ASSESSMENT OF POTENTIAL WATER QUALITY PROBLEMS FROM AGRICULTURAL MANURE HANDLING AND STORAGE SYSTEMS

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Environment

AUSABLE BAYFIELD
CONSERVATION AUTHORITY

ASSESSMENT OF POTENTIAL WATER QUALITY PROBLEMS FROM AGRICULTURAL MANURE HANDLING AND STORAGE SYSTEMS

PREPARED BY

T. E. RYAN

FOR THE

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SUMMARY

This report has attempted to develop a methodology for the identification of livestock operations with a potential to degrade water quality. Using criteria established from factors contributing to waste or nutrient export, potentially polluting farms can be identified on standard 1:10,000 scale air photographs. The methodology was tested on a sub-basin of the Ausable-River Watershed.

It is assumed to be effective in any area typical of rural South Western Ontario. The ground truthing was conducted by farm operator interviews. The interviews identified a concern in the agricultural community about manure management and water quality. There is a need for strengthened programs providing technical and financial aid to implement remedial measures in problem areas.

1. INTRODUCTION

1.1 The Study

This study was completed in response to the concern for potential impact on water quality that may result from inadequate manure handling and storage facilities in the Ausable and Bayfield watersheds.

Expression of this concern by a number of member municipalities prompted the Ausable-Bayfield Conservation Authority to approach the Ontario Ministry of the Environment for assistance. The Ministry in turn made available the services of a Water Quality Technician for three months to assess the potential for pollution from livestock operations in the Ausable and Bayfield watersheds and to consider what types of remedial measures are required.

The objective of the study was to establish a methodology to identify livestock operations exhibiting a potential to adversely affect water quality and subsequently contact the operators of the identified farms.

The study called for a preliminary phase consisting of background data collection and a review of relevant legislation. The second and intensive phase of the study was testing a farm identification methodology developed by Robert Ryerson and Harold Wood (1971) that utilized standard 1:10,000 scale air photographs. The testing of the procedure was directed toward determining effectiveness and accuracy of the methodology and developing subsequent modifications to the method. A questionnaire was completed by operators of farms in a selected sub-basin to aid in ground truthing. The interviews were also used to record farmers' attitudes and perceptions toward water quality problems. This information could be used to develop positive programs to assist in

implementing water pollution controls on private lands. The methodology was tested in sub-basin A-1 of the Ausable River Watershed. The test sub-basin, taken as being typical of rural South Western Ontario, will facilitate the implementation of this study.

1.2 The Problem

Traditionally, farms were not considered as sources of water quality contamination. The original farming system of recycling manure to crop land where the nutrients could return to the animals in the form of feed was ecologically sound. With a decrease in the number of traditional mixed farms and an increasing trend toward intensive livestock husbandry there has been an observed increase in the pollution potential of livestock operations.

Properly managed, manure is a valuable fertilizer, high in phosphorus, nitrogen and potassium and rich in organic matter. Improperly managed, these nutrients are extremely harmful to water quality. In a degraded state water is of limited use to wildlife, livestock, humans and aesthetically unpleasing.

2. MANURE AND STREAM QUALITY

2.1 Manure

Manure if properly managed is an invaluable resource on the farm as a fertilizer. But if manure is mismanaged phosphorus and nitrogen, the same elements that are valuable as a fertilizer can adversely affect water quality.

The potential for a problem is apparent when one considers that on a yearly basis, a dairy cow produces an average of 160 pounds of nitrogen and in 1971 the census recorded 34,324 dairy cows in Huron County alone. The total represents a vast amount of manure that can pose a threat to water quality.

Nitrogen is extremely volatile and easily lost to the air and water. Being water soluble, it responds to any form of water movement, being quickly transported through the soil and water systems. (I.J.C., July 1978) Phosphorus is also transported by water. Phosphorus has a high affinity to soil particles and is therefore moved by erosion processes.

The high content of nitrogen and phosphorus in manure can be explained by the nutrient extraction rate of livestock. Animals utilize approximately 25% of the nutrients that they ingest as feed. The remaining 75% is excreted in manure.

2.2 The Effects of Manure on Water Quality

Manure becomes a pollutant when it enters a stream. Manure can degrade water quality in the following ways:

1. Settling to form objectionable deposits;
2. Floating as debris, scum, oil or other matter to form nuisances and objectionable sights;
3. Producing objectionable colour, odour, taste or turbidity;
4. Injuring, toxic to, or produces adverse physiological or behaviour responses in humans, animals or plants; or
5. Producing undesirable aquatic life or resulting in the dominance of nuisance species.

(M.O.E., 1978)

2.2.1 Toxicity

Free ammonia (ammonia nitrogen) is the primary toxic component in manure. It is poisonous to fish and the organisms that constitute fish food. Although concentrations of ammonia in streams are rarely high enough to affect humans they are frequently high enough to kill fish.

2.2.2 Eutrophication

When excessive amounts of nitrogen and phosphorus enter a stream the productivity of the ecosystem is elevated. This unnatural enrichment is referred to as cultural eutrophication (Smith, 1977). Streams rich in phosphorus and nitrogen have an over abundance of algae and plant growth. The consequent increase in photosynthesis disturbs the oxygen balance, depriving fish life of oxygen. Excessive amounts of oxygen will also be demanded as the increased plant growth dies and bacterial oxidation of the plant growth takes place (M.O.E., date unknown.) Repercussions of manure pollution are felt not only at the point of entry but also downstream and in the Great Lakes (Figure 1).

2.2.3 Bacteria

The presence of disease carrying bacteria in manure is a health risk to humans. Water contaminated by manure should not be used by humans, especially for drinking and swimming. The health of livestock is also a concern since animals that water directly from streams are susceptible to the diseases carried downstream. The higher populations of bacteria that result from high nutrient levels caused by manure use larger quantities of oxygen to break down organic matter and thus decrease the amount of dissolved oxygen in the water. In general terms the production of bacteria and transport by stream systems is a health hazard.

2.2.4 Turbidity and Sediments

Silt build-up is a problem since the larger organic particles of manure tend to settle to the bottom as well as the large amounts of dead and decayed plants that result from the increase in nutrients. This build-up of matter can impede and slow the flow of water and in some cases even block outlets. Suspended organic matter carries bacteria and therefore affects the use of the stream as a water source for livestock. The sediments also coat the stream bed and smother bottom living aquatic life. Discolouration and turbidity resulting from manure inputs decrease the aesthetic and recreational value of a stream.

2.2.5 Groundwater Effects

The infiltration of manure contaminated water into ground water supplies is a concern for a number of reasons. As well as being a health concern due to bacteria the taste and odour may be objectionable. Excessive nitrate levels that may be caused by manure can result in an infant disease known as methomoglobanemia. The blue baby syndrome or cyanosis as it is sometimes called, inhibits the oxygen carrying capacity of the infant's red blood cells. Nitrates although harmless to adults can be fatal to infants. Rural septic systems

can also contribute to the problems. A well integrated management plan on the farm will help to lessen the total adverse effects from agriculture.

