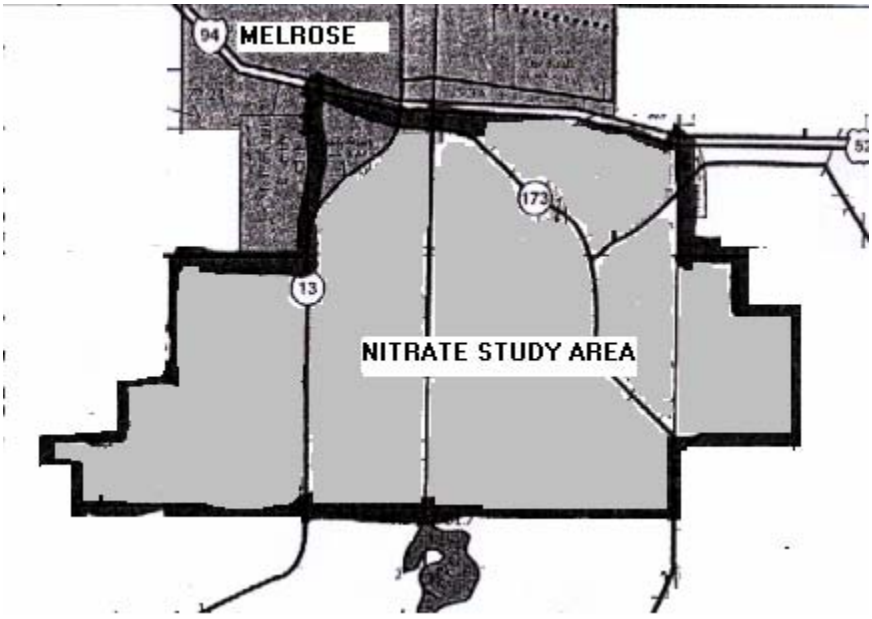
2001 Nutrient Management Assessment of Producers Melrose Nitrate Study Area



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Background

In recent years, Stearns County water managers and resource specialists have been concerned about the increasing nitrate levels found in the City of Melrose drinking water. Recent testing has shown that one of the five wells was above nine parts per million (ppm) nitrate nitrogen while the other four wells were below one ppm. The drinking water standard for nitrate is 10.0 ppm. In response to these concerns, the city of Melrose Wellhead Protection Team and the Minnesota Department of Agriculture (MDA) decided to assess the current use of agricultural nutrients of the potential wellhead area, which is referred to as the Melrose Nitrate Study Area (M-NSA). This report describes the results obtained after interviewing 12 of the 13 farmers (one farmer chose not to be interviewed).

Procedures

Nitrogen fertilizer rates, timing of applications, and manure/legume contributions can have a significant effect on ground water supplies. To get an accurate assessment of the farming activities, the MDA and the Melrose Wellhead Protection Team decided to implement an interview tool called FANMAP (Farm Nutrient Management Assessment Program)

FANMAP is a data-gathering tool and analysis system that was developed seven years ago to provide an understanding of current farm practices regarding agricultural inputs. This information is used to design effective water quality educational programs and provides baseline data to determine program effectiveness over time. In the past seven years, more than 500 farmers throughout Minnesota have volunteered one to three hours of their time to share information about their farming operations. Results can greatly assist in prioritizing response strategies and designing effective educational programs. The FANMAP results are also useful for establishing baseline data and determinimng behavioral changes over time.

Soon after the decision to use FANMAP was reached a list of farmers/operators in the M-NSA was obtained from the Stearns County Farm Service Agency. There are a total of 13 farmers within the M-NSA and introduction letters describing the project were mailed to them in July, 2001. The letter's intent was to identify: 1) the overall project; 2) the purpose of the nutrient assessment; 3) why individual farmers were selected, and; 4) what types of information and amount of time would be necessary to successfully complete the project. The MDA interviewed twelve of the operators in August, 2001.

In addition, the city of Melrose, local Natural Resources Conservation Service (NRCS) personnel and local Soil and Water Conservation District (SWCD) personnel were contacted to inform them of the specifics of the project and its overall goals.

Nutrient Information of the Selected Farms in the Melrose Nitrate Study Area

This report will focus on nitrogen use in regard to the 12 interviewed farm operations.

