General Topics

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A FACTSHEET SERIES ON

ENVIRONMENTAL GUIDELINES FOR POULTRY PRODUCERS

CONTENTS

1. INTRODUCTION

The Environmental Farm Practices Guidelines Project for Poultry Producers in Newfoundland and Labrador, November 2001, was funded by the Canada/Newfoundland Agreement on Green Plan (Sustainable Agriculture), managed by the Newfoundland and Labrador Federation of Agriculture, supported by the Newfoundland and Labrador Department of Forest Resources and Agrifoods. Gardner Pinfold Consulting Economics Ltd. and P. Jacobs and Associates Ltd. prepared the initial version of the document

These guidelines describe management systems and practices that will reduce the risk of pollution and minimize the odour experienced by neighbours. They establish acceptable farming practices for poultry producers in Newfoundland. The objectives of these guidelines are:

- to assist poultry producers in their efforts to prevent pollution and to minimize odour;
- to provide a standard that may be used by industry and government in determining normal, acceptable farming practice;
- to provide local governments with a basis for evaluation of poultry operations;
- to provide information to the general public and government officials who evaluate poultry operations for their potential effects on the surrounding area; and
- to explain farm practice to the general public with the objective of increasing the public's and Government's appreciation/knowledge of the agriculture industry and an understanding of farm practice.

These guidelines are not legislated. They merely provide the poultry industry with various options for managing their operations in a environmentally sound manner.

As technological changes occur, revisions of the Guidelines will be necessary periodically. Your comments on this publication and future revisions are encouraged. Contact the Department of Forest Resources and Agrifoods, Agrifoods Branch, at 709-637-2081, for inquiries.

2. LEGISLATION/REGULATIONS

Manure management and odour control in Newfoundland and Labrador are regulated by a variety of federal, provincial and municipal acts and bylaws. Producers must understand how these laws affect their operations.

2.1 Federal Legislation

1. Canadian Environmental Assessment Act, S.C. 1992, c. 37

2. Canadian Environmental Protection Act

   - Environmental Code of Practice for Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products
   - Environmental Code of Practice for Aboveground Storage Tank Systems Containing Petroleum Products

3. Fisheries Act, R.S.C. 1985, c. F-14

   - Meat and Poultry Products Plant Liquid Effluent Regulations
   - Meat and Poultry Products Plant Effluent Guidelines
   - Potato Processing Plant Regulations
   - Toxicity Guidelines for Potato Processing Plants

4. Meat Inspection Act, R.S.C. 1985, c. 25 (1st Supp.)

5. Canada Water Act, R.S.C. 1985, c. C-11

   - Guidelines for Canadian Drinking Water Quality

6. The Transportation of Dangerous Goods Act, R.S.C. 1989. c. T-19

7. Canadian Environmental Assessment Act, S.C. 1992, c. 37

   - Exclusion List Regulations, SOR 94-639
   - Law List Regulation, SOR 94-636

8. Pest Control Products Act.

2.2 Provincial Legislation

1. Environment Act, S.N. 1995, C. E-13, which includes:

   - Storage and Handling of Gasoline and Associated Products Regulations, CNR 775/96
   - Air Pollution Control Regulations, CNR 957/96
   - The Environmental Control (Water and Sewage) Regulations, CNR 1078/96
   - Environmental Assessment Act
   - Environmental Assessment Regulations

2. Health and Community Services Act, S.N. 95, C, P-37.1, which includes:

   - Sanitation Regulations, CNR 803/96

3. Pesticides Control Act, RSN 1990, c. P-8:

   - The Pesticide Control Regulations, CNR 1166/96

4. Food and Drug Act, S.N. 97, Ch. F-21

   - Food Premises Regulations CNR 1002/96

5. Waste Material Disposal Act, RSN 1990, c. W-4

6. Urban and Rural Planning Act, RSN 1990, c. U-7

7. Municipalities Act, RSN 1990, c. M-23

8. Meat Inspection Act, SN 1997, ch M-2

   - Meat Inspection Regulations CNR 801/96

9. Lands Act:

   - Development Area of Wooddale (Agriculture) Regulations, 1996
   - The St. John's Urban Region (Agriculture) Development Area Regulations, 1996

2.3 Guidelines

1. Farm Practice Guidelines for Producers in Newfoundland and Labrador:

   - Livestock;
   - Poultry; and,
   - Horticultural Producers.

2. Environmental Guidelines for Agriculture Development - Livestock and Poultry Operations Less Than Five Animal Units

3. Environmental Guidelines for Agriculture Development - Non-Livestock or Poultry Production

4. Guidelines and Conditions for the Approval of Swine, Poultry and Other Livestock Enterprises

5. Information Guide for Livestock Facilities, Manure and Waste Management in the Province of Newfoundland, May 1992.

6. Newfoundland and Labrador Meat Inspection Guide, 1994

3.0 SITE SELECTION

When planning a new poultry operation or the expansion of an existing operation, the selection of an appropriate site must be given careful consideration. There are several factors that first mustbe considered when choosing a site. These are:

- know who is responsible for farm development in your area. In most areas of the province, applications must first be reviewed by the municipality and the Government Services Centre. Proposals are also reviewed by other provincial departments responsible for environment, agriculture, health, forestry and fisheries;

- you must contact the municipality in the early stages of the planning as acquisition of the necessary permits may take up to six months. The municipality also administers various building codes. Buildings must be designed and constructed in accordance with the *Canadian Farm Building Code*. You must check with your local municipal office to verify if any other provincial or municipal building codes apply. Submit building plans to the appropriate authority. For example, in the Wooddale and St. John's Agriculture Development Areas, applications for development are reviewed pursuant to regulations written to protect farms and the land base from conflicting uses of the land; and

- if you intend to develop an agricultural operation within a protected water supply area you are required to obtain a written Certificate of Approval from the Department of Environment prior to any development. For more information contact the Watershed Management Specialist with the Water Resources Management Division of the Department of Environment. It is recommended that you consult with a Land Management Specialist, Agrifoods Branch, on all matters related to activities in protected water supply areas. You may also find it useful to review the document, "Environmental Farm Plan Workbook" by the Atlantic Farmers Council. This document contains useful measures of environmental risk with which to evaluate your facilities and farm practices. Call the Newfoundland and Labrador Federation of Agriculture for more information on this workbook.

The provincial Department of Government Services and Lands is responsible for ensuring that existing and developing farms operate in a manner which will minimize the likelihood of pollution and the possibility for land use conflict. Both the Government Services Centre and the Agrifoods Branch require that new or expanding operations obtain a ministerial Environment Certificate of Approval under the Waste Material Disposal Act for manure handling and storage before a farm of more than five animal units is permitted to operate (see Appendix B for metric/imperial unit conversion tables and Appendix C for a description of animal units). This certificate is prepared by the Government Services Centre and released by the Land Management Specialist, Agrifoods Branch. In public water supplies, the Department of Environment also has a role in preparing this certificate.

Once these requirements have been met, careful attention must be paid in site selection to separation distances between the poultry operation and the following structures or areas:

- neighbouring dwelling;
- residential, recreational or commercial areas;
- water supplies;
- provincial highways and roads;
- public buildings; and,
- property lines.

3.1 Proximity to Property Lines, Neighbours and Rural Residential or Recreational Developments

The potential for nuisance conflicts can be minimized by ensuring adequate separation between poultry facilitiesand neighbours. Proximity to developments can determine the potential for future growth of the operation. Greater separation distances afford more opportunity for odours to become diluted by mixing with the air. The intensity of the odour is thus reduced, and the nuisance level decreased. When evaluating sites for **new operations only**, you must select a location that will impact on as few neighbours as possible. Please note, proposals for new operations within 610 metres (2,000 ft) of houses, residential areas or provincial park boundaries will be reviewed by the Government Services Centre and the Agrifoods Branch in regards to the potential for land use conflicts.

General guidelines for the minimum separation distances from property lines are illustrated in Table 1.

TABLE 1

Guidelines for Minimum Separation Distances Between New Operations and Property Lines[1, 2]

Barns	45m (150 ft)
Manure storages	100m (330 ft)

1. Agencies such as the Government Services Centre or municipalities may have other requirements.
2. These separation distances apply to new operations.

The recommended Minimum Separation Distance (MSD) between a poultry operation and single residences, residential or recreational areas varies with the following factors:

- size of the operation measured in animal units;
- degree of expansion from existing operation;
- type of manure storage;
- type of housing; and,
- type of poultry.

It is emphasized that the minimum separation distances are guidelines. Separation distances for new poultry operations may be less in legislated or designated agricultural areas. In addition, a farmer's manure management system may include a land base located away from the home farm which is used for manure spreading.

A method for calculating the MSD is presented in Appendix D. It provides a consistent and uniform technique for assessing the conflict potential of land use change involving a new or expanded construction. For non-agricultural developments, the MSD method provides a recommended minimum separation distance between new or expanding non-agricultural developments and existing poultry facilities. For agricultural developments, it provides a recommended minimum separation distance between new or expanded poultry developments and other existing uses.

In general, larger separation distances are recommended as the size of the operation increases. Municipalities may require different siting criteria from those recommended here. The location of new operations must always be cleared with municipal authorities. Municipal property ownership maps are very useful for evaluating potential sites.

3.2 Proximity to Watercourses and Wells

Plan the location of poultry facilities to maximize the separation from water supply wells. This is particularly important with field or earthen storages where groundwater is obtained from shallow

(dug) wells or where bedrock is found close to ground surface.

Minimum separation distances to watercourses and wells required for manure storages are given in Table 2. Wells must be located uphill from manure storages and constructed in a manner that will prevent pollutants from entering the well. Grouting the annular space outside the casing with cement or bentonite grout must be carried out where appropriate. It is recommended wells should be drilled rather than dug. It is recommended the water be tested twice a year for bacteria.

TABLE 2

Guidelines for Minimum Separation Distances Between Manure Storages and Watercourses and Wells

These distances may vary depending on local conditions such as slope, drainage, land use or zoning.

Storage Type	Distance to	
	Watercourse, m (ft)	Private Surface Well, m (ft)
Storage (synthetic or concrete)	50 (160)	50 (160)
Earthen Storage (where approved)	100 (330)	100 (330)
In a Field	100 (330)	100 (330)
Composting (no liner)*	100 (330)	100 (330)

* Liners may be required depending on the site.

3.3 Proximity to Provincial Highways and Roads

The Department of Government Services and Lands regulates the placing of buildings, structures, fences, plantings and the establishment of various enterprises adjacent to many provincial roads and highways. They also control access to provincial highways and discharge of surface runoff and liquids into highway ditches.

Agricultural buildings, with the exception of residences and fruit and vegetable stands, should be located 91 metres (300 ft) from roadways unless approved by the Government Service Centre. Generally, any buildings, structures, fences and tree plantings to be located within 91 metres (300 ft) of certain provincial highways or within or up to 457 metres (1,500 ft) of major highway intersections require prior approval by the Government Service Centre. Since these distances vary from one highway to another and at different intersections, it is important to consult with the Government Service Centre early in your planning.

3.4 Site Selection for Odour Control

Odours are one of the main causes of conflicts between livestock producers and their neighbours. In most areas, livestock producers represent a small minority of the population. It is, therefore, essential that producers develop and maintain a good image within their community. It is unrealistic not to expect a commercial livestock operation to operate with some odour. The nuisance level can,

however, be significantly reduced when livestock farms are properly sited, designed andoperated.

The potential for odour problems can be minimized by considering the use of bush and windbreaks and accounting for prevailing wind direction. Take advantage of natural terrain and landscaping to minimize conflicts with neighbours. Since every situation is unique,the most practical approach is to evaluate the situation with the assistance of an agricultural engineer and the land management specialist for your area. The land management specialist will be familiar with the zoning for the area and know of proposed subdivisions. The land management specialist can assist in obtaining climate data and interpret the information for a particular site. The prevailing wind direction can vary between seasons. Since summer is the time when odours are more intense and neighbours are outdoors more often, it is important to consider the direction of the prevailing winds for the summer.

Separation distances between new livestock buildings and non-agricultural uses should also be a consideration in selecting a site. Guidelines for minimum separation distances based on the size and type of the farm, along with land use considerations, appear in Appendix D.

