LIVESTOCK DECISION SUPPORT TOOL FOR THE RURAL MUNICIPALITY OF PEMBINA

Agricultureand Agri-FoodCanada
PrairieFarmRehabilitation Administration
Agricultureet AgroalimentaireCanada
Administrationdurétablissement agricoledesPrairies
KAP
Canada

Acknowledgements

Thisproject wasinitiatedunder an agreementbetweenKeystoneAgriculturalProducersandthe PrairieFarmRehabilitationAdministrationtodevelopanddeliver decision supportsystems for sustainableagricultural resourcedevelopment planningtomunicipalgovernmentsinManitoba.

Financial and technicalsupportforthe projectwasprovidedbyWesternEconomic Diversification,KeystoneAgricultural Producers,PrairieFarmRehabilitationAdministration, andtheRuralMunicipalityofPembina.

Thisreport providestheRural MunicipalityofPembinawithvaluabletoolsandknowledgethat will assist them in makinginformeddecisionsregardingsustainable agriculturalandrural development,protectingthewater and soil resource.

Thereport waspreparedby:
DaleTimmerman&
PaulSchelenz
MordenDistrictPFRAOffice

Assistancewasprovidedby:
RAPUnit.

2001

PFRA ARAP
PrairieFarmRehabilitation Administration
Administrationdurétablissementagricole desPrairies

Western Economic Diversification Canada
Canada

KAP

Abstract

With the recent expansion of the livestock industry in Manitoba, local decision makers and rural municipalities are under pressure to ensure that decisions in regards to livestock operations reflect sustainability in terms of environmental, social and economic issues. A decision support tool was developed for the Rural Municipality of Pembina to assist the council in making decisions regarding the livestock industry in the rural municipality.

A Geographical Information System (GIS) was used to integrate resource data, locations and size of livestock operations, and provincial laws and regulations regarding livestock development. Analysis of data collected allowed for creation of map based products and other data tabulation to spatially display and examine issues with respect to livestock development such as the availability of land for manure application or implication of recommended buffering on placement of new or expanded facilities.

Currently, there are 184 livestock operations in the Rural Municipality of Pembina. Cattle operations account for 61% of the livestock operations in the RM, with 20% hog operations. Animal units produced in the are unknown. Based on land use information, approximately 222,000 acres (90,000 hectares) of land is available for manure application in the RM. Provincial setback requirements for manure application, present land use, and soil characteristics such as drainage and texture would place limitations on these acres available for manure application. Soil suitability for earthen storage could further reduce potential areas of expansion should this method of manure storage be proposed in any new or expanded development. Additional data collection one size of livestock operations is required to provide information on the amount land available for the sustainable application of manure in the RM of Pembina.

Table of Contents

1.0 Introduction and Background 1
2.0 Project Description 3
3.0 Methodology 4
3.1 Determine the needs of the Rural Municipality of Pembina 4
2.0 Data Collected 4
Basemap features 4
Ortho-Photo and Quarter Section Fabric 4
Municipal Zones 5
Location of Residences, Rural Businesses (non primary agriculture) 5
Location of Livestock Operations 6
Landuse 7
Soils 8
Soil Texture 8
Soil Drainage 9
Soil Suitability for Sewage Lagoons 10
4.0 Analysis and Discussion 12
4.1 Setbacks for Livestock Operations 12
Setbacks for Livestock Operations in the RM of Pembina: 13
Setbacks for New Residences in the RM of Pembina: 13
4.2 Manure Application 13
Land Base Required for Manure Application in the RM of Pembina: 14
Land Base Available for Manure Application in the RM of Pembina: 14
4.3 Data Maintenance 15
5.0 Summary and Conclusions 16
5.1 Future Steps 16
6.0 Acknowledgments 22
7.0 Data Sources 22

List of Tables

Table 1. Rural Residences, Abandoned Dwellings, and Rural Businesses (non- primary agriculture) in the RM of Pembina. 6
Table 2. Number and Type of Livestock Farms by Ward for RM. of Pembina. 7
Table 3. Land use in the RM of Pembina 7
Table 4. Surface Soil Texture with 1994 Landuse Overlay for the RM of Pembina 9
Table 5. Soil Drainage Class for the RM of Pembina 10
Table 6. Soil Suitability Limitations for Earthen Manure Storage in the RM of Pembina 11
Table 7. Recommended Criteria for Siting Livestock Operations 12
Table 8. Total Land Base Available by Ward for Manure Application based on 1994 LandSat Imagery for the RM of Pembina 14

List of Figures

Map 1 & Ortho - Location map for rural residences, rural business, and abandoned buildings (dwellings).
Map 2 & Ortho - Location map for livestock operations.
Map 3 & Ortho - Location map for rural residences, rural businesses, abandoned yards, and livestock operations.
Map 4 & Ortho - Location map for hog operations.
Map 5 & Ortho - Location map for beef and dairy operations.
Map 6 & Ortho - Location map for other livestock operations.
Map 7 - Land Use.
Map 8 - Surface texture with annual cropland, forage, trees, and grassland overlay.
Map 9 - Drainage interpretive class.
Map 10 - Soil suitability limitations for earthen manure storage.
Map 11 - Farm practices guidelines for siting livestock operations from single residences and surface watercourses, springs and wells.
Map 12 - Farm practices guidelines for siting livestock operations from single residences and surface watercourses, springs and wells.
.

