Farm Practices in the Lake Mendota Watershed:

A Comparative Analysis of 1996 and 2011

Prepared for the
Dane County Office of Lakes and Watersheds, Land and Water Resources Department
June 2012

Acknowledgements

This report was prepared by Ken Genskow & Carolyn Rumery Betz through the University of Wisconsin-Extension Environmental Resources Center.

The project was supported by a contract with Dane County Office of Lakes and Watersheds, Land and Water Resources Department, funded by a Wisconsin Department of Natural Resources Lake Planning Grant.

UW-Madison students Rachel Eder, Kim Meyer, Katie Songer, and Allison Madison conducted the 2010-2011 interviews. Data processing and analysis assistance was provided by Andrew Meyers, UW-Extension Environmental Resources Center.

We would also like to acknowledge the input and assistance of the Dane County Land and Water Resources Department, including Kevin Connors, Pat Sutter, Steve Ottelien, Laurie Lambert, and Sue Jones.

We especially appreciate and thank the farmers in the watershed who participated in this study for their time and their frank and open responses.

Cover Photo Credits:

Manure Spreading: Kevin Connors
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All others: Carolyn Betz

Farm Practices in the Lake Mendota Watershed: 1996 and 2011

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Executive Summary

This report compares responses from two surveys conducted with 62 farm operators before and after implementation of the Lake Mendota Priority Watershed project. We sought insights for understanding past conservation accomplishments and preparing resource managers and conservation partners for future agricultural and watershed challenges. The pre-project 1996 survey was used to understand use of farm practices for managing manure, commercial fertilizer, and pesticides in the watershed. The post-project 2011 survey reflected a broader set of farm management issues. Although the two surveys were not identical, they were highly comparable in their scope, objectives and questions.

Dane County continues to be among the fastest growing areas in the state, putting pressure on land availability to farmers as prime agricultural land is converted into residential and commercial development. While land use patterns have not changed dramatically in the watershed in the past fifteen years, changes on individual farms have changed significantly. Most farms have increased their corn and soybean acreage over this period, and most have increased or maintained their numbers of animals. More farmers are conscious of nutrient management and are taking actions such as crediting manure nitrogen and calibrating their manure spreaders. Farmers are highly aware of the practices available to them make changes based on cost, farm efficiencies, maintenance needs, regulations, perceived environmental benefit, and their longer term plans for the land and their farm operation.

There is a strong desire to maintain an agricultural lifestyle in the area. Most farmers intend to continue operating in the watershed, but concerns about water quality and conservation management compete with many other issues facing farmers. These include current operational challenges, their future, and the future of an agricultural lifestyle in the area. Concerns include the cost and availability of land, price variations in their overall operational costs and products, and the complexity of regulations.

Reflecting their diversity as individual farm operators, farmers indicate mixed levels of trust for agencies delivering information and technical support about soil and water conservation. Most farmers indicated mixed to low levels of trust for government and environmental organizations for information about soil and water conservation including the Dane County LWRD. The majority trusted their crop consultant more than any other source of information.

Many water quality studies and watershed management efforts have been conducted in the Lake Mendota Watershed and all are consistent in their conclusions: the water quality in the watershed is being compromised by excessive phosphorus and sedimentation, and management efforts to reduce the loadings will result in improved water quality. Farmers are

aware that agricultural contributions affect water quality in Lake Mendota and the Yahara Lakes, but they are skeptical of the relative contributions from agriculture and the assignment of "blame" to farmers. Farmers ranked urban sources of pollution (which many see as being closer to the lake) as more problematic for Lake Mendota than rural and agricultural sources. Most farmers felt that manure, crop-field erosion, and commercial fertilizers were not a problem or were only a slight problem for Lake Mendota water quality. While there was a very high level of awareness about conservation practices available to farmers, there was a mixed perception of benefits of those practices for water quality. The majority of farmers indicated their awareness of water quality issues had increased due to coverage of the topic in the media.

Our recommendations from these comparative surveys are intended to support and enhance current and future efforts in the watershed.

- *Initiate new efforts to increase farmer awareness of sources of water quality impairment in Lake Mendota by synthesizing, translating, and communicating existing information*. The format and presentation of most publications and reports documenting modeling results or water quality problems in the Yahara Lakes are too complex and contradictory to communicate clearly to various audiences. New technologies such as mapping and visualization tools and clearly articulated actions and options would be most helpful for reducing problematic sources such as the first-flush loading from spring runoff. Efforts to increase awareness of agricultural sources should be balanced against awareness of pollution reduction efforts in urban areas draining to the lake.
- *Use multiple channels and types of information to reach and support farmers, including continued one-on-one technical assistance for land and water conservation.* Working with farmers on an individual basis is especially important, but can be enhanced through the use of use of innovative tools and new partnerships. Prioritizing assistance could be based on modeled impacts of specific subwatersheds or individual farms across the watershed.
- *Introduce additional innovative outreach and educational approaches, including social marketing focused on appropriate issues such as actions to reduce soluble P and first-flush runoff*. The approach may not be appropriate for more complex processes such as farm conservation planning or nutrient management, but it could be effective if applied to a single high-impact practice, such as actions to reduce first-flush runoff with snowmelt.
- *Continue to support and engage farmers in new initiatives and share information about them with farmers outside of special project areas.* New organizations such as the Clean Lakes Alliance, and adaptive management strategies such as that being implemented through the Madison Metropolitan Sewerage District are examples of new innovations.
- *Communicate with the non-agricultural community and Yahara Lakes stakeholders about reasonable expectations for the pace of change for improving water quality and the promising potential of new initiatives*.

A. Introduction

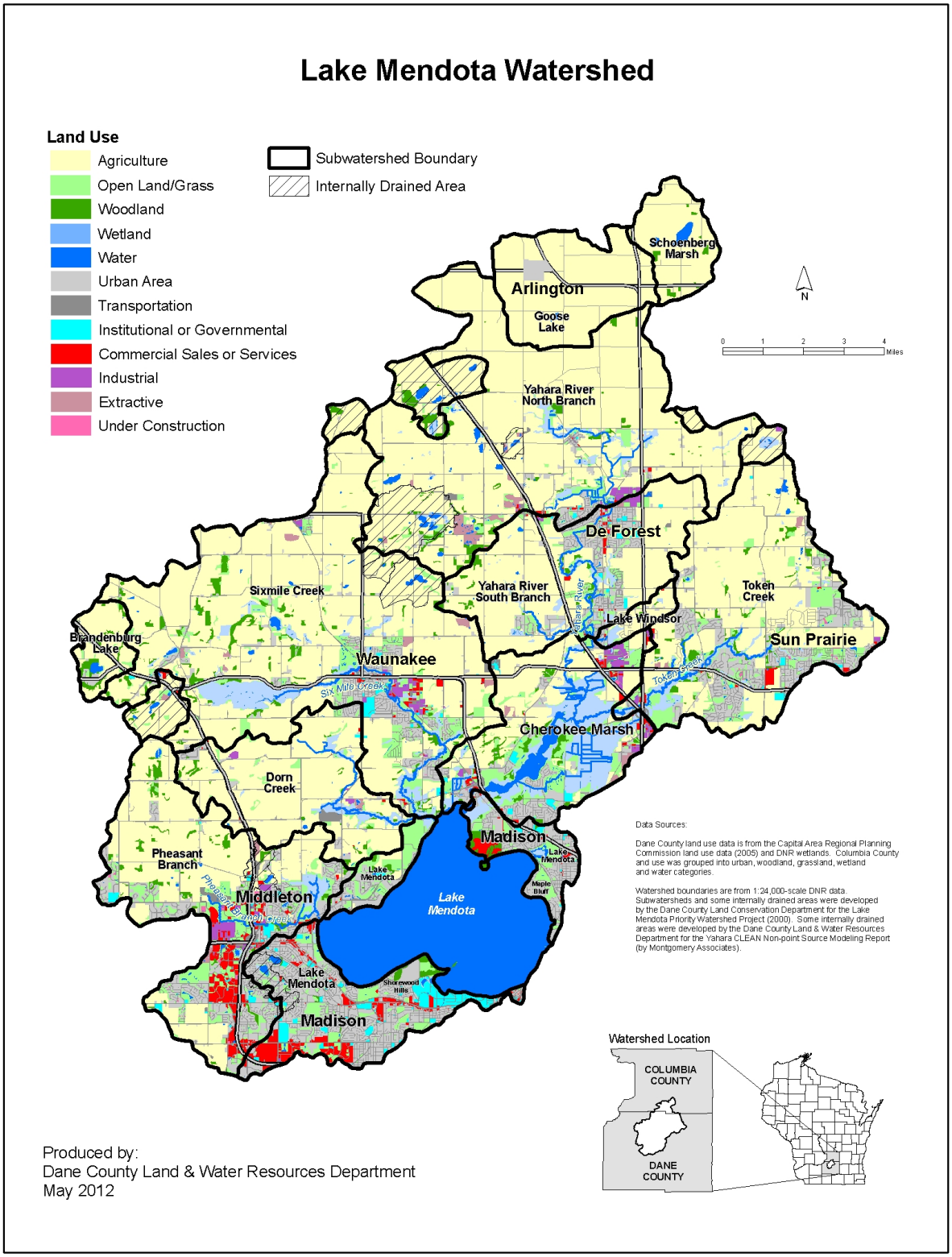
This study examines changes in agricultural management related to water quality among farmers across Dane County's Lake Mendota Watershed between 1996 and 2011. Other studies and reports have documented Lake Mendota's water quality, sources of water quality threats and impairments, and management challenges (see Lathrop and Carpenter 2011, Montgomery Associates 2011, Jones and others 2010, Lathrop 2007, Carpenter et al. 2006). This report focuses on agricultural management and farmer perceptions in the Lake Mendota Watershed.

Data and findings for the report are drawn from interviews with farmers in 1995-96 and again in 2010-11. Farmer interviews used structured survey questionnaires and included a variety of open-ended questions related to water quality and current issues facing agriculture. These paired interviews allow for a comparison of practices and perceptions before and after Dane County implemented the Lake Mendota Priority Watershed Project (described in B2.1 below).

Comparing information about farm practices before and after the Lake Mendota Priority Watershed Project provides insights for assessing project accomplishments, identifying perceptions among farmers about various agricultural management practices pre- and post-project, and identifying farmer perspectives on future agricultural and watershed challenges. Information about farmers' attitudes and behaviors is helpful for designing and conducting outreach and technical support programs. Topics of interest include: how farmers perceive water quality issues in the watershed; how to understand what drives use of conservation practices over time; how pressures from other farmers, developers or renters affect farmer decision-making; and what messages and sources of information about soil and water conservation farmers find credible and trustworthy.