4.0 MANURE HANDLING AND STORAGE

Solids Content

The solids content of poultry manure determines the type of equipment used for manure handling. Poultry manure is classified as either solid, semi-solid or liquid by the following criteria (see Appendix E for manure production rates and characteristics):

(1) **Solid –** The manure's solid content is greater than 20%. Broiler manure normally contains approximately 20-25% moisture compared with liquid manure from layers which is 70% moisture content. The use of bedding material further contributes to the solids content of the manure. To produce a solid manure, the liquid must be drained off and the manure dried or bedding added. At this consistency, the solid manure can then be stacked.

(2) **Semi-Solid** (also referred to as slurry) – Contains 5% to 20% solids.

(3) **Liquid –** Contains less than 5% solids.

System Components

Most poultry operations have some form of confined housing and feeding facility, although turkeys may be raised for part of the year in drier climates on outdoor ranges. Houses for layer, broiler and turkey production may vary greatly in size, appearance and arrangement of facilities. There are two main types of confined poultry facilities: cage houses and floor houses. A variety of manure handling systems for these facilities are described below:

(1) *Cage House, Deep Pit Systems:* The deep pit offers operational advantages over other systems. For example, a separate manure storage facility is not required. In this system, manure is allowed to drop into a 1.5 m to 3.0 m (5 to 10 feet) deep pit under the cages where the droppings undergo a natural composting drying process. This causes a biological degradation of the wastes and reduces the weight and volume of the manure. Manure is usually removed from the storage twice each year. The success of the pit depends on the extent to which excess water can be excluded. If the manure is wet, the composting process will not occur, resulting in odours, fly problems and the need for frequent cleanouts.

If properly operated, a deep pit may not require cleaning for one to three years depending on the depth of the pit. This is an easy system to manage and requires only a front-end loader and a conventional manure spreader to clean out the pit. The deep pit should be constructed of concrete and be completely sealed to prevent groundwater seepage into the pit and escape of contaminants into the environment. In cases where the water table is very high, construction of the deep pit cage house completely aboveground is recommended.

(2) *Cage House, Shallow Pit Systems:* This system uses a concrete pit 15 cm to 20 cm (6 to 8 inches) deep to collect the droppings from overhead cages. The manure is

allowed to collect for a short time, preferably not more than one week, then it can be scraped into a holding facility with a dragline or tractor mounted scraper. In cases where cleaning on a weekly basis is not practical, the droppings may be allowed to "cone-up" under the cages. In this case, additional air circulation is recommended to dry the manure and reduce odours. Also, the droppings should be covered periodically with sawdust or shavings if the manure storage period is greater than one week.

(3) *Cage House, Liquid Systems:* Shallow pit systems can be adapted for liquid manure handling. In this case, manure is flushed frequently into a suitable liquid manure holding tank outside the poultry building.

(4) *Floor Houses, Litter System:* Broilers and turkeys are often raised on litter for at least part of their lives. Breeders and pullets are raised on litter in many cases. Any clean, absorbent material can be used for litter such as wood shavings, shredded paper products or sawdust if available. The litter should be dry and should not produce excessive amounts of dust. The floor should be covered with fresh litter material prior to the housing of each new flock of birds at a recommended depth of 4 to 8 cm (1.5 to 3 inches). The litter removed from the building must be stored in a suitable storage structure.

(5) *Floor Houses, Heated Floor System:* In other areas, the difficulty and expense of acquiring good quality litter has forced some producers to use hot water floor heating. In this system, hot water at approximately 37 to 50ÄC (100 to 120 ÄF) is circulated through plastic or steel pipes embedded in the solid concrete floor. By controlling the rate of circulation, the feed water temperature and pipe spacing, the floor temperature can be maintained between 18 and 35ÄC (65 and 85ÄF) depending on the age of the birds. An added benefit of this system is that the heat dries the manure, thereby reducing odours and simplifying manure handling.

(6) *Floor Houses, Partially Slatted Floor System:* Partially slatted floors offer some advantages over conventional solid floor litter systems. Placing waterers, feeders and roosts over the slatted portion of the floor results in much of the manure being collected in a pit beneath the slats. The litter on the solid portion of the floor remains cleaner and needs to be replaced less often. Up to 12 months of storage may be provided under the slatted floor. This system is not, however, recommended for new layer operations because of the probable odours and fly problems encountered with wet manure collected in the slatted area. However, partially slatted floor systems are commonly used for breeders and pullets and are considered acceptable alternatives for these operations. The partially slatted floor system must be constructed above ground where the watertable is very high.

(7) *Outdoor Ranges:* A limited number of poultry operations in other areas of Canada utilize outdoor ranges. At proper bird densities such ranges are similar to cattle pastures where manure is utilized by pasture plants. Bird densities on outdoor ranges must not exceed 500 chickens (or 200 turkeys) per acre. Where densities exceed this level, the operation would be considered as a confined livestock area.

Manure from most types of broiler poultry operations in Newfoundland is handled and stored as a solid, mostly on the ground. Chicken and turkey broilers, roasters and broiler breeder flocks are raised in barns which utilize straw or wood shavings for bedding. The manure and bedding accumulates in the barn until it is periodically removed when the flock is replaced. Front end loaders are normally used to remove the manure from the barn and transfer it to the storage area. Regular cleaning of the barn is also important to a successful fly control program. Other fly control measures include removing wet feed during fly breeding season, disposing of dead birds and keeping manure storing areas dark. You can also store manure in enclosed structures, protect ventilation inlets with screens and regularly spray with approved insecticides.

Manure from some types of poultry operations (for example, layers) does not stockpile well. If manure has to be stockpiled, you must never stockpile manure over field drainage tiles, near surface water nor dump the manure in wooded or coastal areas. You must also ensure no leaching or run-off occurs and maintain the necessary separation distances.

Caged layer chickens and a limited number of breeder barns utilize manure collection and transfer systems which do not involve the use of any bedding material. The manure is in a liquid or semi-solid form and a variety of collection, transfer and storage systems are used. For example, some layer farms use conveyors to move the manure daily to an area in the barn where it is eventually moved to the storage. While several Newfoundland layer operations have manure lagoons and remove manure daily, many have no adequate storage. In the past, some operators used disposal systems using pipes which lead into the low tide areas of the ocean. Currently, only one operator has a permit to dispose of poultry manure in this manner.

These liquid and semi-solid systems often incorporate in-barn trenches or concrete pits which have limited storage capacity. See 5.1, Seasonal Considerations, for guidelines on manure spreading throughout the year.

The elements of a manure management system include collection, transfer, storage, treatment, utilization and disposal. The components of the various systems for solid, semi-solid and liquid poultry manure are summarized in Table 3.

TABLE 3
Manure Handling Systems for Various Types of Wastes

Operation	Solids	Semi-solid/Liquids
Collection	Front End Loaders	Slatted Floors
Transfer	Manure Wagons Open Tank Spreaders Dump Trucks Earth Moving Equipment Conveyors Pumps	Pumps submerged, open impeller piston pneumatic Augers Vacuum Tank Wagon Pipeline Gravity Continuous Flow Gutters Large Diameter Pipes
Storage	Stockpile Bunk Silo	In-Building Below Ground concrete (open/covered) earthen Above Ground concrete/glass lined steel
Treatment	Aerobic compost dry incinerate Anaerobic	Aerobic pre-storage partial total Anaerobic Solid/Liquid Separation
Utilize/Disposal	Land Application Energy Production Bedding	Land Application Irrigation Energy Production

Source: Farm Practices Guidelines for Poultry Producers in Manitoba.

- Dumping manure in coastal waters or wooded areas is prohibited in Newfoundland and Labrador unless by special permit; and,

- Some Newfoundland poultry producers are trucking manure to other livestock farms (for example, dairy farms) for either disposal or use on forage or vegetables crops. Some fur farms also provide a use for poultry manure for feeding.

4.1 POULTRY HOUSING MANAGEMENT FOR ODOUR CONTROL

Very little odour is given off by fresh manure. Once the manure starts to decompose, odour production begins. Inside a poultry building, even small deposits of manure are a likely source of odour. Solid manure tends to form fewer odours than liquid manure. By keeping conditions dry, the production of odour is reduced. Good housekeeping is the best management method.

While the control of odours within the barn may require additional time or expense, it is beneficial for the welfare of the poultry and the people working within the barn. Frequently, the conditions that contribute to odours also reduce productivity and can make the poultry more susceptible to disease.

The following guidelines for poultry housing management are recommended:

- collect and transfer manure from the barn to storage on a daily basis or every batch (usually every 6 to 7 weeks for broiler operations - layer operations vary) to reduce the production of odours from the building;

- maintain watering systems to prevent water from being added needlessly to manure and bedding;

- thoroughly clean and disinfect buildings between successive groups of poultry;

- do not surpass recommended bird densities in poultry buildings; and

- remove dust, clean ventilation fans and shafts. Keep dust levels low since odours are absorbed and carried in the air on dust particles.

Ventilation of farm buildings, in addition to controlling the temperature and humidity, also controls the production and build-up of poisonous and odourous gases. The following guidelines should be observed:

- maintain maximum air flow through poultry buildings. This will assist to keep conditions as dry as possible and will promote aerobic conditions so that fewer odours are produced. It is also effective in diluting odourous gases as they are released to the outside environment;

- maintain and repair ventilation fans and ensure they have the appropriate capacity for the number of birds being housed in the building; and

- assess local conditions such as the prevailing wind direction and velocity when considering poultry building ventilation.

The position, design and height of exhaust outlets affects the dilution of odourous gases outside of poultry buildings. In general, higher outlets provide greater dilution of exhaust gases. Options for ventilation design may be discussed with experts in the field.

Exhaust gases from poultry buildings may be treated for odour control as part of the ventilation process. Treatment requires additional expenditure, but may be warranted in certain circumstances. For these methods to be effective they must be designed and installed correctly. Qualified professionals should be consulted.

N.B. It is important the general public understand that from time to time, farm activity associated with poultry farms, will result in farm odours, noise, dust, etc. which are a normal part of farming.

4.2 EQUIPMENT SELECTION AND MAINTENANCE

Regardless of the type of manure being transferred, it is important to use equipment designed for that purpose and to operate and maintain the equipment according to manufacturer's instructions. The

equipment must be capable of functioning reliably in a corrosive environment. Equipment also requires proper maintenance if it is expected to have a long service life. Although maintenance of manure handling equipment may be unpleasant, a disruption of spreading due to major repairs is a greater inconvenience and may lead to problems with neighbours.

Preventative maintenance and the use of reliable equipment are critical for avoiding problems when handling manure. For example, a flat tire on a manure spreader may present serious problems. Often the spreader must be emptied before the tire can be repaired. Unless the flat happens near the manure storage it may be difficult to empty the spreader without dumping the manure in an unacceptable place. Another example could be a valve on a manure tank that does not close properly may allow manure to spill onto a public road during transportation.

Pumps used in liquid systems require some method of screening out solid materials. Problems occur when objects enter the pump. In slurries, solids will separate from liquids during storage, therefore, some agitation is required to bring the solids back into suspension. Chopper pumps are appropriate since they do not easily become plugged with hair, etc. These agitation pumps have capacities of about 200 litres (44 gallons) per second. Pumps used for irrigation, on the other hand, may range in capacity from 20-60 litres (4.4-13.2 gallons) per second and can transfer manure up to 1.25 kilometres (.775 miles) through irrigation pipe.

While liquids are transferred by gravity or pumps, solid manure is usually transferred by conveyors, augers, piston pumps or front end loaders.

4.3 PLANNING A MANURE STORAGE

A storage facility is a permanent structure or location designed and operated to contain manure in an environmentally sound manner for the period of time required to allow the manure to be used as an organic fertilizer. The design of the storage will depend upon:

- the location of the storage;
- the storage capacity required for the poultry operation;
- the characteristics of the manure (such as the amount of solids); and
- the methods of filling and emptying.

Although some design considerations are discussed, producers are advised to contact an agricultural engineer for complete design information. Manure storage structures must also provide the following:

- flexibility for timing manure spreading;
- sufficiently impervious to prevent leakage; and
- an appropriate level of odour control.

All manure storage systems must be evaluated to ensure pollution is not occurring and that the

facility meets the requirements under the various acts and legislation existing in Newfoundland and Labrador. Furthermore, if there is insufficient land on the farm to handle the manure, the operator must supply written commitments ensuring that the manure will be removed and used in a fashion acceptable to the Government Services Centre. This issue is addressed in Section 5.7, Acceptable Application Rates.

