

CHAPTER 2 INTRODUCTION

This report presents the conclusions and recommendations of the Solids Handling Facilities Plan for the Madison Metropolitan Sewerage District (MMSD), Madison, Wisconsin. MMSD is a municipal corporation that provides wastewater collection and treatment services to 43 municipal customers in its service area, encompassing approximately 178 square miles and serving a current population of about 330,000 people. MMSD owns 95 miles of interceptor sewers, 29 miles of force mains, 15 miles of effluent force mains, and 17 regional pumping stations. All wastewater collected from the service area is treated at MMSD's Nine Springs Wastewater Treatment Facilities (NSWWTP). The NSWWTP is a 50 mgd plant employing biological nutrient removal to meet effluent discharge standards for ammonia and phosphorus. Treated biosolids (residuals from wastewater treatment) are recycled to agricultural lands through MMSD's Metrogro program, a successful enterprise for the last 30 years.

In the 10th Addition to the Nine Springs WWTP (NSWWTP) the Madison Metropolitan Sewerage District (MMSD) converted its conventional mesophilic anaerobic digestion system to an advanced temperature phased anaerobic digestion (TPAD) process. Since startup in 2006, the TPAD facilities have not been able to achieve the District's goal of a Class A biosolids product. A number of issues have prevented the system from performing as originally intended, primarily related to process heating and stability. MMSD modified the process train to include an acid phase digester prior to the thermophilic and mesophilic phases to alleviate some of the process issues. While partially successful, the acid phase modification did not result in adequate process stability and production of Class A biosolids..

In 2008 MMSD initiated the preparation of a Solids Handling Facilities Plan. The primary goal of the Plan is to provide the District with a detailed roadmap to achieve a reliable, cost-effective, sustainable process yielding a Class A biosolids product. In addition to advanced anaerobic digestion, the Solids Handling Facilities Plan encompasses several related aspects of the existing digestion system.

The facilities planning process is required by the Wisconsin DNR and U.S. EPA prior to construction, expansion, or modification of the wastewater treatment plant. The planning process is a systematic economic, technical, and environmental evaluation of alternatives for wastewater treatment and disposal. The recommended wastewater treatment alternative must

meet the required effluent limitations and be cost-effective. The facilities planning procedure assures the public and all levels of government that decisions regarding the facilities are soundly made and consider all relevant factors.

PROJECT BACKGROUND

The 10th Addition to the NSWWTP encompassed eight years of testing, planning, design, construction, and start-up activities. One of the primary aspects of the 10th Addition was the conversion of the solids handling system to an advanced anaerobic digestion process (temperature phased anaerobic digestion, or TPAD), with the goal of producing a Class A biosolids product. The TPAD process at NSWWTP was designed to operate in a batch-feed, two-stage configuration, with a thermophilic first stage followed by a mesophilic second stage. Three thermophilic digesters were to run in sequential batch feed / digest / drawdown modes, with each mode lasting 12 hours. The 12-hour digestion time at 135 °F would meet the regulatory requirements for producing Class A biosolids. Substantial modifications to the existing anaerobic digestion facilities included new Digester No. 7, gas mixing systems, sludge recirculation and transfer pumping, boilers, and heat exchangers.

The 10th Addition facilities have not achieved the original objectives for a Class A biosolids product after two years of start-up and testing. A series of operational issues have arisen, generally described as follows:

- Process instability resulting in digester foaming
- Heat transfer inhibition leading to inadequate digester heating

The District made process modifications in an effort to address these difficulties, incorporating an acid-phase digester prior to the thermophilic stage in an attempt to reduce grease build-up in heat exchange equipment. The District also made a series of modifications to address related issues:

- Progressing cavity pumps replaced centrifugal sludge transfer pumps to eliminate gas binding.
- Higher ferric chloride doses were employed to mitigate struvite formation downstream of the thermophilic digesters. The iron dosing rate must be balanced against the potential to form vivianite in the secondary heat exchangers.
- Glass-lined piping was installed to replace struvite-laden sludge lines in the Solids Tunnel.

- A grinder was installed in the raw sludge line to reduce ragging in the heat exchangers.
- A gas treatment system was added to remove impurities and moisture in the biogas.

The 10th Addition digestion system was operated in the modified acid-thermo-meso mode of operation, with all sludge being fed through Digester No. 7 as the acid phase digester. Due to some of the materials handling limitations, the system did not achieve a Class A status, and process instability was problematic. The District eventually converted the anaerobic digestion system back to a stable mesophilic operation, which is the current mode of operation. The mesophilic operation is intended to be an interim mode until the Solids Handling Facilities Plan project, with resultant construction can be completed.