Materials used to collect information from the farms included inventory forms and a database design that were patterned after a previous successful FANMAP project[1]. Information was obtained directly from the farmers. In some cases, information such as soil test results and fertilizer rates were collected at their crop retailers. Information collected included (nutrient inputs and yields were specific for the 2001 cropping season.):

- Timing, rates, and method of applications for all nitrogen (N), phosphate (P_2O_5), and potassium (K_2O) inputs (fertilizers, manures, and legumes) on **a field-by-field basis for all inventoried acres within the M-NSA**.

- Pesticide information was gathered on a field-by-field basis, including common name, EPA number, date and rate.

- Soil and manure testing results were collected if available.

- Crop types and manure applications (starting in the fall of 2000) were also collected for the 2000 season for purposes of 2001 nitrogen crediting.

- Livestock census and other specifics for the entire farm (i.e. types of manure storage systems, total farm sizes) were also recorded.

Long-term yield data generally reflected the past three to five years.

Farm Size, Crop and Livestock Characteristics of the Selected Farms in Melrose Nitrate Study Area

Twelve farms participated in the project and were interviewed in August of 2001. A total of 1,052 acres of farmland was inventoried in the M-NSA study for the 2001 crop season. Stearns county offices estimate that there are a total of 1,128 row crop acres in the M-NSA**.** FANMAP inventoried acres made up approximately 93% of all agricultural acres in the M-NSA and 50% of the land area of the WPA. The M-NSA inventoried cropland was dominated by a corn-alfalfa rotation with field corn and alfalfa accounting for 57% of all acres. Irrigated land accounted for 6% of the inventoried acres in 2001. Figure 1 lists each type of crop grown and the corresponding percentage of acres.

[1]Effective Nitrogen and Water Management for Water Quality Sensitive Regions of Minnesota, LCMR 1991-93

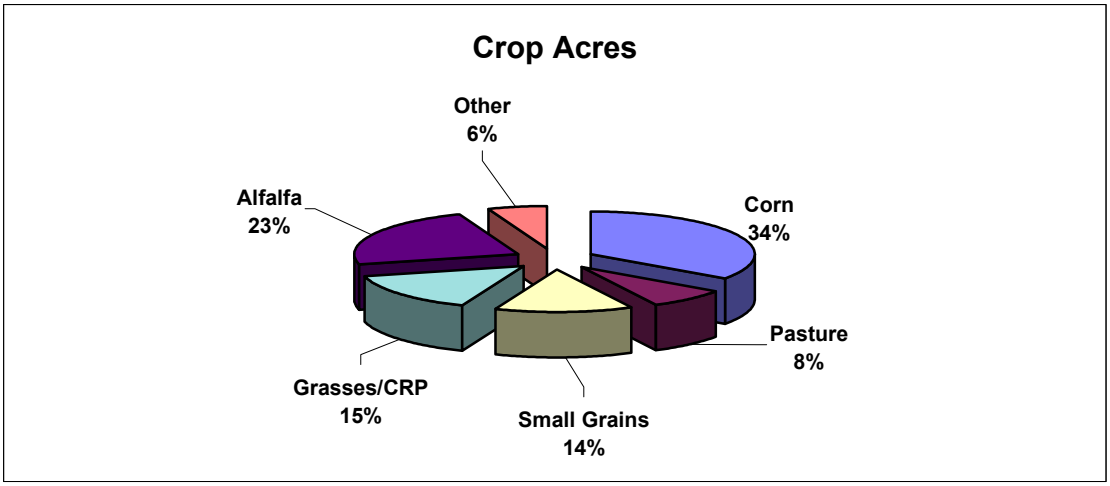

Figure 1. Crop acres inventoried in the M-NSA. Cropland totaled 1,052 acres with corn and alfalfa accounting for 364 and 244, acres respectively.

Commercial Fertilizer Use Characteristics on Selected Farms: Melrose Nitrate Study Area

Field corn accounted for over 64% (10,930) of the 16,962 pounds of commercial N fertilizer use (Figure 2). Commercial N use was limited in this area to an average of only 30 pounds an acre on all corn acres. Total N inputs will be discussed later in the "Nutrient Balances and Economic Considerations" section.