1.0 Introduction and Background

Provincial Industry Trends:

The growth of the livestock industry in Manitoba over the last few years has been dramatic. Due to the removal of the Western Grains Transportation Subsidy, Manitoba is the most cost efficient region in North America to feed livestock. This coupled with investment in new hog operations and processing facilities is expected to continue to drive expansion of the livestock industry for several years. In particular, Manitoba's hog industry has projected extensive growth. Provincial hog numbers increased from 2.3 million hogs in 1992 to 3 million hogs in 1995. Currently, production sits at about 5.35 million hogs. Beef cattle numbers are expected to increase from their current status which resides around 554,000. Sheep and goat production has seen a dramatic increase in the last two years and significant growth has also been seen in the poultry industry, particularly the egg sector. Bison production growth rates remain strong around the 20% per year mark. PMU production in Manitoba has stabilized in the last few years. Dairy cattle numbers are expected to decrease, although combining of quotas into larger operational units will intensify production and management issues.

The expansion of many livestock operations is expected to happen rapidly, and in the hog industry the majority of new enterprises will likely be sited, developed and operational within the next two to five years. Local governments and other decision makers are under pressure to make decisions on livestock operations which must reflect sustainability in terms of environmental, social and economic issues. The resource base data for land use planning, although not complete, is advanced enough to be immediately useful by local governments in their decision making. Social and economic considerations are equally important, but will require additional data and development to be integrated into local decision making.

Rural Municipality of Pembina Livestock Trends:

Livestock operations within the Rural Municipality of Pembina have traditionally been involved in beef and pork and to a lesser extent in dairy, PMU, and poultry production. A significant amount of grain and forage production within the rural municipality (RM) is used in these industries. With an established infrastructure of supporting industries, trained workforce and a strong local knowledge base to build on, expansion of livestock numbers within the RM may have occurred, however this would have to be confirmed through further data collection. The 1996 Stats Canada Census data reveals poultry numbers around 180,000, beef at 5,400, hogs at 37,000, dairy at 600, horses at 500, sheep around 1,000, and goats around 306.

With the increasing sizes and corresponding changes in technologies used by producers, public concern over the environmental and social impact of livestock operations has also increased. To arrive at decisions that allow for a strong and sustainable livestock industry while addressing the concerns of the community requires the RM council and staff to effectively acquire, interpret and disseminate information.

Geographic Information Systems (GIS) is a relatively new tool that can assist local governments in making sustainable resource development decisions regarding the livestock industry. GIS allows the user to spatially display social, economic, and environmental information and produce hard copy maps. GIS can help local governments and planning districts resolve complicated resource planning issues by displaying information in a comprehensive and comprehendible format.

2.0 Project Description

The objective of this project is to provide the RM of Pembina with a tool for analyzing existing and future livestock scenarios and associated land, water, and social constraints. This was achieved through identification of key resource based issues and data requirements, including the collection of livestock operations locations, application of analytical procedures, and preparations of products and results of the analysis in support of local discussion and decision making. At completion, this project will deliver

i. a methodology that supports resource based decision making with respect to livestock expansion,

ii. capability of the Rural Municipality of Pembina to utilize advanced decision support tools,

iii. reports for the project partners that includes hard copy (tabular and map form) results of analysis,

iv digital products and data for continued analysis by the Rural Municipality of Pembina.

3.0 Methodology

3.1 Determine the needs of the Rural Municipality of Pembina

Through discussions with the RM the following general statements about the needs and scope of the project were established. The Rural Municipality of Pembina wishes to have a decision support tool for land use planning capable of spatially illustrating options, issues and factors essential to decisions on livestock development within the parameters set out by provincial guidelines, regulations, acts and laws, and future municipal bylaws. **The product will not replace the need for site specific assessment of each operation but will assist in generalized land use planning for the whole RM.** Data requirements needed to successfully complete the project were discussed and mutually agreed upon and are reported herein.

3.2 Data Collected

Basemap features

The basemap is a digital map that all other information is plotted or corrected to. Essentially, the basemap is the frame upon which the rest of the data is placed. This information includes the position of roads, lakes, rivers, streams, rail lines plus other features. This information was also used in the analysis of environmental setbacks from water bodies, roads and other applicable features. Two separate sources of information were utilized for creating the basemap for the RM of Pembina. These are the National Topographical Survey (NTS) and the ortho-photos with associated quarter section grid. Each source has different levels of information and accuracy.

