Report

Community Manure Management Feasibility Study

Dane County, WI

February 2008

Report for

Dane County, Wisconsin

Community Manure Management Feasibility Study

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EXECUTIVE SUMMARY

This section provides an overall summary of the report. For detailed information and discussion, please refer to the respective report sections.

ES.01 PURPOSE AND SCOPE OF REPORT

This study examines the feasibility of various community or individual farm-based manure management alternatives in the Upper Lake Mendota Watershed area of Dane County, Wisconsin. The study area is shown in Figure ES.01-1. The main goals of the study are to strengthen the livestock industry in the County and protect water quality as related to manure management. The scope of this study included the following elements: (1) survey of area farms, (2) selection of farms to include in the analyses, (3) identification and selection of management alternatives to be studied, (4) technical and economic analyses of the alternatives, (5) discussion of nonmonetary evaluation of the alternatives, (6) potential financing methods, and (7) business structures for the recommended project(s).

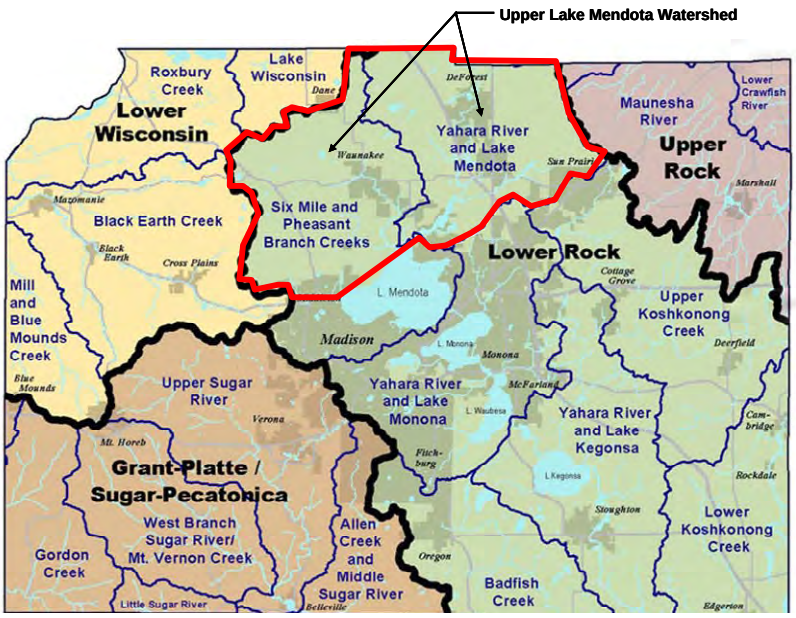

Figure ES.01-1 Upper Lake Mendota Watershed in Dane County

ES.02 CLUSTER IDENTIFICATION AND SURVEY RESULTS

A questionnaire was developed and sent to 117 Dane County farmers in the Upper Lake Mendota watershed to collect information on farming operations and manure management practices in the area. Forty-one farmers responded with useful information. The survey responses were used to identify and select the two clusters (see Figure 2.01-2, Waunakee Cluster and Middleton Cluster) evaluated in this report, and the data collected was used to develop the design bases for the manure management alternatives. Detailed discussion of the clusters, as well as responses to the 16 survey questions, are provided in Section 2.

The Waunakee Cluster includes three farms with a total of approximately 3,145 animal units (A.U.). The farms are located within approximately one-half mile of each other, and additional farms are located nearby. The Middleton Cluster includes seven farms with a total A.U. of approximately 3,813. The Middleton Cluster farms are farther apart from each other than the Waunakee Cluster Farms.

ES.03 TECHNOLOGY REVIEW AND SELECTION OF MANAGEMENT ALTERNATIVES

A review of the status of the various manure management technologies is included in Section 3. The review is focused on viable technologies for manure solids destruction, manure solids separation, and phosphorus removal and recovery from manure. Eight management alternatives were then selected for further study based on the status of technology, potential viability, and ability to meet the project goals, the most significant of which is to reduce the manure-related phosphorus loading to the area lands by at least 40 percent. Three of the eight alternatives are for application at individual farms (F-1 through F-3), and the remaining five alternatives are community solutions that could be applied at the Waunakee or Middleton Clusters (C-1 through C-5). These alternatives are listed below:

- F-1. Fine solids separation with polymer addition.
- F-2. Fine solids separation with ferric chloride and polymer addition.
- F-3. Anaerobic digestion; solids separation with ferric chloride and polymer addition.
- C-1. Fine solids separation with polymer addition.
- C-2. Fine solids separation with ferric chloride and polymer addition.
- C-3. Anaerobic digestion; solids separation with ferric chloride and polymer addition.
- C-4. Fine solids separation with ferric chloride and polymer addition; drying.
- C-5. Drying followed by combustion.

