FINAL

Technical Work Paper on Topic B: Land Use Conflicts and Regulation

Prepared for the
Generic Environmental Impact Statement
on Animal Agriculture
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Land Use Conflicts and Regulation

Executive Summary

The land use team was specifically charged with the following tasks:

Quantifying the trends in animal agricultural production, demographics and land use in Minnesota over the past fifteen years;

Quantifying the causes and characteristics of conflict over feedlots in Minnesota; and

Identifying and evaluating land use regulations and conflict management techniques used by local governments in Minnesota and elsewhere to reduce conflict over feedlots.

Quantifying the trends

In 1997, there were 47,281 farms in Minnesota with gross income over $10,000, a 29% decrease from 1982. The average farm size in Minnesota was 486 acres, an increase of 23% from 1982. Farms are found mainly in a crescent-shaped agricultural belt around the western and southern perimeters of the State, and are most concentrated in the central and southern parts of the State. Farms with 100 to 259 acres decreased the most in number between 1982 and 1997; farms with 500 acres and up increased in many counties, even while total numbers of farms decreased. Demographically, while there was a 15% increase in total population statewide, there was a 2% decrease in rural population and a 33% decrease in farm population. There was a 3% increase in rural non-farm population. Considering farming as an occupations, 50% of farm operators with over $10,000 gross sales reported no days worked off the farms in 1997. This number fell 38% from 1982 to 1997.

Looking specifically at livestock, statewide there were 0.14 hog farms per 1,000 acres in 1997, a decrease of 63.9% from 1982. However, during the same time period, hog numbers increased by 27.9%, to 106.03 hogs per 1,000 acres in 1997. This implies that the number of hogs per hog farm increased between 1982 and 1997. Statewide there were 0.18 dairy farms and 20.82 dairy cows per 1,000 acres in 1997, decreasing 60.3% and 35.5% respectively from 1982. This implies that on average the number of cows per dairy farm increased between 1982 and 1997. In 1997 there were 0.39 beef farms and 23.56 beef cattle per 1,000 acres statewide. These numbers were both down by 22.3% from 1982.

Quantifying conflict

In our attempt to quantify actual conflict and evaluate whether or not land use regulations correlated with reduction in conflict, we found limited data sources for actual conflict. Because of these limitations, we were unable to statistically correlate specific land use regulatory action with a reduction, or increase, in complaints. Using the data sources available, we confirmed the results of the literature review: that an overwhelming percentage of reported complaints in Minnesota are odor based. We also found that a few counties appeared consistently as the locations for complaints.

To supplement the limited applicability of data on actual complaints and to create a tool to measure future effects of land use regulation on conflict, we constructed three indices to predict the potential for complaints by county. The indices used assumptions based on existing literature

about sources of conflict. They also use the data that was compiled to quantify trends in demographics, land use and changes in animal agriculture. Actual conflict data collected in the future can be compared to the predicted level of conflict. If the actual conflict diverges from the predicted level, the divergence could be attributed to land use controls or conflict management methods that were implemented.

Land use regulation to reduce conflict

The land use team also researched how land use regulations to are used to reduce conflict over feedlots. The new research included:

interviews with counties and townships about land use techniques and how effective the techniques are in reducing conflict;
comparison of existing feedlot ordinances with the OFFSET odor model to determine how effective separation distances in current ordinances are at reducing complaints; and
research on innovative land use tools used by local governments across the country.

This research results in a section suggesting model feedlot ordinance elements that a local government should consider if they wish to reduce conflict over feedlots. The model elements include: a participatory process for developing the ordinances; connection between the ordinances and stated community goals; identification of potential areas of conflict over feedlots; and examples of ordinance concepts that address the identified areas of conflict.

To supplement land use regulation, local governments should also consider a conflict management program targeted at reducing conflict over feedlots. A conflict management program will contain elements that address:

technical assistance to the operator to reduce the causes of conflict;
education about typical farm operations, environmental risk and the purpose of regulations; and
continuing communication .

Consideration should also be given to how the program will be funded in the long-term. The conflict management programs should be administered by local government staff and involve a team of technical experts from all levels.

Conclusion

For the period 1982-1997, the land use team observed significant changes in animal agriculture distribution and density in Minnesota, as well as changes in non-farm rural population density. The combination of these two trends can lead to conflict. Our ability to quantify the effect of particular types of land use regulation on the reduction of conflict was hampered by the quality of actual conflict data. Our team created three indices to predict the potential for conflict based on the major causes of conflict as described in the literature review. These indices combined with actual conflict data can be used in the future to test the effectiveness of particular land use techniques. Finally, our team collected data on land use and conflict management techniques used in Minnesota and elsewhere. Based on observations about the effectiveness of these techniques, and the ability of the techniques to address the fundamental causes of conflict, we suggest a process and regulatory elements that can be used by local governments to reduce conflict over feedlots.

Land Use Conflicts and Regulation

Introduction

Animal agriculture has changed significantly over the past two decades in Minnesota. Conflict between feedlot operators and neighbors has accompanied this change. Because of the change and concerns about the impacts of the change, the State of Minnesota directed the Environmental Quality Board (EQB) to prepare a Generic Environmental Impact Statement (GEIS) on animal agriculture. As part of the GEIS, our team of consultants was directed to examine issues surrounding land use and conflict. The land use team was specifically charged with the following tasks:

Quantifying the trends in animal agricultural production, demographics and land use in Minnesota over the past fifteen years;

Quantifying the causes and characteristics of conflict over feedlots in Minnesota;

Identifying and evaluating land use regulations and conflict management techniques used by local governments in Minnesota and elsewhere to reduce conflict over feedlots;

Making policy recommendations on land use and conflict based on our research; and

Updating the land use literature review previously prepared for the GEIS on Animal Agriculture.

This Technical Work Paper (TWP) presents our findings and recommendations.

Section 1:
The Context for Conflict: Changes in Animal Agricultural Industry and Demographics in Minnesota, 1982-1997

The first step in understanding conflict over feedlots is to understand the context in which the conflict takes place. We need to understand changes that have occurred in rural settlement patterns, the density and concentration of animals, and the economic structure of farming. Using existing data from the Office of the State Demographer and the United States Department of Agriculture (USDA) Census of Agriculture, the land use team compiled trend data for a number of agricultural production, demographic and land use variables for the period 1982 through 1997. Some of the data will appear to vary from data for similar variables reported in other Technical Work Papers. In order to construct trend information, we were restricted to using only data sources that are collected at similar time intervals and on consistent variables. Other data sources were considered, but only these sources provided comprehensiveness and comparability over time. Point-in-time data, such as the EQB Feedlot Inventory, is particularly important to have going forward, but was not useful in constructing past trends.

Figures 1-7, which follow page 8, present selected trend data in mapped and charted form for each county in Minnesota. Tables containing the underlying data for figures 1 - 7 are included in Attachment 1. Although we were asked to examine township level data, we found that it was not consistently available for all variables or for the time period examined. The following paragraphs describe the mapped data. Additional analysis of social and demographic variables is included in the Social and Community Impacts study for selected case study counties.

Figure 1 Density, Number of Farms and Average Farm Size - 1982 to 1997

Figure 1 presents information on the numbers of farms, the geographic dispersion of farms, and average farm size in Minnesota. In 1997, there were 47,281 farms in Minnesota with over $10,000 in gross sales as reported in Table 12 of the Census of Agriculture. This number declined by 29% from 1982 to 1997. Our profile of change in agriculture is focused on farms where the operator depends on the farming operation for a significant level of support. This report assumes that farms with gross sales under $10,000 are more likely to be hobby farms and, therefore, not of particular interest to this study.

In Map A of Figure 1, Density and Number of Farms: 1997, farms are located mainly in a crescent-shaped agricultural belt around the western and southern perimeters of the State, and are most concentrated in the central and southern parts of the State. In 1997, Stearns county had the highest number of farms in the State with 2,062, followed by Otter Tail (1,499), Morrison (1,075), Fillmore (1,053), Redwood (1,041), and Goodhue (1,027) counties. Except for Otter Tail, these counties were also among those with the highest density of farms.

Many of the maps in this report portray data that has been normalized over area. Counties in Minnesota vary greatly by the number of acres. Because of this variation, it is sometimes misleading to compare percent change in a statistic over time. For example, Lake County had 2 farms in 1982 and 4 farms in 1997, this represents a 100% increase in the number of farms. In 1982, Stearns County had 2553 farms and in 1997 had 2062, representing a 19% decrease in the number of farms. To portray the percentage change without normalizing the data for density, Lake County would appear to have increased significantly in the number of farms, while Stearns County would have shown a less significant decrease. We have, therefore, chosen to normalize the data in order to avoid misrepresentations and allow the reader to more accurately assess changes.

Map B of Figure 1, Change in Density of Farms: 1982 to 1997, shows that all counties lost farms between 1982 and 1997, with the exception of Itasca and Ramsey counties which had minuscule increases. Central Minnesota and the Red River Valley in northwest Minnesota had the largest percentage decreases.

Map C of Figure 1, Average Farm Size: 1997, shows that average farm size was highest along the northwest edge of the State in 1997. The average farm size in Minnesota in 1997 was 486 acres. Farm size increased by 23% from 1982 to 1997. Kittson county had the highest average farm size at 1,317 acres followed by Wilkin and Polk counties, where average farm size was also over 1,000 acres. The county in the agricultural zone with the lowest average farm size was Stearns, at 273 acres, followed by Wright (278 acres) and Benton (296 acres).

Map D of Figure 1, Change in Average Farm Size: 1982 to 1997, shows that outside of the seven-county metro area, average farm size increased in all counties except Cook between 1982 and 1997. Increases in average farm size were highest in the central and south central counties, with increases from 40% to 63%.

It is interesting to note that Stearns county had the highest number of farms and the lowest average farm size, as we can see in Maps A and C. Counties that had over 1,000 farms also had smaller average farm size (less than 500 acres). Comparing Maps B and D we can see that some of the counties that gained the most in average farm size were also those that lost the highest percentage of farms between 1982 and 1997.

Figure 2 Number of Farms Classified by Size 1982 to 1997

For each county in Minnesota, Figure 2 illustrates the change in number of farms in several size classes, as well the change in total number of farms. All counties except Itasca had fewer farms overall in 1997 than in 1982 (as also shown in Figure 1). In the smallest size class, 1 to 99 acres, most counties had slight gains or losses of farms between 1982 and 1997. This size class represented a small portion of the farms in most counties in 1982 and in 1997. The most dramatic change was in the farms from 100 to 259 acres. The number of farms in this class decreased in every county between 1982 and 1997. In many counties it decreased by 50% or more. This is especially striking because of the fact that in most counties this was the predominant farm size in 1982.

In all counties, the number of farms between 250 and 499 acres decreased between 1982 and 1997. In 1997, the predominant farm size in most counties was 500 acres and up. In several counties, the number of farms with 500 acres and up increased even though the total number of farms in the county decreased.

Figure 3 Population Changes 1982 to 1997

Figure 3 presents information on population changes in the State between 1982 and 1997. Statewide, there was a 15% increase in total population, from 4,120,244 to 4,735,830. Map A, Change in Total Population: 1982 to 1997 shows most of the statewide increase occurring in the Twin Cities and St. Cloud metropolitan areas and the lakes region of central Minnesota.

Maps A, B and C of Figure 3 distill three component of total population: rural population, farm population and rural non-farm population. The land use team was interested in documenting the trend in rural non-farm population because the literature review revealed a belief that rural non-farm residents are more likely to complain about feedlots. Map A shows that rural population decreased statewide by 2% from 1982 to 1997. Counties with the largest losses in actual numbers of rural residents were Carver (-4638, -23%), Wabasha (-3907, -26%), and Pope (-3455, -29%).

Thirty counties saw an increase in rural population. Rural population includes people residing outside of incorporated places greater than 2,500 population, as estimated by the Minnesota State

Demographer s Office. Rural population includes people living in central places (e.g. towns) with less than 2,500 population. It should be noted that changes in rural population can be attributed not only to people moving, but also to factors such as incorporation of rural townships into adjacent municipalities. Counties with the largest gains in actual numbers of rural residents were counties with large gains in rural non-farm population as shown in Map C.

The 2% rural population decline from 1982 to 1997 was comprised of a 33% decrease in farm population and a 3% increase in rural non-farm population. Farm population estimates were made using the number of farms with gross sales over $10,000 multiplied by the average household size as estimated for each county by the State Demographer s Office.

Map C, Change in Farm Population: 1982 to 1997, shows that farm population fell everywhere in the State from 1982 to 1997, with the exception of Itasca county. Decreases in farm population were most concentrated (-47 to -35%) in the far northwestern, western, central, and far southern counties. In Map D, Change in Rural Non-farm Population: 1982 to 1997, we can see that rural non-farm population mainly fell in agricultural areas, and increased in the non-agricultural areas.

Figure 4 Farming as an Occupation 1982 to 1997

Figure 4 presents two characteristics of farm operators that relate to farming as a primary occupation. A farm operator is a person who operates a farm. The operator may be the owner, a member of the owner s household, a hired manager, a tenant, a renter, or a sharecropper. Each farm has only one operator who reports information. Maps A and B illustrate the location of operators who report no days worked off the farm during the reporting year. Maps C and D show the distribution of operators reporting farming as a principal occupation. An operator may, and is likely to, report that farming is their principal occupation and they worked no days off the farm. Reporting that farming is a principal occupation is a more subjective self-description than reporting no days worked off farm. We have included both sets of data as a measure of how counties differ across the state in regards to residents with farming as a primary occupation.

Statewide, 50% of farm operators reported no days worked off farm in 1997, as shown in Map A. From 1982 to 1997, there was a 38% decrease in the number of operators reporting no days worked off farm. The counties with the highest percentage of operators reporting non days worked off farm relate strongly to counties with relatively high numbers of dairy farms per total farms as shown on Figure 6, Map A. In 1997, the four counties with the highest density of operators reporting no days worked off farm were the same as those with the highest density of operators reporting farming as their principal occupation (Stearns, Brown, McLeod, and Carver.)

In 1997, there were an average of 0.68 operators per thousand acres reporting farming as their principal occupation. Similar to the trend in Map B, Map D shows that the number of farm operators reporting farming as their principal occupation fell by 37% statewide between 1982 and 1997. The counties with the highest percentages of operators reporting farming as their principal occupation relate strongly to counties with relatively high numbers of hog or dairy farms per total farms as shown on Figures 5 and 6.

Figure 5 Numbers of Hog Farms and Hogs 1982 to 1997

Figure 5 presents information on the numbers of hog farms and hogs. In 1997, 10% of all farms in Minnesota reported some hogs on site. Farms with hogs as a percent of total farms declined 54% statewide from 1982 to 1997. Map A shows counties with the highest concentration of farms with hogs as a percent of total farms to be located in the southwest quadrant of the state. From 1982 to 1997, farms with hogs as a percent of total farms decreased in all counties, with the highest decreases in the northern two-thirds of the state.

Map A on each of Figures 5 through 12 contain a diagonal striping screen over selected counties. This screen indicates counties where the number of hogs, dairy cows, and beef cattle rate among the lowest one-third in the state for all three species. These counties can be characterized as counties with low levels of animal agriculture. The screen is applicable to all maps in this report.

Figure 5, Map C shows the density of hogs per thousand acres in Minnesota. Counties with the highest density of hogs in 1997 were in the southern third of Minnesota. Eight counties had over 500 hogs for every thousand acres. Martin County had the highest density of hogs, 1048 hogs for every thousand acres. The largest percentage increase in hog numbers in these eight counties occurred during the period 1992 to 1997.

In comparing Maps A and C, we can see that several of the counties that have the highest number of hogs per thousand acres do not have the highest number of hog farms per total farms. This indicates a high concentration of hogs on hog farms in Blue Earth, Pipestone, Rice, Waseca, and Watonwan counties.

In Map D, Change in Density of Hogs: 1982 to 1997, we can see that the number of hogs per thousand acres fell in the northern half of the State between 1982 and 1997, as well as in several of the far southeast counties. Increases were concentrated in the southwest and south central counties. Pipestone county had the highest increase in hog numbers per thousand acres, at 162%, followed by Martin (150%) and Blue Earth (124.4%).

Figure 6 Numbers of Dairy Farms and Dairy Cows 1982 to 1997

Figure 6 presents information on numbers of dairy farms and dairy cows. Statewide, there were 0.18 dairy farms for every thousand acres in 1997. Thirteen percent of all farms in Minnesota reported some dairy cows on site in 1997. In seven counties over one-quarter of all farms had dairy cows on site in 1997, and two counties (Winona and Stearns) had dairy cows on more than one-third of all farms. Counties with the highest percent of dairy farms per total farms in 1997 were located in southeast and central Minnesota. Farms with dairy cows as a percent of total farms declined 49% statewide from 1982 to 1997, as shown on Map B. All counties saw a decline in dairy farms per total farms from 1982 to 1997. The highest declines were across the north, and in the southwest and south central areas.

Map C, Density of Dairy Cows: 1997, shows that dairy cows were concentrated in a corridor from central to southeast Minnesota. In 1997, Stearns county had the highest density of dairy cows per thousand acres (147) with Winona county close behind (144).

The number of dairy cows fell statewide by 35% from 1982 to 1997. Map D, Change in Density of Dairy Cows: 1982 to 1997, shows that all counties lost dairy cows between 1982 and 1997. Percentage losses of dairy cows between 1982 and 1997 were highest in Traverse County at 100%, followed by Jackson (-77.7%) and Pennington (-72.3%). The statewide decrease in the number of dairy cows was slightly greater for the five year period 1982 to 1987 (15%) than for either of the other five year periods (1987-1992 14%, 1992-1997 11%).

Figure 7 Numbers of Beef Farms and Beef Cattle 1982 to 1997

Figure 7 presents information on numbers of beef farms and beef cattle. Statewide, in 1997 there were 0.39 beef farms per thousand acres. Map A shows that in 1997, 29% of all farms in Minnesota reported some beef cattle on site, the same percentage as in 1982. From 1982 to 1997, 38% (33) of Minnesota counties had an increase in the number of farms with beef cattle. Thirty counties reported beef cattle on over one-third of all farms in 1997. There is no one area within the state that shows a concentration of farms with beef cattle.

In Map C, Density of Beef Cattle: 1997, the number of beef cattle per thousand acres was highest in the southeast and southwest corners of the State. The number of beef cattle statewide fell by 22% from 1982 to 1997. In 1997, the counties with the highest number of beef cattle per thousand acres were Rock (110), Pipestone (97) and Houston (87), in the far southwest and southeast corners of the state.

Map D, Change in Density of Beef Cattle: 1982 to 1997, shows that beef cattle declines were highest in Faribault (-63%), Grant (-60.2%), Lac qui Parle (-56.8%), Jackson (-56.7), and Freeborn (-52.7%) counties. The state-wide decrease in the number of beef cattle was by far the greatest during the five year period 1982 to 1987, at -25%.

Relationships between Figures 1-7

It is interesting to make some comparisons between Figures 1-4 on the structural aspects of agriculture and Figures 5-7 on hog, dairy, and beef numbers. First, the counties with the highest concentrations of farms, as shown in Figure 1, Map A, tend to have the highest concentration of operators reporting farming as their principal occupation, as shown in Figure 4, Map C.

Counties that have lower average farm size (less than 500 acres), as shown in Figure 1, Map C, tend to be counties with high concentrations of hog, dairy and beef farms, as shown in Figures 5, 6, and 7. The areas with the highest concentration of operators with farming as their principal occupation, as shown in Figure 4, Map C, are also those with the highest concentrations of hog, dairy, and beef farms, as shown in Figures 5, 6, and 7.

Counties that have the highest concentrations of hog, dairy, and beef farms, as shown in Figures 5, 6, and 7, tended to have had less severe declines in farm population between 1982 and 1997, as shown in Figure 3, Map C.

Figures 6A and 7A, show that that dairy and beef farms overlap geographically in a band from

central to southeast Minnesota. There is some geographic overlap of counties between beef farms and hog farms in southwest Minnesota, as shown in Figures 5A and 7A. However, from Figures 5A and 6A we can see that there is little geographic overlap between hog farms and dairy farms. We can also see that beef farms and beef cattle are more widespread throughout the State than are hog farms and hogs and dairy farms and dairy cattle, as shown in Figures 5A, 5C, 6A, 6C, 7A, and 7C.

Changes in Poultry in Minnesota: 1982 to 1997

Poultry (chickens and turkeys) are also an important component of animal agriculture in Minnesota. We were unable to map information at a county level on changes in numbers and location of poultry because of data suppression. In the 1997 USDA Census of Agriculture, 67 of the 87 counties in Minnesota had poultry data suppressed. Suppression of data indicates a high concentration of animals on a few farms. Data is suppressed when one farm has 60% or more of the total animals of that species in the county. We have included statewide information on trends in poultry numbers in this section of the report, as well as information on selected counties where data was not suppressed.

Over the last fifteen years the poultry industry in Minnesota has seen a tremendous consolidation. USDA Census of Agriculture data on the inventory and sales of poultry agriculture (layers and pullets, broilers, and turkeys) demonstrate the increase in concentration of poultry agriculture in Minnesota. The number of animals in inventory has remained stable from 1982 to 1997 while the number of farms with poultry has decreased. As shown in the table below, the number of farms with layers and pullets decreased from 6,468 in 1982 to 1,964 in 1997. The number of layers and pullets in inventory during the same period increased very slightly from 12,928,376 to 12,047,875.

The inventory of layers and pullets in Minnesota (inventory measured at birds over 3 months of age) has not changed appreciably over the last 25 years. In 1964 the inventory of layers and pullets was reported to be approximately 14.6 million. In 1997, the inventory was at approximately 13 million birds. Over the same time period, however, the number of farms

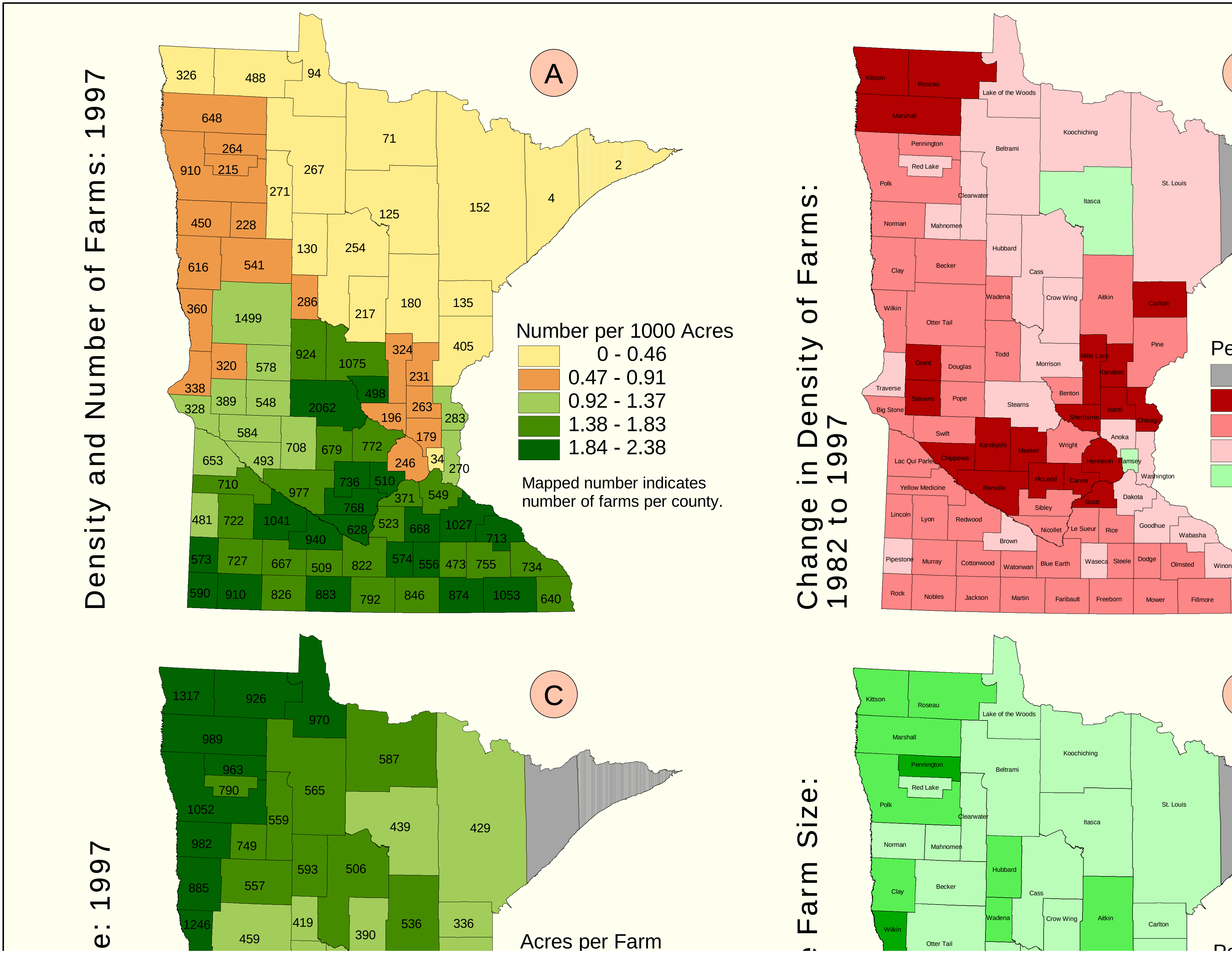
reporting inventory has dropped precipitously from almost 48,000 farms to just under 2,000. The average number of layers and pullets per farm has increased dramatically from 306 in 1964 to 1,999 in 1982 to 6,644 in 1997.

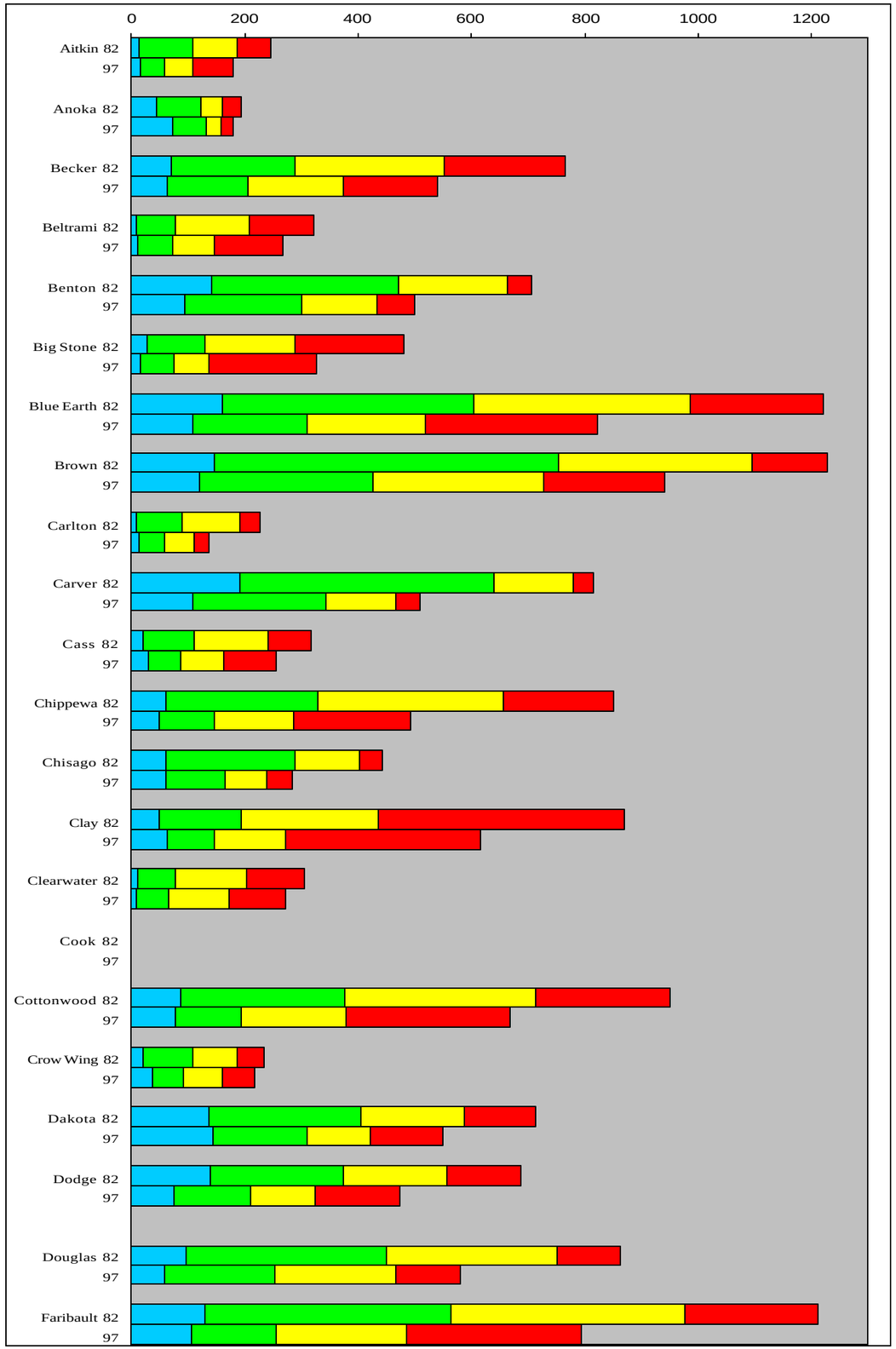
While the long-term trend is dramatic consolidation, the trend has slowed considerably over the most recent 5 years of data (1992 to 1997). The production of chicken products (eggs and meat) declined noticeably from 1992 to 1997 (22% for broilers and other meat, 9% for layers and pullets), although the numbers of layers and pullets continued to increase.

Source: USDA Census of Agriculture

The production of turkeys increased in Minnesota over the 15 years between 1982 and 1997, with total inventories increasing by over 200%. The intensity of turkey farming increased even faster; the number of turkeys per farm increased by 46% from 1992 to 1997, and by almost 350% from 1982 to 1997. The number of farms with turkeys in Minnesota in 1982 was 804. This number declined to 553 in 1997. The number of turkeys in inventory increased statewide from 5,245,232 in 1982 to 16, 220,257 in 1997.

County data for counties with data that is not suppressed, indicates that a few counties produce the majority of products. Four counties (Kandiyohi, Meeker, Stearns and Todd) produced nearly 50% of all turkeys sold in Minnesota. Nineteen farms in Kandiyohi County alone produced 19% of all turkeys sold in Minnesota in 1997. Six counties (Stearns, Morrison, Cottonwood, Benton, Douglas and Fillmore) produced nearly ninety percent of all broilers sold in Minnesota in 1997. Stearns and Morrison Counties were the leading broiler producers.


Density and Number of Farms: 1997
A
Number per 1000 Acres
0 - 0.46
0.47 - 0.91
0.92 - 1.37
1.38 - 1.83
1.84 - 2.38
Mapped number indicates
number of farms per county.
Change in Density of Farms:
1982 to 1997
C
Acres per Farm



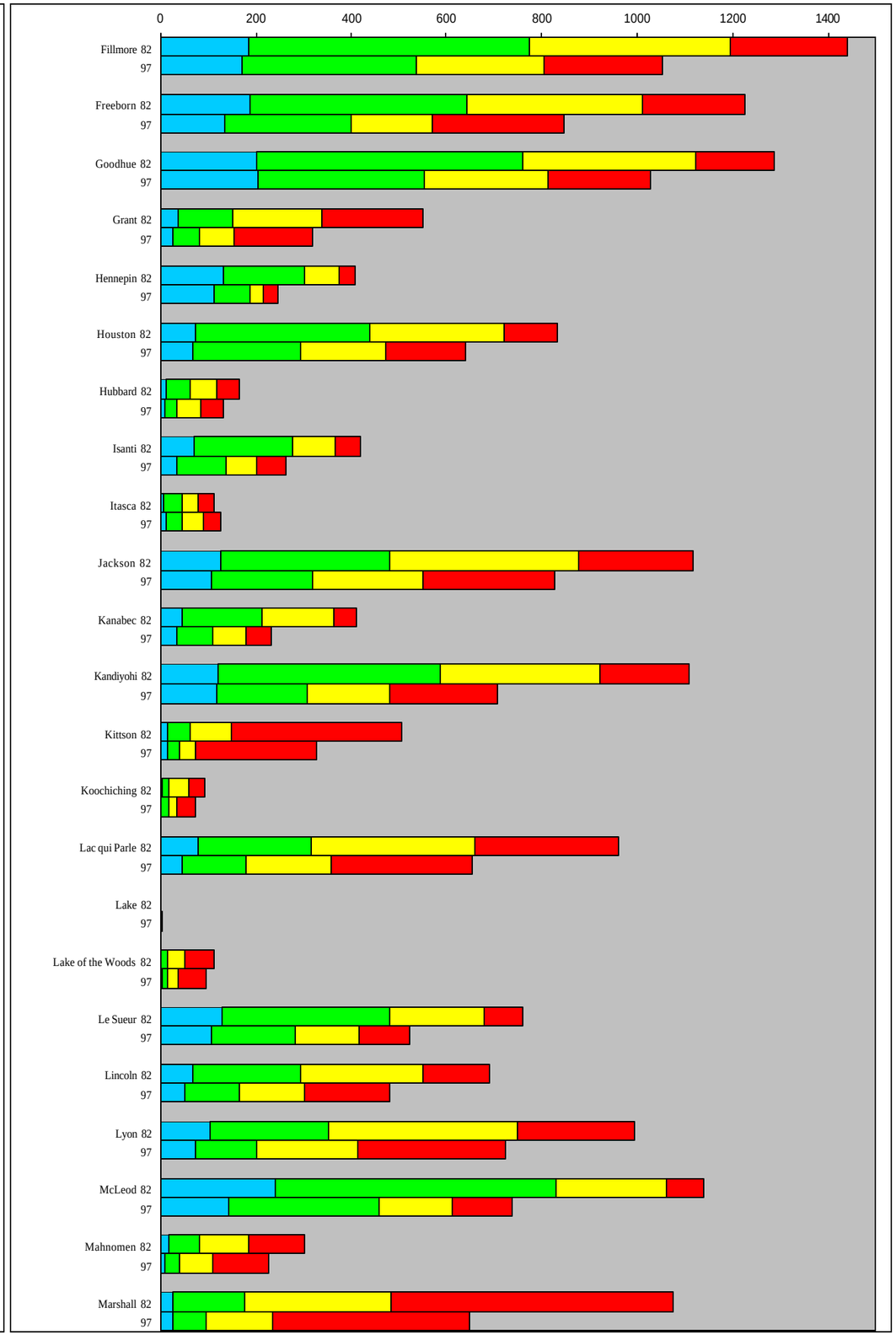


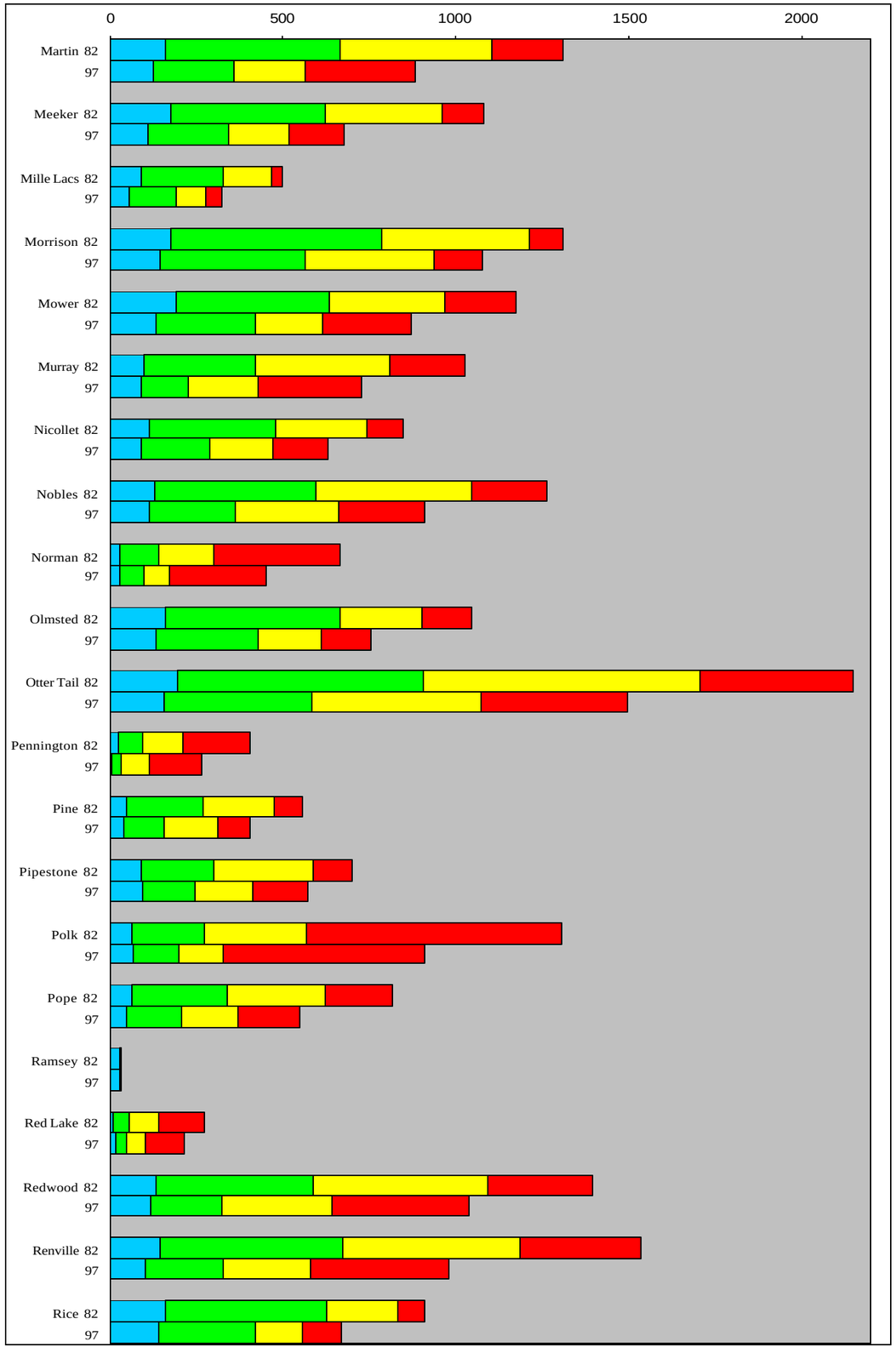
Figure 2A

Change in number of farms classified by size, 1982 to 1997

Aitkin - Marshall Co.

Farm size, acres

- 1 - 99
- 100 - 259
- 260 -499
- > 500



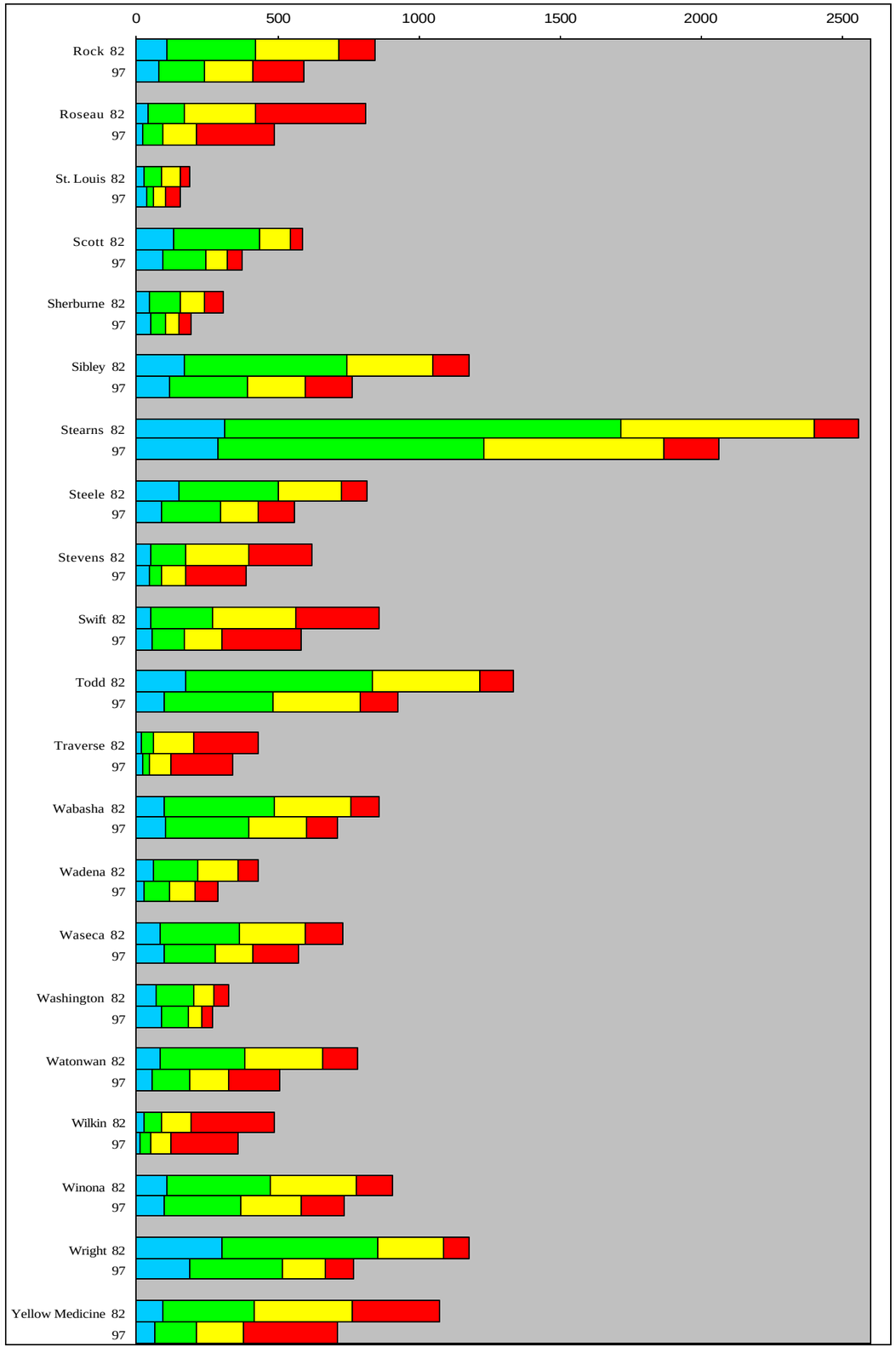


Figure 2B

Change in number of farms classified by size, 1982 to 1997

Martin - Yellow Medicine Co.

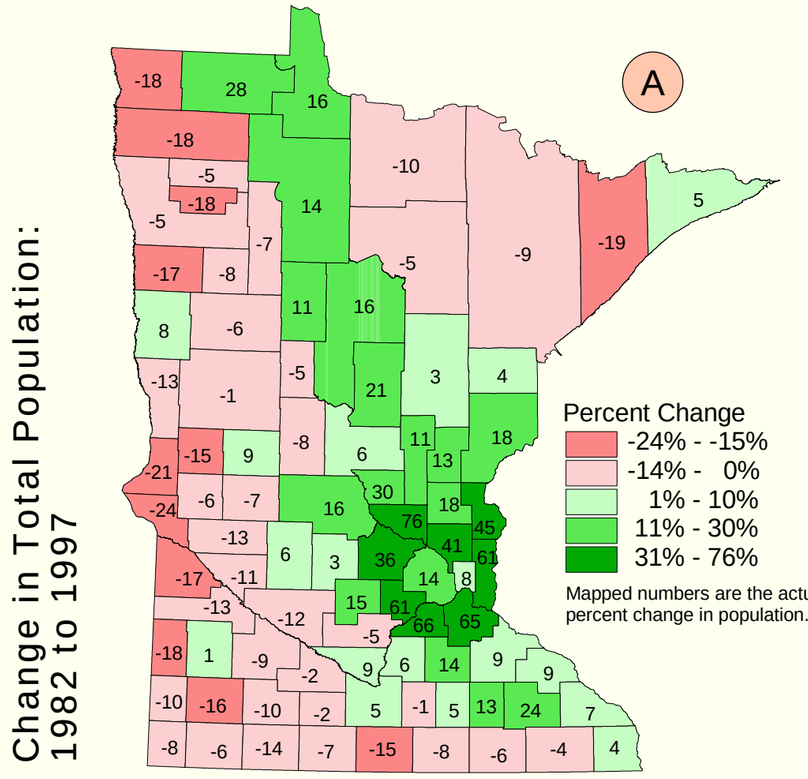
Farm size, acres

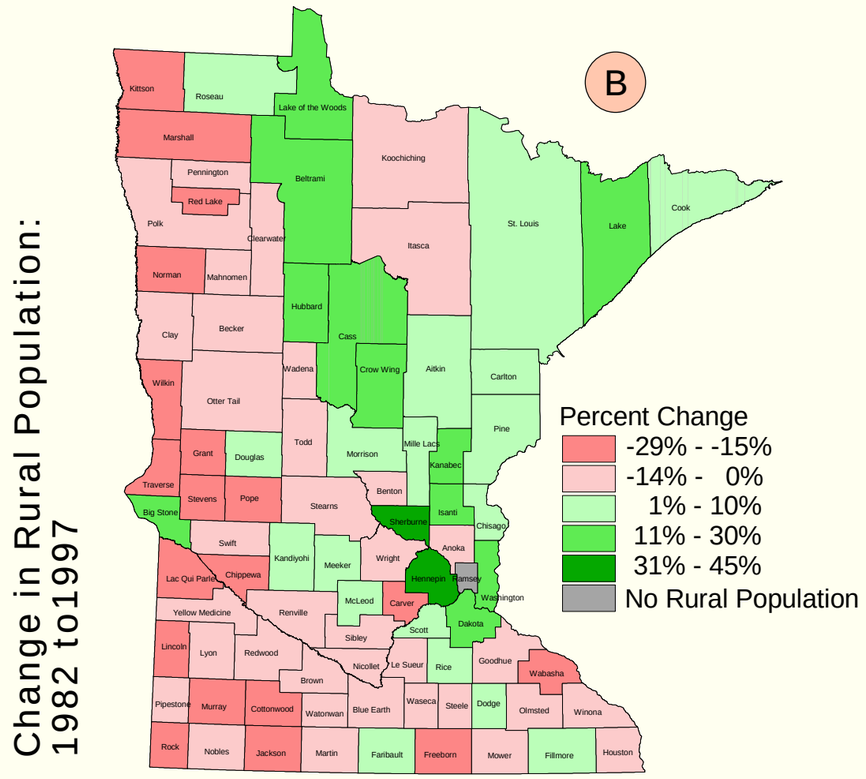
- 1 - 99
- 100 - 259
- 260 -499
- > 500

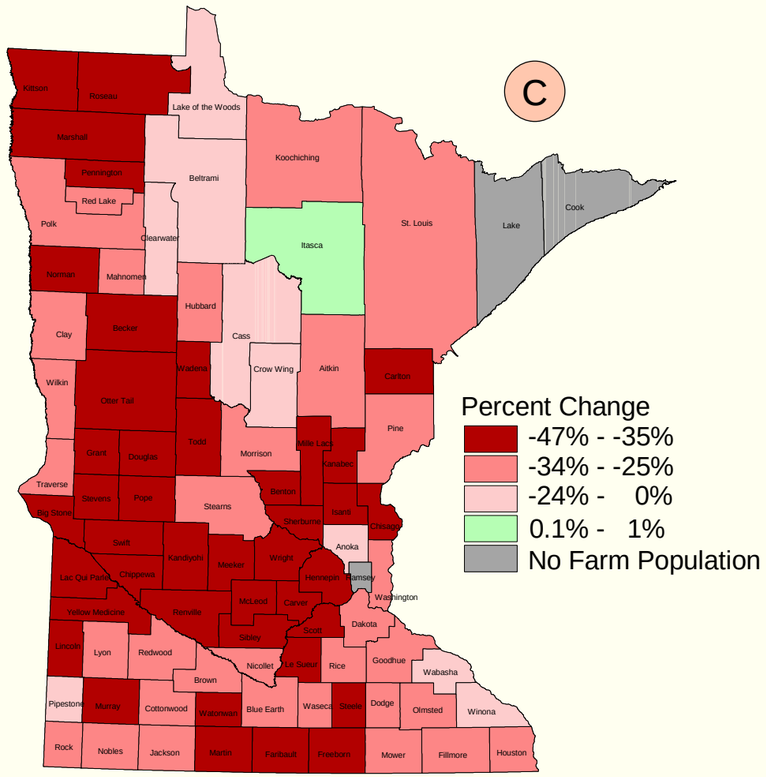
Figure 3

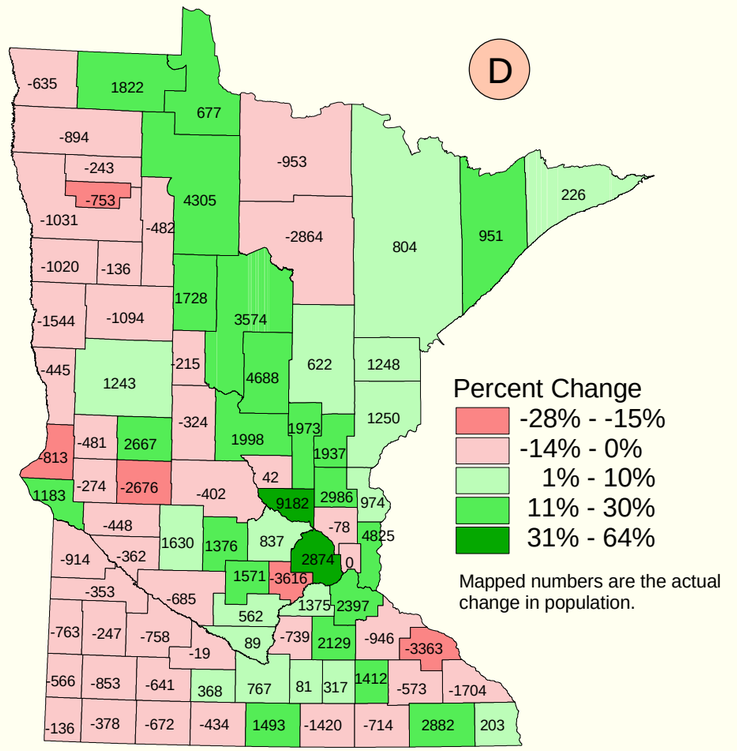
Population Changes 1982 to 1997

A. Change in Total Population: 1982 to 1997
B. Change in Rural Population: 1982 to 1997
C. Change in Farm Population: 1982 to 1997
D. Change in Rural Non-farm Population: 1982 to 1997









General Observations:

Map A
Between 1982 and 1997, the total population of Minnesota increased by 15% from 4,120,244 to 4,735,830. Population growth was largest in the Twin Cities Metro Area. Population decline was greatest among the counties along the western boundary of the state.