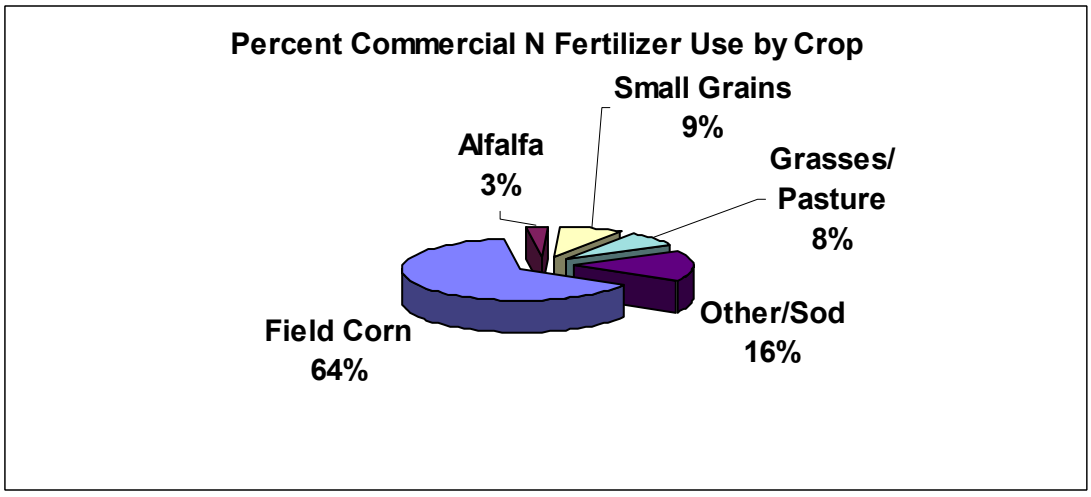

Figure 2. Commercial fertilizer N use on all inventoried acres. A total of 16,962 pounds of commercial nitrogen was applied in the 2001 season on inventoried acres.

Timing of N fertilizer applications for all crops is an important consideration on the coarse-textured soils in east-central Minnesota. Fifty percent (50%) of commercial N applied to all crops was applied at planting (Figure 3). For corn acres, 63% of the N was

applied at planting and 37% was applied as a sidedress. The UM recommends applying N in the spring and as a sidedress rather than fall application.

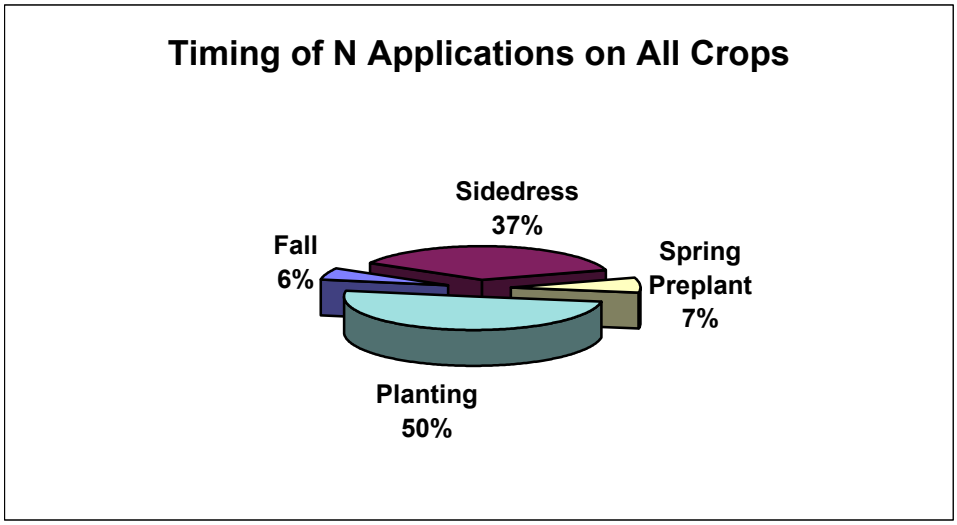

Figure 3. Timing of 2001 commercial N fertilizer applications across all inventoried acres.

Anhydrous ammonia supplied 24% of the commercial N applied to all inventoried acres (Figure 4).