ES.04 OPINION OF COSTS COMPARISONS AND SENSITIVITY ANALYSES

Detailed discussion of the preliminary design criteria and design bases are presented in Chapter 4. The capital costs of the alternatives were developed assuming each facility would be constructed with a capacity to handle the existing manure from the farms, plus the anticipated growth of the farms over the next five years, plus a reserve capacity equal to 25 percent of the anticipated manure loadings. The annual operation and maintenance (O&M) costs were developed using only the current and anticipated manure loadings, which does not include the 25 percent reserve capacity. This latter design basis was used to develop mass flow diagrams for each of the alternatives, which are included in Figures 4.02-1 through 4.02-3 and Figures 4.03-1 through 4.03-10. The opinion of capital costs and annual O&M costs were developed for each of the eight alternatives and are summarized in Table ES.04-1 and ES.04-2, respectively. Total cost opinions are presented as well as costs per animal unit and cost per pound of phosphorus removed. At this feasibility level of detail, all opinions of costs should be considered preliminary and have an approximate confidence level of +/- 25 percent.

Alternative	P Removed (%)	Capital Costs		
		Total	Per Current A.U.	Per Design A.U.
Individual Farm[a]				
F-1	45%	$1,426,000	$2,850	$2,130
F-2	85%	$1,685,000	$3,370	$2,510
F-3	85%	$2,840,000	$5,680	$4,240
Waunakee Cluster[b]				
C-1W	45%	$6,423,000	$2,040	$1,500
C-2W	85%	$8,415,000	$2,680	$1,960
C-3W	85%	$11,495,000	$3,660	$2,680
C-4W	90%	$13,507,000	$4,300	$3,150
C-5W	100%	$11,333,000	$3,600	$2,640
Middleton Cluster[c]				
C-1M	45%	$5,127,000	$1,340	$1,030
C-2M	85%	$8,215,000	$2,150	$1,660
C-3M	85%	$10,934,000	$2,870	$2,210
C-4M	90%	$13,247,000	$3,470	$2,670
C-5M	100%	$10,319,000	$2,710	$2,080

[a] Current A.U. = 500; design A.U. = 669.
[b] Current A.U. = 3,145; design A.U. = 4,293.
[c] Current A.U. = 3,813; design A.U. = 4,957.
[d] The opinion of costs are considered +/- 25 percent at this time.

Table ES.04-1 Opinion of Capital Cost Summary[d]

Based on capital cost comparisons, the cluster alternatives are considerably less expensive than the individual farm alternatives when compared on the bases of “per animal unit” for similar technologies (e.g., comparing F-3 with C-3W and C-3M). The Middleton Cluster has lower “per A.U.” capital costs, which is the result of the pumping and piping infrastructure included in the Waunakee Cluster and not in the Middleton Cluster (see Chapter 3).

Alternative	P Removed (%)	Opinion of Net Annual O&M Expense (Revenue)			
		Year 2007	Year 2012	Year 2012 + 25% (design A.U.)	Per A.U. (2007)
Individual Farm[a]					
Existing	0%	$82,000	$93,000	$107,000	$164
F-1	45%	$152,000	$165,000	$193,000	$304
F-2	85%	$53,000	$47,000	$48,000	$106
F-3	85%	$82,000	$78,000	$80,000	$164
Waunakee Cluster[b]					
Existing	0%	$936,000	$1,059,000	$1,218,000	$298
C-1W	45%	$1,007,000	$1,086,000	$1,291,000	$320
C-2W	85%	$98,000	$20,000	($13,000)	$31
C-3W	85%	($220,000)	($350,000)	($480,000)	($70)
C-4W	90%	$884,000	$890,000	$1,072,000	$281
C-5W	100%	($183,000)	($296,000)	($409,000)	($58)
Middleton Cluster[c]					
Existing	0%	$682,000	$772,000	$926,000	$179
C-1M	45%	$946,000	$1,031,000	$1,222,000	$248
C-2M	85%	$600,000	$612,000	$701,000	$157
C-3M	85%	$304,000	$268,000	$271,000	$80
C-4M	90%	$1,144,000	$1,210,000	$1,451,000	$300
C-5M	100%	$235,000	$199,000	$193,000	$62

[a] Year 2007 A.U. = 500; Year 2012 A.U. = 535; design A.U. = 669.
[b] Year 2007 A.U. = 3,145; Year 2012 A.U. = 3,434; design A.U. = 4,293.
[c] Year 2007 A.U. = 3,813; Year 2012 A.U. = 3,966; design A.U. = 4,957.
[d] O&M costs do not include the cost for any commercial fertilizer required to replace manure-based fertilizer not applied to the soil in any of the alternatives.