Map B
Between 1982 and 1997, rural population in the state decreased by 2%. Counties with the largest losses in actual numbers of rural residents were: Carver (-4638, -23%), Wabasha (-3907, -26%), and Pope (-3455, -29%). Counties with the largest gains in actual numbers of rural residents were counties with large gains in rural non-farm population.

Maps C and D
Farm population decreased by 33%, while rural non-farm population increased by 3%. Rural non-farm population increases were greatest in the Twin Cities Metro Area and in the lakes region of north central Minnesota.

Definitions:

Total Population
Population estimates from the Minnesota (MN) Demographer's Office for each county.

Rural Population
Population located outside of incorporated places greater than 2,500 people as estimated by the MN Demographer's Office. Rural population includes people living in central places (e.g. towns) with less than 2,500 population.

Farm Population
Number of farms with gross sales over $10,000 multiplied by the average household size, as estimated by the MN Demographer's Office for each county.

Rural Non-farm Population
Rural population minus farm population.

Prepared for the "Technical Work Paper for Land Use Conflicts and Regulation" for the Environmental Quality Board's Generic Environmental Impact Statement for Animal Agriculture

Data Source: Minnesota Demographer's Office and USDA Census of Agriculture
Data Preparation: University of Minnesota, Department of Landscape Architecture
Data Representation: URS
Date Prepared: April 24, 2001

H:\gis\population.apr

Figure 4

Farming As An Occupation

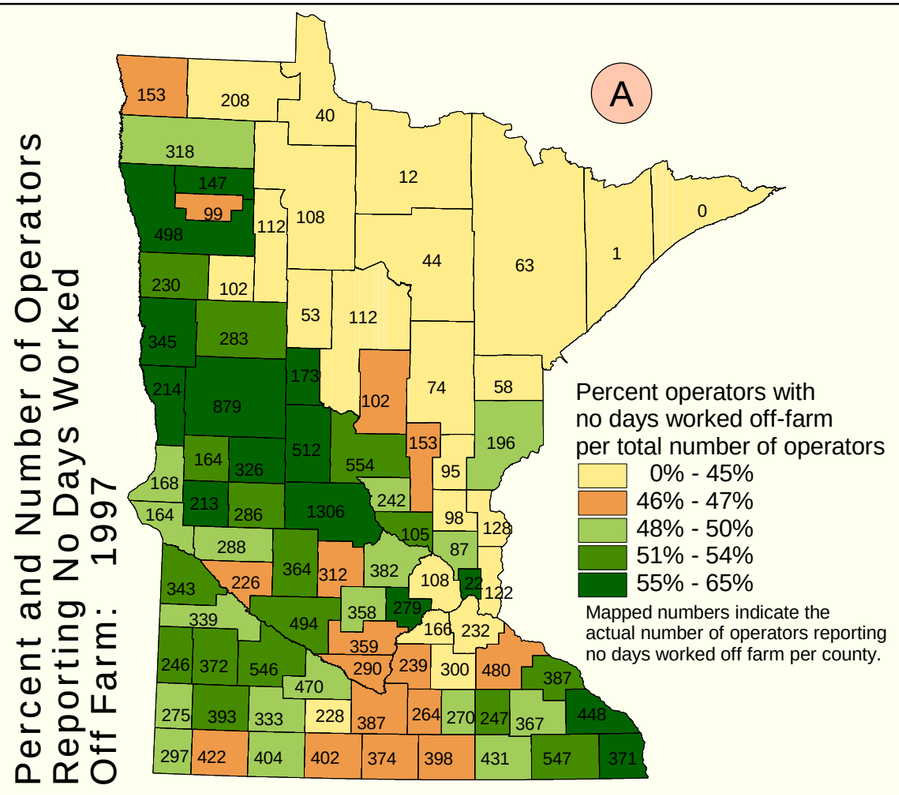
1982 to 1997

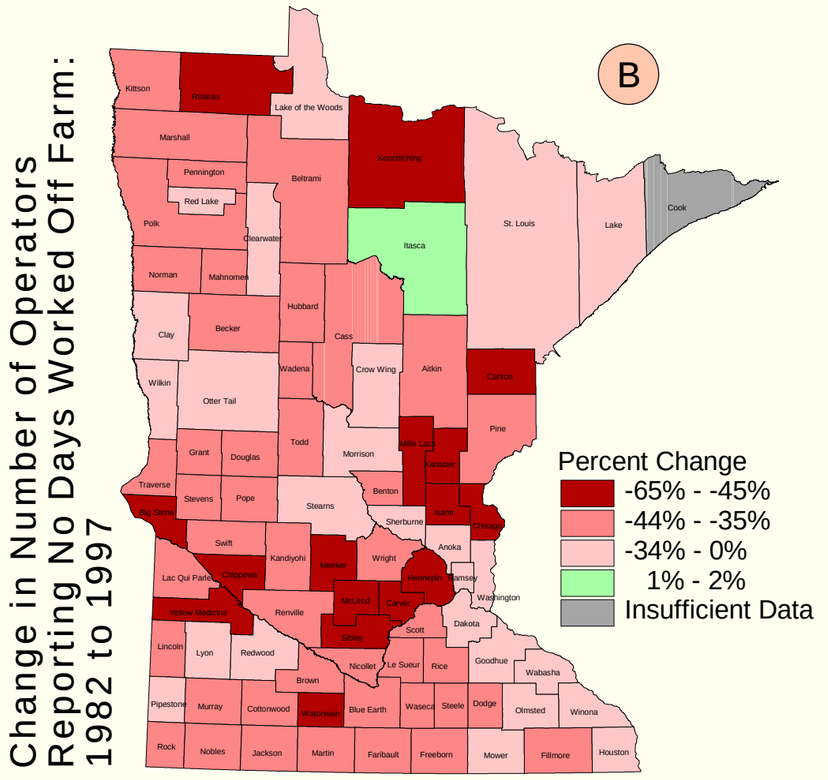
A. Percent and Number of Operators Reporting No Days Worked Off Farm: 1997

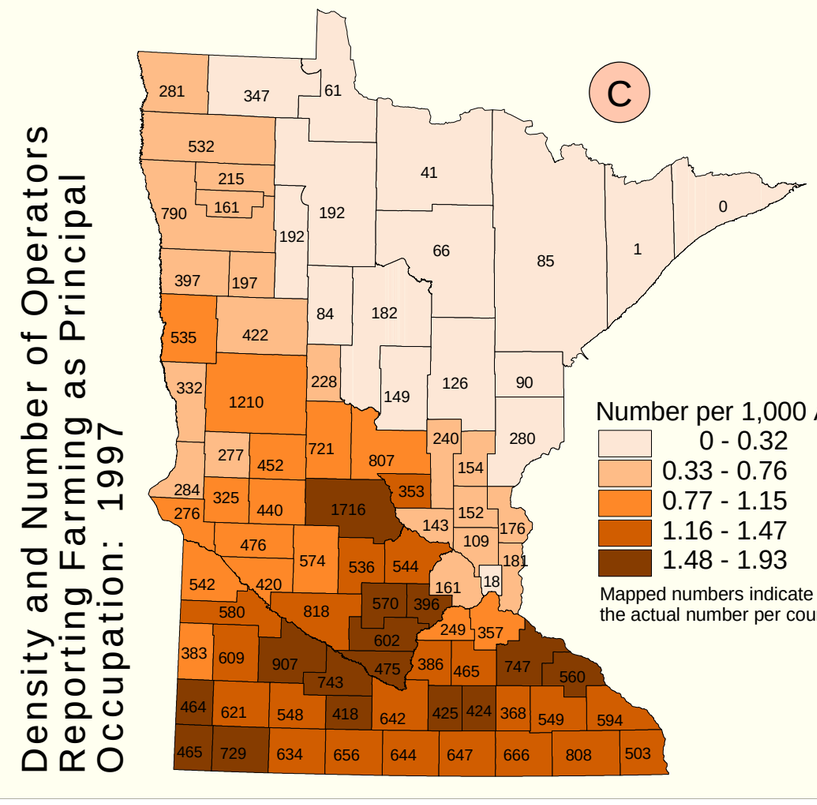
B. Change in Number of Operators Reporting No Days Worked Off Farm: 1982 to 1997

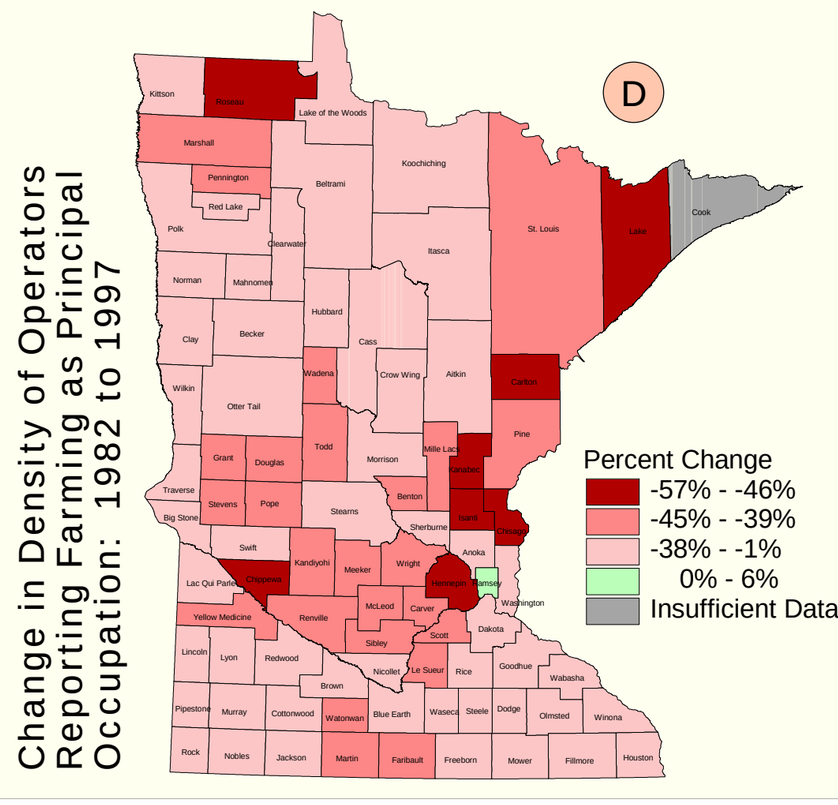
C. Density and Number of Operators Reporting Farming as Principal Occupation: 1997

D. Change in Density of Operators Reporting Farming as Principal Occupation: 1982 to 1997









General Observations:

Maps A and B

In 1997, 50% of operators of farms with over $10,000 gross sales reported no days worked off farm. From 1982 to 1997, there was a 38% decrease in the number of operators reporting no days worked off farm. The counties with the highest percentage of operators reporting no days worked off farm relate strongly to counties with relatively high numbers of dairy farms per total farms. In 1997, the top four counties with the highest density of operators reporting farming as their principal occupation were the same as those with the highest density of operators reporting no days worked off farms (Stearns, Bown, McLeod and Carver).

Maps C and D

Statewide, in 1997 there were an average of 0.68 operators per thousand acres reporting farming as their principal occupation. Similar to the trend shown in B, the number of farm operators reporting farming as their principal occupation fell statewide by 37%. The counties with the highest percentage of operators reporting farming as their principal occupation relate strongly to counties with relatively high numbers of hog or dairy farms per total farms.

Definitions:

Farm Operator

A person who operates a farm. The operator may be the owner, a member of the owner's household, a hired manager, a tenant, a renter, or a sharecropper. For census purposes, the number of operators is the same as the number of farms.

Operator with Farming as Principal Occupation

A farm operator who spent 50% or more of his/her time at farming.

Farm

A farm whose operator reported over $10,000 gross sales as reported in Table 12 of the USDA Census of Agriculture.

Data Notes:

Density:

The data in Maps C and D are normalized over area. The data were derived by dividing the absolute number of farms in a county by the total acres of land in the county. This quotient was then multiplied by 1000. The normalized data permit comparison of the number of farms reported among counties irrespective of differences in county size.

Prepared for the "Technical Work Paper for Land Use Conflicts and Regulation" for the Environmental Quality Board's Generic Environmental Impact Statement for Animal Agriculture

Data Source: USDA Census of Agriculture
Data Preparation: University of Minnesota, Department of Landscape Architecture
Data Representation: URS
Date Prepared: April 24, 2001

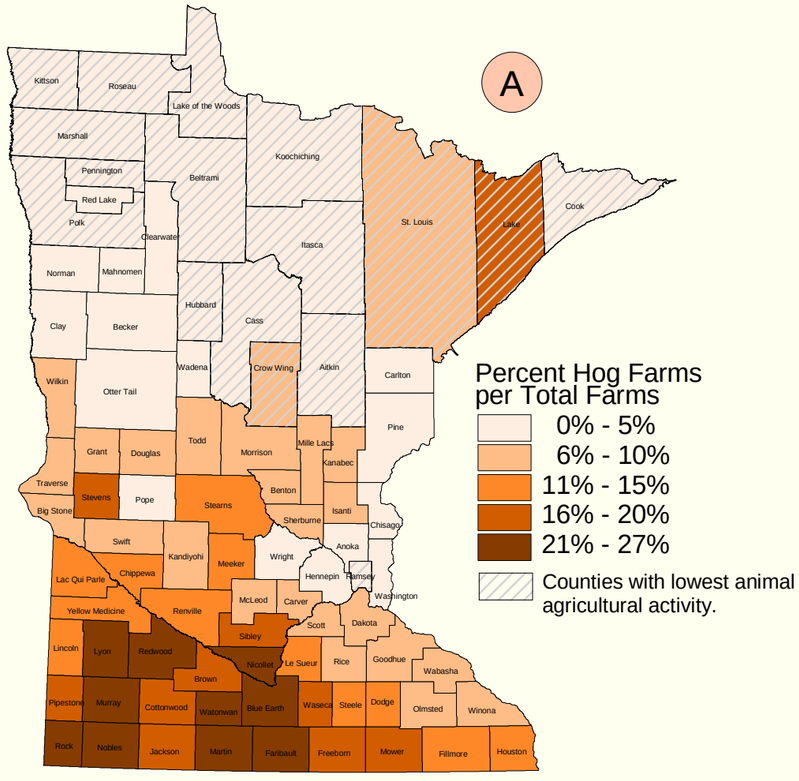
H:\gis\farm_oper.apr

Figure 5

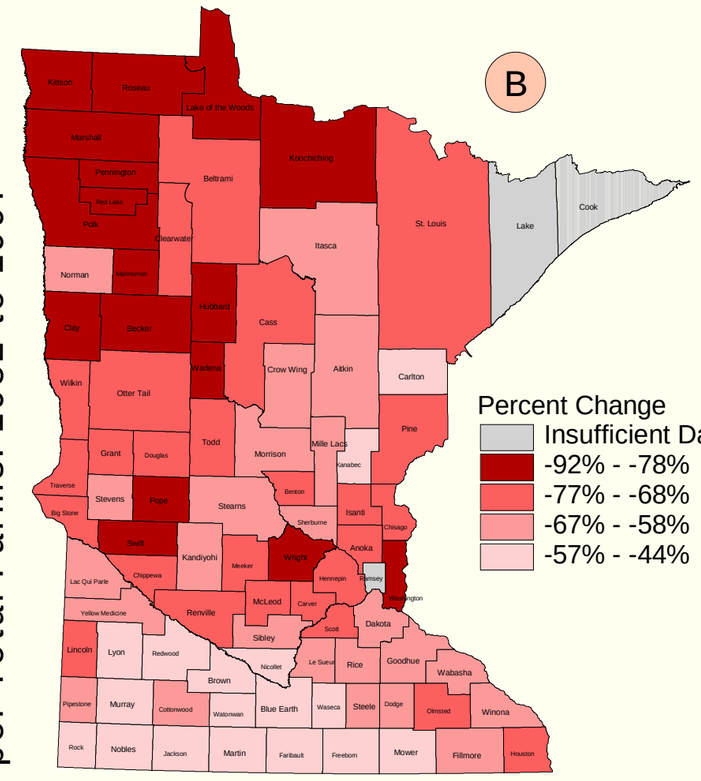
Number of Hog Farms and Hogs 1982 to 1997

A: Percent of Hog Farms per Total Farms: 1997
B: Change in Density of Hog Farms per Total Farms: 1982 to 1997
C: Density of Hogs: 1997
D: Change in Density of Hogs: 1982 to 1997

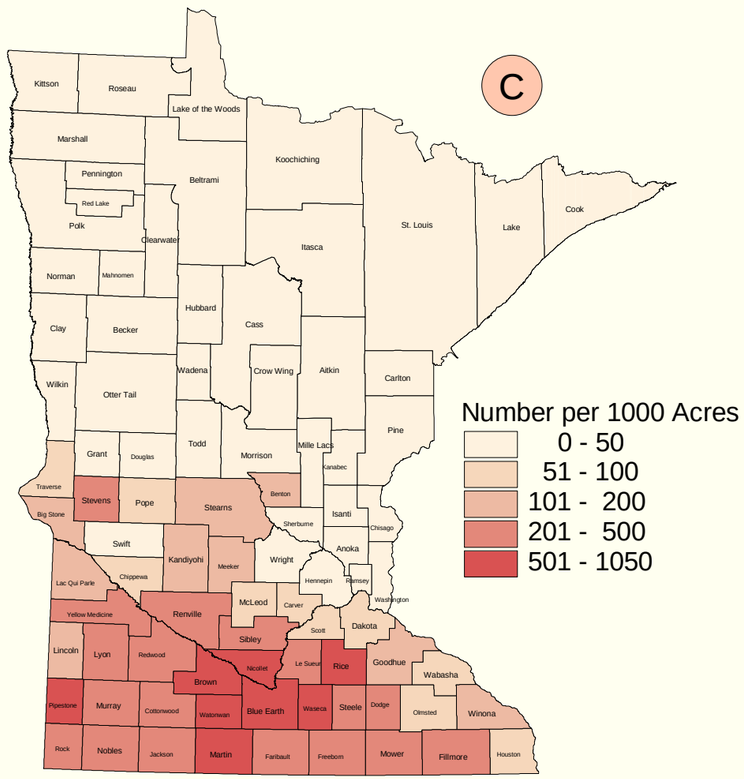
Percent of Hog Farms per Total Farms: 1997



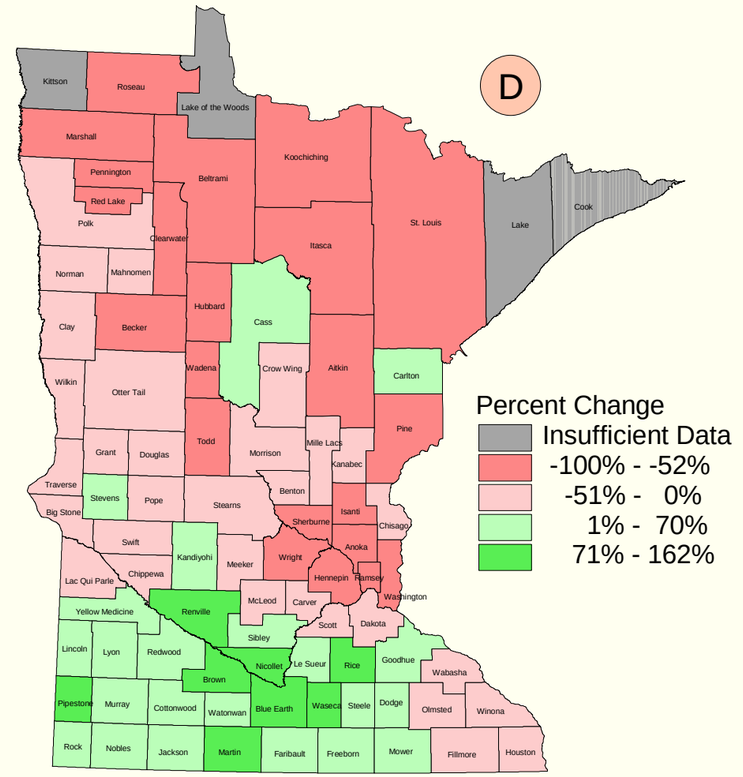
Change in Density of Hog Farms per Total Farms: 1982 to 1997



Density of Hogs: 1997



Change in Density of Hogs: 1982 to 1997



General Observations:

Maps A and B

In 1997, 10% of all farms in Minnesota reported some hogs on site. Farms with hogs as a percent of total farms declined 54% state-wide from 1982 to 1997. In two counties (Rock and Nobles) over one-quarter of all farms had hogs on site in 1997. Counties with the highest percentage of farms with hogs per total farms were concentrated in the southwest quadrant of Minnesota. From 1982 to 1997, hog farms decreased in all counties, with the highest decreases in the northern two-thirds of the state.

Maps C and D

Counties with the highest density of hogs in 1997 were in the southern third of Minnesota. Eight counties had over 500 hogs for every thousand acres. Martin County had the highest density of hogs, 1048 hogs for every thousand acres. The largest percentage increase in hog numbers in these eight counties occurred during the period 1992 to 1997.

Definitions:

Total Farms

All farms whose operators reported any gross sales as reported in Table 1 of the USDA Census of Agriculture.

Hog Farms

Farms reporting any number of hogs on site.

Data Notes:

Density

The data in Maps B, C, and D are normalized over area. The data were derived by dividing the absolute number of farms in a county by the total acres of land in the county. This quotient was then multiplied by 1000. The normalized data permit comparison of the number of farms reported among counties irrespective of differences in county size.

Potential for Conflict Index

Map A is Index Parameter B, used to calculate the Potential for Conflict Index. See Figure 8.C.

The number of hogs, dairy cows, and beef in these counties rates among the lowest one third in the state for all three species. This screen is applicable to all maps.

Prepared for the "Technical Work Paper for Land Use Conflicts and Regulation" for the Environmental Quality Board's Generic Environmental Impact Statement for Animal Agriculture

Data Source: USDA Census of Agriculture
Data Preparation: University of Minnesota, Department of Landscape Architecture
Data Representation: URS

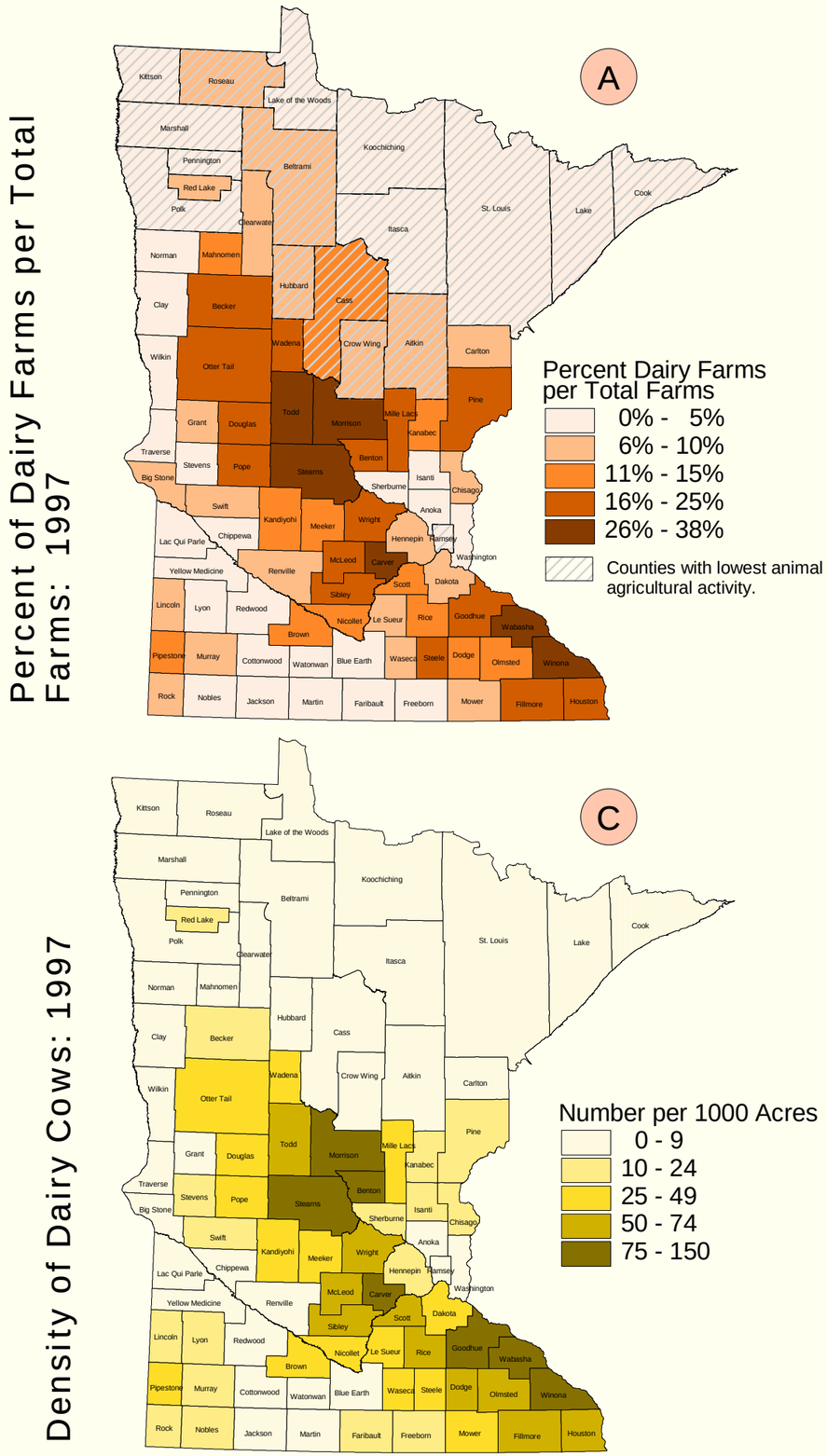
Date Prepared: April 24, 2001

H:\shogs.apr

Figure 6

Number of Dairy Farms and Dairy Cows 1982 to 1997

A. Percent of Dairy Farms per Total Farms: 1997
B. Change in Density of Dairy Farms per Total Farms: 1982 to 1997
C. Density of Dairy Cows: 1997
D. Change in Density of Dairy Cows: 1982 to 1997



General Observations:

Maps A and B

In 1997, 13% of all farms in Minnesota reported some dairy cows on site. Farms with dairy cows as a percent of total farms declined 49% state-wide from 1982 to 1997. In seven counties over one-quarter of all farms had dairy cows on site in 1997, and two counties (Winona and Stearns) had dairy cows on more than one-third of all farms. Counties with the highest percent of dairy farms per total farms in 1997 were located in southeast and central Minnesota.

Maps C and D

The number of dairy cows state-wide fell by 35.5% from 1982 to 1997. In 1997, Stearns (147 per 1,000 acres) and Winona (144 cows per 1,000 acres) counties had the highest concentration of dairy cows. The state-wide decrease in the number of dairy cows was slightly greater for the five year period 1982 to 1987 (15%) than for either of the other five year periods (1987-1992 14%, 1992-1997 11%).

Definitions:

Total Farms

All farms whose operators reported any gross sales as reported in Table 1 of the USDA Census of Agriculture.

Dairy Farms

Farms reporting any number of dairy cows on site.

Data Notes:

Density

The data in Maps B, C and D are normalized over area. The data were derived by dividing the absolute number of farms in a county by the total acres of land in the county. This quotient was then multiplied by 1000. The normalized data permit comparison of the number of farms reported among counties irrespective of differences in county size.

Potential for Conflict Index

Map A is Index Parameter B used to calculate the Potential for Conflict Index. See Figure 8.C.

The number of hogs, dairy cows, and beef in these counties rates among the lowest one third in the state for all three species. This screen is applicable to all maps.

Prepared for the "Technical Work Paper for Land Use Conflicts and Regulation" for the Environmental Quality Board's Generic Environmental Impact Statement for Animal Agriculture

Data Source: USDA Census of Agriculture
Data Preparation: University of Minnesota, Department of Landscape Architecture
Data Representation: URS

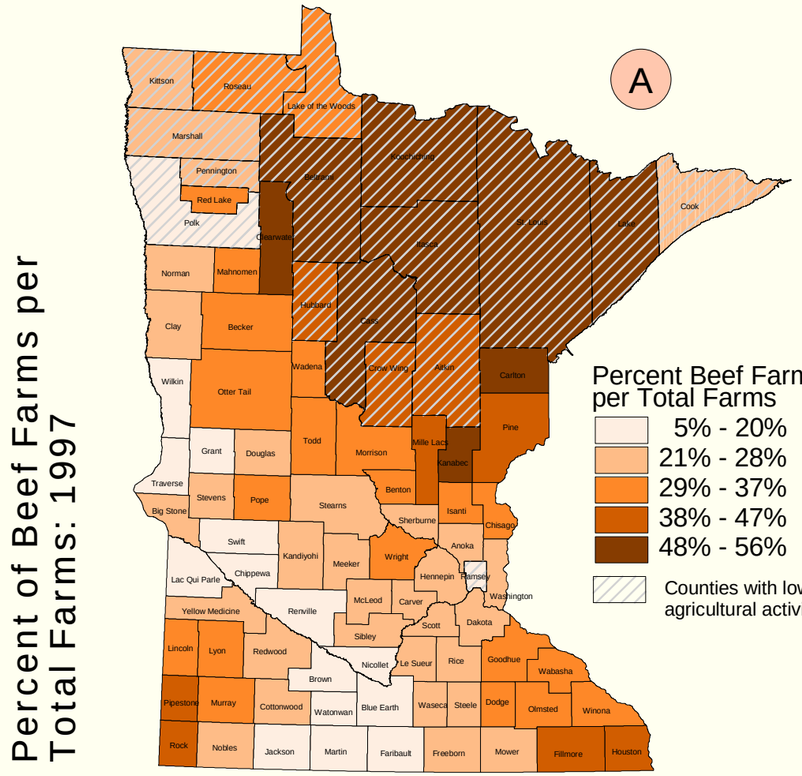
Date Prepared: April 24, 2001

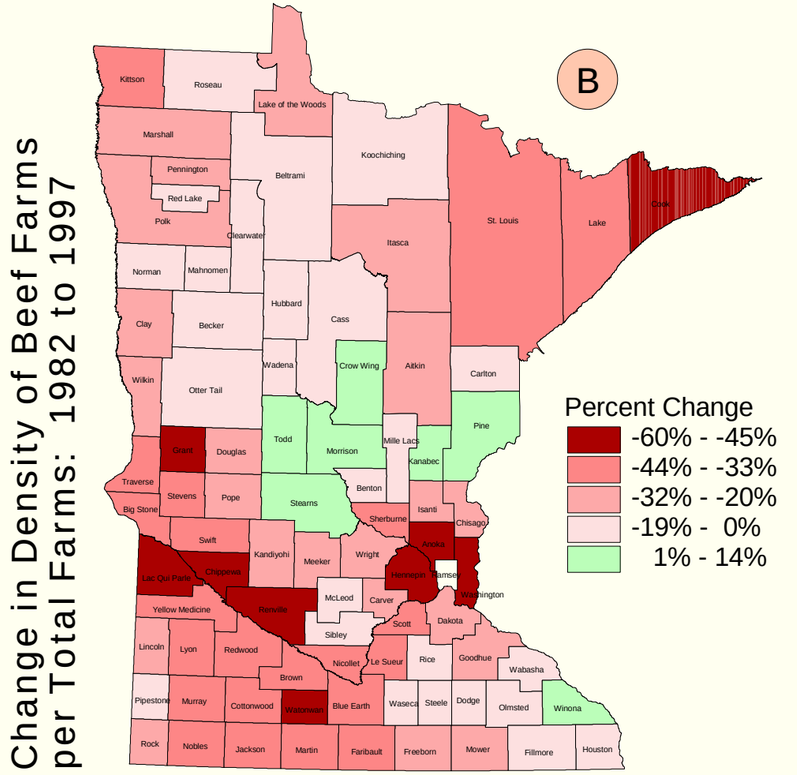
igp_dairy.apr

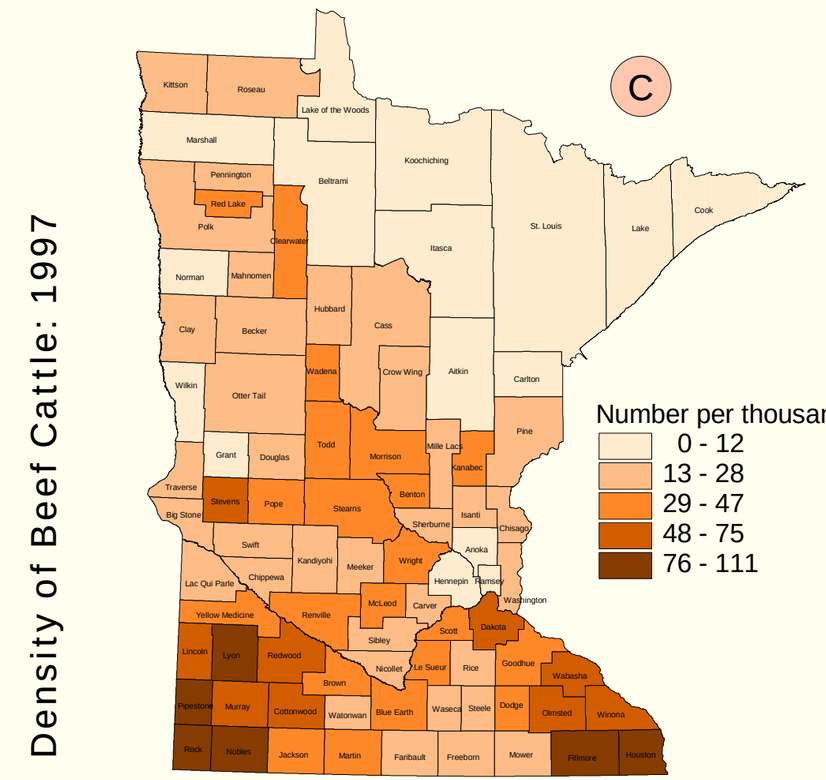
Figure 7

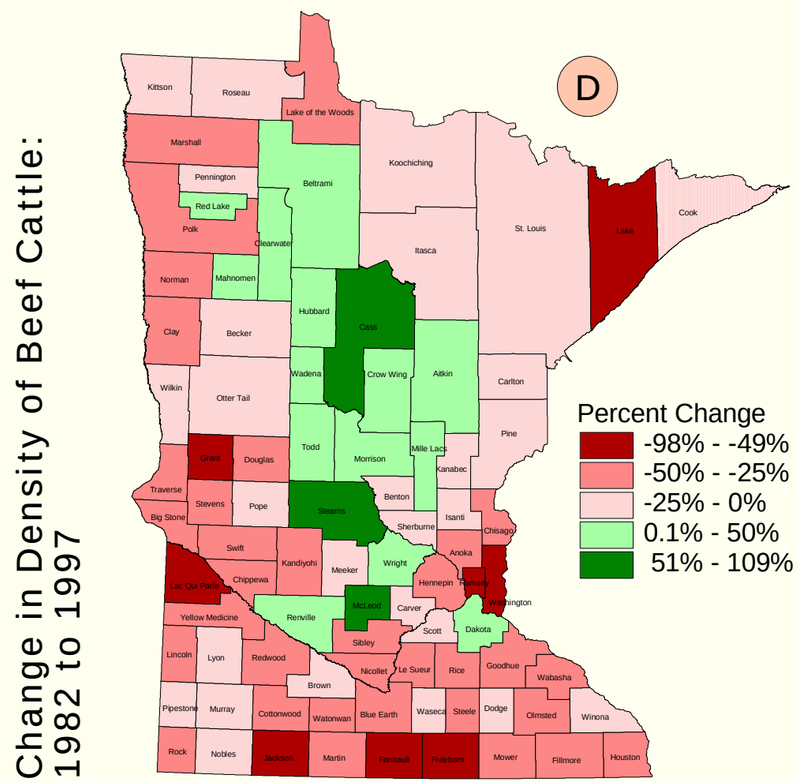
Number of Beef Farms and Beef Cattle 1982 to 1997

A. Percent of Beef Farms per Total Farms: 1997
B. Change in Density of Beef Farms per Total Farms: 1982 to 1997
C. Density of Beef Cattle: 1997
D. Change in Density of Beef Cattle: 1982 to 1997









General Observations:

Maps A and B

In 1997, 29% of all farms in Minnesota reported some beef cattle on site, the same percentage as in 1982. From 1982 to 1997, 38% (33) of Minnesota counties had an increase in the number of farms with beef cattle. Thirty counties reported beef cattle on over one-third of all farms in 1997. There is no one area within the state that shows a concentration of farms with beef cattle.

Maps C and D

The number of beef cattle state-wide fell by 22% from 1982 to 1997. In 1997, the counties with the highest number of beef cattle per thousand acres were Rock (110), Pipestone (97) and Houston (87), in the far southwest and southeast corners of the state. The state-wide decrease in the number of beef cattle was by far the greatest during the five year period 1982 to 1987, at -25%.

Definitions:

Total Farms
All farms whose operators reported any gross sales as reported in Table 1 of the USDA Census of Agriculture.

Beef Farms
Farms reporting any number of beef cattle on site.

Data Notes:

Density
The data in Maps B, C and D are normalized over area. The data were derived by dividing the absolute number of farms in a county by the total acres of land in the county. This quotient was then multiplied by 1000. The normalized data permit comparison of the number of farms reported among counties irrespective of differences in county size.

Potential for Conflict Index
Map A is Index Parameter B, used to caluculate the Potential for Conflict Index. See Figure 8.C.

The number of hogs, dairy cows, and beef in these counties rates among the lowest one third in the state for all three species. This screen is applicable to all maps.

Prepared for the "Technical Work Paper for Land Use Conflicts and Regulation" for the Environmental Quality Board's Generic Environmental Impact Statement for Animal Agriculture

Data Source: USDA Census of Agriculture
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Data Representation: URS

Date Prepared: April 24, 2001

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Section 2:
Measuring Conflict

Introduction

Conflict at its most basic level is a difference in opinion or belief between two individuals or groups. Conflict manifests itself in many ways ranging from brief discussions to war. The purpose of this section is to quantify the causes and characteristics of conflict associated with animal agriculture.

The GEIS literature review on land use (MEQB, 1999) summarized the sources of land use conflicts associated with animal agriculture most often discussed in the literature. They are, in decreasing order:

nuisance concerns about odor;
environmental and human health concerns arising from the risk of air and water contamination from improper manure handling and storage;
differing rural aesthetics; and
economic and social threats to traditional rural culture, including change in the economic structure of the livestock industry.

In order to quantify the causes and characteristics of conflict associated with animal agriculture, the land use team chose to assemble and analyze data on documented complaints. Documented complaints relate to conflict in that they indicate that a conflict has risen to the point of being reported to or noticed by a third party.

It should be noted, however, that documented complaints under-represent the number of actual conflicts that exist. For every conflict that is reported or noticed and documented, there are likely many more conflicts that exist but are never reported to or noticed by a third party; or even if they are reported or noticed, many may not be documented.

The land use team has concerns about the validity of documented complaint data that was collected. These concerns are described in the next section. Because of these concerns and the desire to quantify complaints for the GEIS, we have also created indices to predict where conflict is most likely to occur. These indices predict where conflict is likely to occur based on certain assumptions derived from the literature review about the causes of conflict.

The indices can be used in the future to determine if specific actions, such as the adoption of land use controls, have reduced predicted levels of conflict. For example, a county may be predicted to have a high level of conflict based on assumptions about high-concentrations of animals in proximity to high-concentrations of non-farm residents. If, after the date land use controls are adopted, the actual conflict data shows a lower level of conflict than the index predicted, then the reduced level of conflict may be attributable to the land use controls.

Documented Complaint Data

Sources of Complaint Data

There are three sources of documented complaint data examined in this report:

MPCA complaint records: Minnesota Pollution Control Agency complaint database records from June 1996 to September 2000 were examined by Earth Tech and reported in the Final Technical Work Paper for Air Quality and Odor Impacts for the GEIS.

MPCA Incident Management System (IMS): In January 2000, the Minnesota Pollution Control Agency implemented a new computerized system to handle feedlot-related complaints, the Incident Management System(IMS). IMS complaint data was examined for the period January 2000 through March 2001. There is some overlap between this source and the previous source.

Newspaper reports: The land use team conducted a content analysis of newspaper articles in the two state-wide newspapers (Pioneer Press and Star Tribune) for the period January 1, 1990 to December 31, 2000. Articles reporting complaints or conflicts over animal agriculture were analyzed. (Additional newspaper research is being conducted by the GEIS Social and Community Impacts team. This research focuses on selected counties and local newspapers. The results of this complaint research will be reported in the Social and Community Impacts Technical Work Paper.)

All of these sources of data are imperfect. There are questions about the systematic collection and validity of each type of complaint data. These concerns are addressed as each complaint source is discussed below. Because of concerns over the validity of the documented complaint data a statistical analysis the complaints was not conducted. The complaints are evaluated on a gross level to observe if there are locations that are hot spots for complaints. The results of this analysis are included below.

Attachment 2 contains a listing of the data from each source by county.

Summary of Documented Complaint Data

MPCA complaint data

In its report prepared for the GEIS,[1] Earth Tech reviewed the Minnesota Pollution Control Agency s (MPCA) odor complaint database as well as other information on the number, population and species of animal feedlots. The database included the nonconfidential information from odor complaints compiled between June 1996 through September 2000 for all 87 counties. The database included paper files prior to January 1, 2000, and the computerized Incident Management System from January 2000 through September 2000.

[1] Final Technical Work Paper for Air Quality and Odor Impacts. Prepared for the Generic Environmental Impact Statement on Animal Agriculture and the Environmental Quality Board by Earth Tech, March 2001.

Earth Tech found that a total of 912 complaints about odors from feedlot operations in Minnesota counties[2] were reported to the MPCA between June 1996 and September 2000. Three counties accounted for nearly 46 percent of the total complaints. Renville County registered the most complaints with 167 (18%), followed by Nicollet County which had 150 complaints (14%), and Carver County with 100 complaints (11%).

Complaints from swine operations accounted for 65 percent of the 912 total complaints; 17 percent of the complaints were from operations with unknown species and 15 percent were from dairy operations. Complaints from swine operations outnumbered those from other types of operations in all but six counties registering at least five complaints during the period. In three of the six counties, dairy operations accounted for the majority of complaints, while complaints from unknown species comprised the majority in the other three counties.

In Renville County, the county with the highest number of complaints, nearly 92 percent of the complaints were from swine operations. In Nicollet County, the county with the second highest number of complaints, 96 percent of the complaints were from swine operations. In Carver County, the county with the third highest incidence of complaints, the complaints were distributed in a more even pattern, with 41 percent from unknown species, 30 percent from swine and 29 percent from dairy operations.

There are several factors that reduce the validity of this data, specifically of that collected between June 1996 and January 2000 before the computerized system was developed. According to Earth Tech, the MPCA had no written protocol established for receiving and handling incoming odor complaints. In addition, the database was kept by MPCA staff at the St. Paul headquarters, and there was no protocol to ensure that odor complaints received by the MPCA regional offices or the county feedlot officers were referred to the MPCA headquarters.[3] A report on the MPCA feedlot program by the Office of the Legislative Auditors report (Office of Legislative Auditor, 1999) also noted the lack of consistency in complaint record keeping by MPCA.

Because of these factors, interpretation of the data is limited. For example, it is difficult to make comparisons about of the level of complaints between counties. While it appears that Renville, Nicollet, and Carver counties have the highest level of complaints and hence conflict, these higher numbers could be due to these counties more consistently reporting complaints to the MPCA St. Paul office than did other counties. It could also be due to some MPCA staff being more conscientious in documenting complaints they received. Since the data collection overall was lacking in consistency, it is difficult to know even within an individual county whether the complaint data accurately reflects the numbers and types of complaints reported.

---

[2] According to data furnished by the MPCA, all Minnesota counties except three (Cook, Lake and Ramsey) currently have registered or qualified feedlot operations. Lake County and Ramsey County had one and five feedlots, respectively, at the time of the 1997 Census of Agriculture.