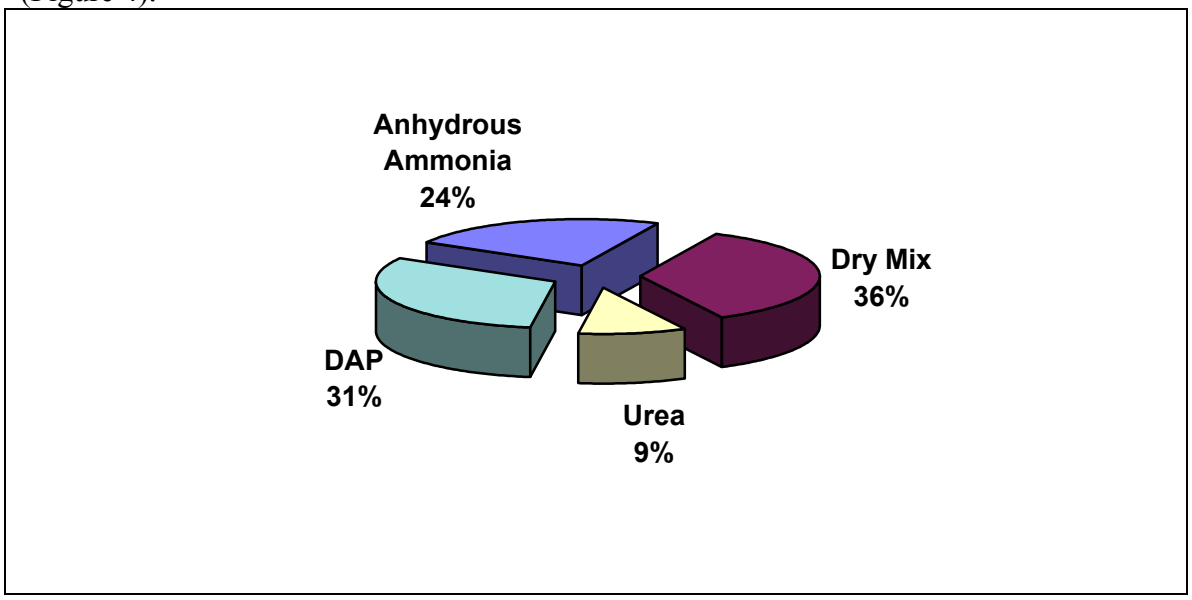

Figure 4. Sources of commercial N used on all inventoried crop acres.

Livestock and Manure Characteristics of the Selected Farms:

Factors directly affecting crop nutrient availability from land-applied manure (including manure storage, types, manure amounts being generated, application methods, incorporation factors and rates) were also quantified to complete the "whole farm"

nutrient balance. Livestock numbers represent the livestock on hand from the fall of 2000 to the summer of 2001. This is the livestock that would contribute manure to the 2001 crops. Seven farm operations had livestock within the M-NSA. Three farmers also applied purchased turkey manure on their fields and one farmer applied city bio-solids.

Animal production in the M-NSA consists of dairy, beef and hog operations. A large turkey farm[2] is also located in the M-NSA, (although the manure is all exported to farmers, three of which have land located in the M-NSA). Table 1 details the variety of animals produced in the M-NSA.

Table 1. 2000 livestock numbers

Livestock Type	Livestock Number
Dairy Cows and Bulls	121
Dairy Calves	145
Replacement Heifers	58
Dairy Steers	63
Beef Cows and Bulls	68
Beef Calves	60
Beef Feeders	235
Sows and Boars	300
TOTALS	**1,050**

Manure production varied by type of livestock in the M-NSA. These animals referred to in Table 1 produced 107,000 pounds of manure N. These totals do not include turkey contributions. Dairy manure supplied 53% of the total amount of N produced from all livestock raised on the farm (Figure 5).

[2] Turkey manure was limited to a rate of 3 tons per acre. Over 90% of the manure was applied outside the M-NSA.

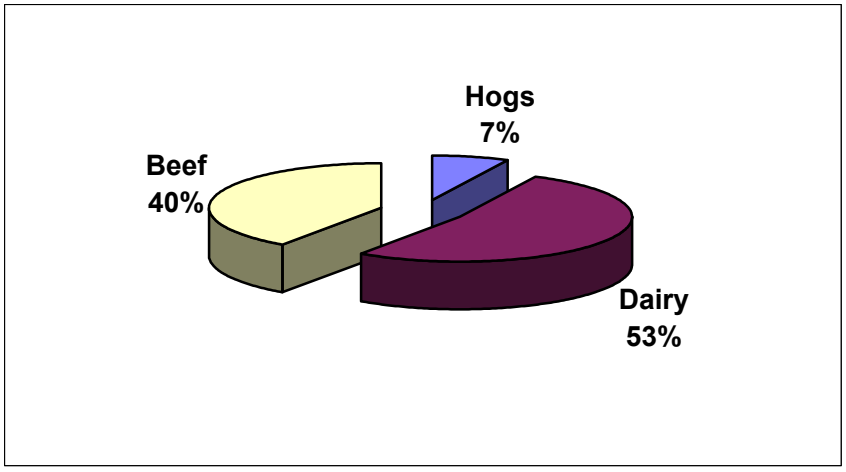

Figure 5. Amounts of nitrogen (total) generated by animal types across all selected farms. A total of 107,133 pounds of manure N was produced by 1,050 animals.