Ortho-Photo and Quarter Section Fabric

A digital ortho-photo is an aerial or satellite photo which accurately represents the surface of the earth at any given location for a specific time. In this case, the original aerial photo has been digitally corrected for many errors that are inherent in the photographic and flight process. Angle of photography, distortion from camera lens, differences in elevation are just some of the factors that are corrected. The ortho photos for Pembina were taken at 1:60 000 scale. The ortho- photo for the RM of Pembina was used as a backdrop in many of the map products.

The quarter section fabric for the RM of Pembina was originally created from a 1:50 000 National Topographic Survey map. Adjustments were then made to the quarter section fabric to match the ortho-photo. This fabric allows users to efficiently locate a position in accordance with the Western Canada Land Survey System. The ortho-photo and the quarter section fabric were obtained from the Land Information Division, Department of Conservation of the Government of Manitoba.

Municipal Zones

Municipal zoning is used by a municipality to control and direct development. The RM of Pembina currently does not have a zoning by-law which sets conditions and/or restrictions on business development including agriculture livestock operations. The RM of Pembina hopes to enter into discussions regarding zoning by-laws with the town of Manitou through the process of a municipal planning district. Presently, the RM of Pembina relies on existing Provincial livestock regulations, guidelines, and laws to direct livestock development.

Location of Residences and Rural Businesses (non primary agriculture)

Residence locations can be used to determine which areas to possibly exclude from livestock expansion or manure application due to close proximity. Using information about residences also allows for an analysis of trends in residential development and their impact upon the livestock industry. Residence locations were determined through analysis of ortho-photos and with the assistance of RM staff.

Conflicts can arise between residential land uses and the livestock industry. As such, the distribution of rural residences can have dramatic impact upon existing, expanding and future livestock operations. Residential development within the RM of Pembina can be split into two main categories: 1) community/villages; and 2) rural residences.

Six residential areas are located within the RM. The local urban districts of La Riviere and Darlingford, and the town of Manitou are all located in the upper half of the RM in Township three. The hamlets of Mowbray and Snowflake located in the lower half of the RM in Township 1 and the hamlet of Kaleida is located in Township 2 (Map 1 and Map 1 ortho). No residential data was collected within the residential areas.

All rural residences and abandoned dwellings within the RM were accounted for. Rural businesses (non-primary agriculture) were also accounted for (Map 1 and Map 1 ortho). Table 1 below shows the number of residences, abandoned buildings, and rural businesses by ward for the RM. A total of 444 rural residences, 92 abandoned dwellings, and 26 rural businesses are found in the RM. Ward 5 has the highest concentration of residences while Ward 3 has the lowest.

Table 1. Rural Residences, Abandoned Buildings, and Rural Businesses (non-primary agriculture) in the RM of Pembina

Location	# of Residences	# of Abandoned Buildings	# of Rural Businesses
Ward 1	91	29	6
Ward 2	79	34	3
Ward 3	39	2	3
Ward 4	76	9	11
Ward 5	94	10	2
Ward 6	65	8	1
Total	444	92	26

Location of Livestock Operations

Knowing the location of existing livestock operations is essential for proper land use planning to occur. This information is extremely useful in determining the direction and scope of future expansion of the livestock industry as well as the sustainable management of existing operations. Livestock locations were determined through the use of ortho-photos and the assistance of RM staff. Information on type of livestock as well as class of operation was acquired from producer interviews. **For farms comprised of several types of livestock (ex. hogs & beef) and/or classes of operation (ex. beef cows & feeders) each distinctive unit was classified as a single operation.** This information was collated into a single database format for all livestock types. The location of operations that are newer than the ortho photos were approximated with the assistance of municipal staff.

The RM of Pembina has a well established livestock industry (Maps 3 & 3ortho, Map 4 & 4ortho, 5 & 5ortho, and Map 6& 6ortho). A total of 184 different livestock operations (Table 2) were identified (Map 2 and Map 2 ortho). Beef (61%) and hog (21%) farms account for the majority (82%) of livestock operations. Horse, poultry, sheep, and goat farms account for the remainder.

Livestock operations within the RM are distributed fairly evenly. A few small pockets of land within the RM have noticeably less operations than others. Ward 3 has less than half the number of livestock operations than any other ward. The majority of hog operations are located in the northern half of the RM. The majority of beef and PMU farms are located in the southern half and eastern portion of the RM.

Total animal units for the RM was not determined in the analysis, nor was a range of operation sizes determined. Further data collection would be required for this. This information could provide very useful information to the RM of Pembina in future decision making processes.

Table 2. Number and Type of Livestock Farms by Ward for RM of Pembina.