Location

Groundwater and soil conditions must be evaluated to ensure that the site is suitable for the type of storage planned. For example, where the groundwater levels are near the bottom of the storage, do not use an earthen storage without a suitable liner (for example, a flexible membrane, concrete or equivalent material). Refer to Section 4.6, Liquid Manure Storage for further information on earthen manure storages.

The site for the storage must provide the following:

- the storage must be located close enough to the barns to allow for convenient filling and still permit expansion of the facilities;
- it must be accessible by an all-weather road for field spreading equipment;
- if possible, it should be located out of sight of the road and dwellings;
- the storage must be located to avoid collecting surface and roof run-off; and
- manure storages must not be constructed on the banks of water bodies, including rivers, drainage, channel ponds and wetlands (bogs, fens). A buffer of 50 metres or more is recommended.

Install a groundwater controlling drain around the manure facility to prevent the entry of groundwater into both earthen or concrete storages. For earthen structures, this drainage prevents groundwater from entering the storage. Groundwater reduces storage capacity and weakens the manure sealing capacity by lowering the total solids content. For concrete structures, this drainage prevents frost heaving, reduces external groundwater pressure when the storage is empty and prevents water entry.

In order to minimize any risk of pollution, all manure storages are required to meet the minimum separation distances discussed earlier in this report.

Size

Manure storage requirements for poultry farms depend on:

- management practices and facilities;
- the type and number of animals;

- the amount of water from spillage or from washing;
- the length of storage time needed;
- the amount of precipitation and/or groundwater added to storage contents;
- the amount of dilution water added;
- the amount of evaporation;
- the amount of bedding material used; and
- additional freeboard (also known as unused manure storage space). Newfoundland guidelines are 60 cm (2 feet) for earthen storages or 45 cm (1.5 feet) for concrete manure storages.

The storage must have some reserve capacity to allow for the accumulation of solids and for precipitation. When the storage is ready for clean out it must have enough capacity to handle a major rainstorm without overflowing. This is especially important for the east coast of Newfoundland which receives higher rates of precipitation.

It is important to estimate manure production rates accurately, especially for expensive covered concrete systems. An agricultural engineer should be contacted to assist in the evaluation of these systems. A useful guide in preparing your estimates is the following equation:

Storage Volume Required = (Manure Volume + Bedding Volume + Wastewater Volume) x (days of storage period)...
+ Precipitation Volume (if an open storage)...
+ Runoff Volume (if applicable) from roofs...
less Evaporation Volume (approx. 10-20% of precipitation in Newfoundland & Labrador)

In preparing your estimate of storage requirements, consider the following:

- examine a facility similar to that being proposed;
- use the above formula and the guidelines for manure production shown in Table 4; and/or,
- contact one of the resource groups listed in Section 10 (Sources of Information).

Overflow of the manure storage is a serious environmental concern and therefore is prohibited. Livestock producers must construct sufficient storage capacity to eliminate the need for winter manure spreading. A minimum storage capacity of 180 days is required by the Department of Environment. Storage capacity of 200 or more days is recommended. If the circumstances of lot layout and adjacent land use/land ownership prevent the construction of a manure storage with this capacity, the farmer will have to implement a manure management/storage plan acceptable to the Government Services Centre and the Agrifoods Branch in consultation with the local municipality. This will also help to minimize the extra management time, labour time and equipment use associated with short term storage. It also provides flexibility in:

- poor weather conditions;
- labour shortages; and
- equipment breakdowns.

TABLE 4

Annual Manure Production

Poultry Type	Housing System	Annual Production per Bird Space	
		kg/yr (lb/yr)	L/yr (ft^3/yr)
Chicken:			
Broilers	floor[2]	10.4 (22.9)	34.8 (1.23)
Roasters	floor[2]	10.4 (22.9)	32.8 (1.16)
Layers	cage[1] floor[3]	15.6 (34.3) 19.8 (43.6)	47.3 (1.67) 47.8 (1.68)
Pullets	cage[1] floor[2]	4.7 (10.3) 6.8 (15.0)	14.0 (0.49) 21.3 (0.75)
Broiler Breeder Pullets	floor[2]	8.8 (19.4)	28.1 (0.99)
Broiler Breeder Hens	cage[1] floor[3]	17.2 (37.8) 26.0 (57.2)	52.0 (1.83) 65.5 (2.30)
Turkey:			
Broilers	floor[2]	33.8 (74.4)	104.0 (3.67)
Heavy Toms	floor[2]	55.1 (121.2)	172.0 (6.06)
Heavy Hens	floor[2]	47.8 (105.2)	151.0 (5.32)

1. Manure removed from barn at 25% moisture content with a density of 320 kg/m^3 (20 lb/ft^3).
2. 50 mm shavings placed on floor. Manure and litter removed from barn at 25% moisture content, with a density of 320 kg/m^3 (20 lb/ft^3).
3. One third litter floor, two-thirds slatted floor. Manure and litter removed from barn at 40% moisture content, with a density of 400 kg/m^3 (25 lb/ft^3).

Source: Farm Practices Guidelines for Poultry Producers in Manitoba.

4.4 SOLID MANURE STOCKPILES

Solid manure containing larger amounts of bedding is often stored in stockpiles. These storages must:

- be constructed and managed to contain all seepage and runoff;
- be constructed to help divert away or contain runoff from surrounding areas (this has the added benefit of minimizing manure volume);
- contain a concrete bucking wall to assist filling the bucket if emptying with a front end loader;
- provide access for unloading and haul out equipment; and
- depending on soil conditions, be constructed with a sloping concrete slab to prevent seepage and facilitate collecting the liquid runoff which can then be collected for removal by vacuum tanker or transferred to a separate storage.

4.5 SEMI-SOLID MANURE STORAGE

Wet manure and liquid runoff can be contained by a storage consisting of earthen dykes in combination with a reinforced concrete wall. Seepage can also be controlled by a concrete slab, depending on soil conditions at the site. By sloping the slab to the corner opposite the entrance ramp, excess liquids can be removed by vacuum tanker or transferred to a separate storage.

A ramp entrance provides access for the front end loader or other removal equipment. This entrance ramp must be crowned to prevent surface water from the yard entering the storage.

4.6 LIQUID MANURE STORAGE

Poultry manure is sometimes stored as a liquid by adding dilution water to facilitate pumping. Liquid poultry manure can be stored in three types of storages:

- concrete tanks below ground;
- lined earthen storages; or
- concrete or steel tanks above ground.

All barns with a proposed system of manure washdown should ideally have a water meter to monitor the volume of water used.

(a) Concrete Tanks Below Ground

The two main benefits of a concrete manure storage include:

- reduced loss of valuable nutrients (see Appendix E for a comparison of losses from different systems); and,
- odours are generally not released except when the manure is agitated

before the storage is emptied.

Concrete tanks are more costly than earthen storages, but because they are impermeable, they are suitable for use in areas having sandy soils. In areas with a high water table level, above ground storage tanks are preferable. There are also a number of synthetic materials designed for use in earthen storages that provide impermeable barriers without the high costs of concrete storages. These are discussed under the section on earthen storages.

Concrete tanks must be designed to withstand all earth, hydrostatic and live loads. In planning the design of the storage, carefully consider the following:

- how the manure is to be agitated (please note that minimizing agitation reduces odours produced during transfer);
- there must be sufficient access ports for the pump if the tank is to be covered;
- liquid manure tanks connected to animal buildings must have gas traps or valves between them to prevent gases from entering the building;
- openings must be covered with grills or covers (these covers must weigh at least 20 kilograms (44 pounds) so they cannot be removed by children or displaced by animals and be of sufficient design so they can not drop through the opening-permanently secure covers with a safety chain);
- open tanks must be surrounded with a fence (at least 1.2 metres or 4 feet high except where the tank walls extend this distance above the adjacent ground level) to prevent accidental entry into the pit;
- agitation is more effective when large tanks are divided into a series of compartments; and
- warning signs must be installed near all covered tanks to warn about noxious gas hazards.

You must wear a self contained breathing apparatus when entering indoor or covered storage tanks. The manure tank must be ventilated with a fan 30 minutes prior to entry and thereafter continuously while any person is in the tank. Wear a safety harness and have on hand two people capable of pulling you out in case of emergency. Never use open flames while inspecting or working in an unventilated storage tank-some manure gases, especially methane, can be explosive. The hazards of dangerous gases are described in Appendix F, Safety.

(b) Earthen Storages

Earthen storages are used for storing liquid manure. The attraction of earthen manure storage is their low capital cost. Unfortunately, this type of structure is responsible for the

most complaints since the manure in these facilities is kept under anaerobic conditions and the large exposed surface area permits large quantities of odourous gases to be released into the air. The odours are generally worst when the manure begins to warm up in the spring. Other disadvantages include:

- the risk of seepage if constructed in improper soil conditions;
- the nutrient loss and the maintenance requirements;
- they should not be used in densely populated areas (see Section 3, Site Selection);
- open storages such as this can be dangerous to children and animals (although the crusted surface may appear solid, it will not support a person); and,
- Earthen lagoons for liquid manure must be lined. This applies to facilities constructed after the approval of these guidelines.
- A maximum permeability 10^{-7} cm/sec should be used as a criteria when considering a site for an earthen lagoon. A hydrological assessment must be conducted before such a facility is constructed.

Several considerations in designing earthen manure storages include: (Siting criteria taken from Manure Management Guidelines for New Brunswick, New Brunswick Agriculture and Rural Development, November 4, 1996)

- the storage must be constructed to be compatible with equipment used for emptying, agitating and maintaining the slopes;
- locate the earthen storage in areas where the depth to the bedrock exceeds one metre for clay soils and three metres for sandy or loamy soils;
- the base of the earthen storage should be a minimum of one metre above the level of the high water table;
- install a groundwater controlling drain;
- provide a berm width of at least 3.0 metres to allow access for tractors and pumps;
- the slope of the sides must not exceed 1.5:1 (run to rise) in parent soil or 2:1 where a clay liner exists (outside slopes must be seeded to grass and maintained);
- the lateral distance from an earthen storage to a subsurface drain must be a minimum of 15 metres (50 ft);

- install concrete pads below inlets and at agitation points to reduce erosion of the bottom;

- plant shelter belts to screen the storage from view; and

- install fencing around the storage for safety.

Earthen manure storage facilitieshave been accepted as environmentally safe as long as the soil used to build them contains at least 15% clay content. However, as mentioned, new facilitiesmust comply with the maximum permeability as previously stated. Coarse sands and gravel are not considered environmentally safe and must be lined with an artificialseal. Products composed of Bentonite (a fine clay material which mixes with the soil to form a liner) or other materials such as synthetic and plastic membranes, geotextiles, bentonite-geotextile membranes, asphalt concrete and asphalt can be used as earthen manure storage liners. Newer types of bentonite liners in which the bentonite clay is held together with two layers of non-woven synthetic materials may be more suitable. For more information on the various earthen manure storage liners contact the structural and environmental specialist within the Department of Forest Resources and Agrifoods. You can obtain more information on the various liners by contacting the Eastern Canada Soil and Water Conservation Centre in Grand-Falls, New Brunswick (506-475-4040)or the Agricultural Engineering Department of McGill University in Ste. Anne de Bellevue, Quebec.

(c) Concrete Tanks Above Ground

Above ground tanks can be either circular silo type with an open or enclosed top or rectangular structures. Depending on the size, the silo structures are generally more expensive than in-ground concrete tanks. Because of the cost, these systems are generally not used to store diluted wastes. This type of storage may be the only choice in conditions where space is limiting or where soil conditions do not permit the use of an in-ground storage. A benefit of this type of structure is that the small surface area may permit formation of a crust on top which would reduce odour production considerably.

The storage may be constructed from concrete staves, reinforced cast-in place concrete, glass lined steel panels or spiral wound coated steel. Some tanks are equipped with filling and agitation equipment designed specifically for that purpose.

4.7 MANURE STORAGE FOR ODOUR CONTROL

Most odour causing gases are formed when manure is in storage. In practice, most manure storage is anaerobic (meaning in the absence of oxygen). The anaerobic conditions promote odour production. These gases either escape from the storage to cause immediate problems or are released later during spreading.

