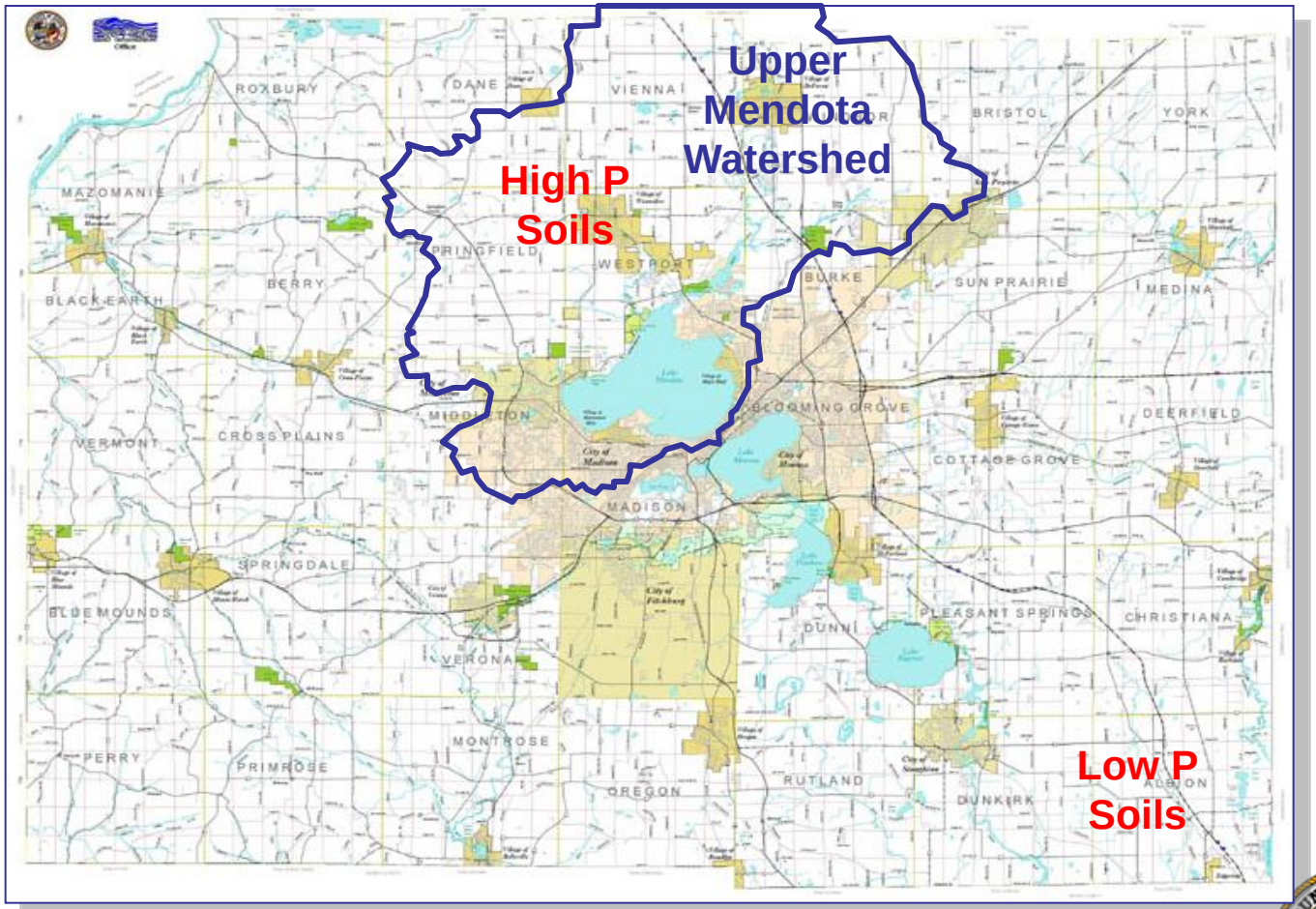
Community Manure Management Feasibility Study