Seventy-four percent (74%) of the manure produced in the survey was collected for land application. Manure not collected was due to pasturing of cattle or holding cattle in wintering areas that were too large for manure collection. A total of 79,573 pounds of manure N was collected. Table 2 further details the specific type of livestock and their respective manure nutrient contributions on the inventoried farms. Nutrient losses from collection and storage were estimated from accepted guidelines[3] for each individual storage system. Two farmers had some type of liquid system. Storage system losses of N due to atmospheric losses ranged between 20% and 30%.

Table 2. 2000 livestock numbers, and fate of manure N produced and available to spread after system losses by livestock types in sample population.

Livestock Type	Livestock Number	Manure Nitrogen Produced	Manure Nitrogen Collected	Manure Nitrogen Available[4]
		Pounds		
Dairy Cattle	387	56,322	42,0912	33,553
Beef Cattle	363	43,011	29,681	19,225
Hogs	300	7,800	7,800	5,850
TOTALS	**1,050**	**107,133**	**79,573**	**58,628**

[3] Livestock Waste Facilities Handbook, Midwest Plan Services, Iowa State University, Ames, Iowa. 1993.

[4] Manure availability was based on calculations from the Livestock Waste Facilities Handbook.

Manured was applied on to 445 crop acres. 353 of those acres were applied with manure from their own livestock and 98 acres were applied with imported turkey manure. Manure was applied on 342 corn acres, or 77% of all manured acres. Manure N available for application, including imported turkey manure, totaled 70,801 pounds. Approximately 600 pounds of manure N was applied outside the M-NSA, leaving 70,238 pounds of nitrogen available for application. Thirty-two percent (32%) of all manure, based on manure N, was applied with no incorporation. After subtracting application losses, a total of 36,326 pounds of N was available for first year N credits to the crop. Approximately 71% of the manure was fall applied with the balance spread thought the year.

Nutrient Sources From Bio-solids Applications on Selected Farms:
Melrose Nitrate Study Area

The city of Melrose applies city bio-solids to area farm fields. Last year, bio-solids were applied to 16 acres of corn in the M-NSA. A total of 2,016 pounds of N were available for the 2001 growing year.

Relative Importance of Nutrient Sources on the Selected Farms:
Melrose Nitrate Study Area

The University of Minnesota recommends legume crops be credited for their N contributions to subsequent crops. Alfalfa credits were available on only 21 acres of field corn. No other N credits were available. A wide winter-kill of alfalfa three years ago caused major replanting of alfalfa acres. Much of the alfalfa is now in its third season and will probably be tilled in the fall of 2001. Field corn acres following alfalfa were given 75 lb N/A credit. A total of 1,575 legume N credits were available for the 2001 growing season.

Commercial fertilizers (30%), manures (63%), bio-solids (4%), and legumes (3%) contributed a total of 56,879 lb of "first year available N" to all inventoried acres in 2001 (Figure 13).

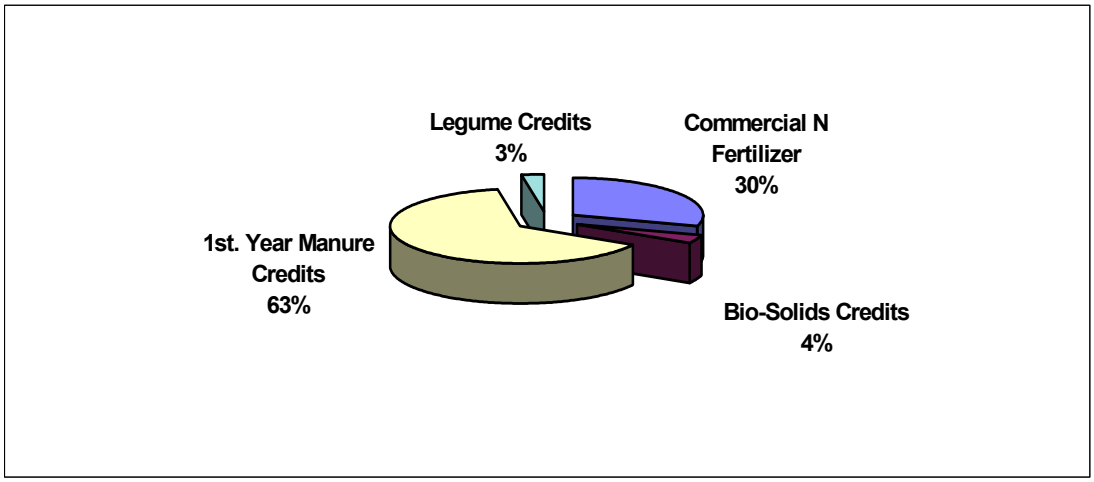

Figure 6. Relative N contributions from fertilizers, manures and legumes across all crop acres inventoried in 2000. Nitrogen inputs totaled 56,879 lb for all sources across all inventoried acres.

