematic for this alternative is provided in Figure 8-4. An indicative layout for the new building is provided in Appendix E. See Appendix H for a larger view of each mass balance figure.

The following major infrastructure is included with this alternative:

- Three, 2-meter belt filter presses each with a capacity of 1,540 lb/hr
- New dewatering control systems for all machines
- New pumps and conveyors
- A new filtrate pumping system would be required. The system would need to handle filtrate and washwater

separately to reduce impacts on liquid treatment processes
- A new polymer system to support all machines
- A new dewatering building
- A new cake storage barn with capacity for 180 days' storage of cake (which is larger than the equivalent building for centrifuge dewatering due to the lower cake solids content)

This alternative also includes an additional cost for odor control to account for odor extraction from the dewatering building not required for the centrifuge options.

Alternative B4 End Use

The end use for Alternative B4 requires the same equipment and staffing as for Alternatives B1, B2, B3. The slightly higher annual cake mass per year does not materially affect operations.

ALTERNATIVE A1 – CENTRIFUGE DEWATERING AND STATIC PILE COMPOSTING

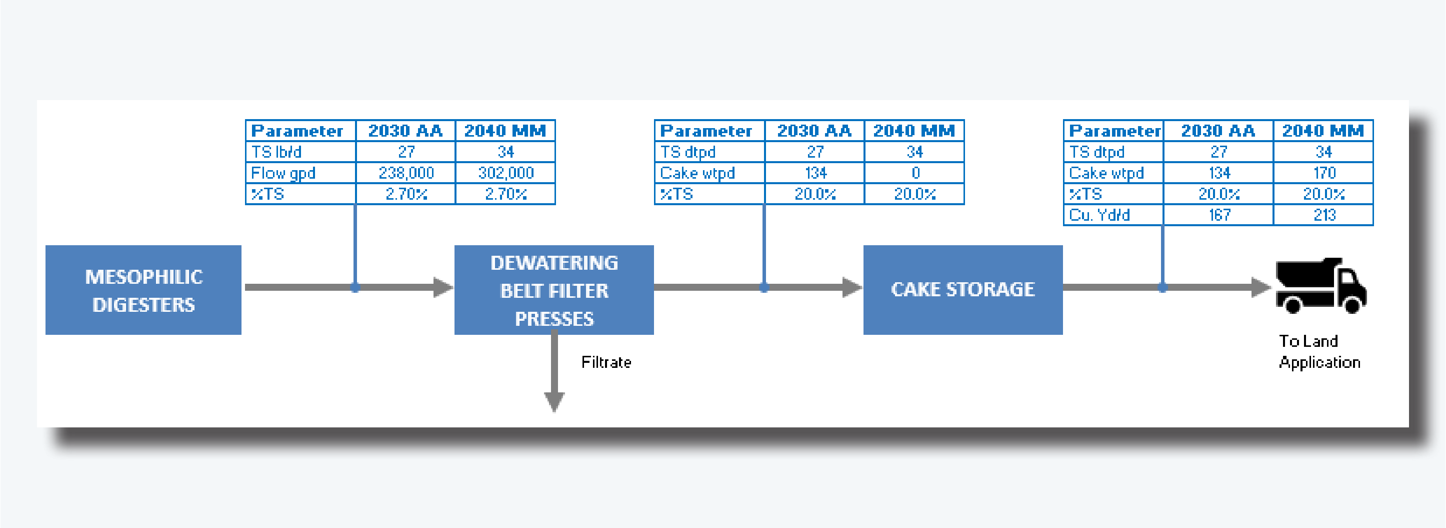
This alternative assumes that a new centrifuge dewatering system is provided as in Alternative B3 but without the addition of the large cake barn, and that the dewatered product is composted at a new aerated static pile composting facility on-site. This composting alternative is based on the use of wood chips as the bulking agent and energy amendment material. In addition to improving the porosity of the mixture, the chips will provide additional energy for the biological degradation process and increase the amount of carbon in the Carbon to Nitrogen (C:N) ratio to optimize the process and product quality. Other forms of wood waste, including processed yard waste, could be used. However, aerated static piles require high porosity, so the amendment needs to have a rigid structure after mixing with biosolids. When yard waste is used, leaves and grass must be limited because these materials will form dense masses when mixed with biosolids and limit porosity.

Screening of the cured compost can be used to recover a portion of the wood chips and recycle them with the initial mix. This helps to reduce the quantity of chips that need to be procured and reduces the wood material in the finished product. A target total solids concentration of 43 percent was used for the initial mix to provide adequate porosity.

The aerated static pile process requires the biosolids, amendment, and any recycle be mixed together prior to being placed in large piles over an aeration header. The aeration header would be connected to a fan or multiple fans depending on the configuration, and air can be forced through the pile or drawn through it, depending on operational conditions. Aeration is used to maintain aerobic conditions within the pile and to maintain process temperatures within the desired range. The aeration header can be temporary piping that is disposed each time a pile is torn down, or a more permanent in-ground system. A permanent in-ground system was assumed for this evaluation to reduce operator labor requirements.

The compost system would produce a Class A product from the Class B digested and dewatered biosolids. The compost product would be relatively low in nitrogen content, but high in organic matter. Although it depends on several factors, biosolids compost will typically have approximately 50 to 60 percent of the total nitrogen concentration of the digested biosolids entering the process. The product could be either land applied in bulk form to

Figure 8-4: Schematic and Mass Balance for Alternative B4, Dewatering Belt Filter Presses in a New Building



agricultural land as a soil amendment and fertilizer or distributed and marketed to more urban uses as a soil amendment and low nitrogen fertilizer.

One concern expressed by local farmers with use of wood chips or wood waste products as amendments is the potential for the further breakdown of the wood in the soil, which could rob plants of vital nitrogen. The compost system would be designed to screen the product to remove a high percentage of the wood material, which would be recycled. In addition, the objective of the process will be to produce a finished product with a C:N ratio of 12:1 or lower. That ratio should be low enough that the material should not impact the crops' ability to benefit from the nitrogen applied to the agricultural land.

It was assumed that for the dewatering element of this alternative, current staff would operate the dewatering equipment. To facilitate comparison to the Baseline Alternative, it was assumed that a 0.5 FTE operator would be engaged in the dewatering operations. For the composting operations, it was assumed that dedicated staff would be required, and it was estimated that 4 FTE staff would be needed to operate the process. In addition, allowances were included for maintenance labor associated with heavy equipment maintenance, equating to 1.5 FTEs.

Table 8-2 summarizes the assumed feedstock characteristics for this alternative. A process flow schematic and mass balance for this alternative is provided in Figure 8-5. See Appendix H for a larger view of each mass balance figure.

Table 8-2: Assumed Feedstock Characteristics for Alternative A1

ITEM	TS (%)	VS (%)	C:N
Biosolids	22	68	12
Wood chips	70	75	40

The following major cost items are included in this alternative:

- New centrifuge dewatering building and equipment as detailed in Alternative B3.
- A new on-site static pile composting facility incorporating the following:
    - A total covered active composting area of 68,750 sq ft for 22 days of active composting.
    - A total covered curing area of 50,000 sq ft for 30 days of curing.
    - Covered fresh amendment and recycled product storage area for 30 days' demand with a total of 7,500 sq ft under cover.
    - Covered product storage area for 90 days' production, with a total of 34,375 sq ft under cover, and an additional 90 days' capacity uncovered.
    - Owner procured equipment including front loader, roto mix mixer, trommel screen, transportation tractor and trailer.

A layout for the composting portion of this alternative is provided in Appendix E. The layout for the dewatering portion will be as shown for Alternative B3 (also in Appendix E).

Static Pile Compost End Use

The end use for Alternatives A1 and A2 revolve around the application of a compost end-product. The major difference between Alternative A1 and A2 is the location of the composting and the additional hauling labor and fuel required to transport amendment or biosolids to the compost sites. In Alternative A1 the compost location was assumed to be at NSWTP, so the additional hauling requirement involves getting amendment to the site. It was assumed that the loadout, hauling and application capacity required for field application would need to match the same available application window each year. Based on historical analysis outlined in Technical Memorandum #1, the average number of days hauled from 2014-2019 was 75 days. To be conservative, it was assumed that the district would not have any more than 70 days available for hauling in future years due to weather, permitted availability, and seasonality of crops. The days available establishes the minimum number of wet tons of compost to be applied per day.

As part of this study, the responsibility of application management was maintained by MMSD and Metrogro. This provides a conservative, robust solution but also alleviates the dependence of end use customers (mostly grain farmers) from having to secure land application equipment. Most grain farmers would be required to rent or purchase fertilizer or manure spreaders that would not efficiently apply solids similar to the Oxbo 5105.

The Oxbo 5105 was again assumed as the equipment to land apply compost to the fields; however, it would be fitted with the Tebbe 30-ton box capacity.The current Oxbo applicators would not be retrofitted and would rather be salvaged and new applicators would be purchased. Filling of the Oxbo Tebbe box would be done via a field located front-end loader. Compost can be pre-delivered and stacked in fields prior to the applicator arriving, which eliminates the applicator dependency on hauling as seen in liquid application scenarios. It was assumed the compost would not be remain stacked in the field for long durations of time due to the perception of good land stewardship of manure or biosolids-derived products. Since this is composted material and not Class B cake, it does not require incorporation. The application season was assumed the same as current practices which are dictated by crop rotation and weather conditions. Equipment summaries per alternative are provided in Chapter 10.

With the reduction in volume hauled, it was assumed the current Metrogro staffing would be sufficient for this alternative. Thus, the labor hours were maintained equivalent to the annual total of 11,445 labor hours, based on the average of years 2019 – 2020.

The following major fleet cost items are included in this alternative:

- Two (2) new Oxbo 5105 applicators with 30-ton Tebbe Box
- Four (4) new 65-cubic yard belt trailers for hauling cake
- One John Deere 644L for NSWTTP trailer filling
- Two (2) new John Deere 8230R front-end loaders for field loading

ALTERNATIVE A2 – CENTRIFUGE DEWATERING AND WINDROW COMPOSTING

This alternative assumes that a new centrifuge dewatering system is provided as in Alternative B3 but without the addition of the large cake barn, and that the dewatered product will be hauled off site to a new windrow composting facility. It was assumed that this facility will be located off site due to the large quantity of agricultural materials that will be used as an amendment. Locating the plant remotely will reduce the distance for delivery of the ag amendment material and reduce truck traffic at the plant site.

During the composting process, biosolids would be processed with agricultural waste materials in a windrow system to make a Class A product. The agricultural materials evaluated as part of this alternative would provide energy for the biological degradation process, improve porosity to help maintain aerobic conditions, and help to increase the C:N ratio to optimize the process and product quality. In contrast to the aerated static pile system where the pile is not disturbed during the active composting process, the windrows created will be agitated periodically during the process. The agitation is used to maintain aerobic conditions within the windrow.

In 2018, MMSD conducted pilot windrow composting tests using biosolids, bedding pack manure, and digestate from a community agricultural digester. The testing was based on an initial mix of approximately one (1) part of each type of feedstock on a volumetric basis. Some windrowing of the agricultural materials was performed prior to adding the biosolids. Discussions with MMSD staff indicated that the alternative should be developed assuming the bedding pack manure is a primary feedstock along with the biosolids, and other agricultural materials could be included in the mixture as appropriate. Other agricultural waste materials that were discussed as possible feedstocks include corn stover and straw. Both materials can be difficult to compost without mixing. The frequent agitation in the windrow process can help mitigate some of these concerns.

For evaluation purposes, it was assumed that biosolids and bedding pack manure would be the primary feedstocks, fed at approximately equal parts by volume, and other agricultural wastes would be used to adjust the initial mix total solids concentration and C:N ratio. Corn stover was used as the basis for the additional feedstock, but other high carbon content wastes may be suitable. The materials balance indicated that adequate energy would be provided by the biosolids and bedding pack manure, but the corn stover would be needed to achieve a target total solids concentration of 43 percent in the initial mix. In addition, the corn stover was needed to adjust the C:N ratio, which was targeted to be between 20:1 – 30:1. The process flow schematic shown in Figure 8-6 would provide an initial mix C:N of approximately 20:1, which is on the low end of the target range. More corn stover or other agricultural materials could be added to increase the C:N. See Appendix H for a larger view of each mass balance figure.

The windrow composting system will have a larger area requirement than the aerated static pile system for several reasons. Windrow systems use a different configuration to help with maintaining aerobic conditions. This configuration results in a larger footprint. In addition, in this alternative the use of the bedding pack manure will significantly increase the mass of materials being handled by the process, which also contributes to the larger footprint.

The agricultural materials characteristics will vary, and it is recommended that additional pilot testing with these materials be performed prior to implementation to evaluate their variability and effects on the process. MMSD may have to stipulate minimum acceptable characteristics for accepting agricultural materials to compost.

Figure 8-5: Schematic and Mass Balance for Alternative A1 Centrifuge Dewatering and Aerated Static Pile Composting:

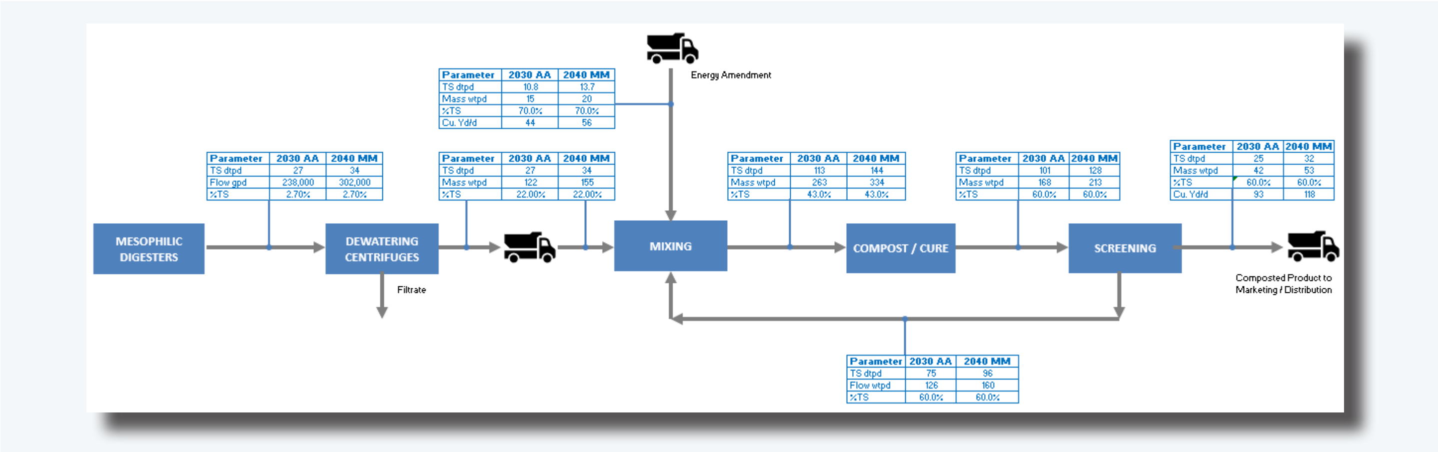


Figure 8-6: Schematic and Mass Balance for Alternative A2, Centrifuge Dewatering and Windrow Composting

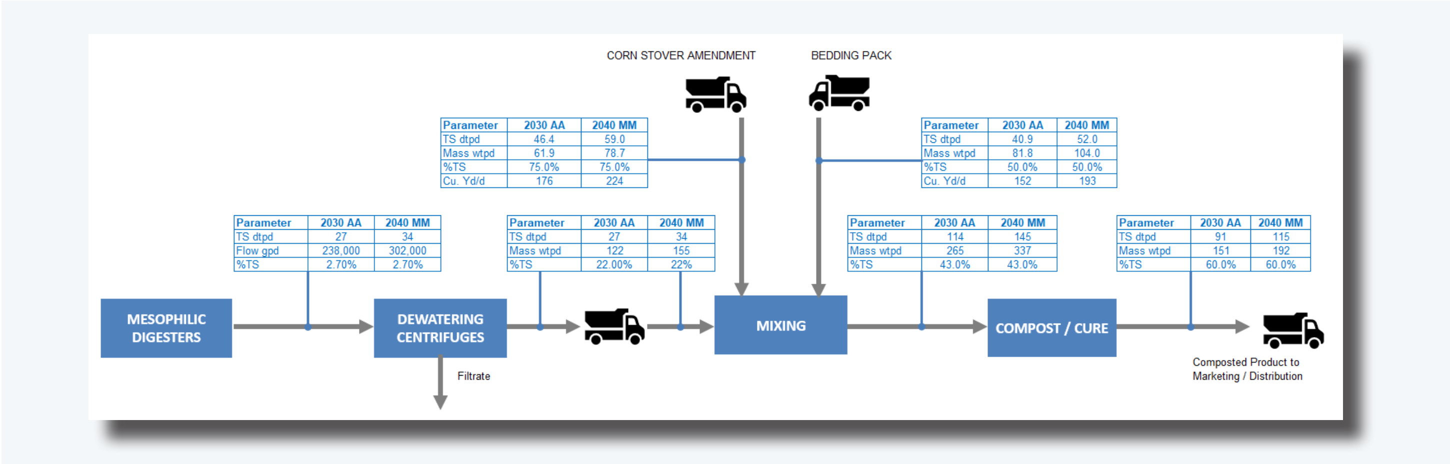


Figure 8-7: Schematic and Mass Balance for Alternative A3, Centrifuge Dewatering and Thermal Drying

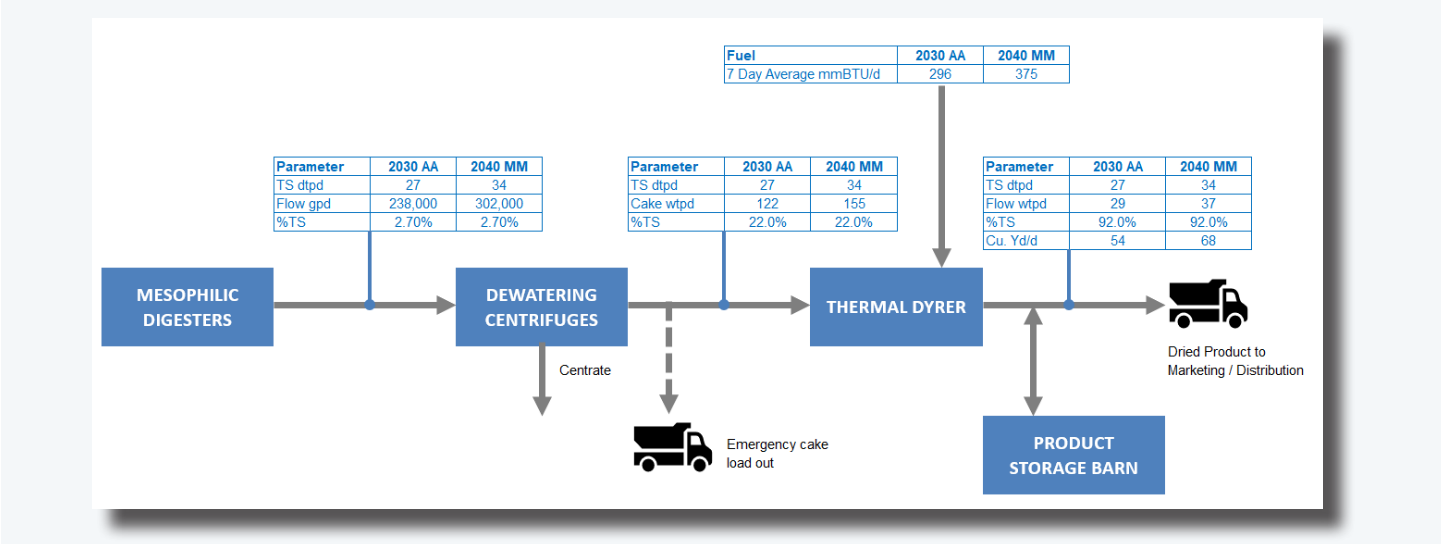


Table 8-3 summarizes the assumptions for the feedstock characteristics for this alternative.

Table 8-3: Assumed Feedstock Characteristics for Alternative A2

PARAMETER	TS (%)	VS (%)	C:N
Biosolids	22	68	12
Bedding pack manure	50	70	13
Corn stover	75	80	32

The compost system would produce a Class A product that is relatively low in nitrogen content, but high in organic matter. Although it depends on several factors, biosolids compost will typically have approximately 50 to 60 percent of the total nitrogen concentration as a digested biosolids product. The product could be either land applied in bulk form to agricultural land as a soil amendment and fertilizer or distributed and marketed to more urban uses as a soil amendment and low nitrogen fertilizer. In this alternative, wood materials would not be used for amendment, which would reduce the potential for nitrogen robbing if the product is not properly cured. Screening was not assumed for this alternative.

It was assumed that for the dewatering element of this alternative, current staff would operate the dewatering equipment. To facilitate comparison to the Baseline Alternative, it was assumed that a 0.5 FTE operator would be engaged in the dewatering operations. For the composting operations, it was assumed that dedicated staff would be required, and it was estimated that 4 FTE staff would be needed to operate the process. In addition, allowances were included for maintenance labor associated with heavy equipment maintenance that equate to approximately 1.5 FTE.

The following major cost items are included in this alternative:

- New centrifuge dewatering building and equipment as detailed in Alternative B3
- A new off-site windrow composting facility incorporating the following:
- A total covered active composting area of 150,000 sq ft for 30 days of active composting.
- A total covered curing area of 137,500 sq ft for 30 days of curing.
- Covered fresh amendment storage area for 30 days' demand with a total of 18,750 sq ft under cover.
- Covered product storage area for 90 days' production, with a total of 125,000 sq ft under cover, and an additional 90 days' capacity uncovered.
- Owner procured equipment including front loader, two windrow turners, transportation tractor and trailer.

A layout for the composting portion of this alternative is provided in Appendix E. The layout for the dewatering portion will be as shown for Alternative B3 (also in Appendix E).

The end use for Alternatives A1 and A2 revolve around the application of a compost end-product. The major difference between Alternative A1 and A2 is the location of the composting and the additional hauling labor and fuel required to transport amendment or biosolids to the compost sites. In Alternative A2 the compost location was assumed to be off-site from NSWTP, so the additional hauling requirement involves getting biosolids and energy amendment to the new compost site. It was assumed that the loadout, hauling and application capacity required for field application would need to match the same available application window each year. Based on historical analysis outlined in Technical Memorandum #1, the average number of days hauled from 2014-2019 was 75 days. To be conservative, it was assumed that the district would not have any more than 70 days available for hauling in future years due to weather, permitted availability, and seasonality of crops. The days available establishes the minimum number of wet tons of compost to be applied per day.

As part of this study, the responsibility of application management was maintained by MMSD and Metrogro. This provides a conservative, robust solution but also alleviates the dependence of end use customers (mostly grain farmers) from having to secure land application equipment. Most grain farmers would be required to rent or purchase fertilizer or manure spreaders that would not efficiently apply solids similar to the Oxbo 5105.

The Oxbo 5105 was again assumed as the equipment to land apply compost to the fields; however, it would be fitted with the Tebbe 30-ton box capacity. The current Oxbo applicators would not be retrofitted and would rather be salvaged and new applicators would be purchased. Filling of the Oxbo Tebbe box would be done via a field located front-end loader. Compost can be pre-delivered and stacked in fields prior to the applicator arriving, which eliminates the applicator dependency on hauling as seen in liquid application scenarios. It was assumed the compost would not be remain stacked in the field for long durations of time due to the perception of good land stewardship of manure or biosolids-derived products. Since this is composted material and not Class B cake, it does not require incorporation. The application season was assumed the same as current practices which are dictated by crop rotation and weather conditions. Equipment summaries per alternative are provided in Chapter 10.

With the reduction in volume hauled, it was assumed the current Metrogro staffing would be sufficient for this alternative. Thus, the labor hours were maintained equivalent to the annual total of 11,445 labor hours, based on the average of years 2019 – 2020.

The following major fleet cost items are included in this alternative:

- Two (2) new Oxbo 5105 applicators with 30-ton Tebbe Box
- Eleven (11) new 65-cubic yard belt trailers for hauling cake
- One John Deere 644L for NSWTTP trailer filling
- Two (2) new John Deere 8230R front-end loaders for field loading

ALTERNATIVE A3 – CENTRIFUGE DEWATERING AND THERMAL DRYING

This alternative assumes that a new centrifuge dewatering system is provided as in Alternative B3 but without the addition of the large cake barn and that the dewatered product is pumped using cake pumps to a new thermal drying facility adjacent to the dewatering building. The evaluation assumes the use of a single train drum dryer system because drum drying produces the most uniform and marketable product of the drying systems available and this product was of greatest interest with local farmers. Alternatives that could be considered include belt dryers, paddle/disc dryers and fluid bed dryers. Dried product storage would be provided with storage silos (normal operation) and additional storage in a dried product storage barn. The dryer system would produce a Class A pelletized product that could be either land applied in bulk form to agricultural land as a fertilizer or distributed and marketed to more urban uses as a fertilizer. A product market assessment could be a first step to identifying alternative uses and potential product value.

The thermal drying facilities were sized to operate under average annual conditions on a continuous basis for five days/week, allowing for equipment maintenance over the weekend. Therefore, centrate storage was provided to equalize the return of centrate and minimize impacts on the liquid treatment process.

Mechanical dewatering and thermal drying are integrally linked processes. For this reason, it was assumed that dedicated staff would be responsible for the operation of both processes. For evaluation purposes, it was assumed that 5 FTE staff would be required for operations and maintenance.

A schematic and mass balance for this alternative is shown in Figure 8-7. See Appendix H for a larger view of each mass balance figure.

This alternative includes the following major cost items:

- New centrifuge dewatering building and equipment as detailed in Alternative B3
- Cake pumps and piping to transfer dewatered cake to the dryer system
- One single train drum drying system with an evaporative capacity of 6,000 kg/hr $H2O$ sized for approximately 5 day per week operation at the future maximum month solids loading condition (with required preventative maintenance being performed over the weekend). The drum dryer includes the following equipment:
    - Cake storage hopper
    - Mixer
    - Furnace
    - Drum dryer
    - Induction fan
    - Air / solids separator
    - Product screen
    - Product cooler
    - Crusher
    - Condenser
    - Two product storage silos
    - Regenerative thermal oxidizer system for odor control
- Dried product storage barn to provide 30 days storage of dried product. A smaller quantity of storage was assumed to reduce the risk for product self-heating. Different configurations can be used. For this analysis, it was assumed that smaller discrete piles would be placed on a covered pad to reduce the risk of self-heating.

A layout for this alternative is provided in Appendix E.

Dried Class A Solid End Use

The end use for Alternative A3 revolves around the application of a Class A solid end-product. It was assumed that the loadout, hauling and application capacity required for field application would need to match the same available application window each year. Based on historical analysis outlined in Technical Memorandum #1, the average number of days hauled from 2014-2019 was 75 days. To be conservative, it was assumed that the district would not have any more than 70 days available for hauling in future years due to weather, permitted availability, and seasonality of crops. The days available establishes the minimum number of cubic yards of Class A solid to be applied per day.

As part of this study, the responsibility of application management was maintained by MMSD and Metrogro. This provides a conservative, robust solution but also alleviates the dependence of end use customers (mostly grain farmers) from having to secure land application equipment. Most grain farmers would be required to rent or purchase fertilizer or manure spreaders that would not efficiently apply solids similar to the Oxbo 5105.

The Oxbo 5105 was again assumed as the equipment to land apply Class A solid to the fields; however, it would be fitted with the Tebbe 30-ton box capacity. The current Oxbo applicators would not be retrofitted and would rather be salvaged and new applicators would be purchased. Filling of the Oxbo Tebbe box would be done via a field located front-end loader. Class A solid can be pre-delivered and stacked in fields prior to the applicator arriving, which eliminates the applicator dependency on hauling as seen in liquid application scenarios. Since this is Class A material and not Class B, it does not require incorporation. Equipment summaries per alternative are provided in Chapter 10.

With the reduction in volume hauled, it was assumed the current Metrogro staffing would be sufficient for this alternative. Thus, the labor hours were maintained equivalent to the annual total of 11,445 labor hours, based on the average of years 2019 – 2020.

The following major fleet cost items are included in this alternative:

- Two (2) new Oxbo 5105 applicators with 30-ton Tebbe Box
- Three (3) new 65-cubic yard belt trailers for hauling cake
- One John Deere 644L for NSWTTP trailer filling
- Two (2) new John Deere 8230R front-end loaders for field loading

ALTERNATIVE A4 – CENTRIFUGE DEWATERING AND CLASS A LIQUID TREATMENT (ALKALINE TREATMENT)

This alternative assumes that a new centrifuge dewatering system is provided as in Alternative B3 but without the addition of the large cake barn, and that the dewatered product is pumped using cake pumps to a new Class A liquid treatment system located in a new building adjacent to the dewatering building. The Class A liquid treatment system incorporates two trains each sized for 18 hour per day operation over seven days per week at the future maximum month loading condition. Centrate storage was provided to equalize the return of centrate and minimize impacts on the liquid treatment process. In each train the dewatered cake is pumped to the reactor where it is dosed with potassium hydroxide to increase the pH (and to add potassium) and heated using a low-pressure steam boiler to 167°F. The combination of the alkali and the high temperature results in thermo-chemical hydrolysis of the sludge cake, producing a Class A liquid product of around 13 to 16% dry solids. The system achieves pathogen reduction using time and temperature (as is used with the existing thermal batching tanks at MMSD). Although the product would have a significantly higher total solids concentration than the current liquid biosolids, the viscosity of the material is changed by the process such that it handles like a liquid as opposed to a cake product. The liquid product would be stored in the existing liquid storage tanks currently used for the Class B liquid and land applied using existing equipment.

If MMSD were to proceed with this alternative, it is recommended that discussions are held with the WDNR regarding the method of demonstrating vector attraction reduction (VAR). The federal biosolids regulations 40 CFR 503 state that “in the case of Class A biosolids, pathogen reduction must take place before or at the same time as vector attraction reduction unless VAR Option 6, 7, or 8 is used”, where VAR options 6, 7 and 8 refer to alkali addition to pH 12, drying with no unstabilized biosolids present and drying with unstabilized biosolids present, respectively. VAR option 9 (soil injection) is another alternative that could be pursued, however for Class A biosolids, it requires injection within 8 hours after discharge from the pathogen-reduction process. Such a requirement would only be practical if it can be agreed that the liquid storage tanks are part of the ‘pathogen reduction process.’

At present the type of system offered in this alternative is only available from a single vendor (Lystek™). Lystek™ has 11 installations in North America, with two full-scale installations in the U.S. as well as a demonstration facility in the U.S. Although Lystek™ refers to their product as a fertilizer, it is a biosolids product and any classification as a fertilizer would need to be applied for through the Wisconsin Department of Agriculture.

It was assumed that existing staff would be responsible for the operation of both dewatering and the alkaline stabilization processes. For evaluation purposes, it was assumed that 1.2 FTE staff would be required for operations and maintenance.

A schematic and mass balance for this alternative is provided in Figure 8-8. See Appendix H for a larger view of each mass balance figure.

This alternative includes the following major cost items:

- New centrifuge dewatering building and equipment as detailed in Alternative B3
- Two dewatered biosolids cake bins
- Two cake pumps and piping to transfer dewatered cake to the thermo-chemical hydrolysis reactors
- Two thermo-chemical hydrolysis reactors
- Two steam boilers
- A potassium hydroxide storage and dosing system with four chemical dosing pumps
- Three reactor discharge pumps (duty/duty/common standby)

A layout for this alternative is provided in Appendix E.

Figure 8-8: Schematic and Mass Balance for Alternative A4, Centrifuge Dewatering and Class A Liquid Treatment

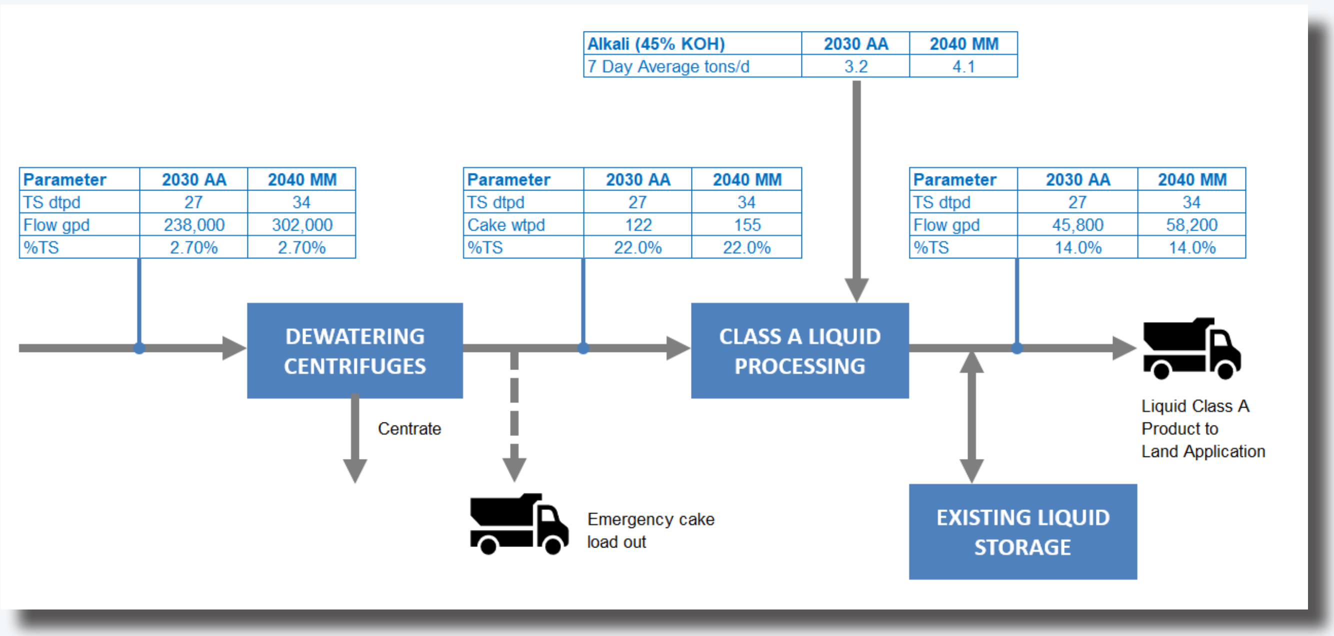
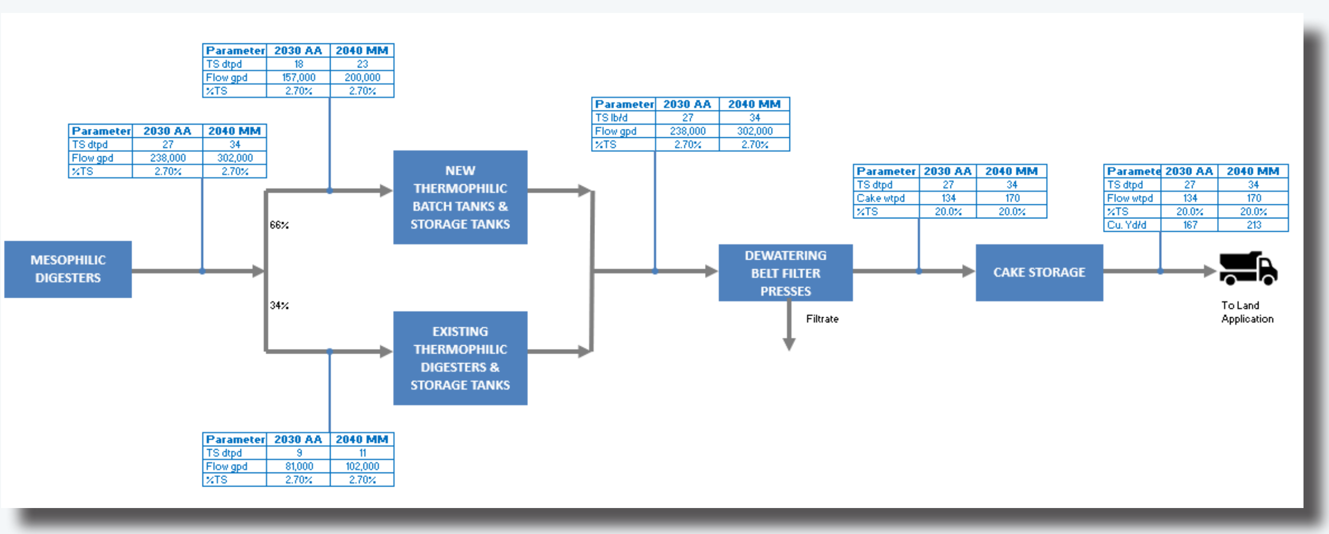


Figure 8-9: Schematic and Mass Balance for Alternative A5, Thermophilic Batch Treatment to Produce Class A Cake with Belt Filter Press Dewatering



Class A Liquid End Use

The end use for Alternative A4 revolves around the application of a Class A liquid end-product. It was assumed that the loadout, hauling and application capacity required for field application would need to match the same available application window each year. Based on historical analysis outlined in Technical Memorandum #1, the average number of days hauled from 2014-2019 was 75 days. To be conservative, it was assumed that the district would not have any more than 70 days available for hauling in future years due to weather, permitted availability, and seasonality of crops. The days available establishes the minimum number of gallons of Class A liquid to be applied per day.

The Oxbo 5105 was again assumed as the equipment to land apply Class A liquid to the fields; however, it would be outfitted with the 6,600-gallon liquid capacity system. The current Oxbo applicator would be used and a new applicator would be purchased. The existing liquid fleet would be used and would not require any additional tankers. Filling of the Oxbo would be done via the top-mounted vacuum connection to tanker trucks. Class A liquid would need to be delivered to field sites in accordance to the same protocol used in the current or Baseline Alternative to prevent back of up trucks. Since this is Class A material and not Class B, it does not require incorporation. Equipment summaries per alternative are provided in Chapter 10.

With the reduction in volume hauled, it was assumed the current Metrogro staffing would be sufficient for this alternative. Thus, the labor hours were maintained equivalent to the annual total of 11,445 labor hours, based on the average of years 2019 – 2020.

The following new major fleet cost items are included in this alternative:

- One new Oxbo 5105 applicator with 6,600-gallon liquid system (total of two)

ALTERNATIVE A5 – THERMAL BATCH TREATMENT WITH BELT FILTER PRESS DEWATERING

This alternative assumes expansion of the existing thermophilic system to include an additional thermal batch treatment system that would allow processing all the solids as a Class A cake. The following assumptions were made in developing this alternative:
The existing thermophilic system will be used to treat 0.102MGD (25% of the projected 2030 max month flow of 0.408 MGD from the original Design Memorandum 11).

The remainder of the sludge will be treated using new thermal batch tanks sized to provide 24 hours batch storage of sludge at the same temperature as the existing system.

Three new tanks will be provided based on a three-day cycle with one tank filling, one tank in batch hold and one tank emptying at any given time. The new tank sizing is based on complete filling and emptying during each cycle in contrast to the existing system which limits the amount of turnover in the tanks to avoid temperature stress on the existing system. This assumption should be further evaluated should this alternative be carried forward as it has a large impact on the cost outcome.

Additional cooling tanks will be provided, sized to provide two days' retention.

It was assumed that existing staff would be responsible for the operation of both dewatering and the thermophilic processes. For evaluation purposes, it was assumed that 1.2 FTE staff would be required for operations and maintenance.

The following major items of infrastructure are included in this alternative:

- Three new batch thermal tanks, 0.2 MG each.
- Two new storage tanks, 0.2 MG each.
- Complete ancillary systems including digester heating and mixing equipment, pipework, heat exchangers and valves.
- A new belt filter press dewatering system as outlined in alternative B4. Note that belt filter press dewatering is used rather than centrifuges to help mitigate the fecal coliform regrowth risk.

A schematic and mass balance for this alternative is provided in Figure 8-9. See Appendix H for a larger view of each mass balance figure.

Class A Cake End Use

The end use for Alternative A5 revolves around the application of a Class A cake end-product. It was assumed that the loadout, hauling and application capacity required for field application would need to match the same available application window each year. Based on historical analysis outlined in Technical Memorandum #1, the average number of days hauled from 2014-2019 was 75 days. To be conservative, it was assumed that the district would not have any more than 70 days available for hauling in future years due to weather, permitted availability, and seasonality of crops. The days available establishes the minimum number of cubic yards of Class A solid to be applied per day.

As part of this study, the responsibility of application management was maintained by MMSD and Metrogro. This provides a conservative, robust solution but also alleviates the dependence of end use customers (mostly grain farmers) from having to secure land application equipment. Most grain farmers would be required to rent or purchase fertilizer or manure spreaders that would not efficiently apply solids similar to the Oxbo 5105.

The Oxbo 5105 was again assumed as the equipment to land apply Class A cake to the fields; however, it would be fitted with the Tebbe 30-ton box capacity. The current Oxbo applicators would not be retrofitted and would rather be salvaged and new applicators would be purchased. Filling of the Oxbo Tebbe box would be done via a field located front-end loader. Class A cake can be pre-delivered and stacked in fields prior to the applicator arriving, which eliminates the applicator dependency on hauling as seen in liquid application scenarios. Since this is Class A material and incorporation is not required. Equipment summaries per alternative are provided in Chapter 10.

With the reduction in volume hauled, it was assumed the current Metrogro staffing would be sufficient for this alternative. Thus, the labor hours were maintained equivalent to the annual total of 11,445 labor hours, based on the average of years 2019 – 2020.

The following major fleet cost items are included in this alternative:

- Two (2) new Oxbo 5105 applicators with 30-ton Tebbe Box
- Six (6) new 65-cubic yard belt trailers for hauling cake
- One John Deere 644L for NSWTTP trailer filling
- Two (2) new John Deere 8230R front-end loaders for field loading

CHAPTER 9
METHODOLOGY & ASSUMPTIONS

METHODOLOGY & ASSUMPTIONS

Capital and O&M costs were developed for each of the alternatives using a combination of quotations from vendors and costs from previous studies of a similar size.

Unit costs for consumables used in the evaluation are summarized in Table 9-1.

Table 9-1: Unit Costs for Consumables

PARAMETER	UNITS	VALUE
Power	$/kWh	0.086
Natural gas	$/MMBtu	8
Labor	$/hr	75
Maintenance (general)	% of equipment cost	3%
Maintenance (dryer)	% of equipment cost	4%
Polymer	$/lb	2.79
Compost amendment – wood chips	$/cubic yd	30
Compost amendment – bedding pack manure and corn stover	$/cubic yd	0
Potassium hydroxide 45% w/w	$/ton	560
Fuel (Road Use)	$/gal	2.609
Fuel (Off-road Use	$/gal	2.175

Assumptions for dewatering using centrifuges and belts are summarized in Table 9-2.

Table 9-2: Assumptions for Dewatering

PARAMETER	UNITS	CENTRIFUGES	BELTS
Cake solids	%	22%	20%
Max polymer consumption	lb/DT	65	60
Average polymer consumption	lb/DT	45	40
Labor	h/d	3	6
Odor treatment capital cost adder for belts	$/SCFM	-	30
Odor treatment O&M cost adder for belts	$/SCFM/yr	-	20

Assumptions used for the composting alternatives for both static pile and windrow composting are summarized in Table 9-3. Note that wood chips were used as the amendment for static pile composting whereas agricultural (ag) materials such as cornstalks and straw was assumed for windrow composting based on demonstration scale testing by MMSD. The ag materials are not suitable for static pile composting as they are not rigid enough to provide porosity to the pile throughout the composting process. Whereas with windrow composting, mixing of the windrow helps to maintain an open structure, as based on the experience from the MMSD demonstration work.

Table 9-3: Assumptions for Composting

PARAMETER	UNITS	STATIC PILE	WINDROW
Biosolids volatile solids	%	68	68
Biosolids biodegradable fraction of VS	%	50	50
Bedding pack total solids	%	-	50
Bedding pack volatile solids	%	-	70
Bedding pack biodegradable fraction of VS	%	-	50%
Energy amendment type	-	Wood chips	Ag materials (Cornstalks, Straw, Hay)
Amendment total solids (wood chips / ag materials)	%	70	75
Amendment volatile solids (wood chips / ag materials)	%	75	80
Amendment biodegradable fraction (wood chips / ag materials)	%	60	50
Initial mixture total solids	%	43	43
Initial mixture Carbon: Nitrogen ratio target		20-30:1	20-30:1
Final product total solids	%	60	60
Final product Carbon: Nitrogen ratio target		≤12:1	≤12:1
Labor full time equivalents	-	5.5	5.5

Assumptions used for evaluation of the thermal drying alternative are summarized in Table 9-4. Note that the evaluation was based on the use of 100% natural gas in the dryer. It is possible to operate drum dryers using biogas, if available or on a blend of biogas and natural gas as needed. The drying energy is the largest factor impacting dryer operating cost. Utilizing biogas could be further examined if this option were selected.

Table 9-4: Assumptions for Thermal Drying

PARAMETER	UNITS	VALUE
Natural gas requirement1	BTU/lb water evap.	1,600
Power required when operating	kW	326
Labor (average over 7 days)	h/d	24
Dried product storage	Days	30
1 includes gas for regenerative thermal oxidizer		

Assumptions used for the Class A liquid treatment using thermo-chemical hydrolysis are summarized in Table 9-5. Power input, heat input and potassium hydroxide consumption were all provided by the vendor.

Table 9-5: Assumptions for Class A Liquid Treatment

PARAMETER	UNITS	VALUE
Power required	kWh/dt	60
Heat input	MMBTU/dt	1.1
Boiler efficiency, net	%	80
Labor	h/d	4
Potassium hydroxide usage	lb/dry ton	190

Assumptions used for batch thermal treatment are provided in Table 9-6 including mixing energy for the tanks and additional labor required for operation of the new batch treatment system.

Table 9-6: Assumptions for Batch Thermal Treatment

PARAMETER	UNITS	VALUE
Mixing energy	W/m3 (hp/1000CF)	10 (0.038)
Labor	h/d	4

Table 9-7: Assumptions for Baseline Alternative (Existing Operation)

PARAMETER	UNITS	VALUE
Total tank volume w/new tank	MG	25.9
Labor	h/d	8

Assumptions used for land application and hauling are shown in Table 9-8. The values used for application densities were calculated using assumed N-P-K ratios and SnapPlus modeling as shown in Appendix F.

Table 9-8: Assumptions for Land Application and Hauling

PARAMETER	UNITS	VALUE
Average Distance to Field	miles	20
Average Field Size	acres	40
Average Filling Rate for Liquid Biosolids	gpm	566
Average Hauling Speed (Tanker to Field)	mph	35
Maximum Hauling Capacity of Tanker or Trailer	tons	40
Average Daily Working Hours	hours/day	10
Class B Liquid Average Application Density	gal/acre	6,500
Class B Cake Average Application Density	cy/acre	8.5
Compost A1 Average Application Density	wtons/acre	2.9
Compost A2 Average Application Density	wtons/acre	4.8
Class A Dry Pelletized Average Application Density	Lbs/acre	2,400
Class A Liquid Average Application Density	gal/acre	2,650
Class A Cake Average Application Density	cy/acre	9.3
Average Liquid Application Speed (During Application)	mph	4
Average Cake or Compost Application Speed (During Application)	mph	5
Average Cake Incorporation Speed (During Incorporation)	mph	5

Capital costs were developed from equipment costs and using previous similar projects. Cost factors used and cost adders for developing project costs are summarized in Table 9-9.

Table 9-9: Capital Cost Factors

PARAMETER	UNITS	VALUE	APPLIED TO
Building - 2 story	$/sf	300	-
Building - 1 story	$/sf	200	-
Cost of cake barn / covered product storage	$/sf	35	-
Installation	%	30%	Equipment cost
Piping & valves	%	10%	Equipment cost
Site work	%	5%	Equipment cost
Electrical / I&C	%	15%	Equipment cost
General conditions	%	12%	Direct cost
Contractor overhead & profit	%	10%	Direct cost
Contingency[1]	%	50%	Direct cost
Engineering, legal & admin[1]	%	25%	Direct cost plus general conditions, contractor overhead & profit and contingency
[1]Note that contingency and the method of applying engineering, legal and admin costs was selected to match the Energy Management Master Plan being conducted for MMSD by others to ensure consistency between the two studies.			

Lifecycle costs were calculated assuming a 20-year project life using an inflation adjusted rate of return of 1.96% (equivalent to a cost of capital of 4% and inflation rate of 2%).

Table 9-10: Life Cycle Cost Factors

PARAMETER	UNITS	VALUE
Cost of capital	%	4.00%
Inflation	%	2.00%
Inflation adjusted rate	%	1.96%
Life cycle cost term	years	20

CHAPTER 10
LAND APPLICATION COMPARISON

LAND APPLICATION COMPARISON

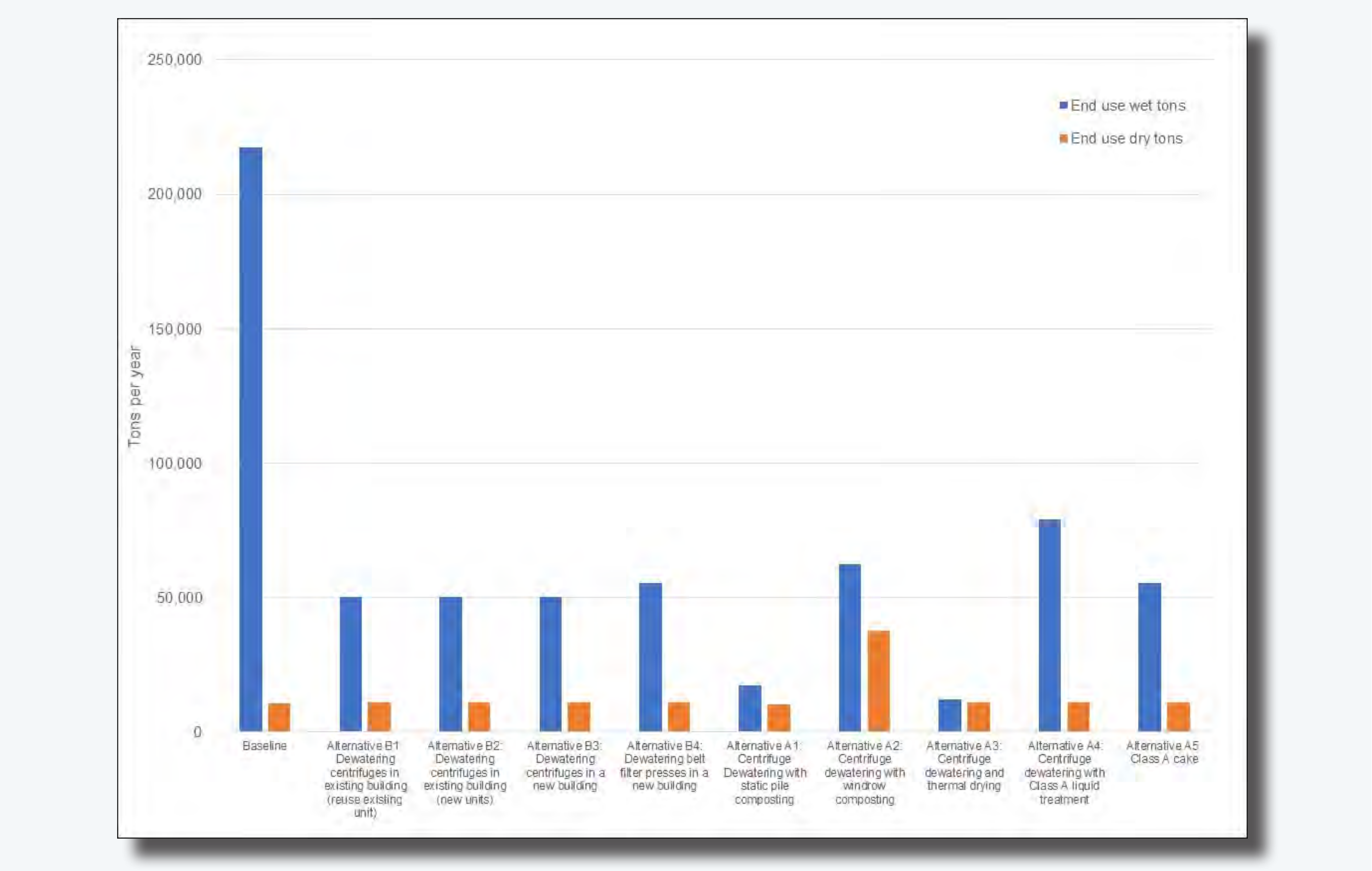
APPLICATION AMOUNTS

Each alternative yields varying volumes, total solids (and corresponding wet weights), and viscosity. A comparison of the end-product produced from each of the alternatives is displayed in the Figure 10-1. This demonstrates the large reduction in total wet weight end-product from conversion of Class B liquid biosolids to either a dried product, compost or Class A product. In most of the alternatives, the mass of biosolids in dry tons will be relatively constant because the processes following digestion generally will not result in the destruction of solids. An exception to that are the composting alternatives. The compost process will break down some of the volatile solids from all the feedstocks (biosolids, wood chips, and ag materials). As shown in Figure 10-1, ultimately dry tons remain constant except for Alternative A2, Windrow Composting, which involves importing large quantities of ag materials.