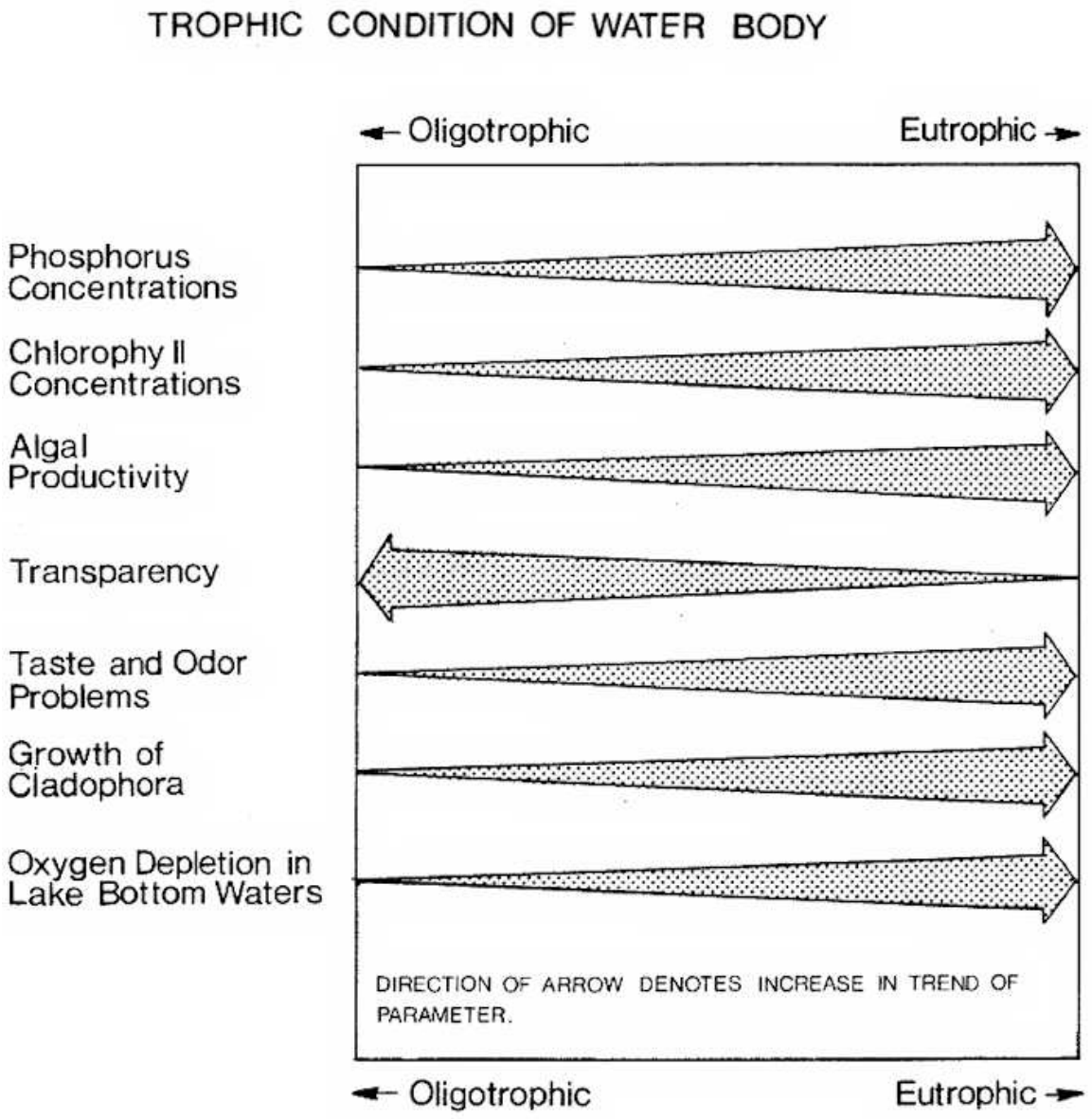

Figure 1: Eutrophication Relationships In Lakes.

REPRODUCED FROM PLUARG, JULY 1978

3. SOURCES OF CONTAMINATION AND VEHICLES OF EXPORT

The purpose of the following section is to provide the background necessary for the recognition and understanding of problem areas in the field.

Manure can gain access to an open water course by direct input and runoff. It is important to understand the factors that affect the problem and the sources the manure originates from.

3.1 Runoff

Runoff is the naturally occurring overland flow that is composed of precipitation not absorbed directly into the land. This flow can include excess manure and phosphorus and nitrogen that is leached from manure. Runoff often terminates in the nearest water course. Manure contaminated runoff can occur from manure storages, confinement areas and improperly applied land spread manure.

(a) Proximity to a Water Course

Generally the closer the source of manure is to an open water course the greater the potential to pollute water. The P.L.U.A.R.G. report by Robinson and Draper (1978) assigned 400 feet (122 m) as the critical minimum distance of separation. It is assumed to represent the distance over which phosphorus is effectively removed from overland runoff. This distance is affected and tempered by a number of the factors such as:

(b) Management

The BEAK report (1977) concluded that the nutrient export on operations of under 500 head is related more to management than to concentration and type of livestock.

Good management is typified by an operation that minimizes the runoff potential of its practices, while at the same time maximizes the fertilizer value of its manure.

(c) Season

During periods of increased precipitation runoff will also increase. Frozen ground will also promote the occurrence of runoff. Spring will generally be the period of greatest manure transport through runoff.

(d) Terrain

The amount of water available and the distance it travels is modified by the terrain it travels over. The following factors are important:

- Slope
- Texture
- Vegetation
- Distance to nearest water course

3.1.1 Manure Management Practices

The following procedures and practices, when applicable, constitute good management. Deviations from these practices may allow manure to move to waterways. It is important to realize that each site is unique and therefore must be judged by its own features. Farm units closer than 400 feet to open watercourses require specific management practices to prevent pollution and maximize on fertilizer potential.

a) The Agricultural Code of Practice (OMAF *et al.*, 1976) outlines good management procedures for confinement areas.

- proper eaves-troughing on all barns to keep water from entering yards.
- minimum paved area per animal approximately 25 sq. ft. per 1,000 lb. of steer.
- divert all outside drainage away from yard by installing dykes, ditches

and drains.

- keep yards scraped as often as possible to reduce amount of manure available for runoff.
- roofing in a portion of the yard will keep out rainfall that promotes runoff.
- retaining walls around the lot will retain the liquid effluent.

(adapted from Agricultural Code of Practice 1976)

b) Solid Manure

Good management practices for solid manure include:

- proper eaves-troughing.
- diversion drainage away from storage.
- roofing the storage will stop the leaching of nutrients.
- retention walls will detain the flow of effluent.
- a concrete pad will stop nutrients from leaching through the ground.
- storage capacity should be a minimum of 6 months to dismiss the need for winter spreading.