Nutrient Balances and Economic Considerations: Melrose Nitrate Study Area

Contributions of N from commercial fertilizer, manure and bio-solids to inventoried acres totaled 55,304 pounds. Corn received most of the N with 82% (45,533 pounds of N) applied to field corn. The corn yield goal across all farms averaged 127 Bu/A while historic yields averaged 125 Bu/A. Yield goals varied greatly due to the very diverse soils across the M-NSA ranging from 80 Bu/A to 160 Bu/A. It appears farmers are using realistic yield goals for corn acres.

University of Minnesota (UM) recommendations are based on economic and environmental factors. Research at the University of Minnesota has shown that the recommendations are based on sound economic decisions and, in the long term, generally result in the most economic profit. UM N recommendations (based on yield goal, crop history, and soil organic matter level) were compared to actual amounts of fertilizer and manure applied to each field. In the fall of 2000, the UM released new fertilizer recommendations for corn. This analysis will compare actual amounts of N to the new UM recommendations. In this survey, all soils in the M-NSA are considered low in organic matter based on soil surveys and actual soil tests. Irrigated soils also receive the UM recommendations for soils low in organic matter. Irrigation was not prevalent on surveyed corn acres with only 67 acres irrigated.

New University of Minnesota N recommendations for corn averaged 141 lb N/A. Actual amounts of N applied from fertilizer, manure and Bio-solids averaged 125 lb N/A across all corn acres (Figure 7). Factoring in all appropriate credits from fertilizer, legumes and manures, there is an **under**-application rate of 16 lb/N/A according to the new UM recommendations.

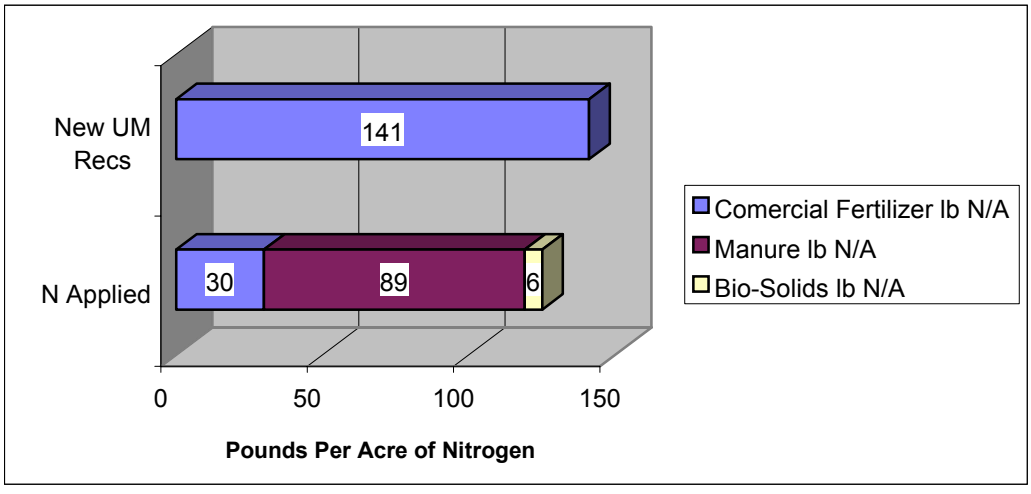

Figure 7. 2000 crop N requirements based on University of Minnesota N recommendations in comparison to actual N inputs (fertilizer and manure) for 364 corn acres in the inventoried area. Average N application was 125 lb N/A.

One of the top advantages of the technique developed through the nutrient assessment process is the ability to examine in detail the nutrient balances and make inferences on where the biggest gains in water quality can be obtained through focused educational programs. Factoring legume N credits and manure N credits into the process on a field-by-field basis, the amounts in excess of UM recommendations are illustrated in Figure 8.

