

Spirit Creek Watershed Monitoring Committee

Five Year Report

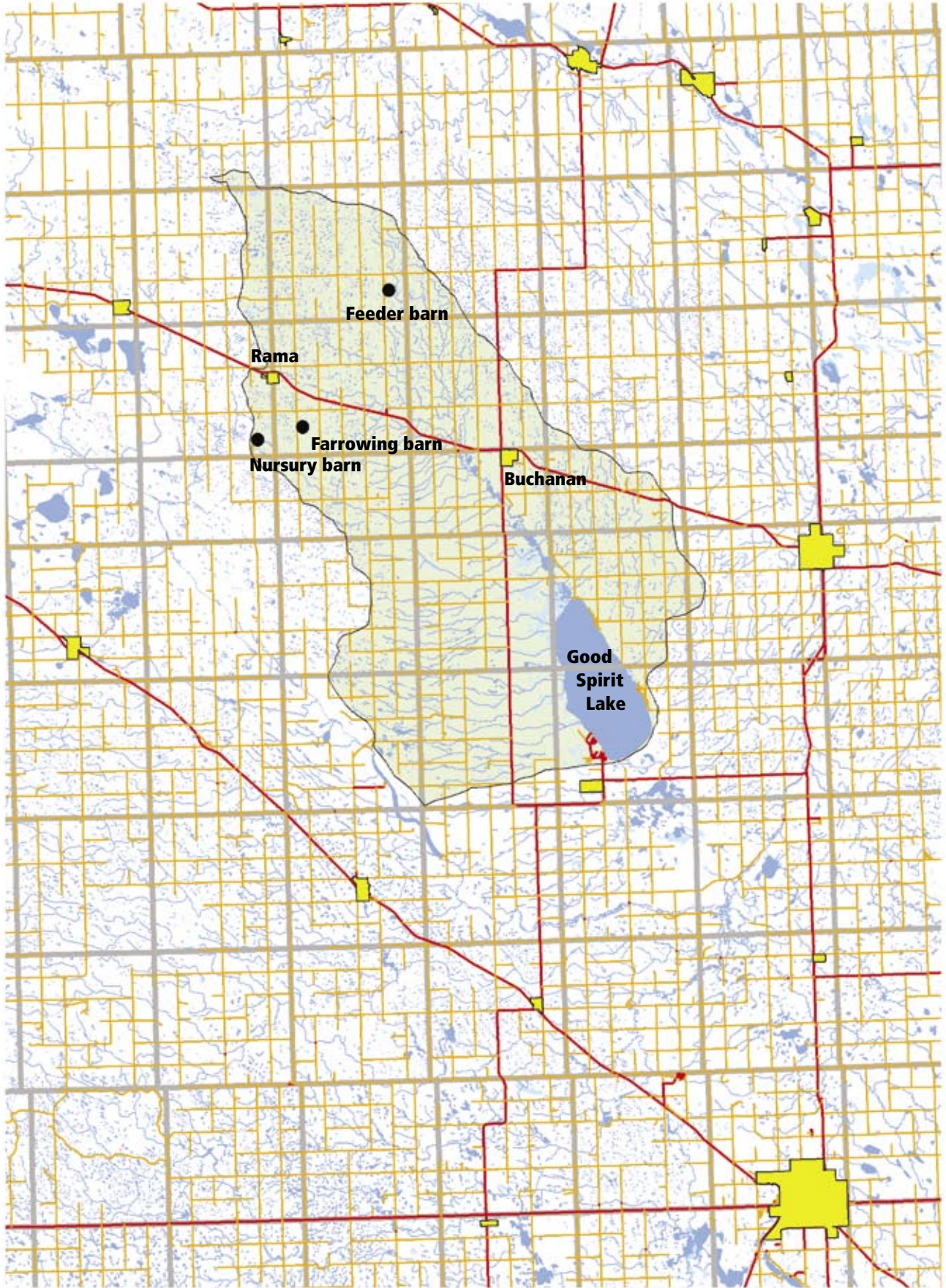


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Letter of Transmittal

July 7, 2006

The Honorable Mark Wartman,
Minister of Agriculture & Food,
Room 3021 Legislative Building,
Regina, Saskatchewan.
S4S 0B3

Dear Minister Wartman:

I am pleased to present you with the Five Year Report (2000-2005) on the work completed by the Spirit Creek Watershed Monitoring Committee. The report is in response to public concerns around a multi-site hog barn project located in the Spirit Creek Watershed, which includes Good Spirit Lake.

This report covers the work of the Committee, resource personnel, stakeholders and research specialists. The report summarizes results, conclusions and recommendations.

Respectfully submitted,



Don Walters
Chairman
Spirit Creek Watershed Monitoring Committee

c.c. The Honorable Clay Serby

Chairman's Report

Our Committee has been in operation since the fall of 2000. At that time the Minister of Agriculture announced the formation of our ten member Board. The Board was to monitor the impact that intensive hog operations would have on the water quality in the Spirit Creek Watershed.

Since our formation, we have expanded our monitoring to include air quality, odour, soil, and manure.

We know that national, provincial and local governments objectives are to develop rural Saskatchewan with environmental protection. We have seen that new development does initially create a large boom for the area. This is especially true when in the construction stage. This is followed by an increase in local job creation, at fair wages and benefits.

Keeping families in the area, as well as new families moving into the area helps to maintain the tax base, which in turn keeps the schools open, maintains recreation, businesses and church. It is said for every person working, we keep three other people employed.

Our Committee is an arms length committee, and we are accountable to the community. We are working with local citizens to find out if odour is a health concern or a nuisance concern? Is water and manure from hog barns a source of contamination?

We also know that there are many other potential sources of contamination such as cattle, poultry, lagoons, human waste, poor cultivation practices, over grazing, riparian damage, old wells, old dugouts, birds, leaking storage systems, chemicals, pesticides, etc. However, we have to be careful who we point to as the source.

After five years of monitoring, the Committee found no increased water contamination from the hog barns in the Rama area. So far they are protecting the environment, as well as safeguarding our soil and water, more so then other Provinces and States. We will know if more stringent regulations are needed.

Five years ago I thought that the "Environment" was the most important part in considering our future economy. But I have since learned that the environment and economy must work together to get it right.

Old fashioned definitions of environment leave out so much. Not only does it leave out the economy, but social values as well. We must get our minds around all of these factors to make it work.

Our Interest - is to support Saskatchewan researched programs and to work with all stakeholders for the betterment of our environment and economy.

Acknowledgements

The Spirit Creek Watershed Monitoring Committee (SCWMC) would like to acknowledge and thank all the committee members who wrote reports and worked on the various sub-committees. Their individual commitment and devotion is commendable, and without it this project would have never succeeded. Committee members:

1. Don Walters – Chairman of the SCWMC
2. Don Olson – Secretary of the SCWMC; Chairman of the website sub-committee; Chairman of the soils sub-committee (from October 2004); Mayor, Town of Sturgis.
3. Jim Davis – Chairman of the soils sub-committee (to October 2004); cottage owner, Canora Beach
4. Ray Riesz – Chairman of the water sub-committee; cottage owner, Good Spirit Lake; member, Friends of Good Spirit Lake.
5. Eugene Prychak – Chairman of the odour sub-committee; livestock and grain producer in the Rama area
6. Adam Kosar – active participant on all sub-committees; Mayor, village of Buchanan.
7. Jack Prychak – active participant on all sub-committees; local cattle producer in the Rama area; Reeve of the R.M of Invermay #305
8. Florian Possberg – CEO of Big Sky Farms Inc.

The SCWMC would like to acknowledge and thank the following individuals in providing their expertise in contractual services:

1. Dr. Huiqing Guo – Assistant Professor, Department of Agriculture and Bioresource Engineering, University of Saskatchewan. Dr. Guo co-coordinated the Odour Monitoring Project and wrote the main report on the research project.
2. Mr. Keith Head – Agrologist with Head and Associates Ltd. Mr. Head coordinated the Soils Monitoring Project and wrote the main report on the research project.
3. Mr. Calvin Daniels – freelance writer/photographer with Calmardan Editorial Services.
4. SIAST Woodland Campus at Prince Albert – initial website set up.
5. Mr. Dick DeRyk – Uncommon Sense. Mr. DeRyk developed and maintains the website.

The SCWMC is a totally independent and unbiased committee appointed by Minister Clay Serby and re-appointed by Minister Mark Wartman to “direct and communicate the monitoring of intensive hog development to ensure the sustainability of the environment in the Spirit Creek Watershed” (general meeting minutes of September 25, 2000). The SCWMC would like to acknowledge and thank the following resource staff:

1. The Honorable Mark Wartman – Minister of Saskatchewan Agriculture and Food (SAF);
2. The Honorable Clay Serby – Deputy Premier, Minister of Regional Economic and Co-operative Development; MLA Yorkton;
3. Saskatchewan Agriculture and Food (SAF) - Donn Farrer, Andy Jansen, Brian Campbell, Chris Low, Darren Stovin and Bryan Gourlie;
4. Saskatchewan Watershed Authority (SWA) – Dr. Joanne Sketchell, Jim Fox, Rob Walcer and Lorelei Benoit;
5. Saskatchewan Environment (SE) – Joe Zarowny;
6. Big Sky Farms Inc. – Ernie Patrick, Bryan Possberg, Duane Karcha and Gary Sleeva;
7. Sask Pork – Neil Ketilson and Harvey Wagner;
8. University of Saskatchewan – Dr. Claude Laguë and Dr. Philip Willson;
9. Mediation Services, Saskatchewan Justice – Ken Acton and John Jacques;
10. Residents of the Village of Rama and surrounding area; and
11. Bill & Joyce Anaka, Environment Canada weather reporters at Good Spirit Lake.



From left: Eugene Prychak, Don Olson, Adam Kosar, Don Walters, Ray Riesz, Florian Possberg, and Jack Prychak.

Executive Summary

We are the first committee of its kind for Intensive Livestock Monitoring in Canada and we are focusing on remaining completely 'unbiased' and to better understand the hog-related environmental issues.

Our mandate is to monitor water, soil and air. We had to have a baseline. What was out there before any pigs were in the barns or any manure spread on the land was important to know in order to properly measure any impact the barns might have.

We feel it is beneficial to have a monitoring committee to tell a true balanced story of intensive livestock development.

The Spirit Creek Watershed Monitoring Committee has been studying three key areas:

1) AIR/ODOUR

It is our understanding that this major undertaking by our Committee has never been done to this magnitude in Canada.