APPLICATION EQUIPMENT SELECTION

The basis for selection of hauling and land application equipment was based on industry standard, product consistency, and best tooling. As discussed in the beginning of this report, the biggest constraint on moving end-product to the field has been the number of days available for application. To determine quantities of applicators required, the assumed target value for application window was less than 70 days per year. The hauling fleet was then sized large enough to support the peak application rate of the number applicators even if that yielded less than 70 days of application. This provides MMSD with flexibility to operate less hauling equipment over a longer duration of time and still move enough end-product for the year. When only one applicator was required to accomplish this timeframe, a second applicator was also recommended for system redundancy and simultaneous multi-field application. For liquid products, it was assumed that the existing Oxbo 5105 would be retained for use in addition to

Figure 10-1: Comparison of End-Product Amount by Alternative



new purchases. For solid product application it was assumed the existing Oxbo 5105 would not be used and new Tebbe Box Oxbo 5105 units would be purchased. Salvage values of existing equipment were not considered in the cost analysis of this study. A summary of the recommended application equipment per alternative is shown in Table 10-1.

FIELD LOADING EQUIPMENT SELECTION

For solid materials, the applicator will not have the ability to direct load from hauling trailers and will require an in-field front-end loader to fill the Tebbe box. This applies to Alternatives B1-B4, A1- A3 and A5. The front-end loader selected for this study is the John Deere 8320R model with a 4-4.75 CY bucket capacity with the ‘high-lift’ capability. The number of front-end loaders required was set equal to the number of applicators as they would work in pairs during application.

The advantage of dry product applicator loading (via front-end loader) compared to liquid loading of an applicator is the decoupling of time-paced delivery of end-product. This allows end-product to be pre-delivered to the site or stacked at the field at a rate greater than the application rate. A summary of the recommended field loader equipment per alternative is shown in Table 10-2.

HAULING EQUIPMENT SELECTION

Liquid End-Product

The current operation has demonstrated the greatest success with the 5,700-gallon capacity liquid tanker trailers with top-mounted suction connections to allow for ease of applicator filling. This tanker setup and capacity was chosen as the preferred liquid hauling method for the Baseline Alternative and Alternative A4. Loadout stations at MMSD would be equipped with a top load feature. A summary of the recommended hauling equipment per alternative is shown in Table 10-3.

Table 10-1: Summary of Recommended Application Equipment per Alternative

ALTERNATIVE	QUANTITY	MODEL	NOTES
Baseline	4	Oxbo 5105 w/Liquid Tank	3 New Purchases + 1 Currently Owned
B1, B2, B3, B4	2	Oxbo 5105 applicator w/ 30-ton Tebbe Box	2 New Purchases (One redundant)
A1 (ASPC)	2	Oxbo 5105 applicator w/ 30-ton Tebbe Box	2 New Purchases
A2 (WRC)	2	Oxbo 5105 applicator w/ 30-ton Tebbe Box	2 New Purchases
A3	2	Oxbo 5105 applicator w/ 30-ton Tebbe Box	2 New Purchases (One redundant)
A4	2	Oxbo 5105 w/Liquid Tank	1 New Purchase + 1 Currently Owned
A5	2	Oxbo 5105 applicator w/ 30-ton Tebbe Box	2 New Purchases

Table 10-2: Summary of Recommended Field Loader Equipment per Alternative

ALTERNATIVE	QUANTITY	MODEL	NOTES
Baseline	-	-	-
B1, B2, B3, B4	2	John Deere Model 8320R	Paired with Applicator
A1 (ASPC)	2	John Deere Model 8320R	Paired with Applicator
A2 (WRC)	2	John Deere Model 8320R	Paired with Applicator
A3	2	John Deere Model 8320R	Paired with Applicator
A4	-	-	-
A5	2	John Deere Model 8320R	Paired with Applicator

Solid End-Product

Solid end-product can be in the form of cake, dried solids or compost. The trailer chosen for hauling these materials was a belt trailer with moisture containment system. The Trinity Trailer model with 65 CY capacity was used for the basis of this study. Hauling amounts of end-product were limited to 25 wet tons per load to meet WDOT weight restrictions. A summary of the recommended hauling equipment per alternative is shown in Table 10-3.

INCORPORATION EQUIPMENT SELECTION

While incorporation equipment may not be required for Class B end-products if they meet Vector Attraction Reduction (VAR), it is recommended and included in the alternatives. This will help reduce the risk of odors and potential complaints. Liquid application will be immediately incorporated with the toolbar attachment of the Oxbo application. For solids or cake options, the Oxbo equipped with the Tebbe box would surface apply the end-product and tractor will follow-up with incorporation. A summary of the recommended tillage equipment per alternative is shown in Table 10-4.

HAULING AND APPLICATION LABOR HOURS

The breakdown of labor hours (excluding Metrogro staff hours) required for loading, hauling, off-loading, and applying, and incorporating under each alternative is compared in Figure 10-2. The drastic difference in hauling products is caused by volume and weight restrictions of the hauling tanker or trailer in combination with the density and amount of material to be hauled. This equates to number of trips driven and therefore the hours to transport each material.

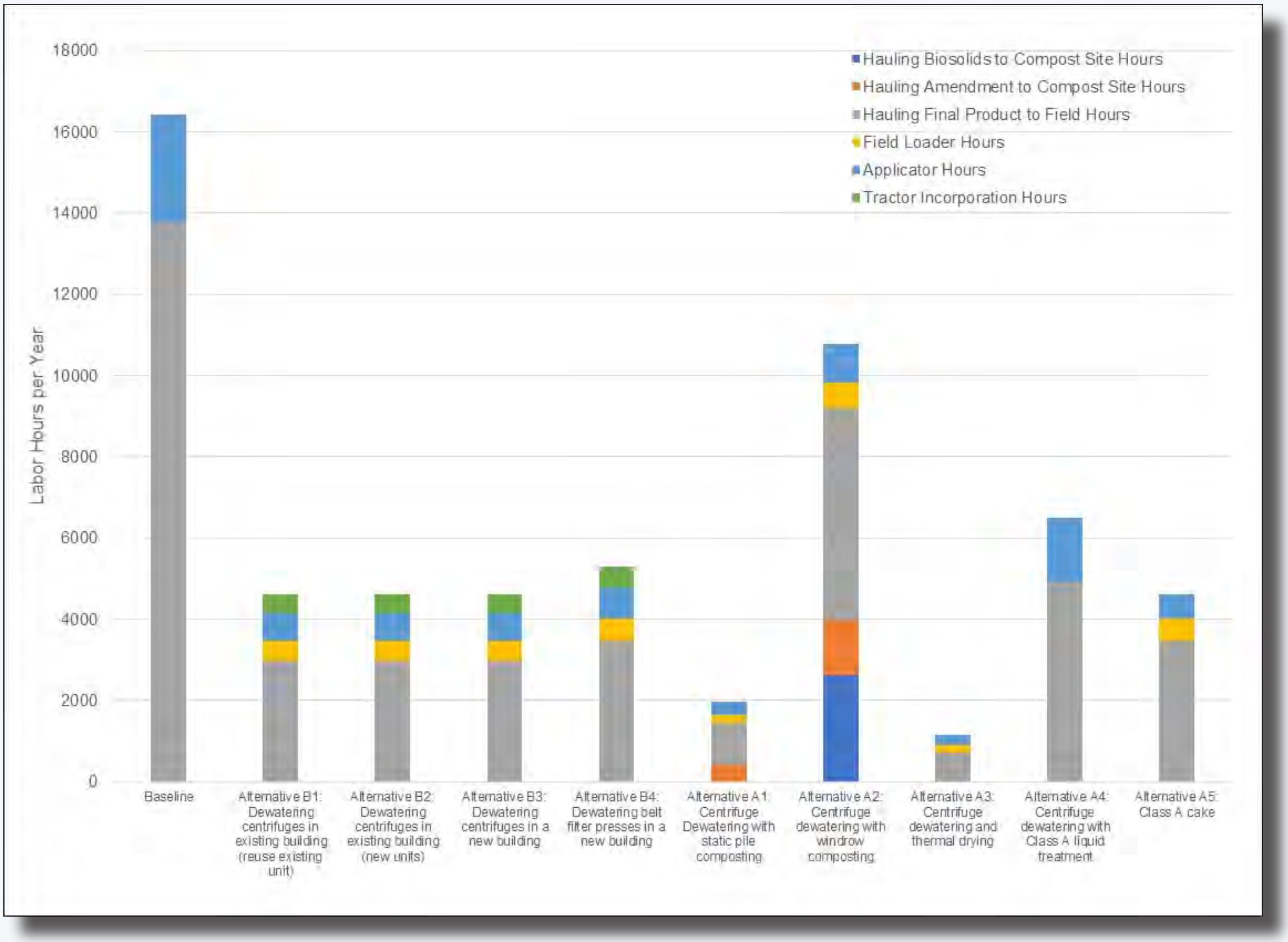
Table 10-3: Summary of Recommended Hauling Equipment per Alternative

ALTERNATIVE	QUANTITY	MODEL	NOTES
Baseline	21	5,700 gallon top load	15 Existing + 6 New Purchase
B1, B2, B3, B4	6	Trinity C-18479	6 New Purchase
A1 (ASPC)	4	Trinity C-18479	4 New Purchase
A2 (WRC)	11	Trinity C-18479	11 New Purchase
A3	3	Trinity C-18479	3 New Purchase
A4	7	5,700 gallon top load	7 Existing
A5	6	Trinity C-18479	6 New Purchase

Table 10-4: Summary of Recommended Incorporation Equipment per Alternative

ALTERNATIVE	QUANTITY	MODEL	NOTES
Baseline	-	-	-
B1, B2, B3, B4	2	John Deere Model 8320R w/30' Tillage Implement	2 New Purchases (One redundant)
A1 (ASPC)	-	-	-
A2 (WRC)	-	-	-
A3	-	-	-
A4	-	-	-
A5	-	-	-

Figure 10-2: Comparison of Labor Hours by Alternative



CHAPTER 11
LIFE CYCLE COST ANALYSIS RESULTS

LIFECYCLE COST ANALYSIS RESULTS

Lifecycle costs were analyzed using a 20-year project life using an inflation adjusted rate of return of 1.96% (equivalent to a cost of capital of 4% and inflation rate of 2%). Figure 11-1 compares the total net present cost of each alternative with uncertainty bars depicting the range of potential cost. Figure 11-2 shows the net present cost on a per dry ton basis with uncertainty bars. Figure 11-3 and Figure 11-4 display the breakdown of net present costs between operational and capital expenditures on a total cost and per dry ton basis, respectively.

Figure 11-1: Comparison of Alternative Net Present Costs

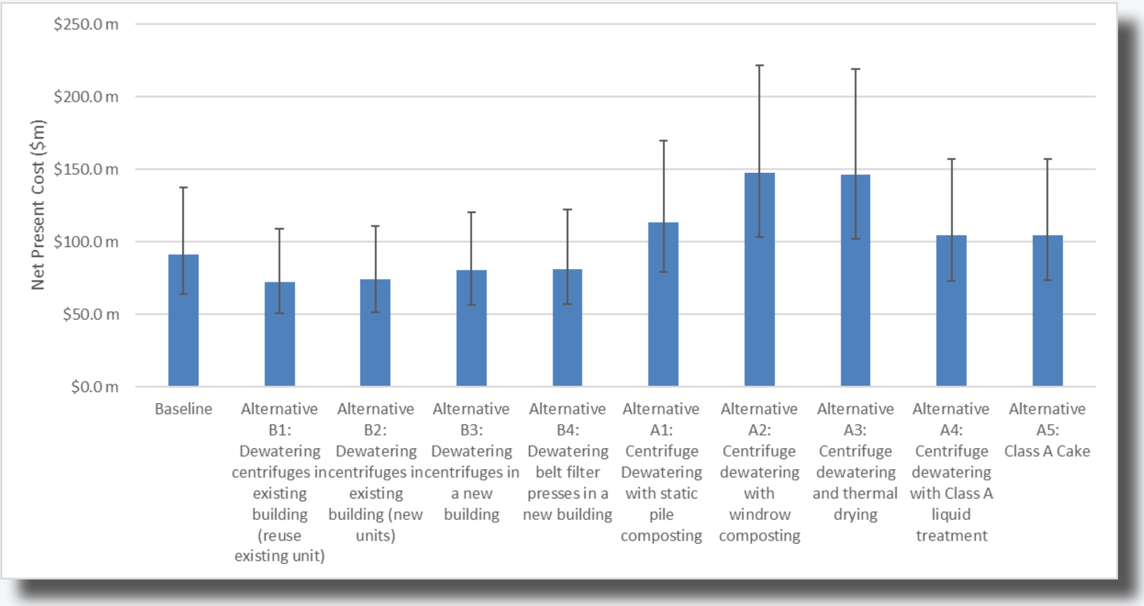


Figure 11-2: Comparison of Alternative Net Present Costs per Dry Ton

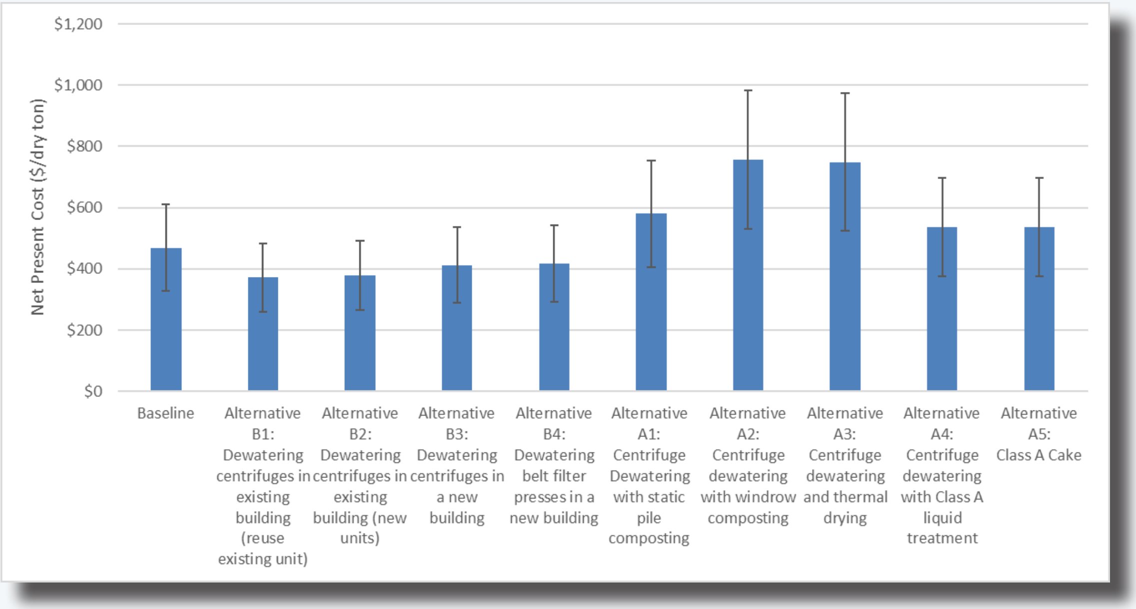


Figure 11-3: Comparison of Capital and Operational Fractions of Net Present Costs

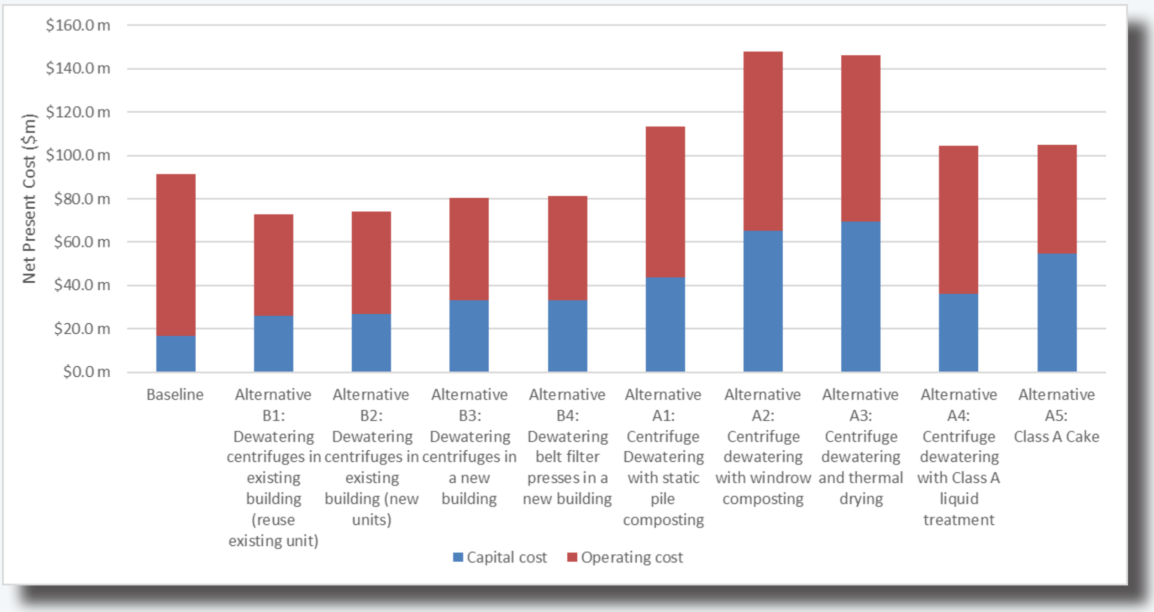
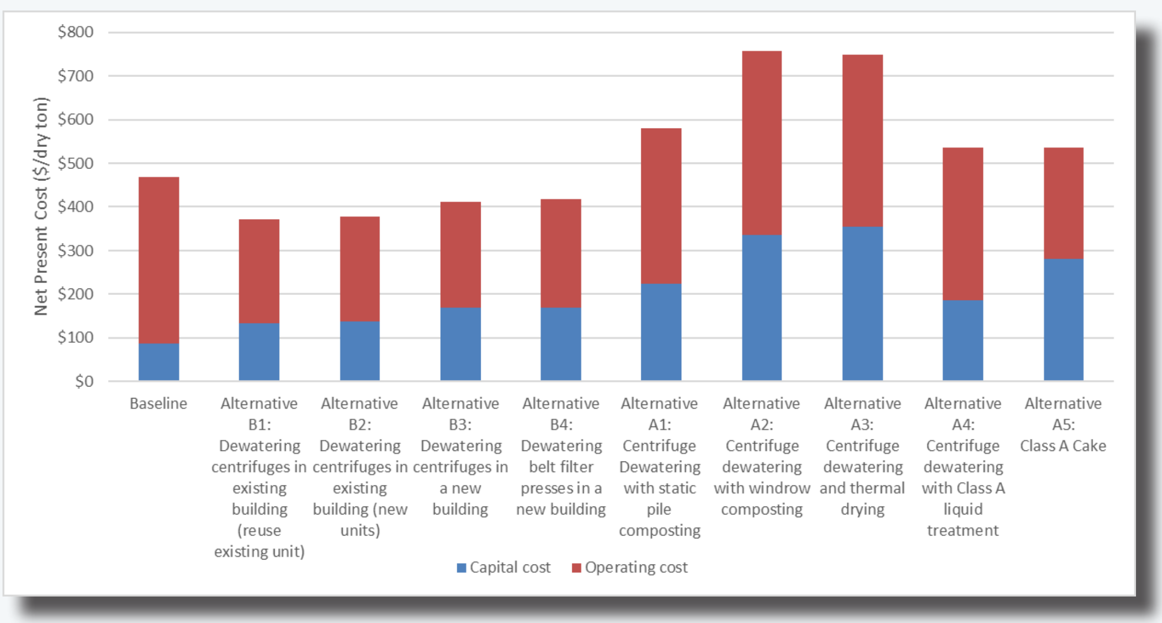


Figure 11-4: Comparison of Capital and Operational Fraction of Net Present Costs per Dry Ton



CHAPTER 12
DATA MANAGEMENT & ADMINISTRATION

DATA MANAGEMENT & ADMINISTRATION

OVERVIEW

A careful review of the existing MMSD administrative and data management workflows was conducted as part of this plan and presented within the Program Assessment phase. This entailed listening to staff, documenting all of the existing datasets used to conduct normal operations, and describing the workflow in verbal text and with a visual diagram (Figure 12-1). Although the existing systems have kept operations functioning, several major issues were identified that created delays in biosolids application, duplication of data entry, and additional administrative workload for the Resource Recovery Manager (RRM).

The goal of this section was to describe all of the identified issues and present a new framework of the Metrogro database to address these issues and improve workflow. This framework is intended to guide the program into the next phases of a database upgrade, focusing on the largest/most important issues identified. A data structure that is flexible will allow the MMSD IT department to make changes to the system as the Biosolids Program adapts over time. Added complexity often seems like a good solution in the near term but can be challenging to modify. This is particularly important to consider as MMSD is reviewing the liquid Class B biosolids program and considering shifting to a different product. Any database solution should be tailored to the ever-changing environment at MMSD, and flexible enough to accommodate and support the staff.

MMSD INFORMATION TECHNOLOGY (IT) DISCUSSIONS

Technical Memo #1 was reviewed with the MMSD IT department, MSA staff, and members of the Biosolids Program (see attendees below). This discussion covered the issues identified within the existing Metrogro database, historical efforts to improve data management, and incorporated the ideas from an IT perspective since any revision to the database will hinge on their support and guidance.

- Laurie Dunn, Information Systems Manager, MMSD
- Kim Meyer, Resource Recovery Manager, MMSD
- Martye Griffin, Information Systems Manager, MMSD
- Amber Converse, Senior GIS Analyst, MSA
- Greg Gunderson, Team Leader, MSA

The group discussed a series of different questions related to improving the Metrogro database, and abbreviated responses are included below for reference purposes.

Web-Based User Interfaces

The existing Metrogro Access database is linked to a SQL server database, but it could be shifted to a web-based format in the future. The MMSD IT department does not currently have any web based solutions, except for the GIS system (which is not currently linked to the Metrogro database). In general, there is not opposition to a web-based environment, but the data itself would most likely remain in house (rather than housed on a remote server). In general, the IT staff are willing to investigate web-based solutions and are open to learning the coding language required to support one.

There are many options for shifting to a web-based format, and modifying this code will require significant support from IT. Some example coding options include:

- **ASP.NET:** Free, but requires programing skills. Can allow for more complex data formatting but will require more support in general.
- **Caspio:** Annual subscription, but does not require programming skills. Tools and applications might be more limited, but the building environment is more intuitive and could be changed relatively easily.

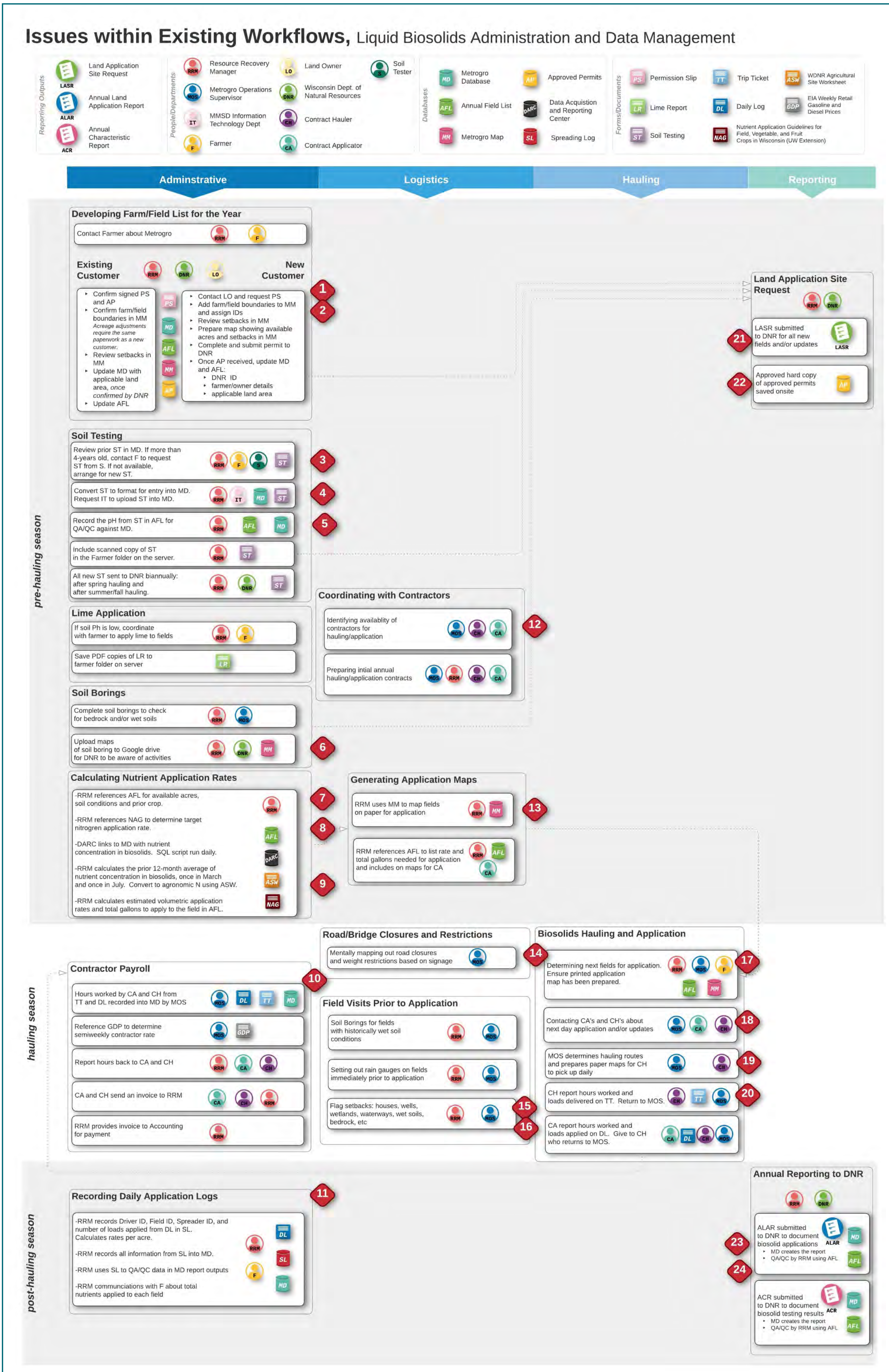
The MMSD IT staff know a variety of different coding languages and in general have an appetite to learn more; ASP.NET is a possible solution for database design. However, there is a consideration for the time availability of IT staff to design a solution, which would require the backing/support of MMSD as a whole to divert resources and human power to the project. Any proposed solutions should be carefully discussed with the IT department to ensure appropriate support would be available to troubleshoot issues and revise the design into the future.

Integrating GIS into the Metrogro Database

Much of the Metrogro day-to-day work requires geographic information, in tandem with more traditional database information. There is a potential to integrate GIS into the new database structure, which could streamline staff workflows. Alternative solutions could be "map centric" or "form/report" centric. If looking at map-centric solutions, something like GeoCortex might be viable to easily prepare forms/reports from SQL and also tie into GIS. This might also be a viable option if MMSD uses Enterprise GIS without having additional software but would require significant more GIS staff time.

The group agreed that better integration with GIS is feasible, but more discussions with District GIS staff would be essential.

Figure 12-1: Issues within Existing Workflow, Liquid Biosolids Administration and Data Management



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Data Storage: Local vs. Cloud-based Solutions

The Metrogro database is currently housed in a SQL server on site, which means that employees only have access to the database when working in the office. There is a potential to shift the data storage to a cloud-based solution, or to continue to house the data locally.

The group agree that keeping data on site would likely be preferred, but a systematic review of storage solutions could be completed if this project moves forward. Keeping the data on site would allow for more privacy control and linking with other data sources within MMSD.

Redesign: Completed In-house or Outsourced

A database redesign could be completed by MMSD IT staff or by an outside consultant. The existing Metrogro database was designed by MMSD IT (Laurie Dunn developed and supported the original design). However, contracting with an outside firm for the design of an updated database may be desired. It was agreed that both options are feasible, it is simply a matter of assessing existing staff availability and timelines. The MMSD IT staff would most likely oversee database maintenance, and therefore, the system should be designed with the District's needs in mind.

The MMSD IT department has been heavily involved with changes and modifications to the Metrogro database design. Although the database structure has functioned to support MMSD's needs, there are known issues3with the structure that staff have already identified. These issues[3] would need to be addressed if the end solution would simply be shifting the existing database to a different platform.

Support from the IT department is imperative to the success of any database redesign, since IT staff will be relied on to provide guidance and complete updates to the database over time. It is strongly recommended to include the IT staff in any future discussions. Not only will they provide valuable insight into what capabilities are currently available in house, they can also help tailor the extent of the redesign and prioritize needs. Developing an 'ideal framework' to address all issues is always desired; it is equally important to recognize that not all solutions can be easily implemented. Focusing on the major needs of the program, and recognizing that not all of the issues can be addressed in an easy-to-use, economical way will help streamline the design process and result in an end product that satisfies the largest needs of the program and can also be easily supported by IT.

IDENTIFICATION OF HIGH, MEDIUM, AND LOW PRIORITIES

Many inefficiencies/issues have been identified within the Metrogro program's daily workflows and the team also suggested some ideas that could improve the program. Both the issues and ideas were prioritized to inform the designers of which challenges to tackle first, and which might be resolved later.

Some of the identified issues are of larger concern since they can delay the distribution of biosolids to fields. Issues that arise early in the hauling season can result in delays in permit applications. Since the program is also juggling the uncertainty of weather conditions, it was expressed by staff that any inefficiencies/issues that can delay permit applications and narrow the available hauling time window should be addressed first. In addition, any issues that might result in discrepancies in annual reporting should also be considered high priority. Other issues that are smaller in nature, resulting in more of an annoyance for staff but do not have a significant impact on overall operations, should be considered secondary.

To better visualize the 'timing' of all the issues, each inefficiency/issue is displayed within the annual workflow diagram. The corresponding number on Figure 12-1 matches the number and description in Table 12 -1. Each issue was then assigned a priority ranking as follows:

- **HIGH:** The issue often impacts the amount of time available for hauling or results in inaccurate reporting.
- **MEDIUM:** The issue sometimes impacts the amount of time available for hauling or results in inaccurate reporting.
- **LOW:** The issue rarely impacts the amount of time available for hauling or results in inaccurate reporting.

Note that some issues impact hauling operations simply because the RRM does not have adequate time to complete an administrative task quickly or while in the field, which leads to further delays. It is understood that this ranking is somewhat subjective in nature but is intended to act as a guide for future planning purposes.

[3]More information on the existing database structural issues was not provided during the meeting (too nuanced of a discussion at this point in the process) but more clarification can be provided by MMSD IT staff, if required.

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Table 12-1: Description of Issue within Existing Workflows, Liquid Biosolids Administration and Data Management

Description of Issues within Existing Workflows, Liquid Biosolids Administration and Data Management

	Description	Priority
1	Landowners often do not return the signed permission slip. Without a permission slip, biosolids cannot be applied and stops the entire process.	HIGH
2	Farm/Field IDs are in addition to the DNR ID, which leads to confusion. Also there is an inability to split land owners once a field is created within the Metrogro database. Results in the RRM and MOS to maintain separate contact information rather	HIGH
3	Soil testing often slow to receive from Coops/fertilizer companies, potentially due to their loss of sales when farmers apply biosolids to their fields.	LOW
4	Soil test report are also supplied as PDFs, which requires more manual data entry. Without a soil test, biosolids cannot be applied.	MEDIUM
5	RRM cannot directly load soil tests. Requires help from IT. Results in delays and inefficiencies for RRM.	MEDIUM
6	Uploading soil boring maps to google drive is often not feasible due to time constraints on the RRM.	LOW
7	Metrogro database does not allow for the RRM to reference the available acres, soil conditions and prior crop. Therefore, it is saved in the Annual Field List. Data duplication and potential for errors (in calculating rates and reporting outputs)	HIGH
8	RRM needs to reference outside materials for lookup tables to calculate application rates on each individual field. This is time consuming and can lead to delays. A similar calculation is done automatically within SnapPlus tool.	HIGH
9	RRM needs to run calculations to convert biosolid nutrient concentrations from the lab reporting outputs to agronomic units (something farmers understand). A similar calculation is done automatically within SnapPlus tool.	HIGH
10	Receiving trip tickets and daily logs from contractors can be inefficient. The paper documents are not always completed accurately.	HIGH
11	The Metrogro database makes it challenging to see all of the field applications within an entire season. Reporting outputs in the Metrogro database need to be carefully QC'd for accuracy since the manual entry of the trip tickets	MEDIUM
12	Finding local contractors for application and hauling can be challenging when the proposed work schedule is highly compressed.	HIGH
13	Creating paper maps can be time consuming for the RRM. Integrates data from the Metrogro Map, Metrogro database, and Annual Field List. Maps could be provided digitally if there was an option.	MEDIUM
14	Road closure information is not recorded anywhere for easy access by all staff. Potential for issues if the MOS is unavailable and hard to track historical road closures for predictive analytics.	LOW
15	The wells database is not available in a mobile format for use during site visits.	LOW
16	The Metrogro Complaint database, which has reports from nearby landowners about hauling concerns, is not integrated into the existing workflows. This information would be helpful to know when conducting site visits and	LOW
17	Determining the next field for application is done on the fly, based more on what fields have approved permits. A slowdown in earlier administrative processes often reduce the options for field applications. Driving schedules are	MEDIUM
18	Contract employees are responding to text messages from RMM and MOS to determine their schedule. Might cause strain on the availability of the workforce who can accommodate this type of scheduling.	LOW
19	Driving routes are provided as paper copy maps or verbal instruction. Drivers might have smart phone/GPS capabilities.	LOW
20	Contract applicators report total number of hauling loads, which is used to calculate the approximate amount of biosolid applied to each field. New applicator equipment can more accurately record location and quantity of biosoilds applied.If this new technology is adopted, it cannot be uploaded into the Metrogro database.	MEDIUM
21	Lots of moving parts in assembling the permit information from Farmers and Landowners. Delays in sending material to the DNR can result in slowdowns in hauling (if the DNR does not have time to review the application).	HIGH
22	Approved permits are saved in hard copy format in the RRM's office. The filing cabinet is currently full. There are plans to scan all of the permits and ideally this would be easily accessed through the Metrogro database.	LOW
23	QA/QC of Metrogro annual reporting to the WDNR is very time intensive. Manual data entry into the Metrogro database slows the process and introduces the potential for human error since many of the entries are from paper Daily Logs which are often reported incorrectly. The RRM has to sort through all of the tickets individually and cannot see the "rolled up" data easily within the Metrogro database.	HIGH
24	Metrogro database was designed for a liquid Class B biosolid program. The class A and class B cake biosolid distribution is not recorded within the Metrogro database.	MEDIUM

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RECOMMENDATIONS

A series of potential improvements/solutions were developed during ongoing discussions between the Metrogro staff, the MMSD IT department, and MSA. Detailed solutions are best saved for the formal redesign of the database; therefore the recommendations were generalized into nine (9) broad categories, as shown in Table 12-2. Each improvement/solution is correlated to the issues it addresses (see Table 12-2).

1: Single Map-Based Interface for Data Entry and Review

The Metrogro program relies on geographic information, therefore it is recommended the database is organized with a "map-based interface."

The Metrogro program currently requires coordination between many different datasets, reducing the amount of time available to support on-the-fly decision making. A map-based user-friendly interface would allow the RRM to enter the data once and be able to automatically reference "roll-up tables" for instant QA/QC of data entry.

The RRM could click on a field within a map, and the pertinent datasets could be accessed from the map view. This method is the most intuitive for staff to be able to visualize all of the fields within the area, mentally account for any setback requirements (e.g. wells, neighbors with complaints, wetlands, etc.) and visualize improved efficiencies (e.g. optimizing hauling routes by grouping together specific fields that have the DNR permitting in place for immediate application). While there are numerous benefits to a map-based solution, it will require more coordination with the District GIS staff and likely require additional software purchases.

A "form-based interface" would satisfy many of the identified issues relating to duplication of data entry, QA/QC of data entry, and improved annual reporting. While it would not allow for immediate visualization of specific fields and their proximity to other elements required for decision making, it might be possible to have a single connecting "link" between the "form-based interface" and the Metrogro Map (e.g. clicking on a field, launching an ArcGIS online map in an internet browser). While not ideal, this type of solution might be easier to implement, considering there is only one GIS staff person at MMSD.

2: Eliminate Duplication of Data Entry

The new system should allow for easy entry into a single location. This would eliminate the need for paper logs and standalone Excel tables and reduce the total number of human errors associated with duplicate data entry.

The RRM currently enters much of the Metrogro data twice or even three times into different data formats. For example, some data is recorded onto paper logs, then transferred to an Excel file where the RRM can complete their own internal review, then ultimately entered into the Metrogro database to be included in final reporting. The original Metrogro database was not designed to have the intermediate step (e.g. entering into Excel) but this was added into the workflow since the RRM was pressed for time during the hauling season and the Metrogro database interface was challenging to use quickly.

3: Ability to Load-In Formatted Data into Database vs. Manual Data Entry

The newly designed system should allow for uploaded files structured in a pre-defined format, which would speed up workflows and reduce the potential for data-entry-errors.

Some data is provided to the Metrogro program from outside entities in a consistent format – specifically soil testing results. Currently, the RRM either must manually type this information into the Metrogro database or ask the IT department to load it into the database for her. This results into a slowdown in the workflow and can delay hauling.

Advancements in GPS capabilities for applicator equipment could also be integrated back into the database to more accurately record the location and quantities of biosolids applied to each field. If MMSD purchases new or retrofits applicators with GPS equipment that can record location and application rates, this information could be recorded to both inform the landowner of where biosolids were applied and for more accurate annual reporting to the DNR. The newly designed system should consider integration with any new applicator equipment that has GPS capabilities.

4: Ability to Enter Data Remotely on a Mobile Device

The updated database should have an online interface formatted for mobile technology that allows for MMSD staff/contractors to access and enter data while in the field.

Mobile technology, specifically smart phones and tablets, allow for rapid review of data while working in the field. The current Metrogro database can only be accessed by the RRM when in the office, reducing the amount of information available to them in the field for on-the-fly decision making.

If the RRM receives information from a landowner/farmer on site, they must return to the office before entering the information into the system. Having the ability to enter data into a mobile device that can sync to the authoritative database would allow for more rapid and efficient workflows in the field and also allow for the RRM to communicate more effectively with landowners/famers on what information is saved within the system.

Ideally, mobile data entry would be extended to both contract haulers and applicators. This would remove the need for paper copies of daily logs and trip tickets as the information would be directly entered in the system. A flag could be installed, requiring the RRM to review all of the entries from haulers/applicators.

5: Ability to Quickly QA/QC Contractor's Daily Logs

The database should allow for the contract haulers and applicators reported logs to be rolled up to daily/weekly/seasonal report.

Currently, the RRM relies on paper logs from contract haulers and applicators to document their hours worked and the amount of biosolids product applied to fields. Since application might happen over the course of several days within a specific field or farm, the RRM manually copies this information into an Excel file for an "easy to read" rolled up version of the data, prior to entering anything into the Metrogro database.

Table 12-2: Recommendations for Improvement on MMSD Liquid Biosolids Administration and Data Management

ID	IMPROVEMENT/ SOLUTION	ISSUES	EXAMPLE OUTCOME
1	Single map-based interface for data entry and review	2, 7, 11, 13, 16, 17, 21, 24	No longer juggling paper logs, Excel files, and the Metrogro database for decision making. The RRM would reference a single application where all information is stored in an easy-to-use format.
2	Eliminate duplication of data entry.	7, 10, 23	Data would be entered once in the database, and immediately available for general use. No more written logs that need to be recorded into multiple locations (e.g. Excel and Metrogro database)
3	Ability to load in formatted data into the database, rather than manual data entry.	4, 5, 20	Soil testing information received in a standard format can be loaded directly into the database, rather than manually typed or coordinating with IT.
4	Ability to enter data remotely on a mobile device.	10	Allows for the RRM to enter information and access information from the field, rather than requiring a trip back to the office or printed off datasets.
5	Ability to QA/QC contractor's daily logs quickly.	10	The RRM can quickly review time logs and field application records to identify errors and report back to farmers in a timely manner.
6	Ability to use lookup tables to calculate target nutrient application rates.	8, 9	The RRM can automatically calculate application rates for a field, based on prior data entries, similar to how it is completed in SnapPlus.
7	Improved QA/QC for annual reporting.	11, 22	Annual reporting can be quickly generated, and a series of flags set up to identify potential data entry errors.
8	Mobile mapping applications to support field work.	13, 14, 15, 16, 19	Maps and information within the Metrogro database can be accessed from the field, without the need to print off maps in the office. Allows for better on-the-fly decision making and reduce the number of trips back to the office.
9	Record distribution of class A and B cake products into the database.	20, 24	No longer relying on paper documents for reporting on distribution of cake products to the DNR.

A newly designed database should have a "roll-up option" immediately available for the RRM to reference (e.g. see all of the contractor's logs from this season's application). This would eliminate the need to maintain a separate Excel file and also has the potential to "flag" data entry errors (e.g. applying significantly more than the recommended amount of biosolids to a field) so that the RRM can identify these errors immediately, rather than uncovering them weeks or months later.

6: Ability to use Lookup Tables to Calculate Target Nutrient Application Rates

The updated database should be able to calculate nutrient application rates readily based on the current recommendations made by the University of Wisconsin and site-specific information.

The RRM currently uses an Excel file with all the pertinent information recorded within the Metrogro database to manually calculate nutrient application rates for a specific field. The program SnapPlus (Wisconsin's Nutrient Management Planning Software) has the ability to reference lookup tables, incorporating the specific field characteristics, and determine the recommended crop nutrients (N, P2O5, K2O) based on the current recommendations made by the University of Wisconsin. This methodology could be emulated within the Metrogro database, with the understanding that the lookup tables might need to change over time, if the University of Wisconsin recommendations change.

Alternatively, the database could export a file format that is compatible with SnapPlus, so that the RRM could simply open the current version of SnapPlus, quickly load the necessary files and determine the application rates. This solution might be easier to implement but would still require additional steps for the RRM manager and is therefore not recommended.

7: Improved QA/QC for Annual Reporting

The database should have QA/QC built in for more regular review of all applications, reducing the amount of time requirements for end of season reporting.

The RRM currently spends a significant time updating the Metrogro database and correcting data entry errors at the end of the year to ensure accurate reporting to the WDNR. This often occurs because the data entry for field application is done daily, without the ability to see a "roll up" for the annual field application for all sites, which might highlight data entry errors more readily. To improve this, the RRM created the "Spreading Log" in Excel to more easily see data entry errors. While this will likely improve the reporting for 2020, a similar roll up built into the Metrogro database would remove the need to maintain a separate Excel file.

8: Mobile Mapping Applications to Support Field Work

The database will allow for mobile mapping, to be used in the field by MMSD staff and contractors.

The current Metrogro Map has a web-based interface, but it is not available as a mobile app for the RRM and other employees to reference or record information while in the field. Instead, maps are often printed in advance of a site visit or need to be printed after the fact. A mobile map-centric data collection system would help with field visits to properly visualize setback requirements, make note of any field observations, and allow the RRM to share and show maps to landowners on the fly.

This capability can be relatively easily implemented using the MMSD ArcGIS Online (AGO) account and the ArcGIS Collector App to show any of the GIS data current only available as a Webmap (e.g. field boundaries, well setbacks, etc.). The MMSD GIS staff can develop a solution relatively easily, but it would require more significant effort to tie any mapping information to the existing Metrogro database.

9: Record Distribution of Class A and B Cake Products into Database

The database should accommodate Class A and Class B cake product distribution and be flexible enough to accommodate new biosolid products into the future.

The Metrogro database was designed to record the distribution of Class B liquid biosolids. The Metrogro program does create some Class A and Class B cake biosolids, but this information is currently not recorded into a formal database. Instead, paper logs are collected at the end of each year, and manually recorded into the WDNR reporting system.

Modifying the Metrogro database to record the distribution of different biosolid types is necessary to ensure proper record keeping and might become a very high priority if MMSD shifts its main product away from Class B liquid. Any redesign of the Metrogro database therefore needs to accommodate a variety of different product types. In the future, MMSD could acquire new applicators or retrofit their existing fleet that support GPS technology. Any GPS information recorded by this new equipment should be incorporated in the newly designed database to more accurately report the location and quantities of biosolids applied.

SUMMARY & RECOMMENDATIONS

The recommended improvements/solutions from Section 12.4 will alleviate many of the data management issues within the Metrogro program. The current Metrogro database structure appears to contain much of the necessary information to fulfill some (or even most) of these solutions, with the exception of the database structure issues identified by Laurie Dunn (MMSD Information Systems Manager, see Section 12.2). Database structure concerns should be addressed first and foremost prior to moving forward with any additional updates.

Ideally, the existing Metrogro database could continue to be used, while a new user-interface is developed. This would allow for Metrogro staff to continue with their normal operations and use the same datasets to test and troubleshoot any newly designed system. However, this will obviously depend on the development timeline and the nuances of the redesign effort.

The timeline for redesigning the database hinges on the availability of the IT staff to coordinate with the effort, the hiring of a new RRM and the availability of funds to support the effort. That being understood, an approximate order of operations is listed below to move forward in the database redesign effort.

1. **Review Issues/Potential Solutions:** Reviewed TM #1 and TM#3 with MMSD IT and the new RRM.
2. **Allocation of Staff or Hire Consultant:** Determine if the redesign will happen in-house by the MMSD IT staff or with an outside consultant.
3. **Review Database Structure Concerns:** Review the known concerns in the Metrogro database data structure with IT and determine if updates to the data structure should happen before any redesign efforts.
4. **Select a Database Design:** Identify a database structure that can be supported by MMSD IT into the future (e.g. using an open source code or purchasing additional software that allows for modifications by IT staff).
5. **Create a Prototype Database:** Create a new database structure, leveraging either the live SQL tables currently supporting the Microsoft Access database or a static copy of those tables.
6. **Compare Prototype against Existing Database:** Allow the RRM to use a prototype of the redesigned database and comparing outputs results against the current database. Note that the RRM could continue to use the existing workflows throughout the redesign process.
7. **Transition to New Database Structure:** Once the prototype has been vetted by the RRM and other staff involved, the prototype could be used on the short term, specifically for data entry in the field. Since remote field data entry might occur in locations with limited cell phone coverage, it is strongly recommended that field data entry is very carefully vetted. Changes to the system (e.g. optimizing offline data entry and automatically syncing when connected to Wi-Fi) might need to occur prior to adopting the new database structure.
8. **Upgrade Mobile Mapping:** The MMSD GIS staff can prepare mobile mapping solutions in tandem with the redesign effort. Note that if the selected database structure is map-centric, the GIS staff will be more heavily involved in the redesign process.

CHAPTER 13
TRIPLE BOTTOM LINE (TBL) ANALYSIS

TRIPLE BOTTOM LINE ANALYSIS

As discussed in Chapter 7, a series of workshops were held with the intent of establishing evaluation criteria for each product alternative described in Chapter 8. Table 7-2 summarizes the four categories (Economics, Operations, Environmental/Regulatory, and Customers Concerns) and the criteria within each category. The consultant team developed a Triple Bottom Line (TBL) Spreadsheet Tool and conducted an initial scoring of the ten (10) alternatives. A workshop was then conducted to with MMSD to review and update the scoring. A summary of the scoring is included in Table 13-1 and Figures 13-1 and 13-2. The sub-alternatives for Class 'B' Cake and Composting are not included for clarity In addition, the figures assume all criteria and categories are weighted equally. The detailed scoring information is included in Appendix K.

Assuming all categories and criteria are equal, **Alternative A1 – Aerated Static Pile (ASP) Composting is the highest scoring alternative in aggregate.** It scores the highest for the non-

Table 13-1: TBL Output Matrix- Baseline

CATEGORY	CRITERIA	BASELINE	B1	B2	B3	B4	A1	A2	A3	A4	A5
ECONOMIC	**Net Present Value** (5 - lowest NPV, 4 - within 15% of lowest, 1 - highest NPV)	3	5	5	5	5	2	1	1	2	2
	Ability to phase capital investment over time (5 - high flexibility, 1 - low flexibility)	2	3	2	3	3	4	4	4	4	3
	Operational Cost (5 - lowest operational cost, 4 - within 15% of lowest, 1 - highest operational cost)	2	5	5	5	4	3	1	2	3	4
	Approach limits spending on single-use assets with low salvage value (5 - high flexibility, 1 - low flexibility)	2	4	4	4	4	3	3	3	4	2
	Category weighted sum	**0.6**	**1.1**	**1.0**	**1.1**	**1.0**	**0.8**	**0.6**	**0.6**	**0.8**	**0.7**
OPERATIONS	**Truck traffic impacts** (5 - fewest trucks, 4 - within 15% of lowest value, 1 - most trucks)	1	3	3	3	3	4	2	5	3	3
	Increases flexibility in hauling hours (5 - fewest hauling hours, 4 - within 15% of lowest value, 1: most hauling hours)	1	3	3	3	3	4	3	5	4	4
	Approach limits business process adjustment needed from other units of the district (5 - high flexibility, 1 - low flexibility)	5	4	4	4	4	3	2	1	2	3
	Category weighted sum	**0.6**	**0.8**	**0.8**	**0.8**	**0.8**	**0.9**	**0.6**	**0.9**	**0.7**	**0.8**
ENVIRONMENT	**Product improves nutrient management and runoff opportunities** (5 - lowest impact, 1 - highest impact)	1	2	2	2	2	3	5	5	3	3
	Environmental Emissions (GHG) & Energy Usage (5 - least, 1 - most)	2	5	5	5	5	4	3	1	3	3
	Processing provides resilience to changing regulations (5 - high resilience, 1 - low resilience)	1	3	3	3	3	4	3	4	2	3
	Category weighted sum	**0.3**	**0.8**	**0.8**	**0.8**	**0.8**	**0.9**	**0.9**	**0.8**	**0.7**	**0.8**
CUSTOMER	**Approach limits business process adjustments needed from end product users/customers** (5 - high flexibility, 1 - low flexibility)	5	2	2	2	2	1	1	1	5	3
	Flexibility for different farming approaches (5 - high flexibility, 1 - low flexibility)	3	2	2	2	2	4	4	5	4	3
	Product improves soil health management opportunities (5 - high benefit to soil health, 1 - low benefit to solid health)	2	3	3	3	3	5	5	4	4	3
	End-product provides regional collaboration opportunities (5 - high regional value, 1 - low regional value)	1	2	2	2	2	5	5	5	2	4
	Category weighted sum	**0.7**	**0.6**	**0.6**	**0.6**	**0.6**	**0.9**	**0.9**	**0.9**	**0.9**	**0.8**
	FINAL SCORE	**2.2**	**3.3**	**3.2**	**3.3**	**3.2**	**3.5**	**3.0**	**3.3**	**3.2**	**3.1**

economic criteria (Operations, Environment, Customers), while Alternative B – Class 'B' Cake (and all sub-alternatives) scores the highest for economics. In general, composting addresses several challenges and goals of MMSD:

- **Significant Volume Reduction.** A significant reduction in truck traffic (and resulting reduction in GHGs), and less compaction on farmers' fields.
- **Minimizes Business Process Adjustments at NSWWTF.** Requires an expansion of the dewatering facilities, but will operate as an 'add-on' process. Thus, minimizing disruption to existing operations at the treatment facility. Comparatively, thermal drying, thermal hydrolysis (Lystek®), and expansion of batch thermophilic digestion would have far greater impact.
- **Class 'A' Product.** Increase flexibility in hauling schedule, provides multiple end use points, improves soil health, provides regional collaboration, and better aligns with modern agricultural conservation practices (e.g. no-till).