(adapted from Agricultural Code of Practice 1976)

c) Liquid Manure Storage

- minimum storage capacity should be from 6-8 months to contain all manure generated in the winter.
- the tank should be covered to keep out precipitation or else have been designed to account for the entrance of water from outside the system.
- drain all surface water away from storage.
- storage capacity should be adjusted if stock is increased.
- extreme care and caution used when pumping and transferring the manure to reduce the possibility of spills.

(adapted from Agricultural Code of Practice 1976)

d) Application

Properly applied manure used as a fertilizer can provide all the essential plant food elements including nitrogen, phosphorus and potassium as well as organic matter (OMAF *et al.*, 1982). However if manure is carelessly or thoughtlessly spread, (and especially if excessive precipitation should occur) its nutritive value may be lost and its potential to pollute watercourses is seriously increased.

To gain the most value from manure and avoid polluting streams the following suggestions are made:

(a) apply manure according to soil and crop needs.
(b) corporate manure immediately after spreading to avoid runoff.
(c) avoid applying manure within 20 feet of a stream bank.
(d) avoid spreading manure in the winter and on flood plains where land is inundated with water.
(e) avoid spreading manure on steep slopes.

3.2 Direct Input

Direct access of manure to watercourses is often more noticeable and less complicated than runoff.

Direct Dumping

Direct dumping of manure into a watercourse is the most severe form of manure pollution and often results from totally negligent behaviour. Even though manure has a high dollar value as fertilizer direct dumping is a quick, cheap method of disposing of the waste, but an unacceptable one that simply cannot be condoned.

Livestock Access to Watercourses

Cattle watering in streams has been a traditional method of watering pastured cattle. This has caused recent concern due to stream bank erosion, stream bed disruption and defecation. Animal health is also a concern. Animals that water directly from streams run the risk of infection from bacteria and other contaminants in the water.

4. METHODOLOGY

The study approach was chosen to identify livestock operations which exhibited a potential to adversely affect water quality. The identified farms were then ground truthed and surveyed to examine the attitudes of farm operators toward water quality projects. The study was tested in a small sub-basin of the Ausable River watershed to determine its usefulness and effectiveness and to assess time requirements for future studies of this nature.

4.1 Location

Sub-basin A-1 is part of the Ausable River Watershed that drains into Lake Huron at Port Franks. Sub-basin A-1 is located approximately 40 miles north of London Ontario on the border of Perth and Huron Counties (Figure 2).

The sub-basin is approximately 24,115 acres in size and consists of about 205 farms. The soils are predominantly clay-loam, drained by natural and municipal drains. The southern portion is relatively flat becoming more undulating to the north. Livestock operations are primarily divided between beef and swine operations with a slightly lower number of dairy operations. The main cash crop is corn with soybeans white beans and mixed grains of somewhat lesser importance.

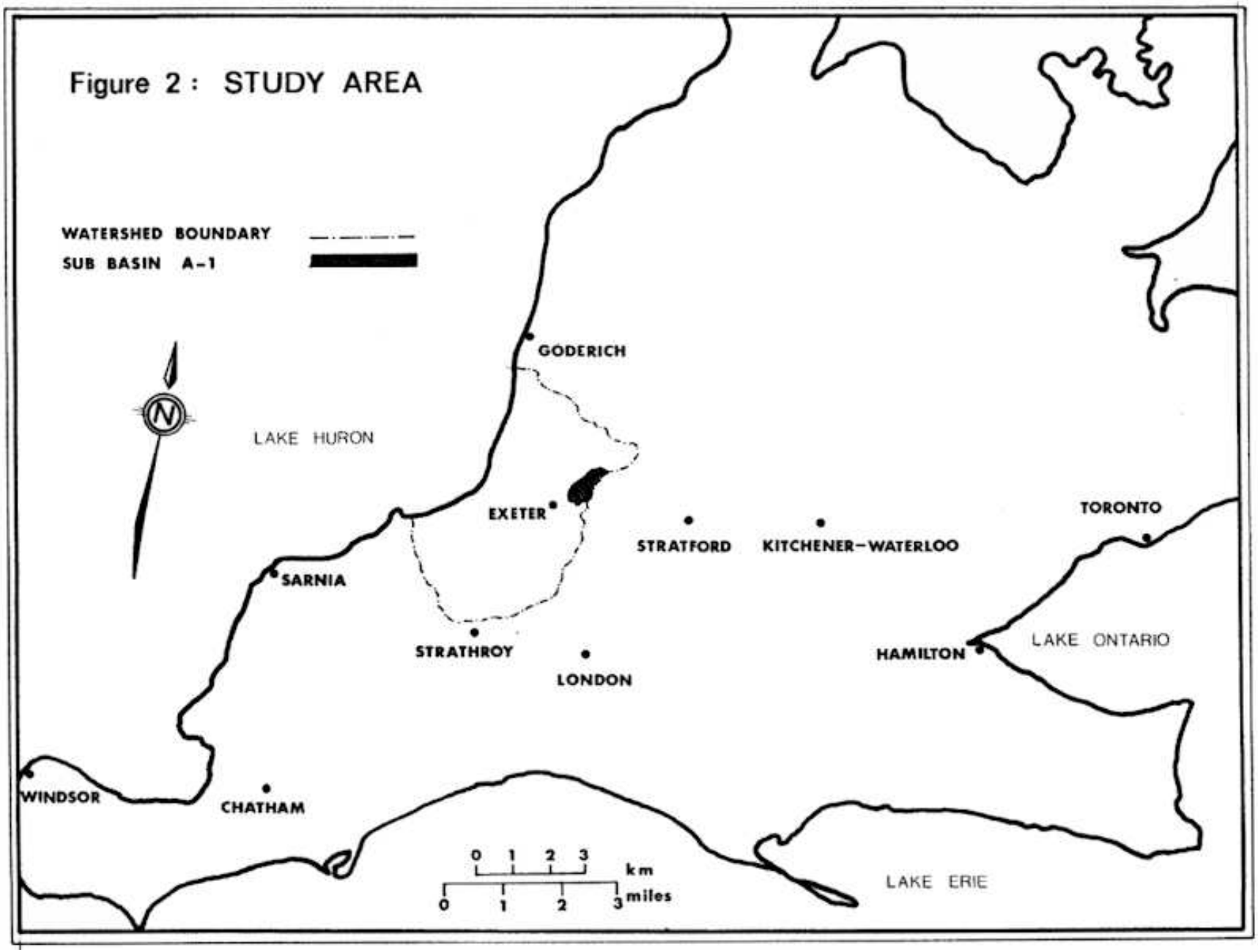
Figure 2 : STUDY AREA
WATERSHED BOUNDARY
SUB BASIN A-1
N
LAKE HURON
GODERICH
EXETER
STRATFORD
KITCHENER-WATERLOO
TORONTO
SARNIA
STRATHROY
LONDON
HAMILTON
LAKE ONTARIO
WINDSOR
CHATHAM
0 1 2 3 km
0 1 2 3 miles
LAKE ERIE

4.2 Methodology Base

The methodology developed is based on the premise that it is possible to identify livestock operations with a potential to contribute to declining water quality through the discharge of manure into watercourses. This had been proven by Agriculture Canada in A Selective Inventory of Large Livestock Operations in South Western Ontario (Coote *et al.*, 1973-74).