The report is organized in four main parts. Section B provides a context for the study by describing the Lake Mendota watershed, its water quality challenges, and programs implemented to address agricultural contributions to water quality issues. Section C describes the methods used for this study. Section D presents summarized results from the study, including general farm descriptions, use and perspectives on various agricultural management practices, farmer perceptions of water quality issues, and reflections on farming and water quality in the Lake Mendota watershed. The report closes with Section E, summary reflections and implications for future watershed activities. This work complements other previous and ongoing initiatives to reduce agricultural impacts to Lake Mendota water quality. We hope it helps to shed light on some aspects of this complex set of issues.

Figure 1 Map of the Lake Mendota Watershed



B. Context for the Study

B1. Lake Mendota Watershed

The 230-square mile Lake Mendota Watershed lies within Dane and Columbia Counties (see map, Figure 1). The watershed is predominantly agricultural with substantial wooded and natural areas. Approximately 20% of the land area is urban.

In 1996, there were 344 farm operations in the watershed that had dairy and/or other livestock, with an average herd size of 254 dairy cows. Forty farms were internally drained; the remaining 304 farms produced 15,000 pounds of phosphorus that drained to a water-body. (WDNR 2000). Across Dane County, in 2007, there were 361 dairy herds, down from 1,258 in Dane County in 1978, but the average herd size had increased from 52 cows to 128. (Montgomery Associates 2011).

Land use in the watershed has changed between 1996 and 2008 as shown in Table 1. Although the data suggest the total amount of agricultural land in the Lake Mendota watershed has not decreased over that period, Dane County has been among the fastest growing areas in the state and is expected to add roughly 50,000 people every decade (Dane Co. CARPC 2011). This anticipated growth could put additional pressure on land availability to farmers if prime agricultural land is converted into residential and commercial development.

Table 1. Changes in land use in the watershed between 1996 and 2011.

Land Use	1996 – acres[1]	1996 %	2008 – acres[2]	2008 %
Cropland	66,105	50%	72,925	53%
Grassland/wildlife/pasture/woodlands	15,760	12%	19,068	14%
Wetland and Open Water	17,023	13%	16,675	12%
Developed	29,304	22%	29,047	21%
Internally Drained	2,806	2%	N/A	N/A
Total	130,998		137,715	

[1]Source: WDNR (2000).
[2]Source: Montgomery Associates (2011).

Although overall land use has not changed significantly, agriculture in the watershed has changed in the past two decades (Dane Co. LWRD 2010). Many of the farms in the Lake Mendota Watershed have transformed from smaller family operations to larger, family corporations resulting in the concentration of livestock and livestock manure. Many of the practices that were suitable to smaller operations in the early- to mid-1990s are not appropriate for larger operations. Practices such as covered barnyards are becoming more commonplace today than fifteen years ago (Dane Co. LWRD 2010).

The average tolerable soil loss value (T) for all of Dane County was 4.11 tons per acre per year (t/a/y) in 2007. In the Lake Mendota watershed, the value ranges from about 4.4-4.7 (t/a/y)(Dane Co. LWRD 2008b). Tolerable soil loss values in the county have decreased over 20 years as more farmers have switched from moldboard plowing to no-till cropping, use of mulch till, and fewer acres planted in canning crops and tobacco.

B2. Water Quality concerns and efforts to address them:

As noted, multiple studies through the years have documented water quality problems in Lake Mendota due to excessive sediment and nutrient loads entering the lake. Concerns with water quality in Lake Mendota and the Yahara Lakes have led to numerous efforts over the past few decades to address agricultural sources of nutrients and sediments in the watershed. These projects have complemented and overlapped each other, in part due to their administration by different levels and units of government. Staff who have implemented various programs have made efforts to link technical and financial assistance opportunities across programs to address landowner needs.

Consistently, the primary concerns for Lake Mendota and its tributaries have been sedimentation, excess nutrient loading leading to algae and aquatic plant growth, decreased water clarity, stream channelization (straightening), and streambank erosion. Other issues included low dissolved oxygen concentrations and thermal loading issues from urbanized areas.

Different modeling efforts have produced various loading estimates for sources of nutrients and sediment. For example, Montgomery Associates (2011) suggested through the use of the SWAT model that agricultural sources accounted for 90% of sediment loads and 84% of phosphorus loadings and urban sources provided 10% of loading for sediment and 14% of phosphorus. In contrast, the priority watershed project (described in the next section) suggested greater contributions from urban sources (up to 30%), particularly construction sites (see Table 2).

Lathrop (2007) analyzed phosphorus loadings to the lake from 1980 – 2006. One of his important findings was that snowmelt and “drizzle-day” runoff events during the January to March seasonal period constituted 43-48% of the subwatersheds’ long-term phosphorus load through 2006. Not only is this load significantly important to the overall input, the phosphorus is much higher in its dissolved form compared to runoff events during warmer months when sediment concentrations are higher. Lathrop and Carpenter (2011) recommend that the overall phosphorus load to Lake Mendota should be reduced by 50% in order to improve the quality of Lake Mendota and the downstream lakes. This is consistent with the recommendation of the priority watershed project (WDNR 2000), and with the analysis by Montgomery and Associates (2011) (conducted in support of Yahara CLEAN). While estimates and quantification of loadings

to the tributaries and Lake Mendota may vary somewhat, all of the studies are consistent in their conclusions: the water quality in the watershed is being compromised by excessive phosphorus and sedimentation, and management efforts to reduce the loadings will result in improved water quality.

B2.1 Wisconsin Priority Watershed Projects

The Lake Mendota Watershed has had two special priority watershed projects addressing agricultural nutrients and sediments spanning nearly thirty years. The Sixmile Creek/ Pheasant Branch Priority Watershed Project was among the first of its kind administered by the Wisconsin Department of Natural Resources (WDNR) between 1980 and 1990. In October 1993, WDNR designated the entire Lake Mendota drainage area as a priority watershed enabling technical and financial assistance provided through WDNR and the Dane County and Columbia County land conservation programs.

The objectives of the Lake Mendota Priority Watershed Project were to reduce sediment and phosphorus loads to Lake Mendota, and to enhance and protect the water quality of the streams, groundwater, wetlands, and other lakes in the watershed (WDNR 2000). The planning and data collection phase of the project (1995-97) included a thorough inventory of the water and land resources in the watershed. This included an appraisal of all of the streams and rivers, collection and analysis of groundwater samples, field visits to approximately 350 farms with barnyards, computer modeling of the upland sediment and phosphorus loading to the lake, and modeling of the lake itself.

Inventory and modeling produced estimates of sediment and phosphorus loadings to the lake (see Table 1). Several surprising findings emerged from the planning work. The first was that although less than 1 percent of the land area was undergoing development, models suggested that portion of land accounted for almost one-quarter of the sediment loading and one-fifth of the phosphorus loading to the lake (WDNR 2000). A second significant finding showed that 65% of all of the wells sampled on 157 farms were contaminated with high levels of nitrates, exceeding the health standard of 10 mg/L. Contamination of groundwater can be the result of improper storage and handling of farm chemicals, fuels, fertilizers and waste products.

Specific water quality goals were established to reduce phosphorus loading to Lake Mendota by 50%, a level thought sufficient to free the lake of nuisance algae blooms the majority of the time in the summer. The watershed plan (WDNR 2000) estimated that it would cost $6.8 million to reach the project goals if 75% of all eligible landowners in Dane and Columbia Counties participated.

Table 2. 1996 Sediment and phosphorus loadings to the lake

1996 Data	Sediment Sources to Lake Mendota	Phosphorus Sources to Lake Mendota
Cropland	58%	48%
Construction Sites	23%	19%
Existing Urban Areas	11%	6%
Streambanks	8%	6%
Barnyards	N/A	21%

Source: WDNR (2000).

Meeting reduction goals for the project required addressing both urban and agricultural sources of nutrients and sediments. The first few years of project implementation focused on the development of low-cost practices due to limited state funds for best management practices. Dane County passed four ordinances; two related to construction site erosion control and stormwater management control, and two related to manure storage and winter spreading of manure.

Most of the efforts to reduce agricultural sources involved working with farmers to support their voluntary adoption of agricultural best management practices. Overall, the Dane County LWRD contacted about 80% of the landowners and renters in the watershed to see if they were willing to participate in the project. Over 50% of those contacts signed a cost-share agreement that allowed a 70% cost-share rate on the installation of BMPs (30% paid by the farmer). Of the 20% who were not contacted, some owned only small acreages or no agricultural land, or they were landowners who rented out their land. Ten barnyard projects were identified as critical sites which provided an option for WDNR enforcement actions had the landowners chosen not to participate. All ten landowners voluntarily signed cost-share agreements.

The county estimates that $776,084 in state Priority Watershed Program funding was used to install best management practices. Over $1.2 million in federal funds were also expended to install conservation practices between 1998 and 2009 (Dane Co. LWRD 2010). Funds through the federal Environmental Quality Incentives Program (EQIP) were used throughout the project; a relatively small number of farmers may also have used Conservation Reserve Program (CRP) or Conservation Reserve Enhancement Program (CREP) funding, although those were not tracked separately for watershed farmers.

Table 3 and Table 4 highlight project activities related to the agricultural practices and nutrient management. About 42% of landowners/producers within the watershed installed or implemented a best management practice. Conservation practices or other management changes were installed on 79 animal lots, reducing animal waste runoff. Additionally, 29 livestock operations developed winter spreading plans to minimize runoff from applications of liquid manure on frozen, snow-covered or ice-covered ground. Nutrient management plans

were developed on more than 30% of cropland acres. The project achieved nearly 75% of the reduction goal for phosphorus from barnyard runoff and almost 40% of the reduction goal for upland sediment to surface water through conservation planning (Dane Co. LWRD 2010).

Table 3 Summary of agricultural implementation activities in the Lake Mendota Priority Watershed (Dane County only).

Practice	Number (Unit)
Farmers eligible for cost-sharing and easements	567 people
Farmers contacted during the implementation period	455 people
Farmers participating in the project using state and federal funding sources	237 people
Barnyard runoff systems installed (eves, sediment basins, roofs)	46 systems
Number of critical site animal lots addressed (of 10)	10
Number of critical site crop fields addressed (of 80)	80
Diversions	10 diversions
Grassed waterways	58.1 acres
Streambank protection	3,105 ft.
Terrace systems	2 systems
Agricultural sedimentation basins	7 basins
Grassed buffers along surface water	148.9 acres
Wetland restoration	18.8 acres

Source: Dane Co. LWRD (2010).

Table 4. Activities supporting nutrient management plans and soil conservation between 1998 – 2009 (Dane County only)

Activity	Number
Landowners who attended workshop on NMP	82 people
Acres of nutrient management plans reviewed	212,009 acres
Percent cropland farmed ≤T	89.6%

Source: Dane Co. LWRD (2010).

B2.2 Other Complementary Activities in the Watershed

Several related programs and project activities took place concurrently with the Priority Watershed Project and have continued since that project ended in 2009. Many have project area boundaries that overlap with the Lake Mendota Watershed. These include Land and Water Resources Management Cost-Sharing, manure digesters, the Wisconsin Buffer Initiative, and the Mississippi River Basin Healthy Waters Initiative (MRBI) and the Environmental Quality Incentive Program (EQIP). The brief summaries below provide additional context.