It is important to consider that Class 'B' cake is the most cost-effective alternative over the 20-year period considered. Further, all the Class 'A' alternatives provide very similar non-economic benefits to composting. The TBL Spreadsheet Tool allows the user the weight each criterion and/or category and allows MMSD decide what goals are most important for the Biosolids Program.

The District needs to decide which categories and criteria are the most important to the organization and then weight them appropriately. The TBL Spreadsheet Tool has been provided to MMSD to as future drivers are realized, and consensus is reached within the District on how to prioritize each criterion.

Figures 13-3 through 13-6 provides a sensitivity analysis for the alternatives by weighting the categories. In each example, one category is weighted at 50% and the remaining equality to create a focus area. For the Operations, Environment, and Customer focus areas, composting still scores highest. For the economics focus, Class 'B' cake scores the highest.

Figure 13-1: TBL Scoring Summary

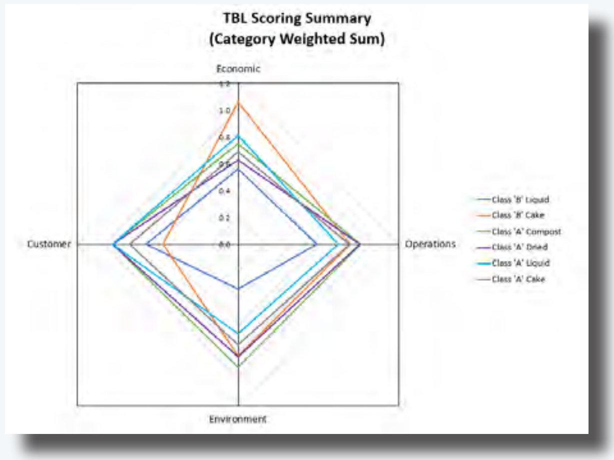


Figure 13-2: TBL Aggregate Score

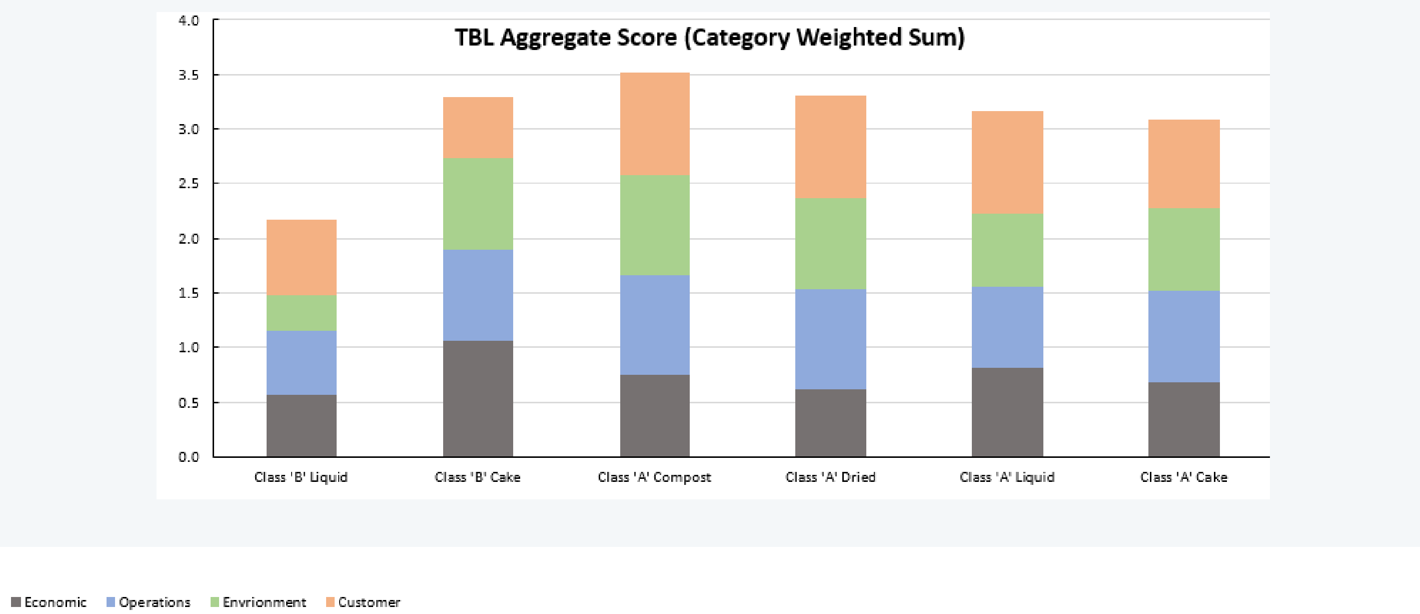


Figure 13-3: Sensitivity, Economic Focus

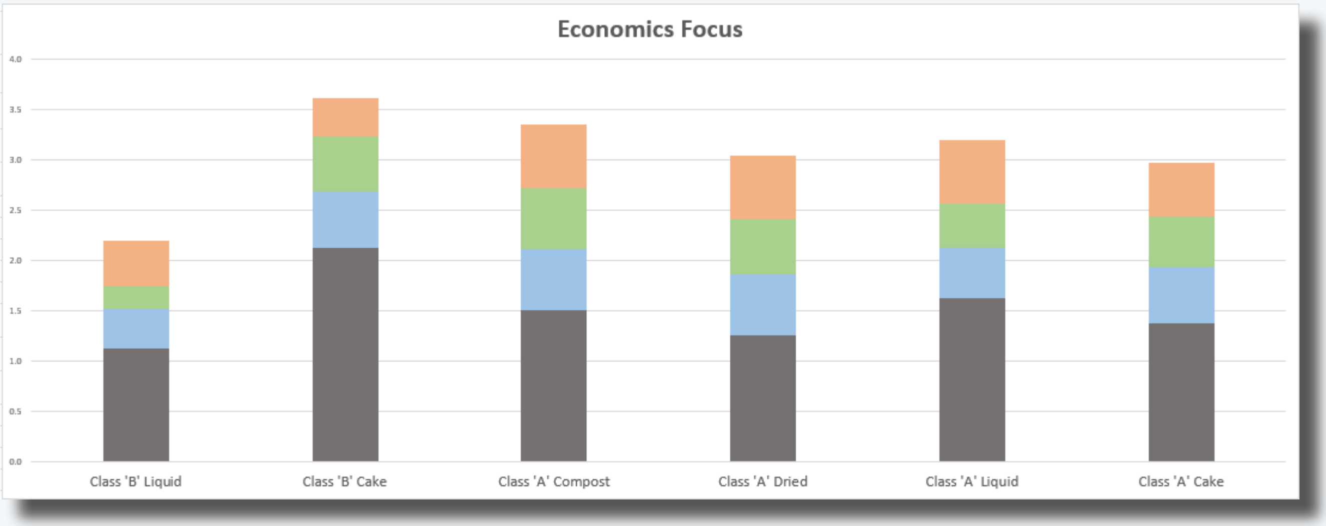


Figure 13-4: Sensitivity, Operations Focus

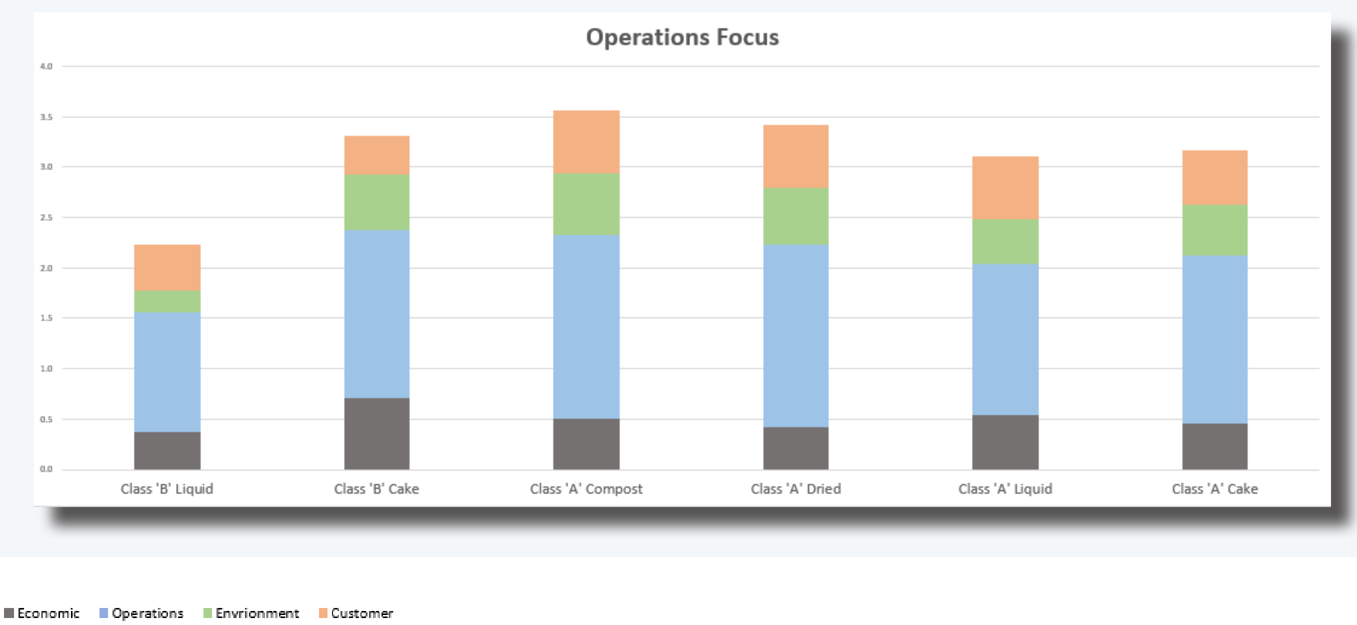


Figure 13-5: Sensitivity, Environmental Focus

Figure 13-6: Customer Score

Economic Operations Envrionment Customer

CHAPTER 14
END USE

END USE EVALUATION

Ensuring market acceptance to future end use products is of concern to the District and was evaluated in this analysis. Discussions with various stakeholders throughout the development of alternatives and application methods, gave insight into customers' and user's needs and desires. Below is a summary of individual meetings and discussions that were held:

STAKEHOLDER MEETING 1

On January 23, 2020, a stakeholder meeting was held at the MMSD Maintenance Facility that was attended by a variety of affiliated parties. The discussion began with the positives and negatives surrounding the current application program and impact to surrounding community, soil health, and long-term use. Each end use customer provided input on how they currently use the product and what types of products they would prefer for ease of application and cropping benefit.

Potential future products were discussed to gauge the likely acceptance and use long term. Many of the end use customers preferred a dryer product but had some concerns about the application process and equipment retooling. They suggested partnering with local fertilizer companies to make an ideal nutrient blend as the current biosolids product lacks all nutrients required for farming. A summary of the meeting minutes is provided in Appendix I.

STAKEHOLDER MEETING 2

On February 12, 2020, a second stakeholder meeting was held to meet up with end users that were not able to attend Stakeholder Meeting 1. As with the first stakeholder meeting, the discussion began with the positives and negatives surrounding the current application program and impact to surrounding community, soil health, and long-term use. Each of the end users provided input on how they currently use the product and what types of products they would prefer for ease of application and cropping benefit.

Being a smaller group that Stakeholder Meeting 1 allowed for further detailed questions to be asked. This included the analysis of the nutrient composition as well as the application method and equipment. Of serious concern to the farmer was the number of field passes and the amount of soil compaction.

Potential future products were discussed, and samples were shown to gauge the likely acceptance and use long term. The end use customers preferred a dryer product but had some concerns about the application process and equipment retooling. They did not seem too interested in paying for a product unless it was further optimized for nutrient content. Additionally, they were potentially interested in plant more wheat, provided the District could provide reimbursement for the cropping. A summary of the meeting minutes is provided in Appendix J.

PAUL'S NURSERY

A discussion with Paul Huggett was held to better understand potential uses of MMSD End Use Products within the local tree nursery industry. Paul's Nursery produces sod and trees for contractors and homeowners. Paul has interest in MMSD biosolids products as a compost and fertilizer. He currently has a Curbside Composter utilizing some of his property for composting of mostly yard waste and brush. Curbside Composter has also been composting food waste with wood chips.

Paul has previous experience with biosolids from Metrogro which provided good nutrient value and growth yield. However, some of the loads of biosolids were very difficult to distribute and spread because of the "slimy" properties. To combat these properties, they used skid loaders to apply it which reduced the area in which the product could be applied. Additionally, it was unevenly spread and had a lingering odor after application.

The sod growth operation is on rotation with corn. Sod takes two years to be harvestable, but if plastic netting is used, one year is adequate because the plastic netting is holding the sod roll together instead of the roots. In general, Paul estimated sod harvesting removes ¼" to ½" of topsoil from the fields. As such, being able to replace the soil and organic matter would be very beneficial for his operation as well as others. This indicates a viable market path for MMSD product provided the properties of the product are adequate for application and handling. Overall Paul would be interested to pilot utilizing products, but felt compost or dried product would fit his operation better if material was just dropped off and he was to apply the product.

MCKAY NURSERY

Discussion with Paul's Nursery led to the recommendation to contact McKay's because their nursery stock would utilize compost. After contacting McKay Nursery, they indicated that they are not a large user of compost because it is only used during planting with an abundance of nutrients being applied through irrigation. McKay recommended further communication with a local container grower because their use of fertilizer products will be much higher for growing container plants. After discussion with McKay's container grower, it was determined that this is not a significant volume industry in comparison to the end product produced by MMSD.

BALL DIAMOND FINE SPORTS TURF, LLC

Ball Diamond Fine Sports Turf, LLC (BDFST) was contacted because of their work with residential lawns and recreation field development and management. BDFST has used other compost products in the past such as Purple Cow compost and Milorganite on residential and commercial lawns and with new construction of sports fields. BDFST has also used Milorganite as a starter fertilizer and for keeping lawns greener longer.

Most of the complaints they have received in regard to current compost products have been due to odor. Their experience with Purple Cow was application through a top dresser and found it has less odor, but it is expensive and requires more labor and machinery to apply than the drier Milorganite. Compost and other dried products similar to Milorganite are great applications for sports fields because most sports fields are sand and need organics added to them to retain water and nutrients. However, high use fields that have been developed using Milorganite often have odor complaints. BDFST has tried a product comprised of feather meal compost mixed with other conventional ingredients in the product. The product has less odor, but odor complaints still existed. Some of the newer fertilizer products with pre-emergent broadleaf and crabgrass herbicides are easier to use and create great results. A larger quantity of product would be utilized with construction of sports fields, but "even ¼-inch application of compost over a 7-acre development is less than one dump truck load".

The result of this discussion yielded the need for a dry, easy-to-apply product with low odor; however, the demand does not appear to be high compared to other avenues for the volume generated by MMSD.

YAHARA PRIDE/BLUE STAR DAIRY/MARK SCHROEDER

As part of the evaluation of potential customers with high volume needs, Yahara Pride Farms was targeted for discussion as they have helped farmers manage compost windrows to show the viability on-farm. One such farm (Blue Star Dairy) had a compost windrow dry out and turned to adding Class A biosolids to the windrow to finish the windrow. At that time, it was also discussed that the compost at Blue Star could be hauled and piloted in one of Schroeder Farm's crop fields as a pilot or demonstration. Metrogro was willing to provide trucking and Yahara Pride would continue to provide turning. Mark Schroeder was willing to try and had a field in mind because of its proximity to the dairy. Blue Star wanted to be compensated for the nutrients because there was cost incurred to pilot composting. Unfortunately, the season did not last long enough to accomplish the task. There was not enough study into the required application rate, and further analysis of compost application on growing crops would be advantageous to develop.

The result of this discussion yielded positive feedback to the use of a biosolids product for composting and supports the demand for the two composting options analyzed within this study.

Feedback from all of the current and potential end users indicates the trend towards a drier, more stable product that can be widely applied. This would indicate a Class A product is preferred compared to a Class B product and a product that has a consistent nutrient concentration and physical properties for uniform application. While end-use customers were kept in mind during the evaluation within this report, the analysis was performed with the best interest of MMSD at the forefront. Outside of cost, external factors contributed to further evaluation and recommendation and are further outlined in this chapter.

CHAPTER 15
APPLIED RESEARCH

APPLIED RESEARCH

RECOMMENDATIONS & APPLIED RESEARCH PROGRAM

The alternatives evaluation and TBL scoring summary led to two key insights.

- A Class 'A' enhanced biosolids product, such as compost, provided a high level of customer value and environmental benefits.
- The economic cost of these enhanced products is may be difficult to justify relative to the cost benefit of Class B cake solids. A Class B cake program would reduce current operating costs by $12M over a 20-year period as compared to the existing Class B Liquid program. A Class A cake program would cost approximately $16M more than the current Class B Liquid program.

A Roadmap (Figure 15-1) has been developed to help guide the District as additional evaluation and research is conducted in the coming years.

The recommended path forward is to focus on two projects in the next three years that will solidify the long-term direction for MMSD. The first project is improvement of data management associated with the Metrogro Program, shown as Global Data Management in the Roadmap. The second project is an applied research program to help understand dewatering to produce a Class B Cake product and completing market research to understand the market for the Class B Cake product. The outcomes of these two projects will finalize the path forward for major infrastructure investment at MMSD. Ultimately, the Roadmap leads to an enhanced biosolids product (Class A cake, liquid, compost, or dried products). The variable is the length of time before the ultimate investment in the Class A product is realized, and it an intermediate investment in the Class B Cake program is viable with the MMSD customers.

These first two steps will lay the foundation for a successful, long-term biosolids management for MMSD. Execution of an applied research project for biosolids should focus on two aspects: 1) the technologies available to produce a cake product, and 2) the market for that product.

For the technology evaluation, MMSD should invest in pilot testing of several dewatering technologies, include belt filter presses, newer centrifuge models, and potential emerging technologies. The focus of the pilot testing should be on potential for regrowth in the biosolids product, achievable cake content, polymer dosing, and general operability. This testing will inform the long-term technology investment decision. In parallel, a market analysis of the Class B Cake product should be completed. If possible, a larger quantify of Class B Cake could be generated using the existing centrifuge equipment. The major negative in terms of driver/goal score for Class B cake was customer acceptance, and therefore the focus of the market analysis should be on the viability of the product with customers. Efforts to expose end users to the handling, application, and quality of the Class B Cake would need to be completed. This would likely entail the rental of application equipment specifically designed for biosolids application, and application on several end-user fields. Given the potential economic savings associated with the Class B Cake program, it is worth the investment to determine if it is a viable product with customers. If the Class B Cake program is not viable, a more rapid move towards an enhanced biosolids product will likely be required.

GLOBAL DATA MANAGEMENT

MMSD's biosolids program needs a major upgrade to their management systems. The existing systems require considerable maintenance to function, while hindering efficient workflows. Significantly operational efficiency improvements are likely to be realized through a modern data management system. The following steps are recommended as part of the redesign effort.

1. **Review Identified Issues/Solutions in Context of Global District Asset Management.** Review identified solutions with District Information Technology (IT) and Asset Management Staff and identify synergies with overall District goals.
2. **Review Database Structure Concerns.** Review the known concerns in the Database data structure with IT Staff and determine if updates to the data structure should happen before any redesign efforts.
3. **Select a Database Design.** Identify a database structure that can be supported by MMSD IT into the future. A database rooted in Geographic Information Systems (GIS) is an ideal ft for the biosolids management program.
4. **Develop & Pilot a Prototype Database.** Create a new database structure, leveraging either the live SQL tables or static copies and compare reporting outputs against current database.
5. **Transition to New Database Structure.** Once the prototype has been vetted by the District, continue to utilize until a new database structure is commissioned.
6. **Upgrade Mobile Mapping.** The MMSD GIS staff can prepare mobile mapping solutions in tandem with the redesign effort, ideally linking the new database to the live mapping data.

APPLIED RESEARCH INTO CLASS ‘B’ CAKE

Execution of an applied research project for biosolids should focus on two aspects: the technologies available to produce a cake product, and the market for that product.

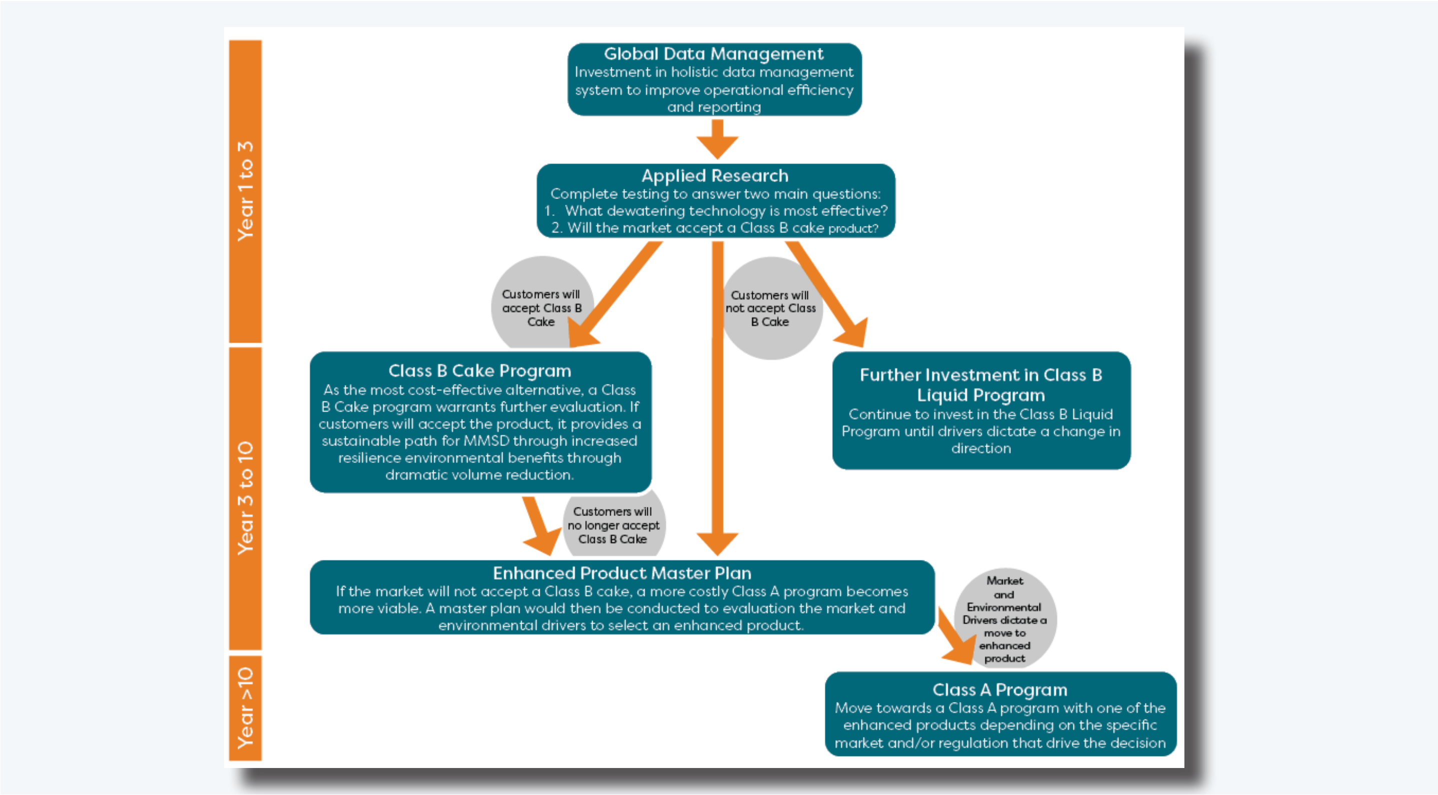
1. **Invest in Dewatering Technology Pilot Tests.** Pilot testing should include several dewatering technologies, include belt flter presses, newer centrifuge models, and potential emerging technologies. The focus of the pilot testing should be on potential for regrowth in the biosolids product, achievable cake content, polymer dosing, evaluate ‘stickiness’ of product, and general operability. This testing will inform the long-term technology investment decision.
2. **Conduct a Market Analysis on Class ‘B’ Cake.** Given the potential economic savings associated with the Class B Cake program, and widespread use nationwide, it warrants investment into further research to determine if it is a viable product with local customers. The District can already create Class B Cake using the existing centrifuge equipment. Therefore, the District can immediately create a product for the market to evaluate with minimal investment. Further, Class B cake could be used as the basis for further composting research. Composting has the highest aggregate score versus all other options when economics was not the primary factor.

The major negative in terms of driver/goal score for Class B cake was customer acceptance, and therefore the focus of the market analysis should be on the viability of the product with customers. Efforts to expose end users to the handling, application, and quality of the Class B Cake is a critical piece of the analysis. This would likely entail pilot testing various hauling and application equipment specifically designed to address customer concerns and potential benefits with the product, such as:

- Evaluate odors and cleanliness of operation if cake is not incorporated
- Minimize issues with ‘stickiness’ through testing various hauling application and equipment
- Evaluate benefits of volume reduction to the customers through less compaction and flexibility in application days.

  If the Class B Cake program is not viable, a more rapid move towards an enhanced biosolids product will likely be required.

Figure 15-1: Biosolids Master Plan Road Map



APPENDIX A
DATA MANAGEMENT ASSESSMENT

(A) Metrogro Access Database

(B) Annual Field List

Field List (2019)

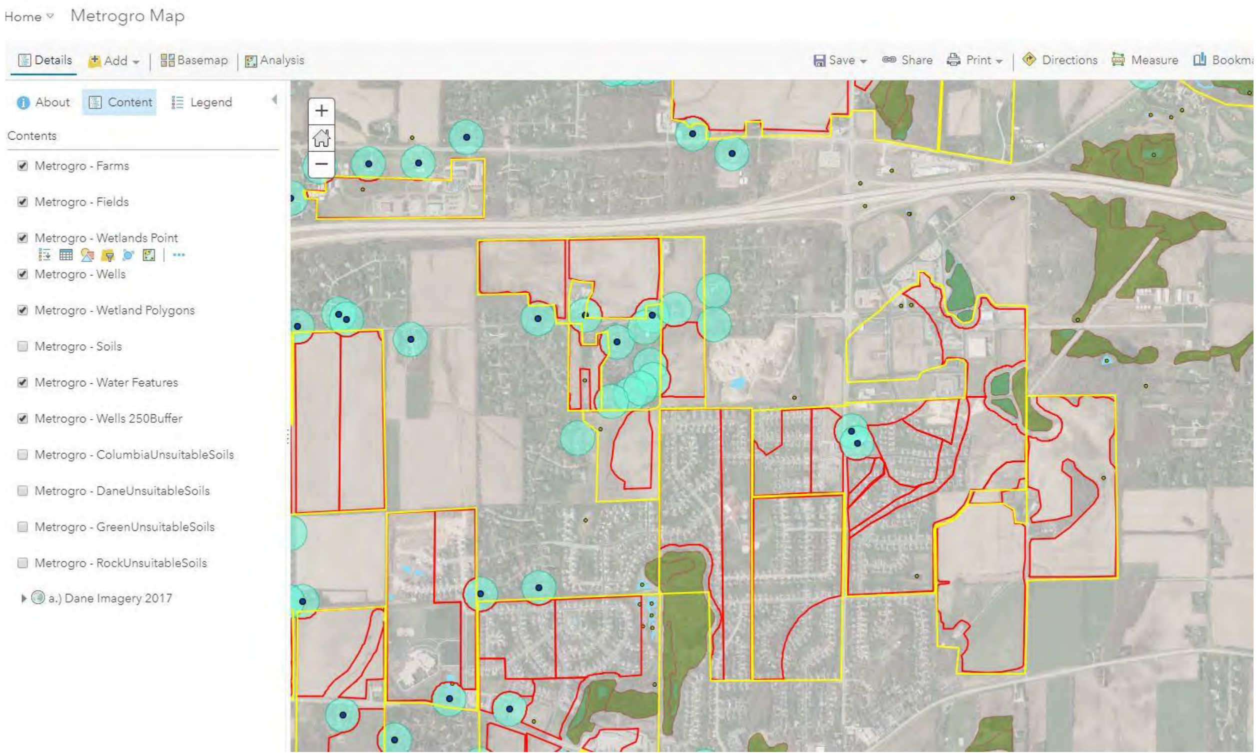
READY	Farmer	Farm	Field	DNR #	Acres	Acres Approved	Soil Test Date	Soil pH	previous Crop	Yield Pot	Soil	Target N	Max N	Est. Rate	Total Gallons	gallons applied	gallons per acre		lbs of N per ac	maps	follow-up	yield guarantee	completed date
	Theis Bros	209	A2	16134	20	30	3/27/2019	5.7	beans	high	plano	140	160	5500	110000	92800	4640	12	103	x	N credits from spring 2017	yes	
	Theis Bros	209	A1	16133	20	30	3/27/2019	5.6	beans	high	plano	140	160	5500	110000	144400	7220	12	161	x	schedule soil tests with AgSource	yes	
x	Theis Bros	475	1	103918	52	75	3/31/2016	6.1	corn	high	plano	140	160	6300	327600	291800	5612		125	x		yes	
x	Theis Bros	475	2	103919	30	30	3/31/2016	6.4	corn	high	ringwood	190	210	8500	255000	258600	8620		192	x	add acres, paperwork to DNR 3-20	yes	
x	Klondike Farms	244	E	97116	20	20	10/9/2015	6.4	corn	high	salter	190	210	8500	170000	172000	8600		192	x	Zac still looking for 1/2 of samples	yes	
x	Klondike Farms	244	F	97119	59	59	10/9/2015	6.4	corn	high	salter	190	210	8500	501500	515000	8729		195	x		yes	
x	Klondike Farms	244	G	97120	56.5	56.5	10/9/2015	6.4	corn	high	salter	190	210	8500	480250	482800	8545		191	x		yes	
x	Klondike Farms	244	H	97121	35	35	10/9/2015	6.4	corn	high	salter	190	210	8500	297500	245800	7023		157	x		yes	
x	Marshall Bros Farms	530	1	115301	70	70	12/4/2018	6.2	corn	high	salter	190	210	8500	595000	581200	8303		185	x		yes	
x	Marshall Bros Farms	530	2	115302	7.5	7.5	12/4/2018	6.2	corn	high	kidder	190	210	8500	63750	61600	8213		183	x		yes	
x	Marshall Bros Farms	530	3	115303	3	3	12/4/2018	6.2	corn	high	st charles	190	210	8500	25500	22400	7467		167	x		yes	
x	Nick Hull	108	10	15877	19	19	3/31/2016	6.9	wheat	high	kegonsa	190	210	5500	104500	115000	6053	50	135	x	N credits from chicken manure	yes	
x	Nick Hull	108	11	15878	5.5	30	3/31/2016	6.2	wheat	high	kegonsa	190	210	5500	30250	33600	6109	50	136	x	N credits from chicken manure	yes	
x	Nick Hull	108	12	15879	25	29	3/31/2016	6.6	wheat	high	kegonsa	190	210	5500	137500	145600	5824	50	130	x	N credits from chicken manure	yes	
x	Nick Hull	108	13	15880	1	23	3/31/2016	7	wheat	medium	sable	145	160	5200	5200	5000	5000	50	112	x	N credits from chicken manure	yes	
x	J & R Farms	396	BR2	77926	43	51	11/6/2015	6.4	corn	high	plano	190	210	8500	365500	324800	7553		168	x		yes	
x	J & R Farms	396	BR3	77927	16	16	11/6/2015	6.4	corn	high	ringwood	190	210	8500	136000	123200	7700		172	x		yes	
x	J & R Farms	411	T2	76845	50	56	11/3/2015	6.4	corn	high	plano	190	210	8500	425000	416000	8320		186	x		yes	
x	Jim Mandt	162	1A	15939	20	20	11/16/2018	6.2	corn	high	mchenry	190	210	8500	170000	95000	4750		106	x		yes	
x	Jim Mandt	162	1B	15940	35	35	11/16/2018	6.2	corn	high	dodge	190	210	8500	297500	330000	9429		210	x		yes	
x	Jim Mandt	162	1C	15941	20	20	11/16/2018	6.2	corn	high	dodge	190	210	8500	170000	318800	15940		355	x		yes	
x	Jim Mandt	162	1D	15942	30	30	11/16/2018	6.2	corn	high	dodge	190	210	8500	255000	180000	6000		134	x		yes	
x	Steve Bowar	492	1	115241	4.5	4.5	10/30/2015	6.6	beans	high	batavia	140	160	6300	28350	153000	34000		758	x		yes	
x	Steve Bowar	492	2	115242	9.5	9.5	10/30/2015	6.5	beans	high	radford	140	160	6300	59850	60000	6316		141	x		yes	
x	Steve Bowar	492	3	115243	26.5	26.5	10/30/2015	6.5	corn	high	radford	190	210	8500	225250	106400	4015		90	x		yes	
x	Jerry Tierney	534	1	115198	30	43	3/27/2019	6.8	beans	medium	Whalan	130	150	6000	180000	181200	6040		135	x		yes	
x	Jim Ace	532	1	115207	37	37	11/1/2016	6.5	corn	high	plano	190	210	8500	314500	415200	11222		250	x		yes	
x	Jim Ace	532	2	115208	38	38	11/1/2016	6.5	beans	high	plano	190	210	8500	323000	186200	4900		109	x		yes	
x	Jim Ace	535	1	115211	3.5	3.5	11/1/2016	6.5	corn	high	troxel	190	210	8500	29750	60400	17257		385	x		yes	
x	Wesley Statz	402	H1	77930	24	25	10/19/2015	6.5	corn	high	plano	190	210	8500	204000	246400	10267		229	x		yes	
x	Wesley Statz	402	H2	77931	25	26	10/19/2015	6.5	corn	high	troxel	190	210	8500	212500	143600	5744		128	x		yes	
x	Wesley Statz	402	H3	77932	35	40	10/19/2015	6.5	corn	high	plano	190	210	8500	297500	351600	10046		224	x		yes	
x	Wesley Statz	402	H4	77934	42	42	10/19/2015	6.5	corn	high	mchenry	190	210	8500	357000		0		0	x		yes	
x	Wesley Statz	402	H5	77935	38	40	10/19/2015	6.5	corn	high	plano	190	210	8500	323000	302400	7958		177	x		yes	
x	Wesley Statz	402	H6	77936	30	30	10/19/2015	6.5	corn	high	st charles	190	210	8500	255000	274400	9147		204	x		yes	
x	Wesley Statz	402	H7	77937	21	22	10/19/2015	6.5	corn	high	st charles	190	210	8500	178500	151200	7200		161	x		yes	
x	Wesley Statz	402	H10	81702	54	62	10/5/2015	5.9	corn	high	plano	190	210	8500	459000	453600	8400		187	x			
	Scott Freitag	306	BA	16653	25	28	11/27/2017	6.4	corn	high	mchenry	190	210	8500	212500	193000	7720		172	x		yes	
	Scott Freitag	306	BB	16654	25	28	11/27/2017	6.4	corn	high	st charles	190	210	8500	212500	176200	7048		157	x		yes	
	Scott Freitag	306	BC	16655	17	17	11/27/2017	6.4	corn	high	griswold	190	210	8500	144500	136400	8024		179	x		yes	
	Scott Freitag	306	BD	16656	20	20	11/27/2017	6.4	corn	high	ringwood	190	210	8500	170000	97800	4890		109	x		yes	
	Norm Monson	536	1	115304	35	35	11/30/2015	6	beans	high	plano	140	160	6300	220500	215000	6143		137				
	Marshall Bros Farms	292	H	72776	88	115	11/29/2018	5.8	corn	high	westville	190	210	8500	748000	683200	7764		173				
	Scott Mickelson	444	4A	105270	37	37	5/7/2017	5.5	corn	high	ringwood	190	210	8500	314500	290000	7838		175		limed in May		
	Scott Mickelson	444	4B	105271	20	20	5/7/2017	5.5	corn	high	ringwood	190	210	5000	100000	85000	4250		95		limed in May		
	Scott Mickelson	444	4C	109721	14	14	5/7/2017	5.5	corn	high	griswold	190	210	5000	70000	90000	6429		143		limed in May		

(C) Spreading Log

Spreading Log (spring 2020)

Application Date	Driver	Field ID	Manure/Process Wastewater Source	Spreader Volume	# Loads	total volume	total per field	Acres Applied	rate per acre	Application (Inject, Incorp, or Surface)
4/5/2020	211	129-1	biosolids	5000.00	34.00	170000.00	170000	20.00	8500	inject
4/5/2020	211	129-2	biosolids	5000.00	4.00	20000.00				inject
4/6/2020	211	129-2	biosolids	5000.00	24.00	120000.00				inject
4/7/2020	211	129-2	biosolids	5000.00	7.00	35000.00				inject
4/7/2020	211	129-2	biosolids	5600.00	16.00	89600.00				inject
4/8/2020	211	129-2	biosolids	5000.00	19.00	95000.00				inject
4/11/2020	211	129-2	biosolids	5000.00	10.00	50000.00	409600	50.00	8192	inject
4/6/2020	214	15-3	biosolids	5600.00	32.00	179200.00				inject
4/7/2020	214	15-3	biosolids	5000.00	3.00	15000.00				inject
4/7/2020	214	15-3	biosolids	5600.00	23.00	128800.00	323000	42.00	7690	inject
4/7/2020	214	15-4	biosolids	5600.00	10.00	56000.00				inject
4/8/2020	214	15-4	biosolids	5600.00	23.00	128800.00				inject
4/10/2020	214	15-4	biosolids	5000.00	2.00	10000.00				inject
4/10/2020	214	15-4	biosolids	5600.00	7.00	39200.00	234000	31.00	7548	inject
4/6/2020	211	156-1	biosolids	5000.00	24.00	120000.00	120000	14.00	8571	inject
4/11/2020	214	24-6	biosolids	5600.00	42.00	235200.00				inject
4/16/2020	214	24-6	biosolids	5600.00	12.00	67200.00				inject
4/16/2020	214	24-6	biosolids	5000.00	1.00	5000.00	307400	34.00	9041	inject
4/3/2020	212	282-1	biosolids	5000.00	39.00	195000.00				inject
4/5/2020	212	282-1	biosolids	5000.00	44.00	220000.00				inject
4/6/2020	212	282-1	biosolids	5000.00	40.00	200000.00				inject
4/7/2020	212	282-1	biosolids	5000.00	29.00	145000.00				inject
4/8/2020	212	282-1	biosolids	5600.00	11.00	61600.00	821600	100.00	8216	inject
4/8/2020	212	282-2	biosolids	5600.00	1.00	5600.00				inject
4/11/2020	212	282-2	biosolids	5600.00	28.00	156800.00				inject
4/15/2020	212	282-2	biosolids	5600.00	25.00	140000.00				inject
4/16/2020	212	282-2	biosolids	5000.00	1.00	5000.00				inject
4/17/2020	212	282-2	biosolids	5600.00	17.00	95200.00	402600	49.00	8216	inject
4/16/2020	212	282-3	biosolids	5600.00	26.00	145600.00	145600	18.00	8089	inject
4/3/2020	210	380-1	biosolids	5600.00	24.00	134400.00				inject
4/5/2020	210	380-1	biosolids	5000.00	11.00	55000.00				inject
4/5/2020	210	380-1	biosolids	5600.00	27.00	151200.00				inject
4/6/2020	213	380-1	biosolids	5000.00	9.00	45000.00				inject
4/6/2020	213	380-1	biosolids	5600.00	37.00	207200.00	592800	70.00	8469	inject
4/3/2020	210	380-2	biosolids	5000.00	18.00	90000.00				inject
4/8/2020	213	380-2	biosolids	5000.00	23.00	115000.00				inject
4/8/2020	213	380-2	biosolids	5600.00	6.00	33600.00				inject
4/11/2020	210	380-2	biosolids	5000.00	2.00	10000.00				inject
4/11/2020	210	380-2	biosolids	5600.00	2.00	11200.00	259800	30.00	8660	inject
4/10/2020	213	411-T3B	biosolids	5000.00	1.00	5000.00				inject
4/16/2020	213	411-T3B	biosolids	5000.00	62.00	310000.00				inject
4/16/2020	213	411-T3B	biosolids	5000.00	8.00	40000.00	355000	45.00	7889	inject
4/11/2020	213	411-T3	biosolids	5000.00	32.00	160000.00	160000	20.00	8000	inject
4/15/2020	213	411-T3A	biosolids	5000.00	57.00	285000.00	285000	36.00	7917	inject
4/17/2020	213	411-T4	biosolids	5000.00	39.00	195000.00				inject
4/18/2020	213	411-T4	biosolids	5000.00	16.00	80000.00	275000	36.00	7639	inject
4/11/2020	211	446-92	biosolids	5000.00	13.00	65000.00				inject
4/17/2020	211	446-92	biosolids	5000.00	31.00	155000.00				inject
4/18/2020	211	446-92	biosolids	5000.00	35.00	175000.00				inject
4/19/2020	211	446-92	biosolids	5000.00	13.00	65000.00				inject
4/19/2020	211	446-92	biosolids	5600.00	1.00	5600.00	465600	55.00	8465	inject

(D) Metrogro Map



(E) Approved DNR Permits

State of Wisconsin, DNR
Septage Certification
PO Box 7921
Madison, WI 53707-7921

Land Application Site Request

Form 3400-053 (R 7/07)

Complete this form for each site and submit to the Sludge / Waste Management Specialist at the appropriate Department of Natural Resources service center for approval evaluation. An approval letter and/or Form 3400-122 must be obtained before sludge can be applied, unless self-approved. See additional instructions on pages 3 and 4.

Notice: Completion and submission of this form is mandatory under s. 283.55, Wis. Stats., and ch. NR 204 or 214, Wis. Adm. Code, for Municipal Sludge and Industrial Waste and under s. 281.48, Wis. Stats., and ch. NR 113, Wis. Adm. Code, for septage. Failure to properly complete and submit this form is a violation of s. 283.91 or s. 281.48, Wis. Stats., and may result in a monetary penalty and/or imprisonment. Personally identifiable information on this form is not intended to be used for other purpose but may be made available to requesters under Wisconsin's Open Records law ss. 19.32-19.39, Wis. Stats.

Permittee Information

Permittee Name (or Licensed Business if Septage Site): Madison Metropolitan Sewerage District

Telephone Number (include area code): 608-222-1201, ext 256

Address: 1610 Moorland Rd

City: Madison

State: WI

ZIP Code: 53713

WPDES Permit Number: WI-00 24957

Septage License Number:

Waste Information

Waste(s) to be Land Applied

- [ ] Whey or Permeate
- [x] Municipal Sludge
- [ ] Industrial Sludge
- [ ] Paper Mill Sludge
- [ ] Food Processing Waste
- [ ] Industrial Wastewater
- [ ] Septage
- [ ] Other (specify)

Site Information

Instructions: **Outline the exact location of the site** on a soils map, a map showing the property boundary, and a USGS topo map or aerial photograph. Also, label the site number.

Soil Map Sheet Number: see map

Site Number / Name: 536

(indicate only one) [ ] City [ ] Village [x] Town of Dunkirk

County (indicate only one): Dane

Field Number	Legal Description	Section	Township	Range	Acreage
1	W 1/2 of S 1/2 of NW 1/4	20	5 N	11E	35.4
			N		
			N		
			N		
	(add additional sheets, if necessary)		N		

Site Owner Name: [redacted]

Site Farmer Name (If different than owner): [redacted]

Name of Entity Applying Waste: Madison Metropolitan Sewerage District

Compliance With Site Requirements: Have all site criteria, including distance criteria for separation between the site boundary and waterways, wells, residences, etc. as indicated on page 2 of this form been complied with? [x] Yes [ ] No

If no, explain:

Comments: site soil investigation on 4/9/2019, see attached

Have all requested sites been in agricultural production in the last 2 years? [x] Yes [ ] No

If no, explain:

Municipal Sludge Only

The soil test results must be submitted prior to site approval. If you need assistance, please contact your DNR Sludge Management Specialist.

Has this site been self approved? [x] Yes [ ] No

If yes, DNR Site Self-Approver Number: 341814

Industrial Waste Only

Season	Proposed Application Rate (gal/acre or ton/acre) Per Application	Total
Summer		
Winter		
Year of Application		

Signature of Responsible Party: [signature]

Date Signed: 4/10/19

Printed or Typed Name: Kim Meyer

Title: Resource Recovery Manager

If any of the applicable separation distances shown below are not complied with, select the "No" box under **Compliance With Site Requirements** on page 1 of this form and provide an explanation in the space provided (or attach sheet if necessary).

Existing Cover Crop

[x] Cultivated Cropland [ ] Tree Plantation [ ] Pasture [ ] Permanent Hayland [ ] Other (specify) ____________

Has the site been used or is it currently being used for the landspreading of non-agricultural waste? [ ] Yes [x] No

If yes, select type(s) of waste, and note in the comments section on the front of this form.

[ ] Holding Tank / Septic [ ] Combined Waste [ ] Whey or Permeate [ ] Municipal Sludge
[ ] Industrial Sludge [ ] Food Processing Waste [ ] Paper Mill Sludge [ ] Industrial Waste
[ ] Other (specify) ____________ ____________

What type of land use is adjacent to site? (select all appropriate)

[x] Residential [ ] Commercial [ ] Industrial [x] Agricultural
[ ] Forest [ ] Landfill [ ] Mining Operation [ ] Recreational
[ ] Other (specify) ____________ ____________

The separation distance between the ground surface and bedrock or groundwater is greater than: [x] 36 inches [ ] 18 inches

Industrial Sludge and Waste Only

Criteria for Industrial Sludge or Waste Applied to Land

Site Criteria	Surface	Incorporation	Injection
Distance to public water supply	1000 ft.	1000 ft.	1000 ft.
Distance to private water supply	250 ft.	250 ft.	250 ft.
Distance to residence	500 ft.	500 ft.	500 ft.
Distance with written permission	500 ft.	200 ft.	200 ft.
Distance to any surface water or dry run	200 ft.	50 ft.	50 ft.
Distance to any surface water or dry run with vegetative buffer	100 ft.	50 ft.	50 ft.

Municipal Sludge / Septage Only

Criteria for Non-Eq Municipal Sludge / Septage Applied to Land

Site Criteria	Surface	Incorporation	Injection
Depth to bedrock	3 ft.	3 ft.	3 ft.
Depth to high groundwater	3 ft.	3 ft.	3 ft.
Allowable slopes	0–6 %	0–12 %	0–12 %
Distance to wells			
Community water supply or school	1000 ft.	1000 ft.	1000 ft.
Other	250 ft.	250 ft.	250 ft.
Minimum distance to residence, business or recreation area	500 ft.	200 ft.	200 ft.
Minimum distance to residence or business with permission	250 ft.	100 ft.	100 ft.
Distance to rural schools and health care facilities	1000 ft.	1000 ft.	500 ft.
Distance to property line	50 ft.	25 ft.	25 ft.
Minimum distance to streams, lakes, ponds, wetlands or channelized waterways connected to a stream, lake, pond or wetland			
Slope 0 to < 6	200 ft.	150 ft.	100 ft.
Slope 6 to < 12	Not Allowed	200 ft.	150 ft.
Minimum distance to grass waterways, or dry run with a 50 foot range grass strip.			
Slope 0 to < 6	100 ft.	50 ft.	25 ft.
Slope 0 to < 12	Not Allowed	100 ft.	50 ft.
Soil permeability range (in/hr)	0.2–6.0	0–6.0	0–6.0

Note: The Department will not determine whether the requested sites are in government sponsored agricultural programs (i.e., CRP, ACR, etc.), or whether they are subject to any local ordinances. The permittee should contact the appropriate government agency to determine whether any additional restrictions or penalties apply.

County: Dane
Township: Dunkirk
Section: 20

Metrogro Application Site
Monson

Date: 04/09/2019
Created by: KJM

Field Instructions:

N

0 300 600 1,200 Feet

metrogro

Madison Metropolitan Sewerage District

Madison Metropolitan Sewerage District - Metrogro Program

2019

MMSD Site #	DNR Site #	Point ID	Lat	Long	Date	Soil Type	Notes	Approved for Application
536-1		1	42.883954	-89.229554	4/9/2019	Batavia	0-28" silt loam, 28" mottling, 28-36" loamy clay, dry	yes

(F) Soils Test Reports

LabID	LabSmplID	SmplDate	Farmer	FarmName	DNR No.	FieldName	Size	PlowDepth	SoilSmplID	PH	OM	P	K
Rock River		7/16/2019	[redacted]	540	115851	3			43	6.9	2.4	49.3	166
Rock River		10/20/2017	[redacted]	407	115843	R3			1	7.5	3.7	41	96
Rock River		10/20/2017	[redacted]	407	115843	R3			2	6.4	2.4	28	86
Rock River		10/20/2017	[redacted]	407	115843	R3			3	6	3.4	64	157
Rock River		10/20/2017	[redacted]	407	115843	R3			4	6.1	2.8	32	116
Rock River		10/20/2017	[redacted]	407	115843	R3			5	6.7	2.5	41	128
Rock River		10/20/2017	[redacted]	407	115843	R3			6	6.6	4.2	64	141
Rock River		10/20/2017	[redacted]	407	81706	R1			7	7.1	7.4	42	88
Rock River		10/20/2017	[redacted]	407	81706	R1			8	7.5	7.5	50	146
Rock River		10/20/2017	[redacted]	407	81706	R1			9	7	7	73	108
Rock River		10/20/2017	[redacted]	407	81706	R1			10	6.5	7	24	133
Rock River		10/20/2017	[redacted]	407	81706	R1			11	7	5.2	10	91
Rock River		10/20/2017	[redacted]	407	81706	R1			12	6.9	7.4	41	145
Rock River		10/20/2017	[redacted]	407	81706	R1			13	6.9	10.4	14	130
Rock River		10/20/2017	[redacted]	407	81706	R1			14	6.7	5.4	21	147
Rock River		10/20/2017	[redacted]	407	81706	R1			15	6.7	6.4	33	117
Rock River		10/20/2017	[redacted]	407	81706	R1			16	7	6	52	139
Rock River		10/20/2017	[redacted]	407	81706	R1			17	7.5	3.7	44	104
Rock River		10/20/2017	[redacted]	407	81706	R1			18	7.3	11.8	16	105
Rock River		10/20/2017	[redacted]	407	81706	R1			19	6.9	4.2	13	99
Rock River		10/20/2017	[redacted]	407	115842	R2			20	6.6	2.7	69	135
Rock River		10/20/2017	[redacted]	407	115842	R2			21	6.6	2.4	80	135
Rock River		10/20/2017	[redacted]	407	115842	R2			22	6.3	2.5	70	110
Rock River		10/20/2017	[redacted]	407	115842	R2			23	6.4	3.9	59	122
Rock River		10/20/2017	[redacted]	407	115842	R2			24	6.8	4.8	21	89
Rock River		10/20/2017	[redacted]	407	115842	R2			25	6.5	2.9	63	167
Rock River		10/20/2017	[redacted]	407	115842	R2			26	6.4	2.8	77	132
Rock River		10/20/2017	[redacted]	407	115842	R2			27	7	2.4	60	113
Rock River		10/20/2017	[redacted]	407	115842	R2			28	6.7	2.8	58	172
Rock River		10/20/2017	[redacted]	407	115842	R2			29	6.7	2.3	57	140
Rock River		10/20/2017	[redacted]	407	115842	R2			30	6.3	3.3	71	182
Rock River		10/20/2017	[redacted]	407	115842	R2			31	6.5	2.9	72	200
Rock River		10/20/2017	[redacted]	407	115842	R2			32	6.4	2.8	76	143
Rock River		10/20/2017	[redacted]	407	115842	R2			33	6.8	3.8	48	179
Rock River		10/20/2017	[redacted]	407	115842	R2			34	7.2	4.1	54	125
Rock River		10/20/2017	[redacted]	407	115842	R2			35	7	3	49	194
Rock River		10/20/2017	[redacted]	407	115842	R2			36	5.8	2.8	37	137
Rock River		10/20/2017	[redacted]	407	115842	R2			37	6.8	3.8	79	253
Rock River		10/20/2017	[redacted]	407	115842	R2			38	6.7	3.7	147	234
Rock River		10/20/2017	[redacted]	407	115842	R2			39	7.1	2.6	64	114
Rock River		10/20/2017	[redacted]	407	115842	R2			40	6.9	2	66	110
Rock River		10/20/2017	[redacted]	407	115842	R2			41	6.6	3.6	93	204
Rock River		10/20/2017	[redacted]	407	115842	R2			42	7.1	2.5	83	164
Rock River		10/20/2017	[redacted]	407	115842	R2			43	6.3	2.4	57	127
Rock River		10/20/2017	[redacted]	407	115842	R2			44	7.2	2.9	58	168
Rock River		10/20/2017	[redacted]	407	115842	R2			45	7.2	3	62	197
Rock River		10/20/2017	[redacted]	407	115842	R2			46	6.7	2.1	60	143
Rock River		10/20/2017	[redacted]	407	115842	R2			47	7.2	1.8	34	91
Rock River		10/20/2017	[redacted]	407	115842	R2			48	6.9	1.4	100	106
Rock River		10/20/2017	[redacted]	407	115842	R2			49	6.8	2.1	53	122
Rock River		10/20/2017	[redacted]	407	115842	R2			50	7	2.4	56	141
Rock River		10/20/2017	[redacted]	407	115842	R2			51	7.2	2.3	80	166
Rock River		10/20/2017	[redacted]	407	115842	R2			52	6.5	2.1	90	123
Rock River		10/20/2017	[redacted]	407	115842	R2			53	6.5	3.5	66	99
AgSource		8/1/2019	[redacted]	341	85443	B3			10	6.4	4.2	56	92
AgSource		8/1/2019	[redacted]	341	85443	B3			11	5.7	2	38	92
AgSource		8/1/2019	[redacted]	341	85443	B3			12	5.9	2.2	25	60
AgSource		8/1/2019	[redacted]	341	85443	B3			13	6	3.2	25	67
AgSource		8/1/2019	[redacted]	341	85443	B3			14	5.9	1.9	48	104
AgSource		8/1/2019	[redacted]	341	85443	B3			16	6.2	4.1	36	76
AgSource		8/1/2019	[redacted]	341	85443	B3			17	6.6	3.3	72	132
AgSource		8/1/2019	[redacted]	341	85443	B3			18	7	3.5	18	66
AgSource		8/1/2019	[redacted]	341	85443	B3			19	5.6	2.2	25	83
AgSource		8/1/2019	[redacted]	341	85443	B3			20	6.5	1.9	37	92
AgSource		8/1/2019	[redacted]	341	85443	B3			21	5.9	2	30	129
UW Soils and Forage		11/10/2016	[redacted]	545	107219	1			3	5.8	1.5	5	94
UW Soils and Forage		11/10/2016	[redacted]	545	107219	1			1	6.8	1.6	6	118
UW Soils and Forage		11/10/2016	[redacted]	545	116110	2			3	5.8	1.5	5	94
UW Soils and Forage		11/10/2016	[redacted]	545	116110	2			1	6.8	1.6	6	118

(G) Lime Records

Footville Rock & Lime Corp

14249 West Dorner Road
Brodhead, WI 53520-9022

Phone # [redacted]

Fax # [redacted]

Invoice

Date	Invoice #
11/20/2016	16/17-274

PAID
12/10/2016

[redacted]

Web Site
www.footvillerocklimecorp.com

P. O. No.	Job	Terms
	Emery Rd- Union Township	Net 30

Item	Delivery ...	Ticket #	Qty	Description	Amount
2 Lime Spre...	11/15/2016	101023	25.25	Lime Spread per ton	311.84
2 Lime Spre...	11/15/2016	101024	22.92	Lime Spread per ton	283.06
2 Lime Spre...	11/15/2016	101025	25.36	Lime Spread per ton	313.20
2 Lime Spre...	11/15/2016	101026	23.06	Lime Spread per ton	284.79
2.5 Lime sp...	11/15/2016	101027	21.52	Lime Spread per ton	265.77
2 Lime Spre...	11/15/2016	101028	23.82	Lime Spread per ton	294.18
2 Lime Spre...	11/15/2016	101029	22.79	Lime Spread per ton	281.46
2.5 Lime sp...	11/15/2016	101030	22.12	Lime Spread per ton	273.18
2 Lime Spre...	11/15/2016	101031	23.25	Lime Spread per ton	287.14
				farm 383-H14	

A finance charge of 1.5% per month, annual rate of 18%, will be applied to accounts over 30 days. In the event of default, I promise to pay legal interest on indebtedness together with such collection costs and reasonable attorney fees as may be required to effect collection.
STATEMENT CHARGES OF $5.00 WILL BE ADDED TO ANY INVOICE THAT IS 30 DAYS PAST DUE. THIS COVERS THE COSTS OF MAILING A STATEMENT.