- a) Is odour a health concern or a nuisance?
- b) Siting distance from hog barn to residence

Stage 1

December 2001 to February 2003-fifty local residents within a five mile radius of the three hog barns (Nursery/Feeder/Breeder) were trained as Odour Observers. They recorded odours that they detected or did not detect at their residence during daily activities on forms that were returned to the U of S Research team.

Stage 2 – Local Residents

March 2003-April 2004

Odour training workshops with thirty seven local residents participating in the study out of one hundred and forty two residents within a five mile radius. They recorded odour events during daily activities. Data recorded included odour intensity on a 0-5 scale. Events detected or non detection were recorded on forms provided. There was also an on site weather station for weather data recording. Odour emission rates from swine production sites were measured once a month.



Odour collection from an earthen manure storage.

Stage 2-Trained Odour Nasal Rangers

Down wind odour occurrence monitoring by trained odour nasal rangers during the period from May to October, 2003. The monitoring was done in one hundred and five predetermined locations within six km of the three Rama hog barns. 81.7% were taken in the early morning – 6:00 to 8:00 a.m., evening – 5:00 to 7:00 p.m. and some afternoons. Intensity measures 1-not annoying, 2-somewhat annoying. These intensities were reported 61% of the time.

Intensity 4 and 5 odours (4-strong, 5-very strong) were reported the least at 19 per cent. Odour intensity 1 and 2 level may serve as odour free levels in the rural area around livestock operations.

Odour detection for the two years would be around 2 per cent of the total time.

Diurnal odour emission profiles of six odour sources were measured in the summer of 2003 and two more in August and September. All data analyzed by U of S, Dept. of Agriculture and Bioresource Engineering, Saskatoon

Findings

- a) Twenty four families detected a total of three hundred and nineteen swine odour events.
- b) Highest odour season-May to July
- c) 61 per cent were detected during early morning, evening or night
- d) No correlations were found between the residence and swine site, number of odour events and odour days

- e) Odour readings seem to be subject to an individual's perception of odour
- f) Frequency, wind speeds and direction affect odour
- g) Odour frequencies vary with direction of the residence from odour source, life style, habit of the residents and nose sensitivity of the residents.
- h) Eleven residents detected no odour occurrence

Objectives

Odour-to identify potential impacts on quality of life of local residents.

- To develop suitable and acceptable criteria for community level exposure to odour/gases to ensure air quality.
- Development and evaluation of Odour Technologies- this would include efficiency and cost effectiveness to allow producers to make informed decisions about odour reduction options. These options will help and can be used to potentially reduce minimum distance separation requirements. This will give more flexibility for new hog operations and may allow the expansion of existing operations. Communication, collaboration and facilitation to deliver credible and relevant odour information to the hog industry and all other stakeholders.

A complete odour report can be found in the Appendices, and on our website www.spiritcreek.ca.

2) SOILS

The Soil/Manure Monitoring Program took place in the vicinity of the Big Sky Farm Inc. three barn complex located in the Spirit Creek watershed near Rama, SK. The program was designed to establish the initial nutrient levels of the soils of selected fields near each of the Big Sky barns. These soil factors were monitored for three crop years (2003, 2004 and 2005) on fields that received manure and fields that received only commercial fertilizer as a means of assessing the relative risks of the nutrient sources to the Spirit Creek watershed.

In the fall of 2001, prior to any manure ever being spread, four fields were soil sampled with the results forming the baseline for future benchmark sample comparisons.

This report marks the end of the five year program (2001 – 2005) that was designed to monitor the effect that pig manure may have on soils on which manure

is used as a crop production input (i.e. fertilizer), and on the crops grown thereon. Regular monitoring of soil conditions and flexibility in the application rates of both manure and fertilizer will allow hog manure to be used to the benefit of crop producers in the area with little or no risk to the Spirit Creek watershed.

A complete soils report can be found in the Appendices, and on our website www.spiritcreek.ca.

3) WATER

Beginning in the fall of 2000 Spirit Creek Watershed Monitoring committee members and Chris Low of Saskatchewan Agriculture and Food have collected water samples of wells, dugouts and runoff in the Spirit Creek Watershed. By the spring of 2004 sufficient data was collected to establish a baseline value and a history of seasonal fluctuations of the wells and dugouts so this monitoring could be suspended for now. Spring runoff sampling will continue throughout the watershed, both upstream and downstream of the manured fields.

This monitoring of water supplies has resulted in an increased awareness of the area residents to the importance of the quality of their source water and many have sought ways to protect and improve it. The results of runoff sampling has shown that there is little difference in the quality of water from manured fields or commercially fertilized fields.

Downstream water bodies need to be protected through the increased use of vegetated buffers and improved riparian areas. Riparian areas are highly valuable ecosystems; their position in the landscape connects aquatic areas with terrestrial areas and allows them to act as natural filters of both surface water and groundwater and buffer against flooding and erosion. Across our watershed, natural riparian areas have been altered by industry, agriculture and urban development, which can have serious consequences for the long-term quality and availability of our water.

As there are no apparent additional stresses placed on the water quality through the actions of Big Sky's hog operation in the Spirit Creek Watershed the recommendations contained in this document are directed to all users of this watershed in order to sustain and improve the water quality.

For detailed results please reference "Assessment of the Ground and Surface Water Quality in the Spirit Creek Watershed" found in the Appendices, and on our website www.spiritcreek.ca.



Typical field appearance after manure injection.

RECOMMENDATIONS OF THE SPIRIT CREEK WATERSHED MONITORING COMMITTEE

The results of the Soil/Manure Monitoring program indicate that manure has increased the soil fertility levels in the soil in the Rama area. The objective of this project is to determine if the current rates of manure applications are sustainable over an extended period of time.

Proposed monitoring of these fields over the next six years will determine if changes to manure management practices will be necessary to maintain the fertility levels without risk to the environment of the Spirit Creek Watershed.

- Continued Soil/Manure Monitoring 2006-2012
- Earthen Manure Storage-sites should be covered with straw or other type covers for odour control
- Notify rural municipalities and/or other stakeholders the location and time of manure application in their area.
- Guidelines for hog manure to be treated as a fertilizer, a resource product, not a waste product
- Manure should be injected into the soil at recommended levels of nitrogen and phosphorus affecting different soils, seasons and local geography.
- More research on the transmission of antibiotic resistant pathogens from animal manure to humans needs to be undertaken since it is an obvious public concern.
- In barns controlling odour and dust particles at the source is an issue requiring more research

Did you know?

Of water flowing into Good Spirit Lake, surface water accounts for 12%; ground water accounts for 35%; and precipitation accounts for 53%.

- Improving the image of the Livestock Industry is a must, as more and more people are living in urban centers and know less about agriculture.
- It is important to maintain open communications between local communities, the public regulators and other stakeholders.
- To improve the quality of the water in the watershed road and drainage ditches should be buffered to reduce the possibility of the transport of excess nutrients and other chemicals.
- A program should be developed (by Government) that would encourage rural residents to have their well water analyzed regularly at a low cost.
- To reduce the risk of surface contamination to the Aquifer land owners should be encouraged to locate and properly de-commission abandoned wells.
- We feel strongly that the rural municipalities' hog barn approval process has to change to develop rural Saskatchewan and that the Provincial Government must become more involved in facilitating the needed change.
- In selection of hog barns sites, separation distance should be revisited in development-e.g. prevailing winds changes, distance of neighbors and land sites.



Farrowing/gestation barn southeast of Rama.

How The Committee Came To Be

Don Walters

When the proposed construction of mega hog barns was announced, "Friends of Good Spirit Lake," a neutral committee, held a meeting at Good Spirit Lake. They invited both opponents and proponents of the development to give their views. Saskatchewan Agriculture and Food was asked to describe the regulation process at the meeting.

Their message was that there were six hog barns, with a total output of 120,000 market hogs to be produced per year and that the hog barn operator was waiting for RM and government approval for these hog barns to be built in the Rama and Hazel Dell area.

Three of these six barns – operated by Big Sky Farms Inc – would be located in the basin that is part of the Upper Assiniboine River Basin, which flows into Spirit Creek and flows into Good Spirit Lake.

We were told that these barns would put an end to our beautiful lake, fish would die, the lake would be full of algae and the list of concerns and fears went on. Doom and gloom were threatened for Good Spirit Lake.

The three barns of concern were:

- **The Korchinski breeder/farrowing complex** is a 6,000 sow farrow-to-wean operation producing approximately 160,000 piglets/year. The complex consists of approximately 6,000 sows, plus boars and gilts and encompasses all aspects of breeding, gestating and farrowing sows. Annual manure production is 34 million litres (7.5 million gallons) and is stored in an engineered earthen storage facility with a capacity of 52 million litres (11.4 million gallons).
- **The Main Road nursery site** consists of four barns which take weaned piglets from the Korchinski site and raise them to approximately 29 kg, at which time they are sent off site for finishing or sold as weanlings. Total capacity of the four barns is 19,200 piglets. Annual manure production is 22 million litres (4.9 million gallons) and is stored in an engineered earthen facility with a capacity of 37.2 million litres (8.2 million gallons).

Did you know?

Over 90 per cent of Canada's farms are family operated.

- **The Matsalla finisher** raises weanlings to market weight and is also used for in-house research. Consisting of 10 rooms with a capacity of 1,200 each, the Matsalla finisher has a total capacity of 12,000 hogs. Annual manure production is 36.8 million litres (8.1 million gallons) and is stored in an engineered earthen storage with a capacity of 54 million litres (11.9 million gallons).

After several meetings with Minister Clay Serby, he took our three options to Regina for discussion. The options were:

- a) Stop the barns from being built.
- b) Compost the manure.
- c) Set up a monitoring committee.

In August of that same year Minister Serby appointed a 10-member monitoring committee. The Committee consisted of Don Walters as Chairperson; Jim Davis, Canora Beach; Adam Kosar, Mayor of Buchanan; Don Olson, Mayor of Sturgis; Eugene Prychak, farmer Rama area; Florian Possberg, CEO of Big Sky Farms Inc.; Jack Prychak, Reeve of Invermay and local livestock operator; Toosh McBride, cabin owner at Burgis Beach; Ray Riesz, Good Spirit cabin owner; and Randy Goulden, Tourism Yorkton. Presently we have a seven-member committee as Randy, Toosh and Jim resigned for personal reasons.