Dane County, Wisconsin

Summary Presentation

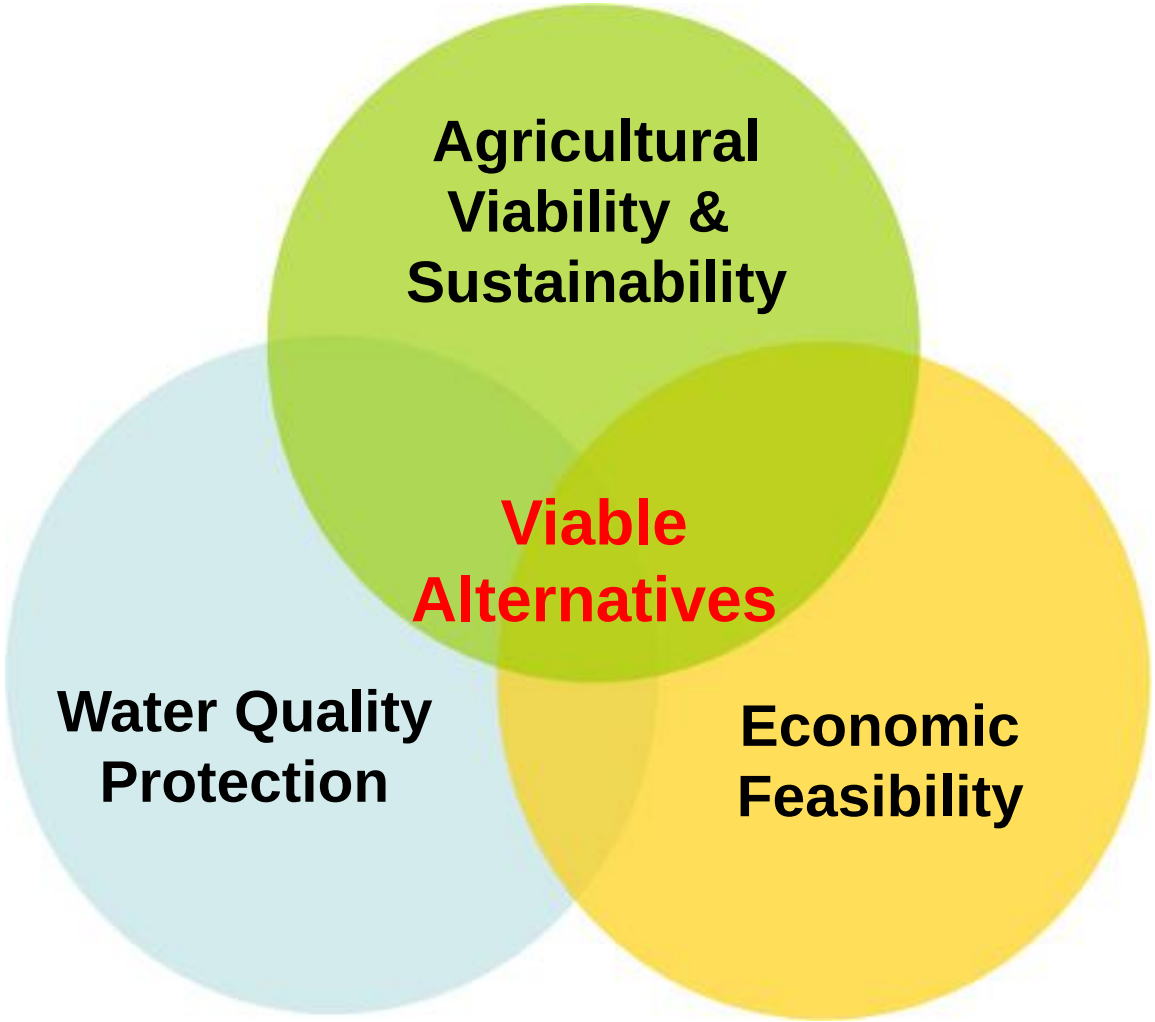
February 1, 2008

The Upper Mendota Watershed has a Long History in Agriculture



Base map courtesy of Dane County Land Information Office

Project Goals were Crafted Early to Direct the Project



Project Scope Followed Logically from Goal Development

1. Survey area farmers
2. Select farm clusters
3. Identify and select management alternatives
4. Evaluate technologies and economics
5. Evaluate nonmonetary aspects
6. Research potential financing/funding opportunities
7. Describe potential ownership and operation models
8. Develop conclusions and recommendations

Feasibility Studies are Not Designed to Provide Firm Answers!

- Determine whether any alternatives could feasibly meet the major goals
- Identify potential opportunities and preliminary assessments
- Identify data gaps and significant unknowns
- Identify next steps
  - Increased detail - reduced unknowns

COUNTY of DANE 1839 WISCONSIN

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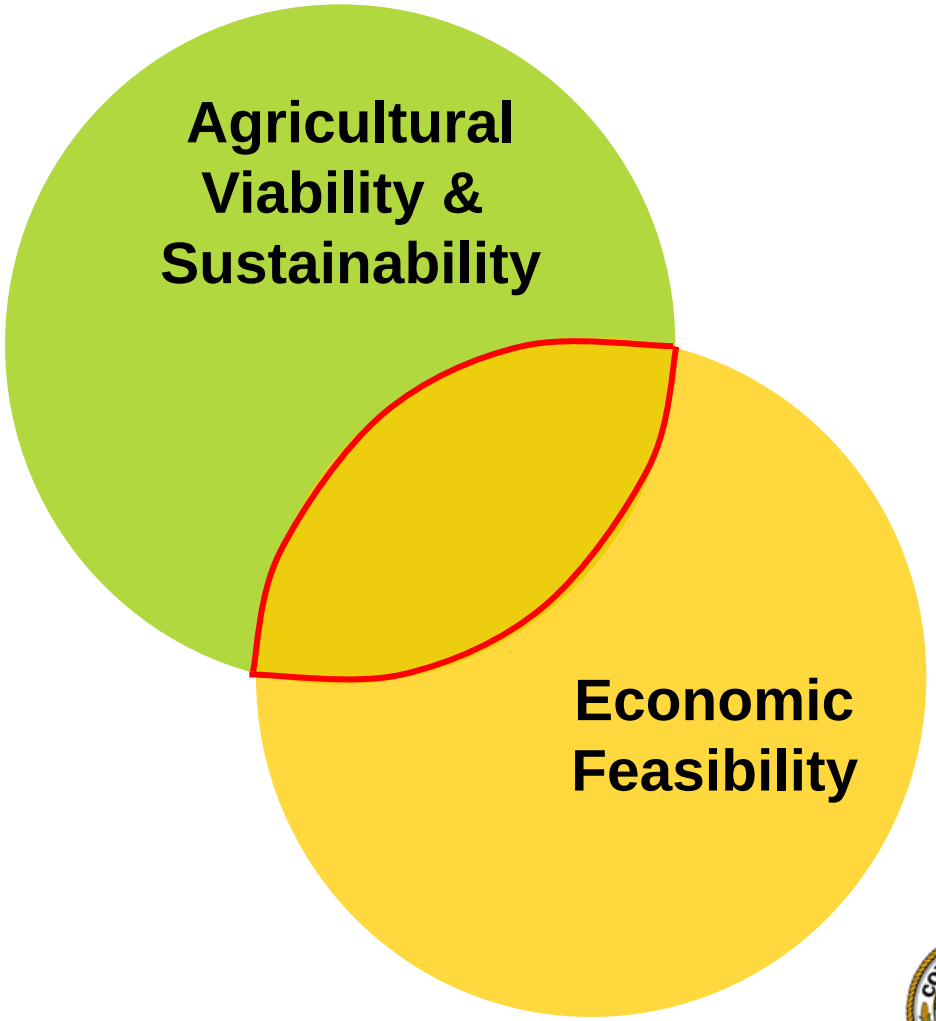
Project's Uniqueness Results from the County's Nutrient Management Goals