B2.2.1 Land and Water Resources Management Cost-Share Program

Additional state funds to support agricultural management practices made available through the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) were allocated to Dane County during an overlapping period with the Lake Mendota Priority Watershed Program. DATCP funding offered land owners 70% cost-share on best management

practices if they agreed to follow an approved conservation plan and maintain the practice for a period of ten years. Between 2003 and 2010, Dane County received $417,660 in grants to implement conservation practices (Dane Co. LWRD 2008a, 2009, 2010a). Funds continue to be awarded annually. No data are available prior to 2003.

B2.2.2 Manure Digester

The Sixmile Creek subwatershed is also home to a Community Manure Handling Facility and digester. The facility, involving three dairy farms within the Sixmile Creek subwatershed was completed in 2011, with approximately $12 million from state, county and private sources. About 60% of the phosphorus from these farms is expected to be removed by the digester (Dane Co. LWRD 2010a). The product will either be taken out of the watershed through wholesale/retail markets or used for bedding by the three farms and then processed by the digester again. By exporting the phosphorus out of the watershed, the phosphorus levels in the soil associated with these farms are expected to decrease over time. Additionally, the digester is expected to produce enough methane gas to power about 2,500 homes in the area (Dane Co. LWRD 2010a). Construction of a second digester in the Pheasant Branch subwatershed began in Spring 2012 funded mostly through private sources. Approximately $6.6 million in state funds supported phosphorus removal technology for both digesters.

B2.2.3 Wisconsin Buffer Initiative Watershed Project

The Wisconsin Buffer Initiative (WBI) was a joint effort between the University of Wisconsin-Madison, WDNR, and multiple conservation partners intended to design a buffer implementation program to achieve water quality improvements in a cost-effective and efficient manner. The WBI final report was released to the public in December 2005 (Nowak 2005), and emphasized the importance of targeting efforts toward areas with disproportionate contributions to water quality loads. The WBI created criteria and methods for prioritizing almost 1,600 watersheds for their potential to improve stream water quality, protect and enhance aquatic biological communities and to sustain lake water quality.

The Dane County LWRD is using the WBI targeting approach and the Wisconsin Phosphorus Index (PI) to evaluate phosphorus levels in the soil of the Pheasant Branch subwatershed and on lands tied to the Waunakee Community Digester Management Facility. The PI results are intended to prioritize where conservation practices are installed and to track reductions on those farms (Dane Co. LWRD 2009).

B2.2.4 Mississippi River Basin Healthy Waters Initiative (MRBI) and Environmental Quality Incentive Program (EQIP)

The U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) was an active partner in the Lake Mendota Priority Watershed Project and supports two ongoing complementary efforts to reduce agricultural nutrients and sediments. NRCS designated the

Pheasant Branch and Waunakee Marsh/Six-Mile Creek subwatersheds as a Mississippi River Basin Healthy Waters Initiative (MBRI) priority area and provided resources including about $2 million for a special project. In this four-year MRBI project (2010 – 2013), the Dane County LWRD serves as a key partner to help producers voluntarily implement conservations practices to avoid, control, and trap nutrient runoff, improve wildlife habitat and maintain agricultural productivity. In 2011, about 8,000 acres of land were assessed for nutrient management plans, for soil test P levels and PI values to measure the amount of P leaving an agricultural field and being transported to a nearby surface water (Dane Co. LWRD 2011). Nine contracts to install BMPs were signed in 2011.

Farmers in the Pheasant Branch and Six-Mile Creek subwatersheds are eligible to apply for cost-sharing through the USDA-NRCS EQIP funds. The eligible conservation practices include nutrient management planning, grassed waterways, buffer strips, crop residue management and other practices that trap sediment and reduce nutrient runoff. Overall funding for the project is over $2 million. In 2010, 20 contracts were signed in the project area totaling $437,206 (Dane Co. LWRD 2010).

C. Methods for this Study

This study compares responses from two surveys conducted as individual, face-to-face interviews with farm operators before and after implementation of the Lake Mendota Priority Watershed project. The first survey took place in 1995-1996, before the watershed project was implemented, and the second in 2010-2011, after the project was completed and while several complementary projects were underway. For the purposes of this report, the years 1996 and 2011 will be used to signify the first and second survey conducted.

The original survey was administered to 82 dairy or livestock farmers in the Dane County portion of the watershed using a structured interview questionnaire. Staff from the Dane County Land Conservation Department (LCD) (now called the Land and Water Resources Department [LWRD]) used the county plat book to identify all of the dairy and livestock farms in the watershed. Staff called or visited farmers and asked them to participate in the survey. About one-third of those contacted agreed to participate in the on-farm interviews.

The tasks associated with the 1995-96 survey delivery, response tracking, and recording were conducted by the LCD staff. Data analysis was conducted by the University of Wisconsin-Extension, Environmental Resources Center. Analysis of 1996 data included generating estimates of nutrient application rates for each farm operation. Results were published in July 1996 as a set of three Farm Practices Inventory reports (Nowak et al. 1996).

The 1996 survey was initially used to understand use of farm practices for managing manure, commercial fertilizer, and pesticides in the watershed. The survey results also highlighted perceived obstacles to implementing new practices and preferred sources of information. Results from the 1996 survey were used by University of Wisconsin-Extension and Dane County staff to develop targeted education programs and technical assistance in the watershed.

The objective of the 2011 survey was to help Dane County LWRD staff assess the following: progress made on implementing key goals of the Lake Mendota Priority Watershed Project; farmer perceptions and constraints associated with best management practices; and farmer perspectives of future agricultural and watershed challenges. Although the 1996 and 2011 surveys were not identical, they were highly comparable in their scope, objectives and questions asked. The 2011 interview questionnaire reflected a broader set of management issues and did not estimate nutrient application rates.

For the 2011 interviews, LWRD staff generated a list of 75 farmers operating the same parcel(s) as those participants in the 1996 survey. Of the 75 operations, 25 had changed farm ownership or management due to retirement, death, consolidation, sale, or other reasons. Eleven of the

75 remaining operations declined to participate. Sixty-four operators completed interviews. Sixty-two of those were able to be paired with 1996 interviews for the study. In other words, they are considered the same operation although the actual operator may be different. Unless otherwise noted, all of the comparisons between 1996-2011 refer to those 62 operations.

The 2011 survey was administered by the University of Wisconsin-Extension, Environmental Resources Center. The individual, face-to-face interviews were conducted by four UW-Madison graduate students between January 2010 and May 2011. Analysis of the 2011 data and a comparison of the two data sets were conducted using the statistical software program, SPSS. Themes from qualitative responses were identified and analyzed with spreadsheet and word processing software.

D. Results and Findings from this Study

This section includes summary results from the 2011 interviews and comparisons with the interviews in 1996. Data presented in "Farm Characteristics and Practices" is a summary of changes in these 62 operations over the past 15 years. "Farmer Perceptions of Water Quality Issues" is an overview of farmer responses to questions about sources and extent of water quality problems, including relative balance of agricultural and urban sources. The final area highlights issues and concerns raised by farmers about current and future farming in the watershed.

D1. Farm Characteristics and Practices – 1996 vs. 2011

In 1996, the majority (73%) of all 82 farmers interviewed considered dairy farming as their main source of income. When asked in 1996 how they anticipated their farms would change in the next five years, about 75% of the farmers anticipated that their operation would not change, in terms of both livestock and acres farmed. About 15% thought their operations would grow, and about 6% said they thought they would get out of farming or decrease the number or size of their operations.

Over the span of the past 15 years, the average number of tillable acres managed has increased by about 21%, from 652 acres per farm in 1996 to 789 acres per farm in 2011. Comparing only the 62 farms that participated in both interviews, almost 40% of the operations increased in land or livestock. One-quarter changed their tillage practices in some way, including expanding their implementation of conservation tillage. An equal number (16) have decreased the size of their operation in land or livestock. Almost as many have made other changes, including the use of grazing, the type of equipment used, crops grown, or the number of livestock managed. Table 5 highlights some of the changes.

Of the farmers surveyed in 2011, half had been in farming for 35 years or longer, only 5% had been farming for 10 years or less, and one reporting farming his entire 75 years. About 10% considered themselves partially retired. Over 90% said they operated their farm with their spouse or other family member (parents, siblings and children). Three farms in the 2011 survey said they operated their farm with a business partner.

Table 5. Changes in overall farm operations between 1996 and 2011

Type of change between 1996 and 2011	Percentage (%) who changed
Increase in land or livestock	39%
Decrease in land or livestock	26%
Tillage changes, including conservation efforts	26%
Change in operations: grazing, equipment, crops grown or livestock	23%
Technology/Efficiency or Modernization	15%
Nutrient Management	11%
Changes in crop rotations	6%
Other	10%

Participants in the 2011 interviews were asked about environmentally sensitive lands on their operation. Without being prompted with a specific definition, more than half reported having sensitive lands on their property. These landowners defined "environmentally sensitive lands" as highly erodible, containing water courses or drainage ways, being close to wetlands/marshes or wells, or having soils that were shallow to bedrock.

Although this study did not include a spatial analysis linking individual farms to sensitive areas within the watershed, Dane County LWRD provided additional information about general location and environmental sensitivity for all of the original 82 farm operations surveyed in 1996. That information affirmed that the operations were distributed throughout the watershed and in a variety of landscape settings. Of the original 82 farmers, 48 were noted as having fields adjacent to a waterway including a drainage ditch, stream, river, or lake, where sediment and nutrients could be delivered directly. Forty of those farms (83%) were also included in the second 2011 survey. Similarly, 46% of the farms in the 1996 survey were located in the MRBI priority area (see section B2.2.4); forty-seven percent (47%) of the farms in the 2011 survey were in the MRBI priority area.

There was variability among the landowners on their historical interactions with Dane County LWRD staff. In the 1996 group, about 69%, or 74 farmers, had some kind of working relationship with the Dane County LWRD at some point in the past. Seventy-three percent (73%) of those surveyed in 2011 had a relationship with the LWRD. Dane County staff had nutrient management plan information on record for 44% of the 2011 survey participants; they had no information about nutrient management planning for the other 56%.

D1.1 Acres Managed

Overall, the *total number* of tillable acres managed by the same farmers who were interviewed in 1996 and 2011 has increased considerably as shown in Table 6. The *average number* of tillable acres managed per farm also increased from 629 in 1996 to 789 in 2011. Both the *total* and average *number* of acres planted in corn and soybeans has also increased. The *total number* of acres planted in alfalfa has decreased substantially. In 2011, only 12 of the 62 farmers had planted alfalfa or clover. Table 6 shows that the average values for farmers participating in the 2011 interviews include 362 acres of corn grain and 129 acres of corn silage, 168 acres of soybeans and 104 acres of clover/alfalfa.

Table 6. Land managed, comparing 1996 to 2011.