Typical runoff sampling site at discharge end of culvert.

Did you know?

70 per cent of the human body is water, as well as 25 per cent of bone.

Our Committee's Mandate and Goal

As the first committee of its kind for Intensive Livestock Monitoring in Canada, we are focusing on remaining completely unbiased to better understand the hog-related environmental issues.

Our mandate is to monitor water, soil and air. We had to have a baseline. What was out there before any pigs were in the barns or any manure spread on the land was important to know in order to properly measure any impact the barns might have. We had a plan and went to work.



Continuous air sampling from an exhaust fan using a peristaltic pump.

AIR QUALITY

Air samples were collected at the barn, 2400 metres upwind of the barn and 600 metres downwind of the barn. The air quality results were not significantly different 600 metres downwind than 2,400 metres upwind.

Research Project: The Spirit Creek Watershed Monitoring Committee worked in conjunction with Philip Willson with the Vaccine and Infectious Disease Organization (VIDO) from the University of Saskatchewan.

Did you know?

The average pig uses 7 litres (1.5 Imperial gallons) of water each day. Note that water is not lost but is recycled directly back to the land.

SOIL AND MANURE

Jim Davis, Don Olson, Adam Kosar and the committee have worked annually with technical partner Keith Head, Big Sky Farms Inc., the public and local land owners to establish a baseline of nutrient concentrations at various soil depths. They did this to track any nutrient movement vertically and horizontally. They collected data and did comparisons at four monitoring sites and two baseline sites and compared hog manure to commercial fertilizer on four fields.

Research Project: The Spirit Creek Watershed Soil/Manure Monitoring Committee worked in conjunction with Head and Associates Ltd.

ODOUR

A community odour monitoring study was completed around the three hog production sites (farrowing, nursery and finishing barn). There were two stages to this project. The first stage was December 2001 to November 2002. Thirty nine families were trained as odour observers. These families along with other local residents monitored odour exposure levels in the area regarding frequency, intensity, duration and offensiveness (FIDO). They participated in various degrees of odour monitoring.

The second stage of the project was March, 2003 to April, 2004. Residents participated in this study to record odour events during their daily activities. Odour forms were supplied to them which recorded odour intensity on the 0 to 5 N-Butanol scale with 0-faint to 5-very strong. They were to record occurrence time and a general statement about the odour, as well as their own physical condition.

The highest odour season for both stages was from May to July.

Two Nasal Rangers from outside the area were hired from May to October 2003. Weather information was recorded by a centrally located weather station. The nasal rangers took measurements at 105 pre-determined locations. Odour emission rates from the swine sites are measured once per month. Lagoon earthen manure storage (EMS) sites are measured six times during the year. All data has been analyzed and reported.

Research Project: The Spirit Creek Watershed Odour Monitoring Committee worked in conjunction with Huiqing Guo, Wendi Dehod, Joy Agnew and S. Pang

of the Department of Agriculture and Bioresource Engineering, University of Saskatchewan and John Feddes of Agriculture and Food Science, University of Alberta.

WATER SAMPLING

Beginning in the fall of 2000, Ray Riesz, assisted by other committee members and Chris Low of SAF, collected water samples from wells, dugouts and runoff in the Spirit Creek watershed. By the spring of 2004, sufficient data was collected to establish a baseline value and a history of seasonal fluctuations of the wells and dugouts so this monitoring could be suspended for now. Spring runoff sampling will continue throughout the watershed, both upstream and downstream of the manured fields.

This monitoring of water supplies has resulted in an increased awareness among area residents to the importance of the quality of their source water, and many have sought ways to protect and improve it. The results of runoff sampling have shown that there is little difference in the quality of water from manured fields or commercially fertilized fields.

PUBLIC PARTICIPATION

We have found that, in talking to residents privately, you will get quite a different picture of what residents think than in a public meeting. We found that those going to meetings represent a more extreme position within a community, and that the community at large would most likely not attend them. Since we wanted to understand our mandate fully, we focused our attention very strongly on the majority of residents in the community.

In talking to residents and attending community meetings, we realized each community has a mix of people, some with opposing hog barn arguments, some in favour of the development and some who don't care either way. Some of the arguments you hear are community impact, environmental or health concerns, farm structure, regulatory issues, economic factors, government involvement, legal concerns, odour worries and animal welfare.

Did you know?

Saskatchewan's land base represents 41 per cent of Canada's total farm land.

We feel it is beneficial to have a monitoring committee to tell a true balanced story of intensive livestock development.

We understand hog barns can be an economic factor, as witnessed by the impact Big Sky Farms Inc has had in Saskatchewan. Big Sky Farms Inc is the largest hog producer in Saskatchewan – utilizing a three site production model. Their current portfolio of operations include:

- own and operate 44 sites in Saskatchewan and three sites in Manitoba;
- own 42,000 sows producing in excess of 1,000,000 pigs per year;
- own and operate 26 feed mills purchasing over 8 million bushels of feed grains per year;
- own and operate three manure application systems fertilizing over 33,000 acres annually;
- employ approximately 500 with an annual payroll of \$13 million; and
- own and operate numerous support activities including trucking, construction, maintenance, truck washes, a slat plant, research and development and a boar stud for semen collection.

Our committee is presenting this report to the public, the Saskatchewan government and the Saskatchewan Pork Industry.

Our Committee believes in the development of rural Saskatchewan, but it must be done in a way that protects our environment today and for the future.



Main manure delivery pump to the field injection unit.

ECONOMIC DEVELOPMENT IN RURAL MUNICIPALITIES

Although everyone has a role to play, rural residents have a greater opportunity to implement changes that will directly improve their future. Rural municipal residents have been caught in the crossfire of those who want economic development, those who do not and those who are just happy to do what they have been doing and are not interested in development of any kind.

The Spirit Creek Watershed Monitoring Committee attended RM information meetings about community intensive livestock development. We have seen those in favour of development called down and dragged down by those opposed. The issue has often left friends, neighbours and families pitted against each other. Relationships will never be the same again, and this is very sad.

Our committee feels rural municipalities should know what kind of development they want and set policy, before the issue of a development project gets to the stage of such divisive debate.

We feel strongly that the RM approval process has to change to develop rural Saskatchewan and that the provincial government must become more involved in facilitating the needed changes.



Nursery barns southwest of Rama.

COMMITTEE EDUCATION

Our committee members enjoy varied backgrounds including farmers, ranchers, an RM Reeve, two town Mayors, an electrician, a Ducks Unlimited member, a potash supervisor, promotion and marketing people and many who have long term community and provincial voluntary experience.

The committee also shares a desire to learn about the needs of rural communities in developing for the present and future, while maintaining a safe and healthy environment. Decisions based on information made in concert with our stakeholders and the residents of Rama are important.

An undertaking of this type and magnitude has not previously been done in Canada, making the work of the SCWMC an important benchmark. Working with 142 residents within an eight km (five mile) radius of the three Rama hog barns is a critical part of the process. We made contact with each resident several times in our research of odour events over a three-year period. Tracking odour daily was done over 700 days.

A special thank you is extended to all Rama and area residents for their participation and valued interest in the operation of the hog barns. Some of the residents' input, we know, will help in resolving conflicts between farmers and neighbours, and help everyone come to a mutual understanding in the development of hog operations.

In addition, as part of our own education committee members attended conferences in Regina, Yorkton, Saskatoon and Winnipeg. These conferences focused on manure, manure management, nutrient management, water and water quality, manure treatment technologies, workers' and environmental regulations, land use and tours of technologies related to intensive livestock production.

Did you know?

Manure is injected at a rate from 3000 to 12,000 Imperial gallons per acre (3,000 gallons equals 4 mm of rain over a football field).

At committee meetings invited speakers gave us information on what is new, what is happening in the industry at present and what is being researched in the livestock and environment area that could impact development in the future. Speakers came from: Saskatchewan Agriculture and Food; Saskatchewan Watershed Authority; Saskatchewan Environment; Alberta Agriculture, Food and Rural Development; Sask Pork; Mediation Services, Saskatchewan Justice; Head and Associates Ltd; Department of Engineering, University of Saskatchewan; Department of Agriculture and Bioresource Engineering, University of Saskatchewan; Big Sky Farms Inc; Machibroda Engineering Ltd; Department of Soil Science, University of Saskatchewan; Vaccine and Infectious Disease Organization, University of Saskatchewan; Fisheries and Oceans Canada; and Alvin Troop, farmer, Quill Lake.



Moving the flexible manure hose.



Coupler on flexible manure hose.

COMMUNICATIONS

In communicating the committee's efforts and findings, meetings were held with Rama residents and interested public. As well, our newsletter, The Monitor, was distributed three times in the past four years to local area residents, with some 12,000 copies distributed each time. Newspaper advertisements, radio and television interviews, information on the SCWMC website (www.spiritcreek.ca) and one-on-one and small group gatherings were also used to disseminate information. We were in attendance or made presentations on behalf of our Committee at MacNutt, Welwyn, Moosomin, Whitewood, Foam Lake, Rose Valley, Archerwill, Rama, Swan River, Langenburg, Pelly and Invermay.

The committee extends its appreciation to all the media outlets that assisted in carrying our message to the public.

Full Committee Meetings*

2000	September 19 to December 31	5
2001	January 1 to December 31	10
2002	January 1 to December 31	9
2003	January 1 to December 31	7
2004	January 1 to December 31	4
2005	January 1 to December 31	7

*Does not include sub-committee meetings

Did you know?

Of total land in crops and fallow in 2000, manure was applied to 4.8% of Manitoba's cropland, 1.4% of Saskatchewan's cropland, 4.7% of Alberta's and 14.4% of British Columbia's.

Commercial fertilizers were applied to 69%, 59%, 56% and 42% respectively.

Summaries of Monitoring Reports

REPORT ON WATER MONITORING

Ray Riesz

Structure and startup:

In keeping with our mandate to monitor the effects on the environment of the Intensive Hog Operation in the Spirit Creek Watershed a sub-committee was established in the fall of 2000 to collect and analyze ground and surface water samples and communicate the findings to the public. Working with the Spirit Creek Watershed Monitoring Committee (SCWMC) are resource and technical personnel from Saskatchewan Watershed Authority, Saskatchewan Agriculture Food, as well as Saskatchewan Health and Saskatchewan Environment.