Fewer odours are produced by solid manure handling systems than by liquid systems. An undisturbed solid manure stack is self sealing so few odours are given off until the pile isdisturbed. Covered storages are an effective way to minimize odour generation. Storage covers: (1) reduce occasional manure agitation caused by wind and rain; (2) reduce the movement of odourous airfrom storage areas to neighbouring residences; and (3) reduce the addition of water from rain andsnow thereby also reducing the total volume of manure to be spread. While in most instances the cost may

preclude covering storage areas, in certain circumstances this expense may be justified.

When evaluating manure storages, consider the following guidelines to reduce the potential for nuisance odours:

- provide additional storage volume for greater flexibility in the timing of manure application. This can reduce the likelihood of storage overflow and permit application to coincide with the most appropriate timing and weather conditions;

- with solid and semi-solid manure management systems, separate the liquid and solid portions of manure in storage to reduce the promotion of anaerobic conditions;

- avoid the addition of silage effluent and waste food products to the manure storage reservoir. These combinations create strong odours; and

- planting a buffer zone of trees around manure storage areas to reduce the movement of air over the manure surface, thereby lowering the amount of odour released. This has the added benefit of removing the storage from the sight of neighbours and improves the image of the farm by providing a pleasant, aesthetically pleasing appearance.

Treatment of manure before it enters long term storage avoids odour problems in storage and during spreading. Treatment systems must be designed to handle the manure volumes generated by the poultry operation. An improperly designed or managed treatment facility will prove unsatisfactory. Often treatment is performed in short-term storage so less expensive reservoirs can be used for the larger, long-term storage. Some treatment methods for odour control are listed in Appendix A. It is important to note these treatments are mostly used in rare cases when dealing with severe odour problems.

5.0 LAND APPLICATION OF MANURE

Manure – A Sustainable Resource

Spreading manure on land is a highly desirable method of recycling a natural, organic by-product of poultry production. Land application of manure has many benefits:

- it is readily available on poultry operations with minimal energy input;
- many poultry operations are surrounded by large areas of productive agricultural land that can benefit from its use;
- land application can significantly decrease crop production costs (fertilizer) by providing plant nutrients; and
- poultry manure acts as a valuable soil amendment when properly managed by adding organic matter which improves soil tilth, structure, aeration, water holding and warming properties (organic matter affects soil color), reduces soil stickiness and helps to control soil erosion.

Poultry manure is an excellent fertilizer given its high nitrogen concentration and poses an environmental risk only when mismanaged. Too much of a good thing, however, can lead to problems such as damage to crops or the risk of pollution. Soil assay tests must be carried out before manure spreading is undertaken to ensure the nutrients applied meet only the soil requirements for beneficial use. Once these results are known, there are two main strategies for manure use on land: maximum nutrient efficiency or maximum application rates. (Source: Best Management Practices: A Manure Nutrient Management Program, Ohio State University Extension, Department of Horticulture and Crop Science.)

If maximum nutrient efficiency is the goal, rates of application need to be based on the nutrient present at the highest level in terms of the crop needs. In many cases, this is phosphorous. Manure must be applied at a rate which will meet the crop requirements for phosphorous. Additional nitrogen and potassium can be supplied with commercial fertilizers. This strategy is least likely to cause undesirable environmental effects and makes the most efficient use of all nutrients in the manure.

The other strategy for utilizing manure on cropland is to determine a rate of application which will satisfy the crop's requirement for nitrogen without causing environmental problems. This strategy maximizes the rate of applications, making less efficient use of phosphorous and potassium than the first strategy outlined above. It is important to note that a manure application strategy based on crop nitrogen requirements will lead to an accumulation of potassium in the long term, especially with repeated applications. Excessive soil test levels of potassium can result in surface water quality problems.

The goals of every poultry producer must be to:

- minimize the nuisance created by spreading manure;

- maximize the utilization of the manure nutrients by crops; and
- minimize the risk of polluting surface waters and groundwater.

One of the easiest ways of achieving these goals is to incorporate the manure into the soil if at all possible. Every possible effort must be made to incorporate manure into soil within 48 hours of application. If incorporation is not feasible, such as on perennial forage crops, then apply manure under favourable weather conditions, when possible.

Some poultry operations do not have an adequate land base to dispose of the manure that they generate. In these cases, it is the farmer's responsibility to identify other producers with an adequate land base who are willing to accept responsibility for the volume of manure being generated.

Increasing amounts of inorganic fertilizers (chemical fertilizers that are either mixed or manufactured) are also being used in the production of horticulture crops in Newfoundland and Labrador. The benefits of using inorganic fertilizers include consistent analysis and ease of handling. You must ensure that elements found in commercial fertilizers do not accumulate in the soil to high concentration levels. Base the amount of inorganic fertilizer used in your operation on soil analysis and follow recommendations for fertilizer use.

Application of other natural fertilizers such as fish offal, kelp, crab shells and similar materials is regulated under the Waste Disposal Act and subject to the approval and conditions of the Government Services Centre. These are sometimes added to the soil as a conditioner and can cause odour problems. Marine products must be turned into the soil within 24 hours unless the Government Services Centre is satisfied that the remoteness of the site will not likely result in conflicts. The soil or crop specialists with the Agrifoods Branch can provide advice on the use of natural fertilizers and compost.

Manure as a Fertilizer

When considering manure as a fertilizer the important characteristics are:

- nitrogen content;
- phosphorous content;
- potassium (potash) content and minerals such as sulphur;
- micro-organisms; and
- organic matter content.

Nitrogen, phosphorous and potassium are the three main nutrients found in manure and used for plant growth.

(a) Nitrogen

Nitrogen promotes rapid vegetative growth and gives plants their healthy green colour. To maximize the fertilizer value, manure must be stored and handled to reduce nitrogen losses. This is important since nitrogen in manure exists in two forms:

- the largest portion is contained in the complex molecules of digested feed and is known as organic nitrogen; and

- ammonium nitrogen and nitrate nitrogen (the general assumption for Newfoundland and Labrador is that ammonium nitrogen equals 50% of total N and nitrate nitrogen equals 5% of total N).

Organic nitrogen is not available for use by plants until it mineralizes to the nitrate form, the same form as the nitrogen in some commercial fertilizers. The rate of mineralization will depend on the composition of the manure, soil type, temperature and moisture content. Generally, 30 to 50% of the nitrogen will be mineralized during the first cropping season with the balance mineralized during the next three years.

Nitrate-nitrogen is dissolved in water and can move away from the root zone in the soil. This process is known as leaching. When manure is handled and spread on land, some of the nitrogen in the manure that exists as ammonia gas will be released to the atmosphere. It is important to minimize the time of exposure by incorporating the manure into the soil as quickly as possible. Most nitrogen losses occur within the first 24 hours after the manure is spread due to volatilization.

Nitrogen can be conserved by using the following practices:

- transfer the manure from the barn to storage as often as possible, especially during the summer;

- use transfer systems such as bottom loading storages that minimize contact between the manure and the air;

- use storage facilities with a minimum of exposed surface area, or cover the manure storage to reduce contact with air;

- when spreading manure, minimize the time of exposure by incorporating the manure into the soil as quickly as possible; and

- limit the application rate to avoid ponding.

Typical nitrogen losses for various methods of spreading are listed in Appendix E.

(b) Phosphorous

Phosphorous stimulates early growth and root formation, hastens maturity, promotes seed production and makes plants hardy. The phosphorous in manure exists in both the organic and inorganic forms, but unlike nitrogen, phosphorous is not released to the air. As with nitrogen, the inorganic form is readily available to be used by plants, but the organic form is not available until the phosphorous is mineralized. Phosphorous is not removed from the root zone unless very high levels build up in the soil. Most

phosphorous loss is due to soil erosion.

(c) Potassium (Potash) and Minerals such as Sulphur

Potassium improves the plant's ability to resist disease and cold and aids in the production of carbohydrates (energy producing organic compounds). Potassium is especially important for stem strength in grasses. Sulphur is needed in small amounts and is essential for protein production.

Manure potassium, chiefly present in the urine, is equivalent to fertilizerpotassium and is available for plant growth inthe year it is applied. It accumulates in the soil which is generally desirable because it supplies the plant needs. Like phosphorous, however, potassium can accumulate to excessive levels and have detrimental effects on plant growth.

(d) Micro-organisms

Although manure contains large numbers of micro-organisms, very few can carry diseases to people. The micro-organisms that carry or cause diseases are known as pathogens. The easiest transfer of pathogens from animals to people is through direct contact. The potential for disease transmission is very low since pathogens are rapidly destroyed by drying and exposure to sunlight. Proper preparation of food includingthe use of clean water further minimizes the likelihood of contaminating food.

(e) Organic Matter

Repeated long-term application of manure at reasonable rates will addorganic matter to the soil thereby improving soil tilth, structure, aeration, water holding properties and reduction of susceptibility to soil erosion.

When fields are cropped, a portion of the organic matter is removed from the field. The use of commercial inorganic fertilizers does not replenish the lost organic material. Depending on the soil type, a steady depletion of soil organic matter can result in a soil structure that is more susceptible to erosion and one which requires high levels of fertilizer to maintain adequate levels of fertility.

For more information on organic matter see the document, *Farm Practice Guidelines for Horticultural Producers in Newfoundland and Labrador*.

Prevent Pollution

A portion of the nutrients in poultry feed is not used by the bird and is excreted in the manure. The

nutrient content of poultry manure depends upon the bird age, the feed type and the manure management system.

The composition of the manure can vary with the following factors:

(1) **Animal Age** – Manure contents are the products remaining after digestion. Animals that are growing willutilize some nutrients more efficiently than mature animals.

(2) **Feed Type** – If the feed is in a form that does not permit the animal to digest all of the nutrients, the undigested nutrients willbe excreted in the manure. Similarly, if a ration isunbalanced, the animal will not be able to use all of the nutrients and excess nutrients will be excreted.

(3) **Manure Management System** – Depending on how the manure is stored and spread on land, some of the nutrients may be lost. The amount of straw or shavings added as bedding will change the manure properties. Some common types of organic bedding materials are straw, sawdust, sand, shredded news prints, composted manure solids, rice hulls, etc. Sand drains well and unlike organic bedding does not provide a conducive environment for micro-organism proliferation. Sand, however, is incompatible with gravity flow or slatted floor manure systems as it tends to settle down in storage and clogs pipes.

The methods of handling, storing and spreading manure also affect the final nutrient content. Nutrients such as nitrogen, phosphorous and potassium not used by the animal are returned to the soil where they are used by the crop. However, when proper management is not used in spreading manure, erosion, runoff and leaching may transfer the nutrients away from the soil and into water sources, causing pollution.

Water Pollution

Pursuant to Section 10(2) (a) of the Environment Act, SN 1995, C. E-13.1, no person shall place, deposit, discharge or allow to remain within a protected water supply area any material of any kind that might impair the quality of the water. You must exercise great care when handling and applying pesticides, fertilizers or manure in water supplies.

There are a number of serious effects when water is polluted by manure:

- water quality is affected (turbidity, colour, suspended solids, nitrate or ammonia, phosphorous, potassium and pathogens);

- the organic material in the manure will decompose and consume the dissolved oxygen in the water, possibly resulting in the death of fish;

- settled solids and nitrogen compounds can kill aquatic life forms;

- nutrients in the manure may increase the growth of aquatic plants that can disrupt

the ecosystem of the water body;

- bacteria and viruses may be introduced, increasing the potential for spreading diseases; and

- excessive nitrates in drinking water can create a health hazard for humans (especially in young children) and reduce the performance of poultry.

You must ensure that manure storages are secure and that land spreading is performed at proper rates so that water sources are not polluted (see Table 5, 6 and 7).

Soil Pollution

Over-application of manure to soils can result in the build up of nutrients in the soil. When the nutrient concentrations become too high, nutrients such as nitrate-nitrogen can move through the soil to groundwater. A prolonged over-application of manure can lead to an imbalance in the soil chemistry which will result in reduced crop yields. High concentrations of manure are toxic to plants. After one year's manure application, grasses, root crops or some type of flora must be planted to take up the nutrients applied to the soil.

Minimize soil compacting by not driving repeatedly over the area of the field with heavy tanks of manure.