By incorporating steps from a procedure developed by Ryerson and Wood, "Air Photo Analysis of Beef and Dairy Farming" with the factors previously identified as affecting a farm's potential to pollute, a quick, easy method of locating possible problem farms was developed. The focus of the method is on a list of subjective and objective criteria against which to judge the farms.

4.2.1 Air Photograph Requirements

Scale: The scale of photograph used in this study was 1:10,000. Ryerson and Wood suggest using photographs ranging from 1:3,600 to 1:12,000 scale. This range appears appropriate.

Season: Photos exposed during July, August or September are best since crops are most easily identified during these months. The month of exposure used in this study was August. During these months corn is identified by its height and carpet-like appearance. Pasture hay and small grains can be identified by the working patterns and textures.

Date: Because of changes in farming practices, renovations to existing buildings and construction of new buildings, it is recommended that for best results the aerial photographs not exceed three years previous to the study. The aerial photographs used for this study were 4 years old.

4.3 Procedure of Analysis

The basic approach of the analysis is to gain a collective image of the livestock operations. Components of this perception are site, size and intensity of production. This can be gained by observing the following:

- total acreage
- crop acreage
- building size
- building site
- building type
- manure system

To measure farm size, farm boundaries must be recognized. Farm units still conform to the original survey pattern although many will have additional acreages elsewhere. Crop acreages will identify the type of livestock by determining the feed mix that is expressed in terms of crop percentages on a farm. The following steps outline the procedure for determining farm type by land use that was developed by Ryerson and Wood (1971):

1. Identify crops on a farm. Calculate the acres of each; corn, hay, pasture and small grains. Roughage derived from 1 acre of improved pasture is equal to 0.6 acres of cultivated hay while 1 acre of rough pasture equals 0.3 acres of hay.

2. Express the acreages of the three ingredients of the feed mix as a percentage.

3. Locate the farms on the land use triangle to identify their livestock type (Figure 3).

The location of the farm on the triangle, besides identifying the type of livestock, may also identify some operational practices. The following were observed by Ryerson and Wood (1971);

45% corn it is a beef stocker operation
50% small grains it is a hog and/or cash crop operation
90% hay it is a cow-calf operation
100% one crop it is a cash crop farm

The appendix provides some brief building descriptions and farm identification characteristics. Further detail and information on farm structures can be gained by reviewing the suggested readings in the Appendix.

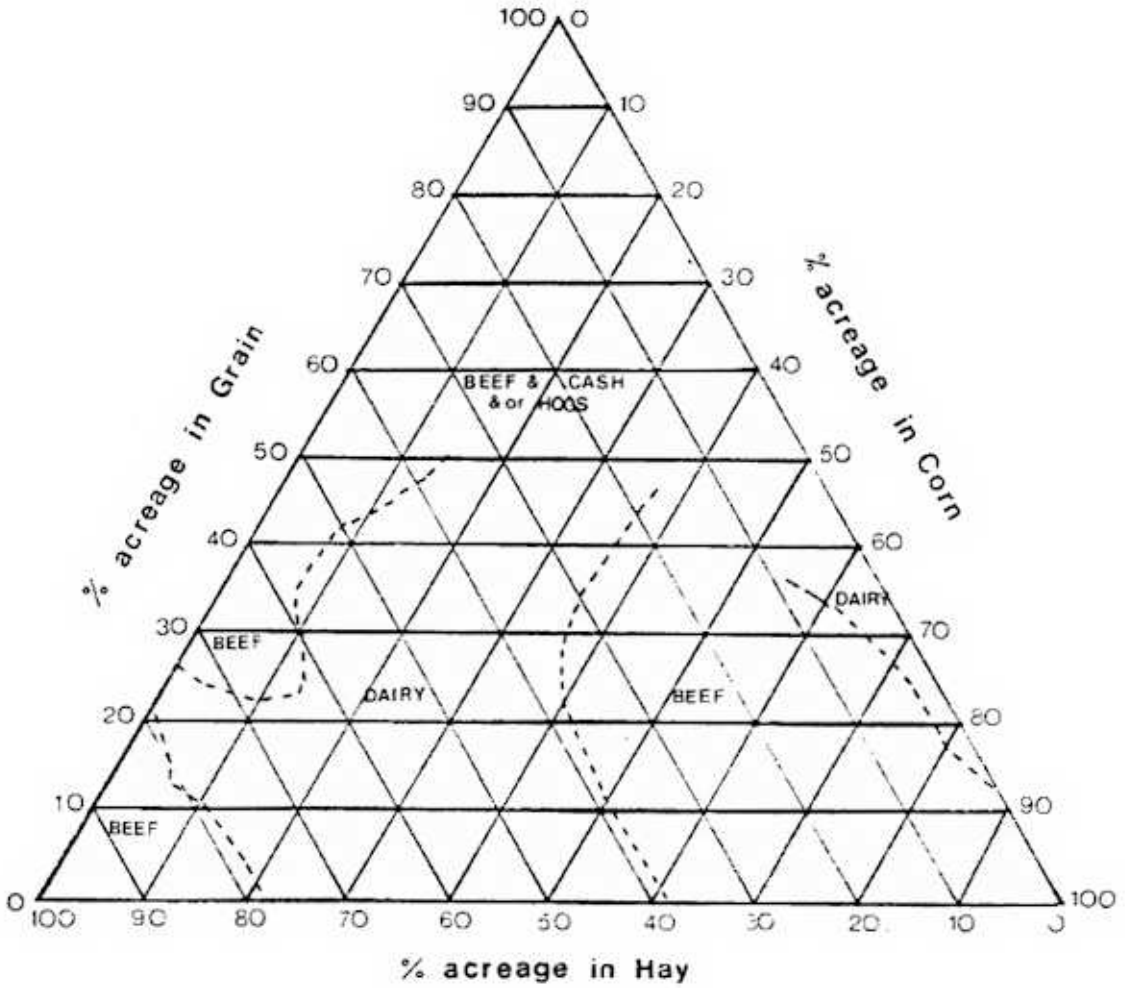

FIGURE 3: The Land-use Triangle.

With recent changes in agriculture occurring, a number of farm buildings may be difficult to identify from air photographs. Older conventional barns may have undergone internal renovation with no exteriorchange in appearance. Most often these renovations have converted the building into a pig barn or a garage. New metal sided pole barns and slatted floor barns often appear similar in air photos. It was found that as the interpreter becomes more familiar with relating air photos to ground truth, personal keys to aid in identification should develop.