Spirit Creek provides drainage for approximately one thousand square kilometers and discharges in Good Spirit Lake, which is considered a partially closed waterbody. Big Sky's three barn complex utilizes less than fifty square kilometers of this area for their buildings and manure application. Manure was first applied to farmland in the spring of 2002. Since that time about 9400 acres around these facilities have received manure. Refer to "Soil/Manure Monitoring Program at Big Sky Rama Complex" located in the Appendices.

The committee's first task was to develop a plan to establish a baseline of the water quality that existed before any liquid hog manure was applied on the land. This would include wells and dugout sites within a three-mile radius of the hog barns as well as runoff sites located throughout the watershed. It would also include the reservoirs that supply water to Rama and Buchanan. Water quality data collected at Good Spirit Lake would also be available.

The well and dugout sampling sites were obtained by contacting each property owner in the target area and getting a description of their water supply and usage (whether for livestock or domestic, or both). We also asked



Shore line of Good Spirit Lake.

permission to take samples in the spring and in the fall. Most of the residents welcomed the opportunity to participate, although there was some skepticism shown by some, who wondered if we would be biased in reporting our findings. We reassured them that we were completely neutral.

The runoff sampling sites were chosen for the ability to provide a clear picture of the quality of runoff water throughout the watershed. Sites were chosen upstream and downstream of the hog barns and the proposed manure application fields. Several sites would track the water quality of Spirit Creek some distance downstream. Runoff sampling would take place only in the spring or after a severe rain event, as most sites in the upper branches of the Creek do not usually flow later in the year.

All samples collected would be "grab samples" which would indicate the quality of the water at that particular moment. Ground water samples would be collected after running the water through the system for a sufficient length of time to allow a fresh supply of water to come into the well. The Committee agreed that this method of sampling would provide a basic understanding of the quality of the water. Many of the wells and dugouts that are used as a source for drinking and/or domestic use had never been analyzed previously. A Committee member would always be present to assist and witness the collection of the samples.

It was agreed that we have the samples collected analyzed for the major ions, general water chemistry and bacteria. There are more than thirty parameters analyzed in each sample. This analyses is preformed at the Provincial Health Laboratory in Regina and some duplicate analyses to verify the results were completed by the Saskatchewan Research Council in Saskatoon.

Did you know?

Green water – the proportion of rainwater that is cycled through vegetation and soil and then returned to the atmosphere via evaporation.

Blue water – rainfall and runoff into lakes, streams, reservoir, ground water.

All sites were to be identified by land location, GPS readings and photographs.

Well and Dugout Sampling:

We were able to begin our sampling before any manure was injected on the land, so we have a great deal of data on the quality of the surface and ground water of the area prior to the operation of the hog barns.

We began sampling wells and dugouts in the fall of 2000 with the sampling of 11 wells and 37 dugouts located in a three-mile radius of the three Big Sky hog barns in the RM of Invermay. This increased to 21 wells and 59 dugouts in the spring of 2001. In the fall of 2002 we reduced the area to be sampled to a two-mile radius. Since then there were 10 wells and 25 dugouts sampled each spring and fall. Over 400 samples were collected by the spring of 2004. After the spring collection we believed that we had gathered sufficient data on each site to establish a baseline that future data may be referenced to.

When the results of our first sampling in the fall of 2000 were received we noticed that 25 samples contained coliform bacteria. The affected residents were phoned and reminded not to consume untreated water, as it could be harmful. Fifteen of the sites used the water for domestic purposes. Those sites were then retested to verify the results. When they were analyzed it was noted that most of the samples had improved as the residents had taken steps to improve their supply through chlorination or some other means such as changing or cleaning their plumbing systems.

Each resident participating in the program received a copy of their analyses along with a variety of publications explaining some of the parameters as well as a copy of the Provincial Drinking Water Objectives. They were encouraged to compare their results to the objectives and to contact Saskatchewan Health or Saskatchewan Watershed Authority if they have any concerns or need assistance with their water quality.

Did you know?

The average pig produces 3.56 litres (0.8 Imperial gallons) of manure each day.

To protect the privacy of the participants no individual's analyses was made public. Instead the results were made available showing only the number of sites sampled and the high and low values recorded as well as the averages for all the parameters tested.

This program was very well received as the sampling sites increased to 25 wells and 59 dugouts even though two residents had opted to withdraw. Many calls were received from residents outside of the study area wanting to be included.

Spring Runoff Sampling:

Runoff samples have been collected each spring at approximately 19 sites as near as possible to full flow conditions since the spring of 2001. These sites are located both upstream and downstream of the hog barns and the lands on which the manure is injected.

The runoff samples are analyzed for the same parameters as the dugouts. As with the dugout and well sampling, we were able to begin our sampling before any manure was injected on the land, so we have a great deal of data on the quality of the water of the area prior to the operation of the hog barns.

All but two of the sites are a part of Spirit Creek. These two sites are on a watercourse that flows directly into the Whitesand River. In total 97 runoff samples have been collected up to spring 2005.



Local community well.

What have we accomplished?

- Through our monitoring program we have established a baseline to which future sampling results can be compared.
- We have communicated the results of our water sampling to the participants by supplying them with a copy of the analytical report as issued by the laboratory.
- We have communicated the results of the sampling to the general public through the use of newsletters, public meetings and our website (www.spiritcreek.ca).
- We have developed a good working relationship with the landowners and residents in the area.
- We have shown that we are unbiased and can be trusted to present the results factually.
- An added benefit to the water monitoring program was the increased awareness of the participants to the condition of their own water supply and many have taken steps to improve it.
- The Committee has become more knowledgeable of the issues concerning hog barns and water quality through attending conferences, speaking to people involved in similar monitoring projects and keeping updated on changes in the industry by inviting speakers as well as reading all information provided to us from all sources.

What have we learned?

- 1) The residents in the area rely almost entirely on the surface and ground water on their property for domestic use. Through the monitoring program many have come to realize that there is much more to water than only hydrogen and oxygen. Because a sample looks, smells and tastes good does not mean that the water is of good quality, particularly for consumption.
- 2) The majority of the wells can be classified as shallow wells (less than 50' deep). Some of the wells were poorly protected from contaminants. These were not properly located or sealed to prevent surface influence. Some well water contained coliforms and some had high levels of nitrate that seemed to change seasonally. A few participants have since made improvements and upgrades to their systems.
- 3) The result of the sampling program shows that each well has its own characteristics and is very dependent on the environment around it.
- 4) The dugouts as well have their own characteristics. Some are extensions of surrounding sloughs

while some are isolated, depending entirely on field runoff. In times of low water supply some are refilled by pumping from another source sometimes quite a distance away. Because of this the analytical results of the water sampling must be considered on a site-by-site basis.

- 5) The sampling of the runoff sites give an indication of the changing water quality as it flows through the watershed. These values may change from year to year depending on the changes in flow conditions. The amount of permanent vegetation along ditches and streams may affect the results as well. It appears at this time that there is very little difference in the water quality coming from the manured fields compared to the fields that are fertilized using commercial fertilizer.
- 6) The monitoring period, from the fall of 2000 to December of 2005, has undergone a variety of climate conditions. Everything from near normal to drought to heavy precipitation situations. The contingency plans utilized by Big Sky at the Rama barns appear to have worked well, as there were no abnormal affects observed.

Where do we go from here?

- After collecting and analyzing water samples from the wells and dugouts in the target area in the spring and fall from the fall of 2000 to the spring of 2004 we felt that we had obtained sufficient data to establish a baseline on each site. We will not sample these sites again for at least three years unless unforeseen circumstances warrant additional studies.
- The spring runoff sampling program will continue throughout the watershed as in previous years, targeting both manured fields and commercially fertilized fields and extending downstream of Patterson Lake. Long term sampling will highlight areas of concern and trends.
- We plan to update our sampling procedures to utilize flow meters and composite sampling to establish a better understanding of quantitative stream loading of nutrients and other chemicals.
- We will continue to inform the public of the results of our monitoring program through our website and newsletters.

Recommendations:*

- 1) A program should be developed (by Government) that would encourage rural residents to have their well drinking water analyzed regularly at a low cost.

- 2) To lessen surface contamination to the aquifer, land owners should be encouraged to locate and properly de-commission abandoned wells.
- 3) To improve the quality of the water in the watershed natural waterways and drainage ditches should be buffered to lessen the possibility of the transport of excess nutrients and other chemicals.

* Since our studies have found that excess nutrients, and other chemicals are found throughout the watershed these recommendations are directed to all users of the watershed including agriculture, municipal and urban residents.

Please refer to "Assessment of the Ground and Surface Water Quality in the Spirit Creek Watershed" located in the Appendices, and on our website www.spiritcreek.ca.

ASSESSMENT OF THE GROUND AND SURFACE WATER QUALITY IN THE SPIRIT CREEK WATERSHED

Lorelei Benoit

Operation of three hog barns (by Big Sky Farms) was approved for the Good Spirit Lake Area in 2000. In response to this approval, the Friends of Good Spirit Lake Stewardship Group hosted a meeting for both proponents and opponents of the hog operations to share their concerns and points of view. Concerns about potential impact of hog barn operations on water quality, soil condition and air quality in the Upper Assiniboine River Basin were raised. The Spirit Creek Watershed Monitoring Committee (SCWMC) was appointed by the Honourable Clay Serby (then Minister of Agriculture, Food and Rural Revitalization) in response to the approval of a multi-site hog barn operation within the Spirit Creek Watershed. This committee was chosen to collect non-biased information to determine potential effects from hog barn operations in their watershed.

The objective of this assessment was to report on and compare the quality of groundwater and surface water supplies within the watershed to Saskatchewan's Municipal Drinking Water Quality Standards and Objectives. Surface water runoff comparisons were made between upstream and downstream locations, including fields that received manure from hog barns and those that did not. Finally, an evaluation of Good Spirit Lake's water quality as compared to Saskatchewan's Interim Surface Water Quality Objectives was determined using the Water Quality Index.

Specific protocols were used for sampling wells, dugouts, surface water runoff and Good Spirit Lake. Sampling took place from the fall of 2000 to the spring of 2004, and was conducted by a sub-committee of the Spirit Creek Watershed Monitoring Committee and Saskatchewan Agriculture and Food. For wells and dugouts, parameters of interest included those which exceeded a health standard (Maximum or Interim Acceptable Concentration) or Aesthetic Objective. In the case of wells, provincial comparisons were made to information obtained through Saskatchewan Watershed Authority's Rural Water Quality Advisory Program. Paired data (spring to fall) for the years 2001 to 2003 was evaluated for wells and dugouts. Five wells of the 25 were paired; 22 of the 65 dugouts were paired.