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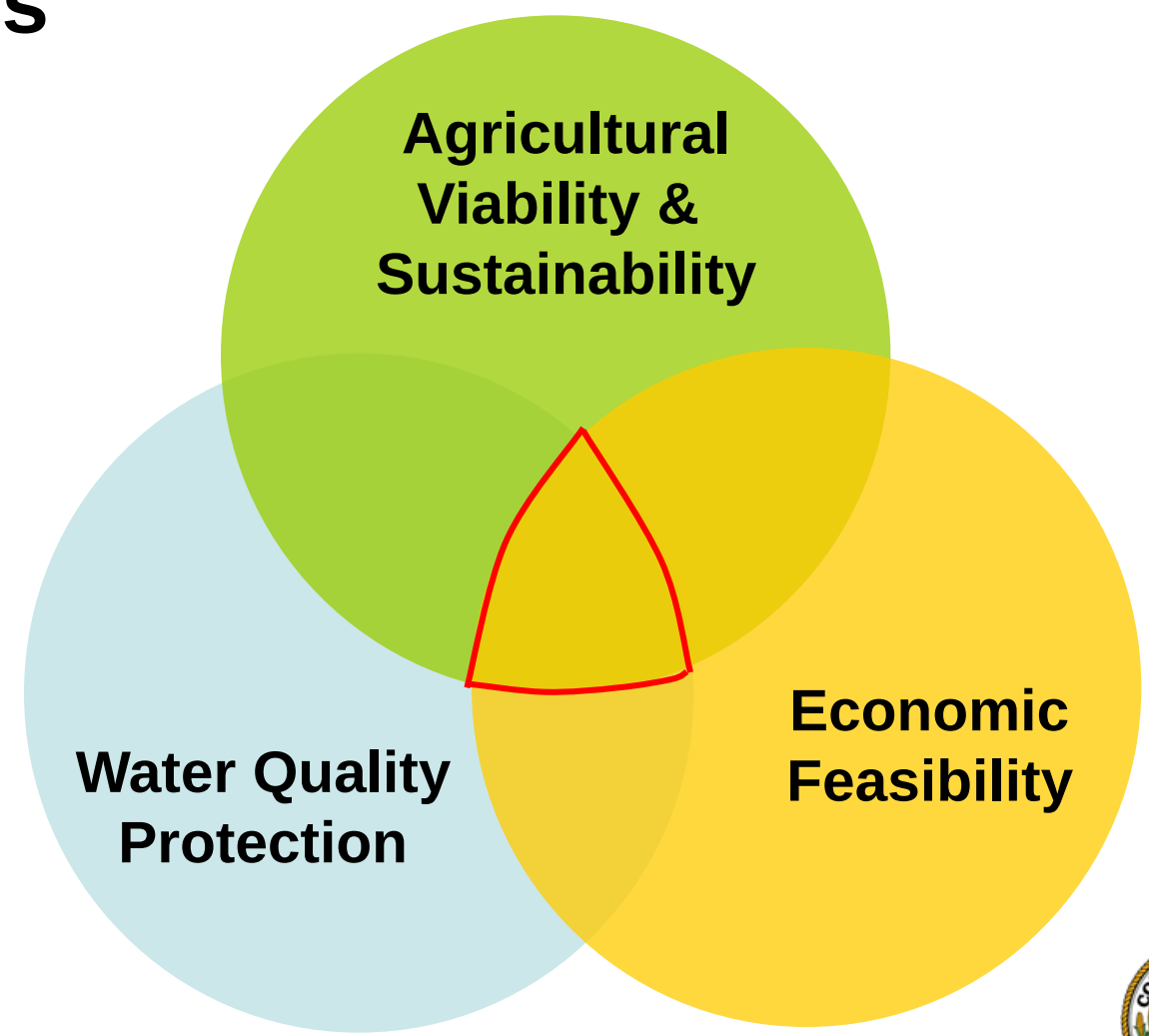


Survey was Developed to Collect Manure Management Data

Dane County Manure Management Survey
April 2007

Please answer all of the questions to the best of your ability. Any information provided will be kept strictly confidential. A summary of survey results will be provided to all respondents. Mail your questionnaire by April 13, 2007 to: Strand Associates, Inc., 910 West Wingra Drive, Madison, WI 53715 or fax it to Rachel Lee, 251-8655. Thanks for your help!