Subtotal	$2,594.62
Sales Tax (5.5%)	$0.00
Total	$2,594.62
Payments/Credits	-$2,594.62
PLEASE PAY THIS AMOUNT	**$0.00**

E-mail
aglime@litewire.net

Straight Rate Spreading

YEAR: 2017 SPECIAL INSTRUCTIONS:

SEASON: Fall WILL CALL FARMER NEEDS TO: BE CALLED / SHOW FIELDS

NAME: [redacted] ACCOUNT#

FARM TO DELIVER: [redacted] SALESMAN: Kutz Crop Care

PHONE: [redacted] DATE RECEIVED: 12-04-2017

LIQUID	DRY	ANHYDROUS
GATOR	AIRFLOW	NURSE TANK(S)
ROGATOR	CUSTOM SPINNER	W/NSERVE
UAN * WATER	VRT SPREAD	CUSTOM 82%
20 GAL WATER	RZB	CUSTOM SIDEDRESS
APPLICATION: 1st or 2nd of 2	SPREADER-BUGGY	28% APPLICATOR
TOTAL PRE * TOTAL POST	TENDER to SPREADER	KNIFE APPLICATOR
CHARGE APPLICATION AS:	TENDER to WAGON	W/COULTERS
	LIME 80-89	VRN

CHEMICAL DELIVERY DELIVERY

PLANTING DATE ______ NO TILL EARLY PP PPI PRE POST ______" DROPS ______"

ACRES ______ FIELDS ______ DEAD VARIETY ______ RECOMMENDED BY ______ CROP STAGE ______

CROP CORN BEANS ALFALFA WHEAT PEAS SWEET CORN TOBACCO OTHER ______

Apply 4 Tons 80-89 lime / Acre to
all of C1 (worked corn ground) 27.2 Acres
all of C4+C5+C6 (worked corn ground) 43.2 Acres
70.4 Acres
= 281.6 Tons

[redacted]

farms 40-13
87-1
87-2

(H) Signed Permission Slips

1610 Moorland Road • Madison, WI 53713-3398 • P: (608) 222-1201 • F: (608) 222-2703

Metrogro Application Permission Form

Madison Metropolitan Sewerage District has permission to recycle Metrogro to land that I own, located at:

1) ______________________ ______________________ __________
Farm Name Township Section

2) ______________________ ______________________ __________
Farm Name Township Section

3) ______________________ ______________________ __________
Farm Name Township Section

4) ______________________ ______________________ __________
Farm Name Township Section

Landowner Name: ____

Landowner Signature:_________________________________Date:_______________

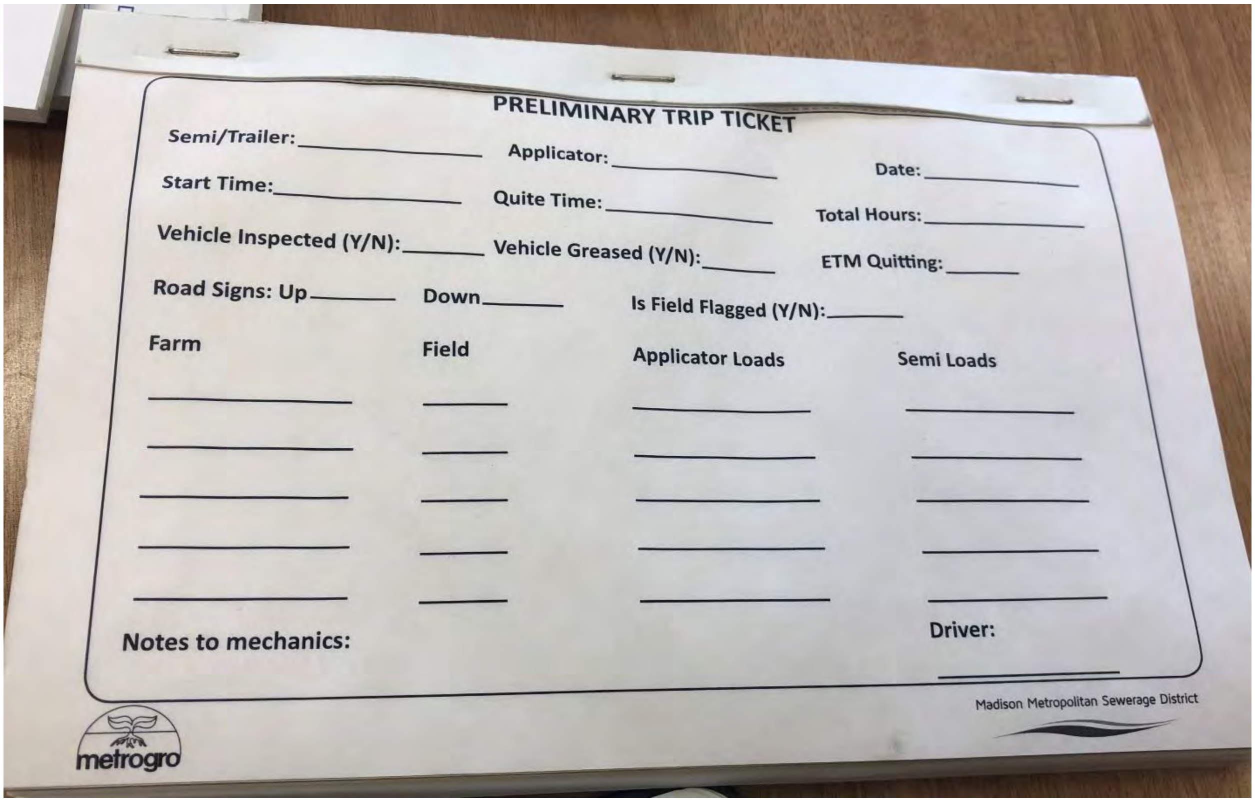
Any questions regarding application of Metrogro can be directed to:

Kim Meyer
Resource Recovery Manager
1610 Moorland Road
Madison, WI 53713
kimm@madsewer.org
608-334-6259

Please send completed forms to Kim Meyer at the address above, or to kimm@madsewer.org.

Madison Metropolitan Sewerage District

(I) Preliminary Trip Tickets



(J) Daily Logs for Application of Biosolids

Madison Metropolitan Sewerage District - Metrogro Program

Daily Log

Applicator (circle one) 209 210 211 212 213 214

Application Date	Driver	Field ID	Total acres end of day	Acres previous day	Acres for the day	Trailer Volume*	# Loads	Total gallons for day	Daily Sum	Applicator recorded gallons	Hours
10/10/2018	*Tim*	*100-5*	*56*	*36*	*20*	*5000*	*18*	*90,000*			*10.5*
						5600	*15*	*84,000*			
									174,000	*172,100*	

Turn in this log on a daily basis, it will be returned to you within 1 day. Keep all daily logs in the applicator binder.

*Trailer Volumes: 501-506 = 5000 gallons per load; 507-515 = 5600 gallons per load

(K) Data Acquisition & Reporting Center (DARC)

Example not provided due to the size of the database. Pertinent biosolids testing information is dynamically added to the Metrogro Database.

(L) Annual Land Application Report, WDNR

State of Wisconsin
Department of Natural Resources
PO BOX 7921, Madison WI 53707-7921

Submit report annually by January 31.

Annual Land Application Report

Form 3400-55 (R 10/01)

Notice: Completion and submission of this form is mandatory under section 283.55, Wis. Stats., and chs. NR 204 or 214, Wis Adm. Code, or s. 281.48(3)(b), Wis. Stats., and NR 113, Wis. Adm. Code. Failure to properly complete and submit this form is a violation of section 283.91 or 281.48, Wis. Stats., and may result in a monetary penalty and/or imprisonment. Personally identifiable information on this form is not intended to be used for any other purpose.

2. Year submitted for: 2019

RETURN FORM TO: BUREAU OF WATERSHED MANAGEMENT
BOX 7921
101 S. WEBSTER STREET
MADISON, WI 53707-7921

REVIEW INSTRUCTIONS ON BACK.

1. WPDES Permit No. 0024597 or License No. ____

Permittee/Licensee Name Madison Metropolitan Sewerage District

FID No. 113002230

County Dane

Total Municipal Sludge Generated: ____ (If Applicable) UNITS: Metric Tons (Gal., Tons, Metric Tons or Cubic Yards)

Total Municipal Sludge Land Applied: 5,069 (If Applicable) UNITS: Metric Tons (Metric Tons)

If septage, check how pathogen vector control requirements were satisfied (check all that apply): ☐ Injection ☐ Incorporation ☐ pH Adjustment

3. DNR Number	4. Fac. Site No./ Field No.	5. Landowner	6. Acres Land Applied	7. Outfall* Number	8. Amount of Waste Applied	9. Units (Gal., Tons, Metric Tons, Cubic Yards)	10. Nitrogen supplied from Waste (lbs/acre)	11. Other Sources of Nitrogen (lbs/acre)	12. Crop Code	13. Crop Year	14. Nitrogen Recom ** (lbs/acre)	15. Method	16. Industrial Only Chlorides Applied (lbs/acre)	17. Site no longer used
15877	108/10	MEYER, BOB	19	002	115000	GALLONS	135	50	17	2019	210	INJ		
15878	108/11	MEYER, BOB	5.5	002	33600	GALLONS	136	50	17	2019	210	INJ		
15879	108/12	MEYER, BOB	25	002	150600	GALLONS	134	50	17	2019	210	INJ		
15939	162/1A	FRAPE CORPORATION,	20	002	173000	GALLONS	193		17	2019	210	INJ		
15940	162/1B	FRAPE CORPORATION,	35	002	300000	GALLONS	191		17	2019	210	INJ		
15941	162/1C	FRAPE CORPORATION,	20	002	179200	GALLONS	200		17	2019	210	INJ		
15942	162/1D	FRAPE CORPORATION,	30	002	271600	GALLONS	202		17	2019	210	INJ		
16007	170/1M	LINK FARMS,	35	002	197400	GALLONS	128	10	17	2020	160	INJ		
16008	170/2A	LINK FARMS,	13	002	75000	GALLONS	131	10	17	2020	160	INJ		

Comments: ____

* If the waste applied is septage, indicate 990 if septic waste, 995 if holding tank waste, or 997 if more than 25% grease interceptor waste.

** Nitrogen recommendation for alfalfa (200 lbs/A) and soybeans (140 lbs/A) are the allowable N application rates for these crops as specified in NR 204.

I certify, under penalty of law, that information gathered to determine compliance with applicable pollutant concentrations, pathogen, vector control requirements, and management practices, as specified in Wis. Admin. Code chs. NR 204, 113 or 214 has been prepared under my direction and supervision in accordance with a system designed to ensure that qualified personnel properly gathered and evaluated this information. I am aware that there are significant penalties for false certification, including the possibility of fine and imprisonment.

Signature of Principal Officer or Authorized Agent	Print or Type Name	Title	Date Signed
	Martin Griffin	**Director of Ecosystem Service**	**05-Feb-20**

State of Wisconsin
Department of Natural Resources
PO BOX 7921, Madison WI 53707-7921

Annual Land Application Report

Submit report annually by January 31.

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1. WPDES Permit No. 0024597 or License No.

Permittee/Licensee Name Madison Metropolitan Sewerage District

FID No. 113002230

County Dane

2. Year submitted for: 2019

Total Municipal Sludge Generated: (If Applicable) UNITS: Metric Tons (Gal., Tons, Metric Tons or Cubic Yards)

Total Municipal Sludge Land Applied: (If Applicable) 5,069 UNITS: Metric Tons (Metric Tons)

RETURN FORM TO: BUREAU OF WATERSHED MANAGEMENT
BOX 7921
101 S. WEBSTER STREET
MADISON, WI 53707-7921

If septage, check how pathogen vector control requirements were satisfied (check all that apply): ☐ Injection ☐ Incorporation ☐ pH Adjustment

REVIEW INSTRUCTIONS ON BACK.

3. DNR Number	4. Fac. Site No./ Field No.	5. Landowner	6. Acres Land Applied	7. Outfall* Number	8. Amount of Waste Applied	9. Units (Gal., Tons, Metric Tons, Cubic Yards)	10. Nitrogen supplied from Waste (lbs/acre)	11. Other Sources of Nitrogen (lbs/acre)	12. Crop Code	13. Crop Year	14. Nitrogen Recom ** (lbs/acre)	15. Method	16. Industrial Only Chlorides Applied (lbs/acre)	17. Site no longer used
16009	170/2B	LINK FARMS,	23	002	134400	GALLONS	133	10	17	2020	160	INJ		
65159	170/2C	LINK FARMS,	32	002	174400	GALLONS	124	10	17	2020	160	INJ		
16010	170/2M	LINK FARMS,	18	002	106400	GALLONS	134	10	17	2020	160	INJ		
15821	192/1	BORK, STEVE	9	002	50400	GALLONS	127		17	2020	160	INJ		
15822	192/3	BORK, STEVE	6	002	39200	GALLONS	148		17	2020	160	INJ		
16099	192/5	BORK, STEVE	3	002	16800	GALLONS	127		17	2020	160	INJ		
60119	196/1	WINGRA STONE,	30	002	158200	GALLONS	120		17	2020	160	INJ		
16133	209/A1	THEIS BROTHERS,	20	002	127600	GALLONS	142	10	17	2019	160	INJ		
16134	209/A2	THEIS BROTHERS,	24	002	154400	GALLONS	143	10	17	2019	160	INJ		

Comments:

* If the waste applied is septage, indicate 990 if septic waste, 995 if holding tank waste, or 997 if more than 25% grease interceptor waste.

** Nitrogen recommendation for alfalfa (200 lbs/A) and soybeans (140 lbs/A) are the allowable N application rates for these crops as specified in NR 204.

I certify, under penalty of law, that information gathered to determine compliance with applicable pollutant concentrations, pathogen, vector control requirements, and management practices, as specified in Wis. Admin. Code chs. NR 204, 113 or 214 has been prepared under my direction and supervision in accordance with a system designed to ensure that qualified personnel properly gathered and evaluated this information. I am aware that there are significant penalties for false certification, including the possibility of fine and imprisonment.

Signature of Principal Officer or Authorized Agent	Print or Type Name	Title	Date Signed
	Martin Griffin	Director of Ecosystem Service	05-Feb-20

State of Wisconsin
Department of Natural Resources
PO BOX 7921, Madison WI 53707-7921

Annual Land Application Report

Form 3400-55 (R 10/01)

Submit report annually by January 31.

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2. Year submitted for: 2019

RETURN FORM TO: BUREAU OF WATERSHED MANAGEMENT
BOX 7921
101 S. WEBSTER STREET
MADISON, WI 53707-7921

1. WPDES Permit No. 0024597 or License No. ________

Permittee/Licensee Name Madison Metropolitan Sewerage District

FID No. 113002230

County Dane

Total Municipal Sludge Generated: ________ (If Applicable) UNITS: Metric Tons (Gal., Tons, Metric Tons or Cubic Yards)

Total Municipal Sludge Land Applied: 5,069 (If Applicable) UNITS: Metric Tons (Metric Tons)

If septage, check how pathogen vector control requirements were satisfied (check all that apply): ☐ Injection ☐ Incorporation ☐ pH Adjustment

REVIEW INSTRUCTIONS ON BACK.

3. DNR Number	4. Fac. Site No./ Field No.	5. Landowner	6. Acres Land Applied	7. Outfall* Number	8. Amount of Waste Applied	9. Units (Gal., Tons, Metric Tons, Cubic Yards)	10. Nitrogen supplied from Waste (lbs/acre)	11. Other Sources of Nitrogen (lbs/acre)	12. Crop Code	13. Crop Year	14. Nitrogen Recom ** (lbs/acre)	15. Method	16. Industrial Only Chlorides Applied (lbs/acre)	17. Site no longer used
97116	244/E	KLAHN, LLOYD/RUTH	20	002	187000	GALLONS	209		17	2019	210	INJ		
97119	244/F	KLAHN, LLOYD/RUTH	59	002	500000	GALLONS	189		17	2019	210	INJ		
97120	244/G	KLAHN, LLOYD/RUTH	56.5	002	482800	GALLONS	191		17	2019	210	INJ		
97121	244/H	KLAHN, LLOYD/RUTH	35	002	282000	GALLONS	180		17	2019	210	INJ		
72776	292/H	TRUMPY, JEFF	88	002	683200	GALLONS	173	10	17	2019	210	INJ		
16653	306/BA	FREITAG FARMS,	25	002	170600	GALLONS	152		17	2019	210	INJ		
16654	306/BB	FREITAG FARMS,	25	002	176200	GALLONS	157		17	2019	210	INJ		
16655	306/BC	FREITAG FARMS,	17	002	121400	GALLONS	159		17	2019	210	INJ		
16656	306/BD	FREITAG FARMS,	20	002	160200	GALLONS	179		17	2019	210	INJ		

Comments: ________

* If the waste applied is septage, indicate 990 if septic waste, 995 if holding tank waste, or 997 if more than 25% grease interceptor waste.

** Nitrogen recommendation for alfalfa (200 lbs/A) and soybeans (140 lbs/A) are the allowable N application rates for these crops as specified in NR 204.

I certify, under penalty of law, that information gathered to determine compliance with applicable pollutant concentrations, pathogen, vector control requirements, and management practices, as specified in Wis. Admin. Code chs. NR 204, 113 or 214 has been prepared under my direction and supervision in accordance with a system designed to ensure that qualified personnel properly gathered and evaluated this information. I am aware that there are significant penalties for false certification, including the possibility of fine and imprisonment.

Signature of Principal Officer or Authorized Agent	Print or Type Name	Title	Date Signed
	Martin Griffin	**Director of Ecosystem Service**	**05-Feb-20**

State of Wisconsin
Department of Natural Resources
PO BOX 7921, Madison WI 53707-7921

Annual Land Application Report

Submit report annually by January 31.

Form 3400-55 (R 10/01)

Notice: Completion and submission of this form is mandatory under section 283.55, Wis. Stats., and chs. NR 204 or 214, Wis Adm. Code, or s. 281.48(3)(b), Wis. Stats., and NR 113, Wis. Adm. Code. Failure to properly complete and submit this form is a violation of section 283.91 or 281.48, Wis. Stats., and may result in a monetary penalty and/or imprisonment. Personally identifiable information on this form is not intended to be used for any other purpose.

1. WPDES Permit No. 0024597 or License No. ______

Permittee/Licensee Name: Madison Metropolitan Sewerage District

FID No. 113002230

County: Dane

2. Year submitted for: 2019

Total Municipal Sludge Generated: ______ (If Applicable) UNITS: Metric Tons (Gal., Tons, Metric Tons or Cubic Yards)

Total Municipal Sludge Land Applied: 5,069 (If Applicable) UNITS: Metric Tons (Metric Tons)

RETURN FORM TO: BUREAU OF WATERSHED MANAGEMENT
BOX 7921
101 S. WEBSTER STREET
MADISON, WI 53707-7921

If septage, check how pathogen vector control requirements were satisfied (check all that apply): ☐ Injection ☐ Incorporation ☐ pH Adjustment

REVIEW INSTRUCTIONS ON BACK.

3. DNR Number	4. Fac. Site No./ Field No.	5. Landowner	6. Acres Land Applied	7. Outfall* Number	8. Amount of Waste Applied	9. Units (Gal., Tons, Metric Tons, Cubic Yards)	10. Nitrogen supplied from Waste (lbs/acre)	11. Other Sources of Nitrogen (lbs/acre)	12. Crop Code	13. Crop Year	14. Nitrogen Recom ** (lbs/acre)	15. Method	16. Industrial Only Chlorides Applied (lbs/acre)	17. Site no longer used
35543	323/1	RAEMISCH, FRANK	23	002	128400	GALLONS	127		17	2020	160	INJ		
35545	323/B	RAEMISCH, FRANK	45	002	240800	GALLONS	121		17	2020	160	INJ		
88708	329/H1	SHARPEE BROTHERS,	80	002	517800	GALLONS	147		17	2020	160	INJ		
35521	330/1	WHEATLAND FARMS,	26	002	149400	GALLONS	130	11	17	2020	150	INJ		
40103	336/20	BENISCH, JEROME	70	002	434600	GALLONS	141	10	17	2020	160	INJ		
85443	341/B3	DORSHORST, FARMS	70	002	625200	GALLONS	203		17	2020	210	INJ		
58718	341/D14	DORSHORST, FARMS	47	002	366600	GALLONS	177	10	17	2020	210	INJ		
102206	341/D4A	DORSHORST, FARMS	18	002	155600	GALLONS	196		17	2020	210	INJ		
58740	373/G3	GROVE, SCOTT	60	002	389200	GALLONS	147		17	2020	160	INJ		

Comments: ______

* If the waste applied is septage, indicate 990 if septic waste, 995 if holding tank waste, or 997 if more than 25% grease interceptor waste.

** Nitrogen recommendation for alfalfa (200 lbs/A) and soybeans (140 lbs/A) are the allowable N application rates for these crops as specified in NR 204.

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Signature of Principal Officer or Authorized Agent	Print or Type Name	Title	Date Signed
	Martin Griffin	Director of Ecosystem Service	05-Feb-20

State of Wisconsin
Department of Natural Resources
PO BOX 7921, Madison WI 53707-7921

Annual Land Application Report

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2. Year submitted for: 2019

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BOX 7921
101 S. WEBSTER STREET
MADISON, WI 53707-7921

1. WPDES Permit No. 0024597 or License No. ______

Permittee/Licensee Name Madison Metropolitan Sewerage District

FID No. 113002230

County Dane

Total Municipal Sludge Generated: ______ (If Applicable) UNITS: Metric Tons (Gal., Tons, Metric Tons or Cubic Yards)

Total Municipal Sludge Land Applied: 5,069 (If Applicable) UNITS: Metric Tons (Metric Tons)

If septage, check how pathogen vector control requirements were satisfied (check all that apply): ☐ Injection ☐ Incorporation ☐ pH Adjustment

REVIEW INSTRUCTIONS ON BACK.

3. DNR Number	4. Fac. Site No./ Field No.	5. Landowner	6. Acres Land Applied	7. Outfall* Number	8. Amount of Waste Applied	9. Units (Gal., Tons, Metric Tons, Cubic Yards)	10. Nitrogen supplied from Waste (lbs/acre)	11. Other Sources of Nitrogen (lbs/acre)	12. Crop Code	13. Crop Year	14. Nitrogen Recom ** (lbs/acre)	15. Method	16. Industrial Only: Chlorides Applied (lbs/acre)	17. Site no longer used
67333	383/H14	MAAS, PAUL	73	002	432000	GALLONS	134		17	2020	160	INJ		
65070	384/2	SCHMID, RUSSELL/AMY	28	002	180000	GALLONS	146		17	2020	160	INJ		
108493	391/U2B	SAYRE, THOMAS	48.6	002	328600	GALLONS	153	20	17	2020	210	INJ		
91552	391/UN1	SAYRE, THOMAS	95	002	644000	GALLONS	154	20	17	2020	210	INJ		
77926	396/BR2	ACKER, JIM	43	002	324800	GALLONS	168		17	2019	210	INJ		
77927	396/BR3	ACKER, JIM	16	002	123200	GALLONS	172		17	2019	210	INJ		
15746	40/3	HERMSDORF, GORDON	19	002	117400	GALLONS	140		17	2020	160	INJ		
77930	402/H1	LEIN, HANS	24	002	207200	GALLONS	193		17	2019	210	INJ		
81702	402/H10	LEIN, HANS	54	002	453600	GALLONS	187		17	2019	210	INJ		

Comments: ______

* If the waste applied is septage, indicate 990 if septic waste, 995 if holding tank waste, or 997 if more than 25% grease interceptor waste.

** Nitrogen recommendation for alfalfa (200 lbs/A) and soybeans (140 lbs/A) are the allowable N application rates for these crops as specified in NR 204.

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Signature of Principal Officer or Authorized Agent	Print or Type Name	Title	Date Signed
	Martin Griffin	Director of Ecosystem Service	05-Feb-20

State of Wisconsin
Department of Natural Resources
PO BOX 7921, Madison WI 53707-7921

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Annual Land Application Report

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2. Year submitted for: 2019

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101 S. WEBSTER STREET
MADISON, WI 53707-7921

REVIEW INSTRUCTIONS ON BACK.

1. WPDES Permit No. 0024597 or License No. ____

Permittee/Licensee Name Madison Metropolitian Sewerage District

FID No. 113002230

County Dane

Total Municipal Sludge Generated: ____ (If Applicable) UNITS: Metric Tons (Gal., Tons, Metric Tons or Cubic Yards)

Total Municipal Sludge Land Applied: 5,069 (If Applicable) UNITS: Metric Tons (Metric Tons)

If septage, check how pathogen vector control requirements were satisfied (check all that apply): ☐ Injection ☐ Incorporation ☐ pH Adjustment

3. DNR Number	4. Fac. Site No./ Field No.	5. Landowner	6. Acres Land Applied	7. Outfall* Number	8. Amount of Waste Applied	9. Units (Gal., Tons, Metric Tons, Cubic Yards)	10. Nitrogen supplied from Waste (lbs/acre)	11. Other Sources of Nitrogen (lbs/acre)	12. Crop Code	13. Crop Year	14. Nitrogen Recom ** (lbs/acre)	15. Method	16. Industrial Only: Chlorides Applied (lbs/acre)	17. Site no longer used
77931	402/H2	LEIN, HANS	25	002	205200	GALLONS	183		17	2019	210	INJ		
77932	402/H3	LEIN, HANS	35	002	295600	GALLONS	188		17	2019	210	INJ		
77934	402/H4	LEIN, HANS	42	002	302400	GALLONS	161		17	2019	210	INJ		
77935	402/H5	LEIN, HANS	38	002	302400	GALLONS	177		17	2019	210	INJ		
77936	402/H6	LEIN, HANS	30	002	224000	GALLONS	167		17	2019	210	INJ		
77937	402/H7	LEIN, HANS	21	002	173600	GALLONS	184		17	2019	210	INJ		
81706	407/R1	OLSON, DAVE & DALE	27.5	002	252200	GALLONS	208		17	2020	210	INJ		
115842	407/R2	OLSON, DAVE & DALE	60.5	002	549800	GALLONS	206		17	2020	210	INJ		
115843	407/R3	OLSON, DAVE & DALE	19	002	127800	GALLONS	153		17	2020	160	INJ		

Comments: ____

* If the waste applied is septage, indicate 990 if septic waste, 995 if holding tank waste, or 997 if more than 25% grease interceptor waste.

** Nitrogen recommendation for alfalfa (200 lbs/A) and soybeans (140 lbs/A) are the allowable N application rates for these crops as specified in NR 204.

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Signature of Principal Officer or Authorized Agent	Print or Type Name	Title	Date Signed
	Martin Griffin	**Director of Ecosystem Service**	**05-Feb-20**

State of Wisconsin
Department of Natural Resources
PO BOX 7921, Madison WI 53707-7921

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1. WPDES Permit No. 0024597 or License No. ____

Permittee/Licensee Name Madison Metropolitan Sewerage District

FID No. 113002230

County Dane

2. Year submitted for: 2019

Total Municipal Sludge Generated: ____ (If Applicable) UNITS: Metric Tons (Gal., Tons, Metric Tons or Cubic Yards)

Total Municipal Sludge Land Applied: 5,069 (If Applicable) UNITS: Metric Tons (Metric Tons)

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76845	411/T2	CARGILL, WIILIAM	50	002	416000	GALLONS	186		17	2019	210	INJ		
99904	424/7	SKAAR, DALE/LINDA	34	002	232200	GALLONS	155	10	17	2020	210	INJ		
81712	428/hnz	KALTENBERG FARMS,	20	002	173200	GALLONS	197		17	2020	210	INJ		
81714	428/LG	KALTENBERG FARMS,	50	002	335000	GALLONS	152		17	2020	160	INJ		
99809	431/H1A	HINCHLEY, DUANE	60	002	527000	GALLONS	199	10	17	2020	210	INJ		
85409	431/SM	HINCHLEY, DUANE	45	002	383200	GALLONS	193		17	2020	210	INJ		
81611	435/4	NELSON, DOUG	35	002	228600	GALLONS	148		17	2020	160	INJ		
105270	444/4A	MICKELSON, SCOTT	37	002	290000	GALLONS	175		17	2019	210	INJ		
105271	444/4B	MICKELSON, SCOTT	20	002	150000	GALLONS	167		17	2019	210	INJ		

Comments: ____

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Signature of Principal Officer or Authorized Agent	Print or Type Name	Title	Date Signed
	Martin Griffin	Director of Ecosystem Service	05-Feb-20

State of Wisconsin
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2. Year submitted for: 2019

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MADISON, WI 53707-7921

REVIEW INSTRUCTIONS ON BACK.

1. WPDES Permit No. 0024597 or License No. ______

Permittee/Licensee Name Madison Metropolitan Sewerage District

FID No. 113002230

County Dane

Total Municipal Sludge Generated: ______ (If Applicable) UNITS: Metric Tons (Gal., Tons, Metric Tons or Cubic Yards)

Total Municipal Sludge Land Applied: 5,069 (If Applicable) UNITS: Metric Tons (Metric Tons)

If septage, check how pathogen vector control requirements were satisfied (check all that apply): ☐ Injection ☐ Incorporation ☐ pH Adjustment

3. DNR Number	4. Fac. Site No./ Field No.	5. Landowner	6. Acres Land Applied	7. Outfall* Number	8. Amount of Waste Applied	9. Units (Gal., Tons, Metric Tons, Cubic Yards)	10. Nitrogen supplied from Waste (lbs/acre)	11. Other Sources of Nitrogen (lbs/acre)	12. Crop Code	13. Crop Year	14. Nitrogen Recom ** (lbs/acre)	15. Method	16. Industrial Only Chlorides Applied (lbs/acre)	17. Site no longer used
109721	444/4C	MICKELSON, SCOTT	14	002	110000	GALLONS	175		17	2019	210	INJ		
109722	444/4D	MICKELSON, SCOTT	16	002	126200	GALLONS	176		17	2019	210	INJ		
88701	448/1	ACE, STEVEN	17	002	95200	GALLONS	127	10	17	2020	160	INJ		
88702	448/2	ACE, STEVEN	18	002	100800	GALLONS	127	10	17	2020	160	INJ		
88705	450/D1	SMITHBACK, DAVID	100	002	771600	GALLONS	175	10	17	2020	210	INJ		
91555	450/D2	SMITHBACK, DAVID	55	002	459800	GALLONS	190		17	2020	210	INJ		
103918	475/1	DOHN, GERALD	52	002	301800	GALLONS	129		17	2019	160	INJ		
103919	475/2	DOHN, GERALD	30	002	248600	GALLONS	185		17	2019	210	INJ		
115241	492/1	BOWAR, STEVE	4.5	002	20000	GALLONS	99		17	2019	160	INJ		

Comments: ______

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Signature of Principal Officer or Authorized Agent	Print or Type Name	Title	Date Signed
	Martin Griffin	**Director of Ecosystem Service**	**05-Feb-20**

State of Wisconsin
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MADISON, WI 53707-7921

1. WPDES Permit No. 0024597 or License No. ____

Permittee/Licensee Name Madison Metropolitan Sewerage District

FID No. 113002230

County Dane

Total Municipal Sludge Generated: ____ (If Applicable) UNITS: Metric Tons (Gal., Tons, Metric Tons or Cubic Yards)

Total Municipal Sludge Land Applied: 5,069 (If Applicable) UNITS: Metric Tons (Metric Tons)

If septage, check how pathogen vector control requirements were satisfied (check all that apply): ☐ Injection ☐ Incorporation ☐ pH Adjustment

REVIEW INSTRUCTIONS ON BACK.

3. DNR Number	4. Fac. Site No./ Field No.	5. Landowner	6. Acres Land Applied	7. Outfall* Number	8. Amount of Waste Applied	9. Units (Gal., Tons, Metric Tons, Cubic Yards)	10. Nitrogen supplied from Waste (lbs/acre)	11. Other Sources of Nitrogen (lbs/acre)	12. Crop Code	13. Crop Year	14. Nitrogen Recom ** (lbs/acre)	15. Method	16. Industrial Only Chlorides Applied (lbs/acre)	17. Site no longer used
115242	492/2	BOWAR, STEVE	9.5	002	60000	GALLONS	141		17	2019	160	INJ		
115243	492/3	BOWAR, STEVE	26.5	002	239400	GALLONS	201		17	2019	210	INJ		
113819	497/5	GROSS, GARY	4	002	28000	GALLONS	159		17	2020	160	INJ		
113820	497/6	GROSS, GARY	17.5	002	114600	GALLONS	149		17	2020	160	INJ		
112281	500/1	KNICKMEIER, RANDY	66.5	002	460800	GALLONS	157	10	17	2020	210	INJ		
114212	524/1	SQUIRE, DON	27	002	179800	GALLONS	151		17	2020	160	INJ		
114213	524/2	SQUIRE, DON	8	002	51800	GALLONS	147		17	2020	160	INJ		
63343	527/2	SQUIRE, DON	55	002	380200	GALLONS	157		17	2020	160	INJ		
115301	530/1	UREN, MICHAEL & NANCY	70	002	581200	GALLONS	185		17	2019	210	INJ		

Comments: ____

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Signature of Principal Officer or Authorized Agent	Print or Type Name	Title	Date Signed
	Martin Griffin	Director of Ecosystem Service	05-Feb-20

State of Wisconsin
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Annual Land Application Report

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Form 3400-55 (R 10/01) Page 10 of 14

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2. Year submitted for: 2019

RETURN FORM TO: BUREAU OF WATERSHED MANAGEMENT
BOX 7921
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REVIEW INSTRUCTIONS ON BACK.

1. WPDES Permit No. 0024597 or License No. ______

Permittee/Licensee Name Madison Metropolitan Sewerage District

FID No. 113002230

County Dane

Total Municipal Sludge Generated: ______ (If Applicable) UNITS: Metric Tons (Gal., Tons, Metric Tons or Cubic Yards)

Total Municipal Sludge Land Applied: 5,069 (If Applicable) UNITS: Metric Tons (Metric Tons)

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3. DNR Number	4. Fac. Site No./ Field No.	5. Landowner	6. Acres Land Applied	7. Outfall* Number	8. Amount of Waste Applied	9. Units (Gal., Tons, Metric Tons, Cubic Yards)	10. Nitrogen supplied from Waste (lbs/acre)	11. Other Sources of Nitrogen (lbs/acre)	12. Crop Code	13. Crop Year	14. Nitrogen Recom ** (lbs/acre)	15. Method	16. Industrial Only Chlorides Applied (lbs/acre)	17. Site no longer used
115302	530/2	UREN, MICHAEL & NANCY	7.5	002	61600	GALLONS	183		17	2019	210	INJ		
115303	530/3	UREN, MICHAEL & NANCY	3	002	22400	GALLONS	167		17	2019	210	INJ		
115207	532/1	OUTHOUSE, DENNIS	37	002	320000	GALLONS	193		17	2019	210	INJ		
115208	532/2	OUTHOUSE, DENNIS	38	002	309400	GALLONS	182		17	2019	210	INJ		
115198	534/1	Yahara Gateway LLC,	30	002	181200	GALLONS	135		17	2019	150	INJ		
115211	535/1	ACE, JIM	3.5	002	32400	GALLONS	206		17	2019	210	INJ		
115304	536/1	MONSON, NORMAN	35	002	215000	GALLONS	137		17	2019	210	INJ		
52212	537/1	JOHNSON, BOB	28	002	200000	GALLONS	162		17	2020	210	INJ		
115841	537/2	JOHNSON, BOB	44.5	002	286000	GALLONS	146		17	2020	160	INJ		

Comments: ______

* If the waste applied is septage, indicate 990 if septic waste, 995 if holding tank waste, or 997 if more than 25% grease interceptor waste.

** Nitrogen recommendation for alfalfa (200 lbs/A) and soybeans (140 lbs/A) are the allowable N application rates for these crops as specified in NR 204.

I certify, under penalty of law, that information gathered to determine compliance with applicable pollutant concentrations, pathogen, vector control requirements, and management practices, as specified in Wis. Admin. Code chs. NR 204, 113 or 214 has been prepared under my direction and supervision in accordance with a system designed to ensure that qualified personnel properly gathered and evaluated this information. I am aware that there are significant penalties for false certification, including the possibility of fine and imprisonment.

Signature of Principal Officer or Authorized Agent	Print or Type Name	Title	Date Signed
	Martin Griffin	**Director of Ecosystem Service**	**05-Feb-20**

State of Wisconsin
Department of Natural Resources
PO BOX 7921, Madison WI 53707-7921

Submit report annually by January 31.

Annual Land Application Report

Form 3400-55 (R 10/01)

Notice: Completion and submission of this form is mandatory under section 283.55, Wis. Stats., and chs. NR 204 or 214, Wis Adm. Code, or s. 281.48(3)(b), Wis. Stats., and NR 113, Wis. Adm. Code. Failure to properly complete and submit this form is a violation of section 283.91 or 281.48, Wis. Stats., and may result in a monetary penalty and/or imprisonment. Personally identifiable information on this form is not intended to be used for any other purpose.

2. Year submitted for: 2019

RETURN FORM TO: BUREAU OF WATERSHED MANAGEMENT
BOX 7921
101 S. WEBSTER STREET
MADISON, WI 53707-7921

1. WPDES Permit No. 0024597 or License No. ______

Permittee/Licensee Name Madison Metropolitan Sewerage District

FID No. 113002230

County Dane

Total Municipal Sludge Generated: ______ (If Applicable) UNITS: Metric Tons (Gal., Tons, Metric Tons or Cubic Yards)

Total Municipal Sludge Land Applied: 5,069 (If Applicable) UNITS: Metric Tons (Metric Tons)

If septage, check how pathogen vector control requirements were satisfied (check all that apply): ☐ Injection ☐ Incorporation ☐ pH Adjustment

REVIEW INSTRUCTIONS ON BACK.

3. DNR Number	4. Fac. Site No./ Field No.	5. Landowner	6. Acres Land Applied	7. Outfall* Number	8. Amount of Waste Applied	9. Units (Gal., Tons, Metric Tons, Cubic Yards)	10. Nitrogen supplied from Waste (lbs/acre)	11. Other Sources of Nitrogen (lbs/acre)	12. Crop Code	13. Crop Year	14. Nitrogen Recom ** (lbs/acre)	15. Method	16. Industrial Only Chlorides Applied (lbs/acre)	17. Site no longer used
52211	538/1	HINCHLEY, DUANE	17	002	110000	GALLONS	147		17	2020	160	INJ		
115840	538/2	HINCHLEY, DUANE	17	002	150600	GALLONS	201		17	2020	210	INJ		
115834	539/1	Brattlie, Brent	24.5	002	205000	GALLONS	190		17	2020	210	INJ		
115849	540/1	Oppie, Jim	4.5	002	39200	GALLONS	198		17	2020	210	INJ		
115850	540/2	Oppie, Jim	16.5	002	140000	GALLONS	193		17	2020	210	INJ		
115851	540/3	Oppie, Jim	22	002	182400	GALLONS	188		17	2020	210	INJ		
115957	543/1	UPHOFF FARMS,	47	002	308600	GALLONS	149		17	2020	160	INJ		
115959	544/1	Trust, Every	10.5	002	72400	GALLONS	157		17	2020	160	INJ		
115961	544/2	Trust, Every	56.9	002	334600	GALLONS	133		17	2020	160	INJ		

Comments: ______

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** Nitrogen recommendation for alfalfa (200 lbs/A) and soybeans (140 lbs/A) are the allowable N application rates for these crops as specified in NR 204.

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Signature of Principal Officer or Authorized Agent	Print or Type Name	Title	Date Signed
	Martin Griffin	**Director of Ecosystem Service**	**05-Feb-20**

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1. WPDES Permit No. 0024597 or License No. ____

Permittee/Licensee Name Madison Metropolitan Sewerage District

FID No. 113002230

County Dane

2. Year submitted for: 2019

Total Municipal Sludge Generated: ____ (If Applicable) UNITS: Metric Tons (Gal., Tons, Metric Tons or Cubic Yards)

RETURN FORM TO: BUREAU OF WATERSHED MANAGEMENT
BOX 7921
101 S. WEBSTER STREET
MADISON, WI 53707-7921

Total Municipal Sludge Land Applied: 5,069 (If Applicable) UNITS: Metric Tons (Metric Tons)

If septage, check how pathogen vector control requirements were satisfied (check all that apply): ☐ Injection ☐ Incorporation ☐ pH Adjustment

REVIEW INSTRUCTIONS ON BACK.

3. DNR Number	4. Fac. Site No./ Field No.	5. Landowner	6. Acres Land Applied	7. Outfall* Number	8. Amount of Waste Applied	9. Units (Gal., Tons, Metric Tons, Cubic Yards)	10. Nitrogen supplied from Waste (lbs/acre)	11. Other Sources of Nitrogen (lbs/acre)	12. Crop Code	13. Crop Year	14. Nitrogen Recom ** (lbs/acre)	15. Method	16. Industrial Only Chlorides Applied (lbs/acre)	17. Site no longer used
115962	544/3	Trust, Every	4.5	002	28000	GALLONS	141		17	2020	160	INJ		
115963	544/4	Trust, Every	2	002	11200	GALLONS	127		17	2020	160	INJ		
115964	544/5	Trust, Every	8.3	002	56000	GALLONS	153		17	2020	160	INJ		
115965	544/6	Trust, Every	15.8	002	102800	GALLONS	148		17	2020	160	INJ		
115966	544/7	Trust, Every	3.7	002	25000	GALLONS	153		17	2020	160	INJ		
115967	544/8	Trust, Every	7.3	002	45000	GALLONS	140		17	2020	160	INJ		
107219	545/1	GOBEL, MARIO	12.7	002	103600	GALLONS	185		17	2020	210	INJ		
116110	545/2	GOBEL, MARIO	3.9	002	35000	GALLONS	204		17	2020	210	INJ		
116111	545/3	GOBEL, MARIO	3.4	002	22400	GALLONS	150		17	2020	210	INJ		

Comments: ____

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** Nitrogen recommendation for alfalfa (200 lbs/A) and soybeans (140 lbs/A) are the allowable N application rates for these crops as specified in NR 204.

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Signature of Principal Officer or Authorized Agent	Print or Type Name	Title	Date Signed
	Martin Griffin	Director of Ecosystem Service	05-Feb-20

State of Wisconsin
Department of Natural Resources
PO BOX 7921, Madison WI 53707-7921

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2. Year submitted for: 2019

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FID No. 113002230

County Dane

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116103	546/1	Marks Farms,	68	002	307400	GALLONS	103		17	2020	160	INJ		
116363	547/1	Swerig, Clayton	7.5	002	55000	GALLONS	166		17	2020	210	INJ		
116364	547/2	Swerig, Clayton	12.5	002	90000	GALLONS	163		17	2020	210	INJ		
116365	547/3	Swerig, Clayton	10.9	002	80000	GALLONS	167		17	2020	210	INJ		
116366	547/4	Swerig, Clayton	6.4	002	30000	GALLONS	106		17	2020	210	INJ		
116362	548/1	HINCHLEY, DUANE	55.3	002	504200	GALLONS	207		17	2020	210	INJ		
116526	549/2	Glesinger, Greg	30	002	234000	GALLONS	177		17	2020	210	INJ		
15193	6/5	FAHEY, DAVID	15	002	100800	GALLONS	153		17	2020	160	INJ		
15194	6/6	FAHEY, DAVID	12	002	78400	GALLONS	148		17	2020	160	INJ		

Comments: ______

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Signature of Principal Officer or Authorized Agent	Print or Type Name	Title	Date Signed
	Martin Griffin	**Director of Ecosystem Service**	**05-Feb-20**

State of Wisconsin
Department of Natural Resources
PO BOX 7921, Madison WI 53707-7921

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Annual Land Application Report

Form 3400-55 (R 10/01)

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FID No. 113002230

County Dane

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Total Municipal Sludge Land Applied: 5,069 (If Applicable) UNITS: Metric Tons (Metric Tons)

RETURN FORM TO: BUREAU OF WATERSHED MANAGEMENT
BOX 7921
101 S. WEBSTER STREET
MADISON, WI 53707-7921

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REVIEW INSTRUCTIONS ON BACK.