Number of Acres	1996 - acres	2011 -acres	Change –acres and percent
Total tillable acres	39,023	48,936	+9,913 (+25%)
Average tillable acres per farm	629	789	+160 (+25%)
Total corn acreage	20,847	Not asked	
Total corn (grain)	Not asked	22,095	
Total corn (silage)	Not asked	6,434	
Average corn *(silage)*	Not asked	129	
Average corn *(grain)*	336	362	+26 (+8%)
Total soybean acreage	3,196	7,042	3,846 (+120%)
Average soybean acreage	123	168	+45 (+5%)
Total alfalfa acres	8,195	1,251	-6,944 (-85%)
Average alfalfa acreage (includes clover)	134	104	-20 (-22%)

Beyond total and average values, Table 7 illustrates changes in land use for individual farms. Between 1996 and 2011, the number of tillable acres managed on 68% of the farms increased by as much as 1,425 acres. On more than 60% of the farms, the number of acres planted in corn and soybeans also increased; 47% of the farms increased the number of acres planted in small grain crops. Eighty-seven percent (87%) of farmers decreased the number of acres planted with alfalfa or clover. Sixty-nine percent (69%) of the farms had no change in the number of acres put aside in conservation practices, and almost one-quarter reported a decrease in that number.

Table 7. Changes in land use on the same farms between 1996 and 2011

Land Use	% of Farms that Decreased	% of Farms with No Change	% of Farms that Increased
Tillable Acreage	29%	3%	68%
Corn Acreage	32%	<2%	66%
Soybean Acreage	11%	29%	60%
Small Grain Acreage	29%	24%	47%
Canning Crop Acreage	29%	65%	6%
Alfalfa/Clover Acreage	87%	3%	10%
Pasture Acreage	27%	55%	18%
Conservation Acreage	24%	69%	6%

D1.2 Number and Types of Animals

Most of the farms are still in crops, dairy, and beef. Only two producers interviewed in 2011 had no livestock. Table 8 compares the average number of animals managed on each farm in 1996 to the same farm in 2011. The average values in 2011 include 579 dairy cattle, more than twice the average number of cows managed in 1996. Averages on the 29 farms that have beef also increased slightly, from 146 head to 163. Only three farms have hogs in 2011, down from 11 in 1996, but the number per farm has increased from 377 to 934. One farm manages a poultry operation.

Table 8. Average number of animals per farm, for 1996 vs. 2011

Number of Animals	1996	2011	% Increase
Average number of dairy cows	245 (n =48)	579 (n =41)	136%
Average number of beef animals	146 (n =29)	163 (n =28)	12%
Average number of hogs	377 (n =11)	934 (n =3)	148%
Average flock size (poultry)	--	43,000 (n =1)	

Overall, half the farms increased the number of dairy cows on the operation, and more than one-third increased the number of beef cows, as indicated in Table 9. This is in contrast to what farmers had envisioned for their farms when asked about the future of their operation 15 years before. More than 75% of the farmers had said they did not envision the number of livestock would change. In 1996, only 15% thought their operation would decrease in size, but over a 15-year period, 34% reduced the number of dairy cows and 27% reduced the number of beef cows they managed.

Table 9. Overall change in number of animals between 1996 and 2011

Animal	% of Farms that Decreased	% of Farms with No Change	% of Farms that Increased
Dairy cows	34%	16%	50%
Beef cows	27%	37%	35%
Hogs	16%	80%	3%
Poultry	N/A	98%	<2%

D1.3 Conservation Practices

D1.3.1 General Use of Conservation Practices

Farmers were asked what management practices they used on their farm operation in 1996 and again in 2011. Most of the farmers in this study used a variety of conservation practices to improve soil health, reduce erosion, and conduct nutrient management planning. Changes are shown in Table 10 and reflect an increase in the use of multiple conservation practices. Comparison of management practices used on farms in 1996 and 2011 include:

- About 20% more farmers credited manure when determining nutrient application rates in 2011 than they did in 1996;
- There was a 16% increase in the number of farmers who credited legumes when determining nutrient application rates in 2011 than did in 1996;
- About 40% more farmers calibrated their manure spreader in 2011 over 1996; and
- Residue management and conservation tillage were used to some extent by almost everyone in both 2011 and 1996.

Table 10. Comparison of management practices used on farms in 1996 and 2011.

Management Practice	1996 - % who use the practice	2011 -% who use practice	1996 - % who a somewhat familiar with practice, know how to use it but are not using it	2011- % who are somewhat familiar with practice, know how to use it but are not using it
Conduct regular soil tests for pH, and nutrients	97%	98%	3%	2%
Residue management/ conservation tillage	94%	97%	5%	3%
Credit manure in nutrient management plan	73%	95%	23%	5%
Credit legumes in nutrient management plans	75%	91%	17%	6%
Calibrate manure spreader	35%	74%	26%	19%

Fewer people used less traditional conservation practices in their operations that may have be perceived as requiring additional cost, knowledge or other investment. The majority of respondents were somewhat familiar with those practices or knew how to use them but were not. The practices are listed in Table 11.

Table 11. Other conservation management practices used in 2011.

Management Practice	% who use this practice	% who are somewhat familiar with practice, know how to use but are not using
Rotate crops to maintain or improve soil	98%	2%
Use a grassed waterway to reduce erosion and soil loss	95%	5%
Sedimentation basin to collect and store sediment or manure	50%	50%
Fences to exclude livestock from streams, rivers, ditches etc.	40%	60%
Stabilize and protect streambanks and/or shorelines	32%	66%
Restore wetlands	11%	87%
Construct and artificial wetland for waste treatment	8%	74%
Use cover crops (grasses, legumes and forbs for seasonal cover and other conservation purposes)	57%	43%
Filter strips (grasses and other plants that provide a vegetative buffer between farmland and watercourses)	64%	34%
Conservation tillage/residue management (residue levels between 30%-80% after planting)	97%	3%
Comprehensive Nutrient Management Plan (CNMP)[1]	73%	27%

[1] Defined as conservation plans unique to livestock operations; they combine conservation practices and management activities to address natural resource concerns related to soil erosion, livestock manure, and disposal of organic by-products.

D1.3.2 Filter strips

Farmers in 2011 were asked specifically about the use of filter strips on their operations. Filter strips include grasses and other plants that provide a vegetative buffer between farmland and watercourses. About 62% currently used filter strips, and the remainder had either never used this practice or were not currently using it, even though they were familiar with the practice. About 10% of those who did not use them said they might be willing to try using filter strips. Respondents said the biggest limiting factor to using filter strips was cost, followed by other constraints: the desire to keep things the way they are; they were hard to use with the existing farming system; it would be difficult to fit them in with the features of the property; and insufficient proof of the water quality benefits. Table 12 summarizes their responses.

Table 12. Response (%) to how much each factor limited famer ability to use filter strips

Factor	Limited A lot	Limited Some or a little	Limited Not at all
Lack of information or skills	3%	30%	67%
Time required	5%	44%	51%
Cost	16%	43%	41%
Features of my property make this difficult	8%	39%	53%
Insufficient proof of water quality benefit	10%	24%	66%
Desire to keep things the way they are	14%	51%	48%
Hard to use with my farming system	19%	34%	48%
Lack of equipment	2%	20%	76%

Farmers were asked if the ability to harvest in filter strips (for example, four years of hay, then one year of corn) would influence their use of them, and that did seem to influence about half of the people who currently do not use this practice. Of the group who said allowing them to harvest filter strips would influence their interest in the practice, most said it would "make it a little better." Several were more enthusiastic in their responses. Others were not interested in using filter strips regardless of whether they could be harvested. Some thought the filter strips were too small to be worth the effort, their equipment would be too big to harvest there, or they wouldn't have enough corn using that rotation. Of those who said they did not use filter strips, most did not have water adjacent to their property. Many remarked that they would have to take land out of production. As one farmer said, "the land is pretty expensive—can't let much of it lay."

Those who already use filter strips recognized the water quality benefits and stated that they have seen reduction in soil erosion. One person reported a noticeable impact on water quality. He currently cleans out existing filter strips in autumn when the strips are dry and he notices an obvious collection of sediment.

D1.3.3 Livestock yard runoff

Survey participants who had livestock yards were asked where runoff water flowed from their livestock yard. Table 13 shows how runoff is directed and how that has changed between 1996 and 2011. In 2011, less than half said that their runoff went into an adjacent field, compared to almost three-quarters who selected this in 1996. More farmers in 2011 said their runoff went into an engineered filter strip or other engineered flow than did in 1996.

Table 13. Comparison of livestock yard runoff destination (1996 and 2011).[1]

Where Runoff Flows	1996 (n = 56)	2011 (n = 62)	Difference
Into an adjacent field	71%	39%	- 32%
Into an engineered filter strip	11%	27%	+16%
Into a roadside ditch	7%	3%	- 4%
Into a farmyard	2%	5%	+ 3%
Other[2]	7%	19%	+ 12%
No livestock yard		7%	
Not sure	2%	Not a choice	

[1] Respondents in 2011 were allowed to select more than one response, so total percentage is greater than 100

[2] Includes engineered basin; all animals under a roof; covered lots; passes through screen to separate and exclude manure then into adjacent field; manure pit; all covered by roof; settling pit - filter strip manure lagoon; goes into lagoon; collection pond; (other livestock yard): flows to collection area; use weave troughs

D1.3.4 Milkhouse waste

Survey participants were also asked what happened to their millhouse and/or milking parlor wastewater on their farm. This included pipeline wash water, milkhouse wash water, and other sources. The biggest changes were that 37% fewer people had their milkhouse waste directed to a septic system in 2011 than did in 1996, and about three times as many people used a liquid manure tank or a settling tank. Additionally, fewer farmers directed their milkhouse waste to a nearby ditch or field drain tile. These results are shown in Table 14.

Table 14. Comparison of milkhouse waste destination (1996-2011).

Where milkhouse waste drains	1996 (n = 46)	2011 (n = 36)
Into a liquid manure tank	17%	44%
Into a settling tank	3%	17%
Into a septic system	46%	14%
Into an adjacent field	11%	11%
Into a nearby ditch	4%	3%
Into a field drain tile	--	3%
Other	20%	9%

Note: There may be more than one place milkhouse waste goes on a farm, so numbers do not add up to 100%. Forty-two percent of the 2011 farmers (26 farms) do not have milkhouse waste water.

D1.3.5 Manure Handling

Current Practices:

Farmers were asked how they handle their manure on their farms; Table 15 presents those results. All of the respondents with animals spread manure on their fields. The majority of farmers put their manure directly into a spreader, although 15% fewer people did this in 2011

than did in 1996. There was a slight increase in the number of farmers storing their solid or liquid manure in a concrete wall pit. Fourteen percent (14%) more left their manure in a barn or building in 2011 than did in 1996.