On at least one occasion, at least one health standard (Maximum Acceptable Concentration or Interim Maximum Acceptable Concentration) was exceeded in 100% of the wells sampled. Parameters exceeding health standards for wells included: total and fecal coliform bacteria, nitrate and turbidity. Findings through the Rural Water Quality Advisory Program have shown that 50% of total wells sampled across the province exceed at least one health standard. Sixty-eight percent of wells in the Spirit Creek Watershed exceeded an Aesthetic Objective at least once compared to 93% of the wells tested through the Rural Water Quality Advisory Program. Aesthetic Objectives exceeded in wells within the Spirit Creek Watershed included: iron, magnesium, manganese, pH, sulphate, total alkalinity, total dissolved solids and total hardness. Typical of most shallow wells in Saskatchewan, wells in the Spirit Creek Watershed are not recommended for human consumption without treatment.

For all the dugouts, at least one health standard was exceeded during at least one sampling event. An Aesthetic Objective was exceeded at least once in 98.5% of the dugouts sampled. The health standards that exceeded in dugouts within the Spirit Creek Watershed were total and fecal coliform bacteria and turbidity. Aesthetic Objectives exceeded in dugouts included: chloride, copper, iron, magnesium, manganese, pH, sodium, sulphate, total dissolved solids and total hardness. Dugout water quality is affected by many factors such as: inherent variability associated with precipitation and season, localized land-use and geology. For individual dugouts, year to year and spring to fall differences were not apparent due to natural variability of the parameters measured.

Analysis of surface water quality during spring runoff from 2001-2005 and a single grab sample from a storm event in 2005 suggests that the inter-annual variability of parameter concentrations was high. Although some of the key nutrients and microbiological indicators appeared to increase in concentration and some of the ionic constituents appeared to decrease in concentration during spring runoff from 2001/02 to 2004/05, concentrations from the 2005 storm sampling event did not follow this trend. Infrequent sampling (usually once a year) with no corresponding data on stream flow meant that it was impossible to draw meaningful conclusions about water quality in these streams. For example, during 2004 and 2005 higher concentrations of total ammonia nitrogen and total phosphorus were observed in the two areas with intensive livestock operations; however, the lack of a rigorous sampling design meant that there was no basis for assessing whether this difference was significant. It is suggested that using stable isotopes or microbial source tracking techniques may improve the sensitivity of detecting potential land-use impacts.

Water quality samples have been collected at Good Spirit Lake since 1998 by the Saskatchewan Watershed Authority and the Friends of Good Spirit Lake Stewardship Group. The Water Quality Index (score) was determined using Saskatchewan's Interim Surface Water Quality Objectives for each year sampled. In general, the Water Quality Index scores for Good Spirit Lake range from Good to Excellent, indicating little change over the past eight years. Parameters which regularly deviate (phosphorus and pH) from the Interim Surface Water Quality Objectives are likely influenced by climate and natural cycles within the lake. Excursions or exceedances in *chlorophyll a*, dissolved oxygen, and fecal coliform bacteria and occur infrequently, but do not indicate poor lake quality, as they were not consistent.

In conclusion, Saskatchewan Watershed Authority suggests the following recommendations:

- Determine aquifer sensitivity as influenced by: depth, permeability, direction of groundwater flow and density of wells.
- An extensive description of site-specific land-use practices, their proximity to the sample site and well characteristics (i.e. age, depth, cribbing material, etc.) should accompany well and dugout water quality measurements. Protocol for this has been established by Saskatchewan Watershed Authority for the Rural Water Quality Advisory Program.
- Define land-use practices adjacent to surface water runoff sampling sites including recent and historical use. In addition, improve sampling methodology to facilitate the determination of total loading during spring runoff or storm events.
- Consider exploring new methods of source tracking for pollutant indicators (i.e. use of tracers such as nutrient isotopes and/or bacterial source tracking techniques).
- With naturally high (exceeding the Saskatchewan Municipal Drinking Water Quality Standards) levels of uranium occurring elsewhere in the province, it is advisable that the drinking water sources in the Spirit Creek Watershed be analyzed for this parameter.



Agitator at earthen manure storage.

Did you know?

All animals, including people, have E Coli in their manure. People can get the bacteria called E Coli-0157 H 7 from contaminated water and food.

REPORT ON SOIL MONITORING

Don Olson

The *Primary Objective* of the soils monitoring program was to measure and report to the general public any possible environmental and health impacts in the Spirit Creek Watershed when liquid manure from the hog barns was injected on land as a nutrient source (i.e. fertilizer).

Much anecdotal information has been offered to justify claims of damage, but nothing specific has been found.

This project will endeavour to provide factual information, which will be relevant to the type of operation (intensive livestock being hogs, cattle or poultry) and to the general area. This information should be applicable throughout Saskatchewan where intensive livestock operations (ILOs) are found or planned.

The *Secondary Objective* of the soils monitoring program was to determine whether there is any measurable difference in the soil characteristics between the use of liquid hog manure and commercial fertilizer. For details on the yield results, refer to the soils document in the Appendices, and on our website www.spiritcreek.ca.

The program monitored the effect that pig manure had on the soil when it was applied within SAF guidelines as a crop production input. The program focused on five major areas of activity:

- 1. The Initial Benchmark Program** – Areas considered to be representative of soils at each of the three barn sites were sampled to establish values for nutrients in the soil prior to manure application.
- 2. Manure/Fertilizer Comparison** – Each of the benchmark fields were divided into two areas. One was fertilized with commercial fertilizer and the other fertilized with hog manure. Crops from each were monitored separately for yield and soil samples were taken to establish nutrient content of each.
- 3. Yearly Monitoring** – Soil samples were taken yearly in the fall after harvest beginning in 2001 and being completed in 2005. Yearly comparison would track nutrient movement in each of the benchmarked fields.

4. Additional Special Benchmarks – Soil samples were taken from four additional fields (two in the fall of 2002 and two in the fall of 2003). These will be used for future reference if required.

5. Reports and Data Management – All soil sample sites were GPS referenced and all data for present and future analysis will be securely stored.

SOIL REPORT SUMMARY

Keith Head

Although the soil nitrate levels have increased as a result of manure application, the increases need to be viewed with some perspective. The soil nitrate levels in the top 48 inches of soil increased an average of 85 lb/acre in the manure plots and 38 lb/acre in the commercial fertilizer plots (Table 12), a difference of only 47 lb/acre. It should be noted that this increase occurred over a four foot soil profile while most routine soil sampling and nutrient guidelines are designed for a depth of only two feet.

Although there are no formal regulations in Saskatchewan regarding soil nitrate levels in manure management, the Manitoba regulations allow up to 140 lb/acre of nitrate in the top two feet of soil.

In the top two feet of soil in the manure fields there is an average of only 80 lb/acre, significantly less than the level considered critical in Manitoba.

Soil test summaries produced by the former Enviro-Test Laboratories in Saskatoon indicate that nitrate levels in summer fallow fields in the Black Soil Zone in Saskatchewan average from 70 to over 100 lb/acre in the top two feet. The manure fields therefore have nitrogen fertility levels comparable to those routinely obtained by the practice of summer fallow.

At this point it is safe to say that manure application to the test fields has improved the fertility status of the soils while maintaining nutrient levels well within accepted environmental guidelines. ***Proposed monitoring of these fields over the next 6 years will determine if changes to manure management practices will be necessary to maintain the fertility levels without risk to the environment of the Spirit Creek watershed.***

Did you know?

Spirit Creek is the main source of surface water for Good Spirit Lake.

REPORT ON ODOUR MONITORING

Huiqing Guo

The objectives of this study were to monitor the odour exposure levels of residents living in the vicinity of swine production operations. A rural area in eastern Saskatchewan was selected for this study. This area had a three-site 5,000 sow farrowing-to-finishing swine operation with a flat topography and a total of 147 residences within 8 km radius of the three sites. There were two stages for this project. Stage I was a preliminary odour monitoring conducted by local residents from December 2001 to November 2002. Stage II was conducted from May 2003 to April 2004 which included a) odour occurrence monitoring by trained residents using modified method, b) odour occurrence monitoring using two hired odour assessors, and c) seasonal and diurnal odour emission measurement from the three swine sites.

Stage I: Odour Occurrence Monitoring by Trained Resident Observers

Fifty residents from 39 families were trained as odour observers to use a 5-point n-butanol intensity reference scale to rate intensities of swine odours detected around their residences for one year.

- a) Swine odours were detected by observers from 23 families living 1.6 km to 6.0 km from the swine farms. Eleven families 2.3 to 6.0 km and five families 6.0 to 8.6 km away from the swine farms did not detect swine odours.
- b) Most swine odours (70.3%) were detected during the warm season from May to October. Manure land application contributed to high odour occurrences in May, June and October. The majority of odours (54.6%) were detected during 1700 to 0900h from the late afternoon throughout the night until the early morning.
- c) Annual odour detection frequencies for twenty families ranged from 0.01% to 0.80%. Three families had higher odour occurrence frequencies of 1.19% (5.9 km), 1.51% (5.4 km), and 3.32% (2.8 km, near two other livestock farms).
- d) Odours with intensity 3 or above were reported the most (82.2%) while very few low intensity odour events were reported. Odours with intensity 5 were reported throughout the year regardless of the season. Odour intensity



Nasal rangers measuring odour.

might have been overestimated by some observers. Similarly, odours with offensiveness 3 or above made up 77.0% of all odours.

- e) No correlation was found between the detection distance and number of odour events.
- f) Using resident odour observers for long term and long distance odour dispersion measurement has proven to be practical and effective. However, improvement of this method is needed to ensure the quality of the data. The possible options include implementing periodic nose calibration, screening the observers for bias for or against the intensive livestock operations, and taking measurements at designated times.

Stage II: Odour Occurrence Monitoring by Trained Resident Observers

Thirty-two resident-odour observers from 28 families (four families had two observers in one family) participated in Stage II of the study during May 2003 to April 2004. They were also trained to use the 5-point n-butanol intensity reference scale to rate intensities of swine odours detected around their residences. They were provided with a set of the intensity reference scale and asked to calibrate their nose at least once a week. They were also asked to measure odours at least twice a day, once in the morning and once in the evening and record any swine odour they detected during their daily activities. The three swine production sites and manure applications were probable sources for a total of 638 odour events.