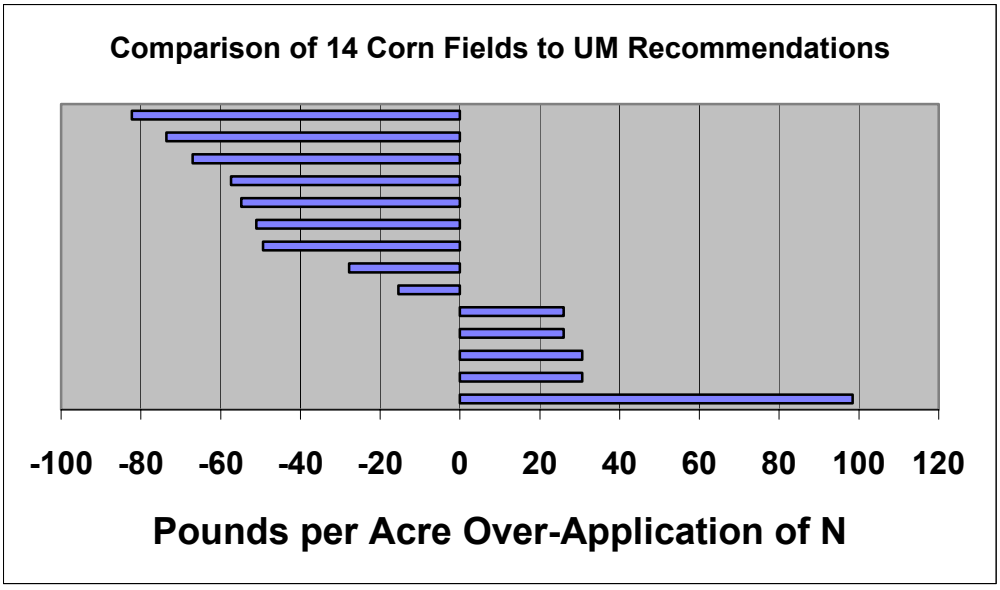

Figure 8. Corn acre N applications when compared to UM recommendations for N.

Five fields of corn totaling 119 acres were over applied with N when compared to the UM recommendations. Three of the fields were applied with manure and commercial fertilizer and two were applied with bio-solids only. No fields with turkey manure applications were over-applied with N. Only one field was over-applied by more than 30 lb/A of N above the UM recommendations. Usually fields within 30 lb/A of N of UM recommendations are also considered within the BMP's for N rate.

Other Nutrient Contributors: Commercial and City Nutrient Practices: Melrose Nitrate Study Area

Two commercial businesses, a golf course and a sod farm, within the M-NSA use N in their operations. The sod farm was inventoried and included in the preceding analysis. The owners of the sod farm were very concerned about protecting the ground water, and have agreed to share specific information for this analysis. Generally, only summaries and averages are given to protect the identity of the interviewee. Sod farming is different than normal crops because it is planted in the fall and is harvested in the spring. Sixty (60) acres of sod are grown in the M-NSA. Typically N is applied in the fall at planting and in the spring before harvest. In this FANMAP, average annual applications of N totaled 46 lb/A for all sod acres.

The golf course covers approximately 60 acres. The golf course staff is also concerned about water quality and as a result was willing to share individual results. Applications of N are applied twice a year and total only 60 lb/A.

In addition to two commercial N contributors, the city of Melrose also applies bio-solids to 16 acres within the M-NSA. Average N applied though Bio-solids on those acres averaged 126 lb N/A. UM recommendations of N for the yield goal the farmer was trying to obtain were 100 lb N/A.

Comparisons of Land Use Scenarios in the Melrose Nitrate Study Area.

Nitrogen sources in the M-NSA come from a variety of sources and is applied to assorted crops including field crops and commercial enterprises. Figure 9 details the comparisons of different scenarios within the M-NSA.