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15381	87/1	HOMBURG, BRUCE	11	002	72400	GALLONS	149		17	2020	160	INJ		
15382	87/2	HOMBURG, BRUCE	19	002	128800	GALLONS	154		17	2020	160	INJ		

Comments: ____

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Signature of Principal Officer or Authorized Agent	Print or Type Name	Title	Date Signed
	Martin Griffin	**Director of Ecosystem Service**	**05-Feb-20**

(M) Characteristic Report, WDNR

CHARACTERISTIC REPORT s. 283.55(1), Wis Stats. Form 3400-49 Rev. 1-98
(Municipal Sludge, Industrial Sludge, Liquid Industrial Waste and By-Product Solids)

Permit No.: 0024597

Facility: MADISION METROPOLITIAN SEWERAGE DISTRICT WWTF
1610 Moorland Road
Madison, WI 53713

Reporting Period: 1/1/2019 to 12/31/2019
Form Due Date: 01/31/2008

Did you land apply this period? Y (Y/N)
If yes and Municipal Sludge:
A) Were Class B (A/B) Pathogen Requirements Satisfied? Y (Y/N)
B) Were Vector Control Requirements Satisfied? Y (Y/N)

FIN: 7291 Region: South Central Region DOC:

FID: 113002230 Office: FITCHBURG Date Received:

Return Form To Bureau of Watershed Management/2
PO BOX 7921
101 S. Webster St.
Madison, WI 53707-7921

If Municipal Sludge then complete sections B and C on the reverse side of this form.
Include copy of lab sheets, unless instructed otherwise

A) **Parameters to be Sampled** **DNR Contact:** LARRY BENSON

Parameter Number	Parameter	Sample Point Number	Date Sample Taken	Sample Type	Analytical Results	Units	Municipal Sludge Only			Lab Certification Number
							Limit	High Quality Limit	Date Smpl Analyzed for Organics	
33	Arsenic Dry Wt	002	1/1/2019	COMP	5.52	MG/KG	75	41		113002230
33	Arsenic Dry Wt	002	2/1/2019	COMP	4.54	MG/KG	75	41		113002230
33	Arsenic Dry Wt	002	3/1/2019	COMP	4.61	MG/KG	75	41		113002230
33	Arsenic Dry Wt	002	4/1/2019	COMP	6.00	MG/KG	75	41		113002230
33	Arsenic Dry Wt	002	5/1/2019	COMP	4.55	MG/KG	75	41		113002230
33	Arsenic Dry Wt	002	6/1/2019	COMP	4.49	MG/KG	75	41		113002230
33	Arsenic Dry Wt	002	7/1/2019	COMP	5.21	MG/KG	75	41		113002230
33	Arsenic Dry Wt	002	8/1/2019	COMP	4.98	MG/KG	75	41		113002230
33	Arsenic Dry Wt	002	9/1/2019	COMP	5.69	MG/KG	75	41		113002230
33	Arsenic Dry Wt	002	10/1/2019	COMP	6.63	MG/KG	75	41		113002230
33	Arsenic Dry Wt	002	11/1/2019	COMP	4.80	MG/KG	75	41		113002230
33	Arsenic Dry Wt	002	12/1/2019	COMP	5.31	MG/KG	75	41		113002230
86	Cadmium Dry Wt	002	1/1/2019	COMP	1.01	MG/KG	85	39		113002230
86	Cadmium Dry Wt	002	2/1/2019	COMP	0.95	MG/KG	85	39		113002230
86	Cadmium Dry Wt	002	3/1/2019	COMP	0.91	MG/KG	85	39		113002230
86	Cadmium Dry Wt	002	4/1/2019	COMP	1.14	MG/KG	85	39		113002230
86	Cadmium Dry Wt	002	5/1/2019	COMP	1.05	MG/KG	85	39		113002230
86	Cadmium Dry Wt	002	6/1/2019	COMP	1.00	MG/KG	85	39		113002230
86	Cadmium Dry Wt	002	7/1/2019	COMP	0.99	MG/KG	85	39		113002230
86	Cadmium Dry Wt	002	8/1/2019	COMP	0.97	MG/KG	85	39		113002230
86	Cadmium Dry Wt	002	9/1/2019	COMP	1.06	MG/KG	85	39		113002230
86	Cadmium Dry Wt	002	10/1/2019	COMP	1.13	MG/KG	85	39		113002230
86	Cadmium Dry Wt	002	11/1/2019	COMP	1.10	MG/KG	85	39		113002230
86	Cadmium Dry Wt	002	12/1/2019	COMP	0.87	MG/KG	85	39		113002230
123	Chromium Dry Wt	002	1/1/2019	COMP	40.1	MG/KG				113002230
123	Chromium Dry Wt	002	2/1/2019	COMP	44.2	MG/KG				113002230
123	Chromium Dry Wt	002	3/1/2019	COMP	47.4	MG/KG				113002230
123	Chromium Dry Wt	002	4/1/2019	COMP	46.2	MG/KG				113002230
123	Chromium Dry Wt	002	5/1/2019	COMP	40.1	MG/KG				113002230
123	Chromium Dry Wt	002	6/1/2019	COMP	44.5	MG/KG				113002230
123	Chromium Dry Wt	002	7/1/2019	COMP	46.7	MG/KG				113002230

A) **Parameters to be Sampled** **DNR Contact:** LARRY BENSON

Parameter Number	Parameter	Sample Point Number	Date Sample Taken	Sample Type	Analytical Results	Units	Municipal Sludge Only			Lab Certification Number
							Limit	High Quality Limit	Date Smpl Analyzed for Organics	
123	Chromium Dry Wt	002	8/1/2019	COMP	48.4	MG/KG				113002230
123	Chromium Dry Wt	002	9/1/2019	COMP	44.4	MG/KG				113002230
123	Chromium Dry Wt	002	10/1/2019	COMP	46.0	MG/KG				113002230
123	Chromium Dry Wt	002	11/1/2019	COMP	46.0	MG/KG				113002230
123	Chromium Dry Wt	002	12/1/2019	COMP	38.6	MG/KG				113002230
145	Copper Dry Wt	002	1/1/2019	COMP	527	MG/KG	4300	1500		113002230
145	Copper Dry Wt	002	2/1/2019	COMP	502	MG/KG	4300	1500		113002230
145	Copper Dry Wt	002	3/1/2019	COMP	483	MG/KG	4300	1500		113002230
145	Copper Dry Wt	002	4/1/2019	COMP	554	MG/KG	4300	1500		113002230
145	Copper Dry Wt	002	5/1/2019	COMP	537	MG/KG	4300	1500		113002230
145	Copper Dry Wt	002	6/1/2019	COMP	537	MG/KG	4300	1500		113002230
145	Copper Dry Wt	002	7/1/2019	COMP	547	MG/KG	4300	1500		113002230
145	Copper Dry Wt	002	8/1/2019	COMP	556	MG/KG	4300	1500		113002230
145	Copper Dry Wt	002	9/1/2019	COMP	583	MG/KG	4300	1500		113002230
145	Copper Dry Wt	002	10/1/2019	COMP	631	MG/KG	4300	1500		113002230
145	Copper Dry Wt	002	11/1/2019	COMP	650	MG/KG	4300	1500		113002230
145	Copper Dry Wt	002	12/1/2019	COMP	493	MG/KG	4300	1500		113002230
262	Lead Dry Wt	002	1/1/2019	COMP	24.4	MG/KG	840	300		113002230
262	Lead Dry Wt	002	2/1/2019	COMP	23.0	MG/KG	840	300		113002230
262	Lead Dry Wt	002	3/1/2019	COMP	20.9	MG/KG	840	300		113002230
262	Lead Dry Wt	002	4/1/2019	COMP	27.9	MG/KG	840	300		113002230
262	Lead Dry Wt	002	5/1/2019	COMP	24.5	MG/KG	840	300		113002230
262	Lead Dry Wt	002	6/1/2019	COMP	23.6	MG/KG	840	300		113002230
262	Lead Dry Wt	002	7/1/2019	COMP	23.4	MG/KG	840	300		113002230
262	Lead Dry Wt	002	8/1/2019	COMP	23.5	MG/KG	840	300		113002230
262	Lead Dry Wt	002	9/1/2019	COMP	24.4	MG/KG	840	300		113002230
262	Lead Dry Wt	002	10/1/2019	COMP	26.2	MG/KG	840	300		113002230
262	Lead Dry Wt	002	11/1/2019	COMP	28.4	MG/KG	840	300		113002230
262	Lead Dry Wt	002	12/1/2019	COMP	19.2	MG/KG	840	300		113002230
278	Mercury Dry Wt	002	1/1/2019	COMP	0.48	MG/KG	57	17		113002230
278	Mercury Dry Wt	002	2/1/2019	COMP	0.39	MG/KG	57	17		113002230
278	Mercury Dry Wt	002	3/1/2019	COMP	0.48	MG/KG	57	17		113002230
278	Mercury Dry Wt	002	4/1/2019	COMP	0.53	MG/KG	57	17		113002230
278	Mercury Dry Wt	002	5/1/2019	COMP	0.53	MG/KG	57	17		113002230
278	Mercury Dry Wt	002	6/1/2019	COMP	0.52	MG/KG	57	17		113002230
278	Mercury Dry Wt	002	7/1/2019	COMP	0.53	MG/KG	57	17		113002230
278	Mercury Dry Wt	002	8/1/2019	COMP	0.40	MG/KG	57	17		113002230
278	Mercury Dry Wt	002	9/1/2019	COMP	0.81	MG/KG	57	17		113002230
278	Mercury Dry Wt	002	10/1/2019	COMP	0.60	MG/KG	57	17		113002230
278	Mercury Dry Wt	002	11/1/2019	COMP	0.64	MG/KG	57	17		113002230
278	Mercury Dry Wt	002	12/1/2019	COMP	0.43	MG/KG	57	17		113002230
295	Molybdenum Dry Wt	002	1/1/2019	COMP	15.8	MG/KG	75			113002230

A) **Parameters to be Sampled** **DNR Contact:** LARRY BENSON

Parameter Number	Parameter	Sample Point Number	Date Sample Taken	Sample Type	Analytical Results	Units	Municipal Sludge Only			Lab Certification Number
							Limit	High Quality Limit	Date Smpl Analyzed for Organics	
295	Molybdenum Dry Wt	002	2/1/2019	COMP	15.1	MG/KG	75			113002230
295	Molybdenum Dry Wt	002	3/1/2019	COMP	15.4	MG/KG	75			113002230
295	Molybdenum Dry Wt	002	4/1/2019	COMP	17.5	MG/KG	75			113002230
295	Molybdenum Dry Wt	002	5/1/2019	COMP	17.0	MG/KG	75			113002230
295	Molybdenum Dry Wt	002	6/1/2019	COMP	16.6	MG/KG	75			113002230
295	Molybdenum Dry Wt	002	7/1/2019	COMP	16.6	MG/KG	75			113002230
295	Molybdenum Dry Wt	002	8/1/2019	COMP	17.6	MG/KG	75			113002230
295	Molybdenum Dry Wt	002	9/1/2019	COMP	21.5	MG/KG	75			113002230
295	Molybdenum Dry Wt	002	10/1/2019	COMP	25.4	MG/KG	75			113002230
295	Molybdenum Dry Wt	002	11/1/2019	COMP	29.4	MG/KG	75			113002230
295	Molybdenum Dry Wt	002	12/1/2019	COMP	14.9	MG/KG	75			113002230
313	Nickel Dry Wt	002	1/1/2019	COMP	25.2	MG/KG	420	420		113002230
313	Nickel Dry Wt	002	2/1/2019	COMP	25.0	MG/KG	420	420		113002230
313	Nickel Dry Wt	002	3/1/2019	COMP	31.6	MG/KG	420	420		113002230
313	Nickel Dry Wt	002	4/1/2019	COMP	28.5	MG/KG	420	420		113002230
313	Nickel Dry Wt	002	5/1/2019	COMP	25.1	MG/KG	420	420		113002230
313	Nickel Dry Wt	002	6/1/2019	COMP	26.8	MG/KG	420	420		113002230
313	Nickel Dry Wt	002	7/1/2019	COMP	27.9	MG/KG	420	420		113002230
313	Nickel Dry Wt	002	8/1/2019	COMP	29.2	MG/KG	420	420		113002230
313	Nickel Dry Wt	002	9/1/2019	COMP	28.8	MG/KG	420	420		113002230
313	Nickel Dry Wt	002	10/1/2019	COMP	28.2	MG/KG	420	420		113002230
313	Nickel Dry Wt	002	11/1/2019	COMP	28.0	MG/KG	420	420		113002230
313	Nickel Dry Wt	002	12/1/2019	COMP	24.5	MG/KG	420	420		113002230
324	Nitrogen Ammonium (NH4-N) Tota	002	1/1/2019	COMP	3.06	PERCENT				113002230
324	Nitrogen Ammonium (NH4-N) Tota	002	2/1/2019	COMP	3.08	PERCENT				113002230
324	Nitrogen Ammonium (NH4-N) Tota	002	3/1/2019	COMP	3.16	PERCENT				113002230
324	Nitrogen Ammonium (NH4-N) Tota	002	4/1/2019	COMP	3.53	PERCENT				113002230
324	Nitrogen Ammonium (NH4-N) Tota	002	5/1/2019	COMP	3.99	PERCENT				113002230
324	Nitrogen Ammonium (NH4-N) Tota	002	6/1/2019	COMP	3.83	PERCENT				113002230
324	Nitrogen Ammonium (NH4-N) Tota	002	7/1/2019	COMP	3.95	PERCENT				113002230
324	Nitrogen Ammonium (NH4-N) Tota	002	8/1/2019	COMP	3.95	PERCENT				113002230
324	Nitrogen Ammonium (NH4-N) Tota	002	9/1/2019	COMP	3.75	PERCENT				113002230
324	Nitrogen Ammonium (NH4-N) Tota	002	10/1/2019	COMP	4.01	PERCENT				113002230
324	Nitrogen Ammonium (NH4-N) Tota	002	11/1/2019	COMP	3.89	PERCENT				113002230
324	Nitrogen Ammonium (NH4-N) Tota	002	12/1/2019	COMP	2.53	PERCENT				113002230
335	Nitrogen Total Kjeldahl	002	1/1/2019	COMP	8.33	PERCENT				113002230
335	Nitrogen Total Kjeldahl	002	2/1/2019	COMP	8.63	PERCENT				113002230
335	Nitrogen Total Kjeldahl	002	3/1/2019	COMP	7.97	PERCENT				113002230
335	Nitrogen Total Kjeldahl	002	4/1/2019	COMP	8.63	PERCENT				113002230
335	Nitrogen Total Kjeldahl	002	5/1/2019	COMP	8.75	PERCENT				113002230
335	Nitrogen Total Kjeldahl	002	6/1/2019	COMP	8.48	PERCENT				113002230
335	Nitrogen Total Kjeldahl	002	7/1/2019	COMP	8.88	PERCENT				113002230

A) **Parameters to be Sampled** **DNR Contact:** LARRY BENSON

Parameter Number	Parameter	Sample Point Number	Date Sample Taken	Sample Type	Analytical Results	Units	Municipal Sludge Only			Lab Certification Number
							Limit	High Quality Limit	Date Smpl Analyzed for Organics	
335	Nitrogen Total Kjeldahl	002	8/1/2019	COMP	8.85	PERCENT				113002230
335	Nitrogen Total Kjeldahl	002	9/1/2019	COMP	8.35	PERCENT				113002230
335	Nitrogen Total Kjeldahl	002	10/1/2019	COMP	8.79	PERCENT				113002230
335	Nitrogen Total Kjeldahl	002	11/1/2019	COMP	8.41	PERCENT				113002230
335	Nitrogen Total Kjeldahl	002	12/1/2019	COMP	7.81	PERCENT				113002230
365	PCB Total Dry Wt	002	4/1/2019	COMP	<0.0081	MG/KG	50			113002230
365	PCB Total Dry Wt	002	5/1/2019	COMP	<0.0081	MG/KG	50			113002230
365	PCB Total Dry Wt	002	6/1/2019	COMP	<0.0081	MG/KG	50			113002230
365	PCB Total Dry Wt	002	7/1/2019	COMP	<0.0081	MG/KG	50			113002230
365	PCB Total Dry Wt	002	8/1/2019	COMP	<0.0081	MG/KG	50			113002230
365	PCB Total Dry Wt	002	9/1/2019	COMP	<0.0081	MG/KG	50			113002230
365	PCB Total Dry Wt	002	9/9/2019	COMP	<0.0081	MG/KG	50			113002230
365	PCB Total Dry Wt	002	10/1/2019	COMP	<0.0081	MG/KG	50			113002230
365	PCB Total Dry Wt	002	11/1/2019	COMP	<0.0081	MG/KG	50			113002230
388	Phosphorus Total As P	002	1/1/2019	COMP	2.81	PERCENT				113002230
388	Phosphorus Total As P	002	2/1/2019	COMP	3.07	PERCENT				113002230
388	Phosphorus Total As P	002	3/1/2019	COMP	2.83	PERCENT				113002230
388	Phosphorus Total As P	002	4/1/2019	COMP	3.01	PERCENT				113002230
388	Phosphorus Total As P	002	5/1/2019	COMP	2.61	PERCENT				113002230
388	Phosphorus Total As P	002	6/1/2019	COMP	2.52	PERCENT				113002230
388	Phosphorus Total As P	002	7/1/2019	COMP	2.89	PERCENT				113002230
388	Phosphorus Total As P	002	8/1/2019	COMP	2.68	PERCENT				113002230
388	Phosphorus Total As P	002	9/1/2019	COMP	2.69	PERCENT				113002230
388	Phosphorus Total As P	002	10/1/2019	COMP	2.74	PERCENT				113002230
388	Phosphorus Total As P	002	11/1/2019	COMP	2.82	PERCENT				113002230
388	Phosphorus Total As P	002	12/1/2019	COMP	2.76	PERCENT				113002230
395	Potassium Total	002	1/1/2019	COMP	0.52	PERCENT				113002230
395	Potassium Total	002	2/1/2019	COMP	0.51	PERCENT				113002230
395	Potassium Total	002	3/1/2019	COMP	0.45	PERCENT				113002230
395	Potassium Total	002	4/1/2019	COMP	0.49	PERCENT				113002230
395	Potassium Total	002	5/1/2019	COMP	0.53	PERCENT				113002230
395	Potassium Total	002	6/1/2019	COMP	0.53	PERCENT				113002230
395	Potassium Total	002	7/1/2019	COMP	0.53	PERCENT				113002230
395	Potassium Total	002	8/1/2019	COMP	0.54	PERCENT				113002230
395	Potassium Total	002	9/1/2019	COMP	0.52	PERCENT				113002230
395	Potassium Total	002	10/1/2019	COMP	0.54	PERCENT				113002230
395	Potassium Total	002	11/1/2019	COMP	0.51	PERCENT				113002230
395	Potassium Total	002	12/1/2019	COMP	0.47	PERCENT				113002230
421	Selenium Dry Wt	002	1/1/2019	COMP	7.19	MG/KG	100	100		113002230
421	Selenium Dry Wt	002	2/1/2019	COMP	6.08	MG/KG	100	100		113002230
421	Selenium Dry Wt	002	3/1/2019	COMP	7.78	MG/KG	100	100		113002230
421	Selenium Dry Wt	002	4/1/2019	COMP	10.0	MG/KG	100	100		113002230

A) **Parameters to be Sampled** **DNR Contact:** LARRY BENSON

Parameter Number	Parameter	Sample Point Number	Date Sample Taken	Sample Type	Analytical Results	Units	Municipal Sludge Only			Lab Certification Number
							Limit	High Quality Limit	Date Smpl Analyzed for Organics	
421	Selenium Dry Wt	002	5/1/2019	COMP	7.47	MG/KG	100	100		113002230
421	Selenium Dry Wt	002	6/1/2019	COMP	6.35	MG/KG	100	100		113002230
421	Selenium Dry Wt	002	7/1/2019	COMP	6.22	MG/KG	100	100		113002230
421	Selenium Dry Wt	002	8/1/2019	COMP	5.19	MG/KG	100	100		113002230
421	Selenium Dry Wt	002	9/1/2019	COMP	5.87	MG/KG	100	100		113002230
421	Selenium Dry Wt	002	10/1/2019	COMP	7.04	MG/KG	100	100		113002230
421	Selenium Dry Wt	002	11/1/2019	COMP	6.34	MG/KG	100	100		113002230
421	Selenium Dry Wt	002	12/1/2019	COMP	6.42	MG/KG	100	100		113002230
461	SolidsTotal	002	1/1/2019	COMP	5.16	PERCENT				113002230
461	SolidsTotal	002	2/1/2019	COMP	5.48	PERCENT				113002230
461	SolidsTotal	002	3/1/2019	COMP	6.07	PERCENT				113002230
461	SolidsTotal	002	4/1/2019	COMP	5.02	PERCENT				113002230
461	SolidsTotal	002	5/1/2019	COMP	5.14	PERCENT				113002230
461	SolidsTotal	002	6/1/2019	COMP	5.12	PERCENT				113002230
461	SolidsTotal	002	7/1/2019	COMP	5.16	PERCENT				113002230
461	SolidsTotal	002	8/1/2019	COMP	5.14	PERCENT				113002230
461	SolidsTotal	002	9/1/2019	COMP	5.20	PERCENT				113002230
461	SolidsTotal	002	10/1/2019	COMP	5.04	PERCENT				113002230
461	SolidsTotal	002	11/1/2019	COMP	5.17	PERCENT				113002230
461	SolidsTotal	002	12/1/2019	COMP	5.72	PERCENT				113002230
551	Zinc Dry Wt	002	1/1/2019	COMP	740	MG/KG	7500	2800		113002230
551	Zinc Dry Wt	002	2/1/2019	COMP	670	MG/KG	7500	2800		113002230
551	Zinc Dry Wt	002	3/1/2019	COMP	666	MG/KG	7500	2800		113002230
551	Zinc Dry Wt	002	4/1/2019	COMP	871	MG/KG	7500	2800		113002230
551	Zinc Dry Wt	002	5/1/2019	COMP	733	MG/KG	7500	2800		113002230
551	Zinc Dry Wt	002	6/1/2019	COMP	727	MG/KG	7500	2800		113002230
551	Zinc Dry Wt	002	7/1/2019	COMP	746	MG/KG	7500	2800		113002230
551	Zinc Dry Wt	002	8/1/2019	COMP	794	MG/KG	7500	2800		113002230
551	Zinc Dry Wt	002	9/1/2019	COMP	906	MG/KG	7500	2800		113002230
551	Zinc Dry Wt	002	10/1/2019	COMP	935	MG/KG	7500	2800		113002230
551	Zinc Dry Wt	002	11/1/2019	COMP	942	MG/KG	7500	2800		113002230
551	Zinc Dry Wt	002	12/1/2019	COMP	615	MG/KG	7500	2800		113002230
686	Phosphorus, Water Extractable	002	4/1/2019	COMP	0.00	PERCENT				113002230
686	Phosphorus, Water Extractable	002	5/1/2019	COMP	0.00	PERCENT				113002230
686	Phosphorus, Water Extractable	002	6/1/2019	COMP	0.00	PERCENT				113002230
686	Phosphorus, Water Extractable	002	7/1/2019	COMP	0.00	PERCENT				113002230
686	Phosphorus, Water Extractable	002	8/1/2019	COMP	0.00	PERCENT				113002230
686	Phosphorus, Water Extractable	002	9/1/2019	COMP	0.00	PERCENT				113002230
686	Phosphorus, Water Extractable	002	10/1/2019	COMP	0.00	PERCENT				113002230
686	Phosphorus, Water Extractable	002	11/1/2019	COMP	0.00	PERCENT				113002230

A) **Parameters to be Sampled** **DNR Contact:** LARRY BENSON

Parameter Number	Parameter	Sample Point Number	Date Sample Taken	Sample Type	Analytical Results	Units	Municipal Sludge Only			Lab Certification Number
							Limit	High Quality Limit	Date Smpl Analyzed for Organics	

Description of Facility Sampling Point:

Comments: Samples are composites for each month, made up of sludge from each day hauled - the sample date listed is the first date of the month.

I certify, under penalty of law that metal testing, pathogen monitoring and testing, and the vector control requirements, if reported on this form have been prepared under my direction and supervision in accordance with a system designed to ensure that qualified personnel properly gathered and evaluated this information. I am aware that there are significant penalities for false certification including the possibility of fine or imprisonment.

Completion of this form is required. Failure to complete this form, as required by s.283.55(1), Wis. Stats., may result in penalties, pursuant to s.283.91(4), Wis Stats. Personally identifiable information on this form is not intended to be used for any other purpose.

Signature:	Print or Type Name: Paul Nehm	Title: Director of O&M	Date Signed: 2/5/2020

(N) Land Application Site Request, WDNR Form 3400-053

State of Wisconsin, DNR
PO Box 7921
Madison, WI 53707-7921

Land Application Site Request

Notice: Complete this form for each site and submit it along with supporting documents to the appropriate WDNR Regional Wastewater Specialist or Engineer for evaluation. Failure to file a complete site request package including supporting documents, approvals, and acknowledgement signatures may result in denial or return of the request. Complete the form pursuant to the instructions on pages 5 and 6.

Completion and submission of this form is mandatory under s. 283.55, Wis. Stats., and chs. NR 204 or 214, Wis. Adm. Code, for Sewage Sludge and Industrial Waste and under s. 281.48, Wis. Stats., and ch. NR 113, Wis. Adm. Code, for Septage. Failure to properly complete and submit this form is a violation of s. 283.91 or s. 281.48, Wis. Stats., and may result in a monetary penalty and/or imprisonment. Personally identifiable information on this form is not intended to be used for other purposes, but may be made available to requesters under Wisconsin's Open Records law ss. 19.32-19.38, Wis. Stats.

Applicant Information

Permittee Name (or Licensed Business)			Phone No.
Address	City	State	ZIP Code
WPDES Permit No. WI-00	Septage License No.	Email	

Methods and Equipment

Application Method Used (check all that apply): ☐ Surface ☐ Incorporation ☐ Injection

Equipment Used (check all that apply): ☐ Injector ☐ Splash Plate ☐ Sprayer ☐ Slinger ☐ Moldboard ☐ Chisel ☐ Disc ☐ Other ____________

Site Request Package Checklist

Prior to submitting the Site Request Package, ensure that all items have been included by using the checklist below:

- ☐ Completed 3400-053 Land Application Site Request Form.
- ☐ Aerial Photograph.
  Requested sites/fields boundaries marked and identified.
  Label restricting features including wells, residences, wetlands, waterways, dry runs, etc.
- ☐ Soil Map Units.
  Maps may be combined with the Aerial Photograph.
- ☐ Proof of Ownership (legal property owner).
  Include a copy of the tax parcel listing showing the property owner along with the parcel map displaying the parcel identification.
- ☐ Setback reduction permissions.
  Include signature(s) from any affected owners and occupants.
- ☐ Soil Test Reports
  - ☐ Nutrient Test Report.
    Submit test report per UWEX A2809 prior to landspreading for sewage sludge, high use septage fields, and other specific cases.
  - ☐ Morphological Report.
    Soil test report of soil horizons, etc., required for sewage sludge, high use septage fields, and other specific cases.
- ☐ Other Site Review Information.
  Field data/surveys, additional equipment lists, waste descriptions, etc. to assist in the site review process.

Property Owner and Farmer Information

If the property is owned by a corporation or trust, enter the legal entity name and registered address in the Property Owner section below and complete the information of the registered agent in the Comments spaces.

Property Owner	Email	Phone No.	
Address	City	State	ZIP Code

Is the Property Owner farming the Property? ◯ Yes ◯ No If Yes, skip Farmer Information below and sign both **Property Owner** and **Farmer** on page 3.

Farmer Name (if different)	Email	Phone No.	
Address	City	State	ZIP Code
Farm/Business Name	Business Email Address (if different)	Business Alt. Phone	
Farm/Business Address	City	State	ZIP Code

Comments:

Site Information

Outline the exact location, and indicate the name of the site(s)/field(s) on a soil map unit map and/or an aerial photograph.

Site Number / Name	(indicate only one) ◯ City ◯ Village ◯ Town of ______	County (indicate only one)

Field Number	Legal Description	Section	Township	Range	Estimated Acreage
			N	◯ E ◯ W	
			N	◯ E ◯ W	
			N	◯ E ◯ W	
			N	◯ E ◯ W	
			N	◯ E ◯ W	

Have all requested sites been in agricultural production in the last 2 years? ◯ Yes ◯ No If no, explain on an additional sheet of paper.

Will application be to an existing crop? ◯ Yes ◯ No

If Yes, check appropriately: ◯ Cultivated Crops ◯ Permanent Hayland ◯ Pasture ◯ Tree Plantation

If Cultivated Crops are being grown, are they being grown for human food? ◯ Yes ◯ No If yes, what crop? ______

Was non-agricultural waste applied to site(s) in the last 3 crop years? ◯ Yes ◯ No

Is non-agricultural waste currently applied to site(s)? ◯ Yes ◯ No

If the answer to either question above is Yes, select the appropriate waste types below:

☐ Septage ☐ Industrial Wastewater ☐ Paper Mill Sludge ☐ Whey or Permeate ☐ Other (specify) ______

☐ Sewage Sludge ☐ Industrial Sludge ☐ Food Processing Waste ☐ Other (specify) ______

Check the appropriate boxes for the land use types adjacent to the site:

☐ Residential ☐ Commercial ☐ Industrial ☐ Agricultural ☐ Other (specify) ______

☐ Forest ☐ Landfill ☐ Mining Operation ☐ Recreational ☐ Other (specify) ______

Is winter application desired on this site? ◯ Yes ◯ No

Check the separation distance between the land surface and bedrock/groundwater: ◯ 18 to 36 inches ◯ Greater than 36 inches

Is this site currently under a 590 Nutrient Management Plan (NMP) per ch. ATCP 50 Wis. Adm. Code? ◯ Yes ◯ No

Are any parts of the site(s) enrolled in the Conservation Reserve Program (CRP)? ◯ Yes ◯ No If Yes, explain on an additional sheet of paper.

Is drain tile installed on the site(s)? ◯ Yes ◯ No If Yes, what depth? ______ inches If yes, identify tile outlets on submitted aerial photograph.

Waste Information

Waste(s) to be Land Applied

☐ Septage ☐ Industrial Wastewater ☐ Paper Mill Sludge ☐ Whey or Permeate ☐ Other (specify) ______

☐ Sewage Sludge ☐ Industrial Sludge ☐ Food Processing Waste ☐ Other (specify) ______

Complete the applicable section for the type of waste intended to be land spread.

Septage s. NR 113, Wis. Adm. Code

Is this application for a High Use Field? ◯ Yes ◯ No If Yes, include Nutrient and Morphological Soil Reports in site request package.

Is this an application for emergency winter approval? ◯ Yes ◯ No Type of Waste? ◯ Emergency Septic ◯ Holding

Proposed typical application rate: ______ Gal/acre ◯ Day ◯ Week Proposed frozen or snow covered application rate: ______ Gal/acre

Sewage (Municipal) Sludge s. NR 204, Wis. Adm. Code

Has this site been Self Approved? ◯ Yes ◯ No If yes, WDNR Self Approver Number: ______

The nutrient soil test results must be submitted prior to land application per ss. NR 204.06.

Industrial Waste s. NR 214, Wis. Adm. Code

Proposed typical application rate: ______ rate (check one) ◯ Gal/acre ◯ Ton/acre ☐ Other (specify) ______

Proposed application rate on frozen or snow covered ground: ______ rate (check one) ◯ Gal/acre ◯ Ton/acre ☐ Other (specify) ______

Proposed application interval (check one) ☐ Daily ☐ Weekly ☐ Monthly ☐ Quarterly ☐ Annually

Total proposed waste applied to site per year: ______ ☐ Gallons ☐ Tons ☐ Other (specify) ______

The following sections to be completed and signed by the Property Owner, Farmer (if different than the Property Owner), and Permittee/Licensee. If using separate agreements, the agreements for land application shall meet the requirements of the department as well as meeting the requirements of the Department of Agriculture, Trade and Consumer Protection (DATCP). Failure to meet the requirements may subject the Permittee and/or Licensed Septage Business to violations and/or fertilizer licensing requirements.

Approval / Acknowledgment Statements

IMPORTANT: Failure to provide signatures from all Parties may result in a denial of this land application site request package.

All Parties understand and agree:

- To all rules and regulations of the Wisconsin Department of Natural Resources (WDNR) that apply to land application including but not limited to horizontal/vertical setbacks, soil map unit suitability, application rates, approximated nutrient values and crop/grazing/public access restrictions.
- The WDNR will review each site/field for approval. Application prior to approval and/or applying to a site that does not meet specific requirements or conditions may be a violation of administrative code and/or WPDES permit requirements. Because site setbacks changes due to construction, land use changes, or other conditions, the areas as show on an approved site map are subject to change. The user of approved sites shall monitor and adhere to any new setbacks. These changes, may include but are not limited to: changes in county-specific soil map unit information, wells, development, sink holes, etc.
- Pursuant to chs. NR 113, 204, and/or NR 214 the WDNR may conditionally approve a site, conditionally approve a site through a variance, or conditionally approve a site where the condition requires a revised Management Plan with discharge monitoring requirements. When a site is approved for landspreading, conditions are included to protect surface water, groundwater, and public health pursuant to statutory and administrative code requirements. When wastes regulated under different administrative codes are combined, then the most stringent requirements from each administrative code apply.

To ensure that Wisconsin Fertilizer and/or Soil Amendment rules are not violated, all parties agree to:

- Understand that while the application of waste for beneficial use may have significant nutrient, soil amendment properties and/or liming benefits, these values are not being guaranteed and are not licensed by chs. ATCP 40 and ATCP 41, Wis. Adm. Code administered by the Department of Agriculture, Trade, and Consumer Protection (DATCP).
- Understand that while the landspreading contractor (municipality, contractor, licensed septage business, or other) is applying the waste, the contractor is in control of the land for the purposes of applying nutrients and/or soil amendments.
- Understand that no financial transaction should occur for receiving the perceived nutrients and/or soil amendments, but rather any financial transaction should clearly itemize and reflect the costs incurred by the land spreading contractor (fuel, maintenance, applicator wage, etc.) for the product being applied during the land spreading event(s).

Property Owner	Farmer	WPDES Auth. Rep. or Septage Owner/OIC
I, ______________________, hereby give *(property owner)* ______________________ (WPDES Permittee/licensed septage business) authorization to land apply the aforementioned waste(s) to my field(s) as listed above. Further, I: • Understand that I can revoke the privilege for use of my land at any time. Revocation of this privilege will result in the department rescinding this site from the permittee/licensees approved site list. • Although the nutrient values are not guaranteed, I accept these wastes onto my field to gain useful nutrients, soil amendment properties and/or lime benefits to my fields. [ATCP 40, ATCP 41]. • Will communicate to the farmer the estimated nutrient content added to these fields so that the nutrients may be credited to a nutrient management plan such as those specified in s. ATCP 50.04(3)(g), Wis. Adm. Code.	I, ______________________ , *(farmer/producer)* hereby certify that: • These listed fields are actively farmed with crop removal each year. • If applicable, the nutrients added to the soils from the waste are accounted for in an appropriate nutrient management plan (NMP) such as those specified in s. ATCP 50.04(3)(g), Wis. Adm. Code to prevent overapplication of nutrients such as nitrogen and phosphorus. • If applicable, the nutrients are accounted for, communicated, and submitted through the NMP to the appropriate Land and Water Conservation Department or other agency, if required. Information regarding crops, planting/harvesting schedules, crop yield and additional fertilizer use will be communicated to the WPDES permittee/septage business to meet permit and licenses requirements. This includes, but is not limited to, if the field is not harvested or left out of production.	I, ______________________ , *(licensed septage business owner/OIC or authorized representative of the WPDES Permittee)* agree to: • Apply at rates that do not exceed the nutrient needs of the crop (minus other inputs, i.e., manure, commercial fertilizer) pursuant to guidelines such as those suggested by UW Extension Bulletin A2809. • Communicate crop restriction requirements to the farmer and owner. • Provide nutrient application rates to the farmer and owner. • Convey waste characteristics associated with the waste that may be required to be reported to the department on the Wastewater Characteristic and Discharge Monitoring Report of the WPDES permitted facility. • Notify and obtain the necessary approvals from the County Land and Water Conservation Department if necessary. • Convey the approvals forms, approval maps, current management plan, and wastewater Characteristic Reports to all contract haulers and spreaders (as applicable).
Property Owner Name (Print)	Farmer Name (Print)	WPDES Permittee/Septage Business OIC (Print)
Signature	Signature	Signature
Date	Date	Date

Site Request Preparer Information

Permittee Name (or Licensed Business)		Phone Number	
Preparer Address	City	State	ZIP Code
Preparer Email			

Compliance with Site Requirements: Are all site criteria compliant with Tables A, B, and/C on pages 4 and 5 of this form? ◯ Yes ◯ No
(If No is checked, explain on additional sheets.)

Preparer's Signature:	Date

Table A—Septage s. NR 113.07 and Table 3, Wis. Adm. Code

Site Criteria	Surface	Incorporation/Injection
Minimum depth to bedrock/groundwater-ss. NR 204.07(3) and Table 3	3 ft.	3 ft.
Slope 0 to 12%-s. NR 113 Table 3	0-6% allowed	0-12% allowed
Slopes >6 and >12%-s. NR 113 Table 3	>6% not allowed	>12% not allowed
Distance to wells		
Community water supply or school-s. NR 113 Table 3	1000 ft.	1000 ft.
Other-s. NR 113 Table 3	250 ft.	250 ft.
Minimum distance to residence, business or recreation area-s. NR 113 Table 3	500 ft.	200 ft.
Minimum distance to residence or business with permission-s. NR 113 Table 3	250 ft.	100 ft.
Minimum distance to rural schools and health care facilities-s. NR 113 Table 3	1000 ft.	1000 ft./500 ft.
Minimum distance to property line-s. NR 113 Table 3	50 ft.	25 ft.
Minimum distance to streams, lakes, ponds, wetlands or channelized waterways connected to a stream, lake, pond or wetland:		
Slope 0 to < 6%-s. NR 113 Table 3	200 ft.	150 ft./100 ft.
Slope 6 to <12%-s. NR 113 Table 3	Not Allowed	200 ft./150 ft.
Minimum distance to grass waterways, or dry run with a 50 foot range grass strip:		
Slope 0 to <6%-s. NR 113 Table 3	100 ft.	50 ft./25 ft.
Slope 6 to <12%-s. NR 113 Table 3	Not Allowed	100 ft./50 ft.
Soil permeability range (in/hr)-ss. NR 113.07(3)	0.2-6.0	0.2-6.0
Frozen or snow covered ground special application rules:		
Slope 0 to 2%-ss. NR 113.07(1)	Allowed	Not Applicable
Slope >2%-ss. NR 113.07(1)	Not Allowed	Not Applicable
Application rate-ss. NR 113.07(1)	<10,000 gal/acre	Not Applicable
Min. distance to surface water, wetland or floodplain-ss. NR 113.07(1)	750 ft.	Not Applicable

Table B—Sewage (Municipal) Sludge s. NR 204.07(3) and Table B, Wis. Adm. Code

Criteria for Non-EQ (Exceptional Quality) Sewage Sludge Applied to Land

Site Criteria	Surface	Incorporation/Injection
Minimum depth to bedrock/groundwater-ss. NR 204.07(3)and Table B	3 ft.	3 ft.
Slope 0 to 12%-s. NR 204 Table B	0-6% allowed	0-12% allowed
Slopes >6 and >12%-s. NR 204 Table B	>6% not allowed	>12% not allowed
Minimum distance to wells:		
Community water supply or school-s. NR 204 Table B	1000 ft.	1000 ft.
Other-s. NR 204 Table B	250 ft.	250 ft.
Minimum distance to residence, business or recreation area-s. NR 204 Table B	500 ft.	200 ft.
Minimum distance to residence or business with permission-s. NR 204 Table B	250 ft.	100 ft.
Minimum distance to rural schools and health care facilities-s. NR 204 Table B	1000 ft.	1000 ft./500 ft.
Minimum distance to property line-s. NR 204 Table B	50 ft.	25 ft.
Minimum distance to streams, lakes, ponds, wetlands or channelized waterways connected to a stream, lake, pond or wetland:		
Slope 0 to < 6%-s. NR 204 Table B	200 ft.	150 ft./100 ft.
Slope 6 to <12%-s. NR 204 Table B	Not Allowed	200 ft./150 ft.
Minimum distance to grass waterways, or dry run with a 50 foot grass strip:		
Slope 0 to <6%-s. NR 204 Table B	100 ft.	50 ft./25 ft.
Slope 6 to <12%-s. NR 204 Table B	Not Allowed	100 ft./50 ft.
Soil permeability range (in/hr)-s. NR 204.07(3) & Table B	0.2-6.0	0-6.0
Frozen or snow covered ground, conditional permission granted on a case by case basis:		
Slope 0 to 2%-ss. NR 204.07(3)	Allowed	Not Applicable
Slope >2%-ss. NR 204.07(3)	Not Allowed	Not Applicable
Application rate-ss.NR 204.07(3)	<10,000 gal/acre	Not Applicable
Minimum distance to surface water, wetland or floodplain-ss. NR 204.07(3)	750 ft.	Not Applicable

Table C—Industrial Liquid Waste, By-Product Solids, and Industrial Sludge ss. NR 214.17 & NR 214.18, Wis. Adm. Code

Criteria for Industrial Sludge or Waste applied to Land

Site Criteria	Surface	Incorporation/Injection
Minimum distance to bedrock/groundwater-ss. NR 214.17(2)(h) & NR 214.18(2)(g)	36 inches	36 inches
Slope 0 to 12%-ss. NR 214.17(2)(f) & NR 214.18(2)(f)	Allowed	Allowed
Slope >12%-ss. NR 214.17(2)(f) & NR 214.18(2)(f)	Not Allowed	Not Allowed
Minimum distance to public water supply-ss. NR 214.17(2)(c) & NR 214.18(2)(c)	1000 ft.	1000 ft.
Minimum distance to private water supply-ss. NR 214.17(2)(c) & NR 214.18(2)(c)	250 ft.	250 ft.
Minimum distance to residence-ss. NR 214.17(2)(b) &NR 214.18(2)(b)	500 ft.	500 ft.
Minimum distance with written permission-ss. NR 214.17(2)(b) &NR 214.18(2)(b)	500 ft.	200 ft.
Min. distance to any surface water or dry run-ss. NR 214.17(2)(g) & NR 214.18(2)(d)	200 ft.	50 ft.
Min. distance to a surface water or dry run with vegetative buffer-see above	100 ft.	50 ft.
Frozen or snow covered ground special application rules:		
Slope 0 to 2%-ss. NR 214.17(2)(f) & NR 214.18(2)(f)	Allowed	Not Applicable
Slope >2 to 6%-ss. NR 214.17(2)(f) & NR 214.18(2)(f)	Case-by-case	Not Applicable
Slope >6%-ss. NR 214.17(2)(f) & NR 214.18(2)(f)	Not allowed	Not Applicable
Application rate-ss.NR 214.17(5)	<6,800 gal/acre	Not Applicable

The department shall also consider past operating performance, nutrient uptake of the cover crop, site conditions, the ability of the soils to treat the pollutants in the discharge, permeability and infiltration rate of the soil, other soil and geologic characteristics, the concentrations and characteristics of pollutants in the discharge and other relevant information when determining discharge limitations.-ss. NR 214.17(4)(a) & NR 214.18(4)(a)

Instructions

This form is designed to provide necessary information to the department for evaluating a land application site pursuant to chs. NR 113, NR 204 and NR 214, Wis. Adm Code. Complete this form in its entirety and submit it to the department to add or revise a site under a current permit or license. The form may be used for multiple sites but only if all the sites are: owned and farmed by one person, located in the same area (city, village, or township), and in the same county. Incomplete applications may be rejected or returned.

The permittee is responsible for contacting other governmental agencies to determine if other restrictions or requirements apply.

1. **Applicant Information.**
   a. **Permittee Name or Licensed Business, Phone Number, Address, City, State, ZIP Code, Email Address:** This information shall be identical to the information on the Permittee's WPDES permit or license. Include the telephone number corresponding to the contact person responsible for the land application program. If the Permittee is a subsidiary of a parent company, then use the name and location appearing on the WPDES permit.

   b. **Permit / License:**
      i. **WPDES Permit No.:** If this is a specific or general permit number for the permittee whose waste/sludge is being land applied, then the WPDES permit number is entered here. Permit numbers are 7 digits; the first 2 zeros are already on the form.
      ii. **Septage License No.:** If domestic septage, holding tank waste, portable restroom, and/or grease interceptor waste is being applied by a licensed sanitary hauler, then the septage business license number is entered here. Disregard this entry if the septage is regulated under a WPDES permit.
2. **Methods and Equipment.**
   a. **Application Method Used:** List all waste application methods. All application methods must comply with chs. NR 113, 204 and/or NR 214 Wis. Adm. Codes, the facility's WPDES permit, and/or Management Plan.
      i. Septage may be surface applied, incorporated after surface application, or injected. Surface applied septage must be evenly distributed using a splash plate or other department approved method. Appropriate vector attraction reduction and pathogen reduction methods are required.
      ii. Sewage sludge may be surface applied, incorporated after surface application, or injected. Cake sludge may be "flung" or spread onto the surface. Surface applied liquid sludge must be evenly distributed using a splash plate or other de-partment approved method. Appropriate vector attraction re-duction methods are required. Specific incorporation require-ments may be required pursuant to the WPDES permit and/or Sludge Management Plan.
      iii. Industrial wastes may be sprayed, flung, laid, or drained onto the ground surface or can be directly injected. Vehicles used for landspreading shall be equipped with a distribution system capable of spreading the waste evenly onto the site. Specific incorporation requirements may be required pursuant to the WPDES permit and/or Management Plan.

   b. **Equipment Used:** This section refers to the equipment used in both the application and incorporation of the waste on the field. A splash plate is a device designed to spread liquid material from a discharging valve so that the spray covers a wider, more uniform area. A sprayer is a mechanical device designed to distribute a pressurized liquid waste uniformly over a large area. A slinger is a device intended to throw solid or semi-solid waste uniformly over an area. Moldboard, chisel, and disc are all different types of farm equipment designed to turn over the upper layer of soil to incorpo-rate and mix the waste with the soil. Check each box for each equipment type used on the requested site. If unlisted equipment is proposed, then check "Other" and list the type of the equipment. Use additional sheets of paper if necessary.
3. **Site Request Package Checklist.**
   a. Prior to submitting the site request package, ensure that all items have been included by using the provided checklist. Check all applicable boxes.
4. **Property Owner and Farmer Information.**
   a. **Property Owner:** List the owner(s) as recorded on the deed of the property. If owned by a corporation or partnership, provide the name and contact information for the agent or responsible person in the "Comments" section. Enter all contact information for the property owner(s) in this area.

   b. **Farmer:** List the name of the person who is responsible for planting, fertilizing, and harvesting the crops. Enter all contact information for the farmer in this area. If the Property Owner is also the Farmer, check the box and leave the Farmer information blank.

5. **Site Information.**
   a. **Site Number / Name:** Insert a unique eight character, or less, identification number or word assigned by the applicant to uniquely identify the requested site. For example, if the site number was the owner's name, the site name could be JIMSMITH.

   b. **Village, City or Town:** If the field is located within the limits of an incorporated city or village, check the box marked "City or Village" and list the name. If the location is in an unincorporated Town , check the box marked "Town" checked and list the name. If requested fields are in a different village, city, or town, then a separate form must be submitted for each village, city or town.

   c. **County:** List the county in which the field is located. If requested fields are located in more than one county, then a separate form must be submitted for each county.

   d. **Field Number:** Insert a unique three character, or less, identification number for each field assigned by the applicant. For example, if site number were the farmer's initials (such as J. S.), the field numbers could be JS1, JS2, JS3, etc. List the field number for each field at the site.

   e. **Legal Description:** This is the geographical description of real estate that identifies its precise location. When describing the location, the description is written from smaller measures to larger measures. When using a legal description to locate a parcel on a map, begin at the end of the legal description and work towards the beginning. Example: ¼ NE, ¼ SE, ¼ NW, S 3, T39N, R11E, Town of xxxx, yyyy County, Wisconsin. The legal description can be obtained from plat books, county property records or other sources.

      i. **Section, Township, and Range:** List the section, township and range. Section numbers will range from 1 to 36. Fields spanning multiple Sections must be split into separate field numbers. Wisconsin townships will always be North and the Range will be designated either East or West. Example: Sec. 19, T 30 N, R 3 E. The "N" for Township is provided, and the box for the direction of the Range (East or West) must be checked.

      ii. **Quarter-Quarter-Quarter Information:** List the divided section in quarters (or halves as necessary) with enough accuracy to provide a complete description of the field. In a nominal section there are typically 640 acres of land divided into quarters to describe the location. Each nominal quarter is approximately 160 acres, each nominal quarter-quarter is 40 acres and each quarter-quarter-quarter is 10 acres. For example, if 20 acres in the North 1/2 of the Northeast 1/4 of the Southeast 1/4 are being submitted for approval, the following is entered: N1/2, NE 1/4, SE1/4.

   f. **Estimated Acreage:** Estimate the acreage being submitted for approval. Example: If the field has 100 acres but only 40 acres are potentially approvable, then 40 is entered in this block.

   g. **Agricultural Production:** Check the box to identify if the site was in agricultural production. Proper land treatment of wastes requires a harvested crop that is grown and removed from the site. Actual crop needs and yield may impact application rates.

   h. **Existing Crop:** Check the intended crop(s) to be grown on the site.

   i. **Cultivated Crops for Human Food:** Check the box if cultivated crops are grown for human consumption. If yes, list the intended crop that will be grown. Restrictions may limit the application of wastes to crops that are intended for consumption by people.

   j. **Non-agricultural waste application:** Check the box if the site has received any non-farm wastes in the last three crop years. Carry-over nutrients from prior applications of waste are accounted for in current application rates.

   k. **Adjacent land use:** Check all boxes that apply. The land use of adjacent properties may affect the suitability of the site. Use the other space for unlisted uses. List additional uses on a separate sheet of paper if needed

   l. **Winter Application:** Check the box if Application of wastes to frozen or snow covered ground is requested as part of this application.

   m. **Separation Distance to Bedrock/Groundwater:** Check the appropriate box indicating depth to groundwater and bedrock. The separation distance from the surface of the soil to bedrock and/or groundwater on a site may affect the suitability of the site for waste application. Land application of industrial waste may be allowed by the department in the 18-36" range.

   n. **Nutrient Management Plan (NMP):** Check the appropriate box to identify if the site is enrolled in a NMP per ch. ATCP 50, Wis. Adm. Code. The applicant is responsible for contacting other governmental agencies to determine if other NMP restrictions or requirements apply.

   o. **Conservation Reserve Program:** Check whether the site is enrolled in any agricultural programs. Explain if checked yes. The department does not determine if lands are enrolled in agricultural programs (i.e., CRP, ACR, etc.) or subject to local ordinances. Enrollment in certain programs may affect the suitability of a site for waste application.

   p. **Drain Tile:** Provide drain tile information. Installation or presence of drain tile may affect the suitability of a site for waste application. If drain tile is installed, include the depth of the tile in inches, and identify the tile outlet locations on an attached aerial photograph as part of the site request package.

6. **Waste Information.**
   a. **Waste(s) to be Land Applied:** Indicate waste type(s) to be applied to the site. If the waste type is not one of the descriptions provided, then check "Other" and describe the waste type in the space provided. Septage is waste from domestic holding tanks, septic tanks, portable restrooms, and sanitary grease interceptor waste. Sewage sludge is typically from domestic treatment works including when industrial wastewater is a component of the wastewater being treated. Sewage sludge may include industrial sludges containing domestic wastewaters. Industrial wastewater means liquid waste such as cheese production wash water, condensate of whey water, etc. Industrial sludges include the solid residue(s) from physical, chemical and biological processes which may also include industrial wastewater treatment systems. Pulp and paper mill sludge is separately listed. Byproduct solids, such as Food Processing Wastes, generally include solid or semi-solid wastes such as sweet corn cobs and husks, cabbage leaves and cores, potato peels, or paunch manure. Whey or permeates are the liquid byproducts from cheese production or any of its components such as lactose permeate. When a combination of wastes are land applied detail the combination under Other.

   b. **Septage:** Identify if site request is for a "high use" application. A high use field requires both a nutrient and morphological soil reports. Provide the intended typical (non-frozen and non-snow covered) and winter application rates.

   c. **Sewage Sludge:** If the sewage sludge applicant has been self-approved, then check Yes. Provide the "WDNR Self Approver Number." Nutrient soil test results must be submitted prior to land application.

   d. **Industrial Waste:** Provide the intended typical (non-frozen and non-snow covered) and winter land application rates.

7. **Approval/Acknowledgments Statements.**
   a. **Approval/Acknowledgement Section:** The Property Owner, Farmer, and Permittee/Licensee indicate their agreement in this section. Each completes their applicable section, prints their respective name in the spaces provided, and signs and dates the application. Incomplete applications may be rejected or returned.

8. **Site Request Preparer Information.**
   a. **Site Request Preparer Information:** Provide the contact information for the individual preparing the Land Application Site Request form.

   b. **Compliance with Site Requirements:** Verify all separation distances and other requirements as noted in the Tables on pages 4 and 5 of this form. If all applicable criteria are satisfied at this site then check Yes. If the requested site is unable to meet setback criteria, then check No. Explain the circumstances on a separate sheet of paper.

   c. **Preparer's Signature and Date:** Sign and date the form indicating the preparer has completed all information necessary for the site request package.

APPENDIX B
VISIONING SESSION 1

1

Madison Metropolitan Sewerage District

Task ‘B’ Workshop – Session 1

Biosolids Master Plan

May 28, 2020

2

Outline

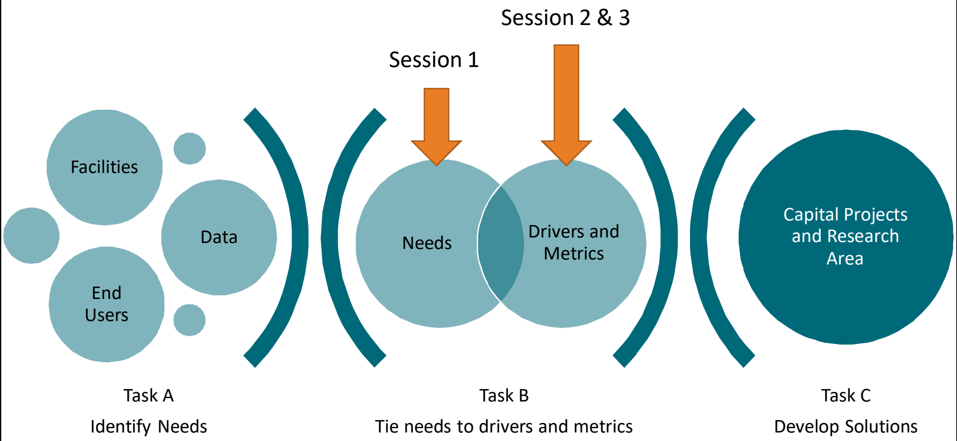
- **Madison MSD mission and goals**
- **Future regulatory**
  - Nutrient management - Andy Skwor
  - Emerging contaminants - Alyssa Sellwood
  - Class A requirements - Scott Carr
- **Distribution and End Use Drivers**
  - Review current limitations
  - Review Customer concerns and needs
  - Regional trends related to labor demand and availability
- **Data Management Drivers**
  - Importance of data management for biosolids application
  - Overview of current best practices
- **Discussion**

3

What are we trying to accomplish over the coming three sessions?