- a) Swine odour was detected up to 6 km downwind. Swine odours were also reported up to 7.6 km from the swine sites although this rarely happened

- (a total of 21 odours reported by 4 families living 6.0 to 7.6 km away from swine sites in a year), but whether these odours were swine odours and whether they were originated from other nearby livestock sources needs to be further validated.
- b) Sixteen families recorded detailed durations of the odour events while the information from the other families was insufficient to calculate the annual odour detection frequency. Annual odour detection frequencies for 15 families ranged from 0.01% to 1.60%. One family had the highest odour detection frequencies of 3.00%.
 - c) The highest odour season was from May to October during May 2003 to April 2004. 52.1% of annual odours and 57.0% of May-to-October odours were detected during the early morning, evening and night.
 - d) Of all swine odours, 44.3% were intensity 1 or 2 odours while 28.1% were intensity 3 odours, the other 27.5% were intensity 4 or 5 odours. This was very different as compared to the Stage I results, where intensities 1 and 2 odours were reported 3.3% and 13.3% of all odours but intensities 4 and 5 odours made up over 50% of all odours. This result indicates that periodical nose calibration was needed to ensure the quality of intensity rating.
 - e) Of all swine odours, 43.8% were assigned offensiveness 1 (not annoying) or 2 (somewhat annoying) and 27.5% as offensiveness 4 (very annoying) or 5 (extremely annoying).
 - f) As rated by the observers, 77.2% of intensity 2 odours were considered as not annoying or somewhat annoying regarding offensiveness.
 - g) Odour intensity might have been over rated for intensity by some odour observers due to the individual's perception and sensitivity to swine odours.

Did you know?

The average Canadian uses 340 litres (75 Imperial gallons) of water per day (homes/gardens).

Stage II: Downwind Odour Occurrence Monitoring by Trained Odour Assessors (Nasal Rangers)

Two trained odour assessors monitored odour occurrences at 105 different locations 0.2 to 6.4 km downwind from the three production sites during the period of May to October 2003. Most measurements (81.7%) were taken in the early morning (0600 to 0800h), evening (1700 to 1900h), and some afternoons. Based on the downwind odour measurements conducted by the two trained odour assessors over the six months of warm season, the following conclusions can be drawn:

- a) Swine odours were detected in 16.1% of all downwind measurements on 105 locations, which resulted in a total of 921 swine odour events. The farthest detected location was 6.0 km from the closest swine site. Five locations were never detected of any odour, including the farthest location (6.4 km) from the swine site.
- b) October and May had the highest odour detection frequency of 25.7% and 24.0%, which might be caused by frequent manure land applications. September had the lowest detection frequency of 8.5%.
- c) Intensity 1 and 2 odours (very faint and faint) were reported the most (61.4%). Intensity 4 and 5 odours (strong and very strong) were reported the least (19.0%); that occurred most frequently in June and October but the least in July and August.
- d) As for odour offensiveness, 64.3% of all odour events were reported as 'not annoying' or 'somewhat annoying' (offensiveness 1 or 2) while 16.6% were reported as 'very annoying' or 'extremely annoying' (offensiveness 4 or 5). A linear relationship existed between intensity and offensiveness ($r^2 = 0.83^{**}$).



Odour sampling at nursery manure storage.

All odours with intensity 1 and 89.7% of odours with intensity 2 were considered not annoying or somewhat annoying by the assessors. This again may shed light on setting acceptable odour intensity criterion. Considering all the odour measurement by the resident observers and the hired odour assessors, odour intensity 2 may serve as odour annoyance free level in rural area around livestock operations.

- e) Regarding diurnal odour occurrence, most measurements (81.7%) were taken during the hours of 0600 to 0800h and 1700 to 1900h and the odour detection frequencies were 13.7% to 20.2%, respectively. Odour detection frequency was the highest between 0800 and 1000h (21.8% to 30.8%). Intensity 4 and 5 odours occurred during most of the measured time periods.
- f) The odour detection frequency at a receptor's location had a weak linear relationship with the distance from the odour source. The average detection frequency per location was the highest within 0.5 km (40.3%) and the lowest at a distance of 4.5 to 5.0 km (6.3%). Beyond 1 km, the higher the odour intensity, the lower its detection frequency was. Odours with all intensities were observed within 6 km except no intensity 5 odour was observed beyond 4.0 km from the source.

For all the three sets of data obtained by the resident odour observers and hired odour assessors, the impact of weather condition, wind speed and atmospheric stability class, was quite similar:



Manure injector showing distribution manifold and trailing deliver hose.

- a) The number of odour events had an inverse linear relationship with the wind speed; the lower the wind speed, the more odour events were reported. Most odour events were detected when the wind speed was equal or less than 5 m/s. Odours with high intensities were detected at various wind speeds up to 9.4 m/s and at a distance of up to 5.8 km from the swine farms.
- b) Most odour events were detected under atmospheric stability class (SC) D (61.0 to 62.9%) with windy or overcastting weather conditions. Stable weather SC E to G occurred mostly at night when observers were likely not outside to conduct measurement. Odours with various intensities were observed under various stability classes except SC A, suggesting that stability class may have limited effect on odour dispersion within the measurement distance (<8 km), which may be different than long distance air contaminant transportation. Rather, wind direction and wind speed are determining factors for odour dispersion. The result of this study indicated that the air dispersion models may not be applicable for odour dispersion within short distance.

The results of this study suggest that odour occurrences, as experienced by the resident odour observers, varied with season, time of day, location including distance and direction from the swine farms, weather conditions (wind speed and direction), presence of the observers outside of their residences including seasonal and diurnal lifestyles and routines, and olfactory sensitivity

Did you know?

Residential indoor water used in Canada:

toilet flush	15-20 litres
bath or shower (10 minutes)	100 litres
dishwasher	40 litres
dish washing, by hand	35 litres
washing hands	8 litres
brushing teeth	10 litres
outdoor water	35 litres/min.
washing machine	225 litres

Did you know?

25 mm (one inch) of rain puts 100,000 litres (22,650 Imperial gallons) of water on an acre of land.

of the residents. All these factors need to be considered when setting odour criteria for communities in the areas located near intensive swine operations.

During the warm season of May to October, the finishing barn had the highest odour emission rate, followed by the nursery, farrowing, and gestation barns. The odour emissions from the farrowing EMS were lower than those from the farrowing barns (which included the farrowing and gestation barns) by 21%; however, the odour emissions from the nursery and finishing barns were lower than those from the nursery and finishing EMSs by 95% and 22%, respectively. This indicated that a) during the warm season, barns and the EMSs were all major odour sources, b) straw covers on the EMSs were effective to reduce odour emissions. Without straw covers, the EMSs would be much greater odour sources than the barns. Comparing the three sites, the finishing site had the highest odour emission rate; the emission rates of the nursery and farrowing sites were 56.2% and 39.2% of the finishing site emission rate, respectively.



Coulter-type liquid manure injector.



Liquid manure injection using dragline.

Did you know?

Comparison of pig densities in the world:

Place	Pigs per acre
Saskatchewan	0.03
Iowa	0.86
China	1.32
North Carolina	1.71
Denmark	2.29

Did you know?

The average pig produces 3.56 litres (0.8 Imperial gallons) of manure each day.

Did you know?

Over 100,000 people visit Good Spirit Lake Provincial Park each year, and spend \$2 million.

Livestock Development and the Community

INVOLVEMENT WITH THE LOCAL RESIDENTS

Adam Kosar

My involvement with the local residents began over 30 years ago when I first started working as an electrical contractor in the area. As a result, I have become well known in the area and have earned the trust and respect of most of the local residents.

Therefore, my serving on the Spirit Creek Watershed Monitoring Committee was an asset to the committee as I know who the people are, where they live and the type of response we might expect upon our arrival.

The locals usually called if they had concerns regarding odour, soil and water contamination. They were reassured these were all being tested periodically to ensure clean air, a safe environment and a safe water supply.

Some of the residents however, did not realize how vital it was for them to fill out the odour monitoring forms. Residents had to be reminded several times that if they didn't participate by filling out these forms, then it would be presumed a problem didn't exist and therefore would not need to be corrected.

I have also had the opportunity to be present for the taking of air samples several times as well as manure injection and soil sampling. Regarding the manure injection, some residents complained of odour and runoff. The odour complaint was valid but the run off was not.

I found the test strips of grain with and without the manure injection very interesting. There was a notable difference in the production of grain in the injected area. The weighing of the grain on the weigh wagon and at the elevator also confirmed the injected area was more productive.

My involvement in every area of the SCWMC has given me a good overall view and understanding of what the committee is striving to do.

In general, most of the residents were positive and were reassured their concerns were being addressed.

LARGE HOG BARN DEVELOPMENT

Jack Prychak

The Council of the Rural Municipality of Invermay was approached to approve the construction of an Intensive Livestock Operation within the Rural Municipality.

Several meetings were held with the council with representation from Big Sky Farms Inc and local board members to discuss the possibilities of constructing a mega hog barn operation.

A special ratepayers meeting was called and a petition was presented and the majority of the ratepayers approved the establishment of the hog barns.

The Reeve of the RM decided to do a survey of approximately 20 ratepayers in the Kelvington area where the barns were in operation to get the impact the barns had on the community. From the survey there were mixed feelings, but the majority appeared to be in favour of the operation - since it has created employment, promoted grain sales and the application of fertilizer.



Feeder barn northeast of Rama.

Did you know?

Saskatchewan is 651,900 sq. kilometres: half of the province is covered by forest, one third is farmland, and one eighth is fresh water.

A group of concerned citizens met several times with the Council to disallow the development in the municipality. Since it was a small minority and all studies were completed in favour of the development Council decided to approve the construction within the RM, which began in 1999. The construction of these barns has created employment in the construction industry and supported the local community.

Now that the barns are in operation, they employ approximately 45 to 50 people. Some families have returned home from elsewhere in the province and from neighbouring provinces to be employed at the barn. Others are local residents that have found employment working at the barn.

A feed mill was also constructed in which local farmers could sell their produce. This and the construction of the barns required an upgrading of the road system within the RM. Approximately 16 km (10 miles) of road were constructed with costs being shared by the provincial, federal and local governments.

Big Sky Farms Inc pays an annual levy for the maintenance of the roads. They also assist financially to provide dust control to residences affected due to the higher volume of traffic.