Manure systems can often be identified on an air photograph. Solid manure storages show up as a pile usually in the barnyard. In the summer the pile itself may be missing but the existence of a litter carrier or stacker will identify the system.

Semi solid storages resemble a feed bunk, having a concrete ramp and walls of concrete or impervious soil (OMAF *et al.*, 1982). A covered storage will be difficult to identify on a photo since it will be similar to a machinery shed or a pole barn.

Liquid manure systems can be identified by the presence of round tanks, covered or uncovered, or large lagoons. Slatted floor barns may not have any storage tanks since the manure is stored under the barn. The absence of any visible manure system may be indicative of a liquid system.

4.3.1 Criteria

The general farm identification must now be compared to a list of criteria to decide if the farm has a potential to adversely affect water quality. The purpose of this procedure is to reduce the number of farms that require ground truthing. A process of elimination was developed by creating a list of criteria for including and eliminating farms using the factors that contribute to a farm's potential to pollute. The existence of a list of criteria will make the method of judgement consistent and strengthen its value as a comparative procedure.

Reasons for Eliminating Farms from Survey

a) Not located within 500 ft of an open watercourse
b) Operation has no livestock
c) Exhibits factors not conducive to nutrient export;
   - separation distance is greater than 400 ft with a lush growth of vegetation separating source and watercourse
   - little or no slope from source to watercourse
   - runoff is physically impeded from reaching watercourse by a retention pond or wall

Reasons for Including Farms in Survey

a) Within 500 ft of an open watercourse
b) Exhibits characteristics of an intensive livestock operation.
c) Exhibits characteristics conducive to pollutant export;
   - steep downgrade from source to watercourse
   - source and watercourse separated by cultivated field, concrete yard or barren ground

- visible drainage channels from source to watercourse.

Note: 500 feet was identified as the critical distance to allow for error and the transport of other contaminants above and beyond the attenuation distance of phosphorus at 400 feet. Operations exhibiting characteristics of intensive livestock production such as feedlots, and slatted floor barns should be ground truthed regardless of their distance to a watercourse due to the volume of manure being produced.

It was found that by weighing the characteristics of the operation against the list of criteria, the interpreter can judge whether or not a farm has the potential to adversely affect water quality.

4.3.2 Ground Truthing

Ground truthing allowed the interpreter to test the results from the air photography against the actual farm operation. It also allowed the author a chance to contact the farm operators. A questionnaire was developed to collect information from the farmers.

The questionnaire was modeled after the Thames Valley Agricultural Practices Survey (C.T.M. Hadwen and Associates, 1978). It was developed to record the operator's present operation and facilities in order to check the results of the air photography procedure. It also was used to record farmers' attitudes toward agriculture and water quality. These results can be used to structure the focus of assistance programs as well as verify the validity of water quality studies and programs. An example of the questionnaire is provided in Appendix II. An information booklet was also left with each farmer interviewed in order to clarify the purpose of the study and the nature of the problem. The booklet stressed the fact that the Conservation Authority is trying to take a positive approach to manure management.

The articles dealt with the use of manure as a fertilizer and its value, environmental problems and their solutions. The booklet also outlined the Ontario Farm Productivity Incentive Program operated by the Ontario Ministry of Agriculture and Food.

Finally a Comment Sheet was included to encourage the suggestions and criticisms of the farmers.

5. SUB BASIN A-1 RESULTS

Analysis of the air photographs located 42 farms in sub-basin A-1 that appeared to have a potential to adversely affect water quality (Figure 4). This number included 5 large operations beyond 500 feet of a watercourse and 6 farms that were unidentified. The total represents approximately 20% of the farms in the sub-basin. As the interpreter becomes more experienced this percentage is expected to be reduced by at least 5% since the number of unidentifiable farms will decrease.

During the survey 3 large livestock operations that had been previously undetected on the air photographs were added to the sample. The ground truthing procedure revealed that in some cases a windshield survey was all that was required. Operations no longer having livestock do not require an on-farm interview. A windshield survey eliminated 14 farms from the interviewing process.

The time budgeted in the study for the survey procedure was 24 days. This time constraint meant that farms could not be revisited if the operator was unavailable. For this reason 11 farms exhibiting a potential to adversely affect water quality were excluded from the results (Figure 5).

Interviews of this type can be completed in approximately 10 minutes. Generally the length of the interviews were 30 minutes long.