Table 15. What type of manure handling is used on each farm operation

Manure Handling System	1996 (n = 60)	2011 (n =62)	% Change
Manure directly into spreader	82%	67%	-15%
Store solid manure in a concrete wall pit	35%	39%	+4%
Leave manure in barn/buildings	23%	37%	+14%
Store as liquid in concrete wall pit	27%	32%	+5%
Pile manure on the ground	32%	29%	-3%
Store in a clay-lined manure storage basin	8%	13%	+5%
Store in a slurry system	2%	3%	-1%
Store in an unlined manure storage system	0	2%	
Other	0	3%	

Notes: farmers could select more than one option so percentages do not add up to 100.

Table 16 shows when farmers indicated they hauled manure. About 20% fewer farmers spread manure daily or frequently throughout the year in 2011 than did in 1996. Roughly the same percentage of farmers (21%) spread their manure at least once a month as spread it once a week for most of the year. Compared to 1996, 14% more farmers in 2011 responded that they spread manure daily or frequently throughout the year except during winter.

Table 16. Frequency of manure being hauled on the farm

Manure Hauled	1996 (n = 60)	2011 (n = 62)	Difference
Daily or frequently throughout the year	60%	40%	-20%
At least once a month for most of the year	15%	21%	+6%
At least once a week for most of the year	17%	21%	+4%
Daily or frequently throughout the year except winter	2%	16%	+14%

Issues related to Winter Spreading and Manure Spreading Restrictions

Eighty-seven percent (87%) of the farmers in the 2011 interviews said they applied manure at some time during the winter. Almost half of the farmers in 2011 said they had enough storage to meet winter spreading restrictions, but several others admitted that they did not have enough storage. When asked, 49 of the 62 farmers said there were no spreading restrictions that were difficult for them to follow in 2011. Of those who did have difficulties with spreading restrictions, five said their problems were related to seasonal restrictions of spreading in the winter and March, and several were not clear whether they were allowed to spread on frozen ground or not. One said, “If winter spreading is banned it would be impossible to operate.”

Another admitted it was difficult to avoid spreading on a waterway, and a different farmer said having to stay away from a waterway reduces his available land for spreading considerably. One person stated because of soil tests showing phosphorus levels over 200 parts per million, he had not been able to spread manure on his farm at all between 1995 and 2005. More recent testing had established that he was able to apply it on some of his crops.

D1.3.6 Nutrient Management Activities

Current Practices:

Participants in the 2011 survey were asked how well they understood four components of their nutrient management activities: soil testing, nutrient value of manure, nutrient value of legumes, and spreading restrictions. All respondents said that they understood each of these components "some" or "a lot." Approximately 20% commented that they could use a better understanding of manure spreading restrictions, and around 15% said they would like a better understanding of the nutrient value of manure and legumes.

When asked, "On what percent of the acreage covered in a nutrient management plan are you actually able to implement the plan," 87% said they implemented their plan on more than 95% of the acres identified in the plan. Table 17 shows the percentage of acres covered by a nutrient management plan on which it is being implemented.

Table 17. Implementation of nutrient management plans

Percentage of acres where plan is implemented	Percentage of respondents (n=54)
95-100%	87%
80-85%	4%
50-60%	7%
10%	2%

Issues related to Comprehensive Nutrient Management Plan (CNMP)

The 2011 group was asked about their use of a Comprehensive Nutrient Management Plan (CMNP). The farmers were not asked if their plans met any specific state or federal standard for nutrient management plans. During the interviews, CNMPs were defined as "conservation plans unique to livestock operations; they combine conservation practices and management activities to address natural resource concerns related to soil erosion, livestock manure, and disposal of organic by-products." Forty-five of the farmers (74%) stated that they use this type of plan, five (8%) do not, and 11 (18%) have never used one. Table 18 shows concerns with the practice.

Table 18. Response (%) to how much each factor limited farmer ability to use a CNMP

Factor	Limited A lot	Limited Some or a little	Limited Not at all
Lack of information or skills	0	18%	82%
Time required	5%	32%	64%
Cost	12%	29%	59%
Features of my property make this difficult	3%	12%	85%
Insufficient proof of water quality benefit	0	20%	80%
Desire to keep things the way they are	3%	27%	70%
Hard to use with my farming system	2%	18%	80%
Lack of equipment	0	14%	86%

Those who do not use a CNMP indicated that cost most limited their ability to use a CNMP. Other limiting factors included: the time required, the desire to keep things the way they are, the features of their property that make this difficult, insufficient proof of water quality benefits, and difficulty of using with their farming system. Several said they were unfamiliar with the practice or had never been approached about it.

Among those using CNMPs, 30 people said that it helped better manage nutrients, saved money and increased yields. As one landowner said, “to utilize all the nutrients that are created on the farm to benefit the farm financially and to benefit land health—prevent over-fertilization.” Another farmer stated, “I had seen waste of fertilizer in the past by my father-in-law. I want to be a better steward to the land and reduce costs. The soil is high in nutrients from over-fertilization.” A third stated, “We want to get the full value of the manure and avoid excessive fertilizer application and expense. We need to get P levels to go down.”

Fifteen farmers said they used a CNMP because it was required as part of a cost-share agreement, or to comply with other government regulations. But one stated, “I was required to use it for cost share, but I will continue to use it after the set time frame is up, and adopt it to other farming practices. Possibly in the future, I would like to use a GPS manure application system along with more no-till manure injections for the best use of phosphorus.” Another respondent said, “I started with a CNMP when the program began. I figure we’ll eventually be required to so I might as well do it. You have to change with the times.”

The responses from some farmers implied that they did some nutrient management planning, followed a manure management plan and did soil testing, but didn’t follow an “official” plan. “I don’t want to be forced to have a crop consultant write up a plan that will sit on a shelf,” one farmer said. Several others mentioned that it was too costly produce a CNMP. Several people identified water quality benefits among their reasons for using CNMPs, but no one claimed to be using the practice solely for that reason. “We keep the nutrients on the land and out of the

water," responded one participant. Another stated, "We need to become aware of sensitive areas and avoid spreading there."

D1.3.7 Conservation Tillage/Residue Management

Almost everyone (97%) in 2011 used conservation tillage (also discussed as residue management), defined as maintaining 30-80% residue levels after planting. This rate is comparable to the 94% indicating they used the practice in 1996. Table 19 shows the different methods that farmers used to achieve a 30-80% residue level. Some landowners report that they leave 100% residue. Two-thirds of those who left less than 100% residue said they estimated or approximated the percentage left in the field. This includes "guessing" and "eyeballing." One-third of them said their fields were checked by a professional, including the County LWRD, the state, or the USDA/NRCS.

Table 19. Methods of achieving 30-80% residue levels

Practice	Number of farms
Minimal/ no till/some overall tillage	43
Reduced tillage, chisel or disc plow, turbo till	39
Leave stalks/ cut high/ leave residue	19
Land specific treatment	6
Specific rotation practices	5
Spread manure/ pen pack	7
Mortar, deep till portion	3
Other/ Misc.	2

Note: farmers were able to identify multiple methods.

Most people stated that they used conservation tillage because of its soil conservation benefits, the ability to reduce erosion, keep soil in its place, and improve soil structure and soil health. Many remarked that there were visible differences and the practice was particularly useful in preventing erosion on highly erodible lands. One said the organic matter on hills had increased dramatically and that he "had improved yield on those areas." Another said "This is the best thing for the land; [I'm a] big believer." For some, there was initial reluctance to use conservation tillage. "Dad didn't like the appearance of a no-till/ minimum till field at first and had to be persuaded. Now he's more enthusiastic." Many commented that using this practice helps reduce input costs, and that this practice saves both money and nutrients.

Of the 3% who did not use the practice in 2011, all said they were willing to try conservation tillage; they explained that they did not currently use the practice due to cost and the desire to keep things the way they were. One person who did not use conservation tillage said it was not

easy to use on heavy soils. Another said it was difficult to spread manure on his acres under chisel plow management.

When asked how they apply manure on the land left with residue, 41 respondents said they surface applied their manure without doing anything else to it. Nineteen farmers who surface applied manure incorporated it into the soil. Twelve injected liquid manure or knifed it in.

D1.3.8 Cover Crops

Both the 1996 and 2011 surveys asked farmers if they used cover crops, and about 60% said they used cover crops in both years (see Table 11). In 1996, cover crops included small grains and clover. In 2011, the definition of cover crops provided to farmers included grasses, legumes and forbs for seasonal cover and other conservation purposes. When asked in 2011 what was limiting their use of cover crops, the most frequent impediment was cost. The other most frequently mentioned impediments were that they were hard to use with the existing farming system and a desire to keep things the way they are. Other drawbacks to using this practice included the time required and property features that make the practice difficult. Table 20 shows how farmers responded about constraints associated with use of cover crops in 2011.

Table 20. Response (%) to how much each factor limited farmer ability to use cover crops.

Factor	Limited A lot	Limited Some or a little	Limited Not at all
Lack of information or skills	3%	30%	67%
Time required	5%	44%	51%
Cost	16%	43%	41%
Features of my property make this difficult	8%	39%	53%
Insufficient proof of water quality benefit	10%	24%	66%
Desire to keep things the way they are	14%	51%	48%
Hard to use with my farming system	19%	34%	48%
Lack of equipment	2%	20%	76%

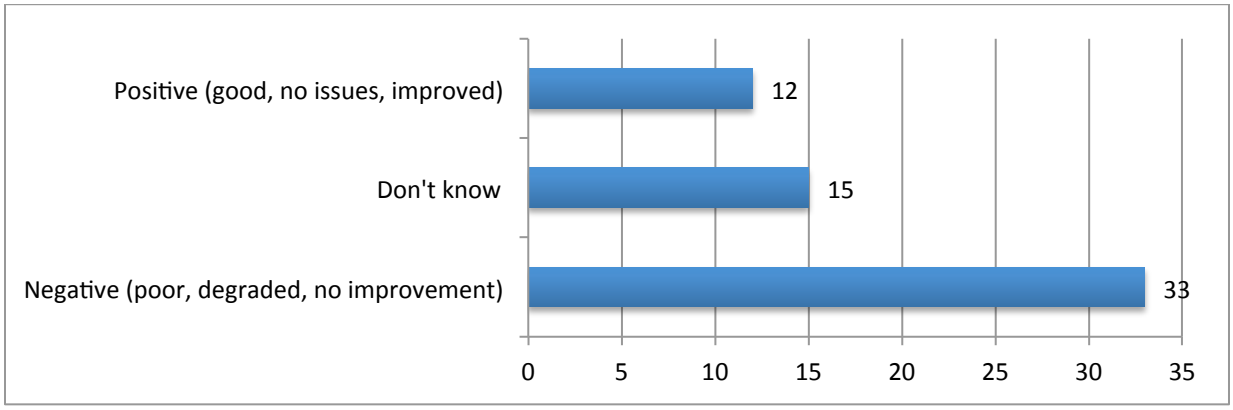
When asked if the timing of getting a crop off, then replanting a cover crop affect their use of the practice, about as many people (19) said this had no effect as said it was a big issue (17). Many people mentioned that if it was a late harvest, there was not enough time and labor to plant a cover crop; others said that a lot of the timing depended on the weather. When asked if the need for silage affected a farmer's use of cover crops, responses were split—about half said this had no effect on their decision. The assumption is that on flat fields where silage is taken, there is no erosion and no need for cover crops. In contrast, eight people said there was a need for a cover crop on steep fields after silage was harvested.