PURPOSE AND SCOPE

A Facilities Plan develops the most cost-effective and environmentally sound plan for wastewater management to abate existing sources of pollution, provide adequate treatment capacity for future growth in the planning area, and meet area wide water quality standards and water management goals issued by the DNR. The most current planning guidelines and regulations distributed by the U.S. EPA and DNR were used to prepare this report.

The scope of work for this Solids Handling Facilities Plan included the following activities:

1. Review existing data and facilities by visiting the facilities with District personnel, and obtaining copies of operating data and reports. The data will include: influent and effluent data as well as biosolids data for a minimum of three years. The data will also include appropriate previous reports.
2. Analyze the performance of the existing anaerobic digestion system, and individual unit operations within. Review existing facilities to identify items that will need modification, upgrading or replacement.
3. Review previous memos addressing modes of operation for the existing facilities. Identify methods to optimize operation of the existing facilities using acid phased digestion. Determine a preliminary list of operating procedure modifications and minor facility enhancements that could improve digester operations during the interim period before the planned facilities are constructed and operational. Complete a workshop with the District staff to present preliminary findings and

brainstorm additional ideas to optimize the existing facilities and develop a consensus on an action plan during the interim period. Prepare a brief memo summarizing of the interim program action plan.

4. Since this is a Solids Handling Facilities Plan, an infiltration/inflow (I/I) analysis will not be included.
5. Utilize 10 year and 20 year population and flow / loading projections provided by the District.
6. Correspondence with the Wisconsin Department of Natural Resources related to developing effluent limits will not be required since this is a Solids Handling Facilities Plan.
7. Select, develop and investigate viable wastewater management alternatives that address the needs of the District. Conduct a brainstorming meeting with the District to obtain input and to screen the alternatives.
8. Make arrangements for visits to plants with District staff to view process arrangements / equipment that are being evaluated during the project if requested.
9. Prepare technical memoranda to provide input for the project-specific issues and as a means of intermediate communication with the District. The technical memoranda will be included as an Appendix to the Facilities Plan. Technical memoranda are anticipated for the following topics:
 - Review / screening of Class A biosolids technologies
 - Plant loading and biosolids production projections for 10 and 20 years
 - Anaerobic digestion modeling
 - Implementation of Acid Phase Digestion
 - Regulatory approval of Class A protocol
 - Solids Thickening
 - Biogas utilization
 - Heat transfer / temperature control
 - Digester mixing evaluation
 - Phosphorus removal for struvite control / mitigation of scale formation

- Grease Receiving and Digestion
 - Digester foaming mitigation
 - Mesophilic anaerobic digestion with Class A sidestream treatment
 - Plant site development
10. Prepare a mid-course review presentation to discuss the project with the District, DNR, and other interested agencies.
 11. Prepare sizing and layouts for the viable alternatives. Identify potential arrangements on the present treatment plant site.
 12. Prepare a cost-effectiveness analysis and a non-monetary evaluation of the viable alternatives. Estimate capital costs and operations and maintenance costs for the viable alternatives. Evaluate non-monetary advantages and disadvantages of the viable alternatives. Recommend a preferred alternative to the District.
 13. Prepare an implementation plan and schedule for the selected alternative. The District will estimate the impact of the selected plan on the District's sewer user charge system.
 14. Prepare a draft facilities plan report and submit 5 copies to the District for review.
 15. Assist the District in conducting a public hearing on the draft facilities plan.
 16. Finalize the facilities plan incorporating comments from the District, and submit 10 copies of the final facilities plan to the District and DNR. Provide electronic versions of the final facilities plan in WORD and PDF formats. Review any DNR comments and prepare a response and provide information as required to obtain DNR approval of the facilities plan.