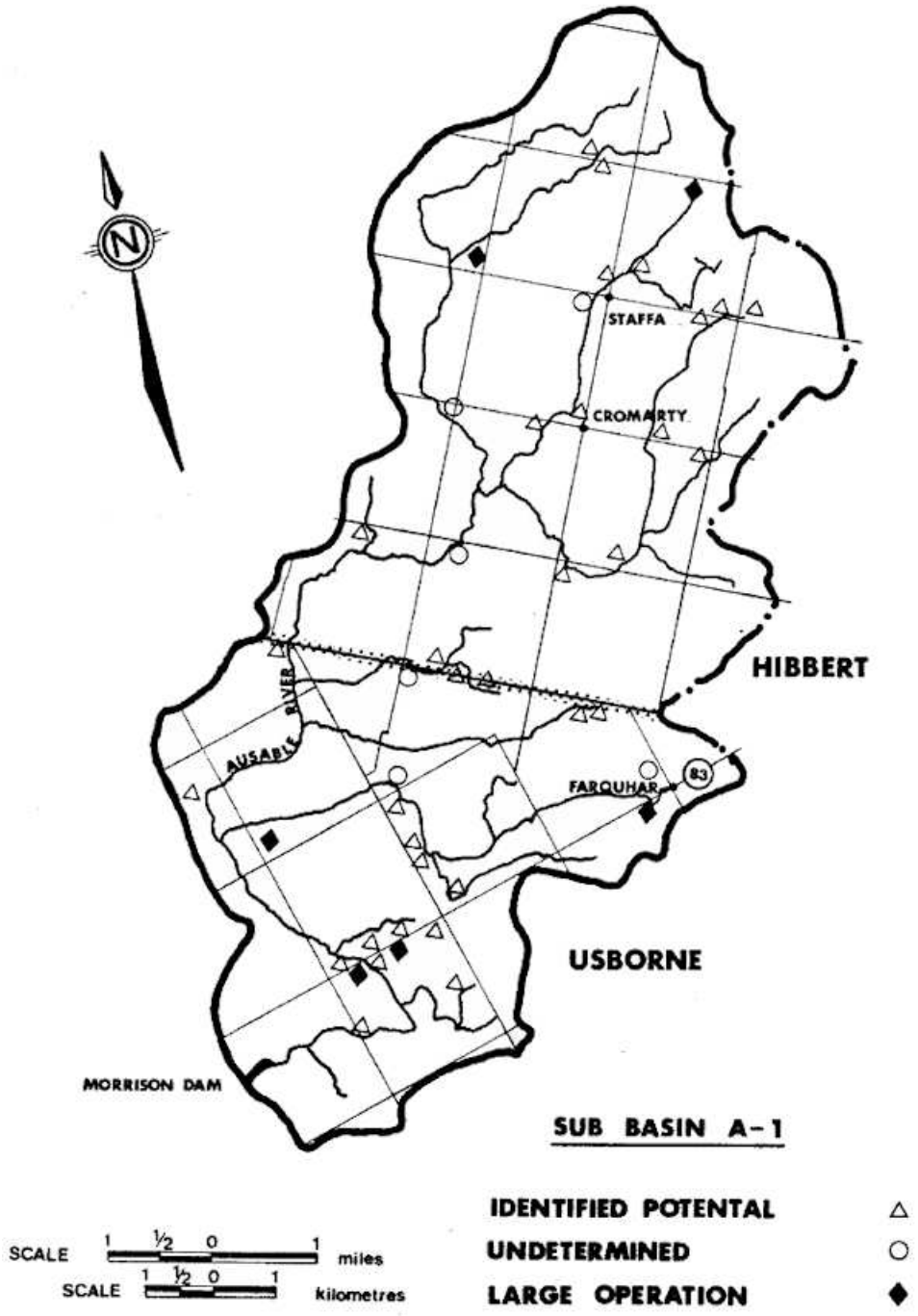

Figure 4: Air Photo Observation Sites.

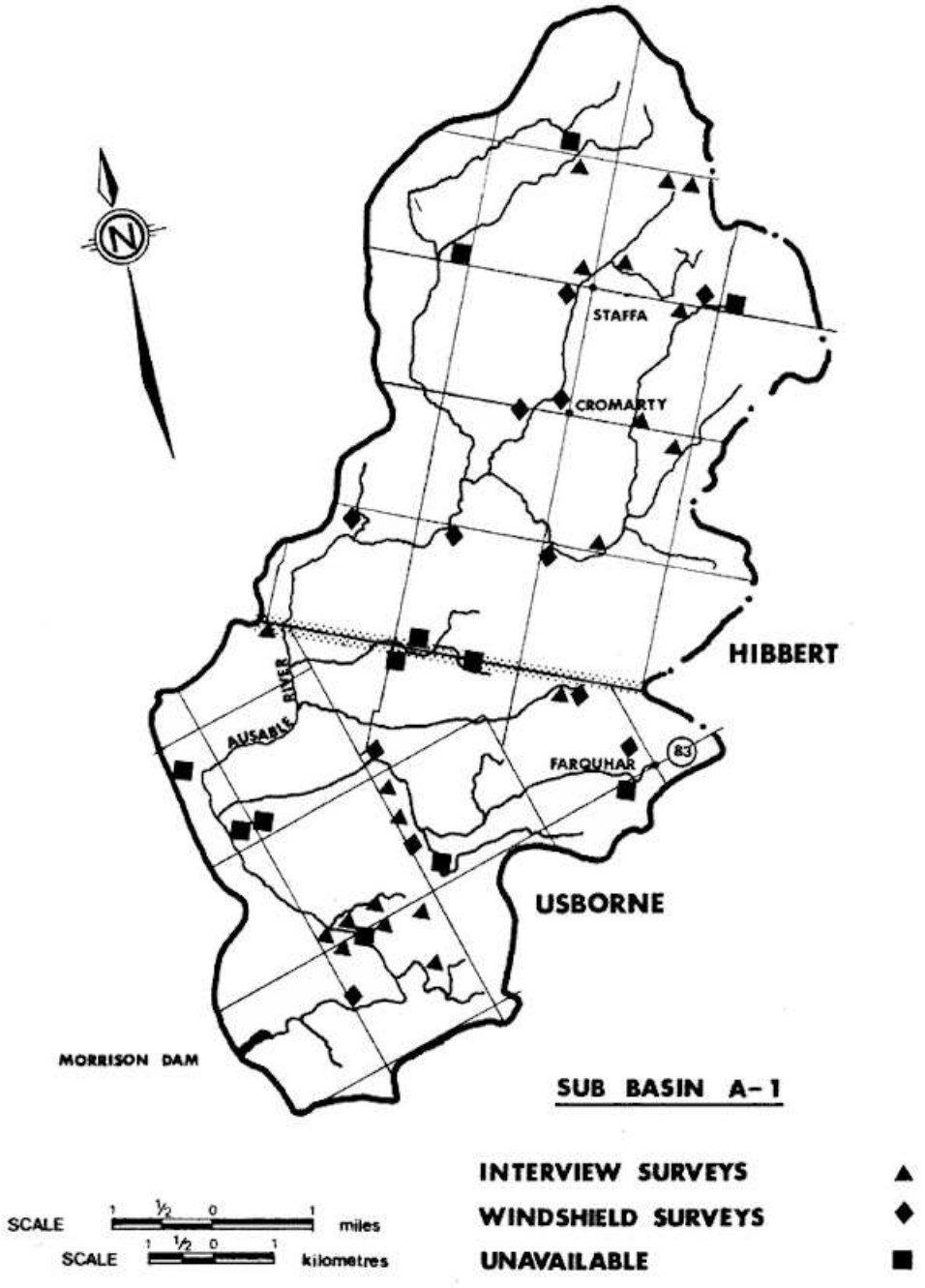

Figure 5: Survey Sites.

The survey of sub-basin A-1 took about 14 hours. This time includes driving to and from the study area as well as visiting each farm at least once. Approximately 9 farms were interviewed a day. During the survey 20 farmers were interviewed and 14 farms eliminated by windshield survey, this represents a return rate of over 75%. The return rates can be improved by revisiting the farmers who are not home. In a few cases it is necessary to make an appointment with the farmer in order to complete the questionnaire.

In general the air photo methodology can be assumed to correctly identify farms 90% of the time. The success rate is governed by the experience of the interpreter and the age of the air photographs.

5.1 Perceptions and Attitudes

The response to the questionnaire as a whole was very favourable. The farmers interviewed had a basic knowledge of the topic and were willing to discuss it. The following is a brief description of the results of the subjective opinion portion of the questionnaire.

Agriculture was felt to contribute a considerable extent to water pollution according to 45% of the respondents. 50% felt that agriculture was a minor contributor and expressed that there are perhaps more problems with industry as a polluter. Poor management, intensive livestock production and chemical sprays were thought to be the major agricultural contributors to water pollution.

Many farmers were unaware of remedial measures to control water pollution and felt that the investment was too great since water pollution control does not enhance production. Still 35% felt that their present farm management practices were adequate to control water pollution.

Many respondents felt that farmers should pay the cost of pollution control methods on their farms conditional to their negligence. A slight majority of farmers felt that the farmer should be responsible for 100% of the cost. The consumer and the federal and provincial government were cited as those who should pay a portion of the cost.