5.1 SEASONAL CONSIDERATIONS

The timing of manure spreading throughout the year is important. Manure will gradually decompose in the soil zone. As decomposition occurs, nutrients from the manure become available for use by the plant. These nutrients, however, also become susceptible to losses through leaching or runoff depending on the time of the year, weather and soil conditions.

(1) *Spring* may be the best time to apply manure, since the crop will be able to use the nutrients as they become available. Soil compacting can be a problem in spring, however, since the land is often not dry enough to handle the heavy wheel loads involved with certain types of spreading methods.

(2) *Fall* application will usually result in the loss of more nutrients than spring application if the manure is not incorporated into the soil. However, fall application usually results in more time available for spreading. In addition, the soil is often quite firm and if compaction does occur, winter freezing and thawing can reduce the damage.

(3) *Summer* application is suitable for pastures, forage crops and summer fallow. Additional care must be exercised when applying manure to summer fallow since these fields usually release enough nitrate nitrogen during the summer to meet the next year's crop demands. Nitrates are more prone to leaching from light-textured soils. Rather than summer-fallowing these soils, producers must consider

establishing a green manure crop which can utilize the nitrates.

(4) Spreading of manure on snow covered or frozen land is not permitted. Spreading in the winter increases the potential of runoff to water courses. Concurrently, the nutrient loss is high and would have few benefits to the soil.

5.2 DISTANCE TO SURFACE WATER AND WELLS

It is important to consider the slope of the land and the absence of buffer areas to reduce runoff when spreading manure. As the slope increases, so does the chance that manure may run off. On steeply sloping land (greater than 15%), extra caution must be used when applying manure. It is recommended that the spreading be supervised at all times to ensure that runoff is not occurring. Sloping land must be maintained with a reasonable amount of crop cover to provide additional protection against erosion.

A buffer area is necessary to absorb the runoff and prevent it from traveling down a slope, thereby reducing the risk of runoff entering surface waters. The effectiveness of a buffer depends on factors such as land use conditions, vegetation and slope. Good judgment must be used in all cases to ensure runoff cannot enter water sources.

Private Water Supplies

A general guideline for spreading manure is to not spread on land situated less than 75 metres (250 ft) from the source of supply of water used for drinking purposes when the draining of the land is towards the water supply. Consequently, a buffer of less than 75 metres (250 ft) may be acceptable depending on the topography of the area. (Public Health Regulations, 1991.)

Public Water Supplies

Draft guidelines for agricultural operations and associated activities such as manure spreading within protected water supplies do not permit development, within the buffer zones as follows:

- intake pond/lake: a minimum of 150 metres (500 ft);
- river intake: a minimum of 150 metres (500 ft) for a distance of 1 kilometre (0.62 miles) upstream and 100 metres (328 ft) downstream;
- main river channel: a minimum of 75 metres (250 ft);
- major tributaries/lakes/ponds: a minimum of 50 metres (160 ft); and
- other water bodies: including wetlands (bogs and fens) a minimum of 30 metres (100 ft) along and around water bodies.

Buffer zones may be broadened or imposed around sensitive areas such as steep or unstable slopes, bogs, marshes or any other areas as deemed necessary by the Department of Environment. For further interpretation of these guidelines contact the

Land Management Specialist, Agrifoods Branch or the Water Resources Officer, Department of Environment.

To protect watercourses (non-water supply), manure must not be spread: (Under review. These distances are measured on the horizontal.)

- within a distance of 15 metres (50 ft) plus 1.5 times the percentage of the slope; and

- on newly cleared land within 30 metres (100 ft) of a watercourse.

Manure may only be spread on land between 15 and 30 metres (50 and 100 ft) of a watercourse if there is a naturally vegetated buffer within0 to 15 metres (50 ft) of the water course.

Salmon Rivers

Buffer requirements may be greater along salmon rivers. The Environmental Assessment Act requires all development within 200 metres (660 ft) of a salmon river to be registered under the Act. Farmers must consult with the Department of Environment if contemplating expansion within 200 metres (660 ft) of a salmon river.

5.3 SENSITIVE GROUNDWATER AREAS

Both soil and groundwater conditions* can be sensitive to agricultural practices which involve the application of either inorganic or organic (manure) fertilizers. Summer-fallowing is another agricultural practice that has the potential to influence surface and groundwater quality. The degree of sensitivity depends on:

- the type and depth of the overburden above an aquifer; and

- the type of vegetation at the soil surface.

* Sensitive groundwater conditions include areas where the groundwater is used for drinking water (wells) and a) the groundwater is close to the surface, or b) where the soil is very permeable and the groundwater is close to the surface, or c) where shallow bedrock occurs.

In order to prevent groundwater pollution during manure spreading, you must be careful to consider the following practices

- care should be taken when spreading manure where the water table in shallow aquifers is near the ground surface;

- care should be taken when spreading manure in areas where very permeable soils such as coarse sand or gravel and sand are found at the surface and the water table is close to the surface;

- do not spread manure where the overburden above an aquifer is very shallow; and

- care should be taken when spreading manure in areas where shallow bedrock occurs.

Nutrients applied to the soil surface may leach rapidly downward beyond crop rooting depths and eventually reach the aquifer. Since areas with the above noted characteristics tend to be well drained, crop vegetation is often relatively sparse and plant uptake of nutrients is low.

Where such sensitive groundwater conditions exist, manure applications must be avoided or manure must be applied at greatly reduced rates from those recommended in Section 5.4, Application Rate. Consult a professional Agrologist for site specific recommendations in these sensitive areas before applying manure.

5.4 APPLICATION RATE

Nitrogen is usually the nutrient that limits manure application rate. The rate of application will ultimately be determined by:

- the rate at which the nutrients are used by the crop; and

- the reserves of nitrogen in the soil.

(1) Soil and manure testing is important. The application rate is often based on estimated soil and manure nutrient levels which may result in inaccuracies. These inaccuracies may lead to application rates lower or higher than required. The fertility of a field can be determined by soil testing. Ideally the manure must be tested since its nutrient content can vary depending on how the manure has been handled. The application rate can be calculated from this information, together with knowledge of the method of application, timing and soil conditions. Proper soil and manure sampling procedures are shown in Appendix G.

(2) Do not over-apply manure. A moderate over-application will not immediately lead to pollution problems or crop damage, especially in dryland conditions. With excessive application rates, nitrogen and phosphorous will generally accumulate in the soil and this accumulation can be detected through subsequent soil fertility tests. If an accumulation occurs, the rate of application must be reduced accordingly. Recording the manure spreading time and rate on each field is one way to avoid long-term over-application and ensures accurate records if needed.

Tables 5, 6, and 7 provide general rates and schedules of manure applications for various crops, soil types and manure sources.

TABLE 5
Rate and Schedule of Manure Application in Tonnes/Hectare
(crops over 60% legume & a sandy loam soil type)

	Early Spring			1st Cut			2nd Cut			Total		
	S	SL	L	S	SL	L	S	SL	L	S	SL	L
L1	3	4	5							3	4	5
B	4	5	6							4	5	6
T	3	4	5							3	4	5

TABLE 6
Rate and Schedule of Manure Application in Tonnes/Hectare
(crops 30-60% legume and a sandy loam soil type)

	Early Spring			1st Cut			2nd Cut			Total		
	S	SL	L	S	SL	L	S	SL	L	S	SL	L
L1	8	11	14	8	10	13	1.5	2	3	17.5	23	29
B	8	11	14	8	10	13	1.5	2	3	17.5	23	29
T	8	11	14	8	10	13	1.5	2	3	17.5	23	29

TABLE 7
Rate and Schedule of Manure Application in Tonnes/Hectare
(crops over 70% grass and a sandy loam soil type)

	Early Spring			1st Cut			2nd Cut			Total		
	S	SL	L	S	SL	L	S	SL	L	S	SL	L
L1	15	20	25	15	20	25	1.5	2	2.5	33	42	52
B	15	20	25	15	20	25	1.5	2	2.5	33	42	52
T	15	20	25	15	20	25	1.5	2	2.5	33	42	52

(1) Legend:
L1 Layer
B Broiler
T Turkey

Headers:

S Solid manure (tonnes), with 25% moisture content removal base from excretion.
SL Slurry manure (tonnes), (raw manure equivalent as excreted).
L Liquid manure (tonnes), with 25% dilution water by volume. To convert tonnes of liquid manure into Imperial gallons, multiply by 211; US gallons, multiply by 250.
Source: Newfoundland and Labrador Department of Forest Resources and Agrifoods.

5.5 LOSSES DURING STORAGE AND APPLICATION

The nutrient content of manure (particularly nitrogen) declines during collection, storage and disposal/application. This is due to ammonia volatilization, as well as leaching and surface runoff of all soluble forms of nutrients (particularly nitrate). Proper management is important to:

- reduce nitrogen losses;
- maximize the nutrient value of the manure; and
- minimize the potential for soil and water pollution.

Suggested management techniques include:

- using proper facilities for storage and handling (a summary of typical nitrogen losses from various storage and application systems is presented in Appendix E); and
- applying manure to cool, moist soil in fall or early spring and incorporating it immediately when feasible. Fields in perennial forage (hay) are not plowed for the sole purpose of manure spreading.

5.6 SOIL AND CROP IMPLICATIONS

The soil characteristics of the field where manure will be spread must be known. On sandy soils, time the spreading of manure to maximize use of the nutrients by the crop. Limit the application to avoid ponding. Manure must not be applied to soil that has a moisture content greater than its field capacity.* The soil is at field capacity if free water is visible when a handful of soil is squeezed.

The yield potential and nitrogen requirement is considerably higher on heavier textured soils than on well-drained sandy soils. In addition, the risk of groundwater pollution by the leaching of nitrates is greater on lighter textured soils than on clays. Therefore, the allowable manure application rate is higher on heavier textured soils. The Atlantic Provinces have high rainfalls and milder winters. In these areas, extensive nitrate leaching can occur after harvest to freeze-up, during extended mid-winter thaws and again in the spring. Please note, though, groundwater nitrate problems are not widespread in Newfoundland and have generally been confined to local sites within sensitive groundwater areas. In some areas manure or inorganic fertilizers have been applied at excessive rates.

* Field capacity is the maximum amount of water the soil can handle without any water seeping out.

A practical way to determine if there is problem with nitrate nitrogen is to test groundwater (preferably a well) for nitrates.

There is considerable variation in the amount of nitrogen required by different crops. Forage crops such as alfalfa can utilize much more nitrogen than annual cereal crops. Alfalfa is a deep-rooted plant capable of withdrawing nitrates that may have leached out of the soils near the surface. High levels of nitrogen in the soil also presents a problem and therefore, soil testing is important to accurately assess plant requirements.

5.7 ACCEPTABLE APPLICATION RATE

Over-application of manure can lead to the following problems:

- negative effect on crops such as excessive vegetative growth, lodging, and/or delayed maturity; and
- an accumulation of salt in the soil from some manures (periodic soil tests can monitor these situations and indicate if management adjustments are necessary).

A Method of Determining Manure Application Rates for Specific Crops

A method for calculating manure application rates is provided in Appendix H. This method uses information on the manure's composition, soil information and the nutrient needs of the crop in question to determine annual application rates and additional fertilizer requirements.

At the start of a series of annual applications to a field, 30 to 40 kg/ha (25 to 35 lb/acre) additional nitrogen fertilizer may be needed to achieve yield potentials. The reason is that not all of the manure nitrogen is available in the year of application. The nitrogen not available will be a source of residual nitrogen for crops in succeeding years.

Fields receiving annual applications of manure should be tested annually. The samples should be taken at approximately 15 cm (6 in) depth and analyzed for nitrogen, phosphorous and potassium (shallow soils in some areas of the province do not contain this much soil cover).

Consulting with a soils or crop specialist is also useful for unusual site-specific conditions (see Section 10, Sources of Information).

A Method to Determine Minimum Land Area Needed for Manure Applications

Do not to apply manure at too high a rate, particularly on coarse-textured sand and sandy loam soils which constitute about 95% of all soils in the province (see Appendix C to determine the recommended minimum land area needed for your manure). Deep rooted crops such as alfalfa, peas and vetch must be included in the crop rotation to retrieve any nitrates that may have leached down into the soil profile.