4

These sessions are critical to evaluation of improvements



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5

Part 1 | Greg Gunderson

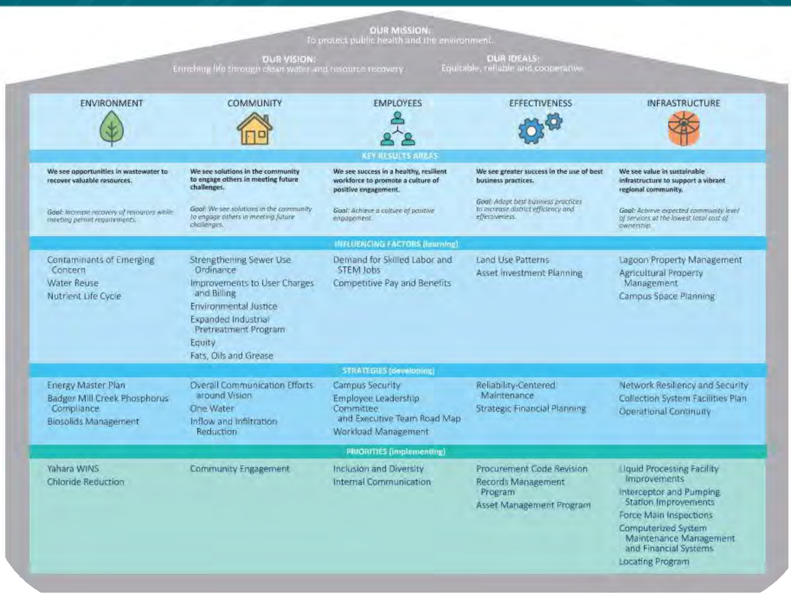
Madison MSD Mission and Goals

6

MMSD Mission & Goals

7

Madison MSD Mission & Goals



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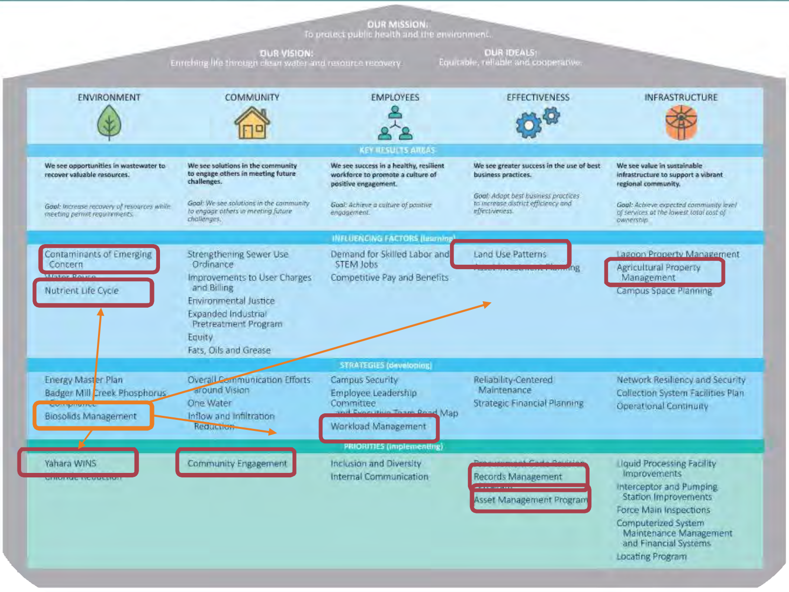
8

Madison MSD Mission & Goals

Influencing Factors (Learning)
Strategies (Developing)
Priorities (Implementing)



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9

MMSD Strategic Plan

- Opportunities & Risks
  - Emerging Contaminants
  - Nutrient Life Cycle
  - Land Use Patterns
  - Agricultural Property Management
- New Initiatives
  - Biosolids Management
  - Workload Management
- Implementing
  - Yahara WINS (Adaptive Management)
  - Community Engagement
  - Records & Asset Management
  - Solids Processing Facility Improvements?

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10

Biosolids Management Plan

Overall Project Goals

1. Determine what biosolids products are most desired by market in our area and region
2. Determine what biosolids processes are the easiest for MMSD to integrate into MMSD's current processes
3. Determine which biosolids processes are most complementary in creating resilient, value-added solutions to the District's resource recovery efforts

11

Biosolids Management Plan

Suggested Evaluation Criteria

1. Labor requirements
2. Process demands
3. Overall lifecycle costs
4. Product compatibility with customer existing infrastructure
5. Product compatibility with customers needs
6. Product transportation requirements
7. Product distribution requirements
8. Product distribution susceptibility to external factors
9. Overall desirability of the product with the current and potential future customer base.

12

Part 2 | Andy, Alyssa, and Scott

Future Regulatory Drivers

13

Nutrient Management

Andy Skwor

14

Nutrient Management

- Attractants to Program:
  - Yield Loss Guarantee (creating acres available)
  - Wheat Yield Guarantee (creating acres available)
  - Free nutrient and Free application
- Quality of Biosolids
  - Nitrogen vs. Phosphorus
  - Potash (Potassium) K_2O – need and high value
  - Questions regarding other chemicals in biosolids
  - Form/Consistency: Liquid vs. Solid
  - Uniformity

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15

Emerging Contaminants

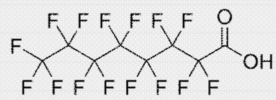
Alyssa Sellwood

16

Emerging Contaminants
Per- and Polyfluoroalkyl Substances (PFAS)

- Traction and Momentum
- Scientific Advancements
  - Toxicity
  - Fate and Transport
  - Treatment
  - Laboratory Methods
- New Regulations
  - State
    - Groundwater Standards
    - Other Media
  - Federal
    - Health Advisory Levels (now)
    - MCLs (future)

PFOA



PFOA - By Edgar181 - Public Domain

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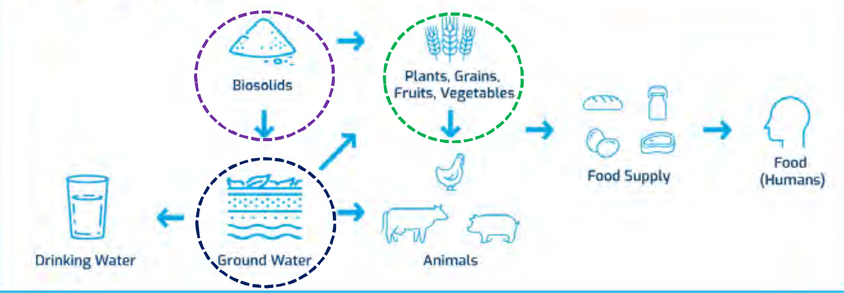
17

Emerging Contaminants
PFAS Uncertainty

Key Question:
What is the potential risk to human health and the environment from PFAS that may be in MMSD's biosolids?

Nine Springs Biosolids: Potential PFAS Fate and Transport



- PFAS Concentrations and Type?
- How PFAS and Local Geology, Climate, and Soil Interact?
- How PFAS Local Soil and Crop Types Interact?

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18

Emerging Contaminants
PFAS Regulatory Uncertainty

- How to Move Forward
  - Identify what we know
  - Specify major uncertainties
  - Take action

- District's Current Actions
  - WDNR PFAS Workgroups
  - PFAS Action Plan
  - Fate and Transport Report
  - Sampling and Analysis Plan
  - PFAS Testing

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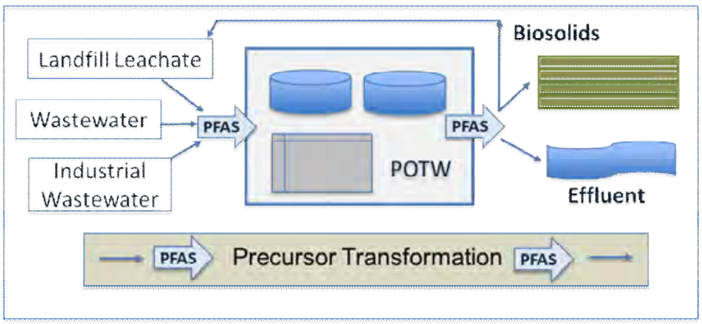
19

Emerging Contaminants
PFAS Fate and Transport – What we know

- PFAS transform, but do not degrade
- PFAS In ≤ PFAS Out at WWTP
- PFAS high when major source(s)



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20

Emerging Contaminants
PFAS Fate and Transport – Uncertainties for MMSD

UNCERTAINTY	ACTION
PFAS Levels at Nine Springs	• Sample Influent and Effluent
PFAS Transport to GW from Biosolids	• Continued Literature Review • Possible Testing
PFAS Uptake by Plants	• Continued Literature Review • Possible Testing
PFAS Reduction Needed?	• Identify Sources and Pretreatment • Track Technology Advancements • Track Regulations

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21

Emerging Contaminants
PFAS Regulations – What we know

- PFAS regulated at low levels (ng/L or ppt)
- States setting regulatory standards
  - Groundwater
  - Other Media (less common)
- Wisconsin Standards
  - Groundwater In Review
    - PFOA and PFOS: **SUMMER 2022**
    - 34 Other PFAS: **FALL 2023**
  - Soil NR 720 RCLs for PFOS, PFOA, PFBS
- Maine has screening levels for biosolids
  - GW pathway
  - Sites > Screening Levels

<u>ME Biosolids Screening Levels</u>
PFOS = 5,200 ng/kg (0.052 mg/kg)
PFOA = 2,500 ng/kg (0.025 mg/kg)
PFBS = 1,900,000 ng/kg (1.9 mg/kg)

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22

Emerging Contaminants
PFAS Regulations– Uncertainties for MMSD Biosolids

UNCERTAINTY	ACTION
PFAS GW Standards	• Participate in WDNR Workgroups • Track other States Progress
PFAS Biosolids Regulations	• Link back to F&T Research • Participate in WDNR Workgroups • Track other States

BOTTOM LINE:
- Groundwater standard is most likely to be first WI regulation
- Potential impact to groundwater from MMSD biosolids unknown
- Best way to reduce PFAS in biosolids = source reduction/pretreatment

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23

Class A Requirements
Scott Carr

24

Class A vs Class B Pathogen Reduction Requirements

PATHOGEN REDUCTION CLASS	NUMERIC LIMIT		PATHOGEN REDUCTION ALTERNATIVE
Class A	Fecal Coliform < 1,000 MPN/g TS or Salmonella <3 MPM/4 g TS	AND	• No. 1: time and temperature • No. 2: pH elevation • No. 3: numeric criteria, clean sludge • No. 4: numeric criteria, normal sludge • No. 5: PFRP(1) • No. 6: PFRP equivalent (2)
Class B(4)	Alt. No. 1: <2,000,000 MPN or CFU fecal coliform	OR	• No. 2: PSRP(3) • No. 3: PSRP equivalent(2)

Notes:
1. PFRP = Process to Further Reduce Pathogens: Composting, Heat Drying, Heat Treatment, Thermophilic Aerobic Digestion, Pasteurization, Irradiation
2. As designated by testing under direction/approval of EPA Pathogen Equivalency Committee
3. PSRP = Process to Substantially Reduce Pathogens: Aerobic digestion, air drying, anaerobic digestion, composting, lime stabilization
4. Class B applications subject to management practices (access, harvesting limits)

25 MSA

25

Importance of Physical Characteristics

Class A Cake Uses
- Bulk agriculture similar to liquid
- Metromix type materials

Class A "High Value" Product Uses
- Broad use as a fertilizer and soil amendment
- More appealing to users, similar to commercial products

26 MSA

26

General Target Markets

Potential Outlets	Digested Class B Cake	Digested Class A Cake	Dried Biosolids	Compost	Manufactured Soil
Agriculture	●	●	●	●	
Silviculture	●	●	●	●	
Sod Farms		●	●	●	●
Horticulture			●	●	●
Parks/Recreation			●	●	●
DOT				●	
Landscapers			●	●	●
Retail (garden centers)			●	●	●
Golf Courses			●	●	

27 MSA

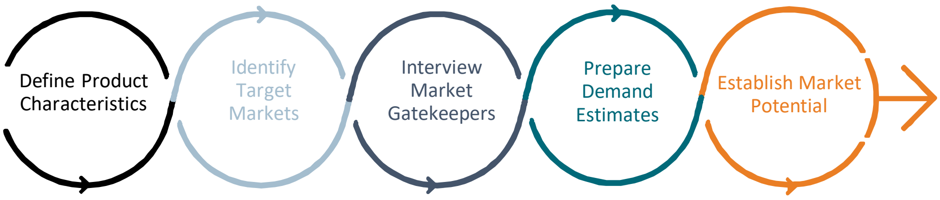
27

EXAMPLES FROM RECENT PROJECT

28

28

Today's Focus



Define Product Characteristics	Identify Target Markets	Interview Market Gatekeepers	Prepare Demand Estimates	Establish Market Potential
Product characteristics determine potential uses	Target markets reflect potential uses for each product	Interviews define market needs, limitations and preferences	Demand estimates are based upon both interviews and land use investigations	identify market potential for each product and further studies needed (if any)

MSA

29

Biosolids Products that Could be Considered

- Included:
  - Class A & B Digested Cake
  - Compost
  - Heat-dried Biosolids
  - Manufactured Soils

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30

Digested Cake Characteristics and Uses

- Class A or Class B (pathogen content)
  - Class B has access limitations
- "Clay-like" consistency
  - 20-30% solids content
- Requires manure spreaders
- Uses
  - Predominantly agriculture, some silviculture
  - New high solids, Class A products seeing limited use in community gardens

MSA

31

Heat-Dried Biosolids Characteristics and Uses

- Shape and physical characteristics driven by dryer type
  - Can range from hard pellets to "Cheetos"
- Solids content ~ 92-95%
- Applied to meet nitrogen requirements
- Pellets and uniform granules suitable for all types of fertilizer applications
- Non-uniform generally limited to agriculture, manufactured soil ingredient

MSA

32

Compost Characteristics and Uses




- Well known product with diverse applications
- Increasing use in agriculture
  - Assessing role in "carbon farming"
- Used alone or with sand/etc. as topdressing
- Application depths range from ¼" to 1" for most uses

33

Manufactured Soil Characteristics and Uses

- Components can include sand, sawdust, bark fines, etc.
- Mixes vary considerably
- Used for topdressing on turf or as soil replacement
- Biosolids programs
  - TAGRO (Tacoma) – decades of experience
  - Bloom (DC Water) – new, but building this market
- Facilities considering Class A digestion are generally interested in this potential product

34

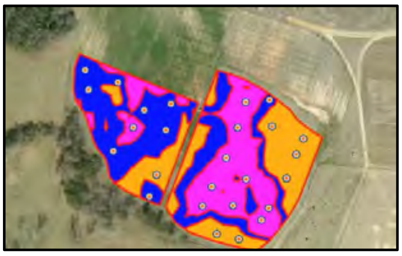
Part 3 | Andy Skwor

Distribution and end users

35

Application/Labor

- Good stewardship of staff
  - Maintains clients
  - NR 204 compliant
  - Distributes product
- Acceptable workload
  - Permanent vs contracted
  - Seasonal/shifts
  - Training needs
- Maximize operating efficiency
  - Gallons/Time vs Cost
- Risk of continued liquid application



MSA

36

Equipment

- Hauling Rates
  - Biosolid production, storage, and loading
- Current Inventory
  - Flexibility limitations
    - Product type
    - Seasonal/crop application
    - Chassis configuration
  - Limited hauling capacity

- Future Planning
  - Dependent on product selection
  - Dependent on agricultural practices
  - Maintenance practices
  - Additional space for equipment storage

MSA

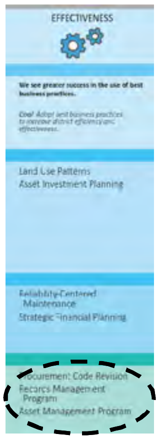
37

Part 4 | Amber Converse

Data management

38

Mission & Goals: Records and Asset Management



RECORDS MANAGEMENT PROGRAM

Project Leader: Amy Bublitz

Background: The District has established a formal records management program. The foundation of the program includes: (a) updated commission policies and administrative guidelines; (b) updated records management software; and (c) reorganized staff roles within IT. The program works on a collaborative team [redacted]

Goal: Continue developing the program, reflecting adopted commission policies and administrative guidelines. Prioritize workflow efforts for geographic information, human resources, engineering, and commission agenda management.

ASSET MANAGEMENT PROGRAM

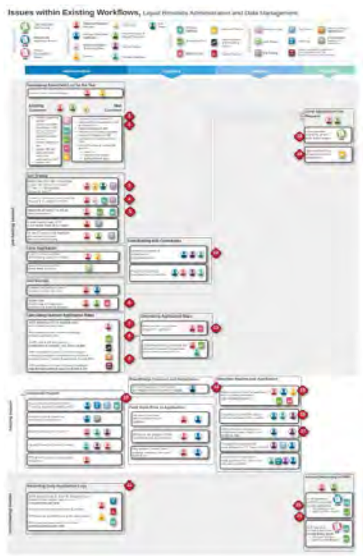
Project Leader: Seth McClure

Background: The District applies advanced asset management principles to several areas of work. Current emphasis is on maintaining quality asset data, implementing the new plant asset management plan, and adopting reliability-centered maintenance practices. The asset management program gives overall direction and support to these activities. The program is transitioning from a period of program development to [redacted]

Goal: Strengthen the asset management team and program in the ways identified above. Finalize the plant asset management plan. Support related initiatives, including the collection system facilities plan and computerized maintenance management system and financial systems.

39

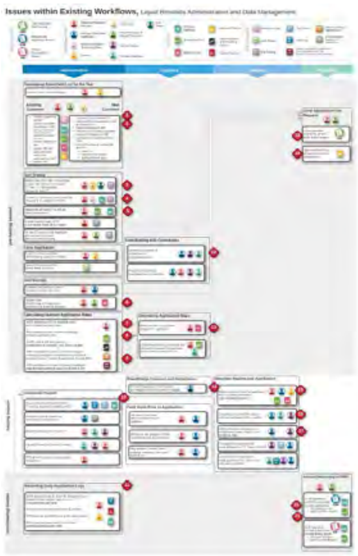
Metrogro Data Management: Issue Identification



- How do data management improvements fit into the overall evaluation?
  - Is it a ‘given’? Or does it need to be evaluated with the Triple Bottom Line?
- Records Management or Asset Management?
- Who else should be consulted within MMSD?
  Seth (asset management), Amy (records management), Mitch (GIS), and Drew (IT)
- Preliminary issue identification added to workflow diagram
  - Which metrics should drive the evaluation?

40

Possible Metrics for Evaluation

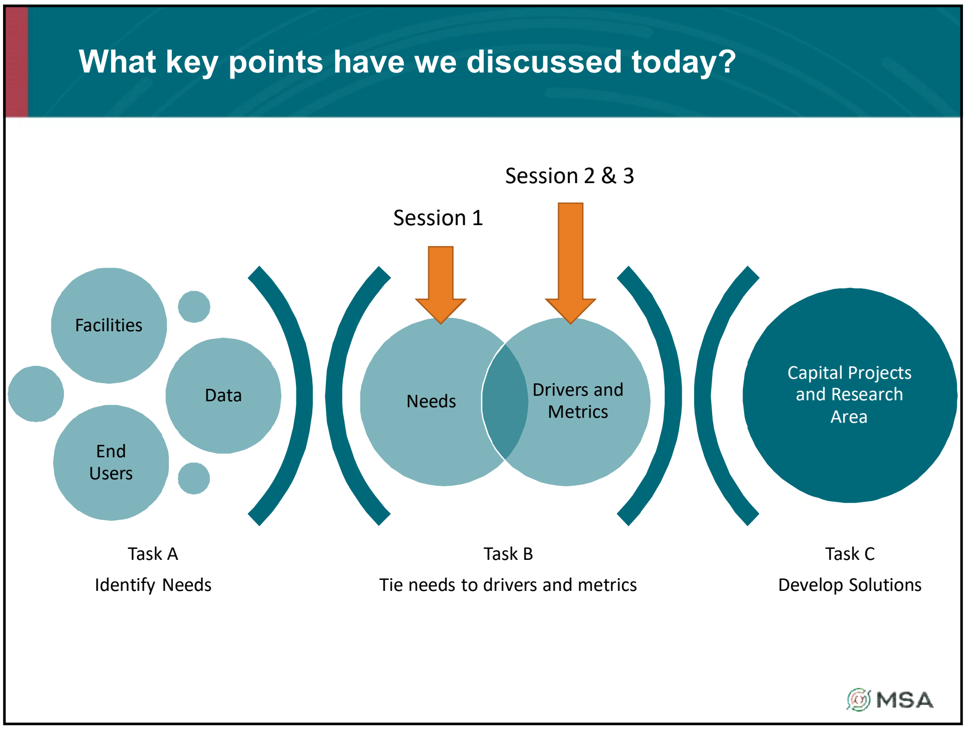


- Inefficient data entry
- Inefficient QA/QC of reporting outputs
- Delays in permitting
- Less time available to RRM and MOS to optimize hauling plan
- Less time available to RRM for strategic planning
- Data redundancy

41

What are the next steps for the biosolids plan?

42



43

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BLACK & VEATCH

44

APPENDIX C
VISIONING SESSION 2

MSA

BLACK & VEATCH

1

Madison Metropolitan Sewerage District

Task ‘B’ Workshop – Session 2

Biosolids Master Plan

May 30, 2020

MSA BLACK & VEATCH

2

Outline

- Review of Project Goals & Drivers
- Future regulatory discussion summary
- Distribution and End Use Drivers
  - Review current limitations
  - Review Customer concerns and needs
  - Regional trends related to labor demand and availability
- Data Management Drivers
  - Importance of data management for biosolids application
  - Overview of current best practices
- How do we develop metrics for our evaluations?

3

Biosolids Management Plan

Overall Project Goals

1. Determine what biosolids products are most desired by market in our area and region
2. Determine what biosolids processes are the easiest for MMSD to integrate into MMSD's current processes
3. Determine which biosolids processes are most complementary in creating resilient, value-added solutions to the District's resource recovery efforts

metrogro

Madison Metropolitan Sewerage District

MSA

4

Biosolids Management Plan

Driver	Type of Driver		Address within 3-5 years?
	Regulatory	End Use	
Nutrient Management	●	●	>5
Emerging Contaminants	●	●	3-5+
Hauling/Application		●	3-5+
Climate Change	●		3-5+
Marketability		●	>5
Labor Cost and Availability	●		<3

MSA

5

Part 1 | Leon Downing

Future Regulatory Drivers Summary

6

What are the key points from Session 1?

- Nutrient management:
  - Focus on optimizing nutrient balance within the wastewater treatment plant
  - How do processes change mass of nutrients per wet ton of biosolids (quantify N-P-K)
  - Position for future end product development
  - Potential for test plots to re-prove nutrient/soil amendment value
- Emerging contaminants:
  - Focus on monitoring and source elimination
  - Limited technology differentiation
  - Position for future
- Class A
  - Class A versus Class B cake will be evaluated as compared to Class B liquid

MSA

7

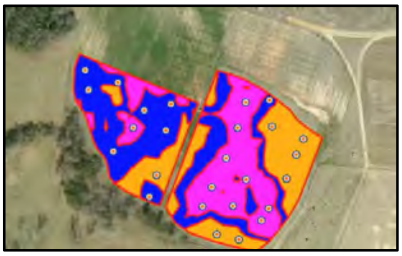
Part 2 | Andy Skwor

Distribution and end users

8

Application/Labor

- Good stewardship of staff
  - Maintains clients
  - NR 204 compliant
  - Distributes product
- Acceptable workload
  - Permanent vs contracted
  - Seasonal/shifts
  - Training needs
- Maximize operating efficiency
  - Gallons/Time vs Cost
- Risk of continued liquid application



MSA

9

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MSA

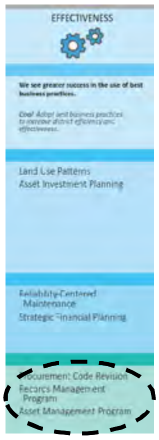
10

Part 3 | Amber Converse

Data management

11

Mission & Goals: Records and Asset Management



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12

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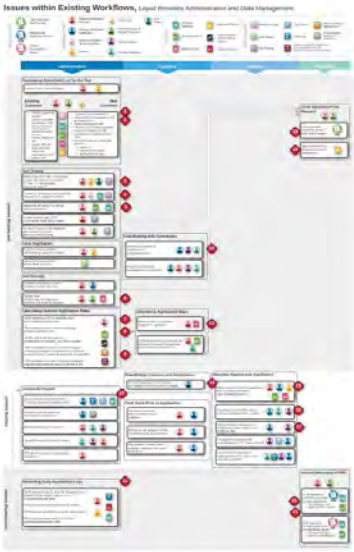

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13

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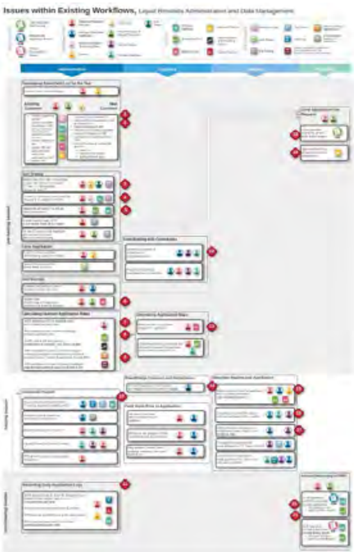


- Inefficient data entry
- Inefficient QA/QC of reporting outputs
- Delays in permitting
- Less time available to RRM and MOS to optimize hauling plan
- Less time available to RRM for strategic planning
- Data redundancy

14

Part 4 | Greg and Leon

Evaluation Metrics

15

Drivers can be tied to strategic plan categories

Driver	Type of Driver		Madison MSD Strategic Plan Categories
	Regulatory	End Use	
Nutrient Management	●	●	Influencing Factors
Emerging Contaminants	●	●	Influencing Factors
Hauling/Application		●	Strategies
Climate Change	●		Strategies
Marketability	●	●	Strategies
Labor Cost and Availability	●		Priorities

16

How will alternatives fit into strategic plan categories?

- Influencing Factors (Long term)
  - Develop test plots for yield
  - Pilot testing of technologies
- Strategies (near/mid term)
  - Different thickening/dewatering
  - New/expanded infrastructure
  - New products
- Priorities (near term)
  - Administrative/data improvements

MSA

17

Goal is to consolidate many ideas into a workable approach

Current Sources

Consolidated Approach

MSA

18

Developing a triple bottom line style approach

Preliminary Evaluation Criteria

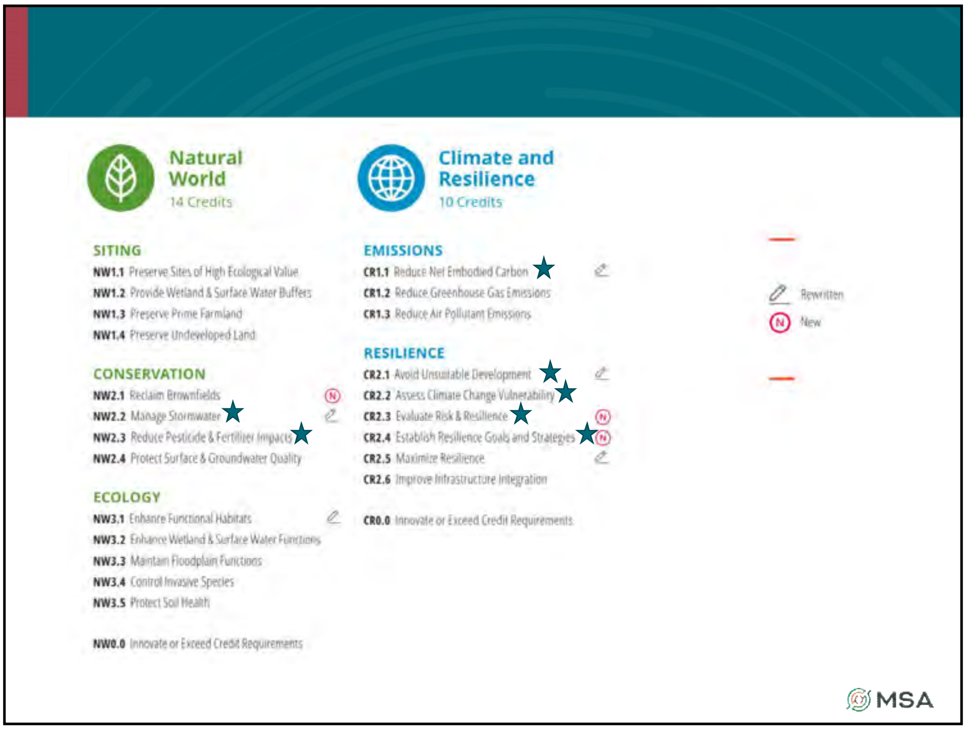
A. Monetary
   1. Labor requirements
   2. Process demands (energy/chemical costs)
   3. Capital costs
   4. Overall lifecycle costs (capital, operating, maintenance, transportation)

B. Non-monetary
   1. Product compatibility with customer existing infrastructure
   2. Product compatibility with customers needs
   3. Product transportation requirements
   4. Product distribution requirements
   5. Product distribution susceptibility to external factors
   6. Overall desirability of the product with the current and potential future customer base.

19

How do we incorporate Envision into planning for non-monetary criteria?

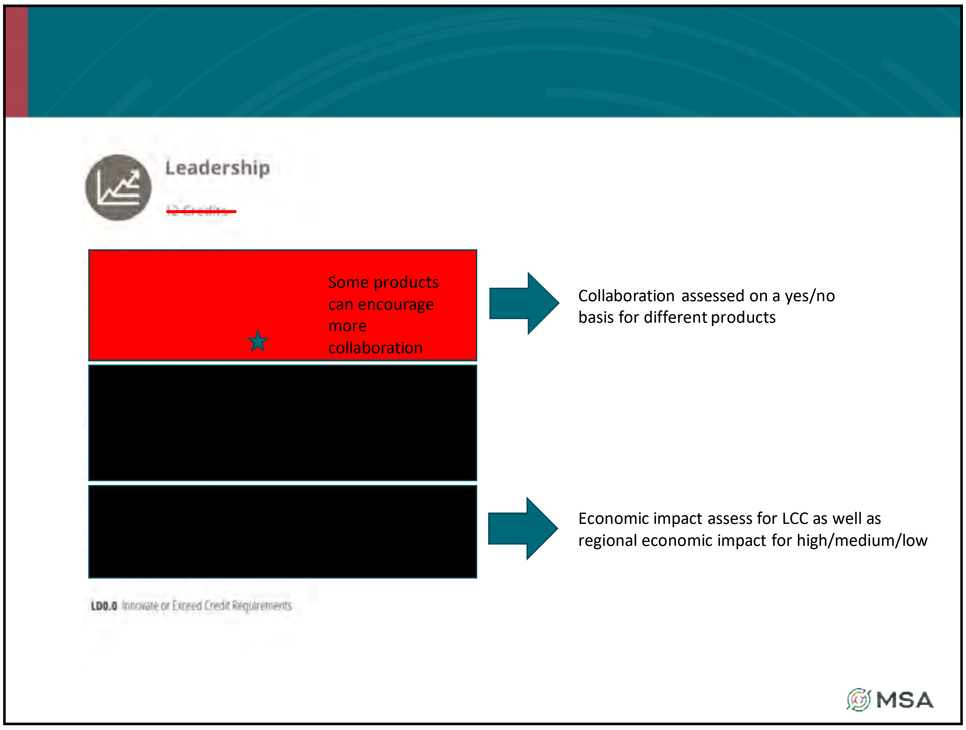
20


Natural World
14 Credits
SITING
NW1.1 Preserve Sites of High Ecological Value
NW1.2 Provide Wetland & Surface Water Buffers
NW1.3 Preserve Prime Farmland
NW1.4 Preserve Undeveloped Land
CONSERVATION
NW2.1 Reclaim Brownfields
NW2.2 Manage Stormwater
NW2.3 Reduce Pesticide & Fertilizer Impacts
NW2.4 Protect Surface & Groundwater Quality
ECOLOGY
NW3.1 Enhance Functional Habitats
NW3.2 Enhance Wetland & Surface Water Functions
NW3.3 Maintain Floodplain Functions
NW3.4 Control Invasive Species
NW3.5 Protect Soil Health
NW0.0 Innovate or Exceed Credit Requirements
Climate and Resilience
10 Credits
EMISSIONS
CR1.1 Reduce Net Embodied Carbon
CR1.2 Reduce Greenhouse Gas Emissions
CR1.3 Reduce Air Pollutant Emissions
RESILIENCE
CR2.1 Avoid Unsuitable Development
CR2.2 Assess Climate Change Vulnerability
CR2.3 Evaluate Risk & Resilience
CR2.4 Establish Resilience Goals and Strategies
CR2.5 Maximize Resilience
CR2.6 Improve Infrastructure Integration
CR0.0 Innovate or Exceed Credit Requirements
Rewritten
New
MSA

21


Quality Of Life
~~14 Credits~~
Differences tied to number of trucks and hauling
Community wellbeing impact of high/medium/low tied to truck traffic
Moderate to no differences for alternatives
[redacted]
QL0.0 Innovate or Exceed Credit Requirements
MSA

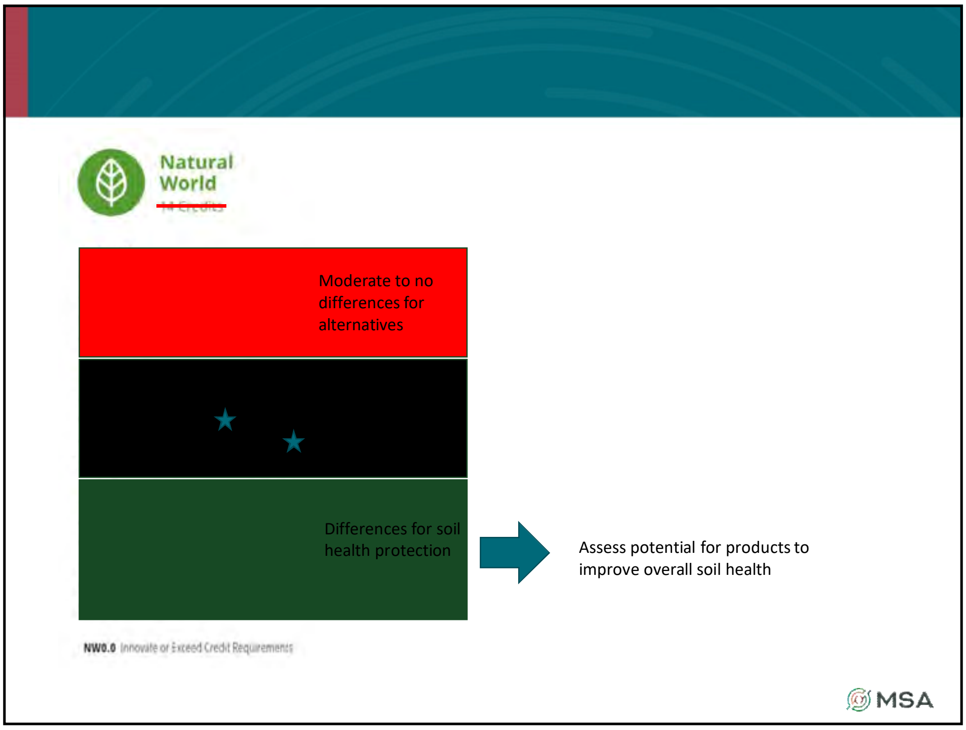
22


Leadership
~~12 Credits~~
Some products can encourage more collaboration
[redacted]
Collaboration assessed on a yes/no basis for different products
Economic impact assess for LCC as well as regional economic impact for high/medium/low
LD0.0 Innovate or Exceed Credit Requirements
MSA

23


Resource Allocation
~~14 Credits~~
Moderate to no differences for alternatives
Operational cost differences
[redacted]
Directing operating cost comparison (energy, chemicals, fuel)
RA0.0 Innovate or Exceed Credit Requirements
MSA

24


Natural
World
Moderate to no
differences for
alternatives
Differences for soil
health protection
Assess potential for products to
improve overall soil health
NW0.0 Innovate or Exceed Credit Requirements
MSA

25


Climate and
Resilience
GHG and air
emissions
impacted
Resilience and risk
comparison to
climate change
and staffing
Hauling and land application
requirements comparison
Hauling and land application
requirements comparison
CR0.0 Innovate or Exceed Credit Requirements
MSA

26

Assessment of Envision categories with simple matrix

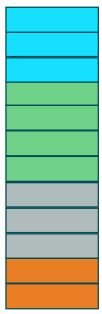
Envision Category Impacted?	Decrease in truck traffic?	Decrease in hauling days?	End-product provides regional collaboration opportunities?	LCC within 15% of lowest value?	Operational cost within 15% of lowest value?	Product improves soil health management opportunities?	Processing provides resilience to changing regulations?
Quality of Life – Wellbeing							
Leadership – Collaboration							
Leadership - Economy							
Resource Allocation – Energy							
Natural World - Ecology							
Climate and Resilience – Emissions							
Climate and Resilience – Resilience							

MSA

27

Unnamed Example 1

Envision Category Impacted?	Decrease in truck traffic?	Decrease in hauling days?	End-product provides regional collaboration opportunities?	LCC within 15% of lowest value?	Operational cost within 15% of lowest value?	Product improves soil health management opportunities?	Processing provides resilience to changing regulations?
Quality of Life – Wellbeing	Yes	Yes					
Leadership – Collaboration			Yes			Yes	
Leadership - Economy					Yes		
Resource Allocation – Energy							
Natural World - Ecology	Yes	Yes	Yes			Yes	
Climate and Resilience – Emissions	Yes	Yes					
Climate and Resilience – Resilience							Yes



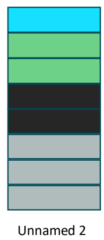
Unnamed 1

MSA

28

Unnamed Example 2

Envision Category Impacted?	Decrease in truck traffic?	Decrease in hauling days?	End-product provides regional collaboration opportunities?	LCC within 15% of lowest value?	Operational cost within 15% of lowest value?	Product improves soil health management opportunities?	Processing provides resilience to changing regulations?
Quality of Life – Wellbeing							
Leadership – Collaboration						Yes	
Leadership - Economy				Yes	Yes		
Resource Allocation – Energy				Yes	Yes		
Natural World - Ecology			Yes			Yes	
Climate and Resilience – Emissions							
Climate and Resilience – Resilience							Yes



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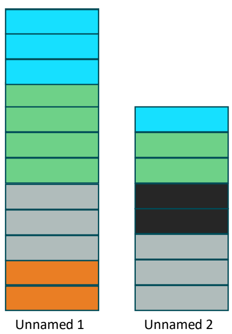
29

Simplifying questions allows for rapid comparison of key criteria to supplement economics

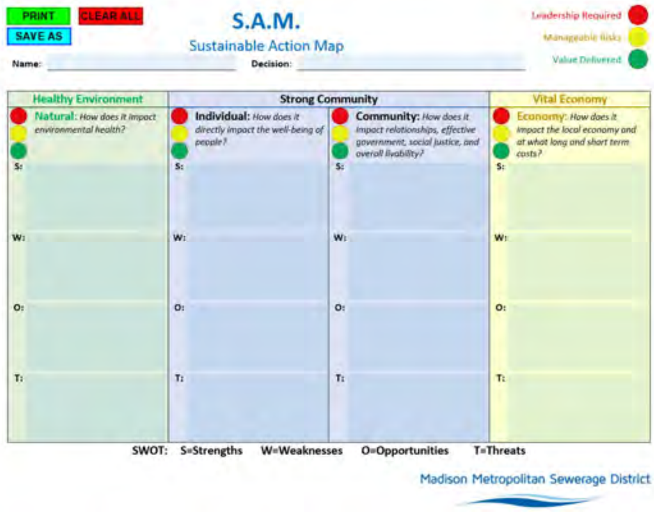


- Quick comparison of how alternatives "stack up"
- Larger stack, more positives
- Understand sustainability versus pure economics quickly

MSA

30

Where does the MMSD SAM fit into biosolids planning?



How do these categories relate to biosolids management?

Identification of SWOT items for each alternative

MSA

31

What are the next steps for the biosolids plan?

32

Alternative evaluation will vary depending on category

- Strategic plan category
  - Influencing factors projects: Applied Research Plan
  - Strategies: Applied Research Plan + Infrastructure
  - Priorities: Infrastructure + Administration/Workforce
- Infrastructure/administrative/workforce projects
  - Monetary assessments of infrastructure alternatives
  - Non-monetary assessment using Envision as a guide

MSA

33

MSA

BLACK & VEATCH

34

APPENDIX D
VISIONING SESSION 3

1

Madison Metropolitan Sewerage District

Task ‘B’ Workshop – Session 3

Biosolids Management Plan

June 3, 2020

6/3/2020 MSA; Black & Veatch

2

Biosolids Management Plan

Overall Project Goals

1. Determine what biosolids products are most desired by market in our area and region
2. Determine what biosolids processes are the easiest for MMSD to integrate into MMSD's current processes
3. Determine which biosolids processes are most complementary in creating resilient, value-added solutions to the District's resource recovery efforts

metrogro

Madison Metropolitan Sewerage District

6/3/2020 MSA; Black & Veatch MSA

3

Outline

- Review evaluation metrics
- Biosolids handling brainstorming

6/3/2020 MSA; Black & Veatch

4

Part 1 | Greg and Leon

Evaluation Metrics

6/3/2020 MSA; Black & Veatch

5

Drivers can be tied to strategic plan categories

Driver	Type of Driver		Madison MSD Strategic Plan Categories
	Regulatory	End Use	
Nutrient Management	●	●	Influencing Factors
Emerging Contaminants	●	●	Influencing Factors
Hauling/Application		●	Strategies
Climate Change	●		Strategies
Marketability	●	●	Strategies
Labor Cost and Availability	●		Priorities
Aging Infrastructure	●	●	Priorities

6/3/2020 MSA; Black & Veatch

6

How will alternatives fit into strategic plan categories?

- Influencing Factors (Long term)
  - Investigation and research projects
- Strategies (near/mid term)
  - New technologies and processing/handling approaches
- Priorities (near term)
  - Administrative/data improvements

6/3/2020 MSA; Black & Veatch MSA

7

Goal is to consolidate many ideas into a workable approach

Current Sources

Consolidated Approach

6/3/2020 MSA; Black & Veatch MSA

8

Preliminary matrix was presented for "yes/no" evaluation based on drivers and Envision

Envision Category Impacted?	Decrease in truck traffic?	Decrease in hauling days?	End-product provides regional collaboration opportunities?	LCC within 15% of lowest value?	Operational cost within 15% of lowest value?	Product improves soil health management opportunities?	Processing provides resilience to changing regulations?
Quality of Life – Wellbeing							
Leadership – Collaboration							
Leadership - Economy							
Resource Allocation – Energy							
Natural World - Ecology							
Climate and Resilience – Emissions							
Climate and Resilience – Resilience							

6/3/2020 MSA; Black & Veatch MSA

9

Additional comments from the District

- #1
- Similar to the category for "provides resilience to changing regulations", how about a category for "Approach limits spending on single-use assets with low salvage value"?
- By "single-use asset" I mean things that we can't use for anything else. An applicator is single use, a van isn't. And by "low salvage value", I mean that we won't get much money if we try to resell it.
- Basically, this question is to identify options where we're not spending a lot of money locking ourselves in to a single approach.
- There's got to be a better way to say it, but the only option I can think of is the technical ag econ term "asset fixity".
-
- #2
- How about a category to get at organizational impacts beyond metrogro. Maybe "Approach limits business process adjustments needed from other units of the district"?
- Should we have a similar questions around business process adjustments within metrogro itself?

- #3
- A category for environmental impacts beyond soil health? Things like runoff risk, contaminants of emerging concern, etc.
- Or maybe this is captured in regulatory flexibility?

- #4
- Thinking about scoring and presenting the comparative results in a simple to communicate waywould a low/medium/high be just as easy yet more informative than true/false? (trichotomy vs a dichotomy?)

6/3/2020 MSA; Black & Veatch MSA

10

Additional comments from the District

- Include two specific Envision categories
  - NW 2.4, Protect Surface and Groundwater Quality
  - NW 3.5, Protect Soil Health
- Energy plan example for weighting

In Clear Cells, Indicate How Much More or Less Important Each Criterion is Between Each Pair.
(1-5 for More Important; 1/2-1/5 for Less Important)

	PRELIMINARY								
Criteria	Improve Reliability/Resiliency	Address Aging Infrastructure	Costs	Regulatory/Legal Flexibility	Technological Flexibility	Strategic Value	Increase Use of Renewable Energy	Score	Relative Weights
Improve Reliability/Resiliency	1	1.00	3.00	3.00	4.00	3.00	4.00	19.0	23.6%
Address Aging Infrastructure	1.00	1	3.00	3.00	4.00	3.00	4.00	19.0	23.6%
Costs	0.33	0.33	1	2.00	3.00	3.00	4.00	13.7	17.0%
Regulatory/Legal Flexibility	0.33	0.33	0.50	1	3.00	3.00	4.00	12.2	15.1%
Technological Flexibility	0.25	0.25	0.33	0.33	1	2.00	4.00	8.2	10.2%
Strategic Value	0.33	0.33	0.33	0.33	0.50	1	3.00	5.8	7.3%
Increase Use of Renewable Energy	0.25	0.25	0.25	0.25	0.25	0.33	1	2.6	3.2%
Total								80	100%

6/3/2020 MSA; Black & Veatch MSA

11

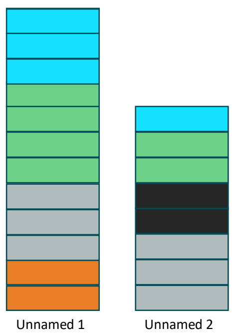
Adjusted matrix based on District comments

Envision Category Impacted?	Decrease in truck traffic?	Decrease in hauling days?	End-product provides regional collaboration opportunities?	LCC within 15% of lowest value?	Operational cost within 15% of lowest value?	Product improves soil health management opportunities?	Processing provides resilience to changing regulations?	Approach limits spending on single-use assets with low salvage value?	Approach limits business process adjustments needed from other units of the district?
Quality of Life – Wellbeing									
Leadership – Collaboration									
Leadership - Economy									
Resource Allocation – Energy									
Natural World - Ecology									
Natural World - Protect Surface and Groundwater Quality									
Natural World - Protect Soil Health									
Climate and Resilience – Emissions									
Climate and Resilience – Resilience									

6/3/2020 MSA; Black & Veatch MSA

12

Simplifying questions allows for rapid comparison of key criteria to supplement economics



- Quick comparison of how alternatives “stack up”
- Larger stack, more positives
- Understand sustainability versus pure economics quickly

6/3/2020 MSA; Black & Veatch MSA

13

Part 2 | Scott Carr

Biosolids Alternatives

6/3/2020 MSA; Black & Veatch

14

What are the next steps for the biosolids plan?

6/3/2020 MSA; Black & Veatch

15

Schedule and deliverables

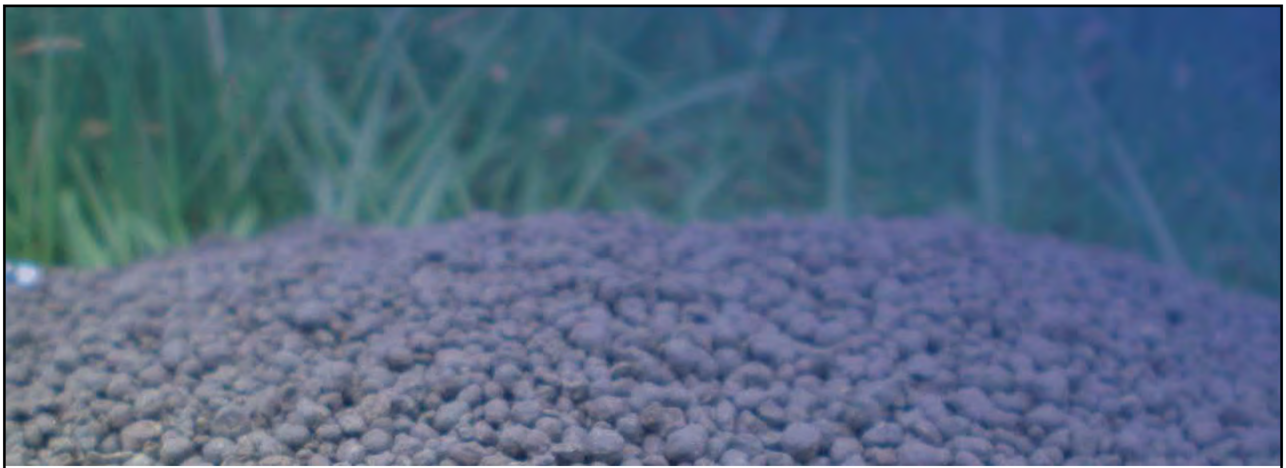
6/3/2020 MSA; Black & Veatch MSA

16

MSA

BLACK & VEATCH

17



Biosolids Processing

BUILDING A WORLD OF DIFFERENCE®

BLACK & VEATCH

1

Mass Balance

Part I: What would it take to keep 'er moving?

Part II: How much would it cost to dewater solids?

Part IIII: What would you do with a dewatered product?

Thickened → Dewatering → ???