The majority of respondents felt that more information on the control of water pollution could be made available. Most farmers were familiar with the Ontario Agricultural Code of Practice.

Half of the farmers felt that the government should not strictly enforce anti-pollution regulations on agricultural practices until pollution from industries is cleaned up. Many farmers cited municipal lagoons which they felt posed a greater threat to water quality than their own manure piles.

100% of the respondents would be willing to co-operate in a subsidized program to establish water pollution control on their farms as long as their portion of the cost was not too great. Most felt that programs aimed at soil conservation practices and manure management practices would best control water pollution.

6. CONCLUSIONS

Declining water quality from manure originating from livestock operations is a problem which needs further consideration in rural South-Western Ontario. This study attempted to develop a methodology to identify farms with a potential to adversely affect water quality as well as validate the need for water pollution controls in this area.

The main problem areas on farms are; confinement yards, manure storage areas, field applications and cattle access to open watercourses. The severity of the problem is affected by proximity to a watercourse, management practices, slope, vegetation and texture of the soil.

In order to identify farms with a potential to pollute watercourses a methodology developed by Robert Ryerson and Harold Wood (1971) to identify beef and dairy farms from standard 1:10,000 scale air photographs was modified. Besides analyzing buildings and crop types farms were analyzed according to their proximity to a watercourse and factors encouraging runoff.

The methodology is subjective in nature and therefore demands less accuracy from the interpreter than the parent procedure. It does however require that the interpreter be familiar with farming practices and buildings as well as the sources and causes of manure contamination of streams. The focus of the methodology is the list of subjective criteria that allows the interpreter to identify farms by a process of elimination.

The procedure was implemented in sub-basin A-1 of the Ausable River Watershed. The accuracy rate of identification of the procedure was 60%. The photographs were 4 years old which is assumed to affect the accuracy by at least 25%. With recent air photographs the procedure is expected to have an accuracy rate of about 90%.

The farmer questionnaire verified the need for a more intensive study on effective remedial measures. Farmers expressed a willingness to co-operate in a subsidized program to implement pollution control methods on their farms. Funding is required to make an implementation program successful since rentention walls, buffer zones and other remedial measures do not enhance farm production.

In conclusion it can be assumed that the methodology is applicable to any area typical of South-Western Ontario. The procedure is an effective time saving means of identifying farms with a potential to pollute watercourses, and this can serve as a basis for systematic remedial efforts.

7. RECOMMENDATIONS

A program to be carried out in co-operation with the Ministry of the Environment and the Ministry of Agriculture and Food is recommended for Conservation Authorities or similar agencies to promote positive manure management and water pollution control through projects such as the following:

Farm Evaluation and Remedial Promotion:

- identify farms by air photography method
- conduct water sampling and site evaluations to determine the severity of the problem and remedial measures required
- promote use of financial and technical assistance to implement feasible remedial measures to reduce pollution

Demonstration:

- stress co-operation of agencies and individual farmers
- use corrected areas as demonstration sites to broaden acceptance of remedial practices

Education:

- teach through experience
- make the Authority more visible and approachable.

Possible Educational Efforts include:

1. Educate interest groups such as -
   - 4-H
   - Junior Farmers
   - Soils and Crops
   - Improvement Associations
   - Pork Producers
   - Cattlemen's Association
   - Milk Producers *

   * all the breed associations

A slide program could also be developed to illustrate positive manure management and water pollution control measures. Use demonstration sites and local farms as examples in the program.

2. Develop suggested classroom programs to be used in schools; biology, chemistry labs and projects illustrating the effect of manure on stream quality and plant growth and its value as a fertilizer.

3. Make use of fairs, plowing matches and farmer oriented functions to promote awareness of the problem, the program, and proper management of manure.

4. Promote the proper use of manure as a fertilizer and a better appreciation of its economic value by providing soil and manure analysis clinics. A program to make this analysis easier and less costly, would help. If the program is made highly visible and perpetuated for a few years a better match of manure application and soil needs as well as a more effective use of commercial fertilizer will develop.

8. Bibliography

Agriculture Canada. Canada Animal Waste Management Guide. Agriculture Canada Publication, 1534. Ottawa, 1974.

Agriculture Canada, Ontario Ministry of Agriculture and Food and Ontario Ministry of the Environment.

Agricultural Watershed Studies, Great Lakes Drainage Basin, Canada; Final Summary Report, submitted to PLUARG Task Group C (Canadian Section) Activity 1. Windsor, Ontario, May 1978.

BEAK Consultants Ltd. Effects of Livestock Activity on Surface Water Quality, Final Report, submitted to PLUARG Task Group C (Canadian Section) Activity 1, Project 20. Windsor, Ontario, July 1977.

Coote, D.R. and F.R. Hore. Pollution Potential of Cattle Feedlots and Manure Storages in the Canadian Great Lakes Basin, submitted to PLUARG Task Group C (Canadian Section) Project 21. Windsor, Ontario, August 1978.

C.T.M. Hadwen and Associates. Thames Valley Agricultural Practices Survey. Prepared for Thames River Implementation Committee. Guelph, Ontario, 1978.

Huron Expositor, 10 February 1982.

International Reference Group on Great Lakes Pollution from Land Use Activities. Environmental Management Strategy for Great Lakes System. Final Report to the International Joint Commission. Windsor, Ontario, July 1978.

Ontario Ministry of Agriculture and Food, Ontario Ministry of the Environment and the Ontario Ministry of. Housing. Agricultural Code of Practice. January 1976.

Ontario Ministry of Agriculture and Food, Ontario Soil and. Crop Improvement Association and Ontario Agricultural College, University of Guelph. Manure Management Manual. 1982.

Ontario Ministry of the Environment. "Impact of Manure on Stream Quality." South Western Region, London, Ontario.

Ontario Ministry of the Environment. Water Management Goals, Policies, Objectives and Implementation Procedures of the Ministry of the Environment. November 1978.

Report of the Working Group on the Mandate and Role of the Conservation Authorities of Ontario, April 1979.

Robinson, J.B. and D.W. Draper. A Model for Estimating Inputs to the Great Lakes from Livestock Enterprises in the Great Lakes Basin, submitted to PLUARG Task Group C, Activity 1. March, 1978.

Ryerson, Robert and Wood, Harold. "Air Photo Analysis of Beef and Dairy Farming." Photogrammetric Engineering February 1971.

Turabian, Kate L. Students Guide for Writing College Papers. 3rd edition. Chicago: University of Chicago Press, 1976.