1. What do you see as your greatest farming challenges now and in five to ten years? **[CHECK ALL THAT APPLY.]**

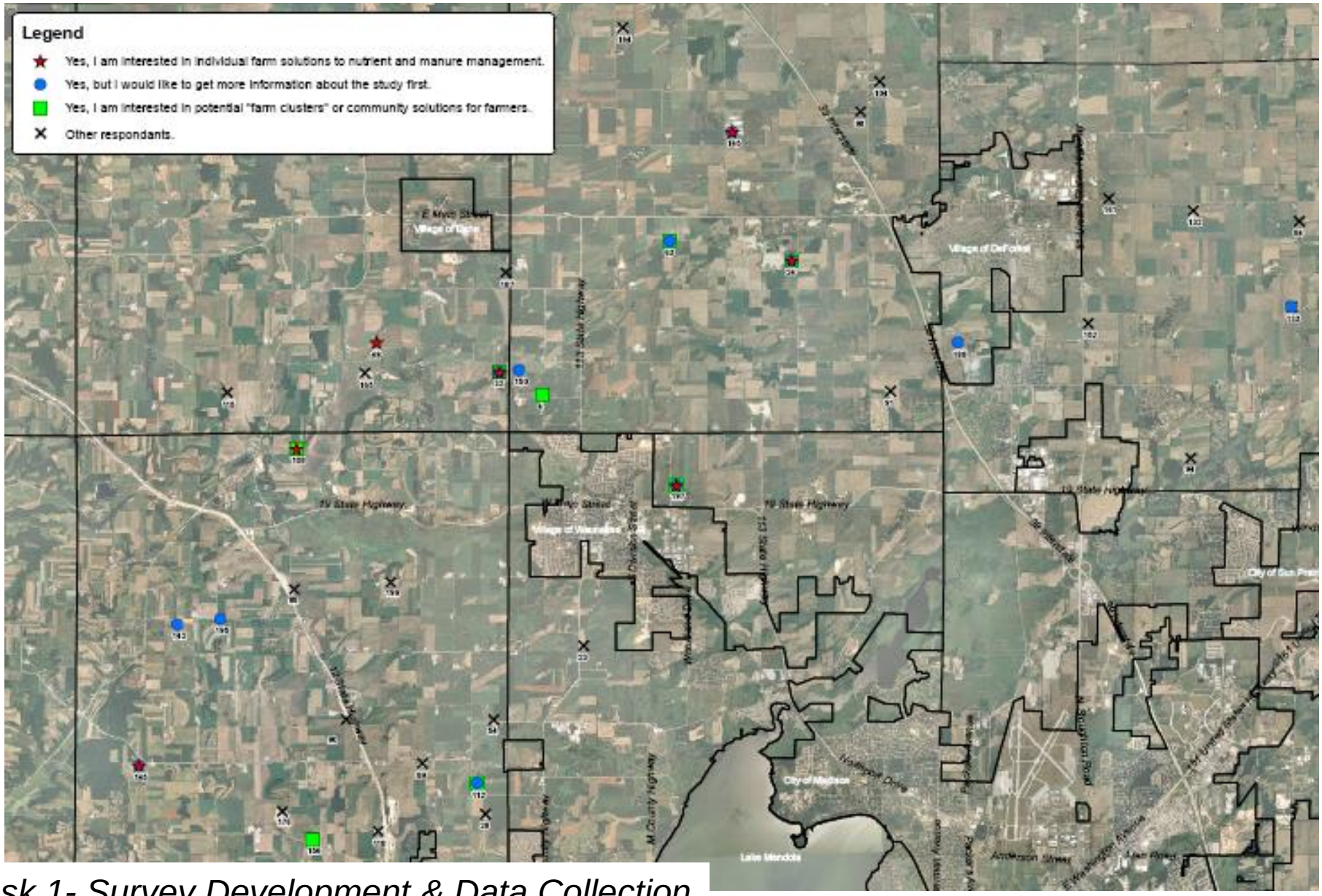
NOW **FUTURE**

❑..... ❑ .....Prices received for grain, milk and livestock
❑..... ❑ .....Cost of land in competition with urban development
❑..... ❑ .....Cost of inputs for grain and livestock production
❑..... ❑ .....Disposal of livestock manure (handling, storing & spreading)
❑..... ❑ .....Environmental laws and restrictions (odor, water quality, development)
❑..... ❑ .....Federal agricultural policies
❑.....Other _____
❑ .....Other _____

2. Please indicate how many acres of each crop you grow. Then enter how many acres of each receive manure.

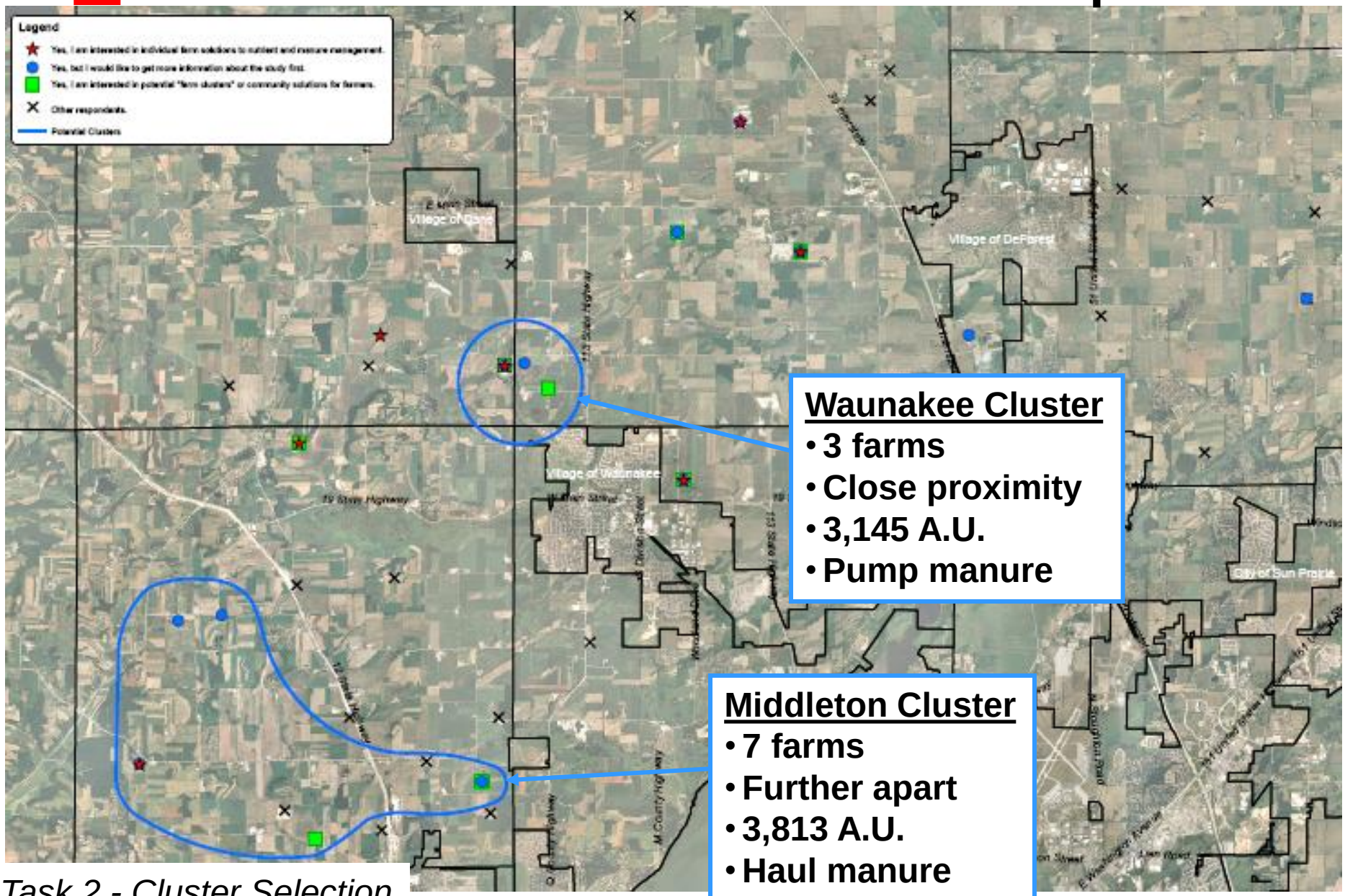
Crop	Acres Grown in 2006	Acres Owned Now Used for Manure Application	Acres Owned by Others Now Used for Manure Application
Corn for grain and silage			
Soybeans			
Small grains			
Alfalfa, clover & other forage crops			
Vegetables			
Pasture			
All other crops			