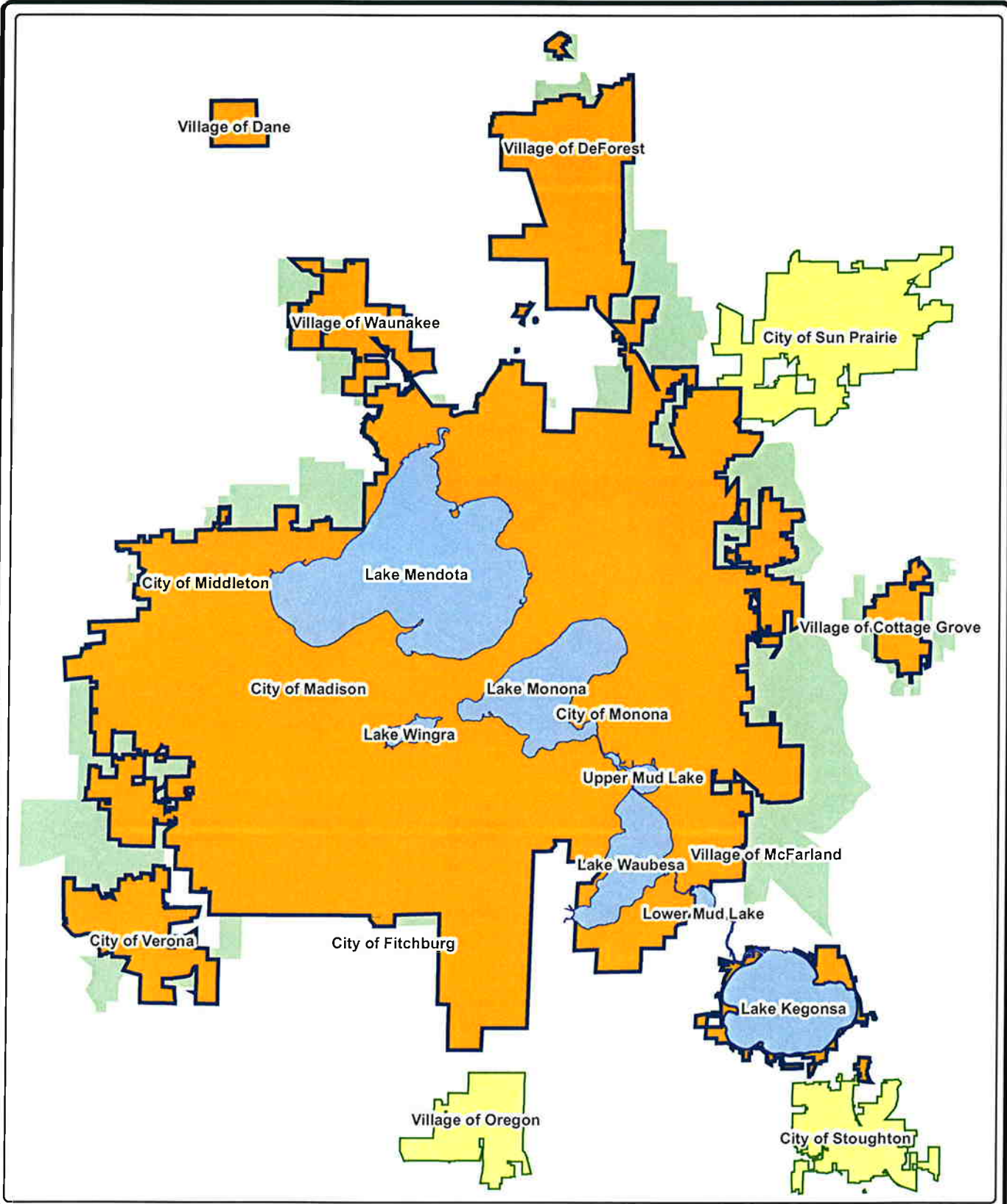
PROJECT DOCUMENTATION

The Solids Handling Facilities Planning effort has been documented through a series of technical memoranda and workshops that are included Appendices attached to this report.

PLANNING AREA AND STUDY PERIOD

The planning area for the Facilities Plan is the same as the 2030 Sewer Service Area, shown in Figure 2-1. The planning area encompasses approximately 219 square miles.

In accordance with state and federal criteria, the planning period for the Facilities Plan will be 20 years. Therefore, the planning period encompasses the years 2010 through 2030.



Village of Dane

Village of DeForest

Village of Waunakee

City of Sun Prairie

City of Middleton

Lake Mendota

Village of Cottage Grove

City of Madison

Lake Monona

City of Monona

Lake Wingra

Upper Mud Lake

City of Verona

City of Fitchburg

Lake Waubesa




Village of McFarland

Lower Mud Lake

Lake Kegonsa

Village of Oregon

City of Stoughton

-  Present District Boundary
-  Potential 2030 Boundary
-  Outside District

**POTENTIAL 2030
MMSD SERVICE AREA**

**MADISON METROPOLITAN SEWERAGE DISTRICT
2008**

FIGURE 2 - 1