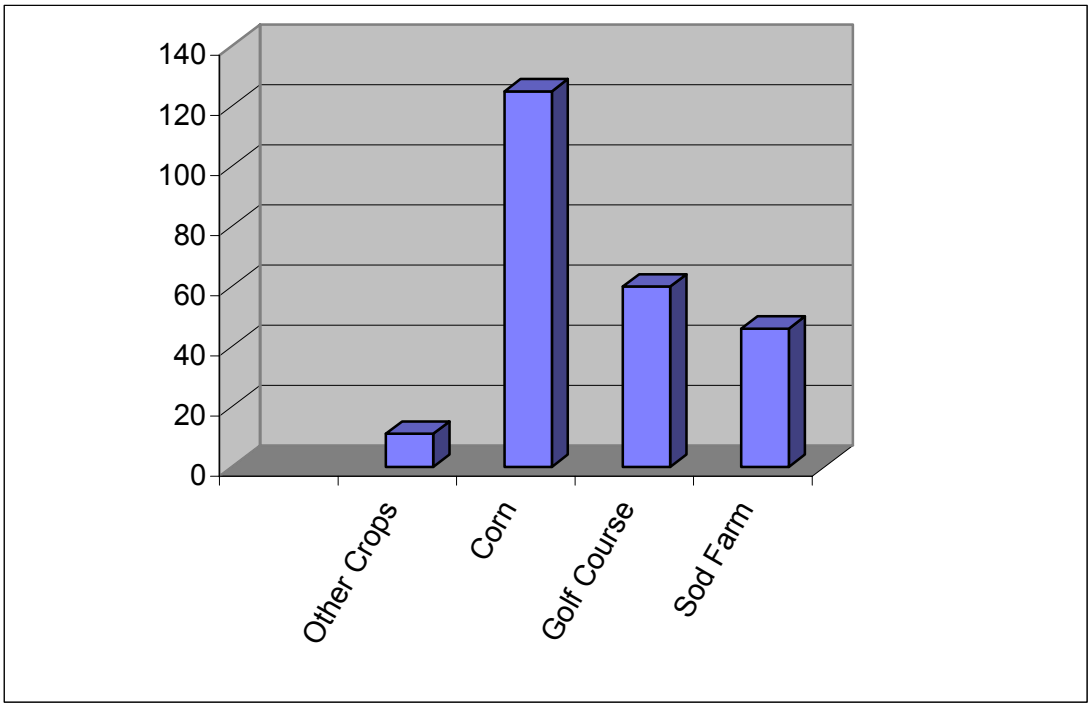

Figure 9. Nitrogen rates on different cropping scenarios and different sources of N. Highest N applications were on corn acres and averaged 125 lb N/A.

Conclusions and Summary of the Current Nutrient Management: Practices for the Melrose Nitrate Study Area.

The Melrose Nitrate Study Area consists of coarse-textured soils in east-central MN. Twelve farmers, farming 1,052 acres in the M-NSA, participated in the FArm Nutrient

Management Assessment Program (FANMAP) with staff from the Minnesota Department of Agriculture. Only one farmer chose not to be interviewed. Producers volunteered one to two hours of their time to share information about their farming operations. The overall purpose of the program was to develop a clear understanding of current farm practices regarding agricultural nutrients and pesticides, and, utilizes this knowledge for future water quality educational programs.

Approximately 93% of the crop acres within the M-NSA was inventoried. Field corn and alfalfa were the dominant crops with 57% of all acres planted to these crops. Irrigation was limited to 67 acres. Sixty-four percent 64% of the 16,962 pounds commercial N was applied to those field corn acres. Most of the N applied to crops in the M-NSA was applied at planting (50%) or sidedress (37%).

Manure N (first year available) accounted for 63% of all relative N contributions with legumes, Bio-solids and commercial N accounting for 3%, 4% and 30% respectively. The dominant manure sources were dairy (53%) and beef (40%).

In the fall of 2000 UM came out with new recommendations for corn. According to the new recommendations only one of the corn fields was over-applied with N. This field was over applied by 30 pounds or more above the UM recommendations and four were within 30 pounds but still above the UM recommendations.

Opportunity for improvements in N applications are very limited in the M-NSA. It would appear that most of the practices currently used should continue. Only one field was over-applied by more than 30 lb/A of N. A reduction of commercial N and or manure N should be reduced on three fields to bring them within the UM recommendations. Also, yield goal information from the farmer should be used when applying biosolids or other forms of N, thus reducing over-application and better following UM recommendations for N. Farmers also need the N content of purchased turkey manure to insure that over-application does not occur. Finally, alfalfa credits should be taken on many of the corn fields in the next two years as much of the alfalfa will be rotated within that time. In the year 2001 these are the only changes needed to have all acres within the UM recommendations.

There were some very positive findings from this study. There is strong evidence that producers are voluntarily adopting the educational materials and recommended N management strategies developed by the University of Minnesota. It appears overall rates of N could be reduced only in very limited situations. It is also evident that promotional activities need to continue and be specifically targeted to deliver the most recent advances in technology and revised N management techniques and recommendations so farmers can continue using N best management practices.

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