Table ES.04-2 Opinion of Annual O&M Costs[d]

The annual O&M cost opinions show similar results, especially for the Waunakee Cluster compared to the individual farm alternatives. The Middleton Cluster alternatives have a less significant O&M cost advantage over the individual farm alternatives, which is a result of the long haul distances from the farms to the centralized cluster facility. Additional observations were made:

1. For the individual farm alternatives, only Alternative F-2–Fine solids removal with polymer and ferric addition appears to lower annual O&M costs significantly compared to the existing O&M cost opinions.

2. For the cluster alternatives, the Waunakee cluster appears to have significantly lower annual O&M costs than the Middleton cluster. This is mainly because in the Waunakee cluster, manure and returned liquids are pumped to and from the cluster site, whereas in the Middleton cluster the manure and returned liquids are transported by truck.

3. For the Waunakee cluster, all the alternatives except C-1W (solids separation) and C-4W (drying) are anticipated to lower annual O&M costs significantly compared to the existing farms' O&M costs. The reason that Alternative C-1W is not anticipated to lower annual O&M costs for the farms in that cluster is that, because of the relatively lower solids and phosphorus removal achieved by this technology, the nutrient level of the liquids returned to the farms will still require trucking to the land, which has a higher O&M cost than pumping to land application fields. Alternative C-4W has a high annual cost for natural gas.

4. For the Waunakee cluster, the options that include energy recovery (Alternatives C-3W and C-5W) appear to generate net revenue. That is, the preliminary estimate of revenue streams (sale of solids, electricity buy-back, and greenhouse gas (GHG) emission reduction credits) exceeds the annual costs to operate the facilities. In addition, as the amount of manure handled increases, the net revenue appears to increase.

5. For the Middleton cluster, only the alternatives with energy recovery (Alternatives C-3M and C-5M) appear to lower annual O&M costs to a significant degree compared to the existing farms' collective O&M costs.

6. For the anaerobic digestion (C-3W) and combustion (C-5W) alternatives for the Waunakee Cluster, the amount of electrical generation potential is approximately 9,700 kWh/day and 13,100 kWh/day, respectively. This is equivalent to the amount of power used by approximately 415 and 560 homes, respectively, with an average energy use of 700 kWh/month.

7. Similarly, for the Middleton Cluster Alternatives C-3M and C-5M, the amount of electrical generation potential is approximately 7,300 kWh/day and 9,800 kWh/day, respectively, which is equivalent to the amount of power used by approximately 313 and 420 homes, respectively.

8. On a preliminary basis, the maximum potential GHG emissions reduction from eliminating long-term lagoon storage of the manure is estimated at approximately 19,800 metric tons/year of equivalent CO_2 for Alternatives C-3W and C-5W (Table 4.05-2). This is approximately equivalent to:

a. The CO_2 emissions from the annual electrical generation to supply 3,800 homes using 700 kWh/month of electricity (1 kWh of electricity ~ 1.37 lbs CO_2).

b. The CO_2 emissions from the annual natural gas use of 3,900 homes using 80 therms of natural gas/month (1 MMBTU of natural gas ~ 117 lbs CO_2).

c. The CO_2 emissions from driving approximately 50 million miles/year at an average fuel economy of 25 miles/gallon (1 gallon of gasoline ~ 21.7 lbs CO_2).

O&M sensitivity analyses were developed for three main factors: manure/returned liquids hauling costs, solids disposal revenue, and GHG emission reduction credits. These were selected because of the significant impact these factors have on the overall O&M cost opinions as well as the relative difficulty in predicting the costs or value of these factors in the future. The base conditions for the sensitivity analyses are 2007 conditions and unit costs. Tables 4.06-1, 4.06-2, and 4.06-3 present the analyses.

ES.05 NONMONETARY ISSUES EVALUATION

Important nonmonetary issues were selected following a review of the Dane County Manure Feasibility Study Committee's goals and issues included in the County's request for proposals. The relative importance of each nonmonetary issue was then established with input from members of the Manure Management Committee and others having knowledge of the issues. Descriptions of the nonmonetary issues and criteria for scoring are provided in Table 5.01-1; weighting factors and scores are provided in Table 5.01-2. The two anaerobic digestion alternatives have the highest nonmonetary scores, with Alternative C-3 (cluster anaerobic digestion) having the highest overall score of 73 and Alternative F-3 (individual farm anaerobic digestion) having a score of 61. The alternatives with fine solids separation and ferric chloride addition, Alternatives F-2 and C-2, were rated the next highest with scores of 50 and 45, respectively. The remaining alternatives were all assigned similar scores of 37 or 38.

ES.06 POTENTIAL FINANCIAL ASSISTANCE

A range of financial assistance opportunities for manure management projects is available from local, state, and federal sources. However, the financing and financial aid opportunities for a manure management project are dependent on several factors, particularly the type of ownership, financial need, and type of project. For example, farmer-owned facilities may be more eligible for certain grants than a venture capital investment firm-owned facility. Likewise, a renewable energy project (e.g., anaerobic digestion, manure combustion) is likely to be more eligible for grants than a project that simply separates solids to improve nutrient management.