41 of 117 Farmers Responded to our Survey



Task 1- Survey Development & Data Collection

Cluster Selection - Location and Responses

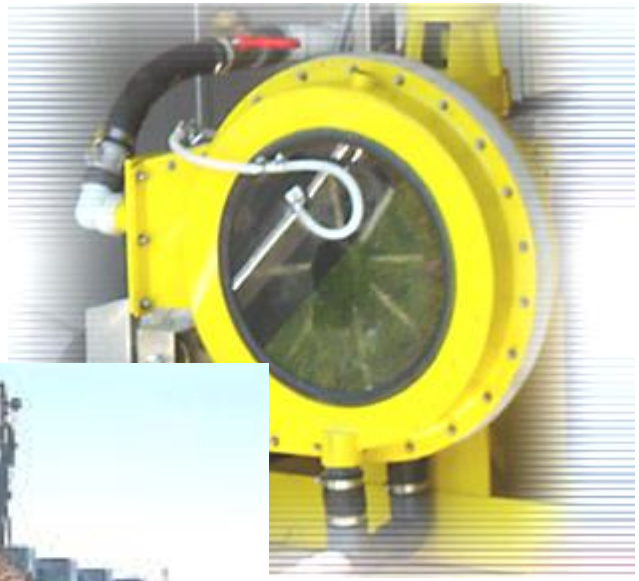


Technology Shortlist was Developed to Meet the Following Criteria

- P reduction of 40 percent, minimum.
- Proven at full-scale or at least long-term pilot scale.
- Individual Farm – 500 A.U.
- Waunakee Cluster – 3,145 A.U.
- Middleton Cluster – 3,813 A.U.
- Increase by anticipated growth + 25%

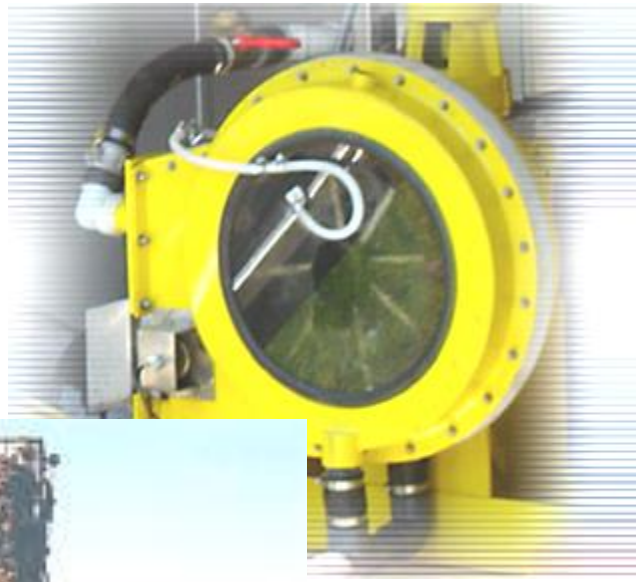
Shortlist - 5 Technologies/Approaches

1. **Mechanical solids separation with polymer**
   - **Single farm (F-1) and clusters (C-1W and C-1M)**
   - **~45% P reduction**



Shortlist - 5 Technologies/Approaches

2. **Mechanical solids separation with ferric and polymer**
   - **Single farm and clusters (F-2, C-2W and C-2M)**
   - **~85% P reduction**

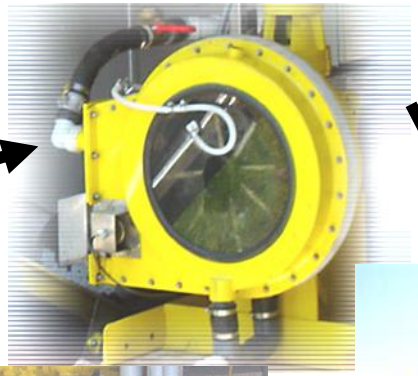


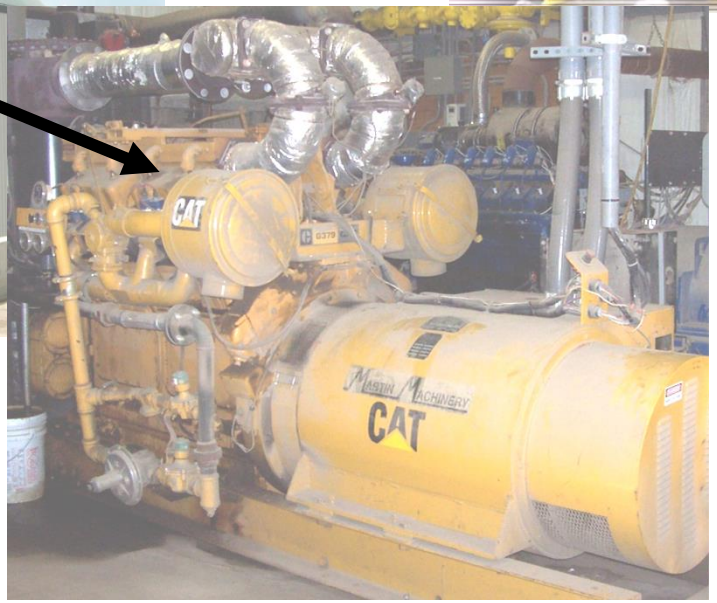
Shortlist - 5 Technologies/Approaches

3. Anaerobic Digestion with solids separation

- Single farm and clusters (F-3, C-3W and C-3M)
- ~85% P reduction
- Energy production

Ferric



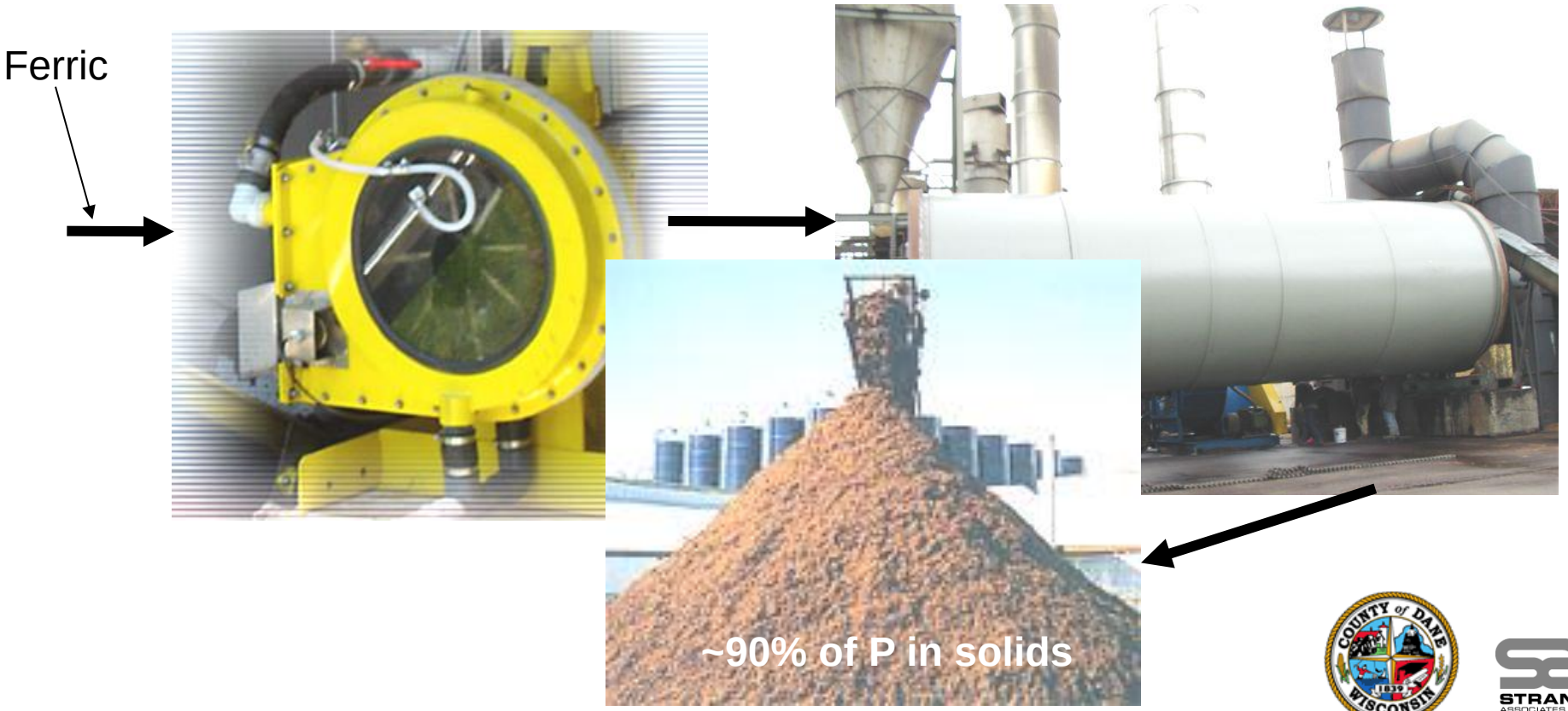


Electricity and Heat

Shortlist - 5 Technologies/Approaches

4. Solids separation followed by Drying

- Clusters only (C-4W and C-4M)
- ~90% P reduction
- Almost all water removed from solids



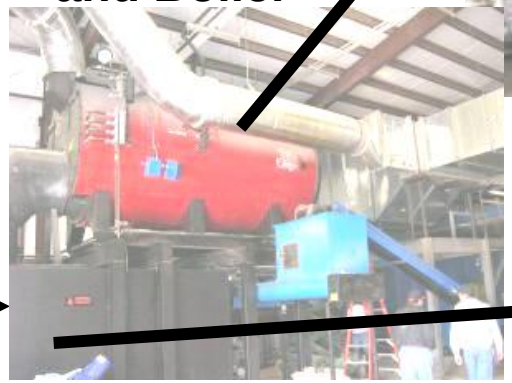
Shortlist - 5 Technologies/Approaches

5. Incineration

- Clusters only (C-5W and C-5M)
- 100% P reduction (and other nutrients)
- No water returned to land

Steam
Electrical
Generation

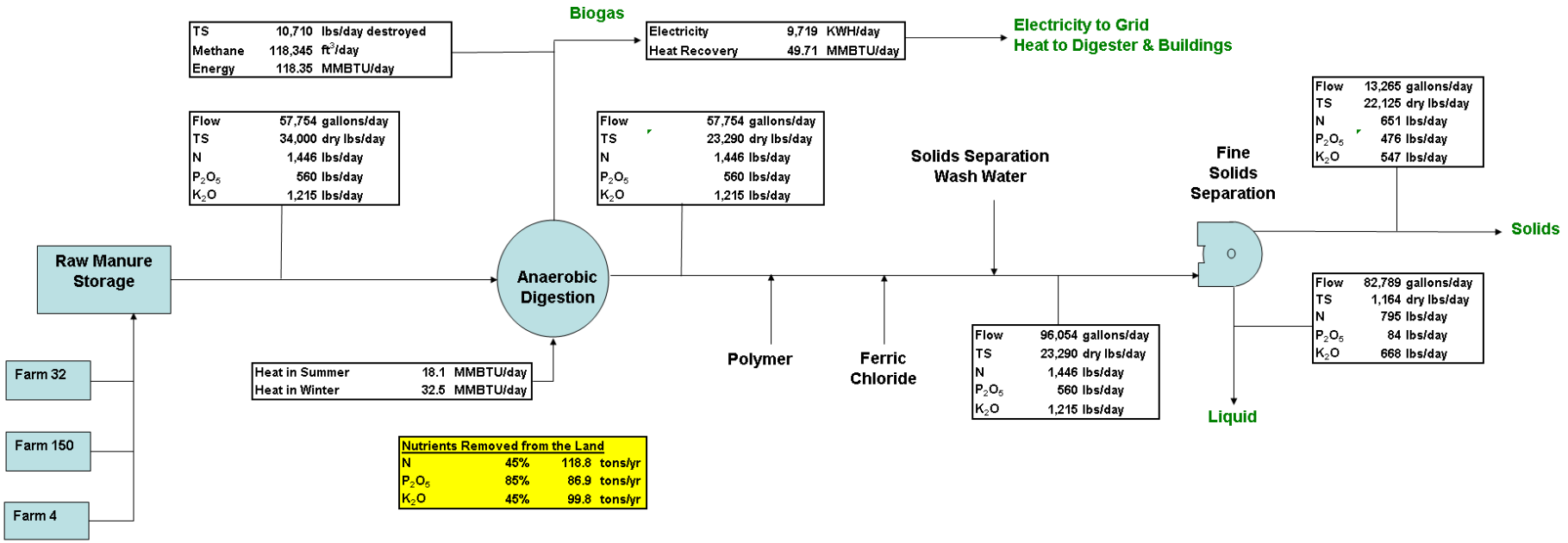
Manure Burner
and Boiler



Summary of Technical Alternatives

Alternative	Single Farm	Waunakee Cluster	Middleton Cluster
Alt. 1 – Solids Separation	F-1	C-1W	C-1M
Alt. 2 – Solids Sep. + Ferric *[Alt. 1 + Chem. P removal]*	F-2	C-2W	C-2M
Alt. 3 – An. Digestion + Solids Sep. *[AD + Alt. 2]*	F-3	C-3W	C-3M
Alt. 4 – Solids Sep. + Drying *[Alt. 2 + Drying]*		C-4W	C-4M
Alt. 5 – Incineration		C-5W	C-5M

Technical & Economic Evaluations



Opinion of Capital Cost Summary

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

$630

$1,100

$470

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.

Opinion of Capital Cost Summary (cont.)

Alternative	P Removed(%)	Capital Costs		
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Capital Cost Summary and Conclusions

- **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., F-3 with C-3W/C-3M)**
  - **Potential to save $600 - $2,000/A.U. with cluster concept**
- **The Middleton Cluster has lower "per A.U." capital costs than the Waunakee Cluster**
  - **Result of the pumping and piping infrastructure included in the Waunakee Cluster and not in the Middleton Cluster**

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Annual O&M Costs/Revenue

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	$174
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)	$30
C-3W	85%	($220,000)	($350,000)	($480,000)	($68)
C-4W	90%	$884,000	$890,000	$1,072,000	$281
C-5W	100%	($183,000)	($296,000)	($409,000)	($73)
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	$156
C-3M	85%	$304,000	$268,000	$271,000	$82
C-4M	90%	$1,144,000	$1,210,000	$1,451,000	$300
C-5M	100%	$235,000	$199,000	$193,000	$51

Annual O&M Costs/Revenue (cont.)

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O&M Cost Summary and Conclusions

- **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.**

- **For the cluster alternatives, the Waunakee cluster appears to have significantly lower annual O&M costs than the Middleton cluster**
  - **Pumping rather than trucking**

O&M Cost Summary and Conclusions

Waunakee Cluster:

- **All 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:**
  - **Alternative C-1W still requires trucking**
  - **Alternative C-4W has a high annual cost for natural gas**

- **Energy recovery options (C-3W and C-3M) appear to generate a net revenue:**
  - **Sale of solids**
  - **Electricity buy-back**
  - **Greenhouse gas (GHG) emission reduction credits**

O&M Cost Summary and Conclusions

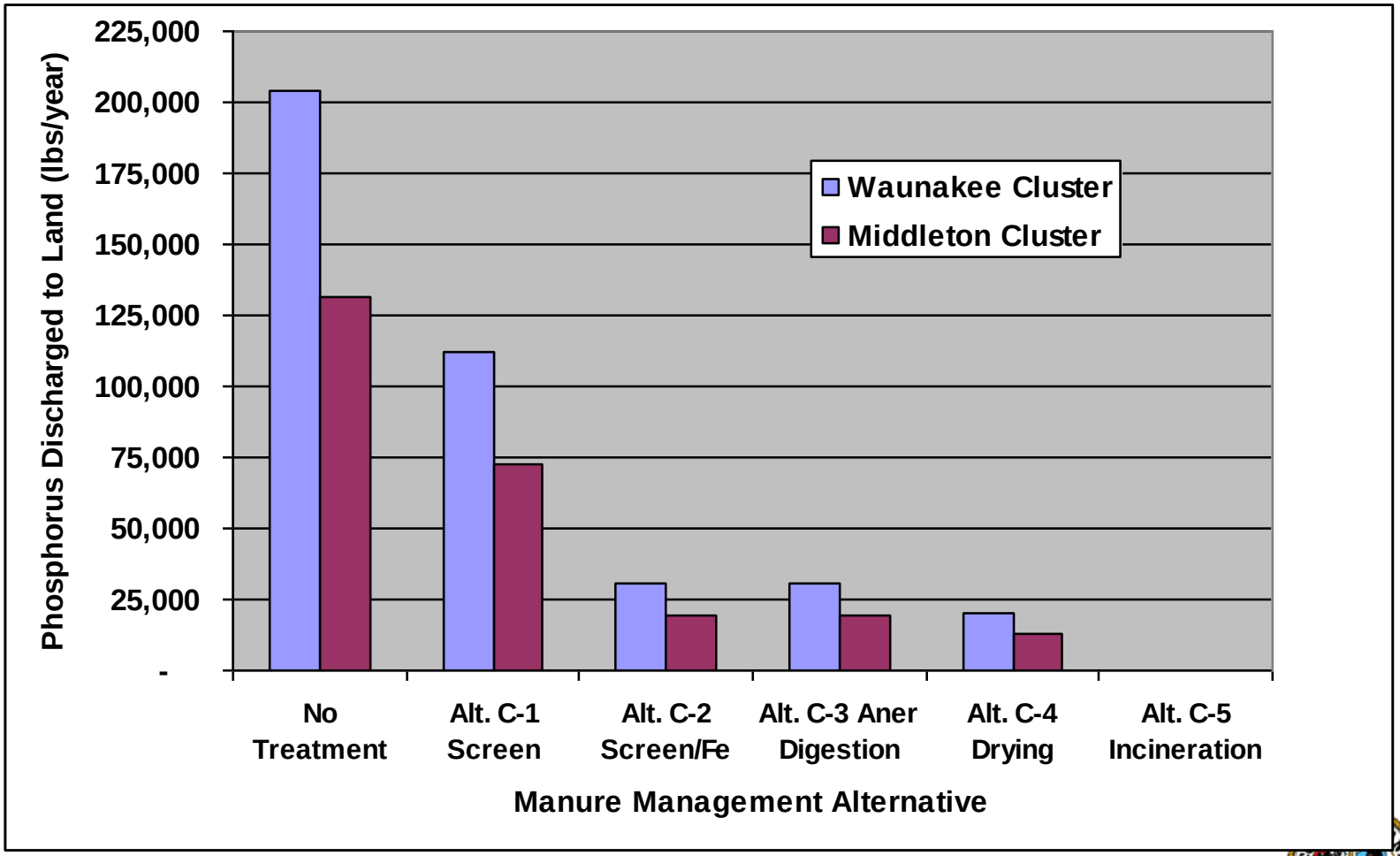
Middleton Cluster:

- **Energy recovery Alternatives (C-3M and C-5M) appear to lower annual O&M costs significantly compared to the existing farms' O&M costs.**

- **None of the alternatives appear to generate a net revenue.**

O&M Cost Summary and Conclusions

Phosphorus Reductions:



O&M Cost Summary and Conclusions

Value of Energy:

- **Waunakee Cluster:**
  - **Alt. C-3W (An. Digestion): 9,700 kWh/day (415 homes)**
  - **Alt. C-5W (Incineration): 13,100 kWh/day (560 homes)**

- **Middleton Cluster**
  - **Alt. C-3M (An. Digestion): 7,300 kWh/day (313 homes)**
  - **Alt. C-5M (Incineration): 9,800 kWh/day (420 homes)**

O&M Cost Summary and Conclusions

Green House Gas Reductions (Waunakee Cluster):

- **~19,800 metric tons/CO_2-equiv./year reduction:**
- **3,800 homes @ 700 kWh/month of electricity**
  - **1 kWh of electricity ~ 1.37 lbs CO_2**
- **3,900 homes @ 80 therms of natural gas/month**
  - **1 MMBTU of natural gas ~ 117 lbs CO_2**
- **Driving approximately 50 million miles/year @ average fuel economy of 25 miles/gallon**
  - **1 gallon of gasoline ~ 21.7 lbs CO_2**

O&M Cost Summary and Conclusions

Sensitivity Analyses:

1. **Manure/returned liquids hauling costs**
   - **Fuel costs**
   - **Land availability and costs**
   - **Labor costs**
   - **Environmental regulation for land application**

2. **Solids disposal revenue (or cost)**
   - **Is there a market for reuse?**
   - **Is this a cost rather than a revenue?**

3. **GHG emission reduction credits**
   - **Requires thorough research and planning**
   - **Which market/program is best suited for the long-term?**

Nonmonetary Evaluations

1. Phosphorus Reduction *
2. Water Quality Impacts *
3. Air Quality Impacts
4. Maintaining Green Space/Water Quantity
5. Maintaining Working Farmland/Culture
6. Nutrient Transportability *
7. Greenhouse Gases and Potential Credits
8. Production of Renewable Energy
9. Aesthetics/Nuisances
10. Safety Issues - Farm/Commuter Traffic
11. Impact on Roads/Truck Traffic
12. Animal Disease Control
13. Status of Technology; Reliability
14. Ease of Operation
15. Expandability
16. Ability to Treat Other Feedstocks
17. Regulatory and Permitting Issues
18. Image of Dane County -Sustainability Leader

Nonmonetary Scores

Alternative	Nonmonetary Score (weighted) Single Farm	Cluster
Alt. 1 – Solids Separation	38	36
Alt. 2 – Solids Sep. + Ferric	50	45
Alt. 3 – An. Digestion + Solids Sep.	61	73
Alt. 4 – Solids Sep. + Drying		37
Alt. 5 – Incineration		37

Financing/Funding Opportunities

- **Dependent on farmer vs. government vs. 3rd party ownership**
- **Dynamic funding programs (loans, grants) and financial aid**
- **Project financing and funding is a major unknown**
- **Can be better defined once project scope is refined**

Ownership and Operation Models

Ownership Type	Advantages	Disadvantages
Farmer-Owned: Single or Cooperative	▪ Better input to serve farmers' needs. ▪ Decisions made to benefit the farm as a whole, not just the bottom line of the manure management business. ▪ Many milk producers are very familiar with the co-op approach. ▪ If manure management costs are reduced, farmers realize benefits directly.	▪ Added operational and maintenance labor and costs. ▪ Not a core part of most farming operations. ▪ Requires varying levels of specialized technical skills.

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Third-Party Power Utility	▪ If energy production is included, good knowledge of this market and of energy generation. ▪ Typically large companies with better access to capital for significant projects. ▪ Less of a risk for a large company. ▪ Farmers can focus on core farming business.	▪ Farmers would have less control of byproducts returning to their land. ▪ Decisions may not be made with the entire farm operation taken into consideration. ▪ If manure management costs are reduced, farmers may not realize the full benefit.

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Combination Co-op/Third Party	▪ Better input to serve farmers' needs. ▪ Decisions could be made to benefit the farm as a whole, not just the bottom line of the manure management business. ▪ Many milk producers are very familiar with the co-op approach. ▪ If manure management costs are reduced, farmers may realize benefits directly. ▪ If established properly, could result in a good match of risk and reward for the farmers and the third party.	▪ Probably the most complex form of ownership.

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Government	▪ Increased scrutiny for design elements, financing, and operations may improve chance of success. ▪ Other similar models have been successful: MMSD, Dane County Landfill, Dane County yard material composting operations. ▪ Easier to obtain DNR and other regulatory permits. ▪ Can accept manure from any farm located within the jurisdiction of the governing entity.	▪ Farmers would have less control of end-products returning to their land. ▪ Capital and operating costs may be higher to meet higher standards. ▪ If manure management costs are reduced, farmers may not realize the full benefit.

Conclusions

- **The Dane County farming community is interested in developing manure management strategies.**

- **Currently many Dane County farms have long hauling distances and need to rent land for land application of the manure.**

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

Conclusions

- **Cluster manure management strategies appear to offer significant economies of scale with respect to capital costs compared to the individual farm systems when compared on a "per A.U." basis.**

- **Several 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**
  - **especially energy recovery alternatives (C-3 and C-5)**

Conclusions

- **The Waunakee Cluster strategies have higher capital costs and lower O&M costs compared to the Middleton Cluster as the result of manure pumping versus hauling.**

- **The Waunakee Cluster alternatives appear to offer more advantages and better long-term cost-effectiveness than the Middleton Cluster alternatives or individual farm alternatives.**

- **After additional review, additional farms may be able to join the Waunakee Cluster, and other clusters may be able to be defined and refined.**
  - **Likely that combination pumping and hauling is feasible.**

Recommendations

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**

Recommendations

4. **Conduct a Facility Planning Study to further refine and develop the scope of select alternatives and strategies:**
   - **Identifying site locations**
   - **Verifying manure quantities and other potential feedstocks**
   - **Develop preliminary layout(s) of alternatives and more accurate cost opinions (capital and O&M)**
   - **Conduct a detailed analysis of overall manure management practices on the affected farms.**
   - **Ownership of the facility**
   - **Operation of the facility**
   - **Funding programs**

Recommendations

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.**

Community Manure Management Feasibility Study

Dane County, Wisconsin

Summary Presentation

February 1, 2008