[3] Final Technical Work Paper for Air Quality and Odor Impacts. Prepared for the Generic Environmental Impact Statement on Animal Agriculture and the Environmental Quality Board by Earth Tech, March 2001.

MPCA Incident Management System

The land use team conducted additional analysis of the complaints reported in MPCA s computerized Incident Management System (IMS), for the period January 1, 2000 to March 10, 2001. Although this time period overlaps in part with the Earth Tech analysis above, this additional analysis was conducted because the data from the computerized IMS is believed to be more consistently collected. It has a written protocol which provides consistency in recording complaints, and places responsibility for documenting complaints with MPCA regional offices in close proximity to the complaints rather than in the St. Paul office.[4] The improved validity of the data allows us to more confidently draw conclusions from this data source.

The Incidents Summary Report from the IMS data for the period January 1, 2000 to March 10, 2001 reported 110 complaints. Of these 93 had the county identified; 17 did not list the place and hence could not be correlated to a specific county. Among the 110 complaints in the report, 74 were for odors, while the remainder comprised unspecified rules violations and assorted complaints about manure (e.g., discharge into waters, spills and improper storage, handling and disposal).

Of the 93 complaints where the county was identified, Renville County had the most complaints with 28. The next highest were Lac qui Parle County with 8 complaints, Nicollet County with 6, and Meeker and Stearns Counties which each had 4. In addition, four counties had 3 complaints each, and eight counties had 2 complaints each.

While this data gives a better look at documented complaints and hence conflict, MPCA staff is still concerned that the data is not being collected consistently among staff. MPCA is working on improving consistency. A disadvantage of the data is that it has been collected for just over a year and thus lacks the time series of the complaint data collected prior to the IMS.

Another limitation of both the IMS data and the complaint data collected prior to the IMS, is that for privacy reasons, it does not include complainant characteristics such as location of complainant relative to the feedlot, whether the complainant is a farmer or non-farm rural resident, and the number of different individuals complaining about one feedlot versus repeated complaints from one person. The lack of this data makes it difficult to identify the causes and characteristics of conflict behind each complaint.

Newspaper stories on feedlots

The land use team conducted a keyword search of the word feedlots appearing in the two state-wide newspapers (Star Tribune and Pioneer Press) from January 1, 1990 to December 31, 2000. The purpose of the search was to identify newspaper stories on conflicts or complaints involving feedlots. The majority of the articles mentioning feedlots concerned proposed changes in MPCA feedlot rules. These articles were not included in the conflict analysis.

[4] Final Technical Work Paper for Air Quality and Odor Impacts. Prepared for the Generic Environmental Impact Statement on Animal Agriculture and the Environmental Quality Board by Earth Tech, March 2001.

The search yielded 26 articles in which conflicts about feedlots were the featured topic or figured prominently in the storyline. The most frequent source of conflict was the accidental or purposeful spilling of manure (14 articles), followed by odors (6 articles), manure runoff (2 articles), and other various concerns or violations. Hogs were cited in 13 articles, poultry were mentioned in three articles while cows were mentioned in only two cases.

Renville County was mentioned seven times for manure spills and odors. Blue Earth County was mentioned three times, twice for improper handling of manure. Four counties were mentioned two times, while 12 counties were mentioned only once. In eight cases, state agencies were involved in investigating a problem, and no complainant was described. In the eighteen articles where complainants were mentioned, neighbors and residents were the complaining parties in the majority of the cases.

While there was no discernible geographic pattern of complaints or corrective actions to the conflicts, the newspaper analysis appears to support the earlier finding based on the MPCA complaint data of Renville County as a hot spot of feedlot conflicts.

As with the previous data sources, this one also has limitations. For example, once an article has been written on a complaint or conflict within a particular county, there may likely be follow-up articles on the same situation. This would over-represent the amount of complaints or conflict in that county. Also, the statewide newspapers may be more likely to pick up certain types of conflict stories than others, or to focus on some counties more than others. All of these factors affect the number of times a county is reported as a site of conflict. Thus the number of articles may not reflect the actual amount of conflict in counties statewide.

Analysis of Documented Complaints

Hot-Spot Counties

Data from complaint sources was examined to identify places in the state where complaints about feedlots appear frequently or could be considered problematic. Data from MPCA s computerized Incident Management System was included in this analysis

2000 on, so that it did not double count the data included in Earth Tech s data set. Since each of the data sources examined has limitations, the conclusions that can be drawn from cross-analyzing them are also limited.

Comparing results across data sources could help confirm the findings of each data source, and in part overcome the limited validity of each.

Because of the larger size of the data set for the MPCA complaint data, looking at the total number of complaints for all data sources would skew the results to match the MPCA complaint data. Hence, to avoid this, all four data sets were treated equally by looking at the percentage of complaints for each county within each data source. The results of this analysis are shown in Table 1.

Table 1. Counties with the highest percentage of documented complaints, by data source		
MPCA Complaint Data	MPCA Incident Management System	Newspaper Articles
Renville (18%)	Renville (30%)	Renville (23%)
Nicollet (14%)	Lac qui Parle (9%)	Blue Earth (10%)
Carver (11%)	Nicollet (6%)	Houston, Lincoln, Watonwan, Yellow Medicine (7%)

Renville County appears consistently with the highest percentage of complaints from each data source. This seems to confirm that Renville county is a hot-spot county for conflict over animal agriculture. Looking back at Figures 5 through 7, we can see that in 1997 Renville County had relatively low concentrations of dairy farms and dairy cows, and beef farms and beef cattle. While more prevalent than dairy or beef, concentrations of hog farms and hogs were not particularly high either. However, the number of hogs per thousand acres in the county increased dramatically (70.4% to 162%) between 1982 and 1997.

Nicollet County appears in the top three for two of the data sources, which says that it is probably a hot-spot county for conflict. Nicollet County had high concentrations of hog farms and hogs, moderate concentrations of dairy farms and dairy cows, and low concentrations of beef farms and beef cattle. Similar to Renville County, Nicollet County had a dramatic increase (70.4% to 162%) in the number of hogs per thousand acres between 1982 and 1997.

Blue Earth County, which appears just once, had a high concentration of hog farms and hogs, a low concentration of dairy farms and dairy cows, and a moderately low concentration of beef farms and beef cattle. Like Renville and Nicollet counties, Blue Earth County had a dramatic increase (70.4% to 162%) in the number of hogs per thousand acres between 1982 and 1997.

Carver County, which appears just once, had a moderately low concentration of hog farms and hogs, a high concentration of dairy farms and dairy cows, and a high concentration of beef farms combined with a low concentration of beef cattle. Lac qui Parle County, which also appears just once, had low concentrations of all three types of livestock farms and livestock in 1997, which is somewhat surprising if indeed it is a hot-spot county. Neither of these two counties experienced the dramatic increase in animal numbers per thousand acres between 1982 and 1997 that did Renville, Nicollet, and Blue Earth.

Species of Conflict

Next, these four sources of data were compared to see which species of livestock were linked to more documented complaints. The data was analyzed in the same manner as described above, with each data source given equal weight. The results of this analysis are shown in Table 2.

Table 2. Species with the highest percentage of documented complaints, by data source		
MPCA Complaint Data	MPCA Incident Management System	Newspaper Articles
Hogs (65%)	n/a*	Hogs (50%)
Unknown (17%)	n/a	Poultry (12%)
Dairy (15%)	n/a	Beef and Dairy (8%)

*The Incident Management System Summary does not include information on species.

Species information is available in only two of the data sources. However, in each of these sources, hogs have by far the highest percentage of documented complaints, at 65% and 50%. Because these percentages are so high, it is fairly safe to assume that hogs are the primary species at the source of most documented complaints.

Causes of Complaints

Last, these four sources of data were compared to see what factors or causes were linked to more documented complaints. The data was analyzed in the same manner as described above. The results of this analysis are shown in Table 3.

Table 3. Conflict causes with the highest percentage of documented complaints, by data source		
MPCA Complaint Data	MPCA Incident Management System	Newspaper Articles
Odor (100%)	Odor (67%)	Manure Spills (54 %)
	Various (33%)	Odor (23 %)
		Manure Runoff (8 %)

It appears that odor is the predominant cause of documented complaints, although this must be qualified by pointing out that the Earth Tech summary of the MPCA Complaint Data only looked at odor complaints. However, according to a follow-up interview with Earth Tech, the overwhelming majority (98%) of complaints in the MPCA Complaint Data were odor related.

It is interesting to note that the newspaper articles focused more on manure spills than on odor. This may be because a spill from a single operation has the potential to impact a much wider range of people than does the odor emitted from a single operation.

Complainants

During our research into complaint data, we attempted to determine the locational and occupational characteristics of complainants. As noted above, for privacy reasons complaint data from MPCA did not include characteristics about the people making complaints. This makes it impossible to determine who the complainants are, their occupation, and their location relative to the feedlot. However, the majority of the newspaper articles named neighbors or residents as complainants.

Although the complaints list causes such as odor, manure spills, and manure runoff, these are most likely just the symptoms of broader, underlying causes such as expectations for a rural lifestyle, aesthetics, environmental risks, and changes in the structure of agriculture. The literature review explains conflict over odor to be a result of the clash between expectations and reality. New residents are often attracted to rural areas by relatively low land prices and the desire for a rural lifestyle. Their expectations for a rural lifestyle include clean air and quiet surroundings, which do not always fit the reality of modern agricultural practices.

However, this explanation may be an oversimplification of the causes behind conflict. During the interviews conducted for this report, which are described in the following two sections, people commented that it is sometimes farmers complaining about other farmers. Unless better information on complainants is available in the future, we will be unable to determine what the true underlying causes of conflict are and unable to develop land use regulations to address them.

Indices for Predicting Conflict

As stated above, concerns about the consistency and adequacy of actual complaint data led the land use team to develop a set of indices to predict the potential for conflict in the rural landscape. The use of the indices is forward looking. The indices predict a certain level of conflict based on assumptions about the causes of conflict. These assumptions are based on the results of the literature review. If reliable actual conflict data is collected in the future, trends in the actual level of conflict can be compared to the predicted level of conflict. If the actual level of conflict diverges from the predicted level of conflict, the cause of the divergence should be determined. Possible causes can include a change in land use policies, changes in state regulations, or a change in technology that reduces odor. The indices could be used to evaluate the effectiveness of new land use regulations in reducing conflict by comparing actual and predicted conflict from the point in time the land use regulation was implemented.

The indices were constructed using the causes of conflict over feedlots, moderated by the economic dependence on agriculture, to predict the potential for conflict in each county in Minnesota. The causes of conflict were derived from the literature review for the GEIS (e.g proximity of non-farm residents to feedlots, manure storage and land application). Three indices were created, each emphasizing a different cause of conflict. The potential for conflict could exist from the interaction between non-farm rural residents and animal agriculture through three different means:

- feedlots and their associated structures (Index 1);
- odor from manure storage (Index 2); and

" odor from manure application (Index 3).

The formulas for the three indices are described below.

Index 1 (I_f): This index predicts the potential for conflict between rural non-farm residents and feedlots and their associated structures as a function of the density of animals present, moderated by the economic dependence of the county on agricultural production.

I_f can be calculated for each species to assess the difference in magnitude of space and facilities required for different species. Formulas here are given with references to hogs; these would be replaced by dairy and beef to calculate the index for those species.

I_f = (A x B x C x D) / E where:

A = (# of hogs in the county) / (# of hog farms in the county)
This calculation provides a measure of the intensity of hog farming in the county. A high number of hogs per farm indicates relatively intense hog operations within the county. As this ratio increases, so does the potential for conflict.

B = (# of hog farms in the county) / (# of total farms in the county)
This calculation provides a measure of the concentrations of hog farming as a component of all farming within the county. A high number of hog farms as compared to all farms indicates a high concentration of the hog industry within the county. As this ratio increases, so does the potential for conflict.

C = (# of farm acres in the county / (# of total acres in the county)
This calculation provides a measure of the concentration of all farming as a component of all land within the county. A high number of farm acres as compared to all acres indicates a high concentration of farming within the county. As this ratio increases, so does the potential for conflict.

D = (# of rural non-farm residents) / (# of total residents in the county)
This calculation provides a measure of the density of rural non-farm residents within the county. A high number of rural non-farm residents as compared to total residents indicates a high density of rural non-farm residents within the county. As this ratio increases, so does the potential for conflict.

E = ($ of agricultural contribution to gross county product) / ($ gross county product)
This calculation provides a measure of the significance of agriculture to the economy of the county. As this ratio goes up, the strength of concern for agriculture increases and the potential for conflict decreases.

Index 2 (I_{ms}): This index predicts the potential for conflict between non-farm rural residents and odor generated by feedlots as a function of the concentration and duration of manure storage, moderated by the economic dependence of the county on agricultural production.

I_{ms} is calculated by animal units for each species, then summed across species.

I_{ms} = (A x B x C x D) / E where:

A = same as above, except that the number of hogs is converted to animal units

B = same as above

C = same as above

D = same as above

E = same as above

Index 3 (I_{ma}): This index predicts the potential for conflict between non-farm rural residents and odor generated by the application of manure to agricultural fields as a function of the amount spread per acre.

I_{ma} can be calculated by animal units for each species, then summed across species to yield a figure for total manure generated within the county.

I_{ma} = (D x F x G) / E where:

D = same as above

F = (# of harvested acres in the county) / (total # of acres in the county)
This calculation provides a measure of the concentration of available land for manure application as a component of all land in the county. A high number of available acres for manure application as compared to all acres indicates a high concentration of available acres. As this ratio increases, so does the potential for conflict.

G = (total animal units of manure generated) / (# of harvested acres in the county)
This calculation provides a measure of tons of manure per acre that needs to be applied to available agricultural land. As this ratio increases, so does the potential for conflict.

Trend data for variables was derived from the Census of Agriculture for the years 1982, 1987, 1992, 1997 Population data was provided by the Office of the State Demographer. The data tables for each index are included in Attachment 3 to this report. Index 1, measuring potential for conflict based on concentrations of animals in proximity to non-farm neighbors, was calculated for three types of feedlots: hogs, dairy, and beef. Figure 11 shows the parameters that remain constant across species for Index 1. Index 2 and Index 3, measuring the potential for conflict based on manure storage and land application, combine species and focus on the amount of manure produced by all animals.

Poultry indices were not calculated because of lack of available data. In general, Census of Agriculture data on the poultry industry is suppressed because of a high concentration of animals on a few farms. Data is suppressed when one farm has 60% or more of the total animals of that species in the county. This lack of data made it impossible to create and include poultry in the three indices.

The results of the indices are summarized below. At a gross level, we have tested the indices by comparing the results to the hot spots for complaints. Other statistical testing of the indices is described in Attachment 3. The indices are presented in mapped form in Figures 8 through 12.

Index 1 - Feedlots and Associated Structures

Index 1: Hogs

The 1997 potential for conflict as calculated by Index 1 for hogs and the change in the index from 1982 to 1997 are shown in Figure 8 along with two of the components of the index: hogs per hog farm, and change in hogs per hog farm. Ten counties have index numbers greater than 67, while most counties lie below 22. The average for the state is 31.4, and the median is 21.4.

The five counties with the highest index numbers were (in order); Martin, Watonwan, Sibley, Dodge, and Lyon. A review of how each of these counties ranked for each parameter in the index showed two general patterns. First, the ratio of agricultural product sales to all product sales (the intensity of agriculture within the county economy) was consistently low. These five counties all tended to have significant non-agricultural economic activity. Second, these counties all showed mid to high levels of intensity for animals (hogs) per farm and for agricultural land uses. Non-farm rural population level did not predict a high index number. It is interesting to note that none of these counties appeared prominently in the documented complaint data.

The hog and hog farm intensity variables were high for some other counties, such as Renville, Pipestone, Nicollet, and Blue Earth. These counties, however, have agriculturally-dependent economies, which significantly lowered their final hog conflict index numbers. It is interesting to note that these counties, with the exception of Pipestone, were identified as hot-spot conflict counties in the documented complaint data.

The largest percentage increases in Index 1 for hogs between 1982 and 1997 appear to be focused in counties with relatively low numbers of hog farms in 1982. None of the ten highest growth rates for hog conflict index numbers resulted in a 1997 index number among the ten highest. Lyon County s index number, the 5th highest in 1997, increased by 80% between 1982 and 1997. Jackson County s index number, the 9th in 1997, decreased by 16% between 1982 and 1997.

Index 1: Dairy

The 1997 potential for conflict as calculated by Index 1 for dairy and the change in the index between 1982 and 1997 are shown in Figure 9, along with two of the components of the index: dairy cows per dairy farm, and change in dairy cows per dairy farm. Twelve counties have index numbers greater than 50, while most counties lie below 24. The average for the state is 28.5, and the median is 23.7.

The five counties with the highest index numbers were (in order); Dodge, Sibley, Lincoln, Stearns, and Todd. A review of how each of these counties ranked for each parameter (the components of the final index) showed one prominent pattern. The ratio of agricultural product sales to all product sales (the intensity of agriculture within the county economy) was well below

the median. All five counties had significant non-agricultural economic activity. The other variables contributed unequally to the top five rank in the dairy farm conflict index numbers. None of these counties appeared prominently in the documented complaint data.

An examination of the relationship between the final index numbers and each of the dependent variables across all counties showed some relationships, although no one variable showed a strong relationship to the final index numbers. Non-farm rural population showed the weakest relationship, while the intensity of dairy farms and agricultural land showed the strongest tie to the final index numbers. The number of dairy animals per dairy farm showed little relationship to the final index numbers.

The dairy farm intensity variables were high for some other counties, including Winona, Morrison, and Wabasha. The prominence of agriculture in these counties' economies, however, lowered their final dairy conflict index numbers.

The largest percentage increases and decreases in Index 1 (dairy) between 1982 and 1997 appear to be focused in counties with relatively low dairy conflict index numbers in 1982. Only three of the counties with the ten highest dairy conflict index numbers for 1997 were among the ten highest increases in index numbers. Clearwater County's index number increased 82% over the 15-year target period, leaving it with the fifth highest dairy index number (57.3). Stevens County had the greatest percentage increase (374%), leaving it with the 8th highest dairy conflict index. Lac qui Parle's index number increased by 110%, resulting in the 9th highest dairy index number (47.1).

Index 1: Beef

The 1997 potential for conflict as calculated by Index 1 for beef and the change in the index between 1982 and 1997 are shown in Figure 10, along with two of the components of the index: beef cattle per beef farm, and change in beef cattle per beef farm. Seven counties have index numbers greater than 50, while most counties lie below 25. The average for the state is 27.3, and the median is 24.7.

The five counties with the highest beef conflict index numbers were (in order); Lincoln, Red Lake, Lyon, Mahnomen, and Clearwater. A review of how each of these counties ranked for each parameter (the components of the final index) showed two general patterns. As found with the hog and dairy index numbers, the intensity of agriculture within the county economy was consistently low. Second, these counties all showed mid to high levels of intensity for animals (cattle) per farm and for beef producing farms per any type of farm. The level of non-farm rural population also played a significant role for four of the five top beef conflict counties. None of these counties appeared prominently in the documented complaint data.

Counties with high cattle and cattle farm intensities that did not rank highly in the beef conflict index numbers include Renville, Nobles, and Murray counties with high rankings for beef cattle per farm, and Itasca, Koochiching, and Kanabec counties with high rankings for beef farms as part of all farms. These counties did not, however, have high final beef conflict index numbers.

Growth in the beef conflict index numbers pushed three counties into the ten highest in 1997:

Clearwater, with a 1997 index number of 57.3 (5th) grew by 72%; Lyon, with a 1997 index number of 68.3 (3rd) grew by 55%; and Cass, with a 1997 index number of 46 (10th) grew by 68%. The highest 1997 index number (Lincoln County s) actually decreased by 13% from 1982, as did Traverse County (6th in 1997 with 55.4, decreasing by 16% from 1982).

Index 2 - Odor from Manure Storage

Figure 12 shows the 1997 index numbers for Index 2 and the change in Index 2 for the period 1982 to 1997. Eight counties have index numbers greater than 190, while most counties lie below 80. The average for the state is 91, and the median is 77. The five counties with the highest conflict index numbers were (in order); Lyon, Sibley, Martin, Watonwan, and Redwood. Again, none of these counties appear prominently in the documented complaint data.

Growth in the conflict index numbers only affected one county in the highest ten for 1997: Lyon County, with a 1997 index number of 259, which grew by 104% since 1982. Three counties in the 1997 highest ten actually decreased since 1982: Sibley, with the second highest index number, decreased almost 3%; Lincoln, with the 6th highest 1997 index number (200), decreased 15%; and Fillmore, with the 10th highest 1997 index number (175), decreased by 45%.

Index 3 - Odor from Land Application of Manure

Figure 12 also shows the 1997 index numbers for Index 3 and the change in Index 3 between 1982 and 1997. Seven counties have index numbers greater than 14, while most counties lie below 8.5 (the median is 8. 4). The average for the state is slightly higher at 8.59, indicating a slight skew in the distribution. The five counties with the highest conflict index numbers were (in order); Sibley, Dodge, Lincoln, Watonwan, and Martin. No single parameter consistently explains the high index numbers for these counties. At least one of these five counties was on the opposite side of the median value from the remaining five for every parameter except the percentage of harvest crop land to total land.

For the entire population of counties, the relationship of each parameter to the final conflict index numbers was more tenuous than with Index 2.

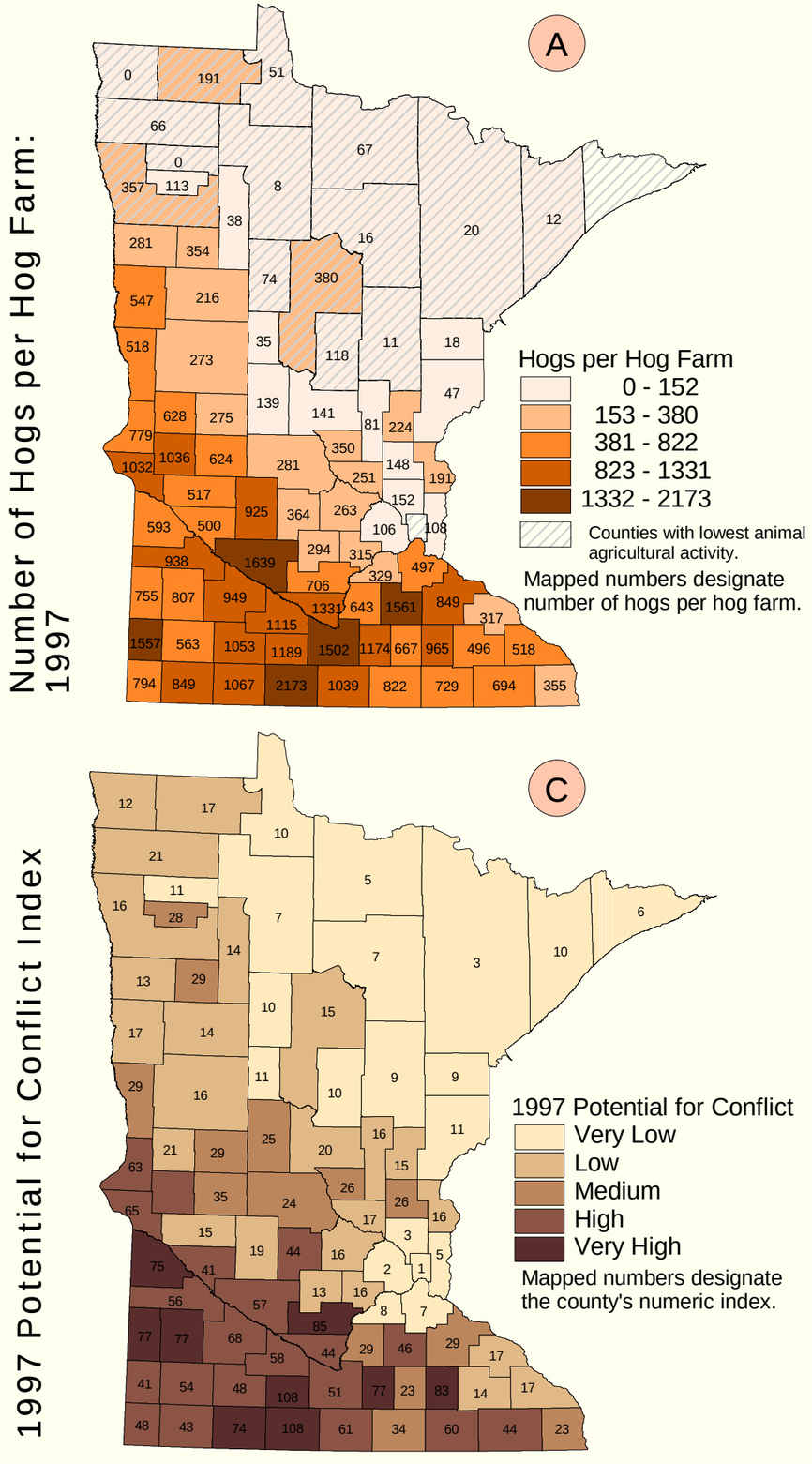
The index is increasing for the state as a whole. The average increase in the conflict index numbers for each county was 8%. The median change was an increase of 3%.

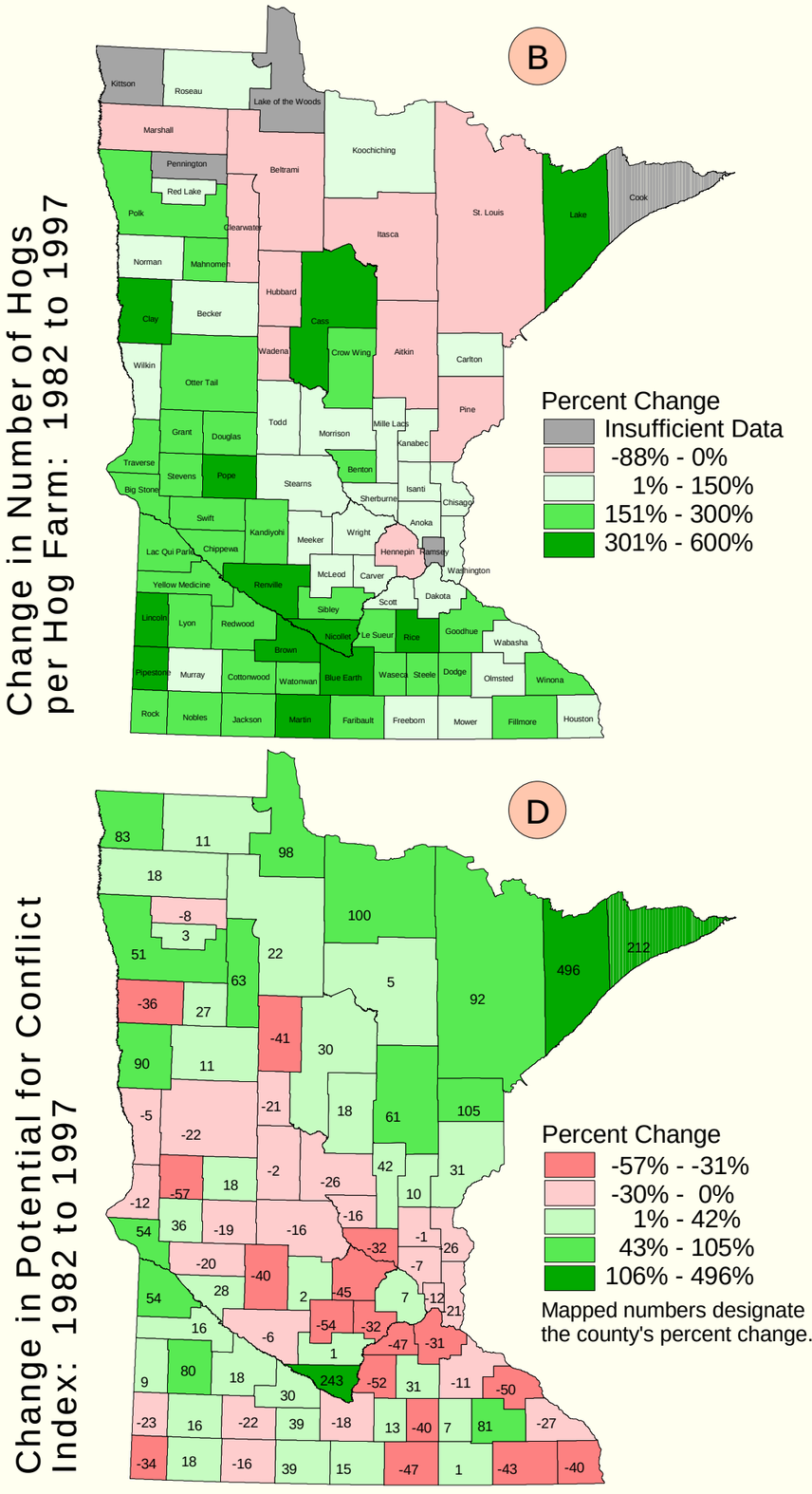
Four of the ten highest counties for the 1997 conflict index numbers also realized among the highest 15-year increases (1982 and 1997) in conflict index 3. Watonwan County (the 4th highest index number, 15.67) grew 41%, Martin County (5th highest, 15.6) grew 111%, Lyon County (8th, 13.3) grew 96%, and Lac qui Parle County (10th, 13.05) grew 71%. None of the highest ten declined from 1982; Todd County showed the smallest 15-year increase (10%) of the highest ten for 1997, a greater change than the average for all counties.

Figure 8

Potential for Conflict Index I: HOGS

A. Number of Hogs per Hog Farm: 1997
B. Change in Number of Hogs per Hog Farm: 1982 to 1997
C. 1997 Potential for Conflict Index
D. Change in Potential for Conflict Index: 1982 to 1997





Index Calculation:

Index of Potential for Conflict Between Animal Confinement Facilities (feedlots, structures, etc.) and Rural Non-Farm Residents (I)

I = (A x B x C x D) / E where:

A = (# of hogs in the county) / (# of hog farms in the county)

B = (# of hog farms in the county) / (# of total farms in the county)

C = (# of farm acres in the county / (# of total acres in the county)

D = (# of rural non-farm residents) / (# of total residents in the county)

E = ($ of agricultural contribution to gross county product) / ($ gross county product)

Data Notes:

Parameter A is mapped in Figure 8.A; Parameter B in Figure 5.A; Parameter C, D, E in Figure 11.

The number of hogs, dairy cows, and beef in these counties rates among the lowest one third in the state for all three species. Screen is applicable to all maps.

Prepared for the "Technical Work Paper for Land Use Conflicts and Regulation" for the Environmental Quality Board's Generic Environmental Impact Statement for Animal Agriculture

Data Source: USDA Census of Agriculture and MN Demographer's Office
Data Preparation: University of Minnesota, Department of Landscape Architecture
Data Representation: URS

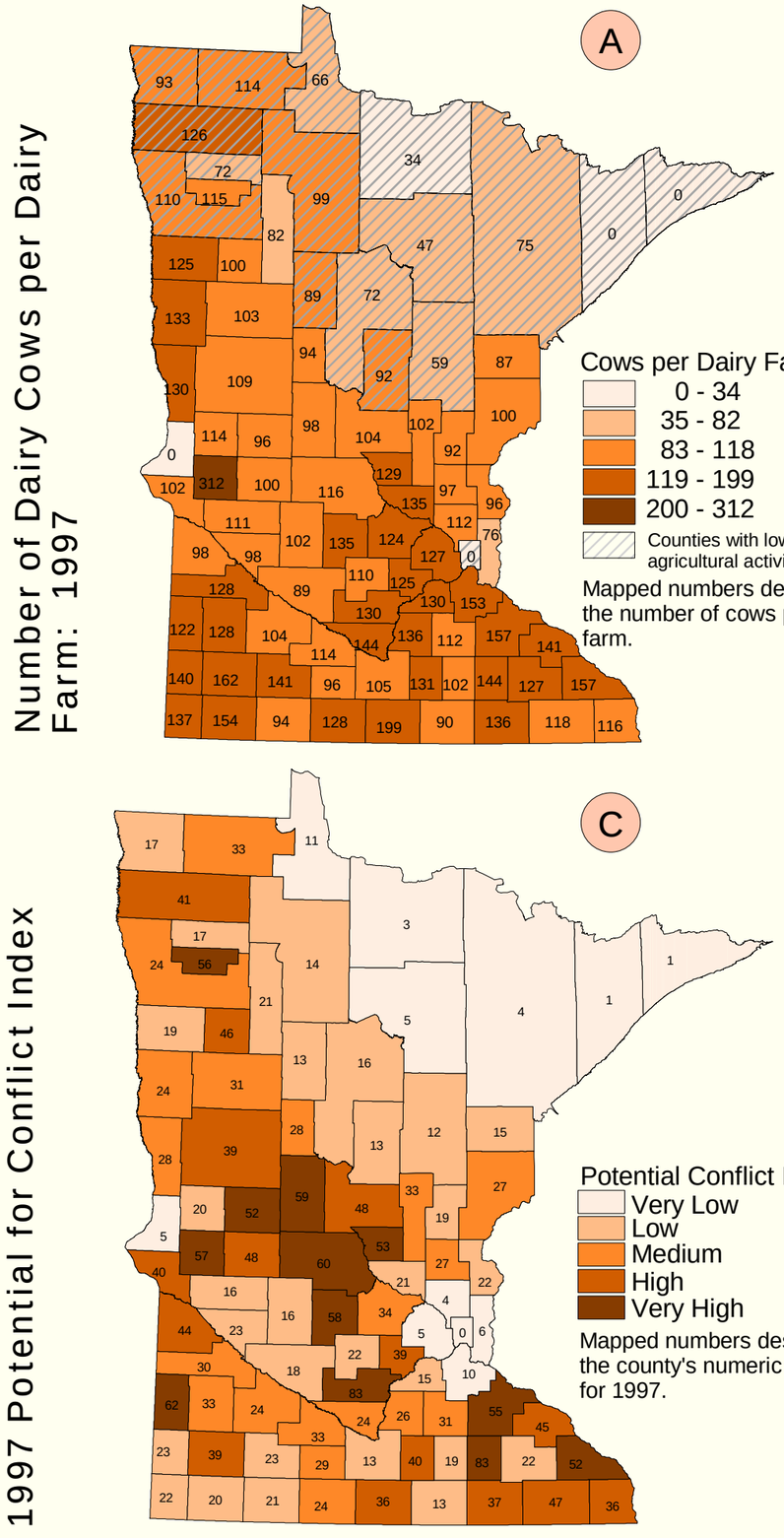
Date Prepared: April 24, 2001

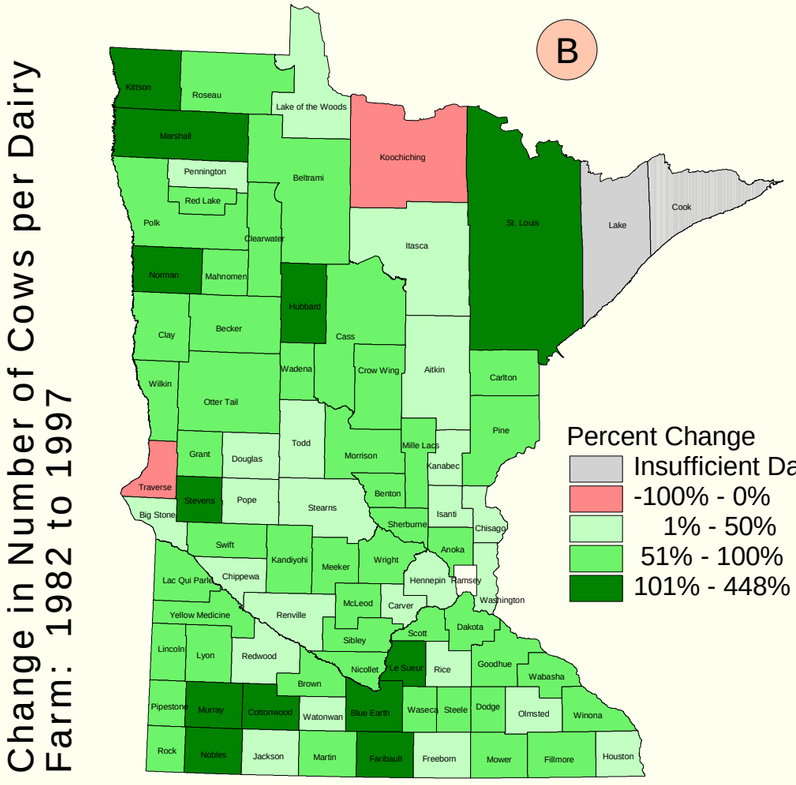
FIG8indices_hog.apr

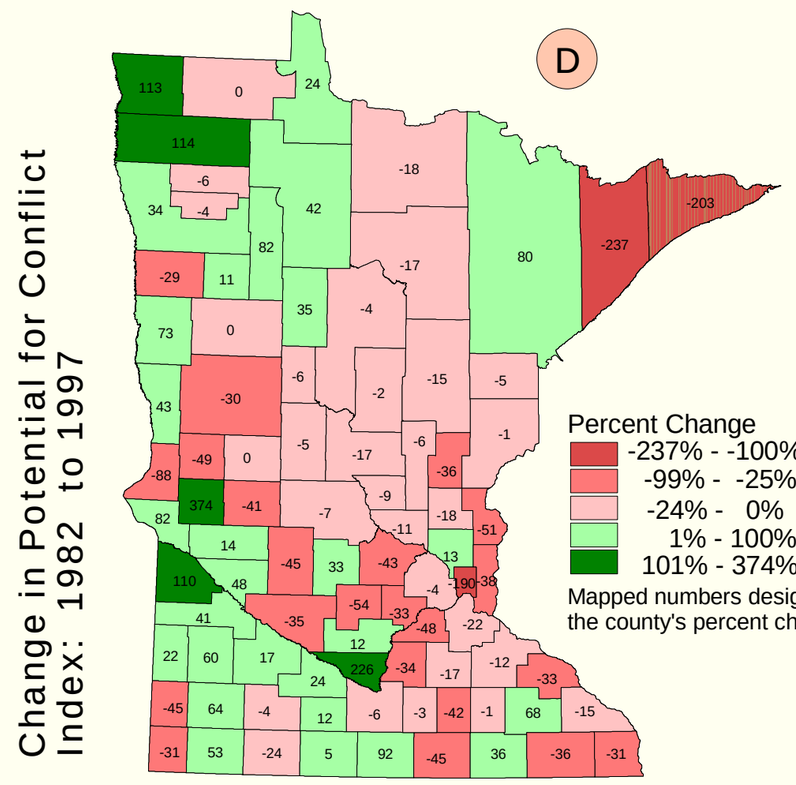
Figure 9

Potential for Conflict Index I: DAIRY

A. Number of Dairy Cows per Dairy Farm: 1997
B. Change in Number of Cows per Dairy Farm: 1982 to 1997
C. 1997 Potential for Conflict Index
D. Change in Potential for Conflict Index: 1982 to 1997







Index Calculation:

Index of Potential for Conflict Between Animal Confinement Facilities (feedlots, structures, etc.) and Rural Non-farm Residents (I)

I = (A x B x C x D) / E where:

A = (# of dairy cows in the county) / (# of dairy farms in the county)

B = (# of dairy farms in the county) / (# of total farms in the county)

C = (# of farm acres in the county / (# of total acres in the county)

D = (# of rural non-farm residents) / (# of total residents in the county)

E = ($ of agricultural contribution to gross county product) / ($ gross county product)

Data Notes:

Parameter A is mapped on Figure 9.A; Parameter B on Figure 6.A; Parameter C, D, E on Figure 11.

The number of hogs, dairy cows, and beef in these counties rates among the lowest one third in the state for all three species. Screen is applicable to all maps.

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Data Source: USDA Census of Agriculture and Minnesota Demographer's Office
Data Preparation: University of Minnesota, Department of Landscape Architecture
Data Representation: URS

Date Prepared: April 24, 2001

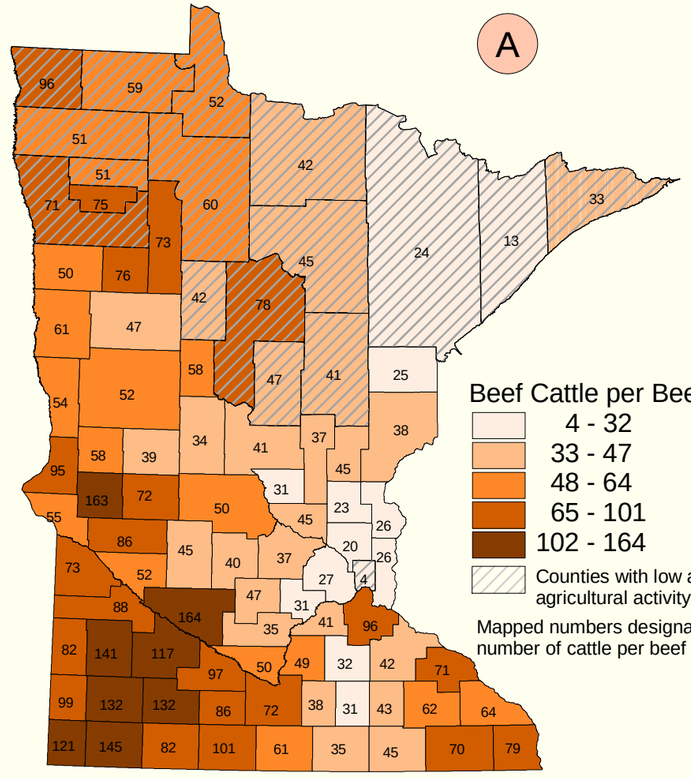
FIG9indices_dairy.apr

Figure 10

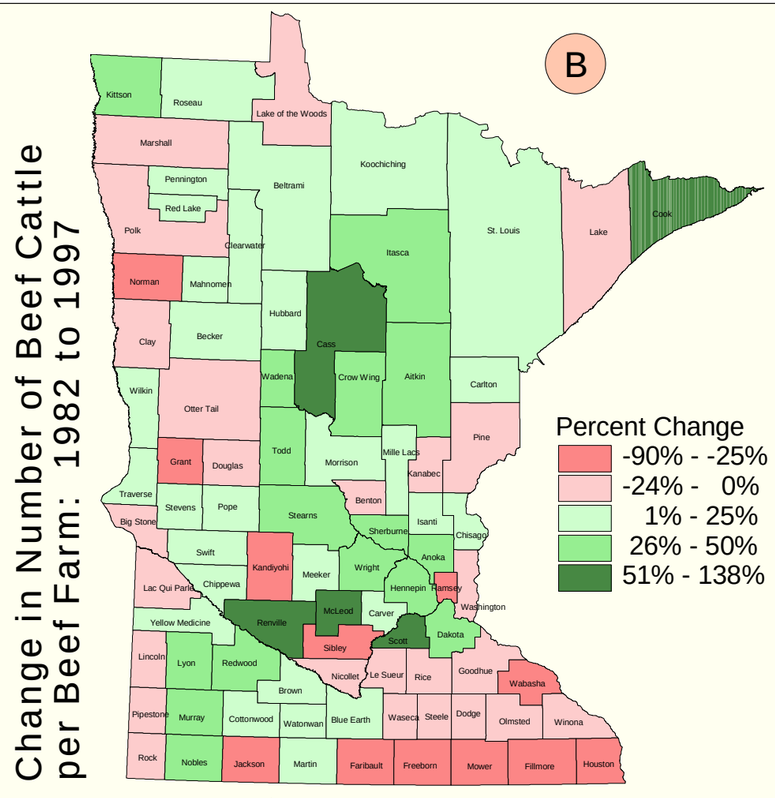
Potential for Conflict
Index 1: BEEF CATTLE

A. Number of Beef Cattle per Beef Farm: 1997
B. Change in Number of Beef Cattle per Beef Farm: 1982 to 1997
C. 1997 Potential for Conflict Index
D. Change in Potential for Conflict Index: 1982 to 1997

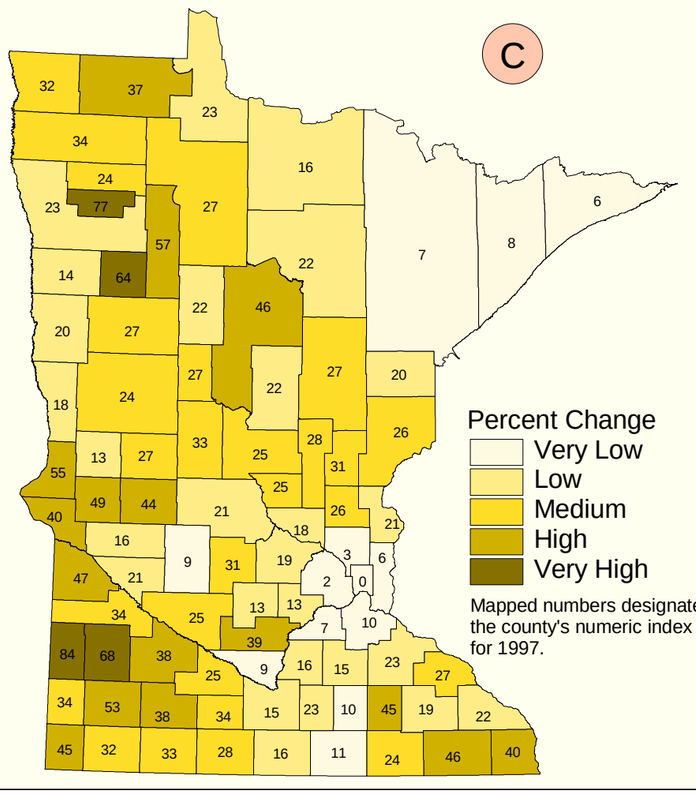
Number of Beef Cattle per Beef Farm: 1997



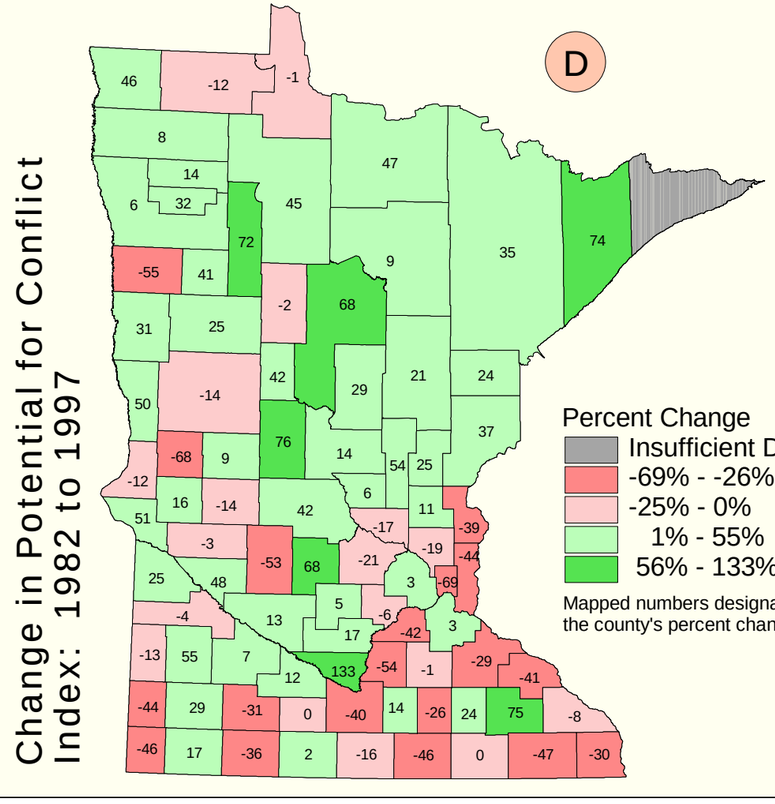
Change in Number of Beef Cattle per Beef Farm: 1982 to 1997



1997 Potential for Conflict Index



Change in Potential for Conflict Index: 1982 to 1997



Index Calculation:

Index of Potential for Conflict Between Animal Confinement Facilities (feedlots, structures, etc.) and Rural Non-Farm Residents (I)

I = (A x B x C x D) / E where:

A = (# of beef cattle in the county) / (# of beef farms in the county)

B = (# of beef farms in the county) / (# of total farms in the county)

C = (# of farm acres in the county / (# of total acres in the county)

D = (# of rural non-farm residents) / (# of total residents in the county)

E = ($ of agricultural contribution to gross county product) / ($ gross county product)

Data Notes:

Parameter A is mapped on Figure 10.A; Parameter B on Figure 7.A, Parameters C, D, E on Figure 11.