Location	# Beef	# Dairy	# Hog	# Poultry	# Horses	# Sheep	# Goat	Total
Ward 1	26	1	7	1	2	-	1	38
Ward 2	24	4	4	-	2	1	2	37
Ward 3	10	-	-	-	1	-	-	11
Ward 4	18	1	14	2	1	1	-	37
Ward 5	16	1	13	3	2	-	1	36
Ward 6	19	1	-	-	3	2	-	25
Total	113	8	38	6	11	4	4	184

Land Use

The way land is used affects decisions about manure application and facility placement. Land use also has an impact on the amount of acres available for manure disposal. Native grasslands and improved forage fields can utilize significantly more nutrients found in manure than annual crops and hence application rates can be considerably higher. Rates of manure application can vary within the improved forage category depending on whether the stand is dominated by a legume such as alfalfa or dominated by grasses. The Farm Practices Guidelines for Livestock Producers outline land base requirements for manure application based on type of land use.

Land use information is derived from Landsat satellite imagery which has a resolution of 30 m^2. The satellite measures the spectral signatures which can then be correlated to 7 general landuse categories (Map 7). These categories are Annual Crop Land, Forages, Grasslands, Trees, Water, Wetlands, and Urban and Transportation. Data was acquired from RadarSat International and classification was performed by Manitoba Remote Sensing Centre.

Annual cropland (67%) is distributed throughout the RM. Treed lands (15%) occur primarily around the Pembina River. Grasslands occur throughout Pembina, with smaller areas of forages occurring throughout the RM. Wetlands occur throughout the central portion of the RM.

Table 3. Land use in the RM of Pembina

Land Use	# of acres	# of hectares	% of total Landuse
Annual Cropland	188,343	76,252	66.6
Trees	42,637	17,262	15
Water	1,600	648	0.7
Grassland	28,824	11,670	10.2
Wetlands	8,472	3,430	3
Forage	5,499	2,226	1.9
Urban & Trans.	7,421	3,004	2.6
Total	282,796	114,492	100

Soils

Soils of a municipality are an important natural resource for the community. Information on soils is important for making decisions about agricultural capability, risk of leaching, and suitability for many uses including agriculture, industrial, construction, and recreational. The soils information for the RM of Pembina is available at a scale of 1:50 000, with 1:20 000 detailed soil survey information available for the Manitou town site area. The soils database contains information about soil texture, drainage, permeability, plus many other characteristics and interpretations. This information plus other soil interpretations can be acquired from the Land Resource Unit of Agricultural and Agri-Food Canada and the Soil Resource Section of Manitoba Department of Agriculture and Food.

Soil Texture (excerpted from descriptions supplied by Agricultural Resource Section of Manitoba Agriculture and Food)

Soil texture strongly influences the soils ability to retain moisture, its general level of fertility and ease or difficulty of cultivation. Water moves easily through coarse textured (sandy) soils so little moisture is retained and they dry out more quickly than fine textured (clay) soils. As well, sandy soils do not retain plant nutrients as well as clay soils and have lower natural fertility. Sandy soils often are characterized by loose or single grained structure, which is very susceptible to wind erosion. Clay soils have a high proportion of very small pore spaces which hold moisture tightly and have higher natural fertility because they are able to retain plant nutrients. Clay soils transmit water very slowly, therefore these soils are susceptible to excess moisture conditions.

Soil texture also affects decisions about manure application and facility placement. Soil texture plays a major role in the amount of manure which can be applied to the land. Medium to heavy textured soils tend to retain nutrients and water better than coarser textured soils which usually corresponds to more plant biomass production. Because of this, manure application rates according to the Farm Practices Guidelines on medium to heavy textured soils (sand loam to clay) can be higher than for coarser textured soils (loamy sand to sand).

Ninety three percent of soils in the RM of Pembina have a fine loamy soil texture and are predominately under annual cultivation. Pockets of heavier textured clay soils are found in center of the RM, range 8 west of the first prime meridian. Table 4 highlights surface soil texture with land use overlay for the RM (Map 8).

Table 4. Surface Soil Texture with 1994 Landuse Overlay for the RM of Pembina.

Surface Texture	# of Acres (hectares) of Annual Cropland on ……	# of Acres (hectares) of Forage on ……	# of Acres (hectares) of Trees on ……	# of Acres (hectares) of Grassland on ……
Eroded Slopes	3,562 (1,442)	525 (212)	10,989 (4,449)	2,674 (1,083)
Unclassified	38 (15)	-	16 (6)	21 (8)
Clayey	5,913 (2,394)	41 (17)	105 (42)	181 (73)
Fine Loamy	175,854 (71,196)	4,935 (1,998)	6,134 (2,483)	8,648 (3,501)
Sand	2,152 (871)	2 (1)	40 (16)	177 (72)
Organic	825 (334)	1 (<1)	48 (19)	227 (92)
Total	188,344 (76,252)	5,504 (2,228)	17,333 (7,017)	11,928 (4,829)

Soil Drainage (excerpted from descriptions supplied by Agricultural Resource Section of Manitoba Agriculture and Food)

Soil drainage refers to the frequency and duration of periods when the soil is free of saturation. Excessive water content in soil limits the free movement of oxygen and decreases the efficiency of nutrient uptake. Delays in spring tillage and planting are more frequent in depressional or imperfectly to poorly drained areas of a field. Improved surface drainage and underground tile drainage are management considerations that can reduce excessive moisture conditions in soils. The majority of poorly drained soils remain in the native state supporting vegetation associated with wetlands and marsh. Five soil drainage classes are indicated in the soil drainage map (Map 9).