D2 Farmer Perceptions of Water Quality Issues

D2.1 Perceptions of Water Quality

Farmers interviewed in 2011 were asked an open-ended question about what they thought of the water quality in Lake Mendota. Figure 2 illustrates their replies. Most stated the water quality was poor, while the rest either didn't know or thought it was good and had no issues. Some of the respondents expanded on their answers by commenting that they were disappointed or annoyed when they hear "that farmers are to blame for poor water quality." Others followed their responses by providing their own explanations as to why the water quality was poor, including urban runoff, geese, boats, and winter spreading of salt on the streets.

Figure 2. Responses to "What do you think about water quality in Lake Mendota?"



Probing further, farmers were asked to rate the severity of each of 18 potential sources of pollution to Lake Mendota, shown in Table 21. The majority ranked urban sources of pollution as more problematic to the lake than rural sources. More thought excessive use of lawn fertilizers and/or pesticides were responsible for poor water quality over any other source. Almost as many thought street salt and sand were among the most severe water quality problems in Lake Mendota. The majority of respondents thought that stormwater runoff from streets, highways, rooftops and/or parking lots created a moderate to severe problem for the lakes. Other sources perceived as being problematic included discharges from industries into streams and lakes and discharges from sewage treatment plants.

Agricultural sources fell toward the bottom of most farmers' ratings of severity. About 44% of farmers said they felt manure from farm animals was a moderate to severe problem. About 34% felt that soil erosion from farm fields was a moderate or severe problem. About 26% felt

the excessive use of fertilizers for crop production was a moderate to severe problem. The remainder perceived those sources as not problematic or only slightly problematic.

Table 21. Perceptions of severity of sources to water quality problems to Lake Mendota.

Source of Pollution	% indicating "not a problem" (1) or "slight problem" (2)	% indicating "moderate" (3) or "severe" (4) problem	% indicating "don't know"	Mean score*
Excessive use of lawn fertilizers and/or pesticides	19%	74%	7%	3.05
Street salt and sand	25%	69%	7%	2.98
Stormwater runoff from streets and/or highways	32%	65%	3%	2.93
Urban stormwater runoff	37%	53%	10%	2.71
Stormwater runoff from rooftops and/or parking lots	44%	50%	7%	2.60
Discharges from industry into streams and lakes	32%	39%	29%	2.57
Soil erosion from construction sites	48%	45%	7%	2.52
Littering/illegal dumping of trash	52%	37%	11%	2.44
Discharges from sewage treatment plants	44%	32%	24%	2.43
Droppings from geese, ducks and other waterfowl	48%	37%	15%	2.42
Manure from farm animals	53%	43%	5%	2.41
Soil erosion from shorelines and/or streambanks	45%	29%	26%	2.35
Soil erosion from farm fields	63%	32%	5%	2.24
Improperly maintained septic systems	55%	32%	13%	2.22
Streambank or shoreline modification/destabilization	53%	27%	19%	2.20
Channelization (straightening) of streams	52%	13%	36%	2.05
Excessive use of fertilizers for crop production	71%	26%	3%	1.97
Upstream impoundment of water	55%	11%	34%	1.83

*mean values exclude "don't know" responses; options were 1 = not a problem, 2 = slight problem, 3 = moderate problem, and 4 =severe problem.

Nearly one-quarter reported not knowing the severity of contributions from sewage treatment plants. More than one-quarter of the respondents reported now knowing the severity of discharges from industry, soil erosion from shorelines and/or streambanks, channelization (straightening) of streams, or upstream impoundment of water. One farmer commented specifically on the contributions of upstream impoundments, suggesting that removing the Token Creek Dam was detrimental to the downstream water quality because it acted as

detention/filtration device. He noted that since its removal there has been more flooding downstream.

D2.2 Changes in water quality awareness and sources of information

Farmers were divided in their responses about changes in their own awareness of water quality issues. Sixteen respondents said they were *not* any more aware of water quality issues than they were 15 years ago, but most thought their awareness of water quality and related issues had increased. One person said that he didn't think water quality is any worse than it was, but it has just been brought to the public's attention more. Others had installed practices specifically to improve water quality downstream and had experienced "increased wisdom and appreciation for taking care of things over time."

When asked to identify specific water quality issues, twenty-five respondents mentioned they were more aware of runoff as a contributor to water pollution. Eleven people mentioned problems such as high nitrate levels in their well water. Others mentioned awareness of algae in the lakes due to high phosphorus levels. Several mentioned that their use of fertilizer has changed based on what the soil test showed was needed. Some said they used herbicides and pesticides more responsibly than in the past. Others said their manure management practices had improved because of their awareness of water quality issues.

Those surveyed in 2011 were also asked what led to their increased awareness of water quality issues. More than any other response, twenty-one people said their awareness had increased due to coverage of the topic in the media. Fifteen said their experiences had taught them about water quality issues, which included things like working with student groups, testing their water or soil, or having to dig a new well. A few also mentioned that they liked to spend time boating or canoeing on local water bodies, or they enjoyed the marshes.

Fourteen people said they had become more aware of water quality issues by working with government agencies or university researchers, information they received in the mail, and "more conservation people talking to you in person, from government agencies." Several specifically mentioned working with the Dane County LWRD and the USDA-NRCS. Some credited exposure to local regulations in the past few years. One person specifically mentioned that he had taken a half-day short-course on nutrient management planning. Besides government agencies and organizations, seven people mentioned getting their information about water quality from crop consultants, the Token Creek Watershed Association (2), the Professional Dairy Producers of Wisconsin, and farm-related publications (including State Farm, Agri-View, ASCS newsletters).

In the 1996 survey, participants were asked where they obtained information, the frequency of contacts with each source, the usefulness of those contacts, and whom they trust. Farm supply dealer or independent crop consultant were recognized as good sources of information in relation to profitability issues. Priority Watershed staff and other conservation professionals were recognized for their expertise in water quality issues.

In 2011, participants were given a list of organizations that provide information and technical support for water quality and land management and asked how much they trusted each organization as a source of information about water quality and land management. Table 22 summarizes the responses in the order of highest (crop consultants) to lowest (local environmental groups) levels of trust. The "slight" and "moderate" trust responses are presented together. The percentage in the "Am not familiar" column represents farmers who indicated they are not sufficiently familiar with the organization to provide a response.

Consistent with the 1996 responses, 53% of the farmers trusted their crop consultants "very much"—more than any other group. Dane County LWRD staff were also trusted highly (29% "very much"); 27% trusted their fertilizer representatives very much. One-quarter of the respondents had high level of trust in other land owners and friends as well as the NRCS.

The least trusted group for providing information and technical support were local environmental groups (54% responding "not at all") and the WDNR (26% "not at all"). Although UW research specialists were well-trusted by a majority of the respondents, almost one-fifth of those in the survey were not familiar with any. Almost the same number of people said they trusted their UW-Extension Agent "very much" as said they did not trust UW-Extension County Agents "at all."

Table 22. 2011 respondent's trust for information and technical support for water quality and land management.

Group	Trusted Not at all (1)	Trusted Slightly (2)	Trusted Moderately (3)	Trusted very much (4)	% Am not familiar	Mean trust "score"[1]
Crop consultants	7%	5%	35%	53%	0	3.4
Other landowners/friends	3%	21%	52%	24%	0	3.0
Fertilizer representatives	7%	26%	40%	27%	0	2.9
Dane County Land and Water Resources Department	13%	23%	34%	29%	2%	2.8
Natural Resources Conservation Service	11%	18%	40%	24%	7%	2.8
UW Research Specialists	10%	13%	47%	11%	19%	2.7
UW Extension County Agent	18%	16%	39%	19%	8%	2.6
Local farm organizations	13%	15%	55%	15%	3%	2.7
Wisconsin Department of Agriculture, Trade and Consumer Protection	11%	34%	36%	16%	3%	2.6
Wisconsin Department of Natural Resources	26%	31%	36%	7%	2%	2.2
Local environmental group	45%	23%	15%	0%	18%	1.6

[1] mean value excludes "Am not familiar" responses. Row totals may not equal 100% due to rounding; n=62

The 2011 group was also asked where else they could also get information about water quality and land management. Twelve respondents mentioned the Farm Bureau; others mentioned co-ops, industry organizations like the Professional Dairy Producers or the Dairy Business Associations. One person mentioned the Goose Pond/Madison Audubon Society. One respondent mentioned the specific environmental groups he did not trust.

D3. Reflections on Farming in the Lake Mendota Watershed

The 2011 interviews asked farmers what issues they were concerned about, their hopes and plans for their own operations, factors that influence their farm management decisions and their use of specific agricultural practices, and where they turn for information about water quality and conservation. Almost all of them intend to continue farming, and although most are optimistic about the future, they share a host of doubts and concerns about farming in the Lake Mendota watershed. Their comments reinforce the complexities involved in blending incentives and regulations for agricultural activities to reduce water quality impacts.

D3.1 Challenges and Concerns

Farmers in 2011 were asked open-ended questions about their biggest challenges and concerns related to their farm operations. Their responses reflect the myriad challenges, uncertainties,

and pressures facing agriculture, including issues in urbanizing agricultural landscapes. Overall, their comments can be grouped into the four broad concerns: 1) profitability and operational costs, including land price and availability, 2) farm size, 3) negative perceptions of farmers and farming, and 4) environmental regulations and enforcement.

D3.1.1 Profitability and Operational Costs

Nearly two-thirds of farmers raised concerns about issues related to *markets, prices and profitability*. Several people specifically mentioned milk prices, noting that as dairy farmers, they couldn't control the price of the input or the price of the product. Respondents also expressed concern about *operational costs* of their farm. This included having enough feed, the cost of protein, the price of fertilizers, the cost of equipment, the price of gas, and the ability to find qualified labor. One stated that his profit margin decreased as these input costs kept rising. Many stated that the volatility of the markets affected their ability to make a profit. One wondered if their operation could be sustainable, and he already was working two off-farm jobs. Another commented that he was considering selling his farm.

Several people expressed similar concerns with *other operational issues.* One stated that he was the only worker and worried about who would do the work if he got sick or injured. Another stated a desire for someone else to take over his operation. Difficulties communicating with farm laborers were also raised.

Half of the farmers interviewed volunteered that they were specifically concerned with land prices and the high price of rental lands. Many commented on the fact that it was hard to get land, or that the prices were steep. Many respondents expressed concern about being able to stay in business because of rising land prices. Land price and availability is particularly concerning to those who feel they will not be able to compete with large "corporate farms." As one farmer commented, "Can't get extra land unless we pay a fortune." Some acknowledged that although they wanted more land, it would mean they would need more labor, so the expansion would have to be sizeable to justify the labor costs.