Since the implementation of the hog barns in the community, employment has increased considerably, farmers have been able to sell their grain locally, many farmers have welcomed the application of fertilizers on their land and the local community has benefited.

However, the public is concerned regarding the odour from the large hog barn development. With regards to the water supply in the local area or to the Good Spirit Creek Basin, our studies have shown there has been no danger of contamination.

Personnel from Big Sky Farms Inc have been very co-operative in all aspects. They have sponsored an annual supper to all residents of the community and have donated to many projects in the community.

Did you know?

55% of the Good Spirit Lake drainage basin is crop land.

WHY I BECAME A COMMITTEE MEMBER

Eugene Prychak

Odour is a major issue for the public when it comes to the establishment of a large-scale hog operation.

People living within the immediate vicinity fear that odours from the barn will impact the quality of their life and potentially the value of their property, because others will not be interested in purchasing land so close to a "smelly barn."

It was those concerns that led to our committee to monitor odours.

The first thing we did was to look at setting up a weather station that would be located in the area of the three barn sites.

Secondly, we hand distributed odour forms to people within an eight km (five mile) radius of each of the three barn sites. Every person in these areas could fill out when there was an odour occurrence.

In addition, as a committee we decided to have odour work shops in Rama and hand out a new type of odour forms. We wanted people to fill out these forms based on the F.I.D.O. method.

Most of the complaints that were being questioned by the public and our group had to do with odour emissions from animal production sites. In 2002, Dr. Huiqing Guo, Assistant Professor, Agriculture and Bioresource Engineering at the University of Saskatchewan, gave a presentation of what she thought she could do to test for odour coming



Straw covered earthen manure storage.

out of hog barns and the lagoons known as earthen manure storage (EMS). In early 2003, the study started on collecting odour emissions data. This was to determine odour emission rates from hog production sources, including animal buildings and manure storage units.

During the testing events, someone from this committee was always at the sites to help observe and to help with the air collection. A total of about 20 days were spent collecting data over a period from January 2003 to March 2004.

In August 2000, I was asked by Saskatchewan Agriculture and Food if I would like to be a member of the Spirit Creek Watershed Monitoring Committee. I accepted and on September 19, 2000 we had our first meeting, with Adam Kosar as secretary.

I personally became involved in the committee because of an interest in hog developments in my local area, which included some concerns about their impact on the lives of those in the area.

In 1997, I was involved with the Saskatchewan Wheat Pool. They were at the time looking at establishing hog barns in the Theodore area. This group was called Yellow Head Hog Ventures. Working with this group, there were a lot of questions about the local impact the industry might have.

The things I liked was the way the group looked at finding locations in a 80 km (50 mile) radius. First when looking at locations a five km (three mile) radius from anyone's home was the minimum unless all the people in that area agreed. Over 20 locations were looked at, but only one of these was ever picked. I knew all of the good things about hog barns, but really none of the so called bad things.



Feedmill north of Regina.

Did you know?

Over 100,000 people visit Good Spirit Lake Provincial Park each year, and spend \$2 million.

In 1999, a group of individuals in the Rama area were looking for an intense livestock facility in this area. I tried asking questions about where in my area facilities would be situated, but no one would say anything until there was a public meeting in Rama.

My wife and I attended, and to our amazement there was the Invermay RM map with site locations on it. One site was one mile east of our home and another site was a mile and a half west of our home. I asked the question who picked these locations and if anyone talked to anyone living around these proposed sites? The answer was no, because the provincial guideline of 1.2 km (0.75 miles) from anyone's home was all they were concerned about. Because we were a mile away they said I should not have any concerns.

Because I asked this question at the meeting, my wife and I were immediately labelled against the project. This was the start of many more questions, as well many more people in the area were also concerned. This led to the forming of the Concerned Citizens for a Safe and Healthy Environment. Still being in opposition of this project, my questions were never fully answered because there were no different answers to possible water, soil and air pollution in this area.

When the Spirit Creek Watershed Monitoring Committee was initiated, I saw being involved as a way to help establish some of the answers I and others in the area had looked for.

I've enjoyed being on this committee from the beginning because most of the baseline data that has been collected on water, soil and air was started before or shortly after this project got in production.

My concerns are the cleanliness of these barns and the poor landscaping that was done, sometimes none. There are no trees or lawn grass, and garbage is handled and burned in small pits around the barns.

PROS AND CONS OF RAMA HOG BARNs

Darrel Dutchak

When the barns were first announced the Village Council of Rama and area residents were excited by the prospect of economic development and spin-offs for the area.

At the same time, there were concerns including possible odour problems and environmental contamination.

While the barns were being constructed, all of our businesses experienced roughly a 25 per cent increase in sales. All available housing (including the hotel) was occupied with renters. Currently, business is still about five per cent higher, on average, for our retailers than pre-barn days.

After the barns were built, we had two families move to Rama specifically to take jobs with Big Sky Farms Inc. There have been approximately 60 jobs created for new and existing area residents which were not there before.

Due to Big Sky Farms Inc needing a reliable source of water for their operations, they purchased our old reservoir which gave the Village of Rama sufficient funds to join the Canora Rural Public Utility Board Pipeline and dramatically improved the quality of our municipal water supply.

Unfortunately, most of the people who work at the barns do not live in Rama and no new housing starts have happened as a result of their presence.

Due to odour and contamination concerns, Minister Clay Serby set up a monitoring board which is tracking odour and contamination complaints.

They are doing a very good job of watching the barns to ensure they do not begin to pose a threat to the environment. That said, we have had next to no problems with odour from the barns and the high quality cost efficient fertilizer which their operation makes available to local farmers is another boost to the local economy.

If you would like more information about the Village of Rama's relationship with the barns, please do not hesitate to contact me at 306-594-2070.

CHANGES IN AGRICULTURE

The Committee

During the last 50 years, the number of Saskatchewan farms has decreased and the size of the individual farms has increased.

There are fewer farms, fewer farmers and larger farms (80 per cent of farm land is now controlled by 20 per cent of the farmers).

The same goes for the hog sector of agriculture. The trend has been from pasture to full-time confinement, with detailed feed management of the hog's nutritional requirements. The move to confinement has also led to the development of manure lagoons and efficient waste removal which makes for a safe and healthy environment for hogs and necessitated the need for provincial agricultural operation regulations to ensure environmental safety is maintained as well.

The move to intensive livestock operations has not been without controversy, but controversy in agriculture is not unusual. From the beginning of farming, small farmers have criticized, protected and organized against creditors, courts, freight rates, markets, small guy vs. big guy, farmers vs. urban, selling, buying, big food processors, animal rights activists, environmentalists, neighbour against neighbour and on and on.

Today, the issue of intensive livestock is still, at least in-part, resistance to "little guys" versus "big farmers," only now, there is more involvement by opposing organizations on a larger scale, with powerful activist allies often involved in small community debates – especially in relation to hog barn development.

Often too, the debate is muddled by differing messages, even from the same people. What an individual will tell a researcher in private may very well not be said in public.

Understanding that change is constant in agriculture and that debate is a factor for many issues relating to farming, it is important that policy is set regarding intensive livestock operations.

Did you know?

one litre of oil can contaminate up to 2 million litres of water.

Report on Committee Expenses

EXPENSES					
Fiscal Year	Honorariums	Member Expenses	Contracts ²	In-Kind ³ (lab)	TOTAL
2005-2006	11,442	8392	2244	7,250	29,328
2004-2005	12,075	7,465	1384	13,000	33,924
2003-2004	15,833	9,637	1581	21,250	48,301
2002-2003 ¹	12,628	10,000	734	33,500	56,862
2001-2002 ¹	14,452	10,000	0	45,500	69,952
2000-2001	7945	5118	0	12,750	25,813
Total Operational Expenses	74,375	50,612	5943	133,250	264,180
Project Expenses					
Odour Project (U of S Project – funding from ADF)					72,630
Soil Sampling Project (TAD contract with Head and Associates)					85,100
Total Project Expenses					
Total					\$ 421, 910

1 – member expenses estimated

2 – website, mapping, executive assistance (writing); website developed 2002

3 – does not include cost of supplies (sample bottles etc)

28



Containers for rendering pickup.

Did you know?

70 per cent of the population in industrial countries lives in urban areas.

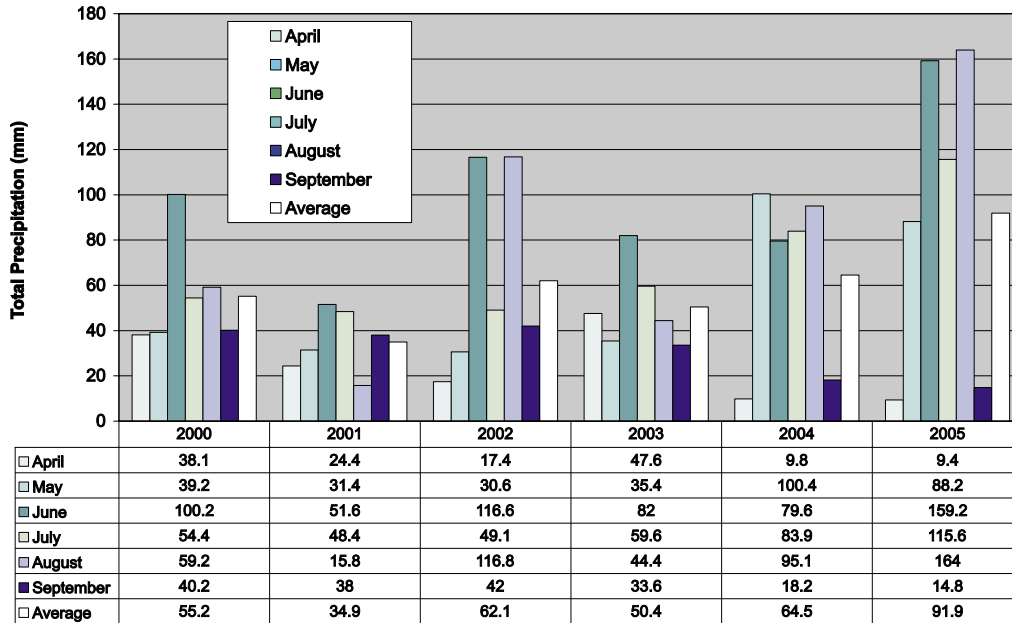
Did you know?

agriculture uses 70 per cent of freshwater resources and could increase by 50 per cent in the next 30-40 years.