Rapidly drained - water is removed from the soil rapidly in relation to supply. Excess water flows downward if underlying material is pervious. Subsurface flow can occur on steep slopes during heavy rainfall. Soils have low water storage capacity and are usually coarse in texture.

Well-drained - excess water is removed from the soil, flowing downward readily into underlying pervious material or laterally as subsurface flow.

Imperfectly drained - water is removed from the soil sufficiently slowly in relation to supply to keep the soil wet for a significant part of the growing season. The source of moisture includes precipitation and/or groundwater.

Poorly drained - water is removed so slowly in relation to supply that the soil remains wet for a comparatively large part of the time when the soil is not frozen. The main water source is subsurface flow and/or groundwater in addition to precipitation.

Very poorly drained - water is removed from the soil so slowly that the water table remains at or on the surface for the greater part of the time that the soil is not frozen. Excess water is present in the soil throughout most of the year.

Well drained soils predominate in the RM of Pembina (60%) and occur throughout the RM. Areas of imperfect, poor, and very poor soil drainage are inter-dispersed throughout the entire RM and correspond with changes in soil type and topography. Areas of rapid soil drainage correspond with slope areas along Pembina River system and feeding tributaries (Map 10).

Although soil drainage is not specifically mentioned in the Farm Practices Guidelines for Livestock Producers, it does play a role in siting of facilities and application of manure. Poor soil drainage can create inherent problems with trafficability around facilities and in fields during manure application. It also has a direct relationship to the amount of potential field runoff or internal leaching for a soil. Significant improvements to soil drainage can sometimes be achieved but usually at a significant cost. Avoiding problem areas is the best measure if possible.

Table 5. Soil Drainage Class for the RM of Pembina

Class	# of acres	# of hectares	% of RM
Water	598	242	0.2
Rapid	39,377	15,942	14.1
Well	168,422	68,187	60.2
Imperfect	52,870	21,405	18.9
Poor	13,842	5,604	4.9
Very Poor	4,426	1,792	1.6
Unclassified	383	155	0.1
Total	279,918	113,327	100

Soil Suitability for Sewage Lagoons (excerpted from descriptions supplied by Agricultural Resource Section of Manitoba Agriculture and Food)

Factors affecting the ability of undisturbed soils to impound sewage and prevent seepage are considered in evaluating soils for their suitability for lagoon areas. This evaluation considers soil both as a vessel for the impounded area and as material for the enclosing embankment. As the impounded liquids could be potential sources of contamination of nearby water supplies, the risk of flooding due to landscape position of the lagoon must also be considered.

The degree of soil suitability is based on the following factors:

- depth to water table
- flooding
- soil permeability
- slope
- organic matter
- coarse fragments, size and amount
- depth to bedrock
- thickness of slowly permeable layer
-subgrade Unified Soil Class

Sewage lagoons, commonly used by rural communities, were considered to be equivalent to the earthen manure storage used by many intensive livestock operations. This interpretation outlines soil factors that should be considered when building a new manure storage facility. A significant portion (97%) of the RM of Pembina can be characterized as having moderate to very significant limitations for construction of earthen manure storage facilities due primarily to one or more parameters such as slope, soil permeability, and subgrade materials. **This classification is meant as a generalized assessment and can not be used for specific site assessments.**

Table. 6. Soil Suitability Limitations for Earthen Manure Storage in the RM of Pembina

Class	Area (acres)	Area (hectares)	Percent of RM
Very Significant	73,638	29,813	26
Significant	9,847	3,987	3.5
Moderate	191,581	77,563	67.8
Negligible	6,985	2,828	2.5
Water	604	244	0.2

4.0 Analysis and Discussion

4.1 Setbacks for Intensive Livestock Operations

An important tool used in municipal planning for livestock operations are setbacks. Setbacks are used to maintain appropriate distances between livestock operations and residences in order to prevent potential nuisance complaints or conflicts. The RM of Pembina does not have zoning bylaws and therefore relies on the Provincial Farm Practice Guidelines for Livestock Producers and the Livestock Manure and Mortalities Management Regulation under the Environment Act to establish appropriate setback distances.

Under the Livestock Manure and Mortalities Management Regulation, most livestock and all manure storage facilities must be placed 100 m from water features such as streams, lakes, wells, dugouts and sink holes. At the time of this study water well locations were accurate only to the quarter section and were not used in the analysis of setback distances.