Other land issues included the proximity of the city to the land they farmed. Some commented on housing and development encroaching on farmland and its effect on land pricing, noting that it was hard to rent land with nearby development. One person shared that he was considering selling his land because there was development nearby.

A number of farmers expressed concern about the county buying up farmland and converting it to parkland. While parkland is valuable, at least five people commented that when then county over-pays for a piece of land, they drive up the price of land in the area. They also felt that those county actions end up increasing their costs through higher taxes. "When land is taken off the tax base, then the rest of us have to make up for it," one said. Some specifically mentioned

that the county purchased one parcel for parkland for $5 million, but it had been appraised at $2.9 million. Several people also expressed concern about taking land out of production for the proposed North Beltline or for residential development.

D3.1.2 Farm Size and Manure Digesters

At least 11 people expressed concern about *farm size* and several expressed sentiments that small dairy operations can't make it any more. Some thought that larger farms were causing more of the problems in the area. Some examples of respondents' concerns with larger farms included:

- Big farms are more interested in the business side of things and "not in touch with what's really going on."
- Big farms may involve more rented land which they don't take care of as well.
- Big farms "are the problem and give small farmers a bad name."

At least four respondents brought up the community *manure digester* that was then being installed in the Six-Mile Creek subwatershed. Several thought that the digester was only serving the larger farms and leaving the smaller operations at a disadvantage (in part because of government subsidizing the digester cost for the large farms). One thought the process used was too political. One landowner was not interested in sending nutrients to the digester because he felt the land needed those nutrients, too, although perhaps they could go to land outside of the watershed. There was a perception that installing manure digesters was allowing large farms to produce more manure, but some farmers questioned whether the phosphorus in the solid manure would be compounded through its use in bedding.

D3.1.3 Negative Perceptions of Farmers and Farming

Several respondents expressed their concerns about how the community at large perceives farming. They noted divisions between rural and urban perspectives and tensions with residents in the Madison area over farming and environmental protection. One suggested the "people don't value farming because they don't realize that food doesn't come from the grocery store." Some thought that there are some "bad actors" in the farming community but most are not, and not all farmers should get the blame for water quality degradation.

As noted previously (see Table 21), the majority thought that the water quality problems in Lake Mendota were due to the urban area that most closely surrounds the lake. Some asserted that the concentration of nutrients applied to urban lawns is higher than on farm fields, and because lawns are closer to the lake, the excess nutrients flowed directly to the lake, reducing

water quality. One said, “If we put as much fertilizer on the farms as they put on the golf courses, we’d go broke. But they always look to the farmer.”

Some farmers thought the [former] County Executive and WDNR tended to place more blame on the farmers, considering farmers “easy scapegoats” and adding fuel to the tensions. In contrast, they sensed government willingness to overlook the negative impacts of growing urbanization and suburban sprawl. This sentiment was also expressed through frustration at a lack of enforcement for controlling urban pollutant sources. Beyond urban fertilizing, farmers noted one road construction project allowed soil from the highway construction to flow across his grassed waterway without repercussion to the road builder or DOT. Another observed stream infill from a residential development project without soil and water conservation on those projects.

Reflecting the diversity of opinions on this issue, farmers were also frustrated with each other, and nearly one-third of those interviewed supported stronger regulation and enforcement related to agricultural impacts to water quality. One farmer, expressing a great deal of concern about water quality in the Lake Mendota watershed, said he tried to do everything he could to protect the health of the land and water for future generations. He got upset when he saw other farmers place greater value on personal profit. Another spoke about the stream on his farm that used to support fish and frog populations, but he blamed his neighbor’s farm practices for damage to the stream and the demise of wildlife. Now the stream was “a stinking mess.” Others were specifically concerned with manure in drinking water and the potential of their well going bad.

Many farmers expressed frustration in *lack of enforcement* of existing rules in agricultural areas. For example, one thought that banning winter spreading of manure would help water quality but all farmers should be made to follow the ban. Another suggested that fines for getting caught spreading in the winter were insignificant to larger operations so they were more willing to take the risk. One respondent stated that conservation plans weren’t enforced and suggested that those who implemented their plans should be rewarded for engaging in good farming practices. Many emphasized the importance of farmers being good stewards of the land.

D3.1.4 Environmental Regulations/Enforcement

While some supported stronger regulation, about a third of the farmers stated they were concerned with *nutrient management and other regulations.* Some were very specific. One asked how he could sustain nutrient management with a limited land base. Several farmers expressed concern about bearing the cost of *regulations*, adding that they were not capable of

passing on these costs, and government agencies should more fully consider the financial impacts, particularly on smaller farmers. They also expressed concern about restrictions on herbicide and/or pesticide use. Still others worried about restrictions for nutrient management and manure hauling. Several felt the various government agencies should categorize farmers and "go after the ones that are the worst" for water quality.

Several people did not specify what regulations caused them concern but were worried about the threat of regulations to their operations in general. One farmer expressed concerns about too many regulations being imposed in the recent past. "Fifteen years ago, you could get a good night's sleep, get up, and feel like working. You could do what you wanted to on the farm. Nobody standing by the door telling you what to do. You were more relaxed. Now Conservation's telling you what to do: put a roof over your yards. Everything you do you've got to have a permit. Not much you can do no more without consulting with somebody." Another farmer echoed, "You can't farm your own operation anymore because of too many regulations." Another expressed a common concerns that, "Rules and regulations are always changing and it's hard to keep up with them."

D3.2 Intentions and Reasons for Change

In the 1996 interviews, farmers were asked to predict how their operations would change over the next five years, and most thought their operation would not change. The 2011 interviews asked the question again and half of the respondents said that five years from now, they anticipate their operation to be about the same as it is today in terms of size, profitability, and ownership. More than one-quarter envisioned that their operation would grow. About one-fifth of them envisioned a smaller operation or felt unsure. Eight farmers explicitly expressed their hope of making their operation more efficient and more profitable. Several of those respondents mentioned wanting to make their operation healthier for their animals by providing a stress-free environment. This could include more seasonal grazing or changing to a freestall operation. Several people said they hoped to be better land stewards and to "work on things that are environmentally friendly."

Six people said they wanted to expand their operation, either by adding more animals, improving the productivity of their animals or adding more land. One person stated that he felt he "almost had to get bigger" to remain in business. Many expressed the desire to just stay in the business, keep viable, keep the land in farming, or to be financially solvent.

There was a strong and consistent desire for the farm to stay in the family, or to have a son take over. Most (71%) thought a family member was likely to take over the operation when they retire or quit. Some expressed doubts, "It'd be nice to pass along, but probably won't happen."

One person expressed the thoughts of many respondents: that his "family will continue to operate successfully and happily." Several suggested that they hoped the size of the operation wouldn't have to increase substantially to remain in business.

These hopes and aspirations underlay decisions about operations and use of specific practices. Three additional themes also arose as important influences and reasons for change: costs and efficiencies, conservation plans and requirements, and a variety of individual circumstance and preferences.

D3.2.1 Costs/Efficiencies

Reflecting their broader concerns, thirty-eight people said they had changed their operation because of *competition or economics*, but the types of change varied. Several said they had to increase the number of cows and steers in order to pay for land, or to just stay solvent or remain competitive. One person said they did not want to invest in new capital improvements and will be committed to milking for 20 more years. Another said that he had specialized in all-dairy because of the potential profitability at the time he made the change.

Some said the opposite: that they had sold their cows because it had become unprofitable. A few had also sold hogs because of declining markets for them. One person sold their cows and transitioned to poultry, in part because both the husband and wife wanted to be active in this new endeavor. Several mentioned that the canning companies moved away or were bought out by the government so the farmers responded by changing what crops they grew.

Almost 70% of the respondents said that *cost* was a factor when deciding to use a new management practice. Costs include labor required for the new practice, cost in time and work load, and cost of start-up equipment. For example, one respondent mentioned that when considering no-till farming, he saw a number of trade-offs, including expensive new equipment and the potential need for more weed spraying which would be an additional cost. Another person mentioned that he was considering manure storage but was concerned about the construction costs. A third person said that if he was close to replacing equipment anyhow, it might be beneficial to just invest in new equipment for new practices.

Almost 70% of the respondents also mentioned that they considered the benefit in return for the cost of the new practice and the impact on yields. Many returned to the issues of profit margin and whether any new practice would be financially viable. "The margin in farming is too small," said one. Nine people said they had implemented changes to improve efficiencies and use best available technologies. One said he was "constantly trying to improve facilities for animals and employees."

Nearly half of the farmers interviewed said that they adopted new practices if they fit in with the *overall operation*, including the layout of the land, the type of crop grown, and how they want to keep things for future generations. Several shared that they were open to trying new things as long as they fit. For example, one farmer noted that frequent soil testing had helped him to recognize that he could decrease the amount of phosphorus fertilizer he used. When making a change, twelve respondents mentioned how important it was to see how a practice was used by others, and how successful that practice had been for them. Farmers suggested several ways of "seeing" this, including through magazines and university publications, observing the results themselves, or watching demonstrations by a consultant or others. As one farmer said, "I want to learn about what other people are doing and if it works for them."

D3.2.2 Conservation plans and requirements

Fourteen people said they made changes to their operation to comply with a conservation plan. The benefits they saw to the operation included controlling soil erosion and improving soil health. One stated the benefit was "to preserve land health [and allow for a] sustainable operation for future generations."

Some said they were interested in implementing a new practice if there was a benefit to the environment, including the land or water quality. Several farmers mentioned specific practices they were considering or had considered in the past. For example, one discussed the county's idea of creating wetlands for water quality, but he also was interested in learning more about sedimentation ponds. While the newer practices may be effective, they needed on-going maintenance. Some of the older practices seemed effective to this farmer, too.

A number of farmers offered additional comments about nutrient management planning on their operation. Some felt that nutrient management planning made sense economically; they understood the importance of using legumes, and they expressed their genuine interest in preserving soil health, water quality, and stewardship of the earth. Some felt that farmers were much more aware of nutrient management now than in the past, and that today's improved machinery allowed for better nutrient management planning in their farming operations than when they were kids and wouldn't haul the manure very far.

Eleven people explicitly attributed changes in their management practices to new regulations. "Rules and regulation—these dictate what I do," one person responded. Another cited stringent requirements imposed for organic farming standards on grazing.

Several people said that they hired a crop consultant and that their *management decisions* were based on that advice. One had hired an agronomist during the time when the farm was transitioning between his father and himself. A third spoke of embracing change and greatly

transforming his operation over the past 15 years. Two generations involved in one interview discussion both emphasized the importance of technological advances in their farm operation. Others noted selective use of technology to maximize efficiency and minimize waste of fertilizer and fuel. For example, one farmer expressing this view had a strong interest in minimum tillage and related technology but not in other conservation practices.

D3.2.3 Individual Circumstances and Preferences

Several people mentioned that they made changes because of their specific circumstances and preferences. Some noted the limitations of their age or physical impairments including knee and back problems. One mentioned changing the operation because of the "burn-out" from the long hours of being on duty seven days a week. Another specifically mentioned the goal of wanting a better lifestyle—which he thought he would have accomplished with the new milking parlor but did not.