The number of hogs, dairy cows, and beef in these counties rates among the lowest one third in the state for all three species. This screen is applicable to all maps.

Prepared for the "Technical Work Paper for Land Use Conflicts and Regulation" for the Environmental Quality Board's Generic Environmental Impact Statement for Animal Agriculture

Data Source: USDA Census of Agriculture and MN Demographer's Office
Data Preparation: University of Minnesota, Department of Landscape Architecture
Data Representation: URS

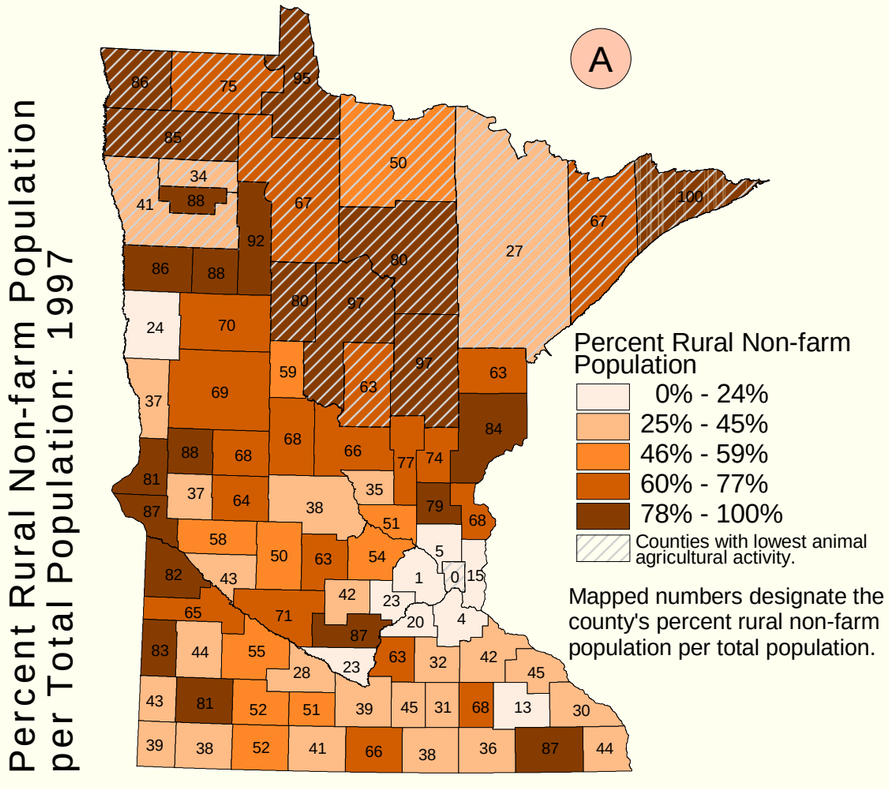
Date Prepared: April 24, 2001

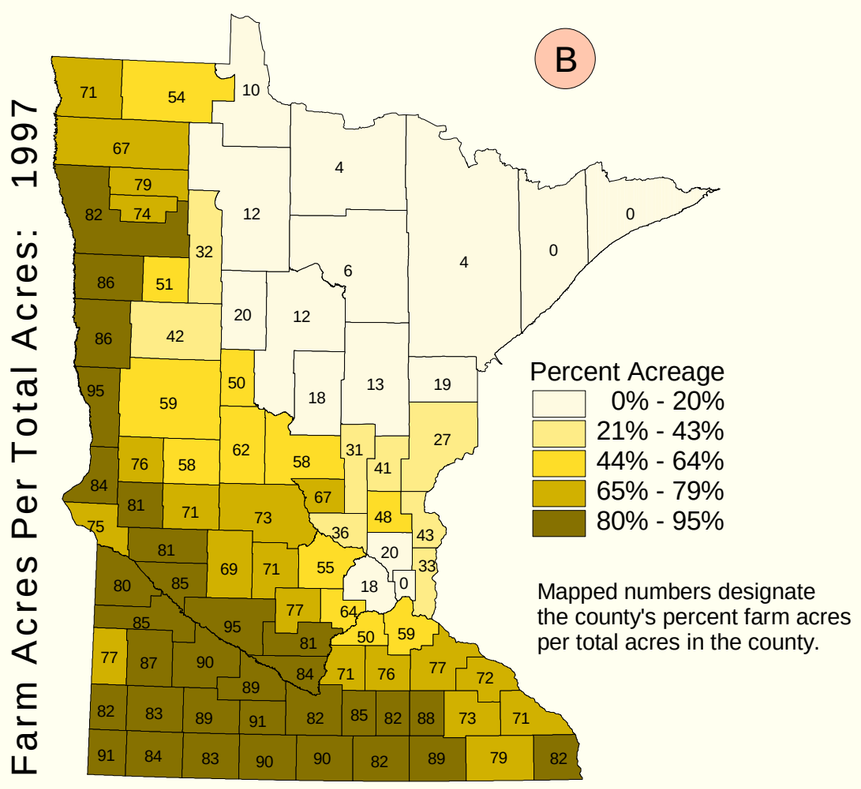
FIG10indices_beef.apr

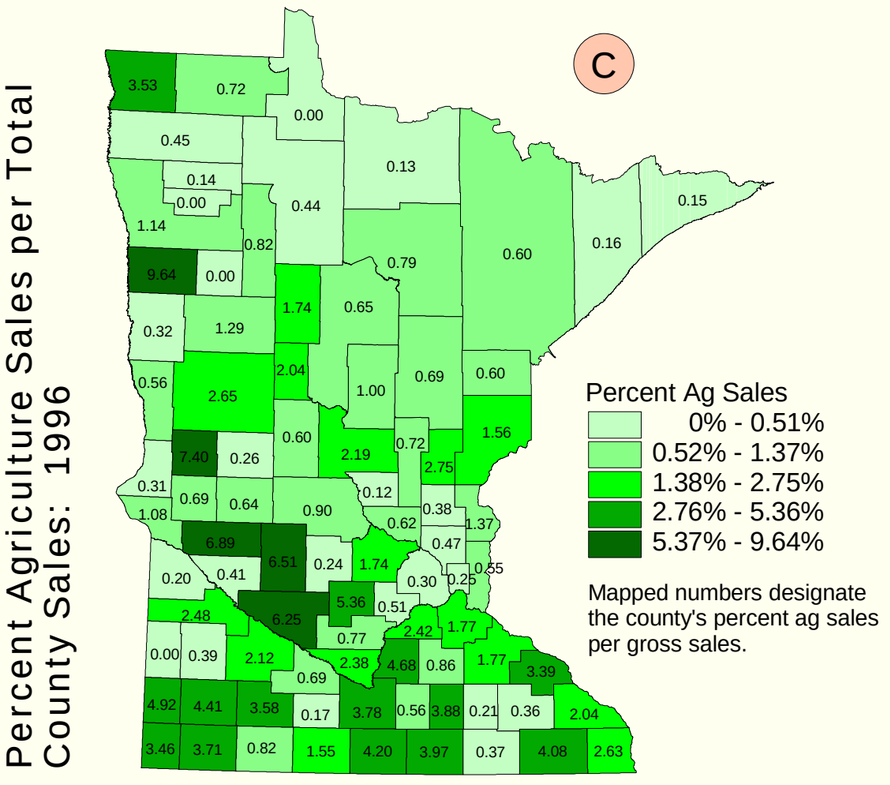
Figure 11

Conflict Parameters That Remain Constant Across Species Index I

A. Percent Rural Non-farm Population per Total Population: 1997
B. Farm Acres per Total Acres: 1997
C. Percent Agriculture Sales per Total County Sales: 1996







Data Notes:
In Map C 1996 percent agriculture sales per total county sales is reported. 1997 data was not available in the Department of Revenue report.

The number of hogs, dairy cows, and beef in these counties rates among the lowest one third in the state for all three species. Screen is applicable to all maps.

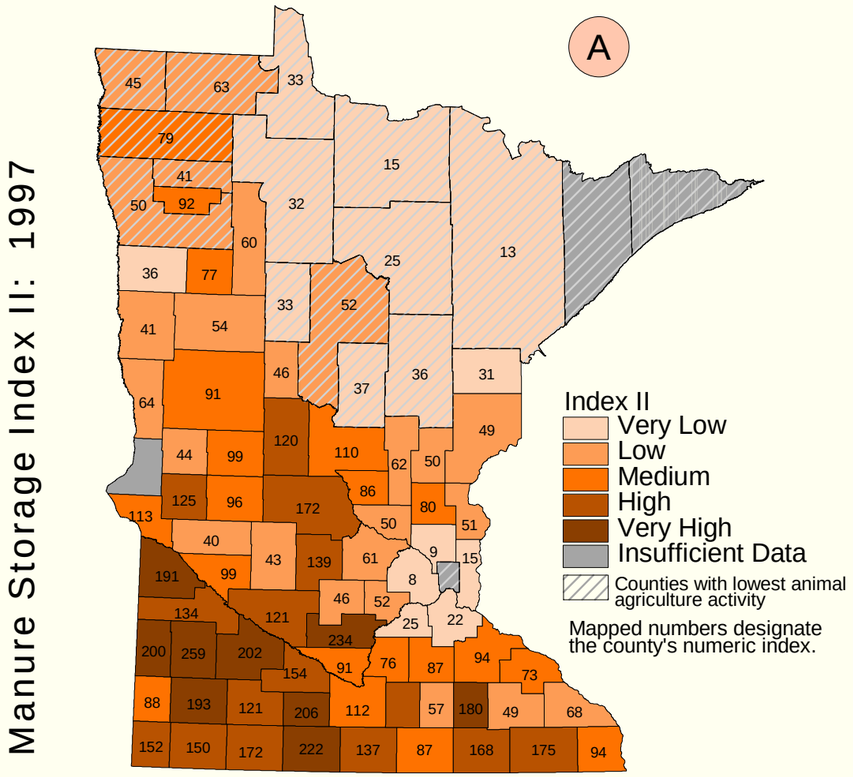
Prepared for the "Technical Work Paper for Land Use Conflicts and Regulation" for the Environmental Quality Board's Generic Environmental Impact Statement for Animal Agriculture
Data Sources: USDA Census of Agriculture, MN Demographer's Office, and MN Department of Revenue
Data Preparation: University of Minnesota, Department of Landscape Architecture
Data Representation: URS
Date Prepared: April 24, 2001

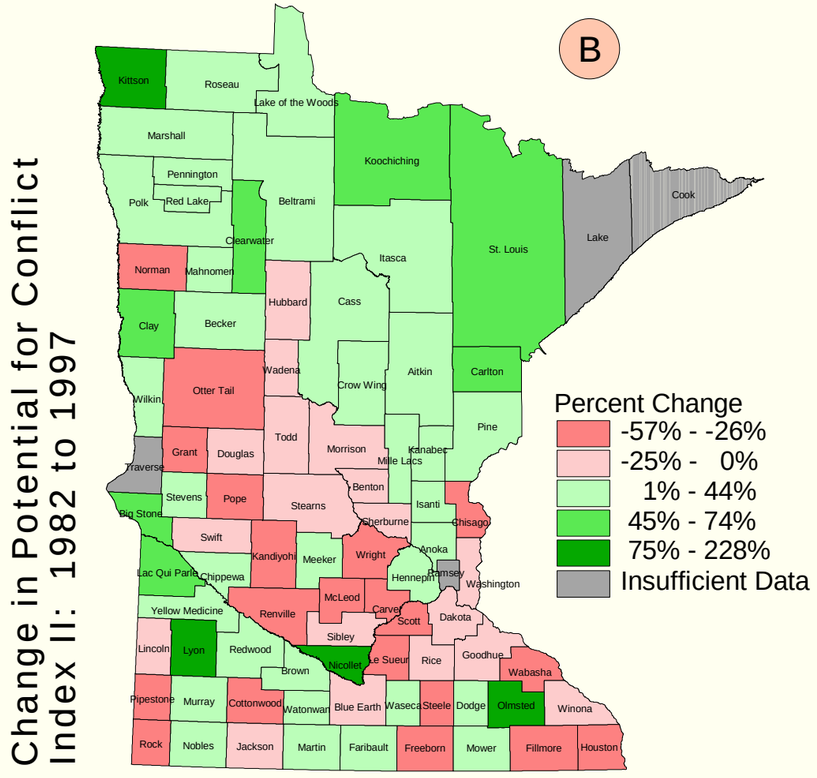
FIG11parameters.apr

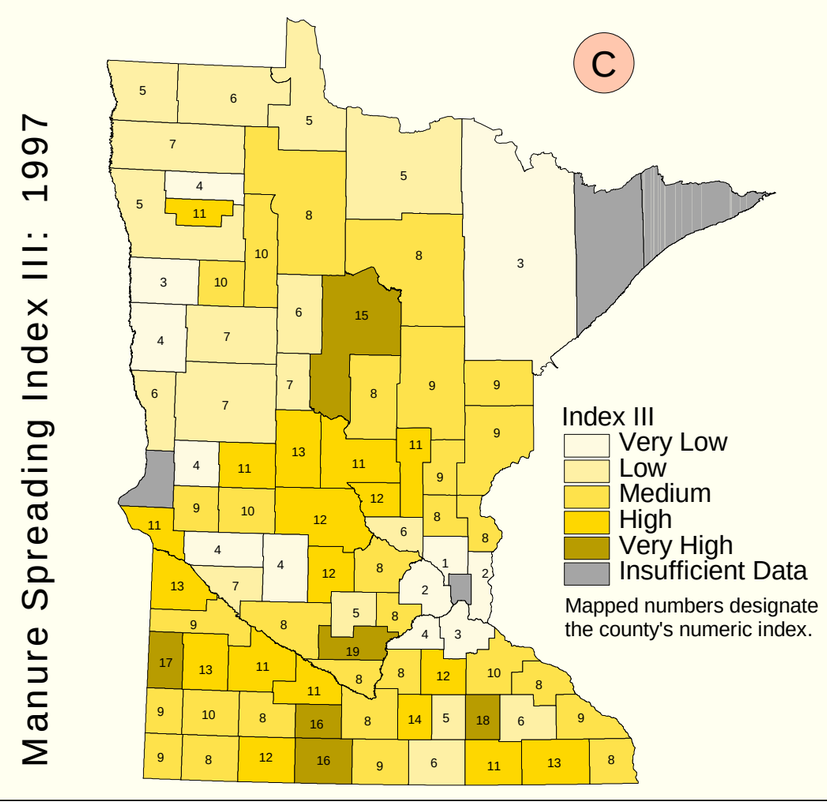
Figure 12

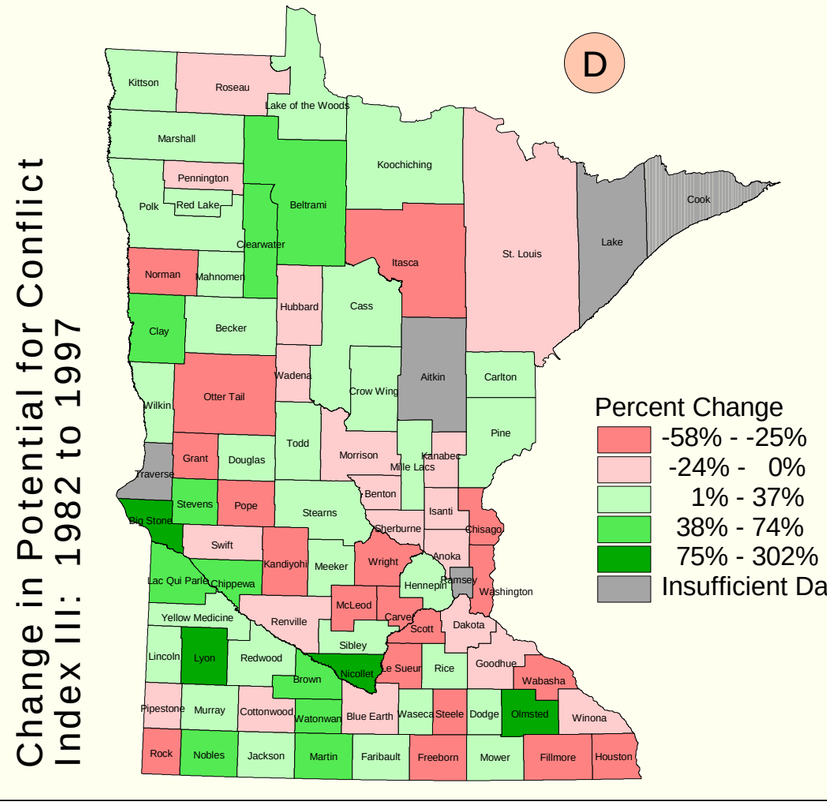
Potential for Conflict
Index II: Manure Storage
Index III: Manure Spreading

A. Manure Storage Index II: 1997
B. Change in Potential for Conflict Index II: 1982 to 1997
C. Manure Spreading Index III: 1997
D. Change in Potential for Conflict Index III: 1982 to 1997









Formula for Index II:

Index of Potential for Conflict Between Manure Storage at Animal Confinement Facilities (feedlots, structures, etc.) and Rural Non-Farm Residents (I)

I = (A x B x C x D) / E where:

A = (# of animal units of manure produced in the county by hogs, dairy cows, and beef cattle) / (# of hog, dairy, and beef farms in the county)

B = (# of hog, dairy, and beef farms in the county) / (# of total farms in the county)

C = (# of farm acres in the county / (# of total acres in the county)

D = (# of rural non-farm residents) / (# of total residents in the county)

E = ($ of agricultural contribution to gross county product) / ($ gross county product)

I was calculated across major livestock commodity groups (hogs, dairy, beef) and all rural non-farm residents within a county. Calculation of animal units of manure:
1 animal on a dairy farm = 1.0 animal unit
1 animal on a beef farm = 0.7 animal unit
1 animal in a hog production unit = 0.3 animal unit.

Formula for Index III:

Index of Potential for Conflict Between Manure Application to Available Agricultural Lands and Rural Non-Farm Residents (I)

I = (D x F x G) / E where:

D = (# of rural non-farm residents) / (# of total residents in the county)

E = ($ of agricultural contribution to gross county product) / ($ gross county product)

F = (# of harvested acres in the county) / (# of total acres in the county)

G = (total animal units of manure generated in the county) / (# of harvested acres in the county)

For Both Formulas

Input parameters are converted to standard normal scores (i.e. z-scores with standard deviation of 1.0) to facilitate arithmetic combination. This eliminates weighting of input parameters.

Rules of Combination

Multiplication of parameters that contribute to increased conflict
Parameters that contribute to decreased conflict

Prepared for the "Technical Work Paper for Land Use Conflicts and Regulation" for the Environmental Quality Board's Generic Environmental Impact Statement for Animal Agriculture

Data Source: USDA Census of Agriculture, MN Demographer's Office, US Census
Data Preparation: University of Minnesota, Department of Landscape Architecture
Data Representation: URS

Date Prepared: April 24, 2001

FIG11indices_stockpile.apr

Section 3:
Land Use Tools to Address Conflict

This section of the report describes:

the legal basis for local government use of land use controls to reduce conflict over feedlots;
how local governments in Minnesota and elsewhere have used land use tools to manage conflict over changes in animal agriculture; and
descriptions of model land use planning and zoning elements for use by local governments in Minnesota.

Legal basis for local land use regulation in Minnesota

To understand land use regulation by local governments in Minnesota, it is important to first understand the overlapping relationships between levels of government. This section of the report briefly describes the current roles, based on state law, of local and state government in land use regulation of feedlots. The roles overlap in jurisdiction and in subject matter. Local governments include counties, townships, and cities. The primary state agency involved in regulation of feedlots is the Minnesota Pollution Control Agency. Federal agencies are also involved in feedlot regulation, but are not considered in this report.

Regulatory issues around feedlots relate to the operations of the feedlot, including manure management, and the location of operations within a jurisdiction and within a site. State and local governments have interest in both issues. Current law, however, gives local government a clearer role in locational regulations. Regulation of operations lies more clearly with the state pollution control agency, although administration of these regulations is shared with county governments. Delegated counties under Minn. Rules 7020 play a service delivery role by administering state rules under state agency review.

Locational concerns primarily revolve around potential nuisance problems with surrounding residents, and the potential for a negative impact on natural resources such as water and soil.

Overlapping land use powers in rural areas

In rural Minnesota three levels of local government exercise land use powers: counties, townships and cities. Local governments in Minnesota exercise land use planning and zoning powers under express statutory delegation of police powers from the State of Minnesota. [5] Delegation statutes for specific units of local government are:

Planning and zoning for counties, Minn. Stat. §§394.01, *et seq.*
Planning and zoning for townships and cities, Minn. Stat.§§462.01, *et seq.*

[5]The summary of local government land use powers is based on the literature review on the Role of Government for the GEIS on Animal Agriculture (pp. C-18 - C25, Minnesota Environmental Quality Board, 1999) and *Planning and Zoning for Animal Agriculture in Minnesota: A Handbook for Local Government* (pp. III-2 - III-6, James Duncan and Associates, 1996), and additional research.

Under these authorizing statutes local governments may adopt zoning ordinances to divide their community into districts that allow specific land uses and do not allow other land uses. Local governments may regulate the density of uses within a district, the location of structures on parcels, and the size of structures. A zoning ordinance may also establish performance standards for allowed uses. These standards may control on- and off-site impacts including odor, noise, and dust.

Relationship between county, township, and city land use ordinances

Cities lie within townships and townships and cites lie within county boundaries. Through statute, the state has established how the potentially conflicting land use regulations of these three jurisdictions relate to each other. If a county adopts a zoning ordinance, a township can not adopt a ordinance that is inconsistent with the county ordinance. (Minn. Stat. §394.33, subd. 1) The township may, however, zone more restrictively.

Within their boundaries, cities have exclusive land use authority. They can also choose to exercise some authority over rural areas in the surrounding township. Minn. Stat. §462.358 allows cities to extend application of their subdivision regulations to unincorporated territory located within two miles of its city limits in any direction. As a counterbalance to this power, Minn. Stat. §462.3585 gives surrounding townships and counties the authority to require cities who invoke extraterritorial power to engage in cooperative planning for the overlapping jurisdictional area.

Because of the overlapping jurisdictions in rural areas, counties, townships and cities must work together to make land use decisions. Rural residents often identify their community by describing their township, a portion of a county (ex. southern Renville County), or naming the county. They may also describe the nearest city. These residents are interested in, and affected by, land use decisions made at all three levels of local government. Economic activity, including agriculture, is also regional in scope and crosses jurisdictional boundaries. Some counties, for example Sherburne, Wright and St. Louis counties, build the county land use plan by facilitating and combining township level plans. This can result in a more unified plan and more effective implementation.

In some instances, counties choose not to plan and zone at the county level. The county may not view an issue, such as feedlots, to be of county-wide concern. If feedlots are an issue for a single township or city, or a combination of townships, they have the statutory authority to address the issue.

Several states have passed laws that require units of local government to cooperate and coordinate in the development of land use plans. New Jersey and Florida require their cities and towns to coordinate plans with counties, and counties to coordinate with state plans. The plans for each level of government must coordinate with higher levels of government, and each level of government participates in the plan development.

Relationship of state action to local land use regulation

Because local land use authority is derived from a delegation of state authority, it is possible for the state to preempt local action. The doctrine of preemption takes authority to act in an area of law away from the local government. Preemption occurs when the state so completely regulates an area that there is not room left for local control.

The GEIS literature review on the role of government (MEQB, 1999) concluded that the state has not preempted local government action in the realm of land use controls (i.e. setback requirements, allowed uses in zoning districts) (see *Canadian Connection v. New Prairie Township,* 581 N.W. 2d (Minn. Ct. App. 1998)) County feedlot ordinances must be submitted for review to the pollution control agency and the Commissioner of Agriculture under Minn. Stat. §394.25, subd. 3c (c). However, the state agencies can not prevent feedlot ordinances from being adopted.

In the area of environmental control of feedlots, the state has acted to a great degree, but still shares authority under Minn. Rules 7020.0100 with counties in a joint feedlot permitting program (see *Blue Earth County Pork Producers, Inc. v. Blue Earth County*, C1-96-1222, Minn. Ct. App. Jan. 28, 1997) As of last year, 51 counties had accepted delegation of joint feedlot permitting powers.

Even though pollution prevention and land use controls may be responsive to the same site, or the same off-site impacts (odor, manure management), the state has not asserted that it has preempted local governments land use authority. Local governments retain the authority to determine the spatial location requirements of agricultural uses and agricultural facilities within a rural community. When local land use regulations attempt to address pollution or environmental issues they begin to step into the realm of state action. In 1998, however, the state legislature specifically confirmed county s authority to adopt feedlot standards that are more stringent the state standards (Minn. Stat. §116.07, subd. 7(k).) A byproduct of state action on environmental issues may be boundaries on local land use decisions. For example, state rules for water quality protection may restrict feedlots from locating near streams (Minn. Rules, 7020.0300.) Local land use controls must work within these boundaries.

Why land use choices are made at the local level

The statutory power to regulate land uses, including feedlots, is based on the belief that local governments are the best forum for resolving local land use conflicts. Local government most closely represents the people who are directly and continuously affected by land use choices. Local government is also the most accessible to citizens. Kundell in his survey of state and county roles in regulating animal feeding operations asserts that siting controversies seem to be the most intense in states where county action is preempted by the state. He observes that this is in part because county officials have little say over where feedlots are located. (p. 38, Kundell, 1999)

Local government officials and staff are charged with the responsibility of creating a safe, healthy, economically strong community for the citizens of their jurisdiction. State agencies are

charged with a similar responsibility, however, their constituency includes all the citizens of the state. Since land use conflicts most intensely affect residents at the county level or smaller, this is traditionally where land use decisions have been made. These decisions are made by the people affected. Pollution concerns are more likely to affect people in a broader area, therefore, pollution control and enforcement has more often occurred at the state level.

Decisions at the state level are more likely to be standardized for the entire state, not allowing for variations at the local level. Land use problems and solutions do not lend themselves to state-wide decision-making. While the state may establish goals and standards for land use planning, the state cannot take into account the varying local history, culture, environmental and economic conditions that are critical to successful land use decisions. Local land use planning and zoning enable communities to move toward desired economic development goals while guiding development to environmentally appropriate locations.

The land uses that lead to conflict change over time. Along with feedlots, currently there are local controversies over cell towers and off-road vehicle parks. There have been other controversial land uses in the past. No single controversial use has been the basis for changing the land use authority of local governments. The process for making land use decisions at the local level has been proven to serve local citizens well. Feedlots should not be a reason for changing for changing local land use authority.

Local government regulation of feedlots in Minnesota

Because of the density of residents, or concerns for sensitive natural resources some communities may choose to not allow feedlots. This is similar to the choice of communities that are predominately residential in nature to not allow industrial uses that create off-site impacts, or to not allow cell-towers in residential areas. The recommendations in this report, however, are directed toward local governments that are interested in allowing feedlots within their community, and wish to know how to minimize conflict.

Local government land use regulations in Minnesota have been summarized in previous documents (Office of Legislative Auditor, 1999; MEQB 1999; MDA, 1999). The following points summarize the current state of local feedlot ordinances:

Local feedlot ordinances in Minnesota contain provisions for:

- Multi-tier agricultural zoning districts
- Separation distances from rural residences, towns, parks, and other places where people gather
- Setback distances from parcel boundaries, roads and other on-site structures
- Procedures and requirements for permitting feedlots as a conditional use instead of a permitted use
- Limits on the number of animals allowed per site or per a specified amount of land
- Public notice and public hearing requirements
- Design and management requirements for manure lagoons and earthen basins that go beyond MPCA standards
- Requirements for land application of manure

Financial and land reclamation requirements for cleanup of abandoned sites

47 counties and several townships require conditional use permits for some feedlots, particularly large feedlots, feedlots with earthen basins or lagoons, and for feedlots within defined distances from water, cities or residences.
Many local governments require greater setbacks and separation distances for larger feedlots than for smaller feedlots: a sliding scale.

Some ordinances prohibit feedlots within areas of high environmental risk: floodplains, shorelands, wetlands, near drainage ditches, wells or sinkholes, and on steep slopes.

Some ordinances establish requirements for manure storage facilities and setback requirements for manure application. A few counties require incorporation of manure within a day of application, and some require injection or immediate incorporation.

Although local governments have land use planning and zoning authority, many have not adopted comprehensive zoning ordinances. Controversy over a feedlots has spurred several counties and townships to adopt zoning ordinances where the concept of zoning had previously been rejected by residents.

Comparison of existing feedlot ordinances to a model for determining appropriate separation distances (OFFSET)

As we know, odor is the most prominent cause of complaints about feedlots. This section seeks to suggest appropriate separation distances between feedlots and neighbors that will minimize odor complaints. The land use team analyzed separation distances in adopted local ordinances as reported *Summary of Animal-Related Ordinances in Minnesota (*MDA, 1999) with the Odor from Feedlots Setback Estimation Tool (OFFSET) developed by the University of Minnesota Biosystems and Agricultural Engineering Department (Jacobson, 1999).

OFFSET considers specie, facility type, facility size, manure storage type and size, and odor control technologies to estimate the necessary separation distance for livestock feedlots that is required to achieve an annoyance free status at varying degrees of frequency. Distances are estimated for sites with a prevailing "downwind" location. Necessary separation distances for non-downwind locations will be over-estimated with this tool.

Annoyance free levels are basically the number of hours per month when there is no annoyance from odor. For example, with a 99% annoyance free level there is 1% annoyance. This equates to 7.44 hours per month (31 days x 24 hours x .01 = 7.44 hours) that there would be annoyance from odor. At 97% annoyance free, the number of annoyance hours would be 22.32 hours per month (31 x 24 x .03). Similarly, at 91% annoyance free, the number of annoyance hours would be 66.96 per month (31 x 24 x .09).

However, it is likely that periods of annoyance would be experienced in shorter time periods when atmospheric conditions would favor odor plume movement near ground level. For instance, a somewhat worst-case scenario for 97% annoyance free is that the 22.32 hours per

month would occur in 3 hour time blocks (likely early morning or early evening), resulting in about 7 annoyance occasions per month.

Forty-three of the ordinances studied defined specific separation distances (some adjusted by animal units, specie, or technology). An additional 14 did not list separation distance requirements but presumably dealt with separation distance through Conditional Use Permit requirements.

OFFSET Calculated Setback Distances

OFFSET was used to determine the setback distances for various annoyance free levels for six swine and two dairy sites. These sites are representative of current technology, and are similar to sites that have encountered siting difficulty or been identified as potentially annoying. In addition, a swine hoop barn site, though not generally considered a severe odor risk, is included for comparison.

Swine Facilities: The following swine systems were analyzed:

1. 2 Barn Swine Finishing-Deep Pit. Barn dimensions = 40 x 200 (16,000 total sq. ft.); 2000 head/site
" 11 Barn Swine Finishing Hoop Site. Hoop barn dimensions = 30 x 80 (26,400 total sq. ft.); 2000 head/site, 182 pigs per barn
" 4 Barn Swine Finishing-Deep Pit. Barn dimensions = 40 x 200 (32,000 total sq. ft.); 4000 head/site
" 4 Barn Swine Finishing-Deep Pit. Barn dimensions = 40 x 200 (32,000 total sq. ft.); 4000 head/site, oil sprinkling
" 2 Barn Swine Finishing-Earthen Basin. Barn dimensions = 40 x 200 (16,000 total sq. ft.); 2000 head/site, 201 x 201 earthen manure storage structure
" 2400 Sow Swine Breeding/Gestation/Farrowing. 88112 ft(2) of barns, alleys, and office; Deep Pit
" 2400 Sow Swine Breeding/Gestation/Farrowing. 88112 ft(2) of barns, alleys, and office; Deep Pit, Bio-Filter

Dairy Facilities: The following dairy facilities were analyzed:

" 400 Cow Dairy-Milking Only. Barn dimensions = 90 x 372, Free Stall, 46 x 274 Holding & Milking Area (46,084 total sq. ft.); 227 x 372 earthen manure storage structure with 4" natural crust
" 1050 Cow Dairy-Milking Only. Barn dimensions = 90 x 372 & 108 x 200 & 108 x 330 Free Stall barns, 46 x 274 Holding & Milking Area (103,324 total sq. ft.); 227 x 372 earthen manure storage structure with 4" natural crust

Maximum Total Odor Emissions Factors

It is also possible to determine the maximum total odor emissions that a facility can have for various setback distances and annoyance free levels. This study looked at 3 separation distances (.25, .375, and .5 miles) for 3 different annoyance free levels (94, 97, and 99%).

Summary and Conclusions about separation distances in existing ordinances

For the seven swine and two dairy sites studied, setback distances suggested by OFFSET range from 0.03 to 0.3 miles for 91% annoyance free levels, from 0.05 to 0.41 miles for 94% annoyance free levels, from 0.1 to 0.75 miles for 97% annoyance free levels, and from 0.28 to 1.92 miles for 99% annoyance free levels. The suggested setback distances for the lower annoyance free levels (91 and 94%) are probably more attainable than those for the higher annoyance free levels (97 and 99%).

The 11 barn swine finishing hoop site has by far the lowest suggested setback distances (0.03 to 0.28 miles) because of its low total odor emission factor (5.28). Setback distances are greatest for the 1,050 cow dairy site (0.3 to 1.92 miles), since this system has the highest total odor emission factor (228). The 2400 sow swine breeding/gestation/ farrowing site is a close second behind the dairy site for total odor emission factor (202.70) and setback distances. However, with the addition of a biofilter, this site becomes the second lowest in terms of total odor emission factor (20.30) and consequently setback distances.

According to this analysis, setback distances in existing county ordinances are fairly effective at attaining a 94% annoyance free level for most site types. They are somewhat effective at attaining a 97% annoyance free level for some site types. They are ineffective at attaining a 99% annoyance free level for almost all site types. This means that in most counties, there are 22 to 45 hours (97% and 94% annoyance free levels, respectively) of odor annoyance per month. Some people may consider these levels to be too high, while others may consider them to be acceptable.

Land use planning can offer an opportunity for these people – livestock producers, their neighbors, and other community residents – to decide collectively what goals the community wants to reach while understanding the tradeoffs involved. In land use planning for livestock ordinances, there are three variables communities should consider:

" What level of annoyance is acceptable? An annoyance free level such as 91% may be considered too low, since in a worst case scenario it could potentially result in 22 annoyance occasions per month. On the other hand, an annoyance free level of 99% could result in a best case scenario of just 1 odor occurrence per month, but this may be an unreasonable expectation for people living in an agricultural production zone if it in effect bans livestock production from the area.

" What setback distance is feasible in the planning area? For an area that is sparsely populated, a setback distance of 2 miles may be feasible, in which case the community would not have to worry about annoyance free levels or total odor emission factors, since all livestock site types would meet a 99% annoyance free level. However, for most areas this large setback distance is not realistic – there would be no locations that have so much land available for siting. In most agricultural areas, a setback distance of 0.5 miles or less would probably be more realistic. However, the shorter the setback distance, the more difficult it becomes to attain annoyance free levels (i.e., the potential for odor annoyance increases).

" What total odor emission factors are reasonable for livestock sites? Some site types have

very high total odor emission factors, and others have very low factors. For some site types, the total odor emission factor can be reduced by using odor mitigation technologies. Since the total odor emission factor affects what annoyance free level can be attained at what setback distance, a community will want to determine a level that is attainable by livestock facilities while at the same time encouraging management that mitigates odor emissions.

In land use planning, these three variables must be balanced to meet community goals for both controlling odor nuisance and allowing livestock production in the area. Using OFFSET to explore various scenarios of the three variables could help all community members understand more fully the potential impacts of their decisions on themselves and other community members, and to devise a plan that can more fully meet all of their goals simultaneously.

Interviews with selected counties about efforts to reduce conflict and effectiveness of existing ordinances

The land use team conducted interviews about feedlot conflicts and other issues with ten Minnesota counties. The counties are Goodhue, Morrison, Nicollet, Pennington, Pipestone, Redwood, Renville, Rice, Rock and Stearns. Morrison, Pennington, Rock, Stearns, and Goodhue were selected because they are the Social and Community Impacts TWP case study counties. The Social TWP case study counties represent counties with a variety of species, high concentration of animals, varying levels of reported conflict, and state-wide distribution.

The additional counties were selected to include the following variables: Nicollet, high concentration of hogs, high conflict, and innovative land use initiatives; Pipestone, this was originally a Social TWP case study with very-high concentration of hogs and high conflict; Redwood, high number of animals, not a delegated county, and innovative land use tools; Rice and Goodhue both are experiencing growth in non-farm rural residences; Renville County has experienced very high levels of conflict and is third in the state in number of hogs.

Staff from the feedlot office in each county completed a two-page survey and participated in a telephone or in-person interview to provide additional data and comments about their county s experience with feedlots. The information collected focused on experience with conflict over feedlots, land use and other tools used to address conflict, and feeling of efficacy about the tools. There appears to be some confusion over the actual and estimated numbers of feedlots in the counties. MPCA data suggest that the number of feedlots is increasing and is projected to continue to do so in the near future. In the interviews with county staff, however, most indicated that they were seeing a consolidation of animal operations and the loss of smaller farms. Perhaps a truer representation of the number of feedlots will be achieved with the completion of feedlot inventories in 2001 and 2002.

All of the counties except Pennington have specific land-use controls (e.g., a separate feedlot ordinance or a zoning ordinance with a section for feedlots) regulating feedlots. Four of the counties adopted their ordinances in the early to mid-1990s; three counties have had feedlot ordinances since the 1970s and two adopted them within the past year.

Pennington County staff and elected officials view feedlots as a possible economic boost to the

depressed agricultural economy. Because of their relative disperse population, they feel there are areas within the county where feedlots could be encouraged with low risk of complaints. Pennington County is currently working to have townships adopt feedlot ordinances that encourage the location of feedlots in pre-approved feedlot zones.

All of the counties also have a comprehensive land-use plan in place. All counties except Redwood, Renville and Pennington counties participate in the MPCA s Feedlot Program. Pennington County withdrew from delegated status because of disappointment with the new rules and insufficient funding for mandated county feedlot services. Renville County is expected to become a delegated program by the end of 2001.

Nicollet County recently began using the Odor from Feedlots Estimation Tool (Jacobson, 1999), as a tool in determining separation distances for feedlots locating within the county. The county adopted revised feedlot regulations in December 2000, after six months of field-testing of OFFSET. The model s predictions are based on several factors, including distance from various types of facilities, the season and prevailing wind patterns, among others. Based on the findings of the OFFSET field tests, the county expanded the setbacks from feedlots according to the model s odor ratings. For example, the new setbacks are designed to ensure that residents in the agricultural zone will be free from annoying odors 93 percent of the time. For cities, the setbacks are designed to ensure freedom from annoying odors 99 percent of the time. The county intends to continue testing the model in late 2001.

The numbers of complaints received by the counties about feedlots ranged from one to 30 in the Year 2000. Nicollet County alone accounted for nearly 16 percent of the feedlots complaints statewide between 1996 and 2000. The complaints in Nicollet County included covered improper disposal of animals, improper handling of manure and odors. The primary source of complaints was from hog operations in seven of the eight counties.

Several counties have written procedures, outside of ordinances, for addressing feedlot complaints. All indicated that their goal is to address feedlot complaints as soon as possible, with a timely site visit (within 24 hours) or at least a follow-up telephone call. The opinion was expressed that responding promptly was important to observe the activity that was the basis of the complaint, and to show how serious they are about enforcement.

All of the counties except Renville indicated that they attempt to notify persons moving into an agricultural zone of potential nuisances associated with living in the zone; this is usually done when a person applies for a residential building permit. Morrison County is the only county that uses a formal written notification

Since August 1998, Morrison County has required a Land Use Notification form to accompany every land use permit for the construction or addition to a dwelling unit in their Agriculture Zone and Agriculture/Forestry Zone. A landowner applying for a permit must sign and record the form with the county recorder. The form educates the landowner on the following points:

Their land is in an agricultural district and feedlots and other agricultural uses are permitted.
Feedlots and other agricultural uses may adversely affect the use or value of their land.
Agricultural uses are given preference over other uses.

A copy of the Morrison County land use notification form is included in Attachment 6.

The form will not completely protect feedlot operators from complaints or lawsuits. It does, however, educate new residents in agricultural districts about possible consequences of living in these areas. Morrison County staff feel that letting people know what to expect can increase tolerance and reduce complaints

Nearly all of the counties have undertaken specific outreach and educational efforts for producers to inform them of the ordinances regarding feedlots. Likewise, nearly all of the counties have taken steps to inform the general public about feedlots as a means to reduce potential conflicts.

Counties have made specific efforts to solicit input from producers and the public in developing or revising feedlot ordinances. All of the counties with ordinances held (mandatory) public hearings during the development and revision of feedlot rules ordinances to adoption. Several counties held multiple meetings, beyond mandatory public hearings. They felt these multiple meetings helped in the development and acceptance of the ordinances. There were few reported cases of intense reaction to the ordinances.

In the early 1970's, Renville County adopted what was characterized by county staff as a producer friendly ordinance with few restrictions on feedlots. After some high profile conflicts, the county undertook the development of a new ordinance. The largest producer offered significant input on the new ordinance which is described as environmentally friendly by staff.

Most of the county staff suggested that an approach based on cooperation was preferable in order to avoid conflicts and complaints about feedlots. All, however, indicated their resolve in employing available legal authority to address egregious or persistent violations. Several commented that without strict enforcement for violations, other operators would become lax in complying with ordinances and rules.

The sentiment of county staff was somewhat mixed when asked about the effectiveness of land-use controls in reducing conflicts about feedlots. In most cases, they believed that having the ordinance in place helps to raise awareness of the relevant issues, as well as to set standards that producers could follow. In a few cases, though, they were not sure that the current state of the science supported the current level of regulation nor quantified its overall benefits beyond what most people would consider reasonable, (e.g., improved water quality). Nicollet County staff seems to place much hope in its use of the OFFSET model for odor prediction and reducing future conflicts.

Specific suggestions from county staff for reducing conflicts included developing standards and rules that are clear and free of personal biases and unifying all enforcement levels either through the counties, the MPCA or the federal government.

Interviews with selected townships about efforts to reduce conflict and effectiveness of existing ordinances

The land use team interviewed township officials in nine townships in addition to the county interviews. The interviews focused on the events leading up to adoption of the ordinances, the

relationship between the township and county, and observations on the effectiveness of the ordinances in reducing conflict. The nine townships were: Belle Prairie Township (Morrison County); Concord Township (Dodge County); Holding Township (Stearns County); Kenyon Township (Goodhue County); New Prairie Township (Pope County); Pleasant Mound Township (Blue Earth County); Red Rock Township (Mower County); Silver Lake Township (Martin County); and Wang Township (Renville County). The criteria for selecting townships included: geographic distribution; variety of ordinances; and townships where the ordinances were the subject of lawsuits.

Townships are active in adopting ordinances addressing feedlot issues, because the issue affects people at a very local level. The Minnesota Department of Agriculture ordinance survey (MDA, 1999) analyzed 34 township feedlot ordinances. Minnesota has 1793 organized townships. Township feedlot ordinances employ the same variety of land use tools as county ordinances: setbacks, separation distances, minimum acreages, agricultural districts, limitations on number of animals, and conditional use permit requirements.

Events leading up to adoption of township feedlot ordinances

Townships adopted ordinances in response to concerns over odors from hog feedlots (Concord, Kenyon, New Prairie, Silver Lake); corporate farms (Red Rock); and the desire to be proactive and make local decisions (Pleasant Mound,Wang). Pleasant Mound Township adopted a feedlot ordinance in anticipation of feedlots locating in the township; the desire to influence what their community looked like; and the feeling the Blue Earth County s ordinances were too lenient.

Kenyon Township was prompted to enact a feedlot ordinance because residents were unhappy about county requirements. New Prairie township first enacted its feedlot ordinance as an indirect response to a powerline controversy according to the township clerk. Concern over powerlines crossing the township, they adopted a zoning ordinance that included conditional use permit standards for feedlots (a feedlot had to be at least 1/4 section away from neighboring residents. The feedlot requirements were updated in 1995 and 1996 following two lawsuits.

Coordination between townships and counties in developing feedlot ordinances

Coordination by townships with counties on land use issues is necessary to the extent a county has adopted a feedlot ordinance. As discussed above, if counties have adopted a feedlot ordinance townships may only adopt ordinances that are at least as strict or stricter. Coordination beyond this level may also be desirable to prepare an ordinance that considers the goals of the larger community. Townships may have local issues, needs and goals that diverge from the larger community and the resulting ordinance may contain different choices than other townships or the county would make. In some cases, counties have not wanted to enter the feedlot fray or feedlots have not affected the entire township but rather concentrate in a few townships. This is the base reason for townships and counties both having land use powers.

Several counties in Minnesota rely on their townships as building blocks for their county land use plans and ordinances. Sherburne and Wright counties conduct systematic outreach to townships

as part of developing county plans and ordinances. St. Louis County s plan and zoning ordinance is an amalgam of township plans and ordinances. County staff provide technical assistance and work with township officials to create township ordinances. Some states, such as New Jersey and Florida require this type of upward coordination or consistency.

Belle Prairie, Holding and Silver Lake Townships have turned over control of feedlots to their respective counties. After having adopted feedlot ordinances, these townships encountered liability costs and negative public opinion. Silver Lake Township resident s have expressed concerns over what they view as too lenient administration by Martin County, and complacent responses from MPCA. Silver Lake Township has purchased air-testing equipment to collect evidence for future complaints.

Effectiveness of township feedlot ordinances in reducing conflict

Communication between township officials, operators and residents before and after ordinances were adopted is important in reducing conflict according to township officials. Communication before adopting the ordinance results in better ordinances. Communication after adoption results in fewer complaints.

Setbacks and separations distance requirements were cited as reducing complaints. The distance requirements separate people from odors that cause complaints. A Red Rock Township official commented that good feedlot management is more crucial than ordinances in reducing complaints.

Barriers to township action

Townships have discovered that when they adopt ordinances, they also take on potential liability in defending the ordinance. New Prairie Township has had to defend several lawsuits. After becoming a defendant to a lawsuit and receiving negative press coverage, Belle Prairie Township decided to turn all control of feedlot regulations over to Morrison County. The township supervisor felt this was possible because of good relations between the township and county. Silver Lake Township spent over two years developing a feedlot ordinance only to then turn control over to Martin County because of heavy legal costs.