The Farm Practices Guidelines for Livestock Producers dictate that as the size of operations increase so does the size of the setback between it and neighboring residences or designated areas (ex. towns/villages). Setback distance from designated areas or zones are greater than from individual residences and the setback distance from earthen manure storage is greater than that for non- earthen storage or from livestock holding facilities (Table 7). Separation distances apply to new and expanding operations. As a rule, existing livestock operations or facilities are considered in compliance if the operation was established before the new guidelines or regulations were in place.

Table 7: Recommended Criteria for Siting Livestock Operations

Animal Units (AU)	Maximum Number of Residences within One Mile	Minimum Distance							
		From Single Residence				From Designated Residential or Recreational Area			
		To Earthen Storage		To Buildings		To Earthen Storage		To Buildings	
		m	ft	m	ft	m	ft	m	ft
10-100	18	200	656	100	328	800	2640	530	1760
101-200	16	300	984	150	492	1200	3960	800	2640
201-400	14	400	1311	200	656	1600	5280	1070	3520
401-800	12	500	1639	250	820	2000	6600	1330	4400
801-1600	10	600	1967	300	984	2400	7920	1600	5280
1601-3200	8	700	2297	350	1148	2800	9186	1870	6135
3201-6400	6	800	2640	400	1311	3200	10560	2130	6988
6401-12800	4	900	2953	450	1479	3600	11871	2400	7920
12801 & greater	2	1000	3278	500	1639	4000	13200	2670	8760

Setbacks for Livestock Operations in the RM of Pembina:

Combining recommended and regulated setbacks limits the number of new or expanded operations that can potentially exists within a region. Using the location of map features such as rural residences and rural businesses, setback distances from earthen storage facilities were digitally created from the center of a residence or business. The effect of the buffers for a range of operation sizes from 10 to 400 AU and from 401 to 3,200 AU are displayed in Map 11 and Map 12. Buffering rural residences and businesses to new or expanded livestock buildings or non-earthen storage facilities would reduce setbacks by one half to that displayed in Maps 11 and 12 for earthen manure storage, as setbacks are smaller for these facilities. Proposed livestock facilities within buffered zones may be considered in some instances, but would likely require consultation and/or approval from neighboring residences, a technical review team, the RM, Manitoba Conservation, and/or other parties. In RM's with zoning by-laws, conditional use permits are often issued as a means of setting out the terms and conditions in which livestock facilities can be located. Conditional use permits usually incorporate livestock guidelines, regulations, and other social, economic, resource, and farm management considerations into siting of new facilities.

The maps about setback distances represent an approximation of the areas where livestock operation can be placed according to the above mentioned bylaws. Other bylaws, regulations, environmental concerns can only be addressed at a level of detail not available for this study. **This report does not replace the need for site specific analysis but rather can act as a generalized guide for overall municipal planning purposes.**

Setbacks for New Residences in the RM of Lorne:

If information on the size of livestock operations exists then the appropriate setback can be placed around individual operations. This would allow the RM to direct development of residences to areas where conflict with existing livestock operations could be minimized. As information was not collected on the size of livestock operations, this analysis was not conducted.

4.2 Manure Application

To be sustainable, livestock operations need a minimum acreage of agricultural land upon which manure can be applied. In order to properly understand the implications for the RM of Pembina given their current status of livestock operations, a two pronged approach could be used. First the total land base required for manure application based on reported livestock units could be performed. Then an analysis of amount of land available for manure application in the RM could be done.

Land Base Required for Manure Application

As information on size of existing livestock operations was not collected, calculation of the amount of land required for manure application was not possible.

Land Base Available for Manure Application

Information on how land is utilized allows the decision maker to see areas where potential for growth of the livestock industry exists, or areas where growth restrictions should be considered. The analysis of two available databases, Soil Survey and 1994 Landsat Landuse provided an understanding of how much land is potentially available for manure application. Essentially manure application would be limited to those areas which are annual cropland, forages, and grasses (Map 7). Areas that are classified as treed, water, wetlands, and urban and transportation are unavailable for manure application and are removed from further analysis. Organic soils (Map 8) whose use for manure application is not well known were also removed from analysis. In the case of RM of Pembina this would mean that approximately 222,666 acres (90,148 ha) are suitable for manure application (Table 8).

Table 8. Total Land Base Available by Ward for Manure Application based on 1994 LandSat Imagery for the RM of Pembina.

Ward #	Annual Crop Land acres (hectares)	Forage acres (hectares)	Grassland acres (hectares)	Total acres (hectares)
1	38,68 (15,662)	1,979 (801)	6,245 (2,528)	46,910 (18,992)
2	40,173 (16,264)	1,285 (520)	8,919 (3,611)	50,377 (20,395)
3	17,038 (6,898)	470 (190)	3,324 (1,346)	20,832 (8,434)
4	32,729 (13,251)	678 (274)	4,417 (1,788)	37,824 (15,313)
5	41,590 (16,838)	402 (163)	3,874 (1,568)	45,866 (18,569)
6	18,127 (7,339)	685 (277)	2,045 (828)	20,857 (8,444)
Total	188,343 (76,252)	5,499 (2,225)	28,824 (11,669)	222,666 (90,147)

However, setbacks from designated residential or recreational areas and individual residences must be removed from total area of land suitable for manure application.. In addition setbacks from water features vary depending on the percent slope of the land surrounding a water feature (see Farm Practices Guidelines for Livestock Producers) and therefore must be removed from the total area available for manure application too. Since accurate slope information does not exist, pin pointing exact acres available was impossible.