Appendices

APPENDIX A: PRECIPITATION GRAPHS FOR GOOD SPIRIT LAKE

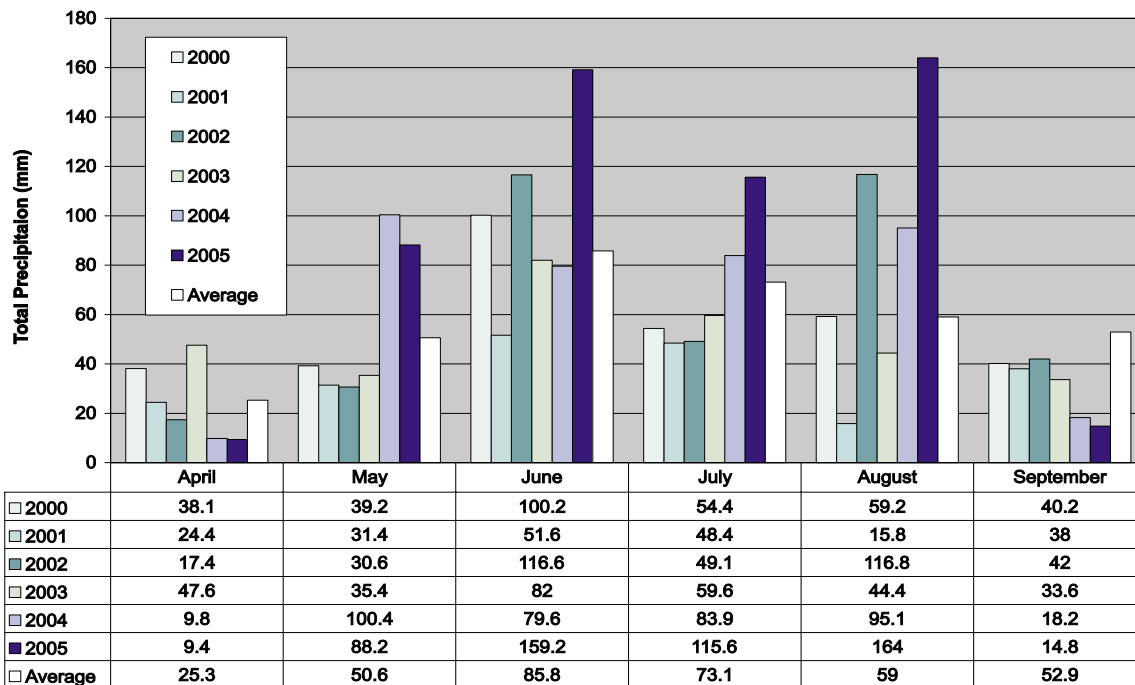
Good Spirit Lake Precipitation Monthly



Average Precipitation Data from 2000 to 2005

Data provided by Bill Anaka and Environment Canada

Good Spirit Lake Precipitation Yearly



Average Precipitation Data from 1977 to 2000

Data provided by Bill Anaka and Environment Canada

APPENDIX B:

Airborne Dust, Endotoxin and DNA Downwind from Swine Barns

Jayda Cleave (1), Laura Ingram (2), Ernest Barber (3), Philip Willson (1)

Introduction

The intensive livestock industry is under continuous scrutiny in relation to potential environmental impacts and health safety issues. Adverse health effects due to dust exposure from intensive livestock facilities have received increasing attention and today are a major concern. There is reason to believe that endotoxins and microbial DNA are present in dust exhausted from swine barns. Endotoxin is a pulmonary irritant contained in the cell wall of Gram-negative bacteria that when inhaled may cause cough, phlegm, wheezing, fever and in severe cases may lead to chronic airway inflammation. In addition, a natural property of the immune system is to respond to the stimulus of microbial DNA. In order to determine the impact of barn aerosols, endotoxin and DNA concentrations must be investigated. Therefore, the objective of this study is to quantify the amount of airborne endotoxin and DNA downwind from a swine facility. It is hypothesized that increased levels of endotoxin and DNA will be detected close to the exhaust fans and that airborne endotoxin and DNA a few hundred meters away will not be different from "fresh air" upwind from the barn.

Materials and Methods

Project Sites

The project sites were Prairie Swine Centre, Elstow Research Farm Inc. and Big Sky Farms, Rama, SK. Total dust sampling for the determination of airborne endotoxin and microbial DNA commenced in April 2001 and was completed in August 2002.

Air Sampling

A total suspended solids high volume air sampler was utilized. Three samples were taken at each time point, prior to seeding, during seeding and in mid-summer to incorporate times of high and low dust loading. High volume sampling was performed at 2400m upwind ("fresh air"), 600m downwind from the barn and at an outlet (0.1m). A standard sampling time of 24 hours was used as recommended by Saskatchewan Environment and Resource Management. Total dust was determined by weighing the filters, in triplicate, before and after each sampling event. A weather station that provided continuous data on wind direction, wind speed, air temperature, and relative humidity was established by Dr. Maule to aid in the interpretation of all air samples. Three samples were excluded from analysis (and repeated) due to change in wind direction or other problems.

Post sampling, the dust was then extracted from the filter with sterile nonpyrogenic water during incubation in a sonicator. The extract was analyzed for endotoxin, using a Limulus Amebocyte Lysate test kit, and DNA, using standard UV absorbance techniques.

Statistical Method

Kruskal-Wallis one-way analysis of variance was used to compare the data. A value of $P < 0.05$ was considered statistically significant.

1 Vaccine and Infectious Disease Organization, University of Saskatchewan

2 Department of Agricultural and Bioresource Engineering, University of Saskatchewan

3 Dean, College of Agriculture, University of Saskatchewan

Results and Discussion

Total dust (Figure 1; $P < 0.001$) and endotoxin (Figure 2; $P < 0.001$) concentrations declined significantly at a distance from the barns. Comparison of mean ranks indicated that at both study sites there was no significant difference between the dust and endotoxin concentrations 600m downwind compared to 2400m upwind, but the concentrations at the outlet were significantly higher than the upwind and downwind locations. Location did not have a significant effect on the DNA concentrations ($P = 0.0733$; Figure 3) around the swine barns. Season did not have a statistical impact on total dust ($P = 0.3496$), endotoxin ($P = 0.3982$) or DNA ($P = 0.8117$) concentrations downwind from swine barns.

The results support the hypothesis that the concentration of total dust and endotoxin 600m downwind from the barns is not statistically different from the “fresh air” upwind from the barn. However, neither distance from the barn nor season had a statistical impact on DNA. Microorganisms are ubiquitous, therefore more detailed research is required to attribute the endotoxin and DNA found in the air downwind from the barns to the swine operation. The data shows that contaminants expelled from the two Saskatchewan swine barns, are diluted to that of background levels 600m downwind from the barn. It may be suggested that airborne contaminants downwind from swine operations are not necessarily a direct result of the swine facility itself, especially in agriculturally active areas. In addition, many environmental factors may have an impact on the distribution of the airborne contaminants. For the purposes of this study it was assumed that the activity within the barn was consistent and would not have an impact on the output of contaminants from the barn, however the activities within the barn could in fact have an impact on the types of contaminants and the amount of contaminants exiting the barn.

Implications

There appears to be modest environmental concern downwind from barns, which may be managed with controls such as landscaping. These results are applicable to modern confinement livestock operations that interact with neighbours or the general public.

Acknowledgments

Support for this work was provided by the Canadian Institutes of Health Research fellowship for Public Health and the Agricultural Rural Ecosystem, Canadian Pork Producers Livestock Environmental Initiative, Saskatchewan Agriculture and Food Development Fund, Big Sky Farms Inc., Spirit Creek Watershed Monitoring Committee, Sask Pork, Alberta Pork, Manitoba Pork.

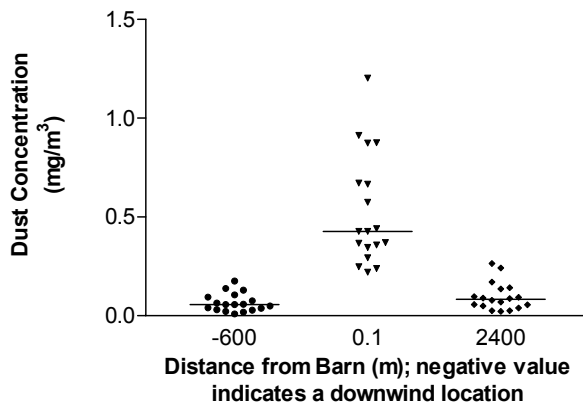


Figure 1. Total dust concentration (mg/m^3) upwind 2400m, at the outlet (0.1m) and 600m downwind from the barns.

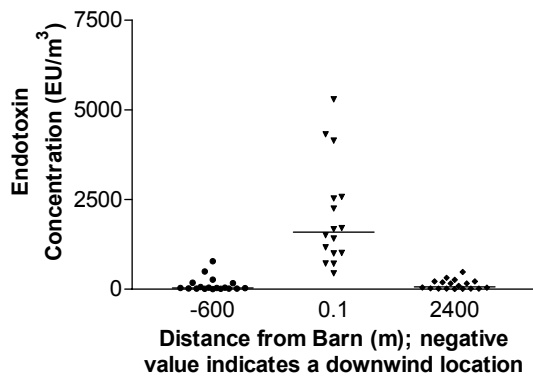


Figure 2. Endotoxin concentrations (EU/m^3) upwind 2400m, at the outlet (0.1m) and 600m downwind from the barns.

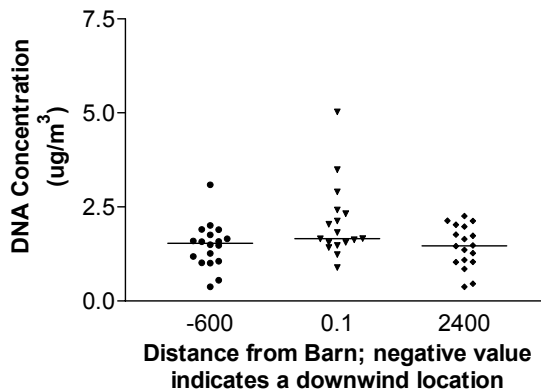


Figure 3. DNA concentrations ($\mu\text{g}/\text{m}^3$) upwind 2400m, at the outlet (0.1m) and 600m downwind from the barns.

SPIRIT LAKE WATERSHED MONITORING COMMITTEE
NOTES

SPIRIT LAKE WATERSHED MONITORING COMMITTEE

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