The cost of administering feedlot ordinances can also be too great for townships. Typically townships do not have staff and rely either on volunteer township officers or contracting with county staff for ordinance administration. Many townships already contract with counties for planning and zoning services (Minn. Stat. §394.22) because of the limited financial resources of townships, and the low level of zoning activity. The same statute that allows townships and cities to contract with counties for administrative services, provides for joint planning. Although counties often administer township ordinances, at least one county has said they do not wish to administer a township feedlot ordinance.

Innovative Local Techniques for Managing Conflicts over feedlots

Researchers reviewed conflict management techniques used by local governments both inside and outside of Minnesota. This section describes additional innovative land use planning and regulatory techniques used by local governments to manage potential conflicts over feedlots. The section identifies where these innovative techniques are being used, and how these techniques help to manage potential conflicts. Additional zoning strategies were discussed in the GEIS literature rev iew on land use (MEQB, 1999).

Managing conflict is a matter of degree. What may create a conflict for one person may not bother someone else. Some techniques local governments are using to manage potential conflicts are more detailed or effective than others.

Nuisance Disclaimer

In areas where farming has long existed as a mainstay of the local economy, a nuisance disclaimer in the agricultural zoning ordinance is one tool that can be used to minimize the potential for conflict. The disclaimer alerts potential property buyers (often non-farmers) who are considering moving to an agricultural zoning district that farming is the preferred use in the agricultural zone, and that residents in the zone may be subject to noise, dust, odors, and other impacts from nearby farming operations. These impacts may cause discomfort or injury, and may reduce the enjoyment of one's property.

A nuisance disclaimer does not prohibit a new resident within the agricultural zone from filing a nuisance suit against a farm operation. However, the plaintiff will have been forewarned about the discomfort, and will have no legal standing unless a violation of a state or federal law is alleged. The disclaimer is meant to provide fair warning of potential conflicts, and thus discourage nuisance suits. It is important to keep in mind that agricultural zoning disclaimers refer to normal and legal farming operations. Farming practices that violate state or federal laws, such as water pollution from feedlot run-off, are grounds for lawsuits by non-farm neighbors.

The nuisance disclaimer is similar to the Land Use Notification form used by Morrison County, Minnesota. This form is discussed above, and a copy is included in Attachment 6.

A number of townships in Pennsylvania have added nuisance disclaimer language to their agricultural zoning ordinances (in Pennsylvania, townships, not counties, have authority over local planning and zoning). Warwick Township, in Lancaster County, Pennsylvania, a leading dairy, chicken, and hog producing area, uses the following language in its nuisance disclaimer:

> "All lands within the Agricultural Zone are located in an area where land is used for commercial agricultural production. Owners, residents, and other users of this property or neighboring property may be subjected to inconvenience, discomfort, and the possibility of injury to property and health arising from normal and accepted agricultural practices and operations, including but not limited to, noise, odors, dust, the operation of machinery of any kind, including aircraft, the storage and disposal of manure, the application of fertilizers, soil amendments, herbicides, and pesticides. Owners, occupants, and users of this property

> should be prepared to accept such inconveniences, discomfort, and possibility of injury from normal agricultural operations, and are hereby put on official notice that the state "Right to Farm Law" may bar them from obtaining a legal judgment against such normal agricultural operations."

Local governments could also require developers to notify potential purchasers, in writing, if a feedlot is within a certain distance from the subdivision. Likewise, there could be a seller/realtor notification requirement that would require sellers of any property to disclose to potential purchasers that feedlot is within a certain distance.

Deterrent to Frivolous Law Suits

Michigan has gone a step further in defending farmers against nuisance suits. Michigan law requires a plaintiff who loses a nuisance suit against a farmer to pay the farmer's legal expenses. The law is aimed at discouraging frivolous nuisance suits that could pose financial hardships on farmers.

Resource Management Easements

One way to avoid nuisance suits is for prospective purchasers of land for non-farm residential use to enter into a resource management easement. A resource management easement may be required by the local government as part of granting a permit to build a non-farm residence in an agricultural zoning district. The resource management easement is a binding contract between the new resident and the local government in which the new resident agrees to give up rights to file a nuisance suit against farmers who are conducting normal or standard farming practices.

As in the case of the nuisance disclaimer, the resource management easement refers to normal and legal farming operations. Farming practices that violate state or federal laws, such as water pollution from feedlot run-off, are grounds for lawsuits by non-farm neighbors.

The resource easement is recorded at the county courthouse and becomes part of the new resident's deed, before a building permit is issued and before any construction begins. Because easements run with the land, future buyers of the new resident's property will be subject to the conditions of the resource management easement.

Mr. Lee Nellis, a planning consultant who first developed the resource management easements for Idaho counties, made the following observation: "It is hard to evaluate the success of these easements. They have not been challenged in any of the counties that use them and most people building rural homes have seemed happy to accept the requirement. I think it is functioning as much as an educational tool as a legal one" (Interview, February 1, 2001).

A sample resource management easement is included in Attachment 6.

Specialized Agricultural Zones

Agriculture as practiced today is often an industrial process involving the use of mechanical equipment, chemicals and heavy machinery. It is common for local governments to employ more than one type of industrial zone, based on the different types of manufacturing and the potential for spillovers of noise, dust, glare, and chemicals from one property to another. Light manufacturing might be put in an M-1 zone, whereas more intensive, heavy manufacturing would be put in an M-2 zone.

Similarly, a local government could use different agricultural zoning districts depending on the intensity of livestock concentrations. For instance, an A-1 zone would allow general agriculture but prohibit the location of livestock operations with more than 1,000 animal units. An A-2 zone would allow both general farming and confined animal feeding operations with more than 1,000 animal units.

There are a number of reasons to support the specialized agricultural zone approach. First, farmers who do not have livestock or operate feedlots have been known to complain about odors from feedlots, just as rural non-farm residents have. Second, feedlots are usually larger operations that may be better able to compete against smaller farms for renting or purchasing nearby land. Third, smaller livestock operators have expressed concerns about bio-security and the potential spread of infectious animal diseases (pseudo-rabies in hogs, avian flu, and brucellosis or tuberculosis in dairy cows) that could originate in feedlots.

As discussed above, Pennington County, Minnesota is working with townships to designate multiple agricultural zones, including a zone for feedlots. In 1999, Elkhart County, Indiana pioneered the use of agricultural zones to separate feedlots from other farming operations. The county amended its ordinances to add three agricultural zoning districts:

The A-3 Farmland Preservation District;
The A-4 Confined Feeding Protection District; and
The A-5 Intensive Livestock Operation District.

A copy of the Elkhart County A-3, A-4 and A-5 zoning districts are included in Attachment 6.

The County Commissioners enacted these districts to enhance "a right-to-farm protection, recognition by the public of the needs of the agricultural community, to promote agricultural economic development, to promote co-existence with residential neighbors and to protect health, safety and general welfare of the residents of Elkhart County" (Elkhart County Ordinance Number PC99-24).

The A-3 Farmland Preservation District allows:

The posting of nuisance disclaimers throughout the district to alert the general public and potential property buyers that farming is the dominant and preferred use in the A-3 district and inconveniences may result from odors, dust, noise, etc. associated with the farming operations;

Virtually any agricultural use and buildings so long as environmental regulations are met and farming practices are sound;

A limitation on the construction of residences within the A-3 district. Residences require a special use permit granted only for owners, and family members and tenants employed in the

farm operation;
Any future residential subdivision of property within 300 feet of an A-3 district must address the following issues before approval is granted:
Off-site surface drainage impacts
Subsurface tiling systems impacts
Irrigation accommodations
Security of A-3 zoned property from non-farm residential uses; and
Subdivision plat notes and restrictive covenants on the property deeds holding harmless agricultural production in the A-3 zone when farmers operate under normal practices.

A landowner may voluntarily apply to be included in the A-3 zoning district. It is not a mandatory district, unlike typical zoning districts. A landowner must apply to the county planning commission to have land designated in the A-3 district and must have at least 40 acres or be contiguous to an existing A-3 district.

The A-4 Confined Feeding Protection District is designed to give greater protection to feedlot operators. Like the A-3 district, the A-4 district is voluntary, not mandatory. The requirements for a landowner to receive the A-4 designation are the same as with the A-3, except that a landowner must have approval from the Indiana Department of Environmental Management for the proposed confined feeding operation. Also, all real estate owners adjacent to the property proposed for A-4 zoning must sign a statement of acknowledgement of the use of the property for confined animal feeding operations, and as long as these operations are conducted in compliance with the provisions of the A-4 district, Indiana Department of Environmental Management regulations, and normal agricultural practices, they will hold harmless the owner of the A-4 property from claims due to noise, dust, odors, etc. emanating from the operations.

In the A-4 district, a confined animal feeding operation must have less than 1,500 animal units. Finally, nuisance disclaimers may be posted within the A-4 zone.

The A-5 zone is a mandatory zone for confined feeding operations that have 1,500 or more animal units as defined in the above chart. The A-5 district combines the restrictions of the A-3 and A-4 zones, except that adjacent landowners are not asked to sign a statement agreeing to hold harmless feedlot operators. Instead, the county planning commission requires that feedlots be sited and manage manure according to the Indiana Department of Environmental Management regulations, and the impacts of odors, gases, manure, noise, truck traffic, and air pollution must be considered and mitigated to the extent required by the planning commission.

Elkhart County Administrator David Hess said that the three additional districts are working well. A number of farmers have requested to place their land in the A-3 or A-4 districts (Interview, February 1, 2001).

Large Minimum Lot Sizes in Agricultural Zones

Agricultural zones with large minimum lot sizes, such as 160 acres (quarter section), will be better able to site new feedlots or accommodate the expansion of livestock operations to more than 1,000 animal units. A 160-acre parcel is about 2,145 feet on a side. If the feedlot is located

in the center of the 160-acre parcel, the nearest property line is roughly 1,000 feet, depending on the size and orientation of the livestock confinement buildings. This distance, compared to the OFFSET setback estimation tool (Jacobson, 1999) suggests that a 160-acre minimum lot size can provide a setback distance that can provide at least a 91 percent comfort level for neighbors of most feedlot operations. The exceptions are dairy farms with 1,050 cows and a sow swine breeding-gestation-farrowing unit with deep pit manure storage.

In Minnesota, Blue Earth County and Waseca County already have 160-acre minimum lot sizes in their agricultural zones. The 160-acre minimum lot size could be combined with a requirement of at least a 1,000 foot setback from the nearest property line. Both of the above counties showed an increase in average farm size and a sizable increase in the number of hogs from 1982 to 1997. Nicollet County, Minnesota is incorporating the OFFSET model into their feedlot ordinance as described in the county profile summary above.

A Ban on Certain Technologies or Feedlot Set-ups

Certain feedlot technologies or barn arrangements may be preferable to others for controlling spillovers of odors onto neighboring properties. For example, in North Carolina, Smithfield Foods, the world's largest hog producer, has agreed to remove manure lagoons on the 276 farms it owns within five years. A county agricultural zoning ordinance could identify lagoons as a prohibited technology. Similarly, the sow swine breeding-gestation-farrowing unit with deep pit manure storage could be banned because of the apparent difficulty of controlling odors from such a feedlot design.

A Cap on the Number of Livestock

A county agricultural zoning ordinance could place a cap on the number of animal units allowed. For example, a 1,050 dairy operation could be difficult to site without frequent spillovers of odor onto neighboring properties. Rice County, and other Minnesota local governments impose a limit on the number of animal units in agricultural zones.

Environmental History Disclosure in Permit Application and On-going Environmental Reporting

Prompted by complaints from two existing large feedlots, Frederick County, Maryland, recently adopted a strict feedlot ordinance for swine operations after an eighteen month moratorium on permitting (APA Zoning News, December 2000). The appointed Intensive Swine Advisory Committee adopted the following provisions:

A detailed definition of swine feeding operation : at least 1,000 hogs stabled, confined, fed, or maintained for 90 days or more in any 12-month period.
Applicants must provide a three-year environmental history from any pervious operations.
Applicants must submit a nutrient management plan, a soil and water conservation plan, a waste management plan, and an odor abatement or control plan.
Approved operations must provide quarterly reports on waste storage and disposal.

Open pit or lagoon waste storage is banned.
Approved operations must maintain 50-foot-wide vegetated buffers along streams, and may not land apply waste within 300 feet of wells.
Feedlots are banned within 1 mile of parks, wildlife refuges, natural resource management areas, or wildland areas.

The information required as part of the application process and on a continuing basis after an operation is approved goes beyond most current feedlot ordinances. The goal is to prevent operations with a history of spills or other bad practices from locating within the county, and to continually monitor environmental practices of approved operations to prevent future problems.

Use of computer modeling to evaluate feedlot sites

Professor Patricia Norris at Michigan State University, has been developing a planning tool for local governments to use in planning and zoning for feedlots. The tool is a computerized spatial decision system, combining Geographic Information Systems (GIS) spatial analysis with several criteria to evaluate the relative suitability of locations for feedlots. The tool is designed for "proactive" planning--i.e. where should feedlots go, rather than reactive planning. The software system is currently being evaluated and may be available to local governments in the near future.

Summary of innovative land use techniques

Although farms are attractive to look at, there may be some inconveniences and even hazards in living next to a large feedlot. Every state, except Iowa, has a "right-to-farm" law that gives farmers some protection from nuisance suits from neighbors who complain about normal farming practices. These laws, however, have not been widely tested in the courts.

A number of innovative techniques can, and in many cases are, being used to minimize conflicts between feedlot operators and both farming and non-farm neighbors. It is realistic that there will have to be compromise on the part of feedlot operators and neighbors. Local governments can encourage such compromises through a resource management easement, a variety of agricultural zones, a large minimum lot size for new feedlot operations, and even limits on livestock barn technologies and numbers of animal units. Clearly, in agriculturally zoned areas, farming is the preferred use; prospective non-farm residents should be put on notice about the impacts of modern farming operations and should expect to enter into legal contracts that hold harmless neighbors who conduct normal and accepted farming practices. On the other hand, feedlot operators must also be good neighbors. This may involve limiting the number of animal units and technologies used.

Model elements of a feedlot land use ordinance

Based on the results of our research on feedlot ordinance components in Minnesota and other states, and the perceptions of how effective various components are in reducing conflict, the land use team has developed a series of model elements for a feedlot land use ordinance.

Ordinance development process

In our interviews, local government staff consistently stated that the using a participatory process for developing feedlot ordinances can reduce the potential for conflict. A participatory process should involve residents, producers, and representatives of all levels of local government. This type of process builds trust in the process and the outcome. It also can build ownership over the final product. If local citizens have and understanding of the feedlot ordinance, and a feeling of ownership, they will make sure their elected officials and local government staff implement the ordinance correctly.

Public involvement can occur at several levels. The level at which residents have the least interest or understanding is notification, making sure residents are notified about potential changes and the opportunity to participate in the process. If residents are notified, they can at least make their own choice whether or not to participate. The next level is education; educating citizens about background information or the consequences of various choices. The highest level of public involvement is participation in the decision-making process. Local governments should make efforts to help as many people as possible participate in the decision-making. At a very minimum local governments should conduct notification and education efforts.

In order to make well-considered decisions, and obtain sufficient public input, a local government may choose to place a moratorium on the siting of new feedlots. This gives the local government time to develop an appropriate ordinance. The time can also be used to inform people of the process and answer their questions with reliable information. The time must be used productively with a defined process and end goal, and not merely used as a cooling off period.

Townships and cities may adopt interim ordinances that act as moratoriums under Minn. Stat. §462.355. Recent court decisions have held up township authority to adopt interim ordinances to address feedlots. (See *Duncanson v. Board of Supervisors of Danville Township,* 551 N.W. 2d 248 (Minn. Ct. App. 1996) and *Berscheit v. Town of Grey Eagle, Minnesota,* CO-98-2298 (Minn. Ct. App. July 13, 1999)) Counties may adopt interim ordinances for one year, with a one-year renewal, under Minn. Stat. §394.34

Base ordinances on comprehensive plan policies

For statutory and policy reasons, ordinances, including feedlot ordinances, should be based on comprehensive plans. (Minn. Stat. §394.22, for counties, ordinances should be consistent with and further the goals of the comprehensive plan; Minn. Stat. §462.352, subd. 5 for townships and cities authorizes comprehensive planning; §462.357, subd. 1 for townships and cities authorizes the development of ordinances to implement the comprehensive plan, ordinances must be consistent with the plan) Comprehensive plans reflect the long-term goals of a community and states a vision for the character of the community. If ordinances are connected to comprehensive plan goals, the ordinances will help reach long-term goals and not merely react to immediate, specific problems.

For example, if a community wants both residential growth and the continuation of agriculture they may choose to create policies that support agricultural zones. This may mean that farmers are protected to some extent from conflict because of restrictions on non-farm residential development in rural areas. But it may also mean that farmers can not sell in the future for development.

Try to be proactive, not reactive

The timing of when feedlot ordinances are developed can also contribute to reducing conflict. If local governments try to address feedlots before they become problems, it may result in amore conscientious ordinance. Some counties and townships have suffered from the thinking that if you ignore feedlots they won t happen or they will go away. The worst time to solve a problem is after the conflict is roaring and positions are entrenched.

Identify potential areas of conflict and address these with ordinance provisions

As part of the ordinance development process, local governments should identify potential areas of conflict and address these issues with specific ordinance provisions. Based on our review of feedlot ordinance provisions, we have found local governments consistently addressing the issues in the following paragraphs.

Spatial relationship of feedlots to other land uses and critical natural resources

The most common cause of conflict over feedlots is odor. The most common method of addressing odor complaints by local governments is regulating the spatial relationship of feedlots to other land uses. Regulating the location of feedlots also addresses another cause of conflict; fear of risk to critical natural resources.

Regulating the spatial relationship between an odor generator and potential complainants is common in industrial zoning, and is now being applied to zoning for feedlots. It has long been held that it is good planning to separate conflicting uses. Although it may not be intuitive, it has been proven over time that agricultural uses and non-farm residential development are not always compatible. Multiple conflicts and nuisance suits have arisen in urban fringe areas when city and country collide. (Daniels, 1999) Many rural communities have recognized that the expectations of rural subdivision residents for an idyllic rural life conflict with the day-to-day realities of modern agricultural practices. Local governments have employed the following spatial separation techniques in feedlot zoning ordinances:

Agricultural zoning districts or large-scale agricultural districts. Standard agricultural zoning districts require relatively large lots sizes, but allow a mix of agriculture and non-farm residential uses in close proximity. Local governments using agricultural zoning districts to control the conflict over feedlots should consider designating a large scale agriculture district. These districts are based on the notion that large scale agriculture is similar to industry and should be separated from other non-farm uses. There is still a need to provide

for separation distances and setbacks within a large-scale agricultural district because of farm residences and sensitive natural resources.

Large-scale agricultural districts as part of a tiered system of agricultural zones. An example of a tiered system is included in Attachment 6. Minnesota courts have supported single-use zones that exclude other uses (*Connor v. Chanhassen Township,* 81 N.W. 2d)

Establishing separation distances and setback requirements.

Notification and communication

Notification and communication efforts can help moderate expectations and increase understanding which leads to reduces conflict. Make sure people moving into agricultural areas know what to expect. On-going communication between operators and neighbors about upcoming events that could cause odor and lead to complaints. Techniques used for notification and communication that have been discussed in this report include:

land use notification forms that must be signed by people wishing to locate in an agricultural zone that allows feedlots;
public hearings required for permit applications; and
notification of neighbors about upcoming odor events.

Use of conditional use permits

Local governments may require conditional use permits for feedlots that do not meet the minimum requirements of the zoning district. Conditional use permits offer local governments more opportunity to mitigate off-site impacts such as odor and risk to water quality. The consideration of an application for a conditional use permit for a feedlot also requires a public hearing. This recognizes the need to consider neighbors opinions in siting feedlots.

Manure management

The odor and environmental risks associated with manure management are an important land use issues addressed in feedlot ordinances. Manure management provisions that aim to reduce associated odor problems and risks to water and soil, can reduce complaints. Ordinances reviewed by the land use team included the following provisions addressing manure management:

bans on certain types of storage, particularly open pits and earthen lagoons;
requirements for filing of manure management plans;
controls on land application of manure, including
- location - buffers from water and wetlands
- time of year - don t spread on frozen ground
- methods of application - incorporation requirements for liquid manure
- notification of neighbors about land application

Enforcement

Enforcement provisions and programs are also important in the development of feedlot ordinances. Consistent enforcement based on clear rules will reduce conflict over time because operators will know what is expected and the consequences of not complying. Enforcement provisions need to identify who enforces and the consequences for non-compliance.

Section 4:
Conflict Management: Another Tool for Local Governments

Land use regulations alone cannot eliminate conflicts between farmers and neighbors. Conflicts often result from an activity on one property that spillover into another. It is easy to think of farm odors, dust, and chemical sprays drifting onto a neighboring residential lot. But non-farm neighbors create conflicts when their dogs harm farmers' livestock and their children trespass on farms and vandalize crops, structures, or equipment. A local government can play an active role in helping to resolve conflicts between neighbors before these conflicts polarize a community and leave a legacy of bitter feelings. Building and maintaining trust among property owners is fundamental to a cohesive community that can rationally address and peacefully resolve problems.

Conflicts between farmers and neighbors typically emerge from a lack of communication, information, or differences in attitudes, perceptions, beliefs, values, or desires. The purpose of conflict resolution is to find common ground on which opposing parties can agree, and thereby avoid expensive and bitter litigation and long lasting bad feelings. It is important to keep in mind, however, that conflict resolution may not succeed. An all-or-nothing attitude on the part of one party will prevent a satisfactory settlement. Conflict resolution depends in large part on the willingness of opposing parties to negotiate (see, Constance and Bonanno, 1999). Ellickson (1991) notes that a negotiated resolution of conflicts is more likely when the stakes are small because legal costs are seen as much higher. Technically complex issues are often difficult to resolve through negotiation.

Role of Local Government

In rural areas, residents often look to local government for conflict management, not merely for regulation. (Kundell, 1999) Residents often feel local government officials and staff are more accessible and responsive. (Minnesota Extension Service, 1996) Local governments have the opportunity, outside of regulation, to create conflict management programs or use conflict management techniques to resolve feedlot conflicts.

In the local government interviews conducted for this report, local staff commented on the conflict management techniques they use. Researchers also asked local staff about their perceptions on the effectiveness of these techniques. Based on these interviews and review of literature on conflict management, this report suggests that local governments interested in reducing conflict over feedlots implement a conflict management program to supplement regulatory efforts.

Because of the overlapping authority between local governments and between the state and local governments, there is a need to be clear about roles. Many rural counties have limited staff where one person fills several roles in relation to feedlots: county feedlot officer, zoning official, and environmental officer. Although there may be a benefit in only having to visit one person about all the aspects of feedlots, it can lead to confusion about when the local staff is playing what role.

In addition to one staff filling several roles, staff from several levels of government may be responsible for responding to complaints: MPCA staff, county staff, township officers. To avoid confusion, the legal sources of authority and the responsibilities under each source of authority must be clear to both the staff person and parties to a conflict. It must also be clear at what point responsibility for environmental permitting decisions transfers to MPCA.

In a process focusing on managing feedlot conflict, the Minnesota Extension Service (1996) noted that there are benefits to having a local conflict manager. These benefits include:

local staff can respond more quickly because they are nearer the site
local staff can work through problems over time and they are always around
local government is viewed as more responsive that state agencies because people can vote out my local government and change things, they can t vote out state agency staff
local staff are seen as understanding local situations better and understanding what local solutions will work

Of course some of the benefits of local staff managing conflict can also be viewed as problems. For example, local staff may be viewed as favoring one side over the other, or being too close to the conflict.

There are benefits to having a state agency conflict manger. State agency staff may be seen as a neutral third party and may have more technical and scientific knowledge. The state may also be seen as carrying a bigger enforcement stick. Just as with local staff, there are perceived problems with state agency staff as conflict managers. For example, they may be perceived as focusing only on the technical aspects and focusing on enforcement which may be effective for reducing pollution, but is not necessarily good conflict management.

People outside of local or state staff also have expertise in managing conflict. These include extension agents and soil and water conservation district staff. An independent third-party conflict manager could also be considered.

Perhaps the best solution is to create a conflict management team directed by local government staff. The local staff can initially respond to complaints and bring in other experts when it would help in resolving the complaint. The initial respondent is local and accessible. Expertise at all levels, however, is available.

As part of a conflict management program, a local conflict manager must be a facilitator. The facilitation tasks of the conflict manager include:

ensuring a safe environment for communication between the parties;
ensuring a confidential environment for communication by the parties with the conflict manager;
modeling respectful behavior and insisting on respectful behavior from parties to the conflict maintaining neutrality;
informing the parties to the conflict about methods of resolution that are available to them, and the costs and consequences of each method; and
helping each party to define what are reasonable expectations.

An important point for conflict managers to understand is that they will not be able to resolve all conflicts quickly, and some they will not be able to resolve. The latter conflicts will most likely be resolved by some form of judicial action.

Elements of a conflict management program

A effective conflict management program targeted at reducing conflict over feedlots will contain elements that address:

technical assistance to the operator to reduce the causes of conflict;
education about typical farm operations, environmental risk and the purpose of regulations; and
continuing communication .

Consideration should also be given to how the program will be funded in the long-term.

Technical assistance to the operator

The base of a conflict management program is providing technical assistance to operators to help them reduce the causes of complaints such as odor. Ideally, technical assistance would be provided before there is a complaint filed. Local governments can identify possible sources of complaints by systematically inspecting feedlots and identifying possible problem operations. The local conflict manager can then act as a broker to connect operators up with technical and financial assistance. Many counties in Minnesota that have completed level III feedlot inventories have inspected all feedlots within their counties. For example, Blue Earth County, Minnesota has inspected more than 400 feedlots.

Education

Another task for the conflict manager is to educate people about feedlots, off-site impacts, and what to expect as a feedlot operator, as a neighbor to a feedlot, or as a member of the general community. Topics for education include:

farming practices and role of agriculture in the local economy;
potential nuisances and health effects from feedlot operations;
the experience with feedlots in other areas of Minnesota; and
current rules that control operation and manure management.

A local government could sponsor separate informational workshops for farmers on coexisting with non-farm neighbors, and for non-farmers on what to expect in getting along with farming neighbors. New non-farm residents who move from cities or suburbs into farming areas often have little understanding of modern farming practices (Castle, 1998, Spaine, 1993). Some local governments in Pennsylvania give new residents a brochure written by the cooperative extension service that describes what residents should know and expect from neighboring farms (Abdalla, 1997). Larimer County, Colorado published "The Code of the West," a sensible warning to people thinking about living in the country to "look before they leap" (Larimer County, 1999).

Local governments can organize on-going forums for speakers and general discussion. Local government in conjunction with farm groups and individual farmers can conduct farm tours to show non-farmers how farms are operated, including environmental safeguards that are in place. Farm organizations sponsor such tours in several areas of the country.

Communication

Local governments may achieve success in resolving conflicts by increasing communication between farmers, neighbors, and other community members. Successful communication can increase trust and tolerance. The local governments role in supporting communication is to sponsor forums for communication. The forums should begin as soon as possible and continue indefinitely. The Minnesota legislature has recognized the benefits of continuing communication. For example, since January 1, 2001, notification of the public is required before issuance of a feedlot permit for 300 or more animal units (Minn Laws (a998, ch 401, sec. 41.).

Public meetings, moderated by a professional facilitator, can bring out and define issues from the perspectives of both farmers and non-farmers. On the one hand, both groups need to understand what their rights and options are under the law, including the provisions of local agricultural zoning, agricultural districts, the state right-to-farm law, and legal rulings. On the other hand, non-farm neighbors need to understand how a farm is operated and how their actions can harm a farm, and farmers need to understand how their farm practices can impact their neighbors.

Local governments could provide additional public hearings outside of the regular planning commission or elected board meetings to present proposals for the construction or expansion of confined animal feeding operations. These meetings would offer farmers the opportunity to explain how the feedlots operate, including responses to environmental considerations. Non-farmers would have the opportunity to express their concerns. This technique is being used in the University of Minnesota s Center for Rural Design s *Community Dairy Partnership* project. Focusing on several counties in central Minnesota, the Center has worked with local governments to convene a series of public meetings. The meetings are designed to educate those attending on the benefits and consequences of dairy expansions, and to facilitate dialogue among neighbors and operators.

Local governments can also encourage one-on-one communication between operators and neighbors. This includes requiring operators to notify neighbors prior to potential odor occurrences.

Third-party mediation

If a local government is anticipating or experiencing extensive complaints, the local government may want to hire a third-party mediator to negotiate settlements. Mediation is attractive because a satisfactory result may be achieved faster and at less cost than going through the courts or governmental proceedings. Also, public opinion favors those who can settle their differences. The challenge is getting both sides to agree to a mediated solution. The settlement could involve a written agreement between the two parties about how the farm will operate and what farm

impacts the non-farmers are willing to tolerate. Monitoring, evaluation, and enforcement are needed to make a negotiated settlement work (Bingham, 1986). Local governments could help with these efforts as well.

In sum, local governments can help reduce conflicts between farmers and neighbors through education and keeping open lines of communication. Local governments must expect landowners to manage their properties responsibly, and encourage landowners to report problems to the local government before seeking a litigated or other high conflict solution. Local governments must be careful not to appear to "take sides" in conflicts. Instead, they should facilitate discussion and negotiation between opposing parties.

Section 5:
Draft Policy Recommendations
Land Use Conflicts and Regulation

Measuring Conflict

1. **Build on past investments in data by continuing to collect quality data and analyze that data for indicators of progress toward goals.** The GEIS has established a strong baseline of data in several areas: DOA ordinance survey; EQB Feedlot Inventory; trend data on demographics and change in animal agriculture; actual complaint data; conflict indices. Baseline data is only valuable if it is updated periodically and analyzed for trends. Baseline data becomes the beginning point for indicators to measure progress. For example, to determine if ordinance changes are reducing (or increasing) conflict in the future, we need to update the conflict data and ordinance survey information.

2. **Improve the collection of data on complaints.** The largest hurdle in evaluating the effect of any action (land use controls, new technology, etc.) on reducing feedlot complaints is the poor quality of complaint data that is collected. There must be consistent reporting formats as well as comprehensive collection. Complaints addressed by counties and the state should be compiled into one database. Additional information should also be memorialized, such as responding agency, more detailed information on the nature of the complaint, and more information on both the complainant and the site about which the complaint is made. Respecting legitimate privacy concerns, it would be useful in the future if data on characteristics of complainants could be aggregated and reported. This would enable policy-makers to base local land use decisions on more than anecdotal information. Complainant characteristics that would be informative include: location of complainant relative to the feedlot; whether the complainant is a farmer or non-farm rural resident; and the number of different individuals complaining about one feedlot versus repeated complaints from one person.

Reducing Conflict Over Feedlots Through Local Action

3. **Don t change the complexion of local land use authority over one issue.** Controversial land issues come and go, but the underlying reason for making land use decisions at the local level remains sound. The people who are most affected by land use decisions should be the decision-makers. Local communities should make decisions about the long-term character of their community.

4. **Be clear about the differing roles state/federal and local government.** This is a corollary to the policy recommendation above. The roles of local staff and state staff need to be clear to both the staff people and the people they serve. If land use enforcement and environmental permitting roles are filled by the same person, such as now occurs in delegated counties, it is likely that there will be confusion about what role the person is filling at any given time. Clarity about roles and boundaries will mitigate confusion to some extent.

5. **Facilitate the development of local feedlot ordinances that address the needs and goals of the community and reduce conflict over feedlots.** Because land use issues are best addressed at the local level, local governments should be given the tools necessary to develop effective ordinances. These tools could range from the development of model ordinance elements, to the provision of technical assistance in planning by local extension educators, to grant funding for communities addressing feedlot conflict through local action. Attention should be paid to local governments that implement innovative tools (such as using OFFSET to determine separation distances or industrial agriculture zones .) Ongoing assessment should occur to determine if the use of innovative tools causes a reduction in actual conflict.

6. **Create conflict management teams trained in the tools to address conflict and coordinated by local government staff.** The creation of such teams would build on the strengths of each level of government. The local staff can initially respond to complaints and bring in other experts when it would help in resolving the complaint. The initial respondent is local and accessible. Expertise at all levels, however, is available. Teams could be incorporated into the 7020 rules for delegated counties. The teams should be trained in a broad spectrum of conflict management techniques. Protocols should be established on how to respond to complaints and conflict. The teams could respond not only to specific complaints, but could be used in the community-wide education and continuing communication activities that are necessary to reduce conflict.

Section 6:
Literature Review Update

Question 1. What are the current land use conflicts associated with animal agriculture in Minnesota including conflicts with the use of resources for recreation and tourism and land for housing and urban development?

Leggett, Christopher G. and Nancy E. Bockstael. "Evidence of the Effects of Water Quality on Residential Land Prices," Journal of Environmental Economics and Management, Vol. 39, pp. 121-144, 2000. The authors conclude that there is a positive relationship between residential land prices and water quality. This finding suggests that homeowners should be willing to pay for improved water quality because, besides health reasons, it increases the value of their property.

Constance, Douglas H., Daniel Lo. Argo, Mirenda Harris, Caron Cates, William Blaine, and Alessandro Bonanno. "Industrialized Poultry Production and Community Controversy in Southeast Texas: A Multi-Media Presentation of Voices of Protest and Organization." Paper presented at the 63rd Annual Meeting of the Rural Sociological Society, August 2000, Washington, D.C. This paper concerns the controversy between the large poultry farms and local residents.

Schulman, Michael and Marybe McMillan. "Hogs and Citizens: A Report from the North Carolina Front." Paper presented at the 63rd Annual Meeting of the Rural Sociological Society, August 2000, Washington, D.C. This paper discusses the efforts to curb large hog farms in North Carolina.

Kleiner, Anna M. and J. Sanford Rikoon. "Pigs, People, and the Democratic Process: The Impact of Proximity to Large-Scale Swine Operations on Elements of Social Capital in Northern Missouri Communities." Paper presented at the 63rd Annual Meeting of the Rural Sociological Society, August 2000, Washington, D.C. This paper focuses on the 70,000 head Premium Standard Farms operation in northern Missouri and its impacts on air and water quality.

Question 2. What zoning and land use planning strategies exist, to what extent are they in place in Minnesota, and are they effective in:

a. Addressing the identified land use conflicts (see #1);
b. Promoting citizen participation;
c. Identifying and promoting the best uses of the land;
d. Addressing development pressures in agricultural areas;
e. Reducing negative environmental, economic, health, and social impacts of animal agriculture; and
f. Balancing property rights?

There have been numerous state and local attempts to regulate feedlots. Some of these attempts have been challenged in court. The court cases find that zoning to regulate feedlots is not legal in some states. However, local governments are likely to be successful if they adopt health standards that feedlots must meet. In the language of planners, these health standards are in effect

performance standards: as long as the feedlot operator can meet the standards, a feedlot will be allowed to be built or expanded.

Metcalfe, Mark. "Location of Production and Endogenous Water Quality Regulation: A Look at the U.S. Hog Industry," Paper presented at the American Agricultural Economic Association meeting, August, 1999. The effect of environmental regulations on the location of hog production. Preliminary results: increased regulation is a minor consideration in location decisions.

Caruso, Brian S. "Comparative Analysis of New Zealand and US Approaches for Agricultural Nonpoint Source Pollution Management," Environmental Management, Vol. 25, No. 1, pp. 9-22, 2000. (To address, non-point source pollution, both countries rely on voluntary approaches. But New Zealand plans for water quality according to watersheds. Regional councils are responsible for most monitoring and management of water quality and non-point source pollution).

U.S. EPA. State Compendium: Programs and Regulatory Activities Related to Animal Feeding Operations, August, 1999, 399 pages. www.epa.gov/owm.stcpfin.pdf (Permitting, inspections, and enforcement).

Sierra Club. "Five Local Strategies to Keep CAFOs Out Proven Successful in Missouri." www.sierraclub.org/cafos/toolkit/tactics.asp

Jeremy and Janice Borron v. Board of County Commissioners of Linn County, MO. Opinion of Missouri Court of Appeals, Western District. November 23, 1999, Case Number WD56648. The Borrons proposed to construct and operate an 18,000 head hog finishing unit and a 2,750 head farrow to feeder pig unit. The County had adopted a health ordinance in 1994 "with rules and regulations regarding permits needed to operate a CAFO." The court ruled in favor of Linn County, stating that the county has "the power to make additional health ordinances to enhance the public health and to prevent the entrance of dangerous diseases into the county." Moreover, the court found that state law does not preempt the ordinance. In effect, the health ordinance is not a zoning ordinance; the Missouri Supreme Court had ruled that local zoning ordinances do not apply to CAFOs (see Premium Standard, 946 S.W.2d at 240).

Land Use Law and Zoning Digest, September, 1999, p. 23. Welsh v. Centerville Township. Supreme Court of South Dakota, June 23, 1999, 595 N.W.2d 622. "In 1998, the township enacted an ordinance regulating the size and location of commercial feedlots." But townships do not have the authority to zone in South Dakota, counties do.

Land Use Law and Zoning Digest, September, 1999, p. 16. Clay County v. Harley and Susie Bogue, Inc. Missouri Court of Appeals, March 9, 1999, 988 S.W. 2d 102. Clay County, Missouri tried to regulate feedlots through a conditional use permit process. The Bogues wanted to expand their hog operation to 5,000 head. The court found that the expansion was not a feedlot but involved buildings and structures which Missouri law exempts from local regulation through the preemption of local regulation.

Coyote Flats, L.L.C. v. Sanborn County Commission. South Dakota Supreme Court, July 14, 1999, SD 87. A county ordinance for a special use permit for construction of a 6,000 head hog

facility is upheld. The county commissioners denied the permit on the grounds that it would: create air pollution through noxious odors, have potential for water pollution, adjacent properties would be devalued, increased truck traffic would damage roads, and there were many people in the area who would be affected. The South Dakota Supreme Court found that the county's denial was not arbitrary, but based on sound reasons.

Potential and emerging developments with the regulation of CAFOS:

Kiplinger Agricultural Letter, May 5, 2000, p. 2. EPA will propose air quality emissions limits on ammonia and hydrogen sulfide. Violators could be cited under the Clean Air Act. EPA is beginning to require large feedlot operators to report hazardous emissions that exceed legal standards. The livestock industry prefers voluntary methods.

Kiplinger Agriculture Letter, May 5, 2000, p. 1. Also, due on December 15 are proposed EPA rules limiting runoff from CAFOs (feedlots with more than 1,000 animal units). The propsoed rules would require CAFO operators to draft nutrient management plans in order to obtain an NPDES permit and keep detailed records on following the permits. Co-permits would be required for agribusiness firms that contract with small farm operations. Many states are already issuing NPDES waste permits under the draft EPA guidelines.

EPA will also propose effluent limitation guidelines by the end of 2000. These would apply to farms with fewer than 1,000 animal units.

Question 3. What are the costs and benefits of these different land use strategies?

Johnson, Renee Selinsky, William J. Wheeler, and Lee A. Christensen. "EPA's Approach to Controlling Pollution from Animal Feeding Operations: An Economic Analysis," American Journal of Agricultural Economics, Vol. 81, No. 5, pp. 1216-1221, December, 1999. This article examines the potential costs to farmers to meet EPA requirements for controlling source and non-point source pollution from manure. These requirements are for effluent limitation guidelines for feedlots and and NPDES discharge permits for CAFOs. EPA intends to conduct a cost-benefit analysis of these regulations.

Huang, Wen-Yuan, Agapi Somwaru, and Mohinder Gill. "Economic Impacts of Restricting Agricultural Uses of Manure on Hog farms in the United States." Paper presented at the American Agricultural Economics Association Annual Meeting, August 2000, Tampa, Florida. If manure spreading on hogs farms is restricted, farmers will need to find ways to export manure off the farm.

Fleming, Ronald A. "The Economic Impact of Setback Requirements on Land Application of Manure," Land Economics, February, 2000. The author analyzes the cost to farmers of complying with setback siting requirements. The farther a hog barn must be located from property boundaries, the more roads the farmer must build, taking land out of production.

The National Academy of Sciences and the General Accounting Office are reviewing the costs to livestock producers and state and federal governments of implementing the TMDL rules.

Researchers Conducting Ongoing Research on Confined Animal Feeding Operations

1. Professor Ronald Fleming, Dept. of Agricultural Economics, University of Kentucky, Rfleming@ca.uky.edu

Professor Fleming has completed a manuscript that analyzes the economic impacts of the State of Kentucky's new setback law for new confined animal feeding operations.
In a rural area, the minimum setback from property lines in 1,500 feet and near cities, the minimum setback in 3,000 feet. The cost of complying with these setbacks is borne by the producers. Professor Fleming notes that these setbacks appear more than adequate for 2,500 to 5,000-head hog operations. For operations above 5,000-head, the setbacks may not be sufficient, depending on the number of hogs.

2. Professor Patricia Norris, Dept. of Agricultural Economics, Michigan State University, norrisp@pilot.msu.edu

Professor Norris has been developing a planning tool for local governments to use in planning and zoning for confined animal feeding operations. The tool is a computerized spatial decision system, combining GIS spatial analysis with several criteria to evaluate the relative suitability of locations for CAFOs. The tool is designed for "proactive" planning--i.e. where should CAFOs go, rather than reactive planning–"is this an ok site for a CAFO?"

The software system is currently being evaluated by Professor Bernie Engel in the Department of Agricultural Engineering at Purdue University.

3. Mark Thornburg, Esq., Staff Attorney, Indiana Farm Bureau, mthornburg@farmbureau.com

Mark Thornburg wrote a thorough discussion of confined animal feeding operations in Indiana, "The Regulatory and Legal Framework Affecting Confined Animal Feeding in Indiana for the Valparaiso University School of Law, December 31, 1997. Mr. Thornburg, in his role as staff attorney to the Indiana farm Bureau, is closely followin the proposed rule-making for CAFOs by the Indiana Department of Environmental Management. The Indiana Department of Environmental Management has conducted a fiscal analysis of the costs to different types of CAFOs to meet the department's proposed rules on CAFOs. The U.S. EPA will review the proposed rules for compliance with the Clean Water Act and specially the National Pollution Discharge Elimination System permit requirements for CAFOs.

References Cited

Abdalla, Charles. *Conflict Resolution at the Rural/Urban Interface.* University Park, PA: Penn State Extension, 1997.

Bingham, Gail. *Resolving Environmental Disputes: A Decade of Experience.* Washington, D.C.: The Conservation Foundation, 1986.

Castle, Emery. Agricultural Industrialization in the American Countryside , 1998.

Constance, Douglas. CAFO Controversy in the Texas Panhandle Region: The Environmental Crisis of Hog Production, Culture and Agriculture 21 (1), 1999.

Daniels, Tom. *When City and Country Collide: Managing Growth in the Metropolitan Fringe.* Island Press, 1999.

Duncan, James, and Associates. *Planning and Zoning for Animal Agriculture in Minnesota: A Handbook for Local Government.* Minnesota Department of Agriculture. June 1996.

Ellickson, Robert C. *Order Without Law: How Neighbors Settle Disputes*. Cambridge, MA: Harvard University Press, 1991.

Jacobson, L.D. and H. Guo. *Odor From Feedlots Setback Estimation Tool (OFFSET).* University of Minnesota, Department of Biosystems and Agricultural Engineering. 1999.

Kundell, James E. *Animal Feeding Operations: The Role of Counties.* National Association of Counties/ Conference of Southern County Associations. 1999.

Larimer County, Colorado. The Code of the West, reprinted in Tom Daniels, 1999. When City and Country Collide. Washington, D.C.: Island Press, pp. 275-279.

Minnesota Department of Agriculture (MDA). *Summary of Animal-Related Ordinances in Minnesota.* MDA, 1999 (updated with Township summary information in 2000).

Minnesota Department of Agriculture (MDA). *Feedlots Financial Needs Assessment.* MDA, 2001.

Minnesota Environmental Quality Board (MEQB). *A Summary of the Literature Related to Social, Environmental, Economic and Health Effects.* MEQB. September 1999.

Minnesota Extension Service. *Community Prespectives on Livestock and Related Issues.* June 1996.

Minnesota, State of, Office of Legislative Auditor. *Animal Feedlot Regulation: A Program Evaluation Summary.* January 1999.

National Pork Producers Council. 2001. Compliance Audit Program. www.porkenvironment.org

Spaine, Daphne. 1993. Been-Heres Versus Come-Heres: Negotiating Conflicting Community Identities. Journal of the American Planning Association, 59: 156-171.

Roundtable interviews conducted by GEIS for Animal Agriculture Social and Community Impacts Team.

Cases cited:

Berscheit v. Town of Grey Eagle, Minnesota, CO-98-2298 (Minn. Ct. App. July 13, 1999)

Blue Earth County Pork Producers, Inc. v. Blue Earth County, C1-96-1222, (Minn. Ct. App. Jan. 28, 1997)

Canadian Connection v. New Prairie Township, 581 N.W. 2d (Minn. Ct. App. 1998)

Duncanson v. Board of Supervisors of Danville Township, 551 N.W. 2d 248 (Minn. Ct. App. 1996)

Attachment 1:

Demographic and Agricultural Industry Data Tables

Attachment 2:

Complaint Data Table

Attachment 3:

Conflict Indices Formulas and Data Tables

Following are the calculations, data notes, and validation methodologies employed in development of the three indices for potential conflict

I. Index of Potential for Conflict Between Animal Confinement Facilities (feedlots, barnyard, etc.) and Rural Non-Farm Residents (I_f) I_f can be calculated by head for each species to assess the difference in magnitude of space and facilities required for different species. (references to ***dairy***, above, would be replaced with ***hog*** and ***beef***.)

$I_f = (A \times B \times C \times D) / E$ where:

A = (# of ***dairy cows*** in the county) / (# of ***dairy farms*** in the county)
This calculation provides a measure of the intensity of ***dairy farming*** in the county a high # of cows per farm indicates relatively intense ***dairy operations*** within the county. As this ratio increases so does the potential for conflict.

B = (# of ***dairy farms*** in the county) / (total # of farms in the county)
This calculation provides a measure of the concentration of ***dairy farming*** as a component of all farming within the county a high # of ***dairy farms*** as compared to all farms indicates a high concentration of the ***dairy industry*** within the county. As this ratio increases so does the potential for conflict.

C = (# of farm acres in the county) / (total # of acres in the county)
This calculation provides a measure of the concentration of all farming as a component of all land within the county a high # of farm acres as compared to all acres indicates a high concentration of farming within the county. As this ratio increases so does the potential for conflict.

D = (# of rural non-farm residents) / (total # of residents in the county)
This calculation provides a measure of the density of rural non-farm residents within the county a high # of rural non-farm residents as compared to total residents indicates a high density of rural non-farm residents within the county. As this ratio increases so does the potential for conflict.

E = ($ of agricultural contribution to gross county product) / ($ gross county product)
This calculation provides a measure of the significance of agriculture to the economy of the county. As this ratio goes up, the strength of concern for agriculture increases and the potential for conflict decreases.