38 dtpd
667 wtpd @ 5.7% TS
~9,730 loads/yr

38 dtpd
185 wtpd @ 20.5% TS
~3,380 loads/yr

2

Matrix

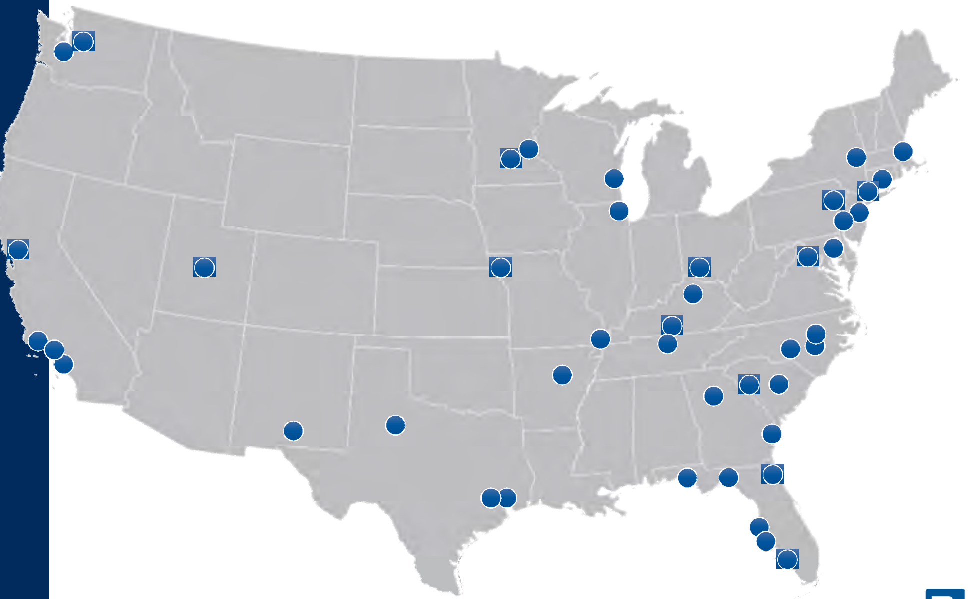
3

Thermal Drying

4

4

Broad Range of Sizes and Locations



5

5

Safety

Typical Concerns

- Fire in process or storage
- Dust explosions

Methods of Addressing Risk

- Extensive monitoring
  - CO_2
  - Temperature (cool product & monitor)
- Controlling O_2 level in atmosphere
- N gas inertion systems
- Automated quench systems
- Regimented startup/shutdown procedures

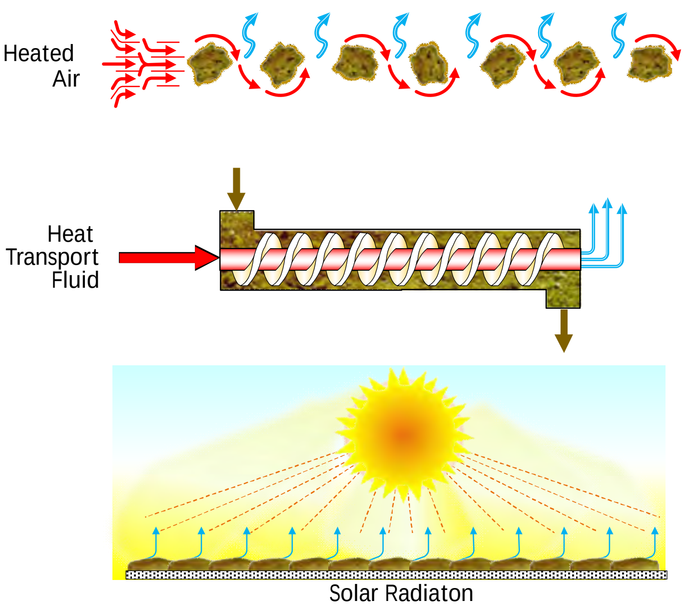
6

System Configurations

7

7

- Direct (Convection)
  - Rotary Drums
  - Belt
- Indirect (Conduction)
  - Paddle
  - Disk
- Solar

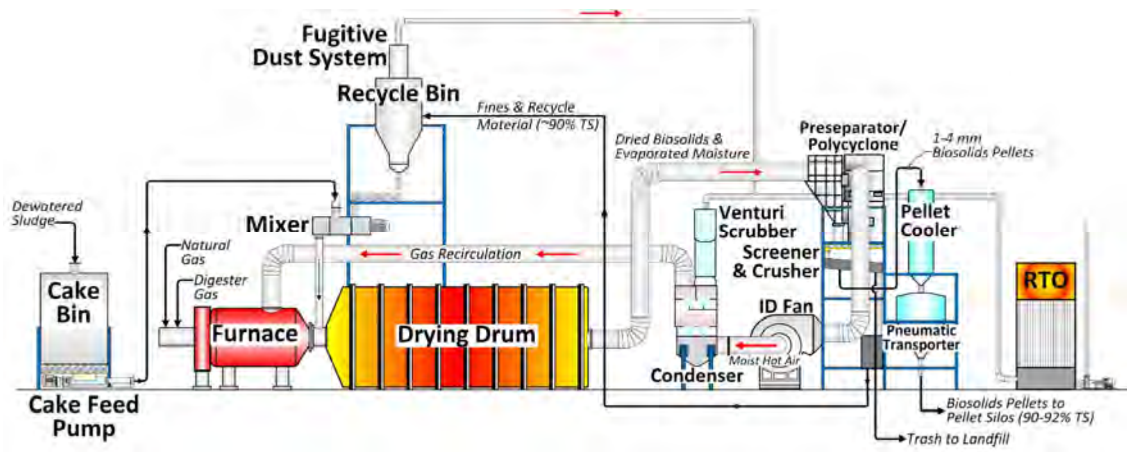


8

Dried Products

9

Rotary Drum Dryer

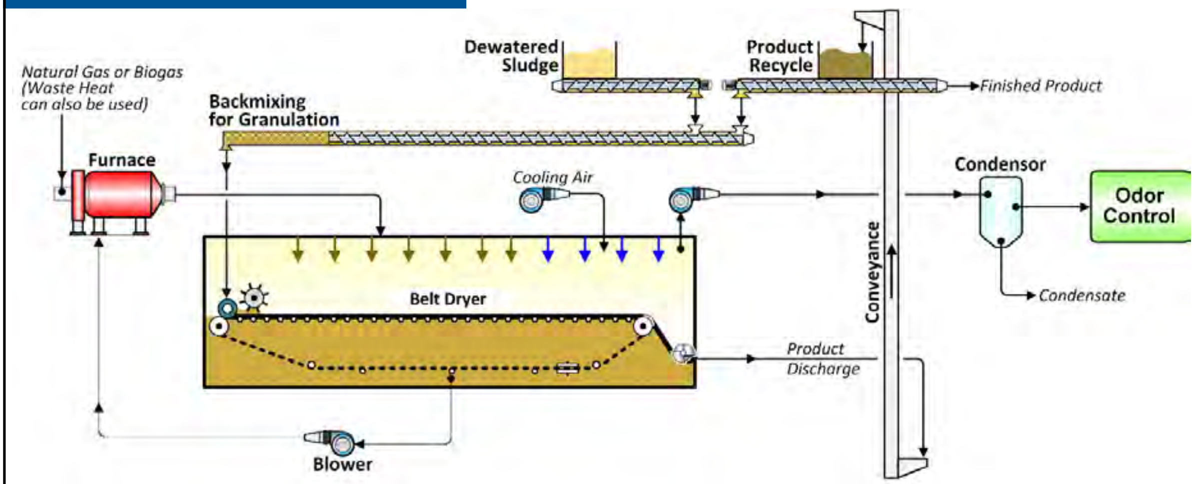


10

Rotary Drum Dryer

11

Belt Dryer Dryer

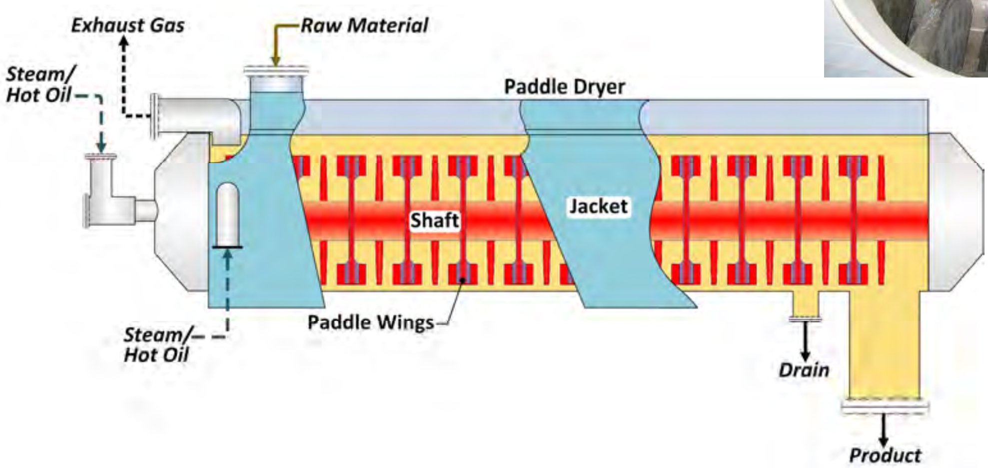


12

Belt Dryer

13

Paddle Dryer



14

Paddle Dryer

15

Compost

16

16

Compost

- Technologies
  - Aerated Static Pile
  - Windrows
  - In-vessel
- Trends:
  - Limited growth
  - Site specific drivers
  - Odor containment and control is essential

Black & Veatch

17

Amendment/Bulking Agent

Purpose

- Improve porosity for aerobic conditions
- Provide carbon for C:N
- ~3 parts amendment to 1 part biosolids (volume)

18

Aerated Static Pile

19

Aerated Static Pile

20

Aerated Static Pile

21

Aerated Static Pile

22

Windrow

23

Windrow

24

Agitated Bed System

Black & Veatch

25

Agitated Bed System

Black & Veatch

26

Solar Drying

27

Solar Drying

28

Solar Drying

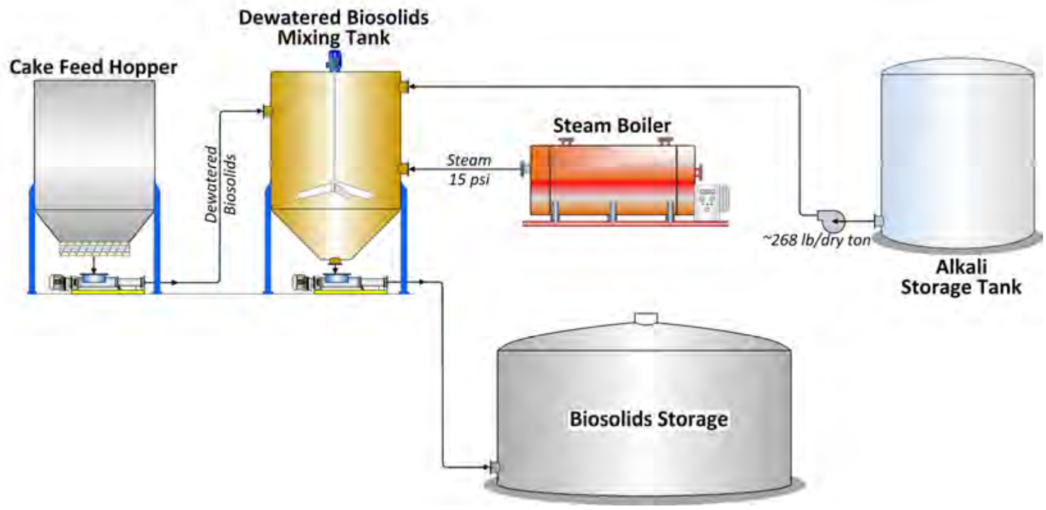
29

Lystek

30

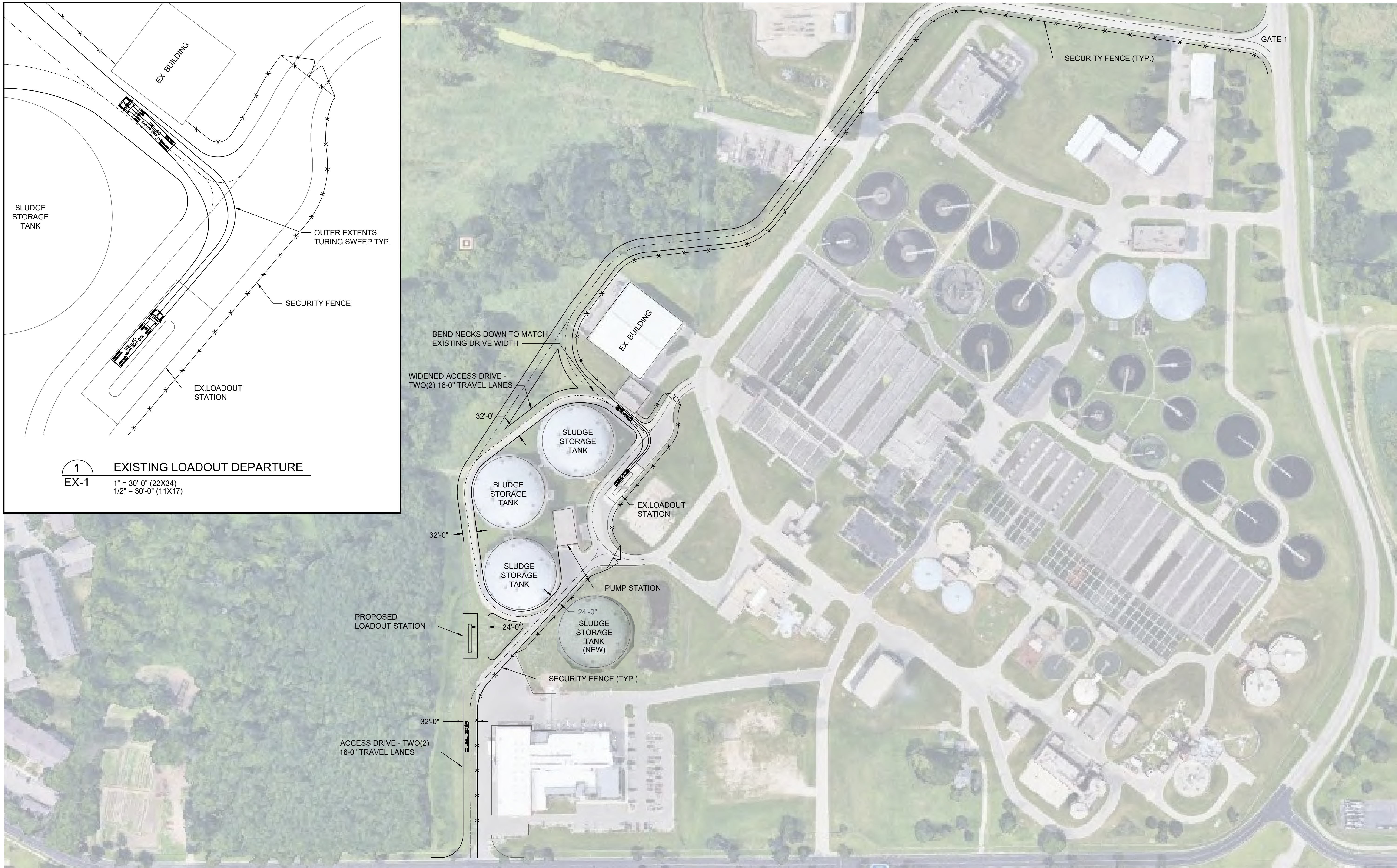
30

Lystek


Dewatered Biosolids
Mixing Tank
Cake Feed Hopper
Dewatered Biosolids
Steam
15 psi
Steam Boiler
~268 lb/dry ton
Alkali
Storage Tank
Biosolids Storage

31

APPENDIX E
PROPOSED ALTERNATIVE SITE LAYOUTS



0 100 200

1" = 100'-0" (22X34)
1/2" = 100'-0" (11X17)

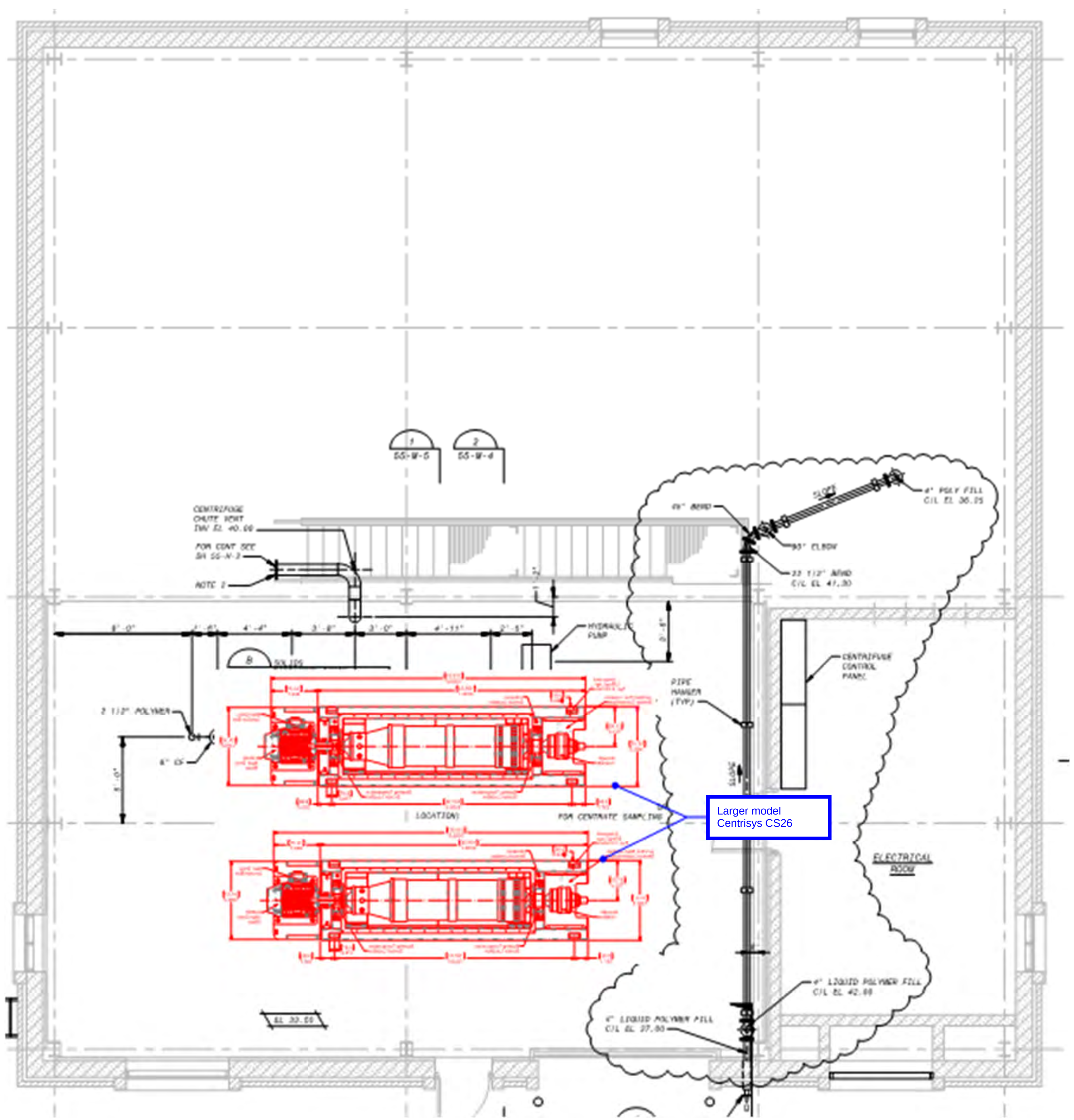
BIOSOLIDS LOADOUT IMPROVEMENTS
MADISON METROPOLITAN SEWERAGE DISTRICT
DANE COUNTY, WI

MSA
ENGINEERING | ARCHITECTURE | SURVEYING
FUNDING | PLANNING | ENVIRONMENTAL
1702 Pankratz St Madison, WI 53704
(608) 242-7779 www.msa-ps.com

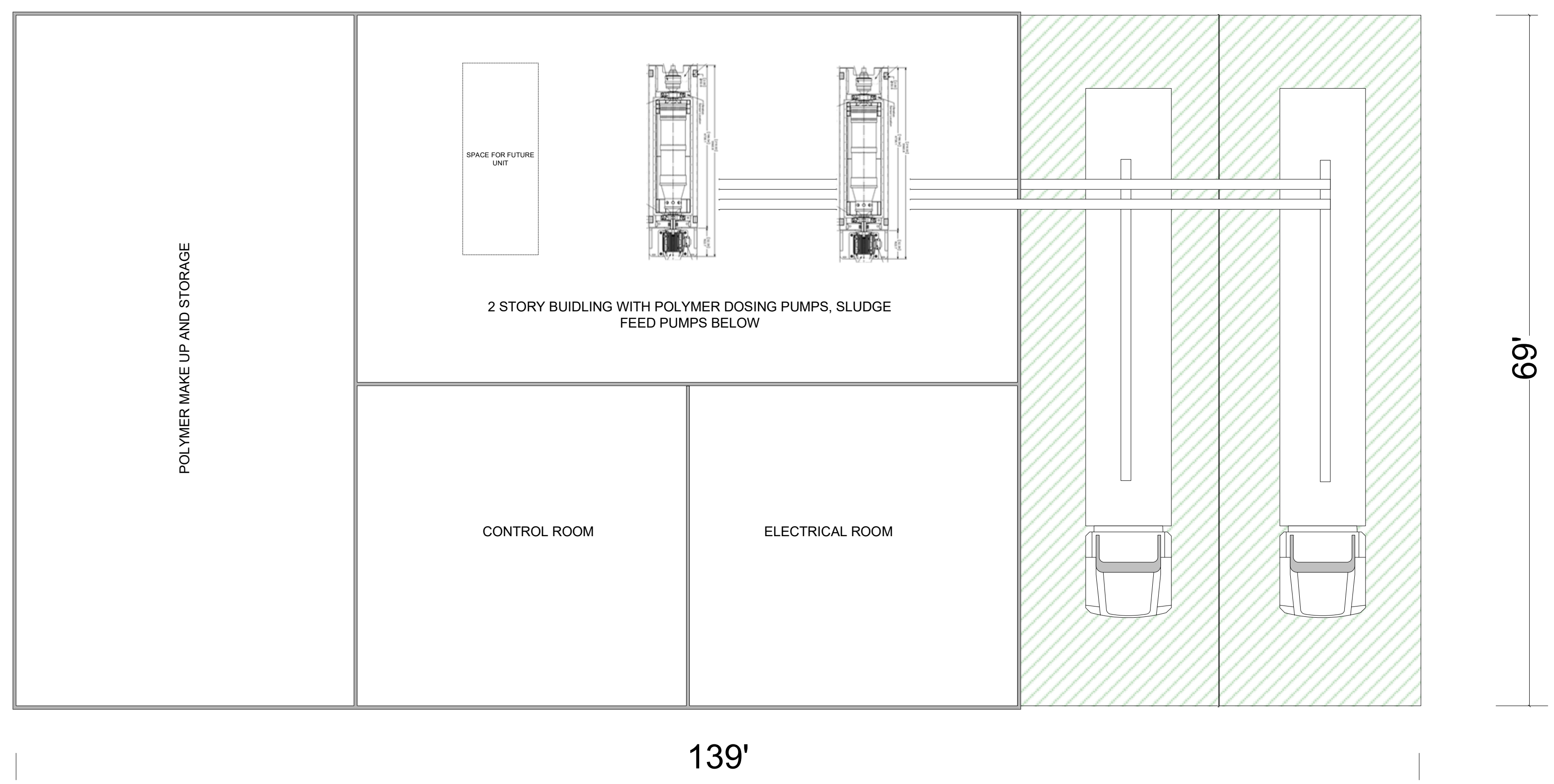
PLOT DATE: Friday, December 4, 2020 2:37:29 PM, P:\1500s\1570s\1579\01579025\CADD\Construction Documents\Sludge Loadout Improvements\MMSD_Biosolids Sludge Loadout Improvements.dwg

01579025

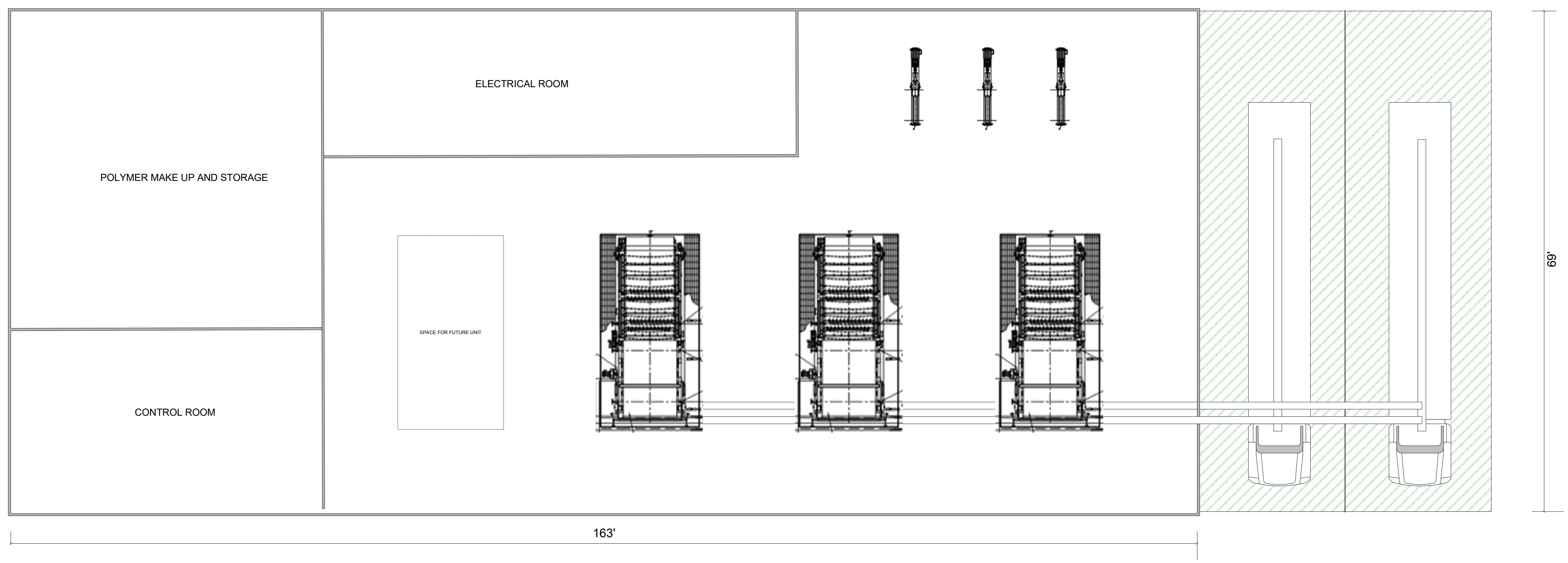
Alternative B2 – New Centrifuges in Existing Building



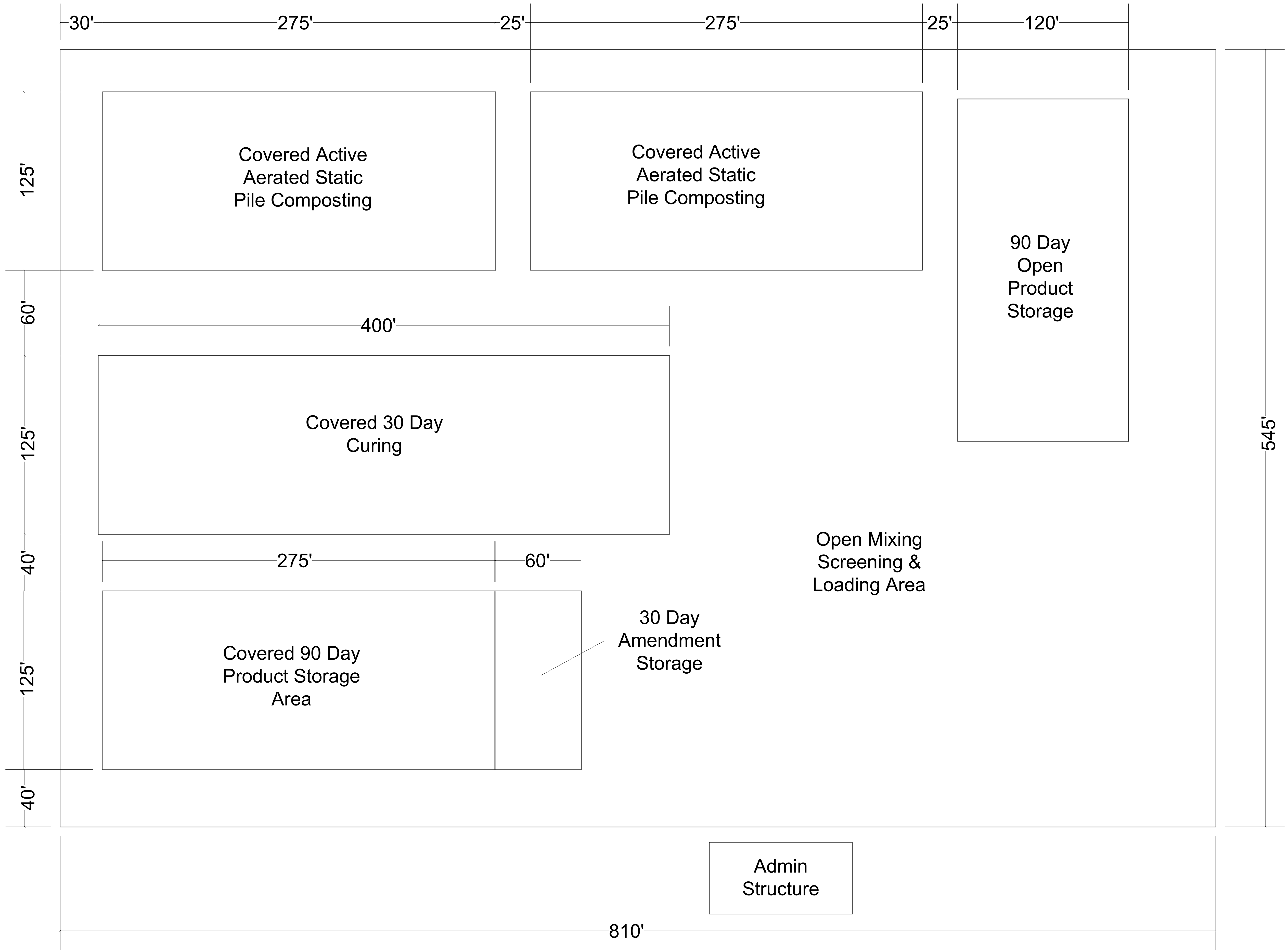
Alternative B3 – Centrifuges in New Building



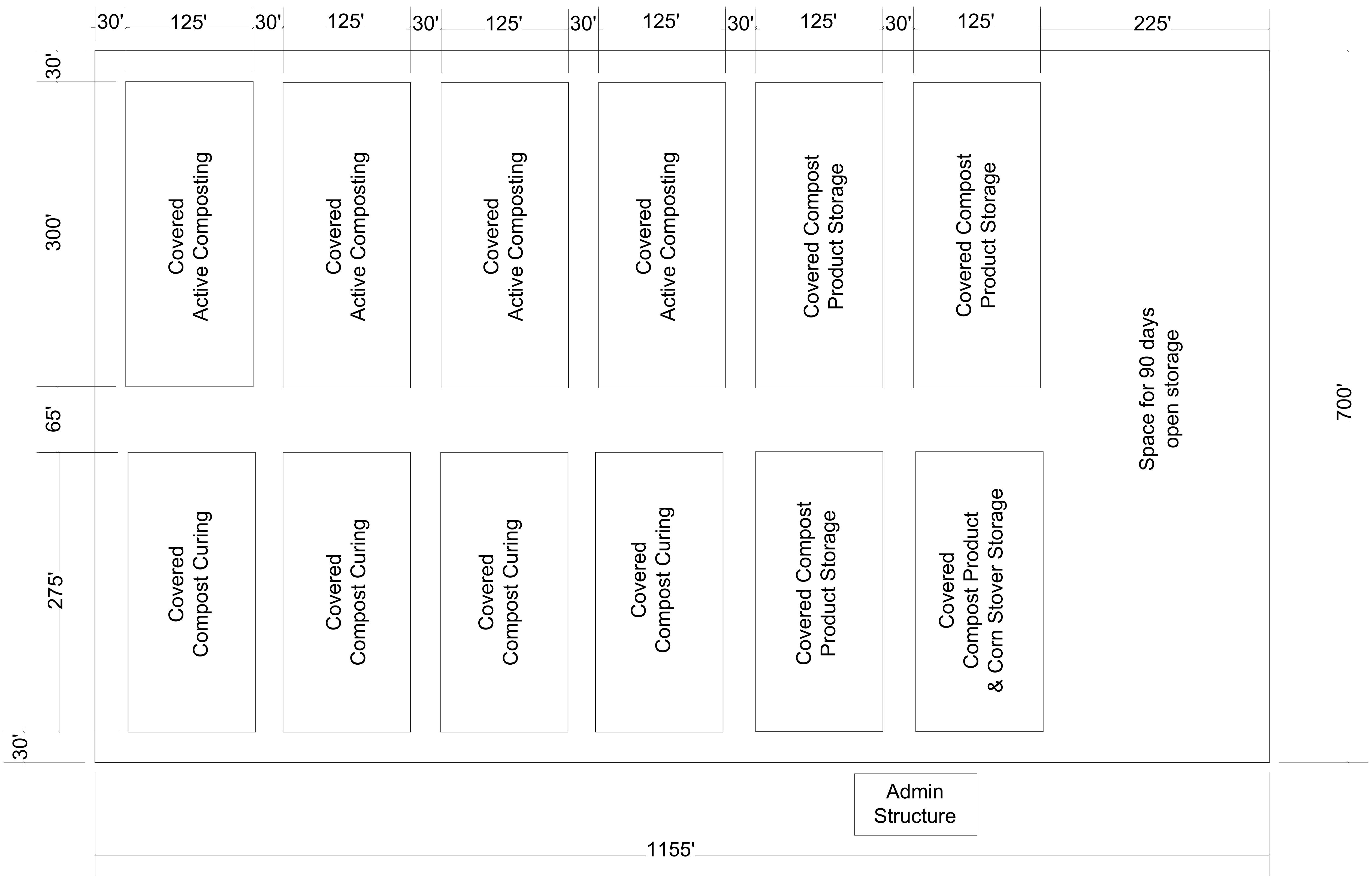
Alternative B4 – Belt Filter Presses in New Building



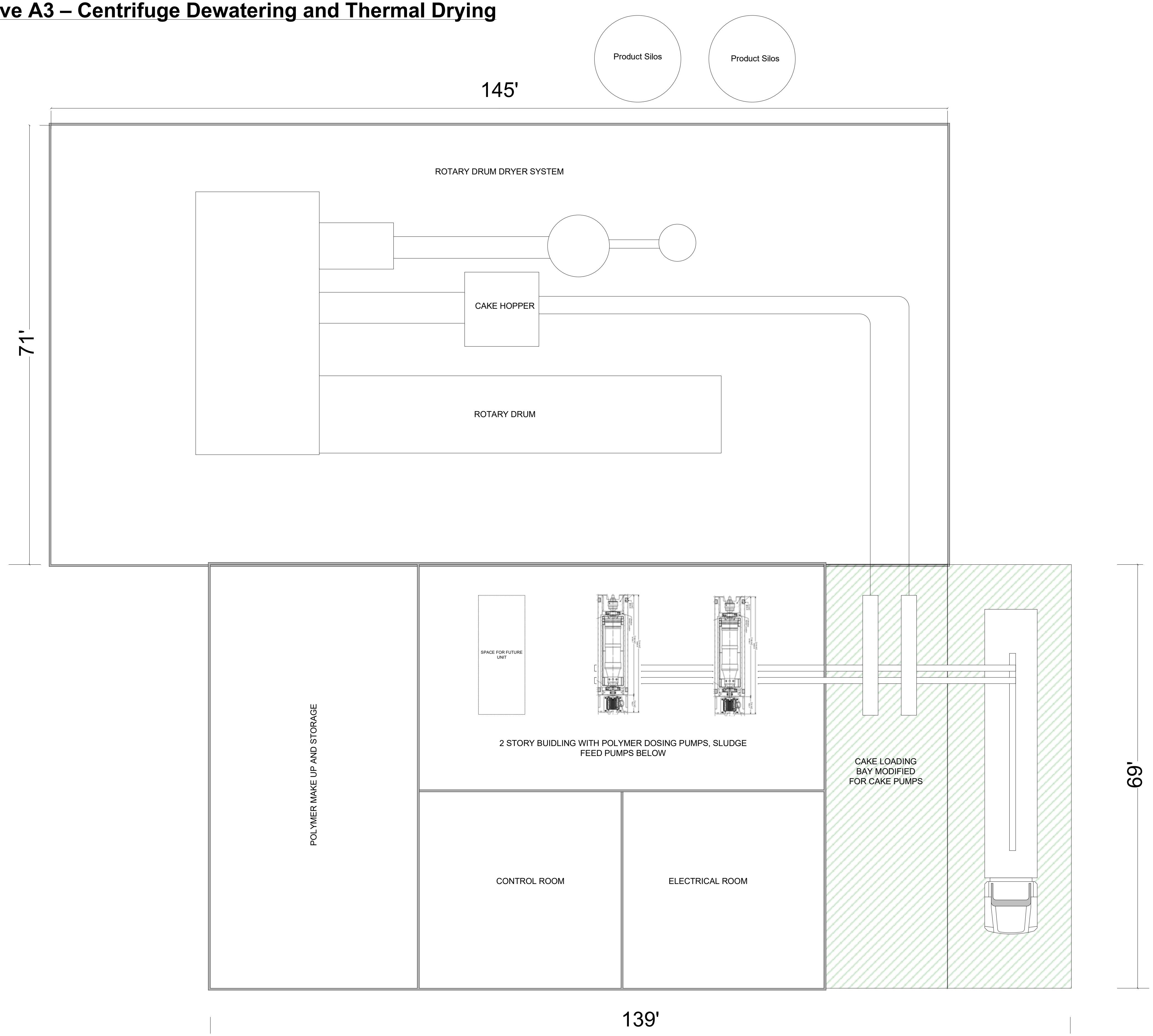
Alternative A1 – Static pile composting (off site location with centrifuge dewatering on site as with alternative B1)



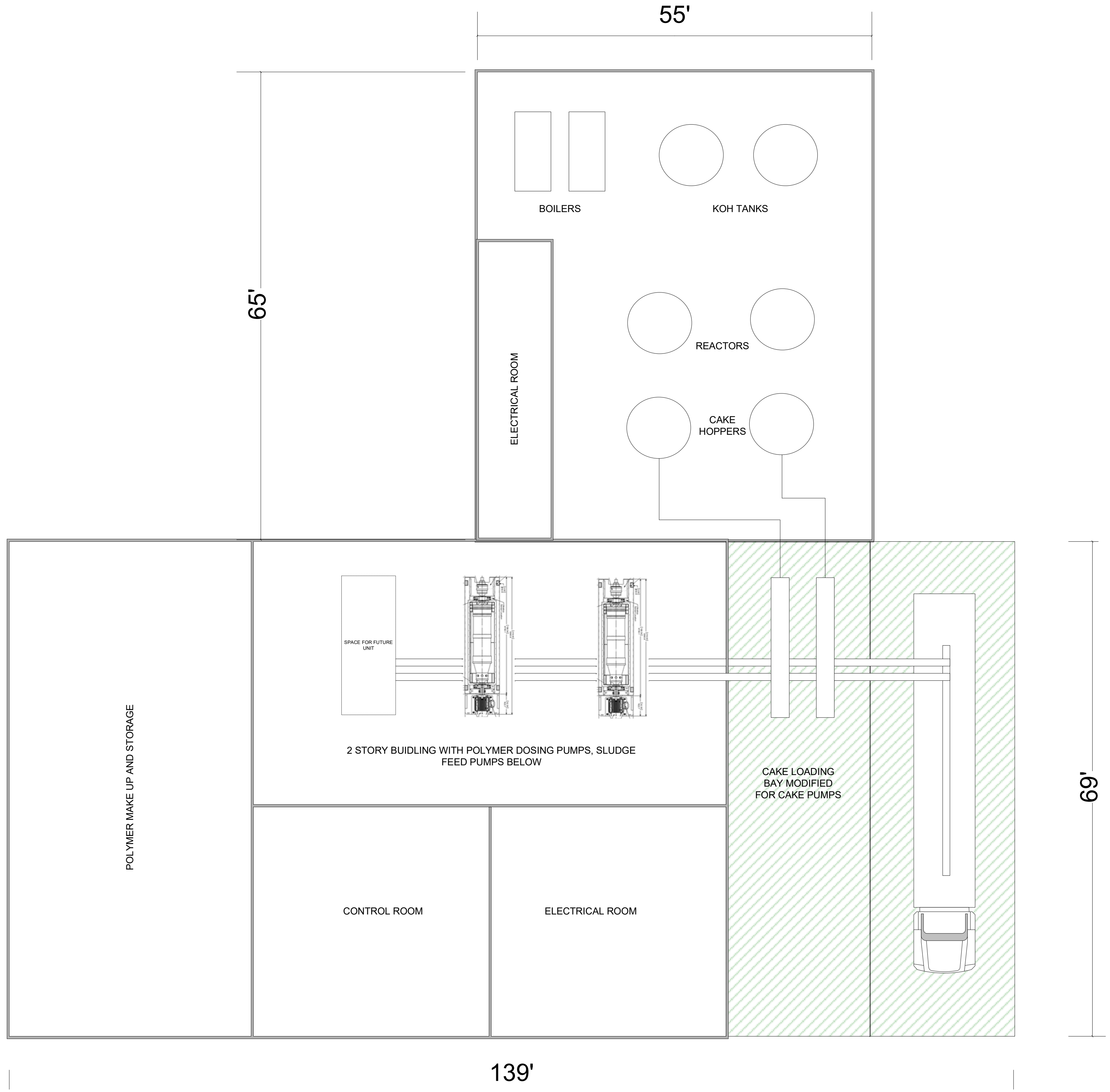
Alternative A2 – windrow composting (off site location with centrifuge dewatering on site as with alternative B1)



Alternative A3 – Centrifuge Dewatering and Thermal Drying



Alternative A4 – Centrifuge Dewatering and Class A Liquid



Alternative A5 - Thermal Batch Treatment

APPENDIX F
APPLICATION NUTRIENT SUMMARY & RATES

FM8: Spreading Plan Report

Nutrient Source Summary for 2021

		First Year Available Nutrients in lb/ton or lb/1000 gallons							Volumes are in tons or gallons			Amount Applied by Season			
SourceName	Type	N	N Incorp	N Inj	P	K	S	Dry Matter (%)	Volume	Amount Applied	Amount Remaining	Fall	Winter	Spring	Summer
Biosolid Liquid	Biosolid, liquid	13.8	22.7	22.7	22.1	2.2	0.0	5	0	178,750	-178,750	178,750	0	0	0
Biosolid Solid	Biosolid, solid	5.0	6.8	6.8	16.7	0.6	0.0	25	0	510	-510	510	0	0	0
Compost	Compost	28.0	0.0	0.0	30.0	24.0	10.0	54	0	144	-144	144	0	0	0
								Total Solid:	0	654	-654				
								Total Liquid:	0	178,750	-178,750				

Manure Applications

30.0 total acres reported

Field Name	App. Acres	N Res	Prior Crop	Planned Crop	Manure Source	Surface	Incorp	Inject	Rate	Total Amount
CIAPCS	5 of 5 Spreadable			Corn grain	Biosolid Solid	-	Fall	-	8.5	43
CIAPCSW	5 of 5 Spreadable			Corn grain	Biosolid Solid	-	Fall	-	8.5	43
CIHPCS	5 of 5 Spreadable			Corn grain	Biosolid Solid	-	Fall	-	8.5	43
CIHPCSW	5 of 5 Spreadable			Corn grain	Biosolid Solid	-	Fall	-	8.5	43
CILPCS	5 of 5 Spreadable			Corn grain	Biosolid Solid	-	Fall	-	8.5	43
CILPCSW	5 of 5 Spreadable			Corn grain	Biosolid Solid	-	Fall	-	8.5	43
COAPCS	5 of 5 Spreadable			Corn grain	Compost	Fall	-	-	4.8	24
COAPCSW	5 of 5 Spreadable			Corn grain	Compost	Fall	-	-	4.8	24
COHPCS	5 of 5 Spreadable			Corn grain	Compost	Fall	-	-	4.8	24
COHPCSW	5 of 5 Spreadable			Corn grain	Compost	Fall	-	-	4.8	24

Field Name	App. Acres	N Res	Prior Crop	Planned Crop	Manure Source	Surface	Incorp	Inject	Rate	Total Amount
COLPCS	5 of 5 Spreadable			Corn grain	Compost	Fall	-	-	4.8	24
COLPCSW	5 of 5 Spreadable			Corn grain	Compost	Fall	-	-	4.8	24
CSAPCS	5 of 5 Spreadable			Corn grain	Biosolid Solid	Fall	-	-	8.5	43
CSAPCSW	5 of 5 Spreadable			Corn grain	Biosolid Solid	Fall	-	-	8.5	43
CSHPCS	5 of 5 Spreadable			Corn grain	Biosolid Solid	Fall	-	-	8.5	43
CSHPCSW	5 of 5 Spreadable			Corn grain	Biosolid Solid	Fall	-	-	8.5	43
CSLPCS	5 of 5 Spreadable			Corn grain	Biosolid Solid	Fall	-	-	8.5	43
CSLPCSW	5 of 5 Spreadable			Corn grain	Biosolid Solid	Fall	-	-	8.5	43
LAPCS	2.5 of 5 Spreadable			Corn grain	Biosolid Liquid	-	-	Fall	6,500.0	16,250
LAPCSW	5 of 5 Spreadable			Corn grain	Biosolid Liquid	-	-	Fall	6,500.0	32,500
LHPCS	5 of 5 Spreadable			Corn grain	Biosolid Liquid	-	-	Fall	6,500.0	32,500
LHPCSW	5 of 5 Spreadable			Corn grain	Biosolid Liquid	-	-	Fall	6,500.0	32,500
LLPCS	5 of 5 Spreadable			Corn grain	Biosolid Liquid	-	-	Fall	6,500.0	32,500
LLPCSW	5 of 5 Spreadable			Corn grain	Biosolid Liquid	-	-	Fall	6,500.0	32,500

Fertilizer Source Summary

Fertilizer Name	Form	N%	P2O5%	K2O %	S%	Mg%	Ca%	Total Applied
Pelletized Biosolids	Solid	5	3.8	0.1	0	0	0	43,500 lb

Fertilizer Applications

30.0 total acres reported

Field Name	App. Acres	N Res	Prior Crop	Planned Crop	Analysis	Surface	Incorp	Subsurface	Rate	Total Amount
PAPCS	2.5 of 5 Entire field			Corn grain	5-3.8-0.1	Spring	-	-	2,900.0	7,250
PAPCSW	2.5 of 5 Entire field			Corn grain	5-3.8-0.1	Spring	-	-	2,900.0	7,250
PHPCS	2.5 of 5 Entire field			Corn grain	5-3.8-0.1	Spring	-	-	2,900.0	7,250
PHPCSW	2.5 of 5 Entire field			Corn grain	5-3.8-0.1	Spring	-	-	2,900.0	7,250
PLPCS	2.5 of 5 Entire field			Corn grain	5-3.8-0.1	Spring	-	-	2,900.0	7,250
PLPCSW	2.5 of 5 Entire field			Corn grain	5-3.8-0.1	Spring	-	-	2,900.0	7,250

Lime Applications

No Lime Apps Found

APPENDIX G
LIFE CYCLE COST SUMMARY

APPENDIX C - LIFE CYCLE COST SUMMARY

PARAMETER	UNITS	Baseline	Alternative B1: Dewatering centrifuges in existing building (reuse existing unit)	Alternative B2: Dewatering centrifuges in existing building (new units)	Alternative B3: Dewatering centrifuges in a new building	Alternative B4: Dewatering belt filter presses in a new building	Alternative A1: Centrifuge Dewatering with static pile composting	Alternative A2: Centrifuge dewatering with windrow composting	Alternative A3: Centrifuge dewatering and thermal drying	Alternative A4: Centrifuge dewatering with Class A liquid treatment	Alternative A5: Class A Cake
END USE COSTS - LIQUID											
End use wet tons	wtpy	167868	-	-	-	-	-		-	69,741	-
END USE COSTS - CAKE											
End use wet tons	wtpy	888	44,381	44,381	44,381	48,819	15,322	55,157	10,613		48,819
EQUIPMENT SUMMARY - DEWATERING EQUIPMENT											
Dewatering											
Number of duty units	-	1	2	1	1	2	1	1	1	1	2
Throughput per unit	lb/hr	2000	2000	3825	3825	1543	3825	3825	3825	3825	1543
Days per week at MM	-	7	7	7	7	7	7	7	5.2	7	7
Days per week at AA	-	7	7	7	7	7	7	7	4.1	7	7
Hours per day future max month	h/d	1	17	18	18	22	18	18	24	18	22
Hours per day 2030 average	h/d	1	13	14	14	17	14	14	24	14	17
Dewatering equipment cost	$	-	$0.71 m	$1.13 m	$1.13 m	$0.94 m	$1.13 m	$1.13 m	$1.13 m	$1.13 m	$0.94 m
Pumps and conveyors		-	$212 k	$339 k	$339 k	$281 k	$339 k	$339 k	$339 k	$339 k	$281 k
Polymer											
Max polymer dose rate	lb/DT	40	65	65	65	60	65	65	65	65	60
Average polymer dose rate	lb/DT	30	45	45	45	40	45	45	45	45	40
Polymer cost	$/lb	2.79	2.79	2.79	2.79	2.79	2.79	2.79	2.79	2.79	2.79
Max polymer demand	lb/hr	40	130	124	124	93	124	124	124	124	93
Equipment cost	$	$311 k	$710 k	$688 k	$688 k	$560 k	$688 k	$688 k	$688 k	$688 k	$560 k
Average polymer usage	lb/yr active	5,858	439,369	439,369	439,369	390,550	439,369	439,369	439,369	439,369	390,550
Odor control cost adder for belt filter press dewatering											
Additional odor control for belts	SCFM	-	-	-	-	8,998	-	-	-	-	8,998
Additional odor capital cost	$	-	-	-	-	269,928	-	-	-	-	269,928
Additional odor treatment cost	$/yr	-	-	-	-	179,952	-	-	-	-	179,952
Other items											
Centrate / filtrate pump station	$	-	-	-	$100 k	$150 k	$100 k	$100 k	$100 k	$100 k	$150 k
Bridge crane	$	-	-	-	$100 k	-	$100 k	$100 k	$100 k	$100 k	-
Dewatering Building											
Footprint	sf	-	-	-	9591	11247	9591	9591	9591	9591	11247
Cost	$/sf	-	-	-	300	200	300	300	300	300	200
Building cost	$	-	-	-	$2,877 k	$2,249 k	$2,877 k	$2,877 k	$2,877 k	$2,877 k	$2,249 k
Cake storage											
Storage	days	-	180	180	180	180	-	-	-	-	180
Wet tons stored	wt	-	23,727	23,727	23,727	26,100	-	-	-	-	26,100
Cake bulk density	lb/ft^3	-	59	59	59	59	-	-	-	-	59
Total barn area	ft^2	-	240,239	240,239	240,239	264,263	-	-	-	-	264,263
Cost	$	-	$8,408 k	$8,408 k	$8,408 k	$9,249 k	-	-	-	-	$9,249 k

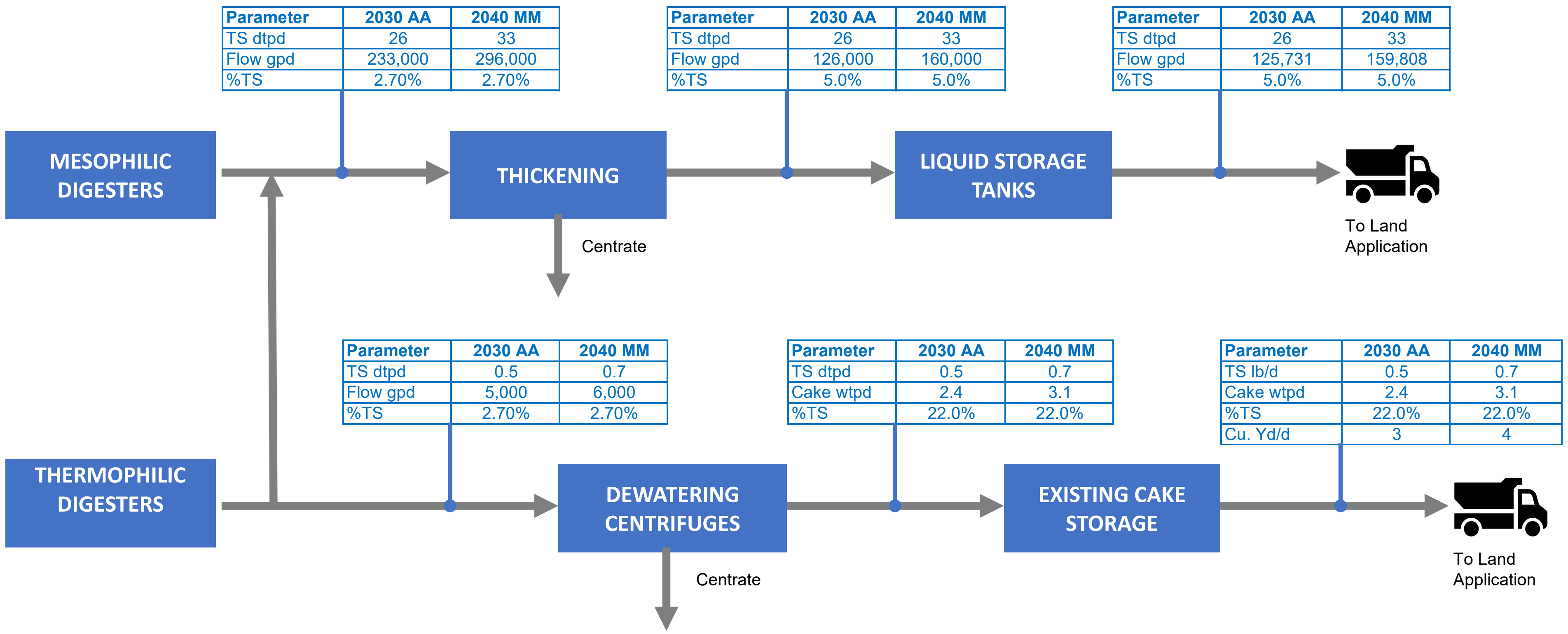
PARAMETER	UNITS	Baseline	Alternative B1: Dewatering centrifuges in existing building (reuse existing unit)	Alternative B2: Dewatering centrifuges in existing building (new units)	Alternative B3: Dewatering centrifuges in a new building	Alternative B4: Dewatering belt filter presses in a new building	Alternative A1: Centrifuge Dewatering with static pile composting	Alternative A2: Centrifuge dewatering with windrow composting	Alternative A3: Centrifuge dewatering and thermal drying	Alternative A4: Centrifuge dewatering with Class A liquid treatment	Alternative A5: Class A Cake
EQUIPMENT SUMMARY - CLASS A TREATMENT											
Thermal dryer											
Dryer capacity	lb/hr H2O	-	-	-	-	-	-	-	13,228	-	-
Product dried solids	%	-	-	-	-	-	-	-	92%	-	-
Days per week operation at 2030 average	d/wk	-	-	-	-	-	-	-	4.08	-	-
Days per week operation 2040 max month	d/wk	-	-	-	-	-	-	-	5.2	-	-
Equipment cost - dryer system & cake load out	$	-	-	-	-	-	-	-	$12,350 k	-	-
Class A liquid treatment											
Equipment capacity	wet tons/hr	-	-	-	-	-	-	-	-	12.6	-
Hours run per day at 2030 average (7d/w operation)	h/d	-	-	-	-	-	-	-	-	9.6	-
Hours run per day at 2040 max month (7d/w operation)	h/d	-	-	-	-	-	-	-	-	12.2	-
Equipment cost - Class A system & cake load out	$	-	-	-	-	-	-	-	-	$5,940 k	-
Class A digestion											
Proportion of flow treated by new system	%	-	-	-	-	-	-	-	-	-	66%
Number of new thermal 24 h batch tanks	-	-	-	-	-	-	-	-	-	-	3
Total cycle time	days	-	-	-	-	-	-	-	-	-	3
Volume each	MG	-	-	-	-	-	-	-	-	-	0.20
Additional storage / cooling tanks HRT	days	-	-	-	-	-	-	-	-	-	2.00
Additional storage / cooling tank volume	MG	-	-	-	-	-	-	-	-	-	0.40
Equipment cost	$	-	-	-	-	-	-	-	-	-	$2,100 k
Tank cost	$	-	-	-	-	-	-	-	-	-	$6,999 k
Composting Cost											
Active composting area	ft^2	-	-	-	-	-	68,000	150,000	-	-	-
Active composting area direct cost	$	-	-	-	-	-	$6,604 k	$9,261 k	-	-	-
Cuing and storage areas	ft^2	-	-	-	-	-	61,320	209,375	-	-	-
Curing and storage area direct cost	$	-	-	-	-	-	$4,100 k	$11,127 k	-	-	-
Mobile equipment cost	$	-	-	-	-	-	$3,030 k	$3,106 k	-	-	-
CONSUMABLES SUMMARY											
Power											
Liquid storage tank mixing	kWh/y	1,608,270	-	-	-	-	-	-	-	1608270	-
Dewatering power	kWh/y	10,935	546,770	546,770	546,770	78,110	546,770	546,770	546,770	546,770	78,110
Power for Class A treatment	kWh/y	-	-	-	-	-	1,000,000	500,000	1,664,433	744,600	13,815
Total	kWh/y	1,619,205	546,770	546,770	546,770	78,110	1,546,770	1,046,770	2,211,203	2,899,640	91,925
Unit rate	$/kWh	$0.086	$0.086	$0.086	$0.086	$0.086	$0.086	$0.086	$0.086	$0.086	$0.086
Natural gas											
Natural gas for dryer	mmBTU/yr	-	-	-	-	-	-	-	108057	-	-
Unit rate	$/mmBTU	-	-	-	-	-	-	-	8	-	-
Fuel											
Fuel for composting	gal/yr	-	-	-	-	-	41,500	42,000	-	-	-
Unit rate	$/gal	-	-	-	-	-	$3.0	$3.0	-	-	-
Composting amendment											
Quantity	yd^3/yr	-	-	-	-	-	15,976	63,500	-	-	-
Unit rate	$/yd^3	-	-	-	-	-	30.00	6.00	-	-	-