9. APPENDIX I

Farm Identification Characteristics

Dairy Farms

- Ontario Average - 45 cows
- presence of milk house or milking parlour appears as a structure projecting outward from the main barn

Tie Stall Dairy Barn

- solid manure system
- stacked/piled storage
- cows fed large quantities of corn silage and hay
- most frequently older conventional barns

Free Stall Dairy Barn

- houses over 75 cows usually
- automated feeding systems, chopped haylage and corn silage
- alfalfa is the main haylage crop
- semi-solid or liquid manure system liquid system - presence of a tank

Beef Farms

- presence of a feedlot or large fenced-in area adjacent to the barn
- pole type barns are often typical of beef farms
- pole barn appears as a long narrow structure with one or two sides open to a feedlot.

Beef Breeding Herd

- hay and pasture system
- drylot in winter, pasture in the summer

Stocker and Feeder Cattle

- cattle ranging from 400-500 pounds up to 650-700 pounds
- roughage corn and hay silage feed
- dry lot makes use of conventional 2 storey barns or single storey pole barns
- manure pack usually or semi solid
- cold environment confinement barns have manure packs

Finishing Cattle

- cattle ranging from 450-500 pounds, finish at 1000-1200 pounds, ready for slaughter as yearlings
- full feed corn silage and grain
- still a number of cattle finished in dry lot
- trend toward confinement barns
    - eliminates yard management problems
    - slatted floors eliminate need for bedding
    - liquid manure system

Feedlot/Drylot

- shelter and outside paved yard
- feed bunks inside or outside (roofed)
- shelter bedded and forms manure pack
- yard scraped, manure pile or semi solid bunker

Confinement/Cold Environment

- completed confined under roof
- often steel clad barn, open ridge, tip-in panels or sliding doors
- usually slatted floor liquid system or solid manure pack
- slatted floor 1.8-2.0 sq. ft./100 pounds of cattle

Swine

- typically long steel clad low lying buildings
- often in converted conventional barns
- usually liquid systems

Farrowing

- breeding herd of sows and boars
- weaners sold at 40-45 pounds

Feeder

- house and feed weaners till they reach market weight at 210 pounds

Farrow to Finish

- breeds and feeds to market weight

Poultry

- 0long metal clad buildings usually two storeys

10. APPENDIX II

Farm Operator Interview
Sub basin:
Farm No: Date:
County: Concession:
Township: Lot:
Farm Operator/Owner: Time Start:
No. of Acres: End:

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1. Type of enterprise

a)

Livestock	No.
Beef	
Dairy	
Swine	
Poultry	
Other	

b)

Crops	No. Acres	Farm %
Corn		
Grain		
Soybeans Hay		
Pasture		
Barn descriptions:		

2. Manure Handling and Storage

a) What kind of manure management system do you have?

solid	_____
semi-solid	_____
liquid	_____
cannot classify	_____
combination	_____

b) Is the manure storage area covered or otherwise contained to prevent runoff?
Yes _____ No _____ D.K. _____

Description:

c) Storage capacity:

d) How close to a clearly defined stream or drainage ditch to you usually store manure?

less than 50 feet	_____
50 to 99 feet	_____
100 to 299 feet	_____
300 to 499 feet	_____
500 feet or more	_____
D.K.	_____

e) terrain around storage:

3. Manure application

a) crop acreage time

Of the total manure you apply to the land, what portion do you usually apply during the winter months (December 1st to March 31)?

none	_____
less than ¼	_____
¼ up to ½	_____
½ up to ¾	_____
¾ or more	_____
all	_____
D. K.	_____

b) approximate rate of application

c) How close to a clearly defined stream or drainage ditch bank do you usually apply manure?

less than 20 feet	_____
20 - 49 feet	_____
50 - 99 feet	_____
100 feet or more	_____
no clearly defined stream or ditches in or beside those fields cultivated	_____
D K	_____

4. Miscellaneous

a) use of commercial fertilizer:

type	crop	time	rate

b) soil analysis:

c) manure analysis:

d) cattle access to watercourse:

5. Comments:

To what extent do you think farming activities contribute to water pollution?

very great extent _____
considerable _____
a minor extent _____
not at all _____
D.K. _____

Which farming activities do you think contribute most of water pollution?
_____
_____

Do you feel that your present farm management practices are adequate for controlling water pollution?
Yes _____ No _____ D.K. _____

Thinking of the cost of water pollution control on their own properties, what portion of this cost do you think farmers should pay themselves?

100%	_____	25 - 49%	_____
75 - 99%	_____	Under 25%	_____
50 - 74%	_____		

(If under 100%) Who do you think should pay the remaining portion of the cost of water pollution control?

Do you think the government should provide farmers with more information on the control of water pollution from farming activities?
Yes _____ No _____ D.K. _____

Have you or your farming operation experienced any adverse effects from water pollution? Yes _____ No _____ D.K. _____

(If Yes) Was the source due to farming activities?
Yes _____ No _____ D.K. _____

Are you familiar with the general guidelines of the Ontario Agricultural Code of Practice and/or the Certificate of Compliance?
Yes _____ No _____ D.K. _____

(If Yes) Do you think that in order to reduce water pollution from farming activities, governments should strictly enforce anti-pollution regulations?
Yes _____ No _____ D.K. _____

Would you be willing to co-operate in a <u>subsidized</u> program to establish water pollution control measures on your farm?
Yes _____ No _____ D.K. _____

These are four ways of controlling water pollution in rural areas. I'd like to know which one you think is:

A) most <u>effective</u>
B) second most effective
C) least effective

i) soil conservation practices _____
ii) farm waste disposal practices _____
iii) municipal drain management _____
iv) stream bank erosion control _____

11. APPENDIX III

Suggested Additional Reading

Bibliography from Coote, D.R., MacDonald, E.M. and Rigby, M.V., 1973-4. A Selective Inventory of Large Livestock Operations (in) Southern Ontario, Agriculture Canada.

Supplied in the Study proposal.

Agriculture Canada Publications:

Number 1451, 1971, Confinement Swine Housing.
Number 1442, (Section 4), 1973, Swine Production, Building and Equipment.
Number 1509, 1973, Broiler Raising in Canada.
Number 1404, 1969, Ventilation of Livestock Buildings.
Number 1358, 1968, Corn for Livestock and Poultry.
Number 1503, 1973, Engineering for Intensive Housing of Livestock.
Number 1390, 1969, Farm and Ranch Equipment for Beef Cattle.

ARDA, 1967-1969, Canada Land Inventory, Soil Capability for Agriculture: 1:250,000 maps and related texts for Southern Ontario map sheets.

Bird, N.A., (n.d.), Department of Agriculture and Food, Ontario, Modern Poultry Building.

Canada Department of Agriculture, Ottawa; Ontario Department of Agriculture, Toronto, (various years) Soil Survey reports and accompanying maps of counties in Southern Ontario.

No. 2701 - Circular Roofed Manure Storage
No. 2702 - Clay Liquid Storage Tank
No. 2703 - Curbed Storage Slabs
No. 2704 - Semi-Solid Storages
No. 2705 - Roofed Storage Area
No. 3750 - Above Ground Circular Storage
No. 3752 - Below Ground Circular Storage