II. Index of Potential for Conflict Between Manure Stockpiling at Animal Confinement Facilities and Rural Non-Farm Residents (I_{ms})

I_{ms} = (A x B x C x D) / E where:

A = same as above, except that # of ***dairy cows*** is converted to animal units

B = same as above

C = same as above

D = same as above

E = same as above

I_{ms} is calculated by animal unit for each species then summed across species

III. Index of Potential for Conflict Between Manure Application to Available Agricultural Lands and Rural Non-Farm Residents (I_{ma})

I_{ma} = (D x F x G) / E where:

D = same as above

E = same as above

F = (# of harvested acres in the county) / (total # of acres in the county)

This calculation provides a measure of the concentration of available land for manure application as a component of all land in the county a high # of available acres for manure application as compared to all acres indicate a high concentration of available acres. As this ratio increases so does the potential for conflict.

G = (total animal units of manure generated) / (# of harvested acres in the county)

This calculation provides a measure of tons per acre that needs to be applied to available agricultural land. As this ratio increases so does the potential for conflict.

I_{ma} can be calculated by animal units for each species, then summed across species to yield a figure for total manure generated within the county.

Data Notes:

1. In calculating the three indices, we calculated indices on the basis of raw values for the various ratios (ie. A, B, C, D, E, F and G). We also standardized the ratios so that they all possess the same standard deviation. This latter procedure compensates for differences in variability of the raw value ratios.

2. Rural non-farm residents are not reported as a category by the State Demographer. Based on recommendations from the Office of the State Demographer, rural non-farm residents were calculated for each of the study years (1982, 1987, 1992, 1997) in the following manner:

> For each county, the number of farms reported by the Census of Agriculture was multiplied by the average household size for each county (as provided by the Office of the State Demographer.) This provided a total for estimated farm population for each county. The rural non-farm population was estimated for each county by subtracting the farm population estimate from the total rural population (as provided by the Office of the State Demographer.)

3. For the third index, we assumed that manure produced within a county is spread, through some method, on land within the county. This assumption has been used by other researchers working with Agricultural Census data.

Validating the Indices of Potential for Conflict Between Animal Agriculture and Rural Residents

The Importance of Validity

The construction of an index to measure a concept such as the potential for conflict between animal agriculture and rural residents must address the validity of measurements that the index purports to make. Validity is concerned with the soundness and effectiveness of the measuring index. In constructing a measurement index, validity raises questions such as:

a) What does the index measure?
b) Does the index, in fact, measure what it is supposed to measure?
c) How accurate and comprehensive are the measurements rendered by the index? (Leedy 1993)

Concurrent Validity. Ideally, the validity of a constructed index might be evaluated by comparing measurements obtained from the index with measurements obtained from a known and accepted method of measuring the concept in question. For example, developers of new devices to measure ambient air temperature might evaluate measurements obtained from use of the device with measurements obtained from a mercury thermometer. To the extent that measurements obtained from the new device correlate with measurements obtained from an accepted standard of measurement for the concept being measured, the new measurement device can be said to possess "concurrent validity" (Zeisel 1981). This quality is also known as "criterion validity" (Leedy 1993).

Concurrent or criterion validity for the indices of potential for conflict between animal agriculture and rural residents throughout the State of Minnesota might be evaluated by comparing the measurements from the indices with measurements of actual conflict in the state. Such an evaluation would require the existence of accurate, reliable and comprehensive records of reported conflict between animal agriculture and rural residents. These records would further need to span the same period of time over which the indices purport to measure the potential for conflict. The Minnesota Pollution Control Agency has a protocol for receiving and acting upon official complaints about animal agriculture in the rural landscape. However, the records are not maintained in a database that can be readily accessed for use in checking the concurrent validity of the constructed indices. Even if the database were complete, there is no guarantee that all complaints would be included therein. Thus application of concurrent or criterion validity to evaluate the soundness and comprehensiveness of the measurements made by the indices is not feasible.

Face Validity. Investigators often develop an intuitive and subjective feel for the soundness of measurements they are making. This feeling provides a sense of "face or intuitive validity" (Leedy, 1993). In examining the conflict between animal agriculture and rural residents, for example, one might intuitively expect this potential to be highest in locales having the greatest concentrations of both animals as well as people. Such a measure is simple and straightforward,

and it seems on face value to identify where conflict between animal agriculture and rural residents might occur.

Construct Validity. Construct validity involves an examination of the relationship between measurements obtained for one concept and measurements obtained for concepts that are theoretically related to the first concept (Leedy 1993, Zeisel 1981). Construct validity emerges when the application of a measurement device to a particular concept produces results consistent with measures of concepts that are logically related to the concept under consideration. A sense of conceptual convergence (Campbell and Fiske 1959) emerges when correlation is observed between and among measurements of related concepts. Thus, the existence of a correlation between the Index of Potential for Conflict Between Animal Confinement Facilities and Rural Non-farm Residents and an intuitively appealing index of the same concept that possesses face validity supports the construct validity of the initial index. Correlation between the constructed index and the intuitively appealing index establishes a sense of conceptual convergence. The fact that two separate indicators converge to produce similar measures of the potential for conflict lends validity to the two indicators used in measuring the concept. The convergence of multiple methods of measurement provides the investigator with greater assurance of the accuracy and soundness of measurements obtained from the constructed indices.

Constructing Alternative Indices to Evaluate Validity

Alternative indices were constructed to measure the concepts being measured by Index of Potential for Conflict Between Animal Confinement Facilities and Rural Non-farm Residents as well as the concepts being measured by the Index of Potential for Conflict Between Manure Stockpiling and Rural Non-farm Residents. In both instances, the alternative index was constructed to be a simple, intuitively appealing measure of the potential for conflict. The indices were constructed for 1997, 1992 and 1982.

An Alternative Confinement Facilities Index.

Assuming that most livestock is produced in confinement facilities located in rural portions of a county, conflicts between confinement facilities and rural non-farm residents are likely to be highest in counties having large numbers of animals and large numbers of rural non-farm residents. As the ratio of animals per non-farm resident increases, the potential for conflict increases. The simplicity of this measure and its intuitive appeal are presumed, for purposes of this analysis, to establish the face validity of the Alternative Confinement Facilities Index.

This ratio was calculated by species of livestock for the years 1997, 1992, 1982, respectively. Inventories of livestock by species were compiled for each county from the Census of Agriculture for 1997, 1992 and 1982, respectively. Rural non-farm population estimates were compiled for each county during the three years of interest using estimates obtained from the State Demographers Office and Census of Agriculture data pertaining to the number of farms in each county. The index was calculated by species for each year, providing, for example, a

measure of the number of cows in Stearns County per rural non-farm resident in Stearns County for 1997.

An Alternative Manure Stockpiling Index.

Assuming that production of livestock confinement facilities requires stockpiling or storage of manure and that these stockpiling/storage facilities are located in rural portions of a county, conflicts between animal manure stockpiling/storage facilities and rural non-farm residents are likely to be highest in counties having large numbers of animal units of manure and large numbers of rural non-farm residents. As the ratio of animal units per non-farm resident increases, the potential for conflict increases. The simplicity of this measure and its intuitive appeal are presumed, for purposes of this analysis, to establish the face validity of the Alternative Manure Stockpiling Index.

This ratio was calculated across species of livestock for the years 1997, 1992, 1982, respectively. Inventories of livestock by species were compiled for each county from the Census of Agriculture for 1997, 1992 and 1982, respectively. Species counts for each county during a given time period were converted to animal units of manure using the following conversion factors:

a. 1 animal on a dairy farm (including milk cows, heifers and calves) = 1.0 animal unit;
b. 1 animal on a beef farm (including cows, calves, heifers, feeder steers, slaughter steers) = 0.7 animal unit.
c. 1 animal in a hog production unit (regardless of weight) = 0.3 animal units.

Rural non-farm population estimates were compiled for each county during the three years of interest using estimates obtained from the State Demographers Office and Census of Agriculture data pertaining to the number of farms in each county. The index was calculated across species for each year, providing, for example, a measure of the number of total animal units in Stearns County per rural non-farm resident in Stearns County for 1997.

Correlations Between the Two Sets of Indices

The construct validity between the Index of Potential for Conflict Between Animal Confinement Facilities and Rural Non-farm Residents and the Index of Potential for Conflict Between Manure Stockpiling and Rural Non-farm Residents, on the one hand, and the Alternative Confinement Facilities Index and the Alternative Manure Stockpiling Index, on the other hand, was evaluated using correlation analyses. In these analyses, a Pearson correlation coefficient was calculated to describe the degree of association be between the Index of Potential for Conflict Between Animal Confinement Facilities and Rural Non-farm Residents and the Alternative Confinement Facilities Index. Similarly, a Pearson correlation coefficient was calculated to describe the degree of association between the Index of Potential for Conflict Between Manure Stockpiling and Rural Non-farm Residents and the Alternative Manure Stockpiling Index.

Correlation is a statistical analysis procedure that examines the extent to which variance (i.e. variability) in measures on one variable is associated with variance on measures for another variable. The procedure produces a coefficient of correlation (r), which describes the association or correlation between the two variables. This coefficient varies between 1.0 and +1.0. As the value approaches one (either 1.0 or +1.0), the magnitude of association or correlation between the two variables increases. Correlation coefficients tending toward +1.0 indicate a direct relationship between the variables, while coefficients tending toward -1.0 indicate an inverse relationship. The square of the correlation coefficient (r^2) is called the coefficient of determination. This coefficient describes the amount of variance in a one variable that can be attributed to variance in another variable. This coefficient varies between 0 and 1.0. Coefficients of 0.60 mean that 60% of the variance in one variable can be explained by variance in another variable. Coefficients of 0.95 mean that 95% of the variance in one variable can be explained by variance in the other variable.

The analysis also calculates the probability that values as large as those derived from the analysis for the correlation coefficient or the coefficient of determination could have been produced by random chance. Probabilities of less than 5 chances in 100 are often recognized as being statistically significant. In a sense, statistical significance means that the effects described by the coefficients are real i.e. they are not a product of random chance. It is important to point out that a coefficient of determination can be statistically significant without being very meaningful. For example, an r^2 value of 0.33 may be statistically significant (i.e. not a product of random chance), but it still means that only one-third of the variance in a dependent variable can be explained by variance in the independent variable. Two-thirds of the variance in the dependent variable is attributable to sources other than variance on the independent variable.

Correlation Between Confinement Facilities Conflict Measures.

Table 1 presents the findings from the analyses that examined correlations between the constructed Indices of Potential for Conflict Between Animal Confinement Facilities and Rural Non-farm Residents and the Alternative Confinement Facilities Indices for 1997, 1992 and 1982. All of the correlation coefficients are statistically significant at a probability of $p<.05$. All of the correlation coefficients are positive, meaning that the relationships between the constructed and alternative indices are direct. An increase in values on the constructed index is directly associated with an increase in values on the alternative index. The magnitude of the coefficients ranges between r=0.57 and r=0.73. The coefficients of determination (r^2) for these correlations range from approximately 0.32 to 0.53. Thus, between 32% and 53% of the variability in one index for any given year can be explained by variability in the other index. These values suggest that the two indices possess a moderate level of construct validity.

Table 1. Pearson correlation coefficients between the constructed Indices of Potential for Conflict Between Animal Confinement Facilities and Rural Non-farm Residents and the Alternative Confinement Facilities Indices for 1997, 1992 and 1982.

Animal species	Year	Alternative Index		
		1997	1992	1982
Hogs	1997	0.72**	n/a	n/a
	1992	n/a	0.73**	n/a
	1982	n/a	n/a	0.73**
Dairy	1997	0.59**	n/a	n/a
	1992	n/a	0.69**	n/a
	1982	n/a	n/a	0.68**
Beef	1997	0.57**	n/a	n/a
	1992	n/a	0.68**	n/a
	1982	n/a	n/a	0.71**

Note: 1. Correlation coefficients followed by double asterisk (**) are statistically significant at $p<.01$.
2. n/a indicates correlation between indices for these time periods is not applicable to the validation analyses.

Correlation Between Manure Stockpiling Conflict Measures.

Table 2 presents the findings from the analyses that examined correlations between the constructed Indices of Potential for Conflict Between Manure Stockpiling and Rural Non-farm Residents and the Alternative Manure Stockpiling Indices for 1997, 1992 and 1982. All of the correlation coefficients are statistically significant at a probability of $p<.05$. All of the correlation coefficients are positive, meaning that the relationships between the constructed and alternative indices are direct. An increase in values on the constructed index is directly associated with an increase in values on the alternative index. The magnitude of the coefficients ranges between $r=0.64$ and $r=0.67$. The coefficients of determination (r^2) for these correlations range from 0.40 to 0.45. Thus, between 40% and 45% of the variability in one index for any given year can be explained by variability in the other index. These values suggest that the two indices possess a moderate level of construct validity.

Table 2. Pearson correlation coefficients between constructed Indices of Potential for Conflict Between Manure Stockpiling and Rural Non-farm Residents and the Alternative Manure Stockpiling Index for 1997, 1992 and 1982.

Year	Alternative Index		
	1997	1992	1982
1997	0.64**	n/a	n/a
1992	n/a	0.67**	n/a
1982	n/a	n/a	0.67**

Notes: 1. Correlation coefficients followed by double asterisk (**) are statistically significant at $p<.01$.
2. n/a indicates correlation between indices for these time periods is not applicable to the validation analyses.

References Cited

Campbell, D. T. and D. W. Fiske. 1959. Convergent and discriminant validation by the multitrait-multimethod matrix. **Psychological Bulletin** 56: 81-105.

Leedy, P. D. 1993. **Practical Research: Planning and Design**. New York: Macmillan Publishing Co., Inc.

Zeisel, J. 1981. **Inquiry by Design: Tools for Environment-Behavior Research**. Monterey, CA: Brooks/Cole Publishing Co.

Attachment 4:

County and Township Profiles

Goodhue County
PROFILE

Goodhue County is located in the southeast triangle of Minnesota, approximately 60 miles south of St. Paul along the Highway 52 corridor. Goodhue County is rural in nature, with nearly 65 percent of the County s 764 square miles of land cover consisting of cultivated land and 19 percent in forests; slightly more than three percent of the County consists of urban and rural development. The County s projected 2000 population was 43,080.[1]

According to data supplied by the Minnesota Pollution Control Agency (MPCA)[2] and County staff,[3] there were 490 feedlots in the County at the time of the 1997 Census of Agriculture; there are approximately 1,000 feedlots currently in the County, according to a Level I Inventory. Staff indicated that the County is primarily a dairy county. Recent trends indicate the shrinking of the actual number of dairy operations through consolidation.

Goodhue County is a relative newcomer to the feedlot business. While the County participates as a delegated county in the MPCA s Feedlot Program, it has done so only since December 2000, when it officially assumed responsibility for feedlots from MPCA. The County adopted a feedlot zoning ordinance in 1993, in part as an attempt to help ensure that the rural areas remained rural and to help limit the number of complaints about feedlots.

The County has a comprehensive plan, which it is now in the process of updating to include more specific references to feedlots. The update is scheduled for completion and adoption later this year. Five of the County s townships have adopted feedlot ordinances, all of which contain more restrictive feedlot setbacks than the County s ordinance. Most of the County is zoned for agriculture, and there is little space left for new development. The County may consider new agricultural residential zoning in response to a perceived flurry of subdivision activity.

During the update of the feedlots ordinance, the County solicited public input from farmers, producers and citizens in four meetings in January and February 2001. There has been no significant reaction to any of the County s official actions. The County has also published articles about feedlots in local papers, held feedlot tours and held public meetings about feedlot registration.

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[1] Population data is from the Minnesota State Demographer s Office.

[2] Data from the 1997 Census of Agriculture supplied by the Minnesota Pollution Control Agency s Feedlot Program and MPCA projections.

[3] Much of the information presented here was obtained from a survey completed by the County s Soil and Water Conservation staff and from an interview conducted on March 2, 2001 with Glenn Roberson, of the Goodhue County Soil and Water Conservation District.

The County received very few complaints about feedlots two in the year 2000. Over time, however, the majority of the feedlot complaints have centered around manure spills and leaks and the application of manure. Hog operations generated the most complaints about odors.

Non-farmers appear to complain more frequently than others, followed by other farmers and newcomers to the area. County staff indicated that their goal is to always respond to complaints within 48 hours. Their plan is to contact the offending feedlot, if known, visit the site, and develop a plan to remedy the problem, if it still exists. The County does advise newcomers to the area about the potential nuisances of living in an agricultural zone.

Staff believes the County s policies and ordinances can be effective in reducing conflicts concerning feedlots because they provide an orderly method for resolving issues. One of the staff s goals is to bring all feedlots into compliance simply by enforcing the County s ordinance. Staff indicated that the consolidation of dairy operations could actually lead to fewer complaints about feedlots since the larger operations are often less of a risk for conflict larger is simpler!

One staff suggestion for reducing conflicts about feedlots is to ensure that MPCA develops standards and rules that are clear and are free of personal biases and opinions.

Morrison County
PROFILE

Morrison County is located near the geographical center of Minnesota. The County is rural in nature, with nearly one-third of its land cover consisting of cultivated land, 25 percent in hay and pasture and 27 percent in forests; less than three percent of the County consists of urban and rural development. The County s projected 2000 population was 31,190.[4]

According to data supplied by the Minnesota Pollution Control Agency (MPCA)[5] and County staff,[6] there are approximately 800 feedlots in Morrison County. That number is expected to reach 1,200 after a Level II inventory is completed. The County has 412 dairy operations, 44 hog operations and 130 poultry operations; the County does not have a current count of beef cattle operations. Poultry represent approximately 41 percent of the animals in the County and dairy cattle account for nearly 40 percent.[7]

Morrison County has a comprehensive plan that contains a land-use ordinance regarding feedlots as part of its zoning ordinance. The County s original zoning ordinance was adopted in the 1970s; it was revised in 1995, 1996 and 1997. No further changes to the ordinance are planned at this time, although the County may examine further the location of extensive feedlots, soil conditions for crop production, and zoning changes for residential buildings in the agricultural zone.

The feedlots ordinance provides for a four-tiered classification system. Tier I is for operations of 50 to 300 animal units. Tier II is for 301 to 650 animal units, Tier III allows 651 to 1000 animal units, and Tier IV is for operations with 1,001 to 1,500 animal units. Operations with more than 1,500 units are not permitted.

Morrison County participates as a delegated county in MPCA s Feedlots Program. In the County, large operators are required to go through the conditional-use permit process and on-site environmental review before expansion.

No specific event precipitated the County s regulation of feedlots, although some expansion of animal operations was occurring at the time the feedlots ordinance was adopted.

The County held several public meetings throughout the development of the feedlots ordinance and published feedlot rules in the local paper.

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[4] Population data is from the Minnesota State Demographer s Office.
[5] Data from the 1997 Census of Agriculture supplied by the Minnesota Pollution Control Agency s Feedlot Program and MPCA projections.
[6] Much of the information presented here was obtained from a survey completed by County staff and from an interview conducted on February 21, 2001 with Michelle Warnberg, the County feedlot specialist.
[7] Data obtained from Minnesota Planning s Land Management Information Center.

County staff indicates that most people were and are OK with the feedlots ordinance. Some livestock producers were concerned with the five-acre splits with houses and the number being built in the County, fearing their livelihood would be jeopardized because of potential complaints. The setbacks put in place were not favored by all, but allowed (hopefully) the livestock producers some room for expansion without worrying about complaints from neighbors. Several farmers have complained that the setbacks in the ordinance can limit size because the required amount of land is not available to them.

When new homes are to be constructed in the agricultural zone, the land owner is required to sign a Land Use Notification acknowledging that they are aware of the potential nuisances of living in the agricultural zone; the notification is recorded with the property deed.

The County receives relatively few (about 10) complaints yearly. The most common complaints occur around issues involving the improper or untimely incorporation of manure. There have been no complaints about hogs. With few exceptions, the County does not know the identity of those initiating complaints, although there is some evidence of repeat callers.

County staff only investigates run-off issues into water and ditches; the County does not have the authority to cite violators. MPCA does all enforcement concerning feedlots. No complaints have ever reached the minimum threshold for investigation for environmental review.

The County staff follows a standard (not formally adopted) procedure for handling complaints. Callers of odor complaints are explained the air-quality exemptions feedlots are accorded in the Chapter 7020 rules. If the odor complaint refers to land application, they are told that neither the state nor the County has an incorporation time frame for manure. Complaints about manure run-off are followed up with a site visit to determine if there is any merit to the complaint. If the complaint is legitimate, clean up of the manure is required, if possible, and suggestions for better manure management are given. For facilities where lot run-off is present, the producer is told to contact the Soil & Water Conservation District for advice.

The County tries to promote a good neighbor policy, where the farmers and operators are encouraged to let neighbors know when manure spreading is going to take place and to try to avoid spreading around holidays and special events. The County has held workshops on manure management for producers and advised them of how to be a good neighbor. The staff does not know whether the adoption of the feedlots ordinance has actually reduced conflicts or complaints about feedlots.

Nicollet County
PROFILE

Nicollet County is located in the south central part of Minnesota. Bordered on the south by the Minnesota River. Nicollet County is rural in nature, with nearly 80 percent of the county s 298,530 acres of land cover consisting of cultivated land; slightly less more than three percent of the county consists of urban and rural development. The county s projected 2000 population was 30,650.[1]

According to data supplied by the Minnesota Pollution Control Agency (MPCA)[2] and county staff,[3] there were 200 feedlots in the county at the time of the 1997 Census of Agriculture. The most recent Level II Inventory estimated some 420 feedlots currently in the county. The county does participate as a delegated county in the MPCA s Feedlot Program.

The Year 2000 animal inventory counted some 245,000 hogs, an increase of more than 18 percent since 1997. There were approximately 1,000 beef cattle and 5,700 dairy cattle during the most recent inventory. The numbers of hog producers and dairy producers have both decreased over the last decade by nearly more than 40 percent, while production decreased only slightly; this follows the oft-seen trend of larger operations.

Nicollet County adopted revised feedlot regulations in December 2000, after six months of field-testing of OFFSET. OFFSET is a statistical methodology for predicting encounters with odors and nuisances from feedlots. The model s predictions are based on several factors, including distance from various types of facilities, the season and prevailing wind patterns, among others. Based on the findings of the OFFSET field tests, the county expanded the setbacks from feedlots according to the model s odor ratings. For example, the new setbacks are designed to ensure that residents in the agricultural zone will be free from annoying odors 93 percent of the time. For cities, the setbacks are designed to ensure freedom from annoying odors 99 percent of the time. The county intends to continue testing the model in late 2001.

During the process to update the feedlot ordinance, in 1999 the county formed a feedlots task force to solicit input from commissioners, farmers, producers, citizens and local officials in focus groups, public hearings and informational meetings.

The overall reaction to the ordinance has been mixed, but there has been somewhat intense reaction from farmers. County staff indicated that farmers were not particularly pleased

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1 Population data is from the Minnesota State Demographer s Office.

2 Data from the 1997 Census of Agriculture supplied by the Minnesota Pollution Control Agency s Feedlot Program and MPCA projections.

3 Much of the information presented here was obtained from a survey completed by the Nicollet County Environmental Services Department staff and from an interview conducted on March 16, 2001 with Tina Rosenstein, the department director.

with the new ordinance but felt they could live the new setbacks. The farmers were upset with the county s setting of a cap of 3,000 animals units per feedlot, although no current operation has that many animal units.

The county typically receives about 10 complaints per year about feedlots. Over time, the majority of the feedlots complaints have centered around improper disposal of dead animals, manure stockpiling and spreading and odors. In the past, hog operations generated the most complaints about odors, followed by poultry and dairy cattle.

Non-farmers and newcomers appear to complain more frequently than others. County staff indicated that they respond to complaints about feedlots using the same procedure for all complaints about any county service. Staff tries to follow-up every complaint with a site visit on the same day, if possible. If an identifiable problem exists, the staff tries to work with the producer to remedy the problem. Staff then follows-up with the person who originally place the call to inform them of the extent of the problem and corrective action taken, if any.

Although it has no formal or written procedure for doing so, the county attempts to advise all newcomers to the county and the agricultural zone about the potential nuisances of living in the zone. Staff shows all persons requesting building permits the location of feedlots and manure-spreading fields in relation to the area in which they desire to build.

Staff believes the county s policies and ordinances have been effective in reducing conflicts concerning feedlots because they provide an orderly method for resolving issues. They indicate that the OFFSET model should do even more to reduce complaints, once it is fully implemented and effective.

Pennington County [4]

PROFILE

Pennington County is located in the northwest corner of Minnesota. Pennington County does not have extensive livestock production and ranks low in the State in terms of number of livestock farms and animals. According to the Minnesota Agriculture Census, the County had just 10 hog farms, 60 dairy farms, and 320 beef farms in 1997. Since 1980, the County has seen a dramatic decline in the number of hog farms (80% decline), and the loss of half of their dairy farms. The beef farms have remained stable, but they are mainly small (50-100) cow operations by part-time operators.

The level of conflict has been low as observed by the former county feedlot officer. He attributes this to the low, disperse population in the county. There is one 1,100 cow dairy in the county, near Thief River Falls, that has caused concern over feedlots among Pennington County residents. It is located near an urban area and in the midst of non-farm rural development. Non-farm neighbors have complained about the diary, and older farmers have been opposed because it is not agriculture, it is a factory.

Pennington County has no ordinances in effect for feedlots. Norden Township is in the process of changing their township ordinance to specifically address keeping very large feedlot operations (usually 300 animal units and more) out of the Township based on citizen request for such limitations. They are very cognizant of the impact that smaller operations, familiarly called "family-owned", would have on the area and are thus limiting the ordinance to the very large, usually corporate operations.

Numedal Township is also in the final stage of drafting an ordinance to control the introduction of very large animal operations into the Township by zoning areas where the operations may be located.

Pennington County was originally a delegated county as part of the MPCA s feedlot permitting program. The County has since decided to withdraw from the program. The decision was made based upon the scope and complexity of the requirements for the feedlot officer to stay in compliance with the program, and the insufficient funding for the County to accomplish the educational and enforcement requirements.

There was a resolution in support of a six-county ordinance, but that was passed prior to when the revisions in MPCA s feedlot rules were finalized. The ordinance will most likely not be implemented due to the withdrawal actions of many of the counties.

In order to manage potential conflict over feedlots, the County (the Pennington County Board of Commissioners and the County Extension Educator) has proposed locating new

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4 Interviews with Howard Person, former Pennington County Feedlot Officer, currently UM Extension Educator; Skip Swanson, Planning and Zoning staff; and Don Jensen, County Commissioner.

feedlots in those Pennington County townships that express a desire for large operations. Some townships view this as an economic development tool. Proposed feedlot operators would be directed to the townships that adopt ordinances allowing large operations.

There have not been any new feedlots located within the County so this technique for managing conflict has not been tested. However, this open policy gives residents and elected officials the chance to think about what may be coming and to feel a part of the process.

Pennington County's primary concerns are to make sure that livestock producers are aware and educated on the changes in MPCA permitting rules so there are no unpleasant surprises. The County is also working on additional grant and governmental programs geared to help smaller animal agriculture operations stay in compliance with overriding laws, rules, and regulations without having the compliance bankrupt the operator.

Pipestone County
PROFILE

Pipestone County is located in the southwestern part of the State, along the State s border with South Dakota. Pipestone County is rural in nature, with more than 80 percent of the County s 464 square miles of land cover consisting of hay and pasture land; less than three percent of the County consists of urban and rural development. The County s projected 2000 population was 10,170.[5]

According to data supplied by the Minnesota Pollution Control Agency (MPCA)[6] and County staff,[7] there are approximately 580 feedlots in Pipestone County. Hogs represent approximately 57 percent of the animals in the County and poultry accounts for nearly 26 percent.[8]

Pipestone County participates as a delegated county in the MPCA s Feedlot Program. The County uses the following to guide its actions: township ordinances, county ordinance, 7020 rules, and EAW and NPDES rules.

Pipestone County s first land-use ordinance was adopted in 1976; a major feature of the ordinance was the re-definition of commercial farms. The first permit regarding feedlots was issued for a sow unit in 1989. The County s comprehensive plan points out areas the zoning ordinance must follow concerning feedlots.

Pipestone County is in the process of combining five plans into one (comprehensive plan, zoning ordinance, feedlot ordinance, SWCD, etc.) in an attempt to make the comprehensive plan more useable. The new combined comprehensive plan will be presented to the County board in March 2001.

Six townships in Pipestone County adopted the same feedlot ordinance in 1998. Troy Township adopted a comprehensive plan and a township-zoning ordinance that are more restrictive than those of the County and of the other townships. Troy Township now has a moratorium on feedlots.

There have been no gross violations (e.g., allow manure to enter the waters of the state) and there have only been three violations in five years.

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5 Population data is from the Minnesota State Demographer s Office.

6 Data from the 1997 Census of Agriculture supplied by the Minnesota Pollution Control Agency s Feedlot Program and MPCA projections.

7 Much of the information presented here was obtained from a survey completed by Pipestone County Feedlots Staff and from an interview conducted on February 7, 2001 with John Biren, Conservation and Zoning Administrator, Gordon Baden, County Commissioner, and Ian Cunningham, Soil and Water Conservation Officer.

8 Data obtained from Minnesota Planning s Land Management Information Center.

During the development of the County s feedlot ordinance, three public hearings were held involving the townships, producer groups and others to solicit input. County staff indicates that reaction to the feedlots ordinance has been positive and will remain so as long as they (the County) and the ordinance don t do something stupid. The staff likes to believe the feedlot ordinance may have helped reduce conflicts around feedlots, although they are not sure. They sense that it s not as tense as it used to be.

The County staff indicated that there were 15 complaints in the year 2000. Six of the complaints were for odor, three for aesthetics, two for spills/leaks and four were other types of complaints. Non-farmers appear to complain more frequently, followed by farmers, newcomers and organized groups. Hog operations generate the most complaints, followed by dairy cattle, beef cattle and poultry operations.

When a complaint is received, County staff tries to first determine the legitimacy of the complaint. If the complaint is determined to be legitimate, an investigation is undertaken immediately, followed by appropriate enforcement actions. The staff have used other methods to inform and involve the public, including public demonstrations, test plot work and annual meetings. Staff indicated that they believe it is their job to try to get the facts out to the public.

Suggestions from County staff for reducing and solving feedlot conflicts include unifying all enforcement levels concerning feedlots, since most government personnel (and feedlot operators) do not understand all the components of the feedlots issues. Those components include township ordinances, county ordinance, state 7020 rules, EAW and Federal NPDES rules.

Redwood County
PROFILE

Redwood County is located in the southwestern quadrant of Minnesota, bordered on the north by the Minnesota River. Redwood County is rural in nature, with 90 percent of the county s 654,174 acres of land cover consisting of cultivated land; slightly less more than two percent of the county consists of urban and rural development. The county s projected 2000 population was 16,960.[1]

According to data supplied by the Minnesota Pollution Control Agency (MPCA)[2] and county staff,[3] there were 220 feedlots in the county at the time of the 1997 Census of Agriculture. County staff estimates some 800 feedlots currently in the county, according to a windshield survey conducted in late 1997.

The Year 2000 animal inventory counted some 198,000 hogs, a decrease of 14 percent since 1997. There were approximately 6,000 beef cattle and 2,400 dairy cattle during the most recent inventory. The numbers of hog producers and dairy producers have both decreased over the last decade by nearly 50 percent, while production has remained about the same; this follows the oft-seen trend of larger operations.

Redwood County staff believes the county was among the first in the state to adopt feedlot regulation. The county adopted a feedlot ordinance in 1993, in part to set standards for feedlots and to help limit the number of complaints about them. The ordinance was revised in 1996 and 1999; no further changes are planned at this time, unless new statewide rules are enacted. The county has a comprehensive land use plan, which it may update in the near future.

The county does not participate as a delegated county in the MPCA s Feedlot Program, believing the program has not worked well and that enforcement of the rules may prove burdensome for a department that already has 10 separate functions. The staff also believes that county administration results in locally appropriate standards and fewer violations.

During the initial development and subsequent updates of the feedlot ordinance, the county solicited input from commissioners, farmers, producers and citizens in public hearings and informational meetings.

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1 Population data is from the Minnesota State Demographer s Office.

2 Data from the 1997 Census of Agriculture supplied by the Minnesota Pollution Control Agency s Feedlot Program and MPCA projections.

3 Much of the information presented here was obtained from a survey completed by the Redwood County Environmental Services Department staff and from an interview conducted on March 16, 2001 with Jon Mitchell, the department director.

County staff also met individually with township officers to address their issues. The overall reaction to the ordinance has been mixed, but there has been little significant reaction to any of the county s actions.

The county typically receives very few complaints about feedlots only one in the Year 2000; however, that was seen as an unusually quite year. Over time, the majority of the feedlots complaints have centered around manure stockpiling and spreading. In the past, hog operations generated the most complaints about odors, followed by poultry and beef cattle.

Farmers appear to complain more frequently than others, followed by non-farmers. County staff indicated that they try to respond to complaints as soon as possible and follow-up every complaint with a site visit. If an identifiable problem exists that cannot be resolved during the visit, the staff informs the offending party that it will use all appropriate remedies to correct the problem.

The county attempts to advise all newcomers to the county and the agricultural zone about the potential nuisances of living in an agricultural zone, although it has no formal or written procedure for doing so.

Staff believes the county s policies and ordinances have been effective in reducing conflicts concerning feedlots because they provide an orderly method for resolving issues.

Renville County
PROFILE

Renville County is located 100 west of the Twin Cities in the west central part of Minnesota. The county is rural in nature, with 91 percent of its 631,730 acres of land cover consisting of cultivated land; slightly less more than two percent of the county consists of urban and rural development.[1] The county s 2000 population was 17,154, a decline of nearly three percent since 1990.[2] Renville County staff estimates some 400 feedlots currently in the county. The county is in the midst of a Level II Inventory, which is expected to be completed later this year.[3]

Renville County is primarily a hog county. The latest animal inventory counted some 245,000 hogs in 2000. There were approximately 1,300 beef cattle and 2,800dairy cows during the most recent inventory.

The county does not participate as a delegated county in the MPCA s Feedlot Program, citing the low level of state funding as the cause of its nonparticipation. The county is, however, expected to enroll in the program by the end of 2001.

Renville County has a comprehensive plan and adopted its first ordinance regulating feedlots in the early 1970s. That ordinance was seen as friendly to producers as it contained few restrictions on feedlot operations. The ordinance was revised in 1996 and is currently being updated. The proposed, six-chapter, land-use ordinance that includes a feedlot section is now seen as environmentally friendly with many of the standards currently in use in other Minnesota counties. The new ordinance will prohibit earthen basins and lagoons, aerial spraying and feedlots in shoreland areas. The revised ordinance has passed an initial review by the planning commission and is expected to be adopted by the county commissioners in May 2001. The county has tabled a proposed odor ordinance.

Six public hearings were held during the development of the new land use ordinance. The largest producer in the county offered significant input on the feedlots chapter. The overall reaction to the ordinance has been mixed, but there has been little significant reaction to any of the county s actions.

County staff indicated that it directly receives relatively few complaints about feedlots, acknowledging that most citizens lodge their complaints directly with the state duty officer because of a sense that the county cannot or will not do anything to address their complaints. County staff cites a lack of enforcement authority as a primary reason for this

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1 Land cover information from Land Management Information Center.

2 Population data from the Minnesota State Demographer s Office.

3 Much of the information presented here was obtained from a survey completed by the Renville County Environmental Services Department staff and from an interview conducted on April 23, 2001 with Eric Van Dyken, the county environmental officer.

situation. Renville County is the leader among Minnesota counties in the number of complaints received by the MPCA about feedlots.
Of the complaints the county does receive and investigate, the majority of the feedlots complaints have been generated by odors almost exclusively from hog operations. Only three complaints received in 2000 by the county involved localized manure spills. Non-farmers appear to complain more frequently than others, followed by farmers and newcomers to the area. County staff indicated that they respond to all complaints as soon as possible and try to follow-up every complaint with a site visit.

The county makes no attempts to advise newcomers to the county and the agricultural zone about the potential nuisances of living in an agricultural zone. The county has co-sponsored meetings with the MPCA, the SWCD and Extension Service to explain the revised feedlot rules.

Staff indicated that it is not sure whether the county s policies and ordinances have been effective in reducing conflicts concerning feedlots. Staff is confident, however, that the new regulations will help reduce or prevent future problems.

Rice County
PROFILE

Rice County is located in the southeastern quadrant of Minnesota, approximately 50 miles south of Minneapolis. Rice County is rural in nature, with nearly 68 percent of the County s 496 square miles of land cover consisting of cultivated land; slightly less than five percent of the County consists of urban and rural development. The County s projected 2000 population was 54,730.[4]

According to data supplied by the Minnesota Pollution Control Agency (MPCA)[5] and County staff,[6] there were approximately 247 feedlots in the County at the time of the 1997 Census of Agriculture, and 803 feedlots according to the most recent Level II Inventory. The County s permitted capacity for feedlots allows for 600 beef cattle operations, 400 for dairy cattle, 390 for hogs, and 235 for poultry.

Rice County adopted its feedlot zoning ordinance in 1988. During the development of the feedlots ordinance, the County solicited public input from farmers, producers and citizens. There has been no significant reaction to the ordinance and no changes are planned for land-use policies or feedlots ordinance at this time. Rice County participates as a delegated county in the MPCA s Feedlot Program.

The County receives a moderate number of complaints about feedlots about 12 in the year 2000. The majority of the feedlots complaints center around manure spills and leaks and the application of manure too close to ditches. Hog operations generate the most complaints about odors.

Non-farmers appear to complain more frequently than others, followed by other farmers and newcomers to the area. Staff believes the County s proximity to the Twin Cities and its increasing attractiveness as a bedroom community in the Twin Cities commuter shed are reasons for the complaints from these groups. Perhaps a contributing factor is that the County does not inform persons moving into the agricultural zone about potential nuisances associated with living in the zone.

County staff indicated that they take timely action to address complaints. They use an unwritten procedure to validate complaints, and no complaint is considered valid unless the caller leaves a name. Once a complaint is validated, staff follows-up with a call or site visit, as appropriate.

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4 Population data is from the Minnesota State Demographer s Office.

5 Data from the 1997 Census of Agriculture supplied by the Minnesota Pollution Control Agency s Feedlot Program and MPCA projections.

6 Much of the information presented here was obtained from a survey completed by the County s Planning and Zoning Department staff and from an interview conducted on March 5, 2001 with Wade Schulz, the County s new feedlot officer.

Staff believes the County s policies and ordinances have been effective in reducing conflicts concerning feedlots. They cite the increased awareness of the feedlot officer and their ability to satisfy or placate complainers as evidence of its effectiveness. One of the staff s goals is to bring all feedlots into compliance with current rules.

Staff also believes the public has a clearer picture of the issues concerning feedlots through its public-information efforts, which it conducts several times a year.

Rock County
PROFILE

Rock County is located in the extreme southwestern corner of Minnesota, along the State s borders with Iowa and South Dakota. Rock County is rural in nature, with nearly 85 percent of the County s 845 square miles of land cover consisting of cultivated land; less than three percent of the County consists of urban and rural development. The County is one of the few in Minnesota with no lakes. The County s projected 2000 population was 9,590.[7]

According to data supplied by the Minnesota Pollution Control Agency (MPCA)[8] and County staff,[9] there are approximately 830 feedlots in Rock County. Some 620 feedlots have more than 500 animal units. Hogs represent approximately 54 percent of the animals in the County and beef cattle account for nearly 38 percent.[10] According to County staff, there are fewer animals in the County now than in 1993.

Rock County adopted its feedlot ordinance in 1993. A force in the development of the ordinance was the County board s desire to have a better sense of local control over issues concerning feedlots. At the time the ordinance was adopted, the County was starting to see a change in agricultural technology and farm practices, with larger buildings and larger concentrations of animals.

Rock County participates as a delegated county in the MPCA s Feedlot Program and follows the State s 7020 rules. Currently, no site visits are required to get a feedlot permit in Rock County and staff indicates that the County does not have the money to help people fully comply with the feedlots ordinance.

County staff indicates that its approach to feedlots is based more on technical support and education than on strict enforcement of rules. Staff believes the policies and ordinances have been effective overall. No changes are planned for land-use policies or feedlots ordinance at this time.

During the development of the feedlots ordinance, the County solicited public input from farmers, producers and citizens. There has been no significant reaction to the ordinance, although there was some confusion about the changes when the ordinance was enacted.

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7 Population data is from the Minnesota State Demographer s Office.

8 Data from the 1997 Census of Agriculture supplied by the Minnesota Pollution Control Agency s Feedlot Program and MPCA projections.

9 Much of the information presented here was obtained from a survey completed by County staff and from an interview conducted on February 7, 2001 with John Burgers, the director of the Rock County Land Management Office and county feedlot officer.

10 Data obtained from Minnesota Planning s Land Management Information Center.

The County experiences a good deal of cooperation from producers, farmers and the general public. Farmers indicate they can live with the ordinance and both sides believe they have a playing field they can understand.

Last March the County held an open meeting to update the public on feedlots and to solicit input on feedlots and the environment; some 300 people attended and the County served a meal at a cost of $8 per person. The meeting was sponsored by producers, businesses and local banks; the County also held meetings with contractors.

The County plans to continue holding public meetings and meetings with other groups, e.g., producers, as necessary, to provide information and solicit input about feedlots. Staff believes the state and county approach should be to concentrate their efforts on the 10 percent who comprise the worst offenders and use loan money to institute best practices in manure management. Staff also believes the good neighbor approach and a focus on better management practices works better than strict enforcement of rules.

The County receives relatively few complaints about feedlots less than five in the year 2000. Non-farmers appear to complain more frequently than others, followed by newcomers, organized groups and farmers. Hogs and dairy cattle operations generate the most complaints, followed by beef cattle and poultry. The County does inform persons moving into the agricultural zone about potential nuisances associated with living in the zone.

County staff indicated that they take immediate action to address complaints by talking with the complainant or visiting the person as soon as possible. Staff believes the County s policies and ordinances have been very effective in reducing conflicts concerning feedlots.

Staff sees some direct environmental benefit to the ordinance and thinks water quality has improved since 1993. A concern is that the benefits cannot be quantified. One other related environmental problem is that the County has to cover some 50 abandoned wells each year.

Stearns County
PROFILE

Stearns County is located in central Minnesota, about 65 miles northwest of the Twin Cities; it is the largest county in the southern half of the state. Stearns County is rural in nature, with slightly more than 58 percent of its 1,394 square miles of land cover consisting of cultivated land and nearly 18 percent in hay and pasture; almost five percent of the County consists of urban and rural development. The County s projected 2000 population was 134,740.[11]

According to data supplied by the Minnesota Pollution Control Agency (MPCA)[12] and County staff,[13] there are 2,770 feedlots in Stearns County s Level II Inventory. There are 2,350 feedlots of 10 or more animal units in the County. Dairy cattle and poultry operations comprise the majority of operations, followed by hogs and beef cattle. Dairy cattle represent approximately 42 percent of the animals in the County while poultry account for 27 percent; hogs and beef cattle each comprise nearly 15 percent of the total.[14] The largest feedlot operation in the County has some 1,400 animal units.

Stearns County adopted its first countywide comprehensive plan in 1996-1997. The County s feedlots ordinance was adopted on September 18, 1998. The County s zoning ordinance was enacted on April 21, 2000. Following state rules, the County does not regulate operations with fewer than 10 animals. Further, the Stearns County feedlots ordinance has setback requirements; the state rules do not.

Stearns County participates as a delegated county in the MPCA Feedlots Program and has submitted the required annual reports to the MPCA. The County staff believes the feedlots ordinance is working as intended and no changes to any of the land-use controls are planned at this time.

The County board appointed a taskforce to guide the development of the feedlots ordinance. The taskforce members included citizens, scientists, farmers, operators, University of Minnesota Extension Service staff, County staff and environmental groups. The taskforce held four open meetings to receive input. Some 300 people attended two public meetings the County held before adopting the feedlot ordinance.

The staff does not feel the feedlots ordinance has helped reduce complaints about feedlots, primarily because that was not its purpose. County staff indicated that there have been no

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11 Population data is from the Minnesota State Demographer s Office.

12 Data from the 1997 Census of Agriculture supplied by the Minnesota Pollution Control Agency s Feedlot Program and MPCA projections.

13 Much of the information presented here was obtained from a survey completed by County staff and from an interview conducted on February 21, 2001 with Lenny Hulburt, environmental specialist-feedlots.

14 Data obtained from Minnesota Planning s Land Management Information Center.

significant reactions (positive or negative) to the feedlots ordinance. The County has not used any other methods (e.g., meetings, public information, etc.) for addressing conflicts over feedlots.

The feedlots staff receives some 30 complaints per year concerning feedlot operations. The most prevalent complaints are about odors, followed by complaints about spills/leaks or cases where the manure spreading is believed to be too close to houses or waters. The County has a formal procedure for registering and investigating feedlots complaints, although it prefers that neighbors work out their differences.

Of the complaints received in 2000 in which the complaining party could be identified, four were from newcomers to the area, three from organized groups (COACT and lake associations), two from farmers, one from non-farmers and five from other sources. Many registering complaints prefer to remain anonymous.

With the issuance of each permit for new residential construction or expansion in the agricultural zone, the County advises the permittee of potential nuisances.

Belle Prairie Township
Morrison County

A few miles North of Little Falls in central Minnesota lies the township of Belle Prairie. Not far from the banks of the Mississippi River, Belle Prairie Township is located in Morrison County and has a population of 1,692.

Gregg LeBlanc, the Belle Prairie Township supervisor, said that the township turned all control of feedlots over to the county effective January 1, 2001, because of liability issues. LeBlanc noted that this was a diplomatic action considering the bad publicity and negative exposure the township was receiving. The most harmful press involved a lawsuit challenging that the township was taking up too much land. According to LeBlanc, the township's relationship with the county is very good which made the deferment of feedlot ordinances to Morrison County an easy choice.

This information is from an interview with Belle Prairie Township supervisor, Gregg LeBlanc on March 26, 2001.

Concord Township
Dodge County

Northwest of Rochester, Concord Township is located in northeast Dodge County. Originally, the township enacted ordinances because of concerns about feedlot odor, added truck traffic, and the potential damage to the roads resulting from the additional industrial traffic. All feedlots under contention were specifically feedlots for hogs. The people who registered complaints were non-farmers, both newcomers and long-time residents.

As new feedlot concerns within the township are voiced, public hearings are held and ordinances are referenced and explained. Bill Lambert of Concord Township feels their ordinances provide effective guidelines, keep corporations limited, and give the town board input and direction when new feedlots are proposed. Suggestions of Concord Township for reducing and resolving complaints and concerns about feedlots are to hold public meetings and to encourage neighbors to talk to one another, keeping communication active.

The separation distances and setbacks established in Concord Township are as follows: new or expanding feedlot with 499+ AU setbacks are: 200' from nearest adjoining property line; 2' for each AU- 1/4 mile minimum from nearest residence other than operator's; 3' for each AU- 1/3 mile minimum from church, school, town hall or similar use, intended as a public gathering place. Feedlot building 200' from centerline of public street, road or highway. New or expanded feedlot setback from existing feedlot containing 250 AU by 2' for each AU of the larger (greater number of AU) of existing, new or expanded feedlot. New or expanded feedlots containing 499+ AU must be setback a minimum of 1/4 mile from existing feedlot with 250 or more AU.

Conditional Use Permits: CUP required for feedlot exceeding 499 AU when following conditions exist: new feedlot is proposed where didn't exist before; restock an existing feedlot with livestock after unused for 1+ yrs. Expansion or modification: 1) of existing feedlot. Expansion or modification: 1) existing feedlot resulting in 500+ AU; 2) already received a CUP - feedlot and expansion resulting in 100+ AU or at least 100+AU than allowed under existing permit; or 3) results in existing feedlot to exceed 100 or more than it had as of the effective date of the ordinance.