It is important to realize that financial assistance programs for manure management projects are constantly evolving and new programs are being developed. In addition, the existing programs may be modified, expanded, or discontinued in the future. Chapter 6 presents a summary of programs currently available from known local, state, and federal sources.

ES.07 ALTERNATIVE BUSINESS STRUCTURES AND OWNERSHIP

A detailed discussion of potential business structures and/or ownership of a manure management facility is beyond the scope of this report. However, Chapter 7 does present a discussion of several ownership options, including individual farm ownership, cooperative ownership, third-party ownership, combination third-party/cooperative ownership, and government ownership. The discussion is focused on the ownership and potential business structure of a community or joint/cluster manure management facility. However, some of the potential ownership alternatives are applicable to single-farm installations of manure management equipment and systems. Table 7.01-1 presents a summary of this discussion, including advantages and disadvantages of each.

ES.08 CONCLUSIONS AND RECOMMENDATIONS

Chapter 8 of the report presents the main conclusions of the report and recommended next steps to move from this feasibility analysis to detailed planning. The following conclusions are provided to summarize the conclusions drawn in this report and to provide the bases for our recommendations:

- There is a great deal of interest from the Dane County farming community to develop manure management strategies. Manure management at many Dane County farms requires long hauling distances and land rental for land application of the manure at agronomic rates.

- Water quality impacts from land application of manure have been shown to be significant, and manure is a major source of phosphorus loading (and other nutrient loading) within the Upper Lake Mendota Watershed.

- Cluster manure management strategies appear to offer significant economies of scale with respect to capital costs compared to the individual farm systems. In general, while comparing similar manure management strategies, the capital cost projections of the cluster systems are approximately 50 to 75 percent of the capital cost of the individual farm systems when compared on a “per A.U.” basis.

- Some of the cluster management strategies have significantly lower annual O&M cost projections (per A.U. basis) than the existing annual O&M costs at the farms as well as the individual farm manure management strategies. In particular, Waunakee Cluster Alternatives C-2W, C-3W, and C-5W, and the Middleton Cluster Alternatives C-3M and C-5M could significantly reduce annual O&M costs and may generate net revenues for the farms.

- The Waunakee Cluster strategies have higher capital costs compared to the Middleton Cluster, which is mainly the result of the added infrastructure required to pump manure to the cluster management facilities rather than trucking the manure. However, because manure trucking is essentially eliminated for the Waunakee Cluster, the projected

annual O&M costs are much lower for the Waunakee Cluster compared to the Middleton Cluster.

- Given the proximity of the Waunakee Cluster farms to each other and the potential to pump manure rather than haul manure to the site, the Waunakee Cluster alternatives appear to offer more advantages and better long-term cost-effectiveness than the Middleton Cluster alternatives or individual farm alternatives. There may be other small clusters similar to the Waunakee Cluster that could also be identified.

The following recommendations are provided to indicate what additional steps should be taken to further define how best to implement such a project.

1. Continue discussions and information exchange with area Dane County farmers to assess on-going interest and promote community solutions.

2. At the County level, determine what level of financial commitment is reasonable to invest in the additional planning, design, and ultimate construction of a manure management strategy.

3. At the County level, discuss and determine whether such a facility could or should be owned and operated by the County. This may be affected by the level of interest in ownership among farmers.

4. Conduct a Facility Planning Study to further refine and develop the scope of select alternatives and strategies included in this report with a focus on the alternatives that appear most viable (C-2W, C-3W, and C-5W). This includes identifying potential site locations, verifying manure quantities and other potential feedstocks, working with system vendors to develop preliminary layout(s) of alternatives and more accurate cost opinions (capital and O&M), and conducting a detailed analysis of overall manure management practices on the affected farms. The output of this study would include an overall recommended manure management strategy and associated costs, which could then be used to better define potential ownership of the facility, operation of the facility, and funding programs that could help finance a project to construct the facility. The Facility Planning Report would provide much better definition of the project and costs to provide to interested third-party technology developers, farmers, and County officials.

5. Define agronomic and related crop management impacts that would result from a manure management facility, and include such impacts in the facility planning analyses.

6. Continue to investigate funding and financing opportunities for manure management facilities.

7. Investigate potential GHG emission reduction credits in more detail and determine what additional steps are needed to obtain maximum credit for such a project.

8. Evaluate the capital and O&M costs from actual full-scale operations in the United States, and estimate how those costs may translate to a similar operation in Dane County.

Regardless of how integral the County is in developing a manure management facility, and regardless of who owns and operates the facility, we recommend that the County maintain involvement throughout the planning, design, construction, and operation of the facility.