Often the costs of handling and applying manure are high, making it non competitive on a pound-per-pound nutrient basis with commercial mineral fertilizers. However, proper periodic applications can result in substantial long-term improvements in the physical characteristics of the soil.

Field Application for Odour Control

Manure spreading is the most common cause of nuisance odour. There are many factors that contribute to the production of odours during application. Good management practices are the best method of minimizing the possibility of complaints.

Minimize Odour

Public Relations

Neighbours are less likely to complain if they understand the problem of the odour control and why manure spreading is a critical component of farming. Neighbours will be more tolerant if they can see a genuine effort is being made to minimize odours. Some specific points to consider are:

- keep the barnyard, manure storage as neat and clean as possible;
- maintain good communications with neighbours. If possible inform your neighbours of your intentions to spread;
- keep transport equipment clean and well maintained to ensure that manure is not deposited on the road; and
- if possible, avoid transporting manure on public roads during periods of high traffic. In some areas, high traffic exists no matter the time of day. However, even in these cases, peak traffic usually occurs early in the morning and late afternoon/early evening, Monday to Friday. It is noted there are other types of slow moving traffic, such as front end loaders and other construction equipment.

Note: Poultry producers can draw one important insight from the subjective nature of odour responses. Odours from the operations of respected neighbours trusted friends and value community supporters are dramatically less objectionable than that of any evasive irresponsible individual. There clearly is a reward for the responsible community member who is appreciated by a neighbour. The reward - fewer complaints.

Weather Conditions

Weather conditions influence the intensity and duration of farm odours. Consider the following factors when deciding when to spread manure;

- **!** manure spread in cool or cold weather will create less odour than manure spread in warm weather;
- **!** wind will help dilute the odours by increased mixing in the air;
- **!** on calm, humid days, rapid drying of the manure and dilution of the odours will not occur;
- **!** if possible, avoid fields a short distance upwind of neighbours during sensitive weather conditions;

Note: The close proximity of forage lands to some urban areas in the Province (such as St. John's) makes it difficult to adopt minimum separation distances to residential properties or residential areas.

- do not exceed recommended rates of application for your soil type. Generally, the period when odours are strongest is during the first 12 to 48 hours after spreading depending on temperature and weather conditions. But, with very heavy applications, odours could last up to 10 days. When spreading liquid manure in sensitive areas, apply it as thin as possible (approximately 50 m^3/ha or 5 mm thick) to maximize absorption into the soil, to enhance drying and to maintain an aerobic environment;

- keep the discharge height of the slurry as low as possible. The higher the trajectory of discharge the greater the release of odours. Listed below are discharge methods in order from least to most effective for odour control:

  – Large gun irrigation,
  – Low trajectory irrigation,
  – Top discharge tanker,
  – Bottom discharge tanker,
  – Dribble bars or booms,
  – Pump and fill tankers release less odours than vacuum filled tankers;

- if possible, incorporate manure into the soil as soon as possible after application. Tilling reduces the release of odours. If applicable, cultivation of manure directly into the soil is an excellent method of odour control. The forage land in the St. John's area is only cultivated every few years, hence it will be seldom practical to incorporate manures in such areas; and

- particle size or droplet size of applied manure influences odour release. Small droplets have more surface area and tend to drift more. This allows for more odourous gases to be released quickly.

6.0 COMPOSTING MANURE

Some farm operators in Newfoundland and Labrador are composting manures as a means of returning nutrients back to the soil. Composting is a biological process in which micro-organisms aerobically convert organic materials into a soil-like material called compost. During composting, the microorganisms consume oxygen while feeding on the organic matter. They also generate heat and large quantities of carbon dioxide and water vapour. The rate at which manure will compost depends on:

- the moisture content;
- temperature;
- level of oxygen available;
- size of the manure particles; and
- relative quantities of carbon and nitrogen available to the microorganisms for use as food.

The optimum solids content for composting is between 40% and 50%. It is, therefore, necessary to increase the solids content of liquid waste to at least 35% before it can be composted. Fresh manure can be screened and the resulting solids, which are about 35% moisture, are composted directly. The liquid portion is collected and goes to storage. It is also possible to add some form of bulking agent, such as straw or sawdust, to adjust the moisture content before beginning composting. During the composting process, the volume of waste will be reduced by up to 50%.

An adequate supply of oxygen is required throughout the pile. To achieve this, maintain the pile at 40 to 50 percent solids and mix the material on a regular basis. This process can be carried out using either a windrow system, aerated static piles or an in-vessel system. The windrow method consists of placing the mixture of raw materials in long narrow rows (typically 1.0 to 1.2 metres high and 3.0 to 3.6 metres wide [4 by 12 feet]). The windrows are then turned on a fixed schedule to increase aeration and to rebuild the bed porosity. Aerated static piles are aerated directly with forced air systems or passive systems where pipes are placed throughout the pile to speed up the process. The in-vessel system confines the composting material within a building or container and uses forced aeration and mechanical turning to speed up the composting process.

Windrow composting generally takes from one to four months depending on the frequency of turning. In-vessel composting or aerated static piles range from two to four weeks. When managed properly, the composting process is aerobic and the release of odours must be minimal - the product will have an earthy odour. If the conditions are not controlled and the manure begins to decompose anaerobically, the compost produces very strong offensive odours and the process can take much longer.

Prevent leachate to ground and surface water through proper site selection (soils, topography), diversion of run-off from surrounding areas, including a bed of peat as a base for compost and relocating compost piles each year to minimize the accumulation of nutrients.

So far, the markets for composted manure are limited and the costs of the composting may not be recoverable in the sale of the final product. Farm operators in central areas of the province are composting a mixture of manure with peat moss. Wood chips are used for composting in areas around St. John's.

7.0 FARM RESIDENTIAL SEWAGE DISPOSAL SYSTEMS

Residential Disposal Systems are subject to the requirements of the Sanitation Regulations. For further information, obtain the document: "Standards of Accepted practice for the Location, Design and Construction of Private Sewage Disposal Systems" from the local office of the Government Service Centre.

8.0 DISPOSAL OF DEAD ANIMALS AND OTHER FARM WASTES

Like most business enterprises, every farm produces some type of waste material. Like manure, these waste materials must be disposed of in an environmentally acceptable manner to minimize the likelihood of contaminating soil and water. Common waste materials found on farms include:

- dead poultry;
- animal health care products;
- general packaging (for example, boxes, bags, plastics);
- petroleum products such as used motor oil;
- paints and preservatives;
- pesticides;
- machinery and equipment including inert components, tires and restricted use components such as batteries;
- farm structures such as old buildings including building components; and
- waste fruit and vegetables (including organic waste dumps).

Disposal of Dead Poultry

Large commercial poultry operations are subject to mortality rates from 2-5% and therefore generate many carcasses for disposal. Mortalities refer to dead poultry that are not marketable for human consumption. Proper disposal of dead birds is extremely important to protect the health of both people and livestock. Any animal carcass may contain bacteria and other disease organisms that can infect humans directly or through contamination of a residential water supply. Disposal of any dead poultry must be in accordance with the Waste Materials Disposal Act. Mortalities must be kept in a secure and frozen state if not disposed of within 48 hours of the time of death. A secure state would be one where scavenger animals such as coyotes, wolves (in Labrador), dogs and birds, were prevented from access to the mortalities. Disposal is specified to be by delivery to a rendering plant, burial, composting or incineration.

Leaving mortalities outside for scavengers to feed on is not an acceptable method of dead animal disposal.

Rendering

Delivery of the carcasses to a rendering company is the preferred method for disposing of dead animals. Currently, a rendering plant (Rothsay Rendering Plant) operates at Foxtrap.

Rendering companies may have certain restrictions regarding the condition of the birds. In general, the birds must be brought in as quickly as possible in the summertime. Birds that die during the winter can be frozen and delivered to the renderer at convenient intervals. Rendering companies will generally not accept dead birds that do not remain intact when handled. Depending on the end product of the rendering process, there may be restrictions on carcass quality and condition. Rendering companies that produce meat and bone meal and inedible tallow will usually accept birds regardless of the course of death; companies that produce an edible material may not.

If a processor is not nearby, however, the time and expense for traveling may make delivery impractical for small numbers of dead birds or farms located far away from the plant. If this is the case, poultry producers must freeze and store mortalities until such time as the birds can be incinerated or buried.

Fur farms in Newfoundland accept mortalities and cull or off-sex birds as feed.

Burial

During the summer months, the carcass can be buried if a rendering service is not available or practical. The Waste Material Disposal Act prohibits the disposal of waste materials on any lands which are not approved waste disposal sites approved by the Government Services Centre. Place dead birds in a trench that is backfilled each time birds are added. Caution is required for burial of dead birds. While at one time carcasses could be brought to sanitary landfills, this is no longer possible in many areas. Municipalities that bury their refuse on a daily basis may allow animals to be deposited in landfill sites. Check with your local municipal office to determine if this is allowed in your area.

Ensure that the burial pit is or has:

- at least 90 metres (300 ft) from wells or domestic water intakes;
- at least 30 metres (100 ft) from any other surface water;
- constructed such that the bottom of the pit is 1.2 metres (4 ft) above the high water table;
- sized for a maximum of 700 kilograms (1,500 lb.);
- hydrated lime (quick lime) to speed up decomposition and deter scavengers and insect infestation; and
- a minimum 0.6 metre (2 ft) of soil covering the carcasses (offers protection from scavengers that will drag the carcasses around, creating both a nuisance and a possible health hazard).

Dead animal burial pits need the approval of a Government Services Centre, Department of Government Services and Lands. Contact the regional Government Services Centre for details.

During the winter it is advisable to put dead birds in a holding area, such as a covered trailer, where they can remain frozen until burial is possible in the spring.

Composting

(Where this is not a common practice in Newfoundland and Labrador, such composting would be appropriate if initiated on a small scale in consultation with the appropriate agricultural and environmental agencies.)

Composting dead poultry is becoming more popular in Canada and, as local experience is gained, it is anticipated that some farm composting facilities will be constructed in the future. Operations using composting of mortalities must be designed and managed in such a way that they do not cause pollution. An aerobic environment must be maintained, and all material must be heated throughout to a temperature of 55ÄC (130ÄF) for at least three days for adequate reduction of pathogen levels.

Where composting is employed for dead bird disposal, they must:

- be of sufficient capacity to dispose of normal mortality rates;
- have all contaminated runoff collected, and clean surface water directed away from the composting facility;
- be located a minimum of 50 m (160 ft) from a watercourse or wells;
- be located to take the farm residence and any neighbouring residences into account. While offensive odours are not usually generated in the composting process, the handling of dead poultry and compost on a daily basis may not be aesthetically pleasing. When locating a composter, consider traffic patterns required in moving dead poultry to the composter, moving the required ingredients to the composter, and removing finished compost from the composter; and
- be situated on a well-drained site and must provide all-weather capability for access roads and work areas.

Fully composted birds, where there is no sign of bones or feathers, can be added to manure for eventual land spreading.

For the proper design of a composting facility for dead bird disposal, qualified professionals should be consulted.

Incineration

Incineration is an acceptable method of disposal if performed properly. For the dead birds to be burnt without creating an odour problem, the temperature of the incinerator must be sufficiently high.

Where incinerators are employed for dead bird disposal, they must:

- where possible, be located so that prevailingwinds carry exhaust fumes away from neighbors;
- have sufficient capacity so that all odour levels stay within tolerable limits;
- be 50 m (160 ft) minimum from wells or domestic water intakes;
- be fire safe; and
- consume all material fed into them.

The installationand operation of any incinerator must be in compliance with the Environment Act. Generally, a single chamber-two burner type of incinerator, or equivalent, will be required. Single burner incinerators are not recommended.

For the proper design of an incinerator for dead bird disposal, qualified professionals should be consulted. An incineration shall be operated to meet the minimum requirements of 0.5 hour retention time in the secondary chamber at 1400 to 1600 feet.

Disposal

Disposal at an approved landfill site or incineration at an approved waste disposal site with the consent of the owner/operator is acceptable.

8.1 OTHER FARM WASTES

For further information, obtain a copy of Disposal of Household and Farm Wastes, Department of Forest Resources and Agrifoods, 1997.