This information is from a survey and interview with Bill Lambert of Concord Township on March 15, 2001, and from the Minnesota Department of Agriculture Feedlot Ordinance Survey.

Holding Township
Stearns County

Northwest of St. Cloud, Holding Township is located in northeastern Stearns County in central Minnesota. Like nearby Belle Prairie, Holding Township handed over all feedlot control to the county. According to Mark Kociemba, the Holding Township supervisor, the township ceded control to the county because it didn't want to be seen in "bad company" with its residents. Since the county already held control over other land use ordinances, the township viewed this submission to county control as a tactful and necessary move.

The feedlots in Holding Township consist of dairy lots, hog lots and poultry facilities, all of which must be 200' from the property line and 700' from neighboring residence (these setbacks may be waived if neighbors legally sign an easement).

This information is from Holding Township supervisor Mark Kociemba and from the Minnesota Department of Agriculture Feedlot Survey.

Kenyon Township
Goodhue County

Kenyon Township lies fifteen miles due East of Faribault, in the southwest corner of Goodhue County in southeastern Minnesota. The township sits along the North Fork River. Feedlots have caused some controversy with the people of the township. In August of 1997, an interim ordinance was adopted, followed by draft zoning ordinance dated June, 29, 1998. According to George Derscheid, Kenyon Township clerk, the zoning and feedlot provisions were initially enacted because the township and its residents were unhappy about county requirements for proposed feedlots. Kenyon Township residents have been strongly supportive of the township's initiative in enacting its own ordinances.

Derscheid cites one feedlot that has stirred local debate in the last year; complaints have been issued to the township about the size of the proposed hog feedlot and the resulting effects such an operation can have on the surrounding area. These complaints have triggered public meetings, which the township sees as an effective tool in addressing and managing conflict. The public forums have aided Kenyon Township in resolving community concerns about feedlots by listening to residents complaints and comments, explaining township, county and MPCA ordinances to residents and prospective feedlot owners, and providing a public space where all interested parties can communicate.

Kenyon Township's separation distances and setbacks: new and expanding feedlots of 500+ AU 1/2 mile from public parks (not public trails), occupied dwellings, and other feedlots. Minimum acreage: new feedlots<100 AU no minimum land area; 100-500 AU 40 acres; 501-750 AU 70 acres; 751-1500 AU 150 acres; 1501+300 acres. Expansion of existing feedlot with <500 AU at date ordinance adopted: expand up to <500-no additional land required; <750 AU-70 acres; <1500-150 acres; >1500 AU-300 acres. Expansion of existing feedlot with 501-750 AU at date ordinance adopted: expand up to <750 AU-no additional land required; <1500 AU- 150 acres; >1500 AU-300 acres. Expansion of existing feedlot with <751-1500 AU at date ordinance adopted: expand up to <1500 AU-300 acres; >1500 AU- 300 acres.

This information is from a survey and interview with the clerk of Kenyon Township, George Derscheid on March 17, 2001, and from the Minnesota Department of Agriculture Feedlot Ordinance Survey.

New Prairie Township
Pope County

New Prairie Township is located in the northwest corner of Pope County in central Minnesota. The township first established feedlot ordinances in 1979 as an indirect response to a powerline controversy. At that time, powerlines ran diagonally across Minnesota from North Dakota to the Twin Cities. Seeing this as a violation of their property rights and one given with little warning, area farmers were inspired to act. The resulting local ordinances were designed to give them more control over what was happening to their land and the surrounding area. The Conditional Use Permits established in 1979 required a feedlot to be 1/4 lot from neighboring residents.

Nancy Barness, New Prairie City Clerk, said the 1979 ordinances were updated in 1995 and 1996 following two lawsuits over hog feedlot odor problems, dubbed New Prairie Township vs. the Canadian Connection. New Prairie won both lawsuits and thus updated their ordinances to attain more control over feedlot regulations. Barness explained that because the township cannot control pollution, they felt it necessary to establish regulations that would identify locations and setbacks that would minimize the nuisances of feedlots for residents and farmers. These regulations have helped to minimize complaints about odor and traffic from large trucks on gravel roads. In keeping with their own experience,

New Prairie Township suggests that controversy around feedlot can be resolved by enacting ordinances at the township level.

Current separation distances and setbacks are as follows; new or expanding feedlot with 450+ AU setbacks are: 200' from nearest adjoining property line; 2' for each AU - 1/4 mile minimum from nearest residence other than operator's; 300' from public or waterway.

Current Conditional Use Permits; 450+ AU; new feedlot where one did not exist; expansion or modification where cumulative total exceeds 450 AU; restock an existing feedlot with livestock unused for 3+ yrs. If existing feedlot had received a prior cup, then any expansion of 100+ AU over the permitted use shall require an updated cup. Any manure storage area for 450+ AU.

This information is from an interview with New Prairie Township Clerk, Nancy Barness on March 30, 2001, and from the Minnesota Department of Agriculture Feedlot Ordinance Survey.

Pleasant Mound Township
Blue Earth County

Southwest of Mankato, Pleasant Mound Township is located in the southwest corner of Blue Earth County in southern Minnesota. Watching trends in animal agriculture, the township anticipated that feedlot problems may be on their way. In response, Pleasant Mound Township began the process of adopting ordinances several years ago. This proactive planning led them to adopt a zoning ordinance in 1998. The reason for enacting township feedlot ordinances was because they saw the county's feedlot restrictions as too lenient.

Soon after the ordinances were in place, a problem arose with a proposed feedlot. The township residents felt that the feedlot would be too big and feared odor and flooding/leakage problems. Public hearings regarding the feedlot proposal were held, along with advisory and planning committee efforts, which eventually prevented the feedlot from being built.

According to Alice Meier, secretary of Pleasant Mound Township, long-time residents of the township are most concerned with large, corporate farms. Having experienced no problems since the initial proposed feedlot, residents are now confident in the feedlot ordinances and restrictions they have set. Meier claims that the township struggles continually with the county over issues of control, that the county wants to remain all powerful. Pleasant Mound Township's suggestions for reducing and resolving conflict over feedlots are to enact stringent restrictions, put farming back into the hands of the farmers and encourage sustainable agriculture.

Separation Distances and Setbacks in Pleasant Mound are; 1 mile from churches and schools; 1/2 mile from historic features; 2070' from nearest neighboring dwelling; 233'

center or town roads; 200' from adjoining properties without structures; 300' from public and private ditches; 500' from other feedlots for which CUP is required. Animal units cannot exceed 600 units per site; 250 swine per site. The township actually has no more than 480 animals on any of their sites.

This information is from a survey and interview with the secretary of Pleasant Mound Township, Alice Meier, on March 15, 2001 and from the Minnesota Department of Agriculture Feedlot Ordinance Survey.

Red Rock Township
Mower County

East of Austin, Red Rock Township is located in eastern Mower County along the Iowa-Minnesota border. Four years ago Red Rock Township enacted feedlot ordinances in response to a prospective corporate feedlot. The township did not want a feedlot of such large size in their area. Also the land that the prospective buyer was considering was in close vicinity to over forty residents on the outskirts of the City of Austin. The ordinances that were enacted require a maximum capacity of 750 animal units per site. According to Red Rock Chairman Roger Slindee, the township and its residents are confident that their ordinances have successfully discouraged corporate farms from moving into the area. Initially, Mower County was reluctant to give support to Red Rock Township s determination of its own ordinances. The county s hesitance, Slindee notes, has given away and a decent working relationship between the county and township has been established.

The township sees poor feedlot management as being more crucial than feedlot size in determining whether a feedlot will have conflicts with regulations and residents. One way that the township helps to maintain a friendly relationship with its farmers is by not requiring any licensing for feedlots that are within said requirements. Suggestions of the township for avoiding feedlot conflict are finding a healthy balance between agriculture and rural residents, and aiding family-owned farms whenever possible.

Red Rock Township's separation distances and setbacks are as follows: new or expanding feedlot with 450+ AU setbacks are: 200' from nearest adjoining property line; 2' for each AU - 1/2 mile minimum from nearest residence other than operator's; 1/2 mile from incorporated city; 2' for each AU - 1/2 mile minimum from church, school, town government building; 1/4 mile from another feedlot. Feedlot building or manure storage area 200' from centerline of township road.

Red Rock Township's Conditional Use Permits are as follows: 450+ AU; new feedlot where one did not exist; expansion or modification where cumulative total exceeds 450 AU; restock an existing feedlot with livestock after being abandoned or unused for 1+ yrs. If existing feedlot had received a prior CUP, then any expansion of 100+ AU over the permitted use shall require an updated conditional use permit.

This information is from an interview with Red Rock Township Chairman, Roger Slindee on March 26, 2001, and from the Minnesota Department of Agriculture Feedlot Ordinance Survey.

Silver Lake Township
Martin County

Near Interstate 90, Silver Lake Township is located in Martin County, along the Iowa-Minnesota border. According to Lawrence Sukalski, Silver Lake Township Chairman, the township heard over ten complaints in the last few years about the strong odor rising from nearby feedlots. As a result of the citizen s concerns, the township spent over two years in moratorium, planning and zoning. Because of the heavy legal costs of this action, however, the township was forced to relinquish control to the county.

Sukalski notes that township residents have not been satisfied in the county s handling of the feedlot odor problems. They feel that the county is too lenient with the policies and ordinances that have been enacted. Silver Lake Township would like to reclaim control of feedlot regulations, but this action would require an estimated $50,000-60,000 in order to complete sufficient planning and zoning ordinances.

Silver Lake Township has also had trouble getting support from the Minnesota Pollution Control Agency. The MPCA, according to Sukalski, seems uninterested in the township's complaints and repeated requests for assistance. Pollution Control s lack of response has led the township to view the organization as siding with the violators of the ordinance more than with those who attempt to regulate it. Sukalski cites one prominent example regarding tile water that was contaminated from a feedlot. This potential violation was brought to the attention of the agency. MPCA, in turn, responded that the contamination wasn't from a feedlot, vaguely saying that it could have been from anything without providing any other information. This response allegedly came after little or no investigation of the complaint. As a result of this lack of support, the township has purchased air-testing equipment to produce concrete evidence of feedlot contamination. Once this data is compiled, Sukalski says, the township s claim will be difficult to ignore. Already they have recorded many violations, and they intend to keep testing until they have enough evidence to garner action towards real solutions to the township s feedlot odor problems.

This information is from an interview with Silver Lake Township Chairman, Lawrence Sukalski on March 21, 2001.

Wang Township
Renville County

Southeast of Montevideo, Wang Township is located in the northwest corner of Renville County in south-central Minnesota. Wang Township Chair Robert Lerohl said the township currently has no feedlots within its limits. Wang has, however, taken a proactive approach to feedlot regulations, having already established an ordinance for feedlots.

The ordinance states that the owner or operator of a feedlot must secure a permit from the township board of supervisors. A feedlot must be setback 700' from neighboring residence. A livestock sewage lagoon that is10 acre feet or less capacity must be1400' from neighboring residence; 10 acre feet, but less than 20 acre feet must be 2800' from neighboring residence; 20 acre feet or more must be 1 mile from neighboring residence.

This information is from Wang Township Chair Robert Lerohl, and from the Minnesota Department of Agriculture Feedlot Ordinance Survey.

Attachment 5

Comparison of MDA Ordinance Survey to OFFSET Model

A Study of Livestock Feedlot Separation Distances With OFFSET

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December, 2000; updated March 2001

Section 1. Introduction

This effort seeks to suggest appropriate separation distances for feedlots and to analyze separation distances reported in Feedlot Ordinances from Minnesota Counties[1] with the Odor from Feedlots Setback Estimation Tool (OFFSET) developed by the University of Minnesota Biosystems and Agricultural Engineering Department.

OFFSET considers specie, facility type, facility size, manure storage type and size, and odor control technologies to estimate the necessary separation distance for livestock feedlots that is required to achieve an annoyance free status at varying degrees of frequency. Distances are estimated for sites with a prevailing "downwind" location. Necessary separation distances for non-downwind locations will be over-estimated with this tool.

Forty-three of the ordinances studied defined specific separation distances (some adjusted by animal units, specie, or technology). An additional 14 did not list separation distance requirements but presumably dealt with separation distance through Conditional Use Permit requirements.

An understanding of the Odor for Feedlot Setback Estimation Tool (OFFSET) is critical to interpreting data in this report. Section 2 includes a brief description of OFFSET, adapted from Odor from Feedlots Setback Estimation Tool (OFFSET) by Larry D. Jacobson and Huiqing Guo. Those unfamiliar with OFFSET will need to gain an understanding of the information in Section 2 to relate to data presented in Sections 3 and 4. Section 5 presents some conclusions of this study.

Section 2. Odor from Feedlots Setback Estimation Tool (OFFSET)[2]

Odor emissions from animal production facilities vary by species, housing types, manure storage and handling methods, and the size of the odor sources. The impact of these odors on the surrounding neighbors and communities depends on the amount of odor emitted from the site, the distance from the site, weather conditions and topography.

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[1]Summary of Animal-Related Ordinances in Minnesota Counties. February 2000. Minnesota Department of Agriculture. Contact Becky Balk. http://www.mda.state.mn.us/DOCS/AGDEV/AgLandUse/animalord.html

[2]This section is adapted from Odor from Feedlots Setback Estimation Tool (OFFSET) by L.D. Jacobson and H. Guo, in Livestock and Poultry Odor Workshop II. Department of Biosystems and Agricultural Engineering, University of Minnesota, St. Paul. Undated.

OFFSET is intended to determine the estimated odor frequencies occurring at various distances from an animal production site. Various odor research projects completed between 1997 and 1999 provided the information needed to develop OFFSET. Information collected included odor emission rates from various animal production sites, evaluation of dispersion models and validation of model results by using trained field sniffers and community residents, and incorporation of odor control technologies.

Table 1 outlines the step-by-step process OFFSET uses for determining the total odor emission factor for a specific animal production site. The odor emission factor includes both animal buildings and or manure storage units at a particular site. The procedure accounts for species, housing types and sizes, manure storage types and sizes, and odor control technologies used at the site. Once the total odor emission factor is established, an additional step is needed to determine the setback distance using an odor frequency curve.

Table 1. Summary table for calculating the total odor emission factor

Column A	Column B	Column C	Column D	Column E
Odor source	Odor Emission Number	Area (sq. ft.)	Odor control factor	Odor Emission Factor (B x C x D/10000)
1				
2				
3				
4				
Total Odor Emission Factor (sum of Column E)				

The first step is to identify and list all odor sources at the site, which are entered in Column A. The second step is to select appropriate odor emission values for these sources from Tables 2 and 3 and to enter them in Column B. Tables 2 and 3 give the geometric means of odor emission data for different animal housing systems and various manure storage units respectively, collected by the odor ratings project and a related project since 1997 from nearly 260 sources on over 80 farms in Minnesota. OFFSET uses total odor emission values based on both animal and housing type rather than animal numbers or another size-dependent variable.

Table 2. Odor emission number for animal housing with average management level

Species	Animal Type	Housing Type	Odor Emission Number (OEN)
Cattle	Beef	Dirt or concrete lot	5
	Dairy	Free stall, deep pit or scrape; Loose housing, flush	7
		Tie stall	2
		Open concrete or dirt lot	5
Poultry	Layer	Deep pit, annual clean out	10
		Deep pit, weekly cleanout	3
	Broiler	Litter	2
	Turkey	Litter	2
Swine	Finishing, gestation or nursery	Deep pit, pull plug or scrape, natural or mechanical ventilation	23
		Cargill (open front) with open concrete lot	8
		Deep bedded hoop barn	2
	Farrowing	Flush, mechanical ventilation	10

Table 3. Odor emission number for liquid or solid manure storage

Storage Type	Odor Emission Number (OEN)
Earthen basin, single cell	20
Earthen basin, 1st cell*	20
Earthen basin, 2nd cell	8
Lagoon,* 1st cell*	4
Lagoon,* 2nd cell	1
Settling tank	50
Stockpile	2

* Earthen basins are designed for manure storage without any treatment. Lagoons are designed specifically for manure treatment. To qualify as a lagoon the storage volume must be at least four times the manure production on the farm. Another indication of a lagoon is the management. Lagoons are pumped without agitation and less than 1/3 of the volume is removed each year. If in question, consult with an engineer familiar with lagoon design.

The third step is to determine the emitting area (in square feet) of each odor source listed and enter it in Column C. This is simply the physical dimensions or size (i.e., floor or surface area) of the animal building or the manure storage unit.

The fourth step in the process accounts for odor control technologies being used or considered. This is done by selecting an odor control factor from Table 4, which lists odor reduction levels for known control technologies. If no odor control technology is being used, enter 1" in Column D for the source.

Table 4. Odor Control Factors

Odor Control Technology		**Odor Control Factor**
Biofilter on 100% of building exhaust fans		0.1
Geotextile cover (>=2.4 mm)		0.5
Straw or natural crust on manure	2" thick	0.5
	4" thick	0.4
	6" thick	0.3
	8" thick	0.2
Impermeable cover		0.1
Oil sprinkling		0.5

The fifth step outlined in Table 1 is to calculate the odor emission factor for each source by multiplying the values in Columns B, C, and D and dividing the product by 10,000. The sixth step is to sum the values in Column E to obtain the total Odor Emission Factor for that animal production system or site.

Once the total odor emission factor is calculated, the final step is to estimate the frequency of odors at various distances from the farm site using Figure 1. This estimation is based on computer models and validation of these models using trained professionals and community members in the field. The horizontal axis in Figure 1 is the total odor emission factor as calculated in Table 1. The vertical axis is the distance from the farm site. The curves represent different frequencies of odor annoyance free time. The annoyance free frequency curves on Figure 1 represent the percent of time where odors are possibly detected but at a level that is not annoying. To find the separation distance for a specific frequency curve and total odor emission factor simply find the total odor emission factor on the horizontal axis then move vertically to the desired frequency curve then move horizontally to the vertical axis. The number on the vertical axis is the separation distance in feet needed to achieve the desired frequency of odors.

Note: Annoyance odors are defined as those odors with an intensity above 2 on a 0 to 5 scale. Odors with an intensity of less than 2 are weak or mild odors not likely to be annoying.

However, a small percentage of the population can be classified as highly sensitive to odor. These individuals may detect odors at very low levels and be annoyed at intensities less than 2.

Figure 1. Estimated setback distances from animal operations at different odor annoyance free requirements of surrounding community leeward of the prevailing wind from animal operations.

Different odor annoyance free frequencies result in different setback distances for the same total odor emission factor. For example, with a total odor emission factor of 150, the separation distance for being free from annoying odors 99% of the time is 1.5 miles. However, during the rest of the time (1% or 7 hours per month), the residents at a distance of 1.5 miles will possibly experience odors stronger than intensity 2 (or annoying odors). Reducing the frequency of annoyance free odors to 96% requires a separation distance of less than one half mile. At this distance residents will experience annoying odors 4% of the time or 30 hours per month. The frequency of each curve represents the odor annoyance free time downwind in the prevailing wind direction from the site for warm weather (mid April to mid October). During the winter months less frequent odor events can be expected due to the reduced odor emissions during cold weather.

OFFSET assumes that the receptor is located downwind of the odor source in the prevailing wind direction. Since OFFSET is based on the worst case (prevailing wind direction), odor occurrences in the non-prevailing wind directions would be expected to occur even less frequently than the percentages given in Figure 1. Even though recent studies have found good agreement between field odor measurements and model predictions, research is still being conducted to improve the accuracy of these curves.

Topography also affects odor dispersion. The odor annoyance free curves given in Figure 3 were obtained assuming flat terrain with no obstructions. The dispersion model (EPA-INPUFF2) used in OFFSET has the capability to consider topographic variations (hills and valleys), but that was not incorporated in the results presented here.

Finally, OFFSET also has the ability to consider multiple sites with odor sources (i.e. several livestock production sites). Again this was not implemented in the procedure presented here. It could be implemented later.

Section 3. Site Type and Technology Impacts on Annoyance Free Setback Distances

OFFSET was used to determine the setback distances for various annoyance free levels for six swine and two dairy sites. These sites are representative of current technology, and similar to sites that have encountered siting difficulty or been identified as potentially annoying. In addition, a swine hoop barn site, though not generally considered a severe odor risk, is included for comparison.

The necessary setback distances are calculated for several annoyance free levels: 91%, 94%, 96%, 97%, 98%, and 99%. Annoyance free levels are basically the number of hours per month when there is no annoyance from odor. For example, with a 99% annoyance free level there is 1% annoyance. This equates to 7.44 hours per month (31 days x 24 hours x .01 = 7.44 hours) that there would be annoyance from odor. At 97% annoyance free, the number of annoyance hours would be 22.32 hours per month (31 x 24 x .03). Similarly, at 91% annoyance free, the number of annoyance hours would be 66.96 per month (31 x 24 x .09).

However, it is likely that periods of annoyance would be experienced in shorter time periods when atmospheric conditions would favor odor plume movement near ground level. Table 5 calculates the number of different occasions of annoyance if the occasions have a duration of 6 hours or 3 hours. These calculations are theoretical but attempt to simulate the impact on neighbors.

For instance, a somewhat worst-case scenario for 97% annoyance free is that the 22.32 hours per month would occur in 3 hour time blocks (likely early morning or early evening), resulting in about 7 annoyance occasions per month.

Table 5. Hours/Month of Annoyance at Various Annoyance Levels
(based on 31 day month, month=744 hours)

Annoyance Free Level	91%	94%	96%	97%	98%	99%
Annoyance Level	9%	6%	4%	3%	2%	1%
Hours/Month of Annoyance	66.96	44.64	29.76	22.32	14.88	7.44
Days per month with annoyance occurrence if 6 hours annoyance exists/day	11.16	7.44	4.96	3.72	2.48	1.24
Days/month with annoyance occurrence if 3 hours annoyance exists/day	22.32	14.88	9.92	7.44	4.96	2.48

Swine Facilities

The following swine systems were analyzed:

"2 Barn Swine Finishing-Deep Pit. Barn dimensions = 40 x 200 (16,000 total sq. ft.); 2000 head/site

"11 Barn Swine Finishing Hoop Site. Hoop barn dimensions = 30 x 80 (26,400 total sq. ft.); 2000 head/site, 182 pigs per barn

"4 Barn Swine Finishing-Deep Pit. Barn dimensions = 40 x 200 (32,000 total sq. ft.); 4000 head/site

"4 Barn Swine Finishing-Deep Pit. Barn dimensions = 40 x 200 (32,000 total sq. ft.); 4000 head/site, oil sprinkling

"2 Barn Swine Finishing-Earthen Basin. Barn dimensions = 40 x 200 (16,000 total sq. ft.); 2000 head/site, 201 x 201 earthen manure storage structure

"2400 Sow Swine Breeding/Gestation/Farrowing. 88112 ft(2) of barns, alleys, and office; Deep Pit

"2400 Sow Swine Breeding/Gestation/Farrowing. 88112 ft(2) of barns, alleys, and office; Deep Pit, Bio-Filter

The site square footages used were based on a combination of actual operation information and planning references such as Midwest Plan Service. The square footage used in these examples may not exactly match all operations with a similar number of animals, but if technology is the same (manure storage, odor control technologies, ventilation system, etc.) the variation in odor emissions due to small differences in building size should not be great. The 11-barn hoop site is equal to the 2 barn finishing sites for number of animals (2000 finishing hogs). Observations of larger deep-bedded barns have not been made at this time as few or none exist in Minnesota.

Table 6 shows the results of the OFFSET analysis for each of the seven swine systems. Distances suggested by OFFSET calculations shown are at prevailing downwind sites. Annoyance frequency will be less at other locations. See Section 2 for details on Odor Control Factors.

Table 6. Site Type and Technology Impacts on Annoyance Free Distances-Swine Facilities

Site	Animal Units [1]	Odor Control Factor	Total Odor Emission Factor	OFFSET Separation Distance Calculation, Miles; At a specific annoyance free level					
				91%	94%	96%	97%	98%	99%
2 Barn Swine Finishing-Deep Pit	800	1	36.80	0.10	0.14	0.20	0.28	0.44	0.75
11 Barn Hoop Site	800	1	5.28	0.03	0.05	0.06	0.10	0.15	0.28
4 Barn Swine Finishing-Deep Pit	1600	1	73.60	0.15	0.21	0.30	0.41	0.64	1.07
4 Barn Swine Finishing-Deep Pit; w/oil Sprinkling	1600	0.5	36.80	0.10	0.14	0.20	0.28	0.44	0.75
2 Barn Swine Finishing-Earthen Basin; earthen manure storage structure	800	1	117.60	0.20	0.28	0.39	0.52	0.82	1.36
2400 Sow Swine Breeding/Gestation/ Farrowing; Deep Pit	960	1	202.70	0.28	0.39	0.54	0.70	1.10	1.80
2400 Sow Swine Breeding/Gestation/ Farrowing; Deep Pit, Bio-Filter	960	0.1	20.30	0.07	0.10	0.14	0.20	0.32	0.55

[1] Based on 0.4 animal units per head for swine over 55 pounds. This is consistent with current federal standards and many current county standards. It was also the state standard when these ordinances were evaluated. Current MPCA rule is 0.3 animal units per head for swine from 55 to 300 pounds and 0.4 for swine over 300 pounds.

When the OFFSET model is applied to these different types, sizes and technology applications for swine facilities, some trends are apparent. At the 91% annoyance free level (66.96 hours of annoyance per month), the suggested setback distances range from 0.03 miles (11 hoop barns) to 0.28 miles (2400 sow swine breeding/gestation/farrowing; deep pit) for the seven swine systems analyzed. These separation distances are fairly common in feedlot settings.

At the 99% annoyance free level (7.44 hours of annoyance per month), the suggested setback distances range from 0.28 miles (11 hoop barns) to 1.80 miles (2400 sow swine breeding/gestation/farrowing; deep pit) for the seven swine systems analyzed. Many of the distances suggested by the 99% annoyance free level are such that it would be very difficult if not impossible to find sites that are removed to that degree from neighboring residences.

At the 97% annoyance free level (22.32 hours of annoyance per month), setback distances range from 0.10 miles (11 hoop barns site) to 0.70 miles (2400 sow swine breeding/gestation/ farrowing; deep pit). This level may provide a compromise where the annoyance free level is acceptable, while the setback distances are still manageable.

Setback distances are greatest for the 2400 sow swine breeding/gestation/farrowing with deep pit site (ranging from 0.28 to 1.80 miles), since this system has the highest total odor emission factor (202.70). However, adding a biofilter to this same system reduces the total odor emission factor to a tenth of that level (20.30), and cuts the setback distances to about a fourth of what they are for the system without the biofilter (ranging from 0.07 to 0.55 miles).

Setback distances are by far the lowest for the 11 deep bedded hoop barns site (ranging from 0.03 miles to 0.28 miles) because of its low total odor emission factor (5.28). Hoop barns and other deep-bedded facilities have generally not generated many odor complaints. This technology has not been widely used at the size modeled in the scenarios shown here.

Dairy Facilities

The following dairy facilities were analyzed:

"400 Cow Dairy-Milking Only. Barn dimensions = 90 x 372, Free Stall, 46 x 274 Holding & Milking Area (46,084 total sq. ft.); 227 x 372 earthen manure storage structure with 4" natural crust

"1050 Cow Dairy-Milking Only. Barn dimensions = 90 x 372 & 108 x 200 & 108 x 330 Free Stall barns, 46 x 274 Holding & Milking Area (103,324 total sq. ft.); 227 x 372 earthen manure storage structure with 4" natural crust

Table 7 shows the results of the OFFSET analysis for each of the two dairy systems. Distances suggested by OFFSET calculations shown are at prevailing downwind sites. Annoyance frequency will be less at other locations. See Section 2 for details on Odor Control Factors.

Table 7. Site Type and Technology Impacts on Annoyance Free Distances-Dairy Facilities

Site	Animal Units [(1)]	Odor Control Factor	Total Odor Emission Factor	OFFSET Separation Distance Calculation, Miles; At a specific annoyance free level					
				91%	94%	96%	97%	98%	99%
400 Cow Dairy-Milking Only; earthen manure storage structure with 4" natural crust	560	0.4	99.8	0.18	0.26	0.36	0.48	0.75	1.25
1050 Cow Dairy-Milking Only; earthen manure storage structure with 4" natural crust	1470	0.4	228	0.3	0.41	0.58	0.75	1.17	1.92

[(1)] Based on 1.4 animal units per head.

Findings for the large-scale dairies are similar to the swine facilities. At the 91% annoyance free level (66.96 hours of annoyance per month), the suggested setback distances are 0.18 miles (400 cow dairy) and 0.3 miles (1,050 cow dairy). These separation distances are fairly common in feedlot settings.

At the 99% annoyance free level (7.44 hours of annoyance per month), the suggested setback distances are 1.25 miles (400 cow dairy) and 1.92 miles (1,050 cow dairy). These distances are such that it would be very difficult if not impossible to find sites that are removed to that degree from neighboring residences.

At the 96% annoyance free level (29.76 hours of annoyance per month), the suggested setback distances are 0.36 and 0.58 miles. This level may provide a compromise where the annoyance free level is acceptable, while the setback distances are still manageable.

Maximum Total Odor Emissions Factors

Rather than looking at individual types of livestock systems like above, it is also possible to look at the maximum total odor emissions factors allowable for various setback distances and annoyance free levels. Table 8 shows the maximum odor emissions that a facility can have at 3 separation distances (.25, .375, and .5 miles) for 3 different annoyance free levels (94, 97, and 99%).

Table 8. Maximum total odor emissions factors

Annoyance Free Level, %	94	94	94	97	97	97	99	99	99
Setback distance, miles	.25	.375	.5	.25	.375	.5	.25	.375	.5
Maximum total odor emissions factor	99	190	310	30	63	110	4.5	10	16.5

For example, in order to attain a 94% annoyance free level (44.64 annoyance hours per month) at a setback distance of 0.50 miles, a site cannot have a total odor emissions factor that exceeds 310. Looking back at the total odor emissions factors for the sites presented in Tables 6 and 7, all nine site types would meet this goal. If the goal were to attain a 94% annoyance free level at a setback distance of 0.25 miles, a site could not have a total odor emissions factor that exceeds 99. Six of the nine site types studied would be able to meet this goal. The three sites that would not be able to meet this goal are the 2 barn swine finishing - earthen basin, 2400 sow swine breeding/gestation/farrowing - deep pit, and the 1,050 cow dairy.

In order to attain a 97% annoyance free level (22.32 annoyance hours per month) at a setback distance of 0.5 miles, the site cannot have a total odor emissions factor that exceeds 110. The same six site types described above would meet this goal. In order to attain a 97% annoyance free level at a setback distance of 0.25 miles, only two of the sites would meet this goal the 2400 sow swine breeding/gestation/ farrowing with biofilter, and the 11 barn hoop site.

In order to attain a 99% annoyance free level (7.44 annoyance hours per month) at a setback distance of 0.5 miles, the site cannot have a total odor emissions factor that exceeds 16.5. Of the nine site types studied, only the 11 barn hoop site would be able to meet this goal. In order to have a 99% annoyance free level at a setback distance of 0.25 miles, a site cannot have a total odor emissions factor that exceeds 4.5. None of the nine site types studied would be able to meet this goal.

Section 4. County Ordinance Separation Distances Compared to OFFSET Results

The estimated separation distances required to achieve 94, 97, and 99% annoyance free levels for the seven swine and two dairy sites analyzed above are compared to separation distances that would be required of these sites by county feedlot ordinances for counties that submitted copies of ordinances to the Minnesota Department of Agriculture in early 1999. It is possible that a limited number of counties may have changed separation distances since that time. However, observation is that while a number of counties have modified their ordinances, separation distances have not likely been changed. Some ordinances address possible differences based on specie and animal units (operation size). However, at the time of this study odor control technologies were not specifically considered by county ordinances, except possibly in conditional use proceedings.

Interpretation of a large number of ordinances is very complex. In order to accurately interpret how the representative sites would be treated by the various county feedlot ordinances, the authors reviewed the MDA summary on separation distances, the appropriate sections of the actual ordinances, and other sections of the ordinances that might have a bearing on siting requirements. Even though misinterpretation could occur in a small number of cases, it is unlikely that conclusions based on final averages and trends are compromised.

Table 9 summarizes the average of deviations of county ordinances from OFFSET suggested setback distances for 94, 97, and 99% annoyance free level, and the number of counties and average deviation of those with less separation distance than that suggested by OFFSET. Note that the average deviation calculations involve averaging individual deviations that are both plus and minus the OFFSET suggested separation distance.

From Table 9, we can see that the setback distances in the 41 to 43 county ordinances studied are on average greater than that required to attain a 94% annoyance free level for the various site types. For the site types that have lower total emission factors (2 barn swine finishing deep pit, 11 barn hoop site, 4 barn swine finishing deep pit, 4 barn swine finishing deep pit with oil sprinkling, and 2400 sow swine breeding/gestation/farrowing with biofilters), just one to nine ordinances in each case had setback distances less than that required to attain a 94% annoyance free level. However, for the site types that have higher total odor emission factors (2 barn swine finishing-earthen basin, 2400 sow swine breeding/gestation/farrowing, 400 cow dairy, and 1050 cow dairy), 27 to 32 of the 41 to 43 ordinances studied had setback distances less than that required to attain a 94% annoyance free level.

At the 97% annoyance free level, on average the ordinances require greater setback distances for some site types and smaller setback distances for other site types. For the sites that have lower total emission factors (2 barn swine finishing deep pit, 11 barn hoop site, 4 barn swine finishing deep pit, 4 barn swine finishing deep pit with oil sprinkling, and 2400 sow swine breeding/gestation/farrowing with biofilters), 3 to 27 ordinances in each case had setback distances less than that required to attain a 97% annoyance free level. For the site types that have higher total odor emission factors (2 barn swine finishing-earthen basin, 2400 sow swine breeding/gestation/farrowing, 400 cow dairy, and 1050 cow dairy), 32 to 43 of the 41 to 43 ordinances studied had setback distances less than that required to attain a 97% annoyance free level.

At the 99% annoyance free level, on average the ordinances require much smaller setback distances for the various site types. For all of the site types except two, all of the 41 to 43 ordinances studied required setback distances much less than that required to attain a 99% annoyance free level. The two exceptions to this are the 11 barn hoop site and the 4 barn swine finishing deep pit with oil sprinkling, for which 27 and 37 of the 43 and 41 ordinances studied, respectively, had setback distances less than that required to attain a 99% annoyance free level.

Table 10 gives more details on the various county ordinances. It shows the number of ordinances for each of the nine site types that fall within each deviation distance category (the actual ordinance distance compared to the OFFSET recommended distance).

Information on the setback distances required in each individual county and the variation from 94, 97, and 99% annoyance free levels for each of the nine site types is presented in Tables 11(a) through 11(i).

Table 9. Summary of Deviation of Minnesota County Feedlot Ordinances from OFFSET Calculated Separation Distances

Operation Description	Average Deviation of County Ordinances from OFFSET Calculated Distance, in feet Annoyance Free Level			Number of Counties Where Separation Distances Were Less Than Calculated by OFFSET @ 94%	Average Deviation, in feet, Where Separation Distances Were Less Than Calculated by OFFSET @ 94%	Number of Counties Where Separation Distances Were Less Than Calculated by OFFSET @ 97%	Average Deviation, in feet, Where Separation Distances Were Less Than Calculated by OFFSET @ 97%	Number of Counties Where Separation Distances Were Less Than Calculated by OFFSET @ 99%	Average Deviation, in feet, Where Separation Distances Were Less Than Calculated by OFFSET @ 99%	Number of Ordinances With Separation Distances For This Site
	94%	97%	99%							
2 Barn Swine Finishing-Deep Pit	823.77	87.37	-2384.83	4	-271.4	27	-364.84	43	-2384.83	43
11 Hoop Barns	1297.17	1034.17	87.37	1	-63	3	-126	27	-364.84	43
4 Barn Swine Finishing-Deep Pit	713.81	-338.19	-3809.79	9	-286.82	26	-946.60	41	-3809.79	41
4 Barn Swine Finishing-Deep Pit	1094.60	358.20	-2114.00	3	-283.06	21	-370.66	37	-2285.41	41
2 Barn Swine Finishing-Earthen Basin	35.07	-1227.33	-5645.73	27	-271.40	41	-1227.33	41	-5645.73	41
2400 Sow Swine Breed/Gest/ Farr	-480.99	-2111.59	-7897.59	32	-845.54	43	-2111.59	43	-7897.59	43
2400 Sow Swine Breed/Gest/Farr w/biofilter	1044.41	518.41	-1322.59	3	-126.00	11	-246.55	43	-1322.59	43
400 Cow Dairy	149.94	-1007.26	-5057.46	27	-296.19	32	-1365.18	42	-5057.46	42
1050 Cow Dairy	205.77	-2161.23	-8315.43	27	-426.33	39	-2382.90	43	-8315.43	43

Table 10. Summary of Deviation of Minnesota County Feedlot Ordinances from OFFSET Calculated Separation Distances by Distance Increments

		Actual Separation Distances More Than OFFSET Calculation (in feet)						Equal to	Actual Separation Distances Less Than OFFSET Calculation (in feet)					
Operation Description	AFL*	Plus 5261 and Up	Plus 2631 to 5260	Plus 1316 to 2630	Plus 658 to 1315	Plus 328.75 to 657	Plus 1 to 328.74	0	Minus 1 to 328.75	Minus 326.76 to 657	Minus 658 to 1315	Minus 1316 to 2630	Minus 2631 to 5260	Minus 5261 and up
2 Barn- Fin-Pit	94%	0	0	11	5	16	7	0	3	1	0	0	0	0
	97%	0	0	0	12	2	3	0	16	7	3	0	0	0
	99%	0	0	0	0	0	0	0	0	0	10	22	11	0
11 Hoop Barns	94%	0	1	12	25	1	2	0	1	0	0	0	0	0
	97%	0	0	13	19	7	1	0	3	0	0	0	0	0
	99%	0	0	13	19	7	1	0	3	0	0	0	0	0
4 Barn- Fin-Pit	94%	0	3	11	3	2	13	0	6	2	1	0	0	0
	97%	0	0	3	0	9	1	0	2	4	19	3	0	0
	99%	0	0	0	0	0	0	0	0	0	0	3	37	1
4 Barn- Fin-Pit-Oil	94%	0	3	12	4	13	6	0	2	1	0	0	0	0
	97%	0	0	3	12	2	2	0	13	6	3	0	0	0
	99%	0	0	0	0	0	0	3	0	0	11	18	9	0
2 Barn- Fin-Basin	94%	0	0	0	9	2	3	0	16	7	4	0	0	0
	97%	0	0	0	0	0	0	0	8	0	6	27	0	0
	99%	0	0	0	0	0	0	0	0	0	0	0	11	30
2400 Sow Unit	94%	0	0	0	0	11	0	0	2	4	22	4	0	0
	97%	0	0	0	0	0	0	0	0	0	11	21	11	0
	99%	0	0	0	0	0	0	0	0	0	0	0	0	43
2400 Sow Unit-Bio	94%	0	0	13	19	7	1	0	3	0	0	0	0	0
	97%	0	0	11	2	4	15	0	7	3	1	0	0	0
	99%	0	0	0	0	0	0	0	11	0	2	29	1	0
400 Cow-Basin	94%	0	0	1	8	1	4	0	14	8	6	0	0	0
	97%	0	0	0	0	1	9	0	0	1	18	13	0	0
	99%	0	0	0	0	0	0	0	0	0	0	0	30	12
1050 Cow-Basin	94%	0	0	4	9	3	0	0	17	7	2	1	0	0
	97%	0	0	0	0	0	0	4	0	0	9	20	10	0
	99%	0	0	0	0	0	0	0	0	0	0	0	0	43

AFL* = Annoyance Free Level

Table 11(a). County Ordinance Separation Distances Compared to OFFSET Output: 2 Barn Swine Finishing-Deep Pit

Variation From Estimated Residence Separation Distance Required For Three Levels of Annoyance Free Status						
Site Description	2 Barn Swine Finishing-Deep Pit					
Site Specifics	barn dimensions = 40 x 200 (16,000 total sq. ft.) 2000 head/site					
# Animal Units	800					
Odor Technology	None					
Odor Control Factor	0					
Total Odor Emission Factor	36.8					
Annoyance Free Level	94%	94%	97%	97%	99%	99%
Necessary Separation Distance, Miles	0.14		0.28		0.75	
Necessary Separation Distance, Feet	736.4		1472.8		3945	
Distance and Variation at This Level	Distance	Variation	Distance	Variation	Distance	Variation
County						
Becker(1)	CUP		CUP		CUP	
Benton(1)	CUP		CUP		CUP	
Big Stone(2)	1315	578.6	1315	-157.8	1315	-2630
Blue Earth(1)	1500	763.6	1500	27.2	1500	-2445
Brown(1)	CUP		CUP		CUP	
Carver(1)	500	-236.4	500	-972.8	500	-3445
Cass(1)	CUP		CUP		CUP	
Chippewa(1)	2630	1893.6	2630	1157.2	2630	-1315
Clay(1)	1000	263.6	1000	-472.8	1000	-2945
Cottonwood	2630	1893.6	2630	1157.2	2630	-1315
Dodge(1)	500	-236.4	500	-972.8	500	-3445
Faribault	1500	763.6	1500	27.2	1500	-2445
Fillmore(1)	2630	1893.6	2630	1157.2	2630	-1315
Freeborn(1)	CUP		CUP		CUP	
Goodhue(1)	1315	578.6	1315	-157.8	1315	-2630
Houston(1)	1315	578.6	1315	-157.8	1315	-2630
Isanti(1)	1000	263.6	1000	-472.8	1000	-2945
Itasca(1)	CUP		CUP		CUP	
Jackson(2)	2630	1893.6	2630	1157.2	2630	-1315
Kandiyohi(1)	CUP		CUP		CUP	
Kittson	1315	578.6	1315	-157.8	1315	-2630
Lake(1)	200	-536.4	200	-1272.8	200	-3745
Lac Qui Parle(2)	2000	1263.6	2000	527.2	2000	-1945
Le Sueur(1)	CUP		CUP		CUP	
Lincoln	1315	578.6	1315	-157.8	1315	-2630
Mc Cleod(2)	2400	1663.6	2400	927.2	2400	-1545
Martin	1320	583.6	1320	-152.8	1320	-2625
Meeker(1)	1315	578.6	1315	-157.8	1315	-2630
Morrison(1)	1320	583.6	1320	-152.8	1320	-2625
Mower	1000	263.6	1000	-472.8	1000	-2945
Murray(1)	2630	1893.6	2630	1157.2	2630	-1315

Nicollet(1)	CUP		CUP		CUP	
Nobles(2)	1972.5	1236.1	1972.5	499.7	1972.5	-1972.5
Norman(1)	2630	1893.6	2630	1157.2	2630	-1315
Olmsted(2)	1315	578.6	1315	-157.8	1315	-2630
Pipestone	1320	583.6	1320	-152.8	1320	-2625
Polk	1315	578.6	1315	-157.8	1315	-2630
Redwood(1)	1315	578.6	1315	-157.8	1315	-2630
Renville(1)	1315	578.6	1315	-157.8	1315	-2630
Rice(1)	1315	578.6	1315	-157.8	1315	-2630
Rock	2630	1893.6	2630	1157.2	2630	-1315
St. Louis(1)	CUP		CUP		CUP	
Scott(2)	1000	263.6	1000	-472.8	1000	-2945
Sherburne(1)	CUP		CUP		CUP	
Sibley(2)	1315	578.6	1315	-157.8	1315	-2630
Stearns(1)	1500	763.6	1500	27.2	1500	-2445
Steele	1000	263.6	1000	-472.8	1000	-2945
Stevens(2)	660	-76.4	660	-812.8	660	-3285
Swift(2)	1315	578.6	1315	-157.8	1315	-2630
Traverse	2630	1893.6	2630	1157.2	2630	-1315
Wadena	CUP		CUP		CUP	
Waseca(2)	1000	263.6	1000	-472.8	1000	-2945
Watonwan	2630	1893.6	2630	1157.2	2630	-1315
Wilken(1)	CUP		CUP		CUP	
Winona(1)	1000	263.6	1000	-472.8	1000	-2945
Wright(1)	CUP		CUP		CUP	
Yellow Medicine(1)	2630	1893.6	2630	1157.2	2630	-1315
CUP = Separation distances may be imposed by Conditional Use Permit						
(1) Conditional Use Permit required based on specified number of animal units (at this size or facility)						
(2) Conditional Use Permit may be required based on specific conditions (other than animal units)						
Average Deviation From Necessary Distance		823.77		87.37		-2384.83
Number of Inadequate Separation Distances		4		27		43
Average Deviation From Necessary Distance for Those With Inadequate Distances		-271.4		-364.837		-2384.83

Table 11(b). County Ordinance Separation Distances Compared to OFFSET Output: 11 Barn Swine Finishing - Hoops

Variation From Estimated Residence Separation Distance Required For Three Levels of Annoyance Free Status						
Site Description	11 Barn Swine Finishing-Hoops					
Site Specifics	Barn Dimensions = 30 x 80 (26,400 total sq. ft.) 2000 head/site					
# Animal Units	800					
Odor Technology	None					
Odor Control Factor	1					
Total Odor Emissions	5.28					
Annoyance Free Level	94%	94%	97%	97%	99%	99%
Necessary Separation Distance, Miles	0.05		0.1		0.28	
Necessary Separation Distance, Feet	263		526		1472.8	
DistanceDistanceandDistance and Variation Distance Level	Variation	VaVariVariation	Variance	VaVariVariation	Variance	VaVariVariationVariation
County						
Becker(1)	CUP		CUP		CUP	
Benton(1)	CUP		CUP		CUP	
Big Stone(2)	1315	1052	1315	789	1315	-158
Blue Earth(1)	1500	1237	1500	974	1500	27
Brown(1)	CUP		CUP		CUP	
Carver(1)	500	237	500	-26	500	-973
Cass(1)	CUP		CUP		CUP	
Chippewa(1)	2630	2367	2630	2104	2630	1157
Clay(1)	1000	737	1000	474	1000	-473
Cottonwood	2630	2367	2630	2104	2630	1157
Dodge(1)	500	237	500	-26	500	-973
Faribault	1500	1237	1500	974	1500	27
Fillmore(1)	2630	2367	2630	2104	2630	1157
Freeborn(1)	CUP		CUP		CUP	
Goodhue(1)	1315	1052	1315	789	1315	-158
Houston(1)	1315	1052	1315	789	1315	-158
Isanti(1)	1000	737	1000	474	1000	-473
Itasca(1)	CUP		CUP		CUP	
Jackson(2)	2630	2367	2630	2104	2630	1157
Kandiyohi(1)	CUP		CUP		CUP	
Kittson	1315	1052	1315	789	1315	-158
Lake(1)	200	-63	200	-326	200	-1273
Lac Qui Parle(2)	2000	1737	2000	1474	2000	527
Le Sueur(1)	CUP		CUP		CUP	
Lincoln	1315	1052	1315	789	1315	-158
Mc Cleod(2)	2400	2137	2400	1874	2400	927
Martin	1320	1057	1320	794	1320	-153
Meeker(1)	1315	1052	1315	789	1315	-158
Morrison(1)	1320	1057	1320	794	1320	-153
Mower	1000	737	1000	474	1000	-473
Murray(1)	2630	2367	2630	2104	2630	1157
Nicollet(1)	CUP		CUP		CUP	
Nobles(2)	1972.5	1709.5	1972.5	1446.5	1972.5	500