Calculation of the percent reduction in acres available for manure application due to setbacks was performed. A 10% (22,801 acres/9,231 hectares) reduction in land available from the available 222,666 acres (90,148 ha) indicated previous would occur due to setback distance requirements if the following assumptions were made.

1. All manure surface applied and incorporated within two days from residences and

designated residential areas (property line setbacks not factored in).
2. All manure surface applied and incorporated within 48 hours from water sources. Assumes all land receiving application has less than 4% slope. Property line setbacks not equated. Setbacks from wells not equated.

Results of this analysis indicated that 0.9 % (1,985 acres/804 ha)) would be due to residence setbacks, 1.1 % (2,496 acres/1,010 ha) due to residential area setbacks, and 8.2 % (18,323 acres/7,418 ha) due to water source setbacks. Some overlap in buffer area calculation for residences, communities, and water sources did occur. Method and timing of manure application would greatly influence available land base required as would manure application on annual cropland verses forage/grasslands (see Farm Practices Guidelines for Livestock Producers).

By comparing the amount of land base "required" verses the amount of land base "available" for manure application decision makers would have a clearer picture as to how much room is available for livestock expansion in the RM from a manure application perspective. This comparison can be done in the future once more data is acquired. Given the number and type of livestock operations identified for this project as well as local appreciation for sizes of operations, one could reasonably assume there is still ample room for livestock expansion in the RM. Depending on the size of any new or expanded livestock operation, setbacks could have more of a bearing on available space for livestock expansion in the RM than land required for manure application.

4.3 Data Maintenance

Information is a time sensitive resource. As the time from original collection increases so does the chance for significant changes to occur. These changes can have significant impact upon the validity of conclusions derived from the data. The rate at which data changes is related to the specific type and scale of data collected. Social information about the location of roads, gas lines, residences, livestock locations, livestock numbers, municipal bylaws and other factors can change significantly within a year. Frequent updates of this information should occur. Information of natural resource information is typically not as dynamic as social information. The location of streams, lake, elevation, soil properties, climate and other properties often change at a more gradual rate than social information. However it should be noted that new data is being acquired constantly and a periodic review should occur. When reviewing improved data one should always remember to consider the present use of the data and if new information is truly needed. For example, new more detailed information about the location of streams may have been created. But if the level of detail required is low then acquiring new data sets may not be justified. Any updates to data should occur only through discussion between the user (RM staff and council) and a professional who is well versed in the data, it's uses and limitation.

The RM of Pembina assumes ownership and management of all hard copy and digital data collected for completion of this report. Release of any detailed information contained within the data set will be at the discretion of the RM of Pembina and their rate payers.

5.0 Summary/Conclusions

With the growth of the livestock industry in Manitoba and the increase in concern for the environment, municipal councillors are under pressure to make informed decisions that address environmental, social and economical issues. By having information such as land resources, location of residences and livestock operations, and infrastructure available in a useable form, through the use of GIS, councillors will be able to make wise decision regarding the livestock industry in their municipality.

Livestock production in the RM of Pembina is quite diverse with production varying from beef and dairy cattle to hogs to horse, goats, sheep and poultry production. Beef cattle operations are the most common in the RM, with hog production second. Currently there are 184 livestock operations in the RM of Pembina

Based on land use and soil information, 222,666 acres (90,148 hectares) are available for manure application. The acres of land available for manure application would be reduced by some 22,801 acres (9,231 hectares) when setback distances required under provincial regulation are accounted for. Soil characteristics such as drainage and texture as well as present land use will also have implications on manure management plans and acres available for application. Livestock expansion may further be reduced depending on method of manure storage, as 29.5 % of the rural municipality has significant to very significant soil suitability limitations for earthen manure storage facilities. Detailed site assessments would have to be done in order to determine nature and degree of limitation for locating livestock facilities.

This report does not replace the need for site specific assessment for new or expanding livestock operations but will assist in generalized land use planning for the whole RM. GIS map products generated under this initiate provide an additional tool for all parties involved with livestock expansion in the RM of Pembina to help steer development in the best direction possible at the onset of any new proposal. This should translate into potential time and cost savings for project proponents and the RM. In addition public confidence should remain higher. From here proponents of livestock development projects and local decision makers can enter into more detailed assessment protocols.

5.1 Future Steps

Additional analysis would require the collection of additional data on livestock operations including size. Information provided in additional analysis, as outline below, would further assist in providing valuable information to ensure any livestock expansion occurs in a sustainable manner in the RM or in a future planning district.