Animal Health Care Products

Spent medicines, empty containers and other items must be disposed of in an acceptable manner. For livestock and poultry producers, no approved incineration facilitiesfor medical wastes exist. As an alternative, you must follow the following practices:

- farm medical wastes that have the potential to cut or puncture such as needles and scalpels must be packaged in rigid containers (for example, a plastic container previously used for cleaning agents) and discarded with household wastes or taken to the local Regional Veterinarian; and
- return medical supplies that have outlived their shelf life (expiry date) to the supplier or to the local Regional Veterinarian.

General Packaging

Reuse or recycle farm plastics (containers, for example, silage wrap, black plastic mulch, greenhouse plastics and greenhouse transplant flats) and other packaging materials whenever possible. Packaging materials that once contained toxic materials, such as pesticides need to be disposed of as per guidelines for the disposal of pesticide containers.

Materials not reused or recycled must be disposed of at an approved municipal land-fill site or any other approved facility. Burning of plastics is also considered acceptable in Newfoundland and Labrador but only after you have contacted the Department of Environment for details.

Petroleum Products (Including Handling and Storage)

All farms use petroleum products and produce petroleum wastes such as gasoline, diesel fuel, machinery oil and hydraulic fluids. These should be stored in a double tank. Improper storage and handling of petroleum products presents a threat to public health and water quality. A few quarts of gasoline in the ground water may be enough to severely pollute your drinking water supply. At low levels, fuel contaminants cannot be detected by smell or taste but present a very real health threat. Petroleum products contain a number of potentially toxic compounds that are known carcinogens (cancer causing agents) to laboratory animals and humans.

Storage and handling of petroleum products are regulated under "The Storage and Handling of Gasoline and Associated Products Regulations" of the Environment Act. These regulations are administered by the Government Services Centre, Department of Government Services and Lands. Additional information on requirements or applications to install systems in accordance with the regulations are available from the Government Services Centre's regional offices in St. John's, Clarenville, Gander, Corner Brook and Happy Valley-Goose Bay. Dispose of unwanted waste oil and hydraulic fluids by first collecting them in either a tank or containers and then transporting them to a local oil recycling depot or a licensed waste oil collection contractor. Used motor oil can be used as a lubricant on equipment. Waste oil should not be burned.

Any floor drainage from a service area where oil is being used has to be routed through an oil separator before being discharged. The used waste oil floating in the separator must be removed regularly and deposited in the waste oil tank or container.

In the case of a petroleum storage and handling leak or spill, immediately call the Environmental Emergencies 24-Hour Report Line (see Section 10). For more information, refer to the Factsheet, Storage and Handling of Petroleum Products on the Farm, Publication GT005, November 5, 1996.

Paints and Preservatives

These and other materials such as adhesives and lubricants must be safely stored on farm and used up as needed, shared with a neighbor or brought to a recycling depot.

Pesticides

Pesticides can be an environmental and health hazard when used improperly. Any use of pesticides must be in accordance with The Provincial Pesticides Control Regulations (CNR 1166/96)under the Pesticide Control Act. The Government of Canada defines a pesticide to include insecticides, fungicides, herbicides, rodenticides, miticides, avicide, plant growth regulators and fumigants.

You must write a Pesticide Applicator License examination administered by the Pesticide Control Section, Provincial Department of Environment. Currently, no person shall store, use or apply a pesticide without an existing license of a prescribed class for that purpose unless exempt under the conditions for storing, use or application prescribed for the pesticide or unless exempted under the regulations (such as home or garden).

Pesticides Control Act, 1990. The categories of pesticide licenses include: agriculture, aquatic, forestry, greenhouse, industrial vegetation, landscape, mosquito and biting fly, fumigation, structural and aerial. Farmers must have an Applicator's License to purchase or apply commercial or restricted pesticides. As of the writing of this document, the use of agricultural class pesticides on an individual's own property is exempt from the requirement for an operator's license (licensing to undertake an operation designed to use a pesticide to control a pest). Individuals applying pesticides must be licensed applicators with the exception of those exempt under the Pesticide Control Regulations. For more information contact the Agrifoods Branch or the Department of Environment.

Pesticides may only be used if they are registered for use by the Federal Pest Control Products Act.

Pesticides will be safely disposed of if you:

- triple or pressure rinse drums, glass bottles, plastic and metal containers and empty rinse liquid into sprayer;
- single rinse paper or plastic bags containers and empty rinse liquid into the sprayer;
- rinse water that cannot be added to the sprayer tank can be applied to a non-crop area which is on your property and which is at least 200 metres (656 feet) from waterbodies and wells;
- crush, puncture (several times) or damage empty containers so they cannot be reused once they have been rinsed; and
- pesticide containers can be discarded with other household garbage (never burn as the residues may not be destroyed and toxic fumes may be released). Containers can also be returned to a recycling depot or triple rinsed and then disposed of at a landfill. Inform the landfill manager in case there is an area for more hazardous materials. On-farm disposal should only be done in consultation with the Government Services Centre, the Department of Government Services and Lands.

Appendix I provides a description of proper pesticide handling and storage procedures that must be followed in Newfoundland and Labrador.

Machinery and Equipment

Reuse and recycle whenever possible. If this is not possible, equipment must be collected and

disposed of at an approved municipal waste disposal site or facility or to a scrap dealer.

Disposal of oil, fuel and antifreeze should be done through a licensed oil contractor. Disposal of refrigerant is regulated under the regulations for refrigerant and halons. Contact your regional Government Services Centres for information on proper disposal methods for these materials.

Farm Structures and Building Components

Building components include such materials as wood frames, glass, sheet steel, plastic, shingles. Store materials on farm for future reuse or recycling. The remaining materials must be collected and disposed of at an approved municipal waste disposal site.

Reuse or recycle where possible. Otherwise, the materials must be taken to an approved landfill, waste disposal site or depot for hazardous materials. Old building materials that are restricted from reuse include such things as insulation, pressure heated materials, asbestos materials, composite products and treated lumber. For the proper disposal of asbestos, contact your regional Government Services Centre.

9.0 ON-FARM SLAUGHTERHOUSES AND MEAT INSPECTION

Slaughter Facilities for Own Use

A number of livestock operations have their own slaughter facilities. Under the Meat Inspection Act (Newfoundland), those who slaughter their own animals on their property for their own use do not need a facility license or to have individual animals inspected. You can, however, minimize environmental and food standard problems in your facility by following guidelines for inspected facilities.

Commercial Slaughter Facilities

Under the Meat Inspection Act (Newfoundland), the slaughter of all livestock must be done in a licensed slaughterhouse. There is no exception for custom kill. The only exemptions are as indicated above (personal use) or for slaughterhouses registered under the Meat Inspection Act (Canada).

In addition to mandatory licensing, the Meat Inspection Act (Newfoundland) provides for voluntary inspection of animals before and during the slaughter process. This results in the stamping of finished product allowing easier access to retail markets.

Construction and Design

A slaughter facility must be located at a site which is free from conditions that interfere with its sanitary operation. These include but are not limited to:

- a reasonable offset from barnyards, stables, dead meat (rendering) operations, waste disposal facilities or other offensive facilities;
- a reasonable offset from any source of pollution or any place that harbours insects, rodents or other vermin likely to cause meat or meat products to become contaminated;
- a reasonable offset from residential property; and
- specific regulations imposed by the Department of Environment (currently being updated).

A reasonable offset is the equivalent of 100 metres (330 ft) unless otherwise determined by the inspector for abattoirs.

In addition to proper construction, it is important that slaughterhouse facilities and equipment are operated in a manner that minimizes the chances of contamination and thereby the risks of food-borne diseases. This includes regular cleaning during and after each day's slaughter and the proper separation and disposal of condemned products.

For more information on the Meat Inspection Program and construction and operational guidelines, please contact the Animal Health Division, Department of Forest Resources and Agrifoods or the

Government Services Centre.

Special Requirement for Poultry Processing

Inspected poultry slaughter and processing facilities must follow additional regulations which are listed below.

(1) *Poultry Receiving and Holding Rooms.* Poultry receiving and holding rooms must be designed to accommodate the unloading of poultry and storage of crates under cover. Dead birds on arrival and those condemned after inspection must be stored in acceptable containers. Bleeding time shall not be less than ninety seconds, and blood must be restricted to the poultry receiving and holding rooms, but separate from holding area and the scalding tank.

(2) *Scalding and Defeathering Rooms.* Scalding and defeathering processes must be conducted in a separate room such that dressing processes are not contaminated by feathers or steam and condensation from the scalding tank. The scalding tank must be adequately vented, temperature monitored and provided with a drain for overflow. Scalding temperatures must remain at approximately 60.5ÄC (140.9ÄF). All water used in the process of scalding must be from a potable (drinkable) source.

(3) *Transfer Facilities*. If poultry are transferred by a non-mechanized system (eg. along a stainless steel table), this shall be done in a manner such that no carcasses touch the same surface before the surface is sanitized. Operators should consider having a suspension system for ease of evisceration and inspection.

(4) *Washing and Singeing*. Sprays at all washing stations shall be directed to wash the hock surface and the carcass below the hock. Water used for washing birds must be from a potable source. Singeing or finishing facilitates must be provided to remove any remaining feathers from poultry carcasses.

(5) *Evisceration and Inspection*. There must be adequate facilities to remove the inedible portions of the bird and the transfer of these inedible portions must be in a direction opposite to the evisceration sequence. Potable water is required for washing both the inside and outside of carcasses. Harvesting and preparation of giblets must be carried out without delay. The working space at each inspection station must not be less than 2.44 m (8 ft) in length and shall be for the exclusive use of inspectors and trimmers. Each trimmer shall have access to a knife sanitizer, providing water at 82ÄC (179.6ÄF) or higher. If vacuum guns are used, the contents of the tank shall discharge directly into the inedible waste section of the establishment.

(6) *Chilling*. The chilling system must have the capacity to lower the temperature of eviscerated carcasses to 4ÄC (40ÄF) within one hour. All poultry must be chilled before it is packaged.

10.0 SOURCES OF INFORMATION

These guidelines present a summary of the information available on environmentally sustainable poultry production practices.

Provincial and Federal Agriculture

Both federal and provincial departments of agriculture are valuable sources of information to the poultry industry. Regional agricultural engineers provide engineering advice related to poultry barn design and manure management systems. The Department of Forest Resources and Agrifoods employs specialists in a variety of disciplines such as animal science, veterinary medicine, soil science and crop production. Newfoundland and Labrador agriculture staff work cooperatively with other professionals across Canada and have a wide range of publications and standard plans available on a variety of subjects. Information can be obtained from the following offices.

(a) Newfoundland and Labrador Department of Forest Resources and Agrifoods:

Soil and Land Management Division
Tel: 709-637-2081 (Director's Office, Corner Brook)
Fax: 709-637-2586

Land Use Planning
Tel: 709-729-6647/6633 (St. John's)
Fax: 709-729-6046
Tel: 709-637-2084 (Corner Brook)
Fax: 709-637-2586
Tel: 709-686 5262 (Pynns Brook)
Fax: 709-686-2491

Soil Specialist
Tel: 709-637-2085 (Corner Brook)
Fax: 709-637-2586

Soil, Plant and Feed Laboratory
Tel: 709-729-6734
Fax: 709-729-6046

Drainage Specialist
Tel: 709-637-2094 (Corner Brook)
Fax: 709-637-2586

Animal Health Division
Tel: 709-729-6879 (Director's Office, St. John's)
Fax: 709-729-0055

Food Quality Lab (St. John's)
Tel: 709-729-0388
Fax: 709-729-0055

Veterinary Diagnostic Lab (St. John's)
Tel: 709-729-6897
Fax: 709-729-0055

Production and Marketing Division
Tel: 709-637-2077 (Director's Office, Corner Brook)
Fax: 709-637-2586

Structural and Environmental Specialist
Tel: 709-729-6868 (St. John's)
Fax: 709-729-2674

Poultry Specialist
Tel: 709-729-6816 (St. John's)
Fax: 709-729-0205

Poultry Veterinarian, Animal Health Division
Tel: 709-729-6886 (St. John's)
Fax: 709-729-0055

Pest Management Specialist
Tel: 709-637-2087 (Corner Brook)
Fax: 709-637-2586

Crops Specialist
Tel: 709-729-2635 (St. John's)
Fax: 709-729-2674
Tel: 709-686-2702 (Pynns Brook)
Fax: 709-686-2491

(b) Agriculture and Agri-Food Canada:

Soil and Drainage Specialist
Tel: 709-772-4170 (St. John's)
Fax: 709-772-6064

Other Resources

The provincial and federal offices for agriculture and the environment offer a variety of publications on manure management. For more information on the subject material found in this report, please

contact the following offices:

(a) Agriculture and Agri-Food Canada
Information Services (Publications)
Tel: 613-759-6626

(b) Environment Canada
Environmental Protection Service
Tel: 709-772-5488 (St. John's)
Tel: 709-637-4375 (Corner Brook)

(c) Government Service Centre:
Tel: 709-729-3699 (St. John's)
Tel: 709-466-4060 (Clarenville)
Tel: 709-256-1420 (Gander)
Tel: 709-292-4206 (Grand Falls)
Tel: 709-637-2204 (Corner Brook)
Tel: 709-896-2661 (Goose Bay)

(d) Water Resources Management Division (Protected Water Supplies)
Tel: 729-2539 (St. John's)
292-4285 (Grand Falls)
637-2367 (Corner Brook)

(e) Department of Environment Pesticide Training Officer
Pesticide Control Section
Tel: 709-729-5707 (St. John's)

A valuable supplement to this guide may be found by reference to Manure Management guides, copies of which can be found in regional agricultural offices of the Department of Forest Resources and Agrifoods.