Norman(1)	2630	2367	2630	2104	2630	1157
Olmsted(2)	1315	1052	1315	789	1315	-158
Pipestone	1320	1057	1320	794	1320	-153
Polk	1315	1052	1315	789	1315	-158
Redwood(1)	1315	1052	1315	789	1315	-158
Renville(1)	1315	1052	1315	789	1315	-158
Rice(1)	1315	1052	1315	789	1315	-158
Rock	2630	2367	2630	2104	2630	1157
St. Louis(1)	CUP		CUP		CUP	
Scott(2)	1000	737	1000	474	1000	-473
Sherburne(1)	CUP		CUP		CUP	
Sibley(2)	1315	1052	1315	789	1315	-158
Stearns(1)	1500	1237	1500	974	1500	27
Steele	1000	737	1000	474	1000	-473
Stevens(2)	660	397	660	134	660	-813
Swift(2)	1315	1052	1315	789	1315	-158
Traverse	2630	2367	2630	2104	2630	1157
Wadena	CUP		CUP		CUP	
Waseca(2)	1000	737	1000	474	1000	-473
Watonwan	2630	2367	2630	2104	2630	1157
Wilken(1)	CUP		CUP		CUP	
Winona(1)	1000	737	1000	474	1000	-473
Wright(1)	CUP		CUP		CUP	
Yellow Medicine(1)	2630	2367	2630	2104	2630	1157
CUP = Separation distances may be imposed by Conditional Use Permit						
(1) Conditional Use Permit required based on specified number of animal units (at this size or facility)						
(2) Conditiona Use Permit may be required based on specific conditions (other than animal units)						
Average Deviation From Necessary Distance	1297.17		1034.17		87.37	
Number of Inadequate Separation Distances	1		3		27	
Average Deviation From Necessary Distance for Those With Inadequate Distances	-63		-126		-364.84	

Table 11(c). County Ordinance Separation Distances Compared to OFFSET Output: 4 Barn Swine Finishing - Deep Pit

Variation From Estimated Residence Separation Distance Required For Three Levels of Annoyance Free Status						
Site Description	4 Barn Swine Finishing-Deep Pit					
# Animal Units	1600					
Odor Technology	None					
Odor Control Factor	0					
Total Odor Emission Factor	73.6					
Annoyance Free Level	94%	94%	97%	97%	99%	99%
Necessary Separation Distance, Miles	0.21		0.41		1.07	
Necessary Separation Distance, Feet	1104.6		2156.6		5628.2	
Distance and Variation at This Level	Distance	Variation	Distance	Variation	Distance	Variation
County						
Becker(1)	CUP		CUP		CUP	
Benton(1)	CUP		CUP		CUP	
Big Stone(2)	1315	210.4	1315	-841.6	1315	-4313.2
Blue Earth(1)	1500	395.4	1500	-656.6	1500	-4128.2
Brown(1)	CUP		CUP		CUP	
Carver(1)	500	-604.6	500	-1656.6	500	-5128.2
Cass(1)	CUP		CUP		CUP	
Chippewa(1)	3945	2840.4	3945	1788.4	3945	-1683.2
Clay(1)	1000	-104.6	1000	-1156.6	1000	-4628.2
Cottonwood	3945	2840.4	3945	1788.4	3945	-1683.2
Dodge(1)	1315	210.4	1315	-841.6	1315	-4313.2
Faribault(1)	1500	395.4	1500	-656.6	1500	-4128.2
Fillmore(1)	2630	1525.4	2630	473.4	2630	-2998.2
Freeborn(1)	1315	210.4	1315	-841.6	1315	-4313.2
Goodhue(1)	1315	210.4	1315	-841.6	1315	-4313.2
Houston(1)	1315	210.4	1315	-841.6	1315	-4313.2
Isanti(1)	1000	-104.6	1000	-1156.6	1000	-4628.2
Itasca(1)	CUP		CUP		CUP	
Jackson(1)	2630	1525.4	2630	473.4	2630	-2998.2
Kandiyohi(1)	CUP		CUP		CUP	
Kittson(1)	1315	210.4	1315	-841.6	1315	-4313.2
Lake(1)	200	-904.6	200	-1956.6	200	-5428.2
Lac Qui Parle(1)	2000	895.4	2000	-156.6	2000	-3628.2
Le Sueur(1)	CUP		CUP		CUP	
Lincoln(1)	1315	210.4	1315	-841.6	1315	-4313.2
Mc Cleod(1)	2640	1535.4	2640	483.4	2640	-2988.2
Martin	1320	215.4	1320	-836.6	1320	-4308.2
Meeker(1)	2630	1525.4	2630	473.4	2630	-2998.2
Morrison	Prohibited by size (1000 animal unit maximum)					
Mower	1000	-104.6	1000	-1156.6	1000	-4628.2
Murray(1)	2630	1525.4	2630	473.4	2630	-2998.2
Nicollet(1)	CUP		CUP		CUP	
Nobles(1)	2630	1525.4	2630	473.4	2630	-2998.2
Norman(1)	2630	1525.4	2630	473.4	2630	-2998.2

Olmsted(1)	1315	210.4	1315	-841.6	1315	-4313.2
Pipestone	2320	1215.4	2320	163.4	2320	-3308.2
Polk(1)	1315	210.4	1315	-841.6	1315	-4313.2
Redwood(1)	1315	210.4	1315	-841.6	1315	-4313.2
Renville(1)	2630	1525.4	2630	473.4	2630	-2998.2
Rice	Prohibited by size (1500 animal unit maximum)					
Rock	3945	2840.4	3945	1788.4	3945	-1683.2
St. Louis(1)	CUP		CUP		CUP	
Scott(2)	1000	-104.6	1000	-1156.6	1000	-4628.2
Sherburne(1)	CUP		CUP		CUP	
Sibley(1)	1315	210.4	1315	-841.6	1315	-4313.2
Stearns(1)	2000	895.4	2000	-156.6	2000	-3628.2
Steele(1)	1000	-104.6	1000	-1156.6	1000	-4628.2
Stevens(2)	660	-444.6	660	-1496.6	660	-4968.2
Swift(1)	1315	210.4	1315	-841.6	1315	-4313.2
Traverse(1)	2630	1525.4	2630	473.4	2630	-2998.2
Wadena	CUP		CUP		CUP	
Waseca(2)	1000	-104.6	1000	-1156.6	1000	-4628.2
Watonwan(1)	2630	1525.4	2630	473.4	2630	-2998.2
Wilken(1)	CUP		CUP		CUP	
Winona	Prohibited by size (1500 animal unit maximum)					
Wright(1)	CUP		CUP		CUP	
Yellow Medicine(1)	2630	1525.4	2630	473.4	2630	-2998.2
CUP = Separation distances may be imposed by Conditional Use Permit						
(1) Conditional Use Permit required based on specified number of animal units (at this size)						
(2) Conditional Use Permit may be required based on specific conditions (other than animal units)						
Average Deviation From Necessary Distance		713.8146		-338.185		-3809.79
Number of Inadequate Separation Distances		9		26		41
Average Deviation From Necessary Distance for Those With Inadequate Distances		-286.822		-946.6		-3809.79

Table 11(d). County Ordinance Separation Distances Compared to OFFSET Output: 4 Barn Swine Finishing - Deep Pit with Oil Sprinkling

Variation From Estimated Residence Separation Distance Required For Three Levels of Annoyance Free Status						
Site Description	4 Barn Swine Finishing-Deep Pit					
Site Specifics						
# Animal Units	1600					
Odor Technology	oil sprinkling					
Odor Control Factor	0.5					
Total Odor Emission Factor	36.8					
Annoyance Free Level	94%	94%	97%	97%	99%	99%
Necessary Separation Distance, Miles	0.14		0.28		0.75	
Necessary Separation Distance, Feet	736.4		1472.8		3945	
Distance and Variation at This Level	Distance	Variation	Distance	Variation	Distance	Variation
County						
Becker(1)	CUP		CUP		CUP	
Benton(1)	CUP		CUP		CUP	
Big Stone(2)	1315	578.6	1315	-157.8	1315	-2630
Blue Earth(1)	1500	763.6	1500	27.2	1500	-2445
Brown(1)	CUP		CUP		CUP	
Carver(1)	500	-236.4	500	-972.8	500	-3445
Cass(1)	CUP		CUP		CUP	
Chippewa(1)	3945	3208.6	3945	2472.2	3945	0
Clay(1)	1000	263.6	1000	-472.8	1000	-2945
Cottonwood	3945	3208.6	3945	2472.2	3945	0
Dodge(1)	1315	578.6	1315	-157.8	1315	-2630
Faribault(1)	1500	763.6	1500	27.2	1500	-2445
Fillmore(1)	2630	1893.6	2630	1157.2	2630	-1315
Freeborn(1)	1315		1315		1315	
Goodhue(1)	1315	578.6	1315	-157.8	1315	-2630
Houston(1)	1315	578.6	1315	-157.8	1315	-2630
Isanti(1)	1000	263.6	1000	-472.8	1000	-2945
Itasca(1)	CUP		CUP		CUP	
Jackson(1)	2630	1893.6	2630	1157.2	2630	-1315
Kandiyohi(1)	CUP		CUP		CUP	
Kittson(1)	1315	578.6	1315	-157.8	1315	-2630
Lake(1)	200	-536.4	200	-1272.8	200	-3745
Lac Qui Parle(1)	2000	1263.6	2000	527.2	2000	-1945
Le Sueur(1)	CUP		CUP		CUP	
Lincoln(1)	1315	578.6	1315	-157.8	1315	-2630
Mc Cleod(1)	2640	1903.6	2640	1167.2	2640	-1305
Martin	1320	583.6	1320	-152.8	1320	-2625
Meeker(1)	2630	1893.6	2630	1157.2	2630	-1315
Morrison	Prohibited by size (1000 animal unit maximum)					
Mower	1000	263.6	1000	-472.8	1000	-2945
Murray(1)	2630	1893.6	2630	1157.2	2630	-1315
Nicollet(1)	CUP		CUP		CUP	
Nobles(1)	2630	1893.6	2630	1157.2	2630	-1315

Norman(1)	2630	1893.6	2630	1157.2	2630	-1315
Olmsted(1)	1315	578.6	1315	-157.8	1315	-2630
Pipestone	2320	1583.6	2320	847.2	2320	-1625
Polk(1)	1315	578.6	1315	-157.8	1315	-2630
Redwood(1)	1315	578.6	1315	-157.8	1315	-2630
Renville(1)	2630	1893.6	2630	1157.2	2630	-1315
Rice	Prohibited by size (1500 animal unit maximum)					
Rock	3945	3208.6	3945	2472.2	3945	0
St. Louis(1)	CUP		CUP		CUP	
Scott(2)	1000	263.6	1000	-472.8	1000	-2945
Sherburne(1)	CUP		CUP		CUP	
Sibley(1)	1315	578.6	1315	-157.8	1315	-2630
Stearns(1)	2000	1263.6	2000	527.2	2000	-1945
Steele(1)	1000	263.6	1000	-472.8	1000	-2945
Stevens(2)	660	-76.4	660	-812.8	660	-3285
Swift(1)	1315	578.6	1315	-157.8	1315	-2630
Traverse(1)	2630	1893.6	2630	1157.2	2630	-1315
Wadena	CUP		CUP		CUP	
Waseca(2)	1000	263.6	1000	-472.8	1000	-2945
Watonwan(1)	2630	1893.6	2630	1157.2	2630	-1315
Wilken(1)	CUP		CUP		CUP	
Winona	Prohibited by size (1500 animal unit maximum)					
Wright(1)	CUP		CUP		CUP	
Yellow Medicine(1)	2630	1893.6	2630	1157.2	2630	-1315
CUP = Separation distances may be imposed by Conditional Use Permit						
(1) Conditional Use Permit required based on specified number of animal units (at this size or facility)						
(2) Conditional Use Permit may be required based on specific conditions (other than animal units)						
Average Deviation From Necessary Distance		1094.6		358.2		-2114
Number of Inadequate Separation Distances		3		21		37
Average Deviation From Necessary Distance for Those With Inadequate Distances		-283.067		-370.657		-2285.41

Table 11(e). County Ordinance Separation Distances Compared to OFFSET Output: 2 Barn Swine Finishing-Earthen Basin

Variation From Estimated Residence Separation Distance Required For Three Levels of Annoyance Free Status						
Site Description	2 Barn Swine Finishing-Earthen Basin					
Site Specifics	barn dimensions = 40 x 200 (16,000 total sq. ft.) 2000 head/site, 201 x 201 earthen manure storage structure					
# Animal Units	800					
Odor Technology	None					
Odor Control Factor	0					
Total Odor Emission Factor	117.6					
Annoyance Free Level	94%	94%	97%	97%	99%	99%
Necessary Separation Distance(1)	0.28		0.52		1.36	
Necessary Separation Distance, Feet	1472.8		2735.2		7153.6	
Distance and Variation at This Level	Distance	Variation	Distance	Variation	Distance	Variation
County						
Becker(1)	CUP		CUP		CUP	
Benton(1)	CUP		CUP		CUP	
Big Stone(1)	1315	-157.8	1315	-1420.2	1315	-5838.6
Blue Earth(1)	1500	27.2	1500	-1235.2	1500	-5653.6
Brown(1)	CUP		CUP		CUP	
Carver(1)	500	-972.8	500	-2235.2	500	-6653.6
Cass(1)	CUP		CUP		CUP	
Chippewa(1)	Basins prohibited					
Clay(1)	1000	-472.8	1000	-1735.2	1000	-6153.6
Cottonwood	Basins prohibited for new construction					
Dodge(1)	500	-972.8	500	-2235.2	500	-6653.6
Faribault	1500	27.2	1500	-1235.2	1500	-5653.6
Fillmore(1)	2630	1157.2	2630	-105.2	2630	-4523.6
Freeborn(1)	CUP		CUP		CUP	
Goodhue(1)	1315	-157.8	1315	-1420.2	1315	-5838.6
Houston(1)	1315	-157.8	1315	-1420.2	1315	-5838.6
Isanti(1)	1000	-472.8	1000	-1735.2	1000	-6153.6
Itasca(1)	CUP		CUP		CUP	
Jackson(1)	2630	1157.2	2630	-105.2	2630	-4523.6
Kandiyohi(1)	CUP		CUP		CUP	
Kittson	1315	-157.8	1315	-1420.2	1315	-5838.6
Lake(1)	200	-1272.8	200	-2535.2	200	-6953.6
Lac Qui Parle(1)	2000	527.2	2000	-735.2	2000	-5153.6
Le Sueur(1)	CUP		CUP		CUP	
Lincoln	1315	-157.8	1315	-1420.2	1315	-5838.6
Mc Cleod(2)	2400	927.2	2400	-335.2	2400	-4753.6
Martin	1320	-152.8	1320	-1415.2	1320	-5833.6
Meeker(1)	1315	-157.8	1315	-1420.2	1315	-5838.6
Morrison(1)	1315	-157.8	1315	-1420.2	1315	-5838.6
Mower	1000	-472.8	1000	-1735.2	1000	-6153.6
Murray(1)	2630	1157.2	2630	-105.2	2630	-4523.6
Nicollet(1)	CUP		CUP		CUP	

Nobles(2)	1972.5	499.7	1972.5	-762.7	1972.5	-5181.1
Norman(1)	2630	1157.2	2630	-105.2	2630	-4523.6
Olmsted(2)	1315	-157.8	1315	-1420.2	1315	-5838.6
Pipestone	1320	-152.8	1320	-1415.2	1320	-5833.6
Polk	1315	-157.8	1315	-1420.2	1315	-5838.6
Redwood(1)	1315	-157.8	1315	-1420.2	1315	-5838.6
Renville(1)	1315	-157.8	1315	-1420.2	1315	-5838.6
Rice(1)	1315	-157.8	1315	-1420.2	1315	-5838.6
Rock	2630	1157.2	2630	-105.2	2630	-4523.6
St. Louis(1)	CUP		CUP		CUP	
Scott(2)	1000	-472.8	1000	-1735.2	1000	-6153.6
Sherburne(1)	CUP		CUP		CUP	
Sibley(1)	1315	-157.8	1315	-1420.2	1315	-5838.6
Stearns(1)	1500	27.2	1500	-1235.2	1500	-5653.6
Steele	1000	-472.8	1000	-1735.2	1000	-6153.6
Stevens(1)	660	-812.8	660	-2075.2	660	-6493.6
Swift(1)	1315	-157.8	1315	-1420.2	1315	-5838.6
Traverse(1)	2630	1157.2	2630	-105.2	2630	-4523.6
Wadena	CUP		CUP		CUP	
Waseca(2)	1000	-472.8	1000	-1735.2	1000	-6153.6
Watonwan(1)	2630	1157.2	2630	-105.2	2630	-4523.6
Wilken(1)	CUP		CUP		CUP	
Winona(1)	1000	-472.8	1000	-1735.2	1000	-6153.6
Wright(1)	CUP		CUP		CUP	
Yellow Medicine(1)	2630	1157.2	2630	-105.2	2630	-4523.6
CUP = Separation distances may be imposed by Conditional Use Permit						
(1) Conditional Use Permit required based on specified number of animal units (at this size or facility)						
(2) Conditiona Use Permit may be required based on specific conditions (other than animal units)						
Average Deviation From Necessary Distance		35.06585		-1227.33		-5645.73
Number of Inadequate Separation Distances		27		41		41
Average Deviation From Necessary Distance for Those With Inadequate Distances		-365.022		-1227.33		-5645.73

Table 11(f). County Ordinance Separation Distances Compared to OFFSET Output: 2400 Sow Swine Breeding/Gestation/Farrowing - Deep Pit

Variation From Estimated Residence Separation Distance Required For Three Levels of Annoyance Free Status

Site Description2400 Sow Swine Breeding/Gestation/Farrowing

Site Specifics 88112 ft(2) of barns, alleys, and office-Deep Pit

Animal Units960

Odor TechnologyNone

Odor Control Factor0

Total Odor Emission Factor202.7

Annoyance Free Level94%94%97%97%99%99%

Necessary Separation Distance, Miles0.390.71.8

Necessary Separation Distance, Feet 2051.436829468

Distance and Variation at This LevelDistanceVariation DistanceVariation DistanceVariation

County

Becker(1)CUPCUPCUP

Benton(1)CUPCUPCUP

Big Stone(2)1315-736.41315-23671315-8153

Blue Earth(1)1500-551.41500-21821500-7968

Brown(1)CUPCUPCUP

Carver(1)500-1551.4500-3182500-8968

Cass(1)CUPCUPCUP

Chippewa(1)2630578.62630-10522630-6838

Clay(1)1000-1051.41000-26821000-8468

Cottonwood2630578.62630-10522630-6838

Dodge(1)500-1551.4500-3182500-8968

Faribault1500-551.41500-21821500-7968

Fillmore(1)2630578.62630-10522630-6838

Freeborn(1)CUPCUPCUP

Goodhue(1)1315-736.41315-23671315-8153

Houston(1)1315-736.41315-23671315-8153

Isanti(1)1000-1051.41000-26821000-8468

Itasca(1)CUPCUPCUP

Jackson(2)2630578.62630-10522630-6838

Kandiyohi(1)CUPCUPCUP

Kittson1315-736.41315-23671315-8153

Lake(1)200-1851.4200-3482200-9268

Lac Qui Parle(2)2000-51.42000-16822000-7468

Le Sueur(1)CUPCUPCUP

Lincoln1315-736.41315-23671315-8153

Mc Cleod(1)2640588.62640-10422640-6828

Martin1320-731.41320-23621320-8148

Meeker(1)1315-736.41315-23671315-8153

Morrison(1)1320-731.41320-23621320-8148

Mower1000-1051.41000-26821000-8468

Murray(1)2630578.62630-10522630-6838

Nicollet(1)CUPCUPCUP

Nobles(2)1972.5-78.91972.5-1709.51972.5-7495.5

Norman(1)2630578.62630-10522630-6838

Olmsted(2)1315-736.41315-23671315-8153

Pipestone1520-531.41520-21621520-7948

Polk1315-736.41315-23671315-8153

Redwood(1)1315-736.41315-23671315-8153

Renville(1)1315-736.41315-23671315-8153

Rice(1)1315-736.41315-23671315-8153

Rock2630578.62630-10522630-6838

St. Louis(1)CUPCUPCUP

Scott(2)1000-1051.41000-26821000-8468
Sherburne(1)CUPCUPCUP
Sibley(2)1315-736.41315-23671315-8153
Stearns(1)1500-551.41500-21821500-7968
Steele1000-1051.41000-26821000-8468
Stevens(2)660-1391.4660-3022660-8808
Swift(2)1315-736.41315-23671315-8153
Traverse2630578.62630-10522630-6838
WadenaCUPCUPCUP
Waseca(2)1000-1051.41000-26821000-8468
Watonwan(1)2630578.62630-10522630-6838
Wilken(1)CUPCUPCUP
Winona(1)1000-1051.41000-26821000-8468
Wright(1)CUPCUPCUP
Yellow Medicine(1)2630578.62630-10522630-6838

CUP = Separation distances may be imposed by Conditional Use Permit
(1) Conditional Use Permit required based on specified number of animal units (at this size or facility)
(2) Conditiona Use Permit may be required based on specific conditions (other than animal units)

Average Deviation From Necessary Distance-480.993-2111.59-7897.59
Number of Inadequate Separation Distances324343
Average Deviation From Necessary Distance for Those With Inadequate Distances-845.541-2111.59-7897.59

Table 11(g). County Ordinance Separation Distances Compared to OFFSET Output: 2400 Sow Swine Breeding/Gestation/Farrowing with Bio Filter

Variation From Estimated Residence Separation Distance Required For Three Levels of Annoyance Free Status
Site Description2400 Sow Swine Breeding/Gestation/Farrowing with Bio Filter
Site Specifics 88112 ft(2) of barns, alleys, and office-Deep Pit
Animal Units960
Odor TechnologyBio-Filter
Odor Control Factor0.1
Total Odor Emission Factor20.27
Annoyance Free Level94%94%97%97%99%99%
Necessary Separation Distance, Miles0.10.20.55Necessary Separation Distance, Feet 52610522893
Distance and Variation at This LevelDistanceVariation DistanceVariation DistanceVariation
County
Becker(1)CUPCUPCUP
Benton(1)CUPCUPCUP
Big Stone(2)131578913152631315-1578
Blue Earth(1)150097415004481500-1393Brown(1)CUPCUPCUP
Carver(1)500-26500-552500-2393
Cass(1)CUPCUPCUP
Chippewa(1)263021042630157826 30-263
Clay(1)10004741000-521000-1893Cottonwood263021042630157826 30-263Dodge(1)500-26500-552500-2393
Faribault150097415004481500-1393Fillmore(1)263021042630157826 30-263Freeborn(1)CUPCUPCUP
Goodhue(1)131578913152631315-1578Houston(1)131578913152631315-1578
Isanti(1)10004741000-521000-1893
Itasca(1)CUPCUPCUP
Jackson(2)263021042630157826 30-263Kandiyohi(1)CUPCUPCUP
Kittson131578913152631315-1578
Lake(1)200-326200-852200-2693
Lac Qui Parle(2)2000147420009482000-893
Le Sueur(1)CUPCUPCUP
Lincoln131578913152631315-1578
Mc Cleod(1)264021142640158826 40-253
Martin132079413202681320-1573Meeker(1)131578913152631315-1578Morrison(1)132079413202681320-1573
Mower10004741000-521000-1893Murray(1)263021042630157826 30-263Nicollet(1)CUPCUPCUP
Nobles(2)1972.51446.51972.5920.51972.5-920.5Norman(1)263021042630157826 30-263Olmsted(2)131578913152631315-1578Pipestone152099415204681520-1373
Polk131578913152631315-1578Redwood(1)131578913152631315-1578Renville(1)131578913152631315-1578
Rice(1)131578913152631315-1578
Rock263021042630157826 30-263
St. Louis(1)CUPCUPCUP
Scott(2)10004741000-521000-1893Sherburne(1)CUPCUPCUP
Sibley(2)131578913152631315-1578Steams(1)150097415004481500-1393
Steele10004741000-521000-1893Stevens(2)660134660-392660-2233
Swift(2)131578913152631315-1578
Traverse263021042630157826 30-263
WadenaCUPCUPCUP
Waseca(2)10004741000-521000-1893Watonwan(1)263021042630157826 30-263Wilken(1)CUPCUPCUP
Winona(1)10004741000-521000-1893Wright(1)CUPCUPCUP
Yellow Medicine(1)263021042630157826 30-263
CUP = Separation distances may be imposed by Conditional Use Permit
(1) Conditional Use Permit required based on specified number of animal units (at this size or facility)
(2) Conditiona Use Permit may be required based on specific conditions (other than animal units)

Average Deviation From Necessary Distance1044.407518.407-1322.59
Number of Inadequate Separation Distances31143
Average Deviation From Necessary Distance for Those With Inadequate Distances-126-246.545-1322.59

Table 11(h). County Ordinance Separation Distances Compared to OFFSET Output: 400 Cow Dairy - Milking Only

Variation From Estimated Residence Separation Distance Required For Three Levels of Annoyance Free Status

Site Description400 Cow Dairy-Milking Only

Site Specifics barn dimensions = 90 x 372 Free Stall, 46 x 274 Holding & Milking Area (46,084 total sq. ft.), 227 x 372 earthen manure storage structure

Animal Units560

Odor TechnologyNatural Crust

Odor Control Factor0.4

Total Odor Emission Factor99.8

Annoyance Free Level94%94%97%97%99%99%

Necessary Separation Distance(1)0.260.481.25Necessary Separation Distance, Feet 1367.625 24.86575Distance and Variation at This LevelDistanceVariationDistanceVariationDistanceVariation

County

Becker(1)CUPCUPCUP

Benton(1)CUPCUPCUP

Big Stone1315-52.61315-1209.81315-5260

Blue Earth(1)1500132.41500-1024.81500-5075

Brown(1)CUPCUPCUP

Carver(2)500-867.6500-2024.8500-6075

Cass(1)CUPCUPCUP

Chippewa(1)26301262.42630105.22630-3945

Clay(1)1000-367.61000-1524.81000-5575

Cottonwood26301262.42630105.22630-3945

Dodge(1)500-867.6500-2024.8500-6075

Faribault1500132.41500-1024.81500-5075

Fillmore(1)26301262.42630105.22630-3945

Freeborn(1)CUPCUPCUP

Goodhue(1)1315-52.61315-1209.81315-5260

Houston(1)1315-52.61315-1209.81315-5260

Isanti(1)1000-367.61000-1524.81000-5575

Itasca(1)CUPCUPCUP

Jackson(1)26301262.42630105.22630-3945

Kandiyohi(1)CUPCUPCUP

Kittson1315-52.61315-1209.81315-5260

Lake(1)200-1167.6200-2324.8200-6375

Lac Qui Parle(1)2000632.42000-524.82000-4575

Le Sueur(1)CUPCUPCUP

Lincoln1315-52.61315-1209.81315-5260

Mc Cleod1680312.41680-844.81680-4895

Martin1320-47.61320-1204.81320-5255

Meeker(1)1315-52.61315-1209.81315-5260

Morrison(1)990-377.6990-1534.8990-5585

Mower1000-367.61000-1524.81000-5575

Murray(1)1315-52.61315-1209.81315-5260

Nicollet(1)CUPCUPCUP

Nobles(2)2958.8159 1.2295 8.8434 2958.8 -3616.2

Norman(1)26301262.42630105.22630-3945

Olmsted(2)1315-52.61315-1209.81315-5260

Pipestone1320-47.61320-1204.81320-5255

Polk1315-52.61315-1209.81315-5260

Redwood(1)1315-52.61315-1209.81315-5260

Renville(1)Open basin not allowed

Rice(1)1315-52.61315-1209.81315-5260

Rock26301262.42630105.22630-3945

St. Louis(1)CUPCUPCUP

Scott(2)1000-367.61000-1524.81000-5575
Sherburne(1)CUPCUPCUP
Sibley(2)658-709.6658-1866.8658-5917
Stearns(1)1500132.41500-1024.81500-5075
Steele1000-367.61000-1524.81000-5575
Stevens(1)660-707.6660-1864.8660-5915
Swift(1)1315-52.61315-1209.81315-5260
Traverse26301262.42630105.22630-3945
WadenaCUPCUPCUP
Waseca(2)1000-367.61000-1524.81000-5575
Watonwan(1)26301262.42630105.22630-3945
Wilken(1)CUPCUPCUP
Winona(1)1000-367.61000-1524.81000-5575
Wright(1)CUPCUPCUP
Yellow Medicine(1)26301262.42630105.22630-3945
CUP = Separation distances may be imposed by Conditional Use Permit
(1) Conditional Use Permit required based on specified number of animal units or utilization of open basin (at this size or facility)
(2) Conditiona Use Permit may be required based on specific conditions (other than animal units)

Average Deviation From Necessary Distance149.94-1007.26-5057.46
Number of Inadequate Separation Distances273242
Average Deviation From Necessary Distance for Those With Inadequate Distances-296.193-1365.18-5057.46

Table 11(i). County Ordinance Separation Distances Compared to OFFSET Output: 1,050 Cow Dairy - Milking Only

Variation From Estimated Residence Separation Distance Required For Three Levels of Annoyance Free Status
Site Description1050 Cow Dairy-Milking Only
Site Specifics barn dimensions = 90 x 372 & 108 x 200 & 108 x 330 Free Stall barns, 46 x 274 Holding & Milking Area (103,324 total sq. ft.), 227 x 372 earthen manure storage structure
Animal Units1470
Odor TechnologyNatural Crust
Odor Control Factor0.4
Total Odor Emission Factor228
Annoyance Free Level94%94%97%97%99%99%
Necessary Separation Distance(1)0.30.751.92
Necessary Separation Distance, Feet 1578 3945 10099.2
Distance and Variation at This LevelDistanceVariation DistanceVariation DistanceVariation
County
Becker(1)CUPCUPCUP
Benton(1)CUPCUPCUP
Big Stone(1)1315-2631 315-26 30131 5-8784.2
Blue Earth(1)1500-7815 00-244 51500-8599.2
Brown(1)CUPCUPCUP
Carver(1)500-10 78500-34455 00-9599.2
Cass(1)CUPCUPCUP
Chippewa(1)394 52367 39450 3945-6 154.2
Clay(1)1 000-57 81000-29451 000-90 99.2
Cottonwood394 52367 39450 3945-6 154.2
Dodge(1)131 5-2631 315-26 30131 5-8784.2
Faribault(1)1500-78150 0-2445 1500-8 599.2
Fillmore(1)2630 10522 630-13 15263 0-7469.2
Freeborn(1)13 15-263 1315-2 63013 15-878 4.2
Goodhue(1)13 15-263 1315-2 63013 15-878 4.2
Houston(1)131 5-2631 315-26 30131 5-8784.2
Isanti(1)10 00-578 1000-2 94510 00-909 9.2
Itasca(1)CUPCUPCUP
Jackson(1)263 01052 2630-1 31526 30-746 9.2
Kandiyohi(1)CUPCUPCUP
Kittson(1)1315-2 63131 5-2630 1315-8 784.2
Lake(1)2 00-137 8200-3 74520 0-9899.2
Lac Qui Parle(1)20 00422 2000-1 94520 00-809 9.2
Le Sueur(1)CUPCUPCUP
Lincoln(1)1315-26313 15-263 01315-8784.2
Mc Cleod(1)2 64010 62264 0-1305 2640-7 459.2
Martin1 320-25 81320-26251 320-87 79.2
Meeker(1)263 01052 2630-1 31526 30-746 9.2
Morrison(1)132 0-2581 320-26 25132 0-8779.2
Mower1000-57810 00-294 51000-9099.2
Murray(1)263 01052 2630-1 31526 30-746 9.2
Nicollet(1)CUPCUPCUP
Nobles(1)394 52367 39450 3945-6 154.2
Norman(1)263 01052 2630-1 31526 30-746 9.2
Olmsted(1)131 5-2631 315-26 30131 5-8784.2
Pipestone2147 56921 47-179 82147-7952.2
Polk(1)1315-2 63131 5-2630 1315-8 784.2
Redwood(1)1 315-26 31315-26301 315-87 84.2
Renville(1)Open basin not allowed
Rice(1)1 315-26 31315-26301 315-87 84.2
Rock(1)3945 23673 94503 945-61 54.2

St. Louis(1)CUPCUPCUP
Scott(2)1000-5781000-2945 1000-9099.2
Sherburne(1)CUPCUPCUP
Sibley(1)1315-2631315-2630 1315-8784.2
Stearns(1)20004 22200 0-1945 2000-8099.2
Steele(1)1000-5781000-2945 1000-9099.2
Stevens(1)660-9186 60-3285660-9439.2
Swift(1)1315-2631315-2630 1315-8784.2
Traverse(1)2630 1052 2630-1315 2630-7469.2
WadenaCUPCUPCUP
Waseca(2)1000-5781000-2945 1000-9099.2
Watonwan(1)2630 1052 2630-1315 2630-7469.2
Wilken(1)CUPCUPCUP
Winona(1)1000-5781000-2945 1000-9099.2
Wright(1)CUPCUPCUP
Yellow Medicine(1)2630 1052 2630-1315 2630-7469.2

CUP = Separation distances may be imposed by Conditional Use Permit
(1) Conditional Use Permit required based on specified number of animal units or utilization of open basin (at this size or facility)
(2) Conditiona Use Permit may be required based on specific conditions (other than animal units)

Average Deviation From Necessary Distance205.7674-2161.23-8315.43
Number of Inadequate Separation Distances273943
Average Deviation From Necessary Distance for Those With Inadequate Distances-426.333-2382.9-8315.43

Section 5. Summary and Conclusions

For the seven swine and two dairy sites studied, setback distances suggested by OFFSET range from 0.03 to 0.3 miles for 91% annoyance free levels, from 0.05 to 0.41 miles for 94% annoyance free levels, from 0.1 to 0.75 miles for 97% annoyance free levels, and from 0.28 to 1.92 miles for 99% annoyance free levels. The suggested setback distances for the lower annoyance free levels (91 and 94%) are probably more attainable than those for the higher annoyance free levels (97 and 99%).

The 11 barn swine finishing hoop site has by far the lowest suggested setback distances (0.03 to 0.28 miles) because of its low total odor emission factor (5.28). Setback distances are greatest for the 1,050 cow dairy site (0.3 to 1.92 miles), since this system has the highest total odor emission factor (228). The 2400 sow swine breeding/gestation/ farrowing site is a close second behind the dairy site for total odor emission factor (202.70) and setback distances. However, with the addition of a biofilter, this site becomes the second lowest in terms of total odor emission factor (20.30) and consequently setback distances.

According to this analysis, setback distances in existing county ordinances are fairly effective at attaining a 94% annoyance free level for most site types. They are somewhat effective at attaining a 97% annoyance free level for some site types. They are ineffective at attaining a 99% annoyance free level for almost all site types. This means that in most counties, there are 22 to 45 hours (97% and 94% annoyance free levels, respectively) of odor annoyance per month. Some people may consider these levels to be too high, while others may consider them to be acceptable.

Land use planning can offer an opportunity for these people livestock producers, their neighbors, and other community residents to decide collectively what goals the community wants to reach while understanding the tradeoffs involved. In land use planning for livestock ordinances, there are three variables communities should consider:

'What level of annoyance is acceptable? An annoyance free level such as 91% may be considered too low, since in a worst case scenario it could potentially result in 22 annoyance occasions per month. On the other hand, an annoyance free level of 99% could result in a best case scenario of just 1 odor occurrence per month, but this may be an unreasonable expectation for people living in an agricultural production zone if it in effect bans livestock production from the area.

'What setback distance is feasible in the planning area? For an area that is sparsely populated, a setback distance of 2 miles may be feasible, in which case the community would not have to worry about annoyance free levels or total odor emission factors, since all livestock site types would meet a 99% annoyance free level. However, for most areas this large setback distance is not realistic there would be no locations that have so much land available for siting. In most agricultural areas, a setback distance of 0.5 miles or less would probably be more realistic. However, the shorter the setback distance, the more difficult it becomes to attain annoyance free levels (i.e., the potential for odor annoyance increases).

What total odor emission factors are reasonable for livestock sites? Some site types have very high total odor emission factors, and others have very low factors. For some site types, the total odor emission factor can be reduced by using odor mitigation technologies. Since the total odor emission factor affects what annoyance free level can be attained at what setback distance, a community will want to determine a level that is attainable by livestock facilities while at the same time encouraging management that mitigates odor emissions.

In land use planning, these three variables must be balanced to meet community goals for both controlling odor nuisance and allowing livestock production in the area. Using OFFSET to explore various scenarios of the three variables could help all community members understand more fully the potential impacts of their decisions on themselves and other community members, and to devise a plan that can more fully meet all of their goals simultaneously.

Attachment 6 a-c

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a: Morrison County, Minnesota, Land Use Notification Form

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b: Elkhart County, Indiana, Agricultural Zoning Districts

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c: Fremont County, Idaho, Resource Management Easement

MORRISON COUNTY, MINNESOTA
I HEREBY CERTIFY THAT
THIS INSTRUMENT #_____
WAS FILED/RECORDED IN THIS OFFICE FOR RECORD
ON THE _____DAY OF_____A.D. 20_____
FEE_____S.C._____CHECK_____CASH_____P.P._____
WILL CERT_____SEPTIC CERT _____
REC D_____
RETURN_____

DATE_____

NAME_____

ADDRESS_____

PARCEL NUMBER_____ PERMIT # _____

LEGAL DESCRIPTION_____

LAND USE NOTIFICATION

Section 1205 of the Morrison County Land Use Control Ordinance states that every land use permit for the construction or addition to a dwelling unit in Agriculture and Agriculture/Forestry Zoned, shall inform the owner that:

1. **The land on which the dwelling unit or dwelling unit addition id or will be located in is an Ag or Ag/Forestry district. The construction. Expansion and operation of animal feedlots and other agricultural uses are permitted in this district.**
2. **Feedlots and other agricultural uses may adversely affect the residential use or value of the property.**
3. **Agricultural uses are given preference over other uses in Ag and Ag/Forestry districts.**

This notice shall be recorded in the Morrison County Recorder s Office at the expense of the applicant.

Signature of Land Owner_____

ELKHART COUNTY, INDIANA
"A-3" FARMLAND PRESERVATION DISTRICT

The goals of the A-3 District are:

1. Enhanced Right-to-Farm protection.
2. Recognition by community.
3. Promote agricultural economic development.

General requirements for consideration of A-3 designation:

1. Request for consideration to Plan Commission by landowner.
2. Minimum of 40 acres or contiguous to an existing A-3.

Permitted uses:

1. Agricultural uses, including but not limited to crop farming, livestock and poultry farming, grazing lands, and the operation of any machinery, vehicles, and other uses customarily incidental to agricultural actually being pursued on the premises.
2. Buildings associated with agricultural uses actually being pursued on site - provided no more than 5% of the A-3 real estate is covered by structures.
3. Parking and storage of operable farm vehicles, farm machinery and other motor vehicles actually used on the premises in connection with any use permitted in this district.
4. No prohibition from expanding agricultural enterprise as long as environmental regulations are met and agricultural practices are sound. Sound agricultural practices - refers to those practices necessary for the on-farm production, preparation, and marketing off agricultural commodities.

Limitations:

1. Construction of residential housing not permitted except by Special Use granted only for owners, family members employed in the agricultural operation on the premises, or tenants involved in the agricultural operations on the premises.
2. That any future residential subdivision of property within 300 ft. of an A-3 zoned property must address as part of the requested Primary Approval the following:
3. Off site surface drainage impacts
4. Subsurface tiling systems impacts
5. Irrigation accommodations
6. Security of A-3 zoned property from residential uses
7. Subdivision plat notes and restrictive covenants on the property deeds holding harmless agricultural production in the A-3 zone when operating under normal practices

Agricultural use notice:

To help reduce conflicts between farmers and non-farm neighbors, the property owner may post signs along country roads within an A-3C zone. The signs would identify the area as Farmland Preservation Zone and give notice that dust, noise, odors, and other inconveniences may occur due to normal farming activities. Size, design and location of these signs are to be approved by the staff of the Elkhart County Plan Commission.

ELKHART COUNTY, INDIANA
"A-4" CONFINED FEEDING PROTECTION DISTRICT

The purpose of the district is to permit intensive agricultural uses and to recognize certain needs of the agricultural community.

The goals of the A-4 District are:

1. Enhanced Right-to-Farm protection.
2. Recognition by community.
3. Promote agricultural economic development.
4. Co-existence with residential neighbors.

General requirements fore consideration of A-4 designation:

1. Request for consideration to Plan Commission by landowner.
2. Minimum of 40 contiguous acres or acreage contiguous to an existing A-4.
3. That the proposed confined feeding operation must have state approval within state rules for confined feeding operations - regardless of number of animal units.

Permitted uses:

1. Agricultural uses, including but not limited to crop farming, livestock and poultry farming, grazing lands, and the operation of any machinery, vehicles, and other uses customarily incidental to agricultural uses actually being pursued on the premises.
2. Buildings associated with agricultural uses actually being pursued on site.
3. Parking and storage of operable farm vehicles, farm machinery and other motor vehicles actually used on the premises in connection with any use permitted in this district.

Limitations:

1. Construction of residential housing not permitted except by special use, granted only for owners, family members employed in operation, or tenants involved in confined feeding operations on the premises.
2. That confined feeding operations, including manure management techniques, are to be placed on the site in accordance with state rules for confined feeding operations.
3. That in order for the County Commissioners to grant an A-4 zoning designation, all real estate owners adjacent to the proposed A-4 zoning at the time the application is filed with the Plan Commission must sign a statement of acknowledgment of the use of this property for confined feeding operations, and that as long as these operations are conducted in compliance with this A-4 district, any state regulation and normal agricultural practices, they will hold harmless the owner of the A-4 real estates from claims due to dust, noise, odors, etc. emanating from the operation.
4. That any future splits of property adjacent to the A-4 District, whether subdivision or metes and bounds, must include the wording of the above mentioned release of the deed as a perpetual deed restriction in order foe the County to consider such splits as potential buildable tracts.
5. That a confined feeding operation must maintain less than 1500 animal units

as determined from the following chart:

ANIMAL TYPE	ANIMAL UNIT(S)
Calves (150-500 lb)	.5
Feeder Cattle (500-1200 lb)	.75
Beef Cows	1
Young Dairy Stock (500-100 lb)	.75
Dairy Cows	1
Nursery Pigs (up to 50 lb)	.2
Grower/Feeder Pigs (up to 50 lb)	.3
Finishing Hogs (100 lb - market wt.)	.4
Sows	.5
Boars	.5
Sheep	.5
Turkeys	.10
Layer Chickens	.01
Broiler Chickens	.01
Ducks	.01
Horses	1

Agricultural use notice:

To help reduce conflicts between farmers and non-farm neighbors, the property owner may post signs along county roads within an A-4 zone. The signs would identify the area as Confined Feeding Protection District and give notice that dust, noise, odors, and other inconveniences may occur due to normal farming activities. Size, design and location of these signs are to be approved by the staff of the Elkhart County Plan Commission.

ELKHART COUNTY, INDIANA
"A-5" INTENSIVE LIVESTOCK OPERATION DISTRICT

The purpose of the district is to address extremely large confined feeding operations and to recognize certain Health, Safety, and General Welfare needs of Elkhart County.

The goals of the A-5 District are:

1. Protect Health, Safety and General Welfare of residents of Elkhart County.
2. Recognition by community.
3. Promote agricultural economic development.
4. Co-existence with residential neighbors.

General Requirements:

1. That for an Intensive Livestock Operation (as defined in Req 2) to operate in Elkhart County, it must be located within real estate zoned "A-5".

An Intensive Livestock Operation is:

Any farm or farm operation engaged in raising, breeding, or feeding beef or dairy cattle, horses, swine, sheep, goats, poultry/fowl, turkeys/ducks, or other livestock in concentrations of 1500 or more animal units, including any buildings, structures, excavations, or enclosed areas directly involved therein, including land used for pasture or feedlot or areas directly connected to or associated with such operations.

Permitted Uses:

1. Agricultural uses, including but not limited to crop farming, livestock and poultry farming, grazing lands, and the operation of any machinery, vehicles, and other uses customarily incidental to agricultural uses actually being pursued on the premises.
2. Buildings associated with agricultural uses being pursued on site.
3. Parking and storage of operable farm vehicles, farm machinery and other motor vehicles actually used on the premises in connection with any use permitted in this district.

Limitations:

1. Construction of residential housing not permitted except by special use, granted only for owners, family members employed in operation, or tenants involved in the intensive livestock operations on the premises.
2. That Intensive Livestock Operations, including manure containment management techniques, are to be placed on the site in accordance with state rules for confined feeding operations.
3. That proposed uses and accessory uses will not be injurious to the public welfare in the surrounding neighborhood. Specifically impacts of odor, gases, manure, noise, truck traffic, and air pollution must be considered and mitigated to the extent required by the Commission.
4. That compliance with all state laws, especially the Indiana Department of Environmental Management's Animal Waste Regulations with the Indiana Confined Feeding Control Law, is mandatory.

Agricultural use notice:

To help reduce conflicts between farmers and non-farm neighbors, the property owner may post signs along county roads within an A-5C zone. The signs would identify the area as Intensive Livestock Operation District and give notice that dust, noise, odors, and other inconveniences may occur due to normal farming activities. Size, design and location of these signs are to be approved by the staff of the Elkhart County Plan Commission.

Sample Natural Resource Easement from Fremont County, Idaho.

RESOURCE MANAGEMENT EASEMENT

_____ are the owners of real property described as follows:

In accordance with the conditions set forth in the decision of Fremont County dated _____, approving a permit for residential development on the above described property, and in consideration of such approval, Grantors grant to the owners of all property adjacent to the above described property, a perpetual nonexclusive easement as follows:

1. The Grantors, their heirs, successors, and assigns acknowledge by the granting of this easement that the above described property is situated in an agricultural area and may be subjected to conditions resulting from commercial agricultural operations on adjacent lands. Such operations include the cultivation, harvesting, and storage of crops and livestock raising and the application of chemicals, operation of machinery, application of irrigation water, and other accepted and customary agricultural activities conducted in accordance with federal and state laws. These activities ordinarily and necessarily produce noise, dust, smoke, and other conditions that may conflict with Grantors' use of Grantors' property for residential purposes. Grantors hereby waive all common law rights to object to normal and necessary agricultural management activities legally conducted on adjacent lands which may conflict with Grantors' use of Grantors' property for residential purposes and grantors hereby grant an easement to adjacent property owners for such activities.

2. Nothing in this easement shall grant a right to adjacent property owners for ingress or egress upon or across the described property. Nothing in this easement shall prohibit or otherwise restrict the Grantors from enforcing or seeking enforcement of statutes or regulations of governmental agencies for activities conducted on adjacent properties.

This easement is appurtenant to all property adjacent to the above described property and shall bind to the heirs, successors, and assigns of Grantors and shall endure for the benefit of the adjoining landowners, their heirs, successors, and assigns. The adjacent landowners, their heirs, successors, and assigns are hereby expressly granted the right of third party enforcement of the easement.

IN WITNESS WHEREOF, the grantors have executed this easement dated this_____ day of _____, 19____.