PARAMETER	UNITS	Baseline	Alternative B1: Dewatering centrifuges in existing building (reuse existing unit)	Alternative B2: Dewatering centrifuges in existing building (new units)	Alternative B3: Dewatering centrifuges in a new building	Alternative B4: Dewatering belt filter presses in a new building	Alternative A1: Centrifuge Dewatering with static pile composting	Alternative A2: Centrifuge dewatering with windrow composting	Alternative A3: Centrifuge dewatering and thermal drying	Alternative A4: Centrifuge dewatering with Class A liquid treatment	Alternative A5: Class A Cake
Labor											
Thickening, dewatering, storage tank management (thickening for options other than baseline)	h/yr	1095									
Thickening and Dewatering	h/yr		1460	1460	1460	1460	1460	1460	1460	1460	1460
Class A treatment	h/yr	-	-	-	-	-	11520	11520	8760	1460	1460
Total labor	**h/yr**	**1095**	**1460**	**1460**	**1460**	**1460**	**12,980**	**12,980**	**10220**	**2920**	**2920**
Labor rate	$/hr	175	75	75	75	75	75	75	75	75	75
Chemicals											
Thickening polymer	lb/yr	133,959	-	-	-	-	-	-	-	-	
Dewatering polymer	lb/yr	5858	439,369	439,369	439,369	390,550	439,369	439,369	439,369	439,369	390,550
Total	**lb/yr**	**139817**	**439,369**	**439,369**	**439,369**	**390,550**	**439,369**	**439,369**	**439,369**	**439,369**	**390,550**
Unit rate	$/lb	2.79	2.79	2.79	2.79	2.79	2.79	2.79	2.79	2.79	2.79
Trucking to composting facility											
Vehicle miles	vehicle miles/yr	-	-	-	-	-	0	282,045	-	-	-
Rate	$/vehicle mile	-	-	-	-	-	0.00	1.25	-	-	-
CAPITAL COSTS											
Installed equipment											
Dewatering system (inc. pumps, polymer, conveyors, odor, filtrate)	$	-	$1.63 m	$2.16 m	$2.36 m	$2.20 m	$2.36 m	$2.36 m	$2.56 m	$2.46 m	$2.20 m
Class A treatment system equipment	$	-	-	-	-	-	Inc. below	Inc. below	$12.35 m	$5.94 m	$2.10 m
Total equipment	**$**	**-**	**$1.63 m**	**$2.16 m**	**$2.36 m**	**$2.20 m**	**$2.36 m**	**$2.36 m**	**$14.91 m**	**$8.40 m**	**$4.30 m**
Installation	$	-	$0.49 m	$0.65 m	$0.71 m	$0.66 m	$0.71 m	$0.71 m	$4.47 m	$2.52 m	$1.29 m
Piping & valves	$	-	$0.16 m	$0.22 m	$0.24 m	$0.22 m	$0.24 m	$0.24 m	$1.49 m	$0.84 m	$0.43 m
Site work	$	-	$0.08 m	$0.11 m	$0.12 m	$0.11 m	$0.12 m	$0.12 m	$0.75 m	$0.42 m	$0.21 m
Electrical / I&C	$	-	$0.24 m	$0.32 m	$0.35 m	$0.33 m	$0.35 m	$0.35 m	$2.24 m	$1.26 m	$0.64 m
Buildings, civil structures	$	-	-	-	$2.88 m	$2.25 m	$2.88 m	$2.88 m	$7.38 m	$3.58 m	$2.25 m
Cake / product storage	$	-	$8.41 m	$8.41 m	$8.41 m	$9.25 m	-	-	$0.85 m	-	$9.25 m
Composting installation	$	-	-	-	-	-	$27.93 m	$48.89 m	-	-	-
Additional thermal batch and storage / cooling tanks	$	-	-	-	-	-	-	-	-	-	$7.00 m
Total direct cost	**$**	**-**	**$11.02 m**	**$11.86 m**	**$15.06 m**	**$15.01 m**	**$34.58 m**	**$55.54 m**	**$32.08 m**	**$17.02 m**	**$25.37 m**
General conditions	$	-	$1.32 m	$1.42 m	$1.81 m	$1.80 m	$0.80 m	$0.80 m	$3.75 m	$2.04 m	$3.04 m
Contractor overhead & proffit	$	-	$1.10 m	$1.19 m	$1.51 m	$1.50 m	$0.66 m	$0.66 m	$3.12 m	$1.70 m	$2.54 m
Contingency	$	-	$5.51 m	$5.93 m	$7.53 m	$7.51 m	$3.32 m	$3.32 m	$15.61 m	$8.51 m	$12.69 m
Engineering, legal & admin	$	-	$3.36 m	$2.97 m	$3.76 m	$3.75 m	$1.66 m	$1.66 m	$12.17 m	$6.09 m	$8.21 m
Total	**$**	**-**	**$22.31 m**	**$23.37 m**	**$29.66 m**	**$29.58 m**	**$41.03 m**	**$61.99 m**	**$66.74 m**	**$35.36 m**	**$51.85 m**
End use capital costs (MSA input)	**$**	**$16.9 m**	**$3.6 m**	**$3.6 m**	**$3.6 m**	**$3.6 m**	**$2.8 m**	**$3.4 m**	**$2.7 m**	**$0.9 m**	**$3.0 m**
Total capital costs including end use equipment	**$**	**$16.87 m**	**$25.90 m**	**$26.96 m**	**$33.26 m**	**$33.17 m**	**$43.82 m**	**$65.42 m**	**$69.43 m**	**$36.26 m**	**$54.82 m**
Breakdown											
Dewatering	$	-	$22.31 m	$23.37 m	$29.66 m	$29.58 m	$13.10 m	$13.10 m	$13.73 m	$13.42 m	$29.58 m
Class A treatment	$	-	-	-	-	-	$27.93 m	$48.89 m	$52.16 m	$21.95 m	$22.272 m
Total	**$**	**-**	**$22.31 m**	**$23.37 m**	**$29.66 m**	**$29.58 m**	**$41.03 m**	**$61.99 m**	**$65.89 m**	**$35.36 m**	**$51.85 m**
OPERATING COSTS											
Power	$/yr	$139 k	$47 k	$47 k	$47 k	$7 k	$133 k	$90 k	$190 k	$249 k	$8 k
Natural gas	$/yr	-	-	-	-		-	-	$864 k	$137 k	-
Fuel	$/yr	-	-	-	-		$115 k	$43 k	-		-
Amendment	$/yr	-	-	-	-		$479 k	$381 k	-		-
Labor	$/yr	$192 k	$110 k	$110 k	$110 k	$110 k	$974 k	$974 k	$767 k	$219 k	$219 k
Maintenance	$/yr	$39 k	$49 k	$65 k	$71 k	$66 k	$162 k	$164 k	$571 k	$74 k	$101 k
Chemicals	$/yr	$390 k	$1,226 k	$1,226 k	$1,226 k	$1,090 k	$1,226 k	$1,226 k	$1,226 k	$1,886 k	$1,090 k
Odor control	$/yr	-	-	-	-	$180 k	-	-	-	-	$180 k
Trucking to composting facility (removed - already in MSA costs)	$/yr										
End use opex costs (MSA input)	**$/yr**	**$2.8 m**	**$1.4 m**	**$1.4 m**	**$1.4 m**	**$1.5 m**	**$1.1 m**	**$2.1 m**	**$1.1 m**	**$1.6 m**	**$1.4 m**
Total	**$/yr**	**$3.6 m**	**$2.8 m**	**$2.9 m**	**$2.9 m**	**$2.9 m**	**$4.2 m**	**$5.0 m**	**$4.7 m**	**$4.2 m**	**$3.0 m**

PARAMETER	UNITS	Baseline	Alternative B1: Dewatering centrifuges in existing building (reuse existing unit)	Alternative B2: Dewatering centrifuges in existing building (new units)	Alternative B3: Dewatering centrifuges in a new building	Alternative B4: Dewatering belt filter presses in a new building	Alternative A1: Centrifuge Dewatering with static pile composting	Alternative A2: Centrifuge dewatering with windrow composting	Alternative A3: Centrifuge dewatering and thermal drying	Alternative A4: Centrifuge dewatering with Class A liquid treatment	Alternative A5: Class A Cake
NET PRESENT COSTS											
NET PRESENT COSTS		**Baseline**	**Alternative B1: Dewatering centrifuges in existing building (reuse existing unit)**	**Alternative B2: Dewatering centrifuges in existing building (new units)**	**Alternative B3: Dewatering centrifuges in a new building**	**Alternative B4: Dewatering belt filter presses in a new building**	**Alternative A1: Centrifuge Dewatering with static pile composting**	**Alternative A2: Centrifuge dewatering with windrow composting**	**Alternative A3: Centrifuge dewatering and thermal drying**	**Alternative A4: Centrifuge dewatering with Class A liquid treatment**	**Alternative A5: Class A Cake**
Capital cost	$	$16.9 m	$25.9 m	$27.0 m	$33.3 m	$33.2 m	$43.8 m	$65.4 m	$69.4 m	$36.3 m	$54.8 m
Operating cost	$	$72.0 m	$46.8 m	$47.0 m	$47.1 m	$48.2 m	$69.4 m	$82.3 m	$76.7 m	$68.3 m	$49.9 m
Total net present cost	**$**	**$88.8 m**	**$72.7 m**	**$74.0 m**	**$80.4 m**	**$81.4 m**	**$113.3 m**	**$147.7 m**	**$146.1 m**	**$104.6 m**	**$104.8 m**
Range - low	30%	$26.6 m	$21.8 m	$22.2 m	$24.1 m	$24.4 m	$34.0 m	$44.3 m	$43.8 m	$31.4 m	$31.4 m
Range - high	50%	$44.4 m	$36.3 m	$37.0 m	$40.2 m	$40.7 m	$56.6 m	$73.8 m	$73.1 m	$52.3 m	$52.4 m
NET PRESENT COSTS / DT											
Capital cost	$/DT	$86	$133	$138	$170	$170	$224	$335	$356	$186	$281
Operating cost	$/DT	$369	$239	$241	$241	$247	$356	$421	$393	$350	$256
Total net present cost	**$/DT**	**$455**	**$372**	**$379**	**$412**	**$417**	**$580**	**$756**	**$748**	**$536**	**$536**
Range - low	30%	$136	$112	$114	$123	$125	$174	$227	$225	$161	$161
Range - high	50%	$227	$186	$189	$206	$208	$290	$378	$374	$268	$268

APPENDIX H
ALTERNATIVE MASS BALANCES & SCHEMATICS

Baseline - current treatment approach



Parameter	2030 AA	2040 MM
TS dtpd	26	33
Flow gpd	233,000	296,000
%TS	2.70%	2.70%

Parameter	2030 AA	2040 MM
TS dtpd	26	33
Flow gpd	126,000	160,000
%TS	5.0%	5.0%

Parameter	2030 AA	2040 MM
TS dtpd	26	33
Flow gpd	125,731	159,808
%TS	5.0%	5.0%

Parameter	2030 AA	2040 MM
TS dtpd	0.5	0.7
Flow gpd	5,000	6,000
%TS	2.70%	2.70%

Parameter	2030 AA	2040 MM
TS dtpd	0.5	0.7
Cake wtpd	2.4	3.1
%TS	22.0%	22.0%

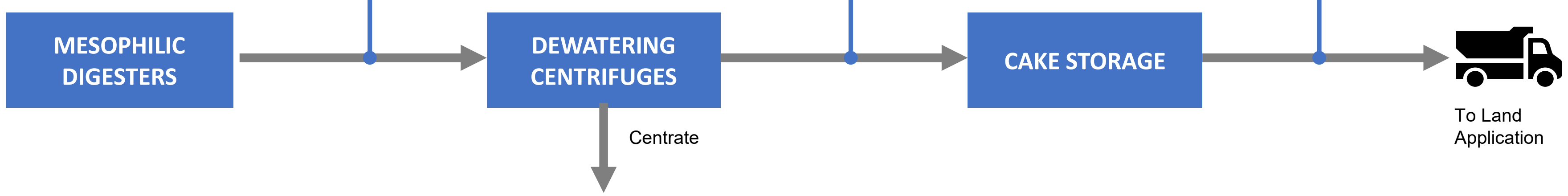
Parameter	2030 AA	2040 MM
TS lb/d	0.5	0.7
Cake wtpd	2.4	3.1
%TS	22.0%	22.0%
Cu. Yd/d	3	4

Alternative B1, B2 and B3 - Centrifuge dewatering

Parameter	2030 AA	2040 MM
TS dtpd	27	34
Flow gpd	238,000	302,000
%TS	2.70%	2.70%

Parameter	2030 AA	2040 MM
TS dtpd	27	34
Cake wtpd	122	155
%TS	22.0%	22.0%

Parameter	2030 AA	2040 MM
TS lb/d	27	34
Cake wtpd	122	155
%TS	22.0%	22.0%
Cu. Yd/d	152	193

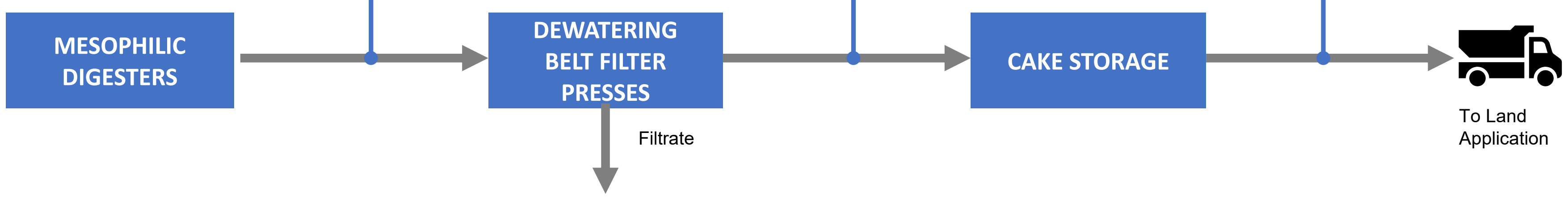


Alternative B4 - Dewatering with Belt Filter Presses

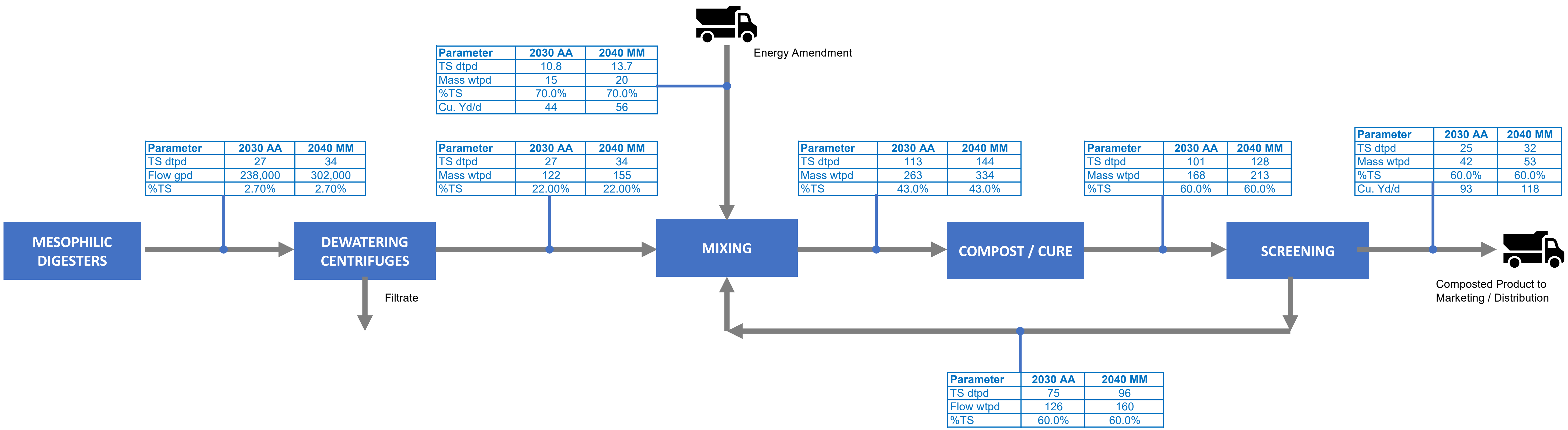
Parameter	2030 AA	2040 MM
TS lb/d	27	34
Flow gpd	238,000	302,000
%TS	2.70%	2.70%

Parameter	2030 AA	2040 MM
TS dtpd	27	34
Cake wtpd	134	0
%TS	20.0%	20.0%

Parameter	2030 AA	2040 MM
TS dtpd	27	34
Cake wtpd	134	170
%TS	20.0%	20.0%
Cu. Yd/d	167	213



Alternative A1 - Centrifuge Dewatering with Static Pile Composting



Parameter	2030 AA	2040 MM
TS dtpd	10.8	13.7
Mass wtpd	15	20
%TS	70.0%	70.0%
Cu. Yd/d	44	56

Parameter	2030 AA	2040 MM
TS dtpd	27	34
Flow gpd	238,000	302,000
%TS	2.70%	2.70%

Parameter	2030 AA	2040 MM
TS dtpd	27	34
Mass wtpd	122	155
%TS	22.00%	22.00%

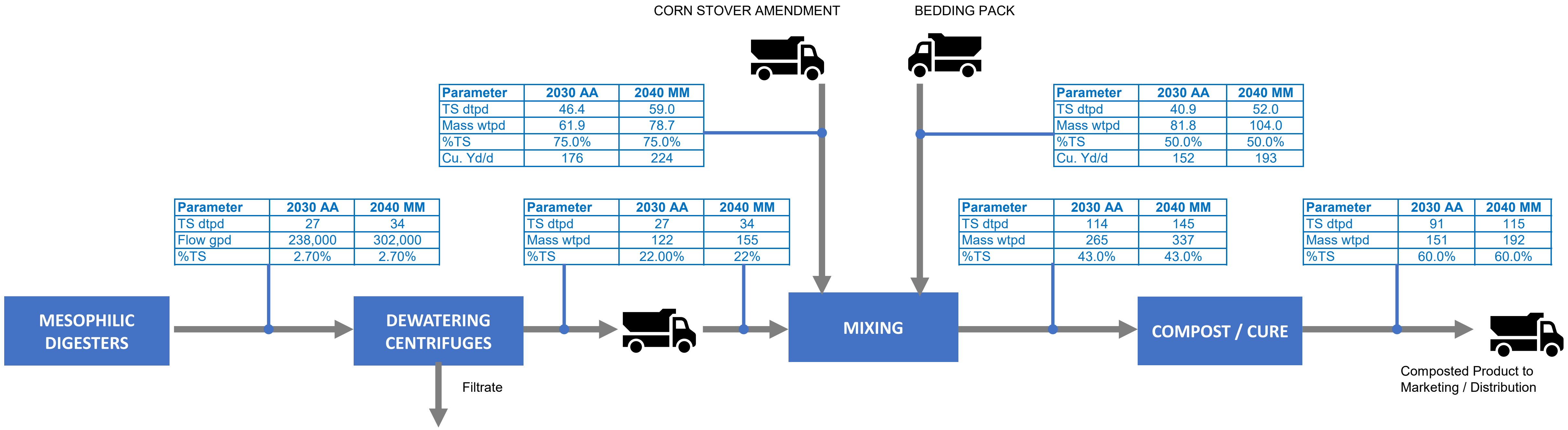
Parameter	2030 AA	2040 MM
TS dtpd	113	144
Mass wtpd	263	334
%TS	43.0%	43.0%

Parameter	2030 AA	2040 MM
TS dtpd	101	128
Mass wtpd	168	213
%TS	60.0%	60.0%

Parameter	2030 AA	2040 MM
TS dtpd	25	32
Mass wtpd	42	53
%TS	60.0%	60.0%
Cu. Yd/d	93	118

Parameter	2030 AA	2040 MM
TS dtpd	75	96
Flow wtpd	126	160
%TS	60.0%	60.0%

Alternative A2 - Centrifuge Dewatering with Windrow Composting



Parameter	2030 AA	2040 MM
TS dtpd	27	34
Flow gpd	238,000	302,000
%TS	2.70%	2.70%

Parameter	2030 AA	2040 MM
TS dtpd	27	34
Mass wtpd	122	155
%TS	22.00%	22%

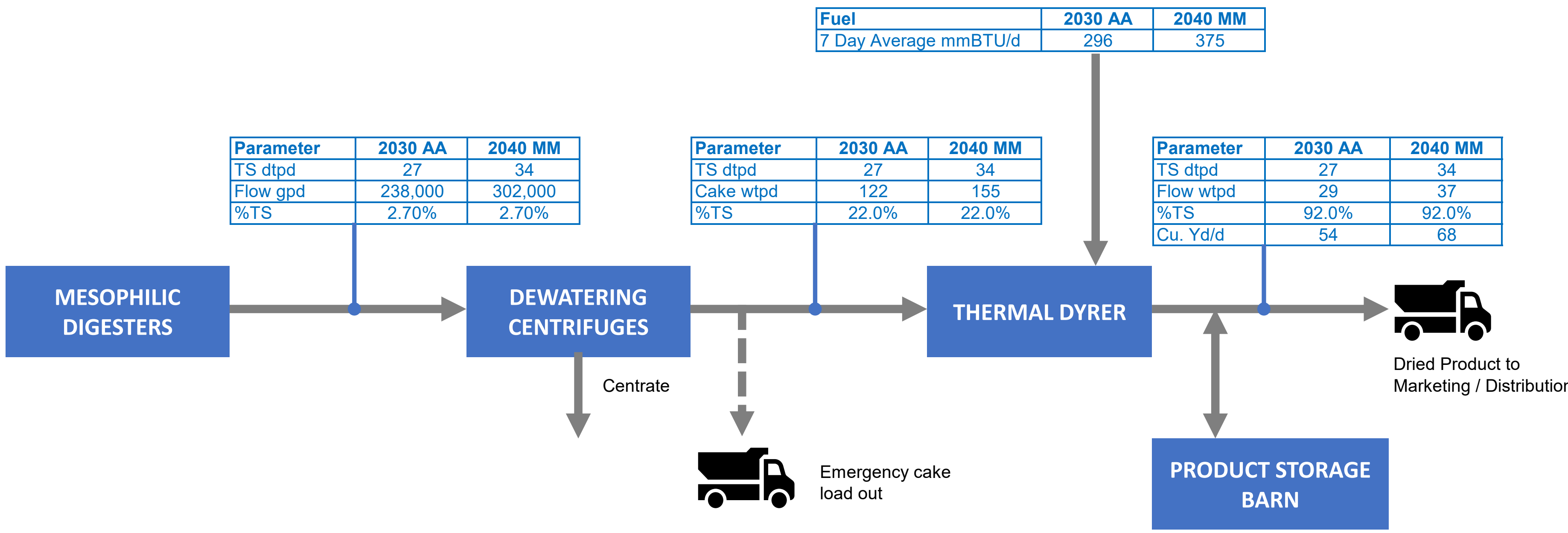
Parameter	2030 AA	2040 MM
TS dtpd	46.4	59.0
Mass wtpd	61.9	78.7
%TS	75.0%	75.0%
Cu. Yd/d	176	224

Parameter	2030 AA	2040 MM
TS dtpd	40.9	52.0
Mass wtpd	81.8	104.0
%TS	50.0%	50.0%
Cu. Yd/d	152	193

Parameter	2030 AA	2040 MM
TS dtpd	114	145
Mass wtpd	265	337
%TS	43.0%	43.0%

Parameter	2030 AA	2040 MM
TS dtpd	91	115
Mass wtpd	151	192
%TS	60.0%	60.0%

Alternative A3 - Centrifuge Dewatering and Thermal Drying



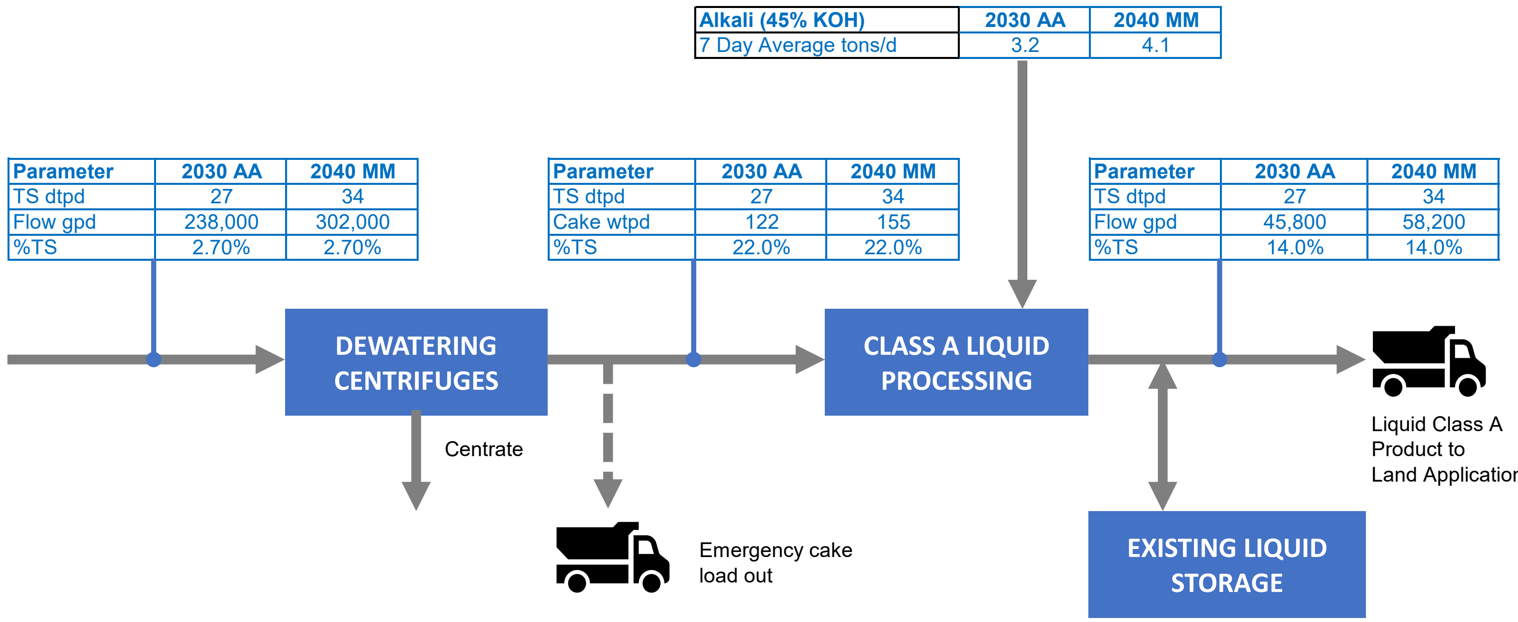
Fuel	2030 AA	2040 MM
7 Day Average mmBTU/d	296	375

Parameter	2030 AA	2040 MM
TS dtpd	27	34
Flow gpd	238,000	302,000
%TS	2.70%	2.70%

Parameter	2030 AA	2040 MM
TS dtpd	27	34
Cake wtpd	122	155
%TS	22.0%	22.0%

Parameter	2030 AA	2040 MM
TS dtpd	27	34
Flow wtpd	29	37
%TS	92.0%	92.0%
Cu. Yd/d	54	68

Alternative A4 - Centrifuge Dewatering and Liquid Class A



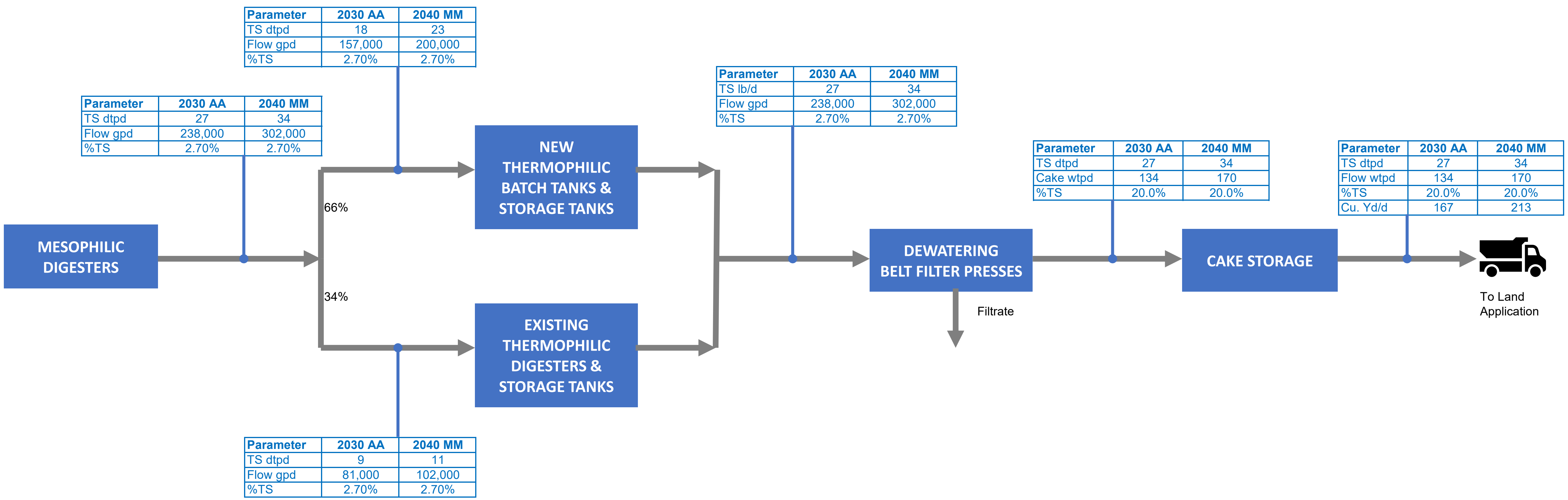
Alkali (45% KOH)	2030 AA	2040 MM
7 Day Average tons/d	3.2	4.1

Parameter	2030 AA	2040 MM
TS dtpd	27	34
Flow gpd	238,000	302,000
%TS	2.70%	2.70%

Parameter	2030 AA	2040 MM
TS dtpd	27	34
Cake wtpd	122	155
%TS	22.0%	22.0%

Parameter	2030 AA	2040 MM
TS dtpd	27	34
Flow gpd	45,800	58,200
%TS	14.0%	14.0%

Alternative A5 - Belt filter press dewatering with class A Cake



Parameter	2030 AA	2040 MM
TS dtpd	27	34
Flow gpd	238,000	302,000
%TS	2.70%	2.70%

Parameter	2030 AA	2040 MM
TS dtpd	18	23
Flow gpd	157,000	200,000
%TS	2.70%	2.70%

Parameter	2030 AA	2040 MM
TS dtpd	9	11
Flow gpd	81,000	102,000
%TS	2.70%	2.70%

Parameter	2030 AA	2040 MM
TS lb/d	27	34
Flow gpd	238,000	302,000
%TS	2.70%	2.70%

Parameter	2030 AA	2040 MM
TS dtpd	27	34
Cake wtpd	134	170
%TS	20.0%	20.0%

Parameter	2030 AA	2040 MM
TS dtpd	27	34
Flow wtpd	134	170
%TS	20.0%	20.0%
Cu. Yd/d	167	213

APPENDIX I

STAKEHOLDER MEETING 1/23/2020

METROGRO STAKEHOLDERS MEETING MINUTES

1/23/2020
11 AM – 2 PM
MMSD MAINTENANCE FACILITY

Attendees:

Name	Affiliation	Email	Attended?
Chuck Bolte	AgSource	cbolte@agsource.com	Yes
Scott Carr	Black & Veatch	CarrJS@bv.com	Yes
Amber Converse	MSA	aconverse@msa-ps.com	Yes
Wesley Dorshorst*	Dorshorst Farms		No
Leon Downing	Black & Veatch	DowningL@bv.com	Yes
Jeff Endres	Yahara Pride	jeffjenendres@gmail.com	Yes
Martin Griffin	MMSD	marting@madsewer.org	Yes
Greg Gunderson	MSA		Yes
Paul Haag	Haag & Associates	the4haags@charter.net	Yes
Duane Hinchley*	Producer	tina@dairyfarmtours.com	No
Ross Hollfelder	MMSD	rossh@madsewer.org	Yes
Josh Michel	Klondike Farms	klondikefarms@gmail.com	Yes
Jason Marshall	Marshall Bros. Farms	staceyhardy@frontier.com	Yes
Kim Meyer	MMSD	KimM@madsewer.org	Yes
Robert Mickelson	Mickelson Agronomics	r.mick844@gmail.com	Yes
Dale Olson	D&D Olson	ols8412@cloud.com	Yes
Matt Seib	MMSD	seibm@madsewer.org	Yes
Mark Schroeder	Schroeder Grain	mschroedergrain@gmail.com	Yes
Randy Shotliff	Producer	rshotliff@gmail.com	Yes
Brett Skaar*	Producer	brettskaar@yahoo.com	No
Andrew Skwor	MSA	askwor@msa-ps.com	Yes
Adam Travis*			No
Kendal Uphoff*	Uphoff Company	uphoffcompany@gmail.com	No
Nick Viney	Badgerland Grain	nick@badgerlandgrain.com	Yes

1. **Welcome & Background – Kim Meyer**

2. **Introductions & Meeting Goals – Andy Skwor**

   A. *What about biosolids/manure keeps you up at night?*

   - **Mark Schroeder**
     - Does not use Metrogro, but neighbors do. Has not heard anything bad about the program
     - Not excited about what Metrogro does for soil in July
     - Wheat economics don't drive crops. Cost for trucking wheat and finding a market is a major challenge for wheat.

- "Metrogro high in metals and iron" is a general comment, a misperception commonly referenced about biosolids
- Soil health is a key. Trying to improve soil structure

- **Paul Haag**
  - County is harder to work with when managing manure than biosolids
  - Concerns with cake: concerns with spreading, can have an odor, requires immediate tilling, requires setbacks from waterways
  - Biosolids are easier than manure
  - The hemp market is not materializing as advertised
- **Robert Mickelson**
  - Lots of growers use biosolids
  - Phosphorus is a concern and soil tests show an increase over time
  - Spring soil compaction is a large problem. Yield reductions where truck tires compressed the soil. Might be reduced with larger ties and a good spreader
  - Interested in a dried product, fewer trips, more desirable
  - Might consider a forage rotation, which would increase the bio solids application window
  - What about winter crops?
    - Other crops, like wheat barley and oats do not have a good market
    - Incentives are great, but what is the cost to actually harvest and distribute the wheat products. Economics are pretty tough for wheat products
    - Is Madison MSD going to buy back wheat?
- **Nick Viney**
  - Corn/soybean grower
  - Has used biosolids in the past
  - Issue: fields are currently no till/strip till, which causes problems with injection product
  - Prior use and history of dairy results in high soil phosphorus
  - Concerns on using biosolids:
    - Wants uniformity of operation (consistent application across the fields)
    - Concerns about restrictions on how the product is applied near waterways/wells
    - Concerned with traffic/soil compaction
    - Several landlords prohibit biosolids application, likely concerns of heavy metals
  - No local market for wheat or oats
  - Vegetable crops restrict biosolids
  - Concerns about crop insurance. Lower yield due to compaction with stay in your record and affect insurance rates. Yield incentive from MMSD is good for that year, but it impacts the future crop insurance rates
  - All growers have GPS on equipment,
    - *NOTE: Madison MSD does not have mapping on their equipment*
- **Josh Michel**
  - Compaction, compaction, compaction, especially with wet springs
  - Operations are moving towards strip tilling
  - Landlords are concerned about biosolids, a lot for compaction reasons
  - Desire for better stability of the nitrogen from the Metrogro product. Can the nitrogen be more available? Dairy also has this issue
  - Noticeable yield loss in the main through ways when applying biosolids
  - Trend towards cover crops in fall/winter
- **Jason Marshall**
  - Currently has cash crops
  - Have worked with Metrogro for 15 years
  - Compaction is an issue

- Wheat issue: just not economically feasible even with current incentive. An increased incentive might push more farmers to grow wheat?
- Summer/fall has less compaction than spring
- Dredge line is more economical now than in the past. Dredge line should be considered for big fields
  - NOTE: IS THE DIVERSITY OF CAKE, LIQUID, COMPOST GOING TO BE WORTH THE ADDITIONAL OPERATIONAL COMPLEXITY TO ENSURE A PRODUCT THAT THE END-USERS WANT? OR MAYBE A DRYER FOR SPING APPLICATION BUT NOW DRIED PRODUCT STORAGE?
- Interested in a dry product

- **Dale Olson**
  - Mapping and setback really limits application
  - Used Milorganite, really easy to work with. It can be applied with a spreader over an existing crop

3. **Interactive Lunch & Learn – Jeff Endres, Scott Carr, Chuck Bolte**
   - Kick off of Group Discussion
     - Focus on soybean and corn in the room
     - All large cash crop operations
     - Existing equipment is set up for corn/soybeans. Could manage to grow wheat/alfalfa, but might need to hire someone to do certain tasks
   - Compost (Jeff Endres)
     - **Jeff Endres**
       - Using manure in composting. Testing out using biosolids within compost next
       - Primarily used on hay
       - Can apply the compost on growing crops
       - Lot of data: Recording differences between compost mixes (ratios of nutrients/overall content) and other characteristics of compost batches
     - **Nick Viney**
       - One compost study completed on his field. Northern ½ had compost applied in the fall, southern ½ did not. All other management practices remained consistent between the sites
       - Recorded yields with GPS equipment to see if compost had an impact
       - Unfortunately had an equipment malfunction one year, therefore GPS yields not recorded in the year immediately after the compost application
       - The next year, the northern field as saw some improvements in yield, but not sure if it will be replicated elsewhere.
       - Northern ½ of field historically had better yields due to soil differences. Would like to try a similar study in a more uniform field?
       - Displayed yield maps with and without manure compost
         - NOTE: DOES THE REDUCED VOLUME OF HAULING A COMPOST PRODUCT PAY FOR THE ADDITIONAL EQUIPMENT AND O&M? OR THE RESILIENCE FOR LONGER/MORE DIVERSE SPREADING OPPORTUNITIES?
     - Classify Biosolids as a fertilizer product?
       - Package as "no less than X" makes it not a fertilizer product
       - Once you make it an actual fertilizer product, regulations get more intense
       - If you can get a fertilizer number, it does help reduced county interaction
     - Compost is a great opportunity in this region to figure out how to redistribute nutrients in a watershed
     - Three major sources of Phosphorus: feed truck, fertilizer truck, grocery store

- Circular economy concept, don't forget about the grocery store for redistributing nutrients in the watershed
- If compost improves soil health, this is a huge benefit
- Soil health improvement is a slow process (Cornell study showed 4 to 5 years before benefits are observed).

- Soil health
  - Is this a real thing or just a nice talking point? How do you get funding from a bank for something that improves soil health?
  - How to define soil health: how the water moves through the soil (down and up)
  - Jeff Andres: any product has to consider overall soil health
  - How does soil health impact phosphorus run off? Some data has shown that organic matter helps to keep phosphorus bound in soil.
  - Soil health: air water management; compaction control; no direct measurement technique for 'soil health' but farmers see the difference between their fields and there is soil health.
    - *NOTE: SHOULD MMSD INVEST IN RESEARCH TO DEVELOP A QUANTITATIVE MEANS OF SOIL HEALTH INDICATION?*
  - Lack of tillage: not increasing organic matter. But perhaps no till is helping organic matter to remain stable/constant. Would it have gone down with other practices?
  - Material will compost better if you start at 40 or 45% solids product.
    - *NOTE: IS THIS A DRIVER FOR THP? INTERMEDIATE SOLAR DRYING FACILITY?*
    - *NOTE: PARTIAL DRYING AND MIXING BACK WITH CAKE TO GET THAT 40 OR 45% CAKE PRODUCT?*
  - Cost needs to be competitive with dry fertilizer products, if MMSD is going to sell a product
  - *NOTE: Quantify costs in terms of cost per pound of nitrogen and pound of phosphorus*
  - Dale Olson: Historically applied one ton of Milorganite per acre
  - Jeff Endres: Cost to produce a ton of compost: $8 to $10 per ton, not delivery. Spreading is $5 to 7.5 per ton.
- Overview of Possible Wastewater Products (Scott Carr)
  - Liquid Product: 5% solids, 95% water.
  - Cake Product: 25% solids, 75% water.
    - High water content means cake still 'flows'
    - Potential for uneven spreading
    - Side slinger is the most common application method to fields
  - Compost
    - Space intensive, requires land area for longer term storage
    - Can have an odor
    - Using woody waste (like brush) is preferred
  - Dried Product: 90% solids, 10% water
    - Requires high temperatures for drying that is energy intensive
    - Concerns for fire
    - Various size/shapes of product depending on processing (e.g. pellets like Milorganite or more of a 'Cheeto' shape)
- Precision Agriculture (Chuck Bolte)
  - Soil health is currently the 'buzz word'
    - Microbes?
    - Air to roots?
    - Physical soil structure?

4. **Guided Discussion**

   A. Small group – *Skipped due to good discussion as a larger group*

B. Large group

C. Questions for Discussion

1) *What do you like about the Metrogro program?*
   - Cheap fertilizer?
   - Soil benefit
   - Low cost fertilizer
   - Minimal till
   - Nice people to work with
   - Good price
   - Using a resource in our watershed (local)
   - Nitrogen and phosphorus cost savings with the yields
   - Free, low cost fertilizer (high phosphorus levels, but also high yields)

2) *What could be improved?*
   - It is currently aggressive tillage, need alternative tillage package
   - Most guys re-till the application; focused on being able to min- or low-till practices
   - Dry, spreadable product would open up opportunities
   - Compost product may be in demand during wet seasons
   - Make a product that is compatible with no till
   - Less compaction
   - Dragline system
   - Supplement liquid with cake or dried product
   - Soil condition is the larger driver for Metrogro drivers
   - If land application of dried material, pellet is the major driver
   - Keep nitrogen in ammonium form longer
     - If cake, the majority of nitrogen is present as organic nitrogen
   - Can potassium be recovered and added to the biosolids?

3) *What type of product could Metrogro provide to help your operation?*
   - Something I can apply with my unit that is dry with nutrient value
   - Diverse product
   - Cake is tough and goey; dried or compost
   - Pellets that have a fertilizer number
   - Class A cake and composted biosolids; pellet is nice but not necessary
   - Dried product or class A cake
   - Liquid in the fall and early summer
   - Dried pellet with a fertilizer number
   - Compost has spreader issue
   - Low cost nutrient value is going to be the preferred product if it can be spread
   - Compost looks like with a balanced profile, but it more difficult to apply to the fields
   - Class A cake or a biosolids compost
   - A spring application with dry or cake product (reduce compaction)
   - Concerns about density of dried pellet – would need to reduce the spread and make more passes on fields
   - Biosolids cannot be classified as organic, based on current federal rules

4) *How could Metrogro help you implement your farm conservation goals? (e.g. nutrient management, soil health, reduced/no-till)*
   - Include cover crops with Metrogro nutrients to help take up N

- Incorporate N-Serve© to stabilize the nitrogen. If the N is in ammonia form, it can wash off over the winter. The goal is to keep the N on the field until the spring when plants are growing.
- Increase K in the biosolids
- A biosolids product that be applied by the grower using their own equipment (rather than an outside party)

5) *How can Metrogro help reduce the risk of your investment?*
   - Better pulse on the weather?
   - Everyone needs to be profitable, but everybody has different drivers and business practices
   - Allowing the grower to spread the biosolids with existing equipment (likely requires a dried product)
   - Prefer a BB-sized product (rather than a Cheeto) with a fertilizer #
   - Keep roughly the same N/P ratio, but increase the K
   - Get rid of setback requirements

5. Metrogro Tour *(Skipped due to time)*

Action or follow-up necessary:

1. Adjust plan of study according to key takeaways
   - Uniform prills, similar to Milorganite
   - Class A cake
   - Get involved with local fertilizer companies for potential blending
   - Growers don't have spreaders for compost
   - More potash (K) desired

2. Andy & Kim to meet up with stakeholders that could not make meeting

3. Follow-up questions to stakeholders, if needed.

Minutes Prepared By: Leon Downing, Amber Converse, Scott Carr

APPENDIX J
STAKEHOLDER MEETING 2/12/2020

METROGRO STAKEHOLDERS LUNCH MINUTES

2/12/2020
11 AM – 2 PM
NORA'S DINER

Attendees:

Name	Affiliation	Email	Attended?
Kim Meyer	MMSD	KimM@madsewer.org	Yes
Andrew Skwor	MSA	askwor@msa-ps.com	Yes
Steven Sell	MSA	ssell@msa-ps.com	Yes
Kevin Klahn	Klondike Farms	klondikefarms@frontier.com	Yes
Brett Skaar	Producer	brettskaar@yahoo.com	Yes
Adam Travis	Producer		Yes

1. **Welcome & Background – Kim Meyer**

   Discussed MSA & MMSD Partnership on this study to develop a short term (3-5 year) plan and a long-term vision.

2. **Introductions & Meeting Goals – Andy Skwor**

   This is in intended to be an informational gathering session for those stakeholders vital to the future success of Metrogro.

3. **Questions**

A. What is your definition of Soil Health?
Important and more benefits are being discovered all the time with increasing organic matter.

1) Is soil compaction your #1 concern in regards to soil health?
All three noted compaction as being #1 or biggest issues with Metrogro. Skaar & Adam Travis do not take any Metrogro in spring and Kevin Klahn only takes spring Metrogro to be helpful.

All three would prefer less trips on the soil to minimize compaction.

Image of compaction may be skewed by the last few years as they have been particularly bad for soil compaction and application windows. It is not known if this is the new 'norm' or sequence of bad events.

B. What is your preference on fertilizer product and application method?
Order of preference is 1. Dried/compost; 2. Liquid; 3. Cake. Do not want to deal with inconsistency of cake application.

1) Dry (dried product similar to Milorganite vs. Wet (Cake) vs. Liquid Application
Experience with Milorganite at 6-4-0 there is just too much volume required to be added per acre. Cake is too sticky to spread.

2) Application Style
3) Does applying cake concern you from lack of uniformity of spread, compaction, etc.?
This leads to a 'nightmare' in nutrient management and corrective action to remedy the situation.

C. Based on the first stakeholder meeting we have determined Potash (K2O), Nitrogen (Total N), and Phosphorus (P2O5), in this order are the priorities for growers.
1) Is this true for your operation?
Nitrogen was most desirable. Adam noted if P and K were stable and no nitrogen in the fall. All noted Instinct (stabilize N) which we do not know if it's labeled for biosolids use.

2) What other nutrients would be valuable to have in biosolids?
Mn, Bo, Ca, Mg

D. Do you know the difference between Class A vs. Class B biosolids?
Kim covered this, but no questions. Preference was to have available Class A to reduce or eliminate setbacks; however, there was no dramatic increase of Class A over Class B if it meant paying for it.

E. What is your opinion of dragline use and application?
Not very feasible.

F. If finished compost was a product that met certain goals and expectations for your operation would that be a desirable product?
1) Would you be willing to buy it by the ton?
They said yes because of the all the added properties compost brings to the table, but would not give a price to buy it at. They seemed to like the nutrient and application model the best.

G. In regards to neighbors or other perceptions, do you see liquid puddling as a long-term effect of nutrient application to your land?
Not an issue, but do not want it to be an issue either.

H. Based on land/acres being needed to apply nutrients, what is the likelihood of your land (estimated acres) being developed
1) In 5 years
35% loss for Travis (solar farm influences)
10% for Skaar
5% for Klahn

2) In 10 years
Unknown

3) In 20 years
Unknown

I. If biosolids are converted to a product of higher fertilizer value, in a form that best suits you (end user), would you be willing to pay for the product?

1) Asking you to speculate, if the product is pelletized or dried and could be surface applying and of high fertilizer value, what would be a price per ton that would make sense for your operation?
Would not provide a range of price they would pay for nutrients, but they did like the application.

J. What do you like about the Metrogro program?
People (Kim Meyer specifically), Equipment/Well maintained – do not have to stop a task to go help fix, repair, etc., do what they say they will do, clean and neat, and incentives are nice.

1) What could be improved?
Reduce or eliminate compaction.

K. What type of product could Metrogro provide to help your operation?
Consolidated nutrients, less water, more dense nutrients, and allow customer application.

L. How could Metrogro help you implement your farm conservation goals? (e.g. nutrient management, soil health, reduced/no-till)
Not create a problem later, down the road (metals and PFAS were noted)

M. How can Metrogro help reduce the risk of your investment?
Uniformity of spread/application with solid biosolids
Continue to Care

N. Open Discussion

PFAs

Adam Travis asked about PFAS: If PFAS is high in the biosolids and a farmer allows the application, is the farmer guilty by association?

Discussion about wheat acres:

The price point at which a farmer has minimal risk ended up being $150/ac. At that price point there seemed to be some interest:
Skaar would have a max of 100 acres for wheat
Klahn would go from 100 acres to 500-600 acres
Travis would have 100-200 acres
May be a good transition short-term plan. Would also have to compare the current wheat incentive vs this proposal.

High Organic Matter

Increase soil water holding capacity, soil health and could mitigate effects of compaction

Nitrogen

All three indicated that they would prefer nitrogen be more concentration and put into solids at higher concentration like commercial fertilizer.

Skwor Opinion:

Based on the two stakeholder meetings it seems that several products would be the most advantageous. Dried/composted seems to have the most interest with more windows for application. However, there is a desire to keep the liquid because of the nitrogen. I think cake application is least desirable. The higher content and more nutrients in the biosolids product the better.

4. **Actions/Follow-Ups**
   A. Andy & Kim to use answers to adjust questions and hold additional conversations with other stakeholders.
   B. Investigate fertilizer augmentation options

Minutes Prepared By: Andy Skwor & Steven Sell

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