In case of an environmental emergency, you must contact:

Environmental Emergencies 24-Hour Report Line:

Tel: 709-772-2083 (St. John's)
Tel: 1-800-563-2444 (Other Areas)

APPENDIX A

Odour Treatment Techniques

Examples of Exhaust Air Treatment

Scrubbers or odour absorbing filters remove the odourous compounds from the exhaust.

- **Biofilters** remove odours by biological action. The biofilter provides a medium for certain odour reducing bacteria to live.
- **Incineration** of odour compounds by passing the air through a flame.
- **Anti-odour agents or masking sprays** reduce the nuisance of the odour.

Examples of Manure Treatment

Aerobic Methods

Composting solid manure reduces odours. By mixing or ventilating, oxygen is mixed with the manure. This keeps conditions in the manure aerobic so no odours are produced. Composting can be done simply by turning a pile with a loader or in more complex vessel systems. Composted manure is more stable than untreated manure and can often be sold off the farm as a value added product.

Naturally aerated lagoons or oxidation ponds are typically large shallow ponds which rely on surface effect to keep conditions aerobic.

Mechanical agitation of liquid manure mixes air with the slurry to maintain aerobic conditions. To properly aerate, a storage requires a well designed system of agitation.

Oxidation is a form of aeration where a single agitation point is used ina circular ditch to keep air mixed with the slurry.

Air Injection into the storage pit will also maintain aerobic conditions and provide agitation.

Anaerobic Methods

- Anaerobic ponds are one example, where crusting keeps the surface sealed; and,
- **Methane digesters** are another example of an anaerobic treatment process where manure is treated in an enclosed vessel at a constant temperature which is ideal for methane production. The methane gas produced can be used as a source of energy. The treated manure has few odours.

Other Methods

Moisture Removal – By reducing the moisture level, odour production is also reduced.

Biological/Chemical Control – Bacterial culture or enzymes are added to counteract the natural odour producing process.

Chemical Masking – Chemicals can be added to manure to produced more pleasant smell.

APPENDIX B

Converting Metric Units to Imperial

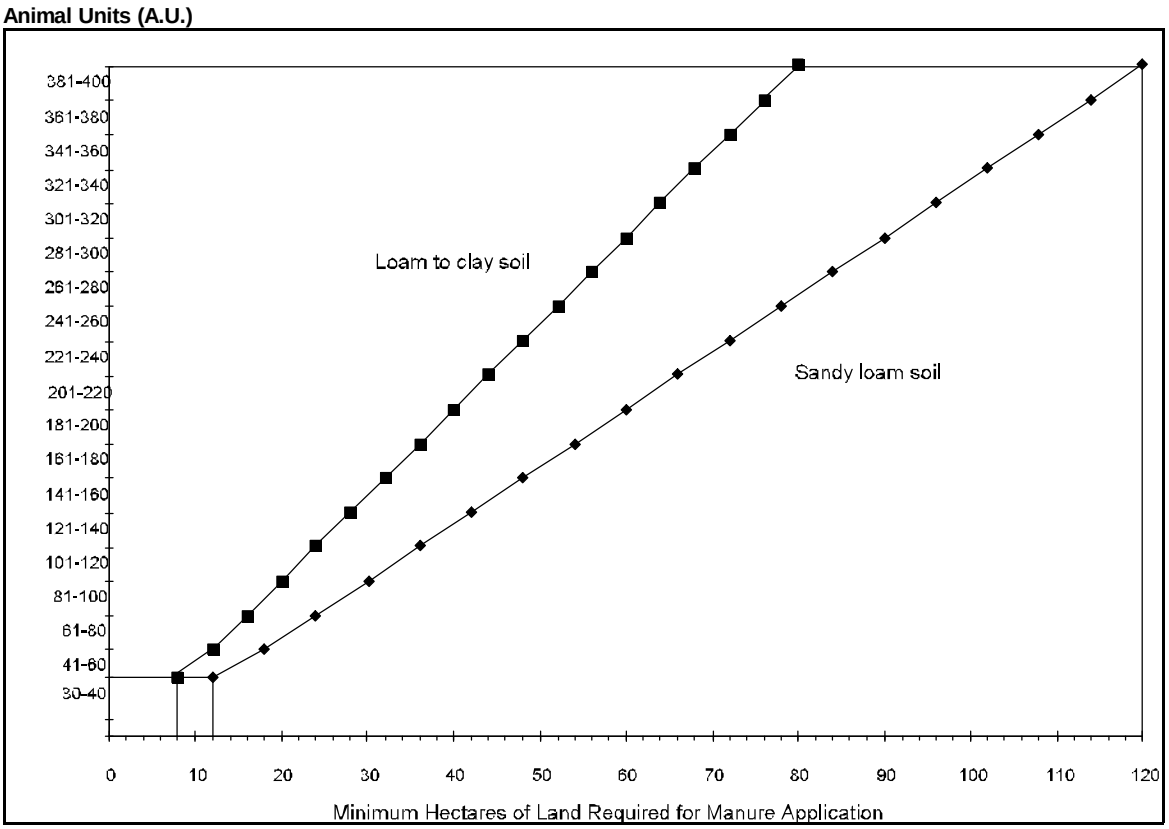
Length		Area	
1 millimetre (mm)	0.04 inch	1 square centimetre (cm^2)	0.16 square inch
1 centimetre (cm)	0.40 inch	1 square metre (m^2)	10.77 square feet 1.20 square yards
1 metre (m)	39.40 inches 3.28 feet 1.09 yards	1 square kilometre (km^2)	0.39 square mile
1 kilometre (km)	0.62 mile	1 hectare (ha)	107,636 square feet 2.5 acres
Volume		**Volume (Dry)**	
1 millilitre (ml)	0.035 fluid ounce	1 cubic centimetre (cm^3)	0.061 cubic inch
1 litre (L)	1.76 pints 0.88 quarts 0.22 gallons (Imp) 0.26 gallons (U.S.)	1 cubic metre (m^3)	1.31 cubic yards 35.31 cubic feet
		1,000 cubic metre (m^3)	0.81 acre-foot
		1 hectolitre (hl)	2.8 bushels
Weight		**Speed**	
1 gram (g)	0.035 ounce	1 metre per second	3.28 feet per second
1 kilogram (kg)	2.21 pounds	1 metre per second	2.24 miles per hour
1 tonne (t)	1.10 short tons	1 kilometre per hour	0.62 miles per hour
1 ton (t)	2,205 pound		
Pressure		**Temperature**	
1 kilopascal (kPa)	0.15 pounds/sq. in	$^oF = (^oC \times 9/5) + 32$	
		$^oC = (^oF - 32) \times 5/9$	

Converting Imperial Units to Metric

Length		Volume (Dry)	
inch	2.54 cm	cubic yard	0.76 m^3
foot	0.30 m	bushel	36.37 L
yard	0.91 m		
mile	1.61 km		
Area		**Volume (Liquid)**	
square foot	0.09m^2	fluid ounce (Imp)	28.41 millilitre (ml)
square foot	0.84 m^2	pint (Imp)	0.57 L
acre	0.40 ha	gallon (Imp)	4.55 L
		gallon (U.S.)	3.79 L
Weight		**Pressure**	
ounce	28.35 g	pounds per sq. inch	6.90 kPa
pound	453.6 g	ton	0.91 tonne

APPENDIX C

Recommended Minimum Land Area for Manure Applications



Note: For example, a 10,000 hen layer operation (equal to 40 animal units (AU) since 10,000 ÷ 252 hens/animal unit from Table D.1) would require a minimum of 8 hectares of loam soil or 12 hectares of sandy loam soil. This is calculated by extending a horizontal line from the 30-40 AU point on the vertical axis over to the two heavy lines and then drawing another line downwards to the horizontal axis to 8 and 12 hectares, respectively. This same process can be repeated for any sized operation once the AUs have been determined from Table C.1.

TABLE C.1

Animal Unit Equivalents[1] (A.U.) (C)

Type of Livestock	Av. Weight Per animal (kg)	Number of Livestock = 1 AU	Number of A.U. per Livestock
Laying Hens	1.8	252	0.00396
Broilers	0.9	500	0.0019
Pullets	1.3	350	0.0029
Broiler Turkey	6.5	70	0.0143
Heavy Turkey	7.5	60	0.0165
Heavy Toms	12.0	40	0.0264

(1) One animal unit is equivalent to 454 kg (1,000 lb.) live weight.

Source: Newfoundland and Labrador Department of Forest Resources and Agrifoods.

APPENDIX D

Calculating Minimum Separation Distance (MSD)

The MSD calculation in Table D requires you to calculate the base distance (the value for "A" is found in Table D.2), expansion factor (the value for "B" is found in Table D.3), manure system factor (the value for "C" is found in Table D.4)) and the livestock or animal unit factor (the value for "D" is found in Table D.5).

TABLE D.1
Minimum Separation Distances (MSD)

	MSD (metres)
Nearest neighbouring dwelling	A x B x C x D
Residential, commercial or recreational areas	2 x A x B x C x D
Public buildings	3 x A x B x C x D

TABLE D.2

Base Distance as a Function of Number of Animal Units (A)

Animal Units	Base Distance (metres)
0 - 100	300
101 - 200	400
201 - 300	475
301 - 400	550
401 - 500	600
501 - 600	650
> 600	700

TABLE D.3

Expansion Factor as a Function of % Increase (B)

% Increase [1]	Expansion Factor
0 - 50	0.7
51 - 75	0.77
76 - 100	0.83
101 - 150	0.91
151 - 200	0.97
201 - 300	1.04
301 - 400	1.08
401 - 500	1.11
> 500	1.14
New Operations	1.16

(1) % increase = (proposed AU-present AU) ÷ present AU, then x 100.

TABLE D.4

Manure System Factor (C)

Manure System	Factor
Dry litter in-situ	0.7
Solid open manure pile	0.8
Semi-solid or liquid covered concrete tank	0.8
Semi-solid or liquid open concrete tank	0.9
Semi-solid or liquid uncovered earthen tank	1.0

TABLE D.5

Livestock Factor Based on Livestock & Housing Type (D)

Manure System	Type of Housing	Factor
Caged Layers	Manure stored in barn	1.0
Caged Layers	Manure removed daily	0.8
Chicken Breeder Layers		0.8
Chicken Broilers/Roasters		0.65
Pullets		0.7
Turkeys		0.7

For example:

(1) For an existing 5,000 layer operation with less than 50% expansion, semi-solid or liquid manure with an earthen manure storage where the manure is removed daily:

5,000 layers ÷ 144 (from Table D.6) = 35 animal units

MSD to nearest neighbouring dwelling = **300** (Table D.2, base distance for 0-100 animal units) x **0.7** (expansion factor of less than one-half of 5,000 [35 AUs], or 17, which falls within the 0-50 category as shown in Table D.3) x **1.0** (manure system factor in Table D.4) x **0.8** (livestock factor in Table D.5) =**168 