A. Setbacks for New Residences in the RM of Pembina:

If information on the size of livestock operations exists then the appropriate setback can be placed around individual operations. This would allow the RM to direct development of residences to areas where

conflict with existing livestock operations could be minimized. In addition to highlighting areas where operations can establish, the ability to spatially display setback distances of various sizes allows an RM council or other local decision makers to review proposed bylaws to ensure that they provide a balanced approach to livestock development. This information can then be easily presented to their constituents which promotes a higher level of public input into development of the livestock industry within the RM. The same analysis also becomes useful for rural communities and residents trying to attract or making the case for livestock development and/or infrastructure opportunities.

B. Land Base Required for Manure Application in the RM of Pembina:

Since information on size of existing livestock operations was not collected, the first analysis on amount of land required for manure application was not possible. Total land base required for manure application could be performed using the methodology set out in the Farm Practices Guidelines for Livestock Producers. The calculation is as follows:

Total Animal Units
x Storage & Application Factor
x Soil & Crop Nitrogen Utilization Factor
x Days in Feeding Location
= Land Base Required

Using the equation above, livestock operations could be grouped by type as required to produce the following calculations:

Hogs & Poultry -	A.U. x 0.57 x 1.6 x 365 / 365 = acres required
Dairy -	A.U. x 0.71 x 1.6 x 241 / 365 = acres required
Beef, Horses, Sheep, Goats -	A.U. x 0.67 x 1.6 x 150 / 365 = acres required
	Sum = Total acres required for RM

Assumptions used:

1. Earthen storage used for all hog & poultry operations.
2. Manure pack used for all beef, horse, sheep, & goat operations.
3. Dairy scrape used for all dairy operations.
4. Dairy cattle confined 25% more (ie. 91 days) than beef.
5. Beef confined from Dec. 1 to April 30 (5 months or 150 days).
6. All manure is applied in the fall by broadcast and incorporated within 48 hours.
7. All manure is applied on annual crop land of medium to heavy texture (90% of soils have loam texture - Table 4).

Based on this method of analysis, the total land base required for manure application could be calculated on an RM wide basis or by ward.

As livestock expansion occurs, the RM will likely develop their own bylaws. GIS can be used to analyze and visually display the impact of proposed bylaws on the RM. Ultimately councillors can determine which bylaws are most appropriate for their RM or planning district.

Manure spread for some facilities will be targeted outside of the RM, reducing how much manure

is applied within an RM. Knowing this information, the amount of land available for additional manure application from potential livestock expansion can be calculated. In the event of the development of planning district this information can be extended to the district as a whole to assist with the sustainable expansion of livestock.

As the RM gains familiarity with the use a GIS, they may wish to incorporate more of their day to day operations into such a system. For example, internal management of infrastructure works such as location of and/or repairs and maintenance on culverts, bridges, roads, drainage ditches, signs and other infrastructure. Also tax role and assessment can be included in a GIS environment. The improved ability to bring information together in an easily understood format, such as maps, will assists councillors in their decision making, but will also facilitate public input into decisions. Improved decision making that will arise from this and similar projects will allow the RM council and staff to better serve the people of the RM of Pembina.

6.0 Acknowledgments

Support for this project has been provided by Western Economic Diversification, Keystone Agricultural Producers, Agriculture and Agri-Food Canada (Prairie Farm Rehabilitation Administration and Western Land Resource Group (Manitoba), and the Rural Municipality of Pembina. The authors would also like to acknowledge additional assistance provided by Manitoba Agriculture and Food and Manitoba Conservation.

7.0 Data Sources

Ortho-Photos and Quarter section grid: Linnet Geomatics International Inc., Winnipeg, Manitoba. 1:60 000, 1997.

National Topographic Survey: Department of Energy, Mines and Resources, Surveys and Mapping Branch, Ottawa Canada. 1:50 000.

Soils of the Rural Municipality of Pembina: Glenn Podolsky, 1993. Report No. D77. Canada-Manitoba Soil Survey. Winnipeg.

Soils and Terrain - An introduction to the land resources. RM of Pembina. Information Bulletin 97-10. 1998 Manitoba Land Resource Unit.

Land Use: Satellite imagery obtained from RSI. Landsat TM (30 m pixel resolution) Date of image: annual crop land and forage September 17, 1994. All other classes May 22, 1986. Classification from the Manitoba Remote Sensing Centre. Winnipeg, Manitoba.

Livestock, Rural Residence, Rural Business, Recreational and Designated Residential data from personnel communication with RM of Pembina staff and councillors, 2000, Manitou, Manitoba.

Hog Production and Agronomy Information: Farm Practices Guidelines for Hog Producers in Manitoba, Manitoba Department of Agriculture, 1998.

Manitoba Agriculture and Food web site www.gov.mb.ca/agriculture/livestock and personal communication with Janet Honey, Manager, Market Analysis and Statistics Section, Program and Policy Analysis Branch, Winnipeg, Manitoba.