In twenty-one of the interviews, people said they had made changes to their operation because of *family circumstances*, including age, health or other personal reasons. Examples included a son who now worked off the farm, which caused his father to pay additional labor costs in his place; two brothers split and each now ran his own operation; and a transition period involving three generations of operators. In other cases, a son or partner was added to the management of the operation, which increased profitability.

E. Summary Reflections and Insights

Conservation partners working to improve and protect water quality in Lake Mendota face many of the same challenges and realities as others across the country. Resource managers and farmers have a desire to reduce agricultural inputs while balancing profitable farming with land conservation and protection. They are seeking approaches to protect individual privacy and decision making while targeting conservation efforts toward lands with proportionally greater contributions to water quality degradation. Those promoting and supporting conservation are depending primarily on voluntary action by farmers, recognizing a limited capacity to enforce (and monitor) management practices on individual farms, and getting mixed receptions by farmers they most need to influence. Consistent with research across the country, farmers throughout the watershed are not of a single mind about much of anything. These are complex challenges with no "easy" solutions. This section seeks to distill a few key major points emerging from this study and recommendations for moving forward.

E1. Major Points

There is wide diversity of thinking and individual circumstances within the Lake Mendota watershed agricultural "community" that are sometimes masked in general assumptions about agriculture, farmer decision-making, and its impacts on water quality. This study focused on management activities and perceptions among a set of farmers in the watershed at two points in time. By doing so, we have not "evaluated" or sought conclusions about the effectiveness of a single watershed "program," but rather we sought insights for understanding past conservation accomplishments and preparing resource managers and conservation partners for future agricultural and watershed challenges. Looking across the results summarized in section D, several important themes stand out.

1. *Farmers are aware of reports that agricultural contributions affect water quality in Lake Mendota and the Yahara Lakes, but they are skeptical of the relative contributions from agriculture and the assignment of "blame" to farmers.* Farmers ranked urban sources of pollution (which many see as being closer to the lake) as more problematic for Lake Mendota than rural and agricultural sources. They specifically noted impacts from urban lawn fertilizers and pesticides, street salt, and sand. Other sources perceived as being problematic included discharges from industries and sewage treatment plants, even though these are no longer sources of pollution to the lake or its tributaries. Farmers in the watershed also witness anecdotal contributions (like erosion from road construction) that don't seem to be acknowledged or addressed by officials or by the media.

There is high awareness of urban pressure for sound and defensible nutrient and manure management on farms, but mixed sentiment over that issue. In contrast to the research studies mentioned earlier in this report, most farmers interviewed for this study expressed that manure, crop-field erosion, and commercial fertilizers were not a problem or were only a slight problem for Lake Mendota water quality. While there was a very high level of awareness about conservation practices available to farmers, there was a mixed perception of benefits of those practices for water quality.

With some notable exceptions, most of the farmers in this study have very limited personal connections with Lake Mendota. A number of the farmers commented on the distance between their land and the lakes and noted they do not use or visit Lake Mendota. They are sensitive to negativism toward agriculture related to water quality in the lake. More than any other response, farmers indicated their awareness of water quality issues had increased due to coverage of the topic in the media and noted that coverage often placed blame on agriculture. Some are frustrated with a perceived general lack of acknowledgement of non-farm contributions to the water quality issue. Some farmers recognize a direct link between water quality and agriculture and are frustrated with other farmers' lack of conservation practices.

2. *Reflecting their diversity as individual farm operators, farmers indicate mixed levels of trust for agencies delivering information and technical support about soil and water conservation*. Although some farmers reported trusting agencies very much, most farmers indicated mixed to low levels of trust for government and environmental organizations for information about soil and water conservation. Thirty-six percent responded that they trusted Dane County LWRD slightly or not at all for this kind of information. Their trust in farm consultants, other landowners/friends, and fertilizer representatives was relatively high, although still not uniform. They viewed University resources (UW-Extension and UW research specialists) with similar levels of trust as local farm organizations, and WDATCP, although one-fifth of them were not familiar enough with UW researchers to comment.

   Overall, their responses suggest a guarded skepticism toward all advice related to soil and water conservation, including the extent of water quality impacts from agriculture. No single source or type of information was most effective for these farmers. They rely on multiple channels for farm management information (e.g., trade publications, local media, consultants, etc.). They identified multiple types of information delivery as persuasive, including demonstrations, technical articles, training, and testimonials from others.

3. *Concerns about water quality (and conservation) compete with many other concerns facing farmers related to current operational challenges, their future, and the future of an agricultural lifestyle in the area.* Although many farmers stated the importance of sound environmental stewardship, their other concerns were dominant. These include concerns about cost and availability of land, price variations in their overall operational costs and products, and the complexity of regulations. There is a strong desire to maintain and agricultural lifestyle in the area. Most farmers intend to continue operating in the watershed, and more than seventy percent expect a family member to take over the operation when they retire.

4. *Agricultural operations and land and water conservation practices in the Lake Mendota watershed have changed over the past fifteen years and will continue to be dynamic.* Most farms have increased their corn and soybean acreage over this period, and most have increased or maintained their numbers of animals. More farmers are conscious of nutrient management and are taking actions such as crediting manure nitrogen and calibrating their manure spreaders. Farmers are highly aware of the practices available to them for using on their operation; some indicated a lack of specific information or skills limited their ability to use key practices. Cost, time involved, and concerns about how a conservation practice fits with an operation also pose barriers to broader use. When farmers do change practices they base their decisions on many factors including cost, farm efficiencies, maintenance needs, regulations, perceived environmental benefit, and their longer term plans for the land and their farm operation.

   Most farmers in this study said that their awareness of water quality issues had increased over the past fifteen years. Conservation partners have initiated many ongoing and past efforts in the watershed. Although details of who sponsors which initiative may blur, farmers are aware of new and ongoing efforts to reduce agricultural nutrients.

E2. Recommendations

As evident through recent publications and ongoing projects by conservation partners, the Lake Mendota watershed is experiencing a sense of reinvigoration aimed at reducing water quality impacts from agriculture (for example, Clean Lakes Alliance 2012a, Jones and others 2010). Those efforts draw upon innovative policy approaches and emphasize adaptation, collaboration, and blended public-private partnerships. They build upon a solid foundation of

conservation activities, and they offer a promising environment for developing creative solutions to long-standing problems.

The following recommendations, drawn from this study, are intended to support and enhance current and future efforts in the watershed. Underlying all of the recommendations is the acknowledgement that reaching farmers with persuasive information about water quality and conservation requires multiple communication channels and information formats. That lesson was clear in this study and is consistent with decades of research that suggests the way information is conveyed is critically important in how people respond to the message (for example, Rogers 1995, Prokopy et al. 2008). There is an opportunity to work with a variety of individuals, organizations, and information outlets in the watershed, including those most trusted by farmers.

1. *Initiate new efforts to increase farmer awareness of sources of water quality impairment in Lake Mendota by synthesizing, translating, and communicating existing information*. The format and presentation of most publications and reports documenting modeling results or water quality problems in the Yahara Lakes are too complex and contradictory to communicate clearly to various audiences. It would help to create clear messages and informational materials by synthesizing key findings, assumptions, and limits of past analyses. Take advantage of new technology and use mapping and visualization tools to illustrate contributions of specific areas, farms, and fields. Include information about assumptions used in identifying those areas and their contributions. As part of this effort, outline actions and options available to farmers for reducing problematic sources, such as the first-flush loading identified as a high-percentage source of phosphorus by Lathrop (2007). Efforts to increase awareness of agricultural sources should also address farmer concerns that the deck is stacked against agriculture, and that urban residents are not sharing in a fair and balanced approach. This could include acknowledging contributions of non-agricultural sources and summarizing the range of ongoing efforts to address those sources, for example, through municipal management practices, ordinances, and outreach and education programs.

2. *Use multiple approaches to reach and support farmers, including continued one-on-one technical assistance for land and water conservation.* As noted, reaching farmers with water quality and conservation information and technical support should involve multiple channels and types of information. Moving forward, these will likely include interactive web-based tools and applications for mobile devices in additional to traditional fact sheets and hard-copy materials. State agencies and UW Cooperative Extension are among those developing these kinds of tools. Reaching farmers will also involve continued individual

support, both through traditional conservation agencies and through new and expanded partnerships. One-on-one technical support is especially important for discussing farm-appropriate practices and their connection to the watershed and broader water quality goals. This requires staff time and staff availability to outline potential timelines for practices and to accommodate adjustments to make practices fit with multiple farming systems. Prioritizing assistance could be based on modeled impacts of specific subwatersheds or individual farms across the watershed.

3. *Introduce additional innovative outreach and educational approaches, including social marketing focused on appropriate issues such as actions to reduce soluble P and first-flush runoff*. Concentrated social marketing campaigns can be effective at changing behaviors if they focus on a single activity, provide clear and consistent messages, and reinforce those messages through multiple channels and reminders. This kind of approach involves selecting a single action or set of actions that is relatively easy to recall and implement. The approach may not be appropriate for more complex processes such as farm conservation planning or nutrient management, but it could be effective if applied to a single high-impact practice, such as actions to reduce first-flush runoff with snowmelt. We recommend engaging a consultant, a university-level communications class, or a specialized staff person to pursue this approach.

4. *Continue to support and engage farmers in new initiatives and share information about them with farmers outside of special project areas.* For example, the newly formed Clean Lakes Alliance is a non-profit organization working as a private-public partnership with a mission to restore and protect the lakes through community engagement. The Clean Lakes Alliance and the Dane County Land and Water Resources Department have initiated a farmer-driven group of volunteers called the Yahara Pride Conservation Board to work with a group of farmers in the Dorn Creek subwatershed. The farmers, identified with the Madison Metropolitan Sewerage District (MMSD), are part of a pilot project to reduce loadings to the lake through the use of winter cover cropping (Clean Lakes Alliance, 2012b). This effort is part of an innovative "adaptive management" approach to pollution load reduction enabled through recent changes in state administrative rules. The project involves a wide range of conservation partners and is expected to reduce nutrient loads and save the MMSD millions of dollars in upgrades to the Nine Springs Sewage Treatment Plant. Sharing information about creative initiatives helps reinforce the connections between agriculture and water quality and that farmers are taking steps to reduce their impacts.

5. *Communicate with the non-agricultural community and Yahara Lakes stakeholders about reasonable expectations for the pace of change for improving water quality and the*

promising potential of new initiatives. Despite a desire for a quick-fix or easy solution, every approach to complex problems has limitations. Voluntary approaches to reducing agricultural nutrient loads depend on the decisions of individual farmers. Regulatory and environmental approaches require rule making, compliance monitoring, and enforcement that may not be politically, economically, or administratively feasible. Creative approaches that move toward reduced impacts while emphasizing balance and flexibility may be the best route to a healthy and vibrant future for the Yahara Lakes. A sustainable long-term solution will likely require ongoing and long-term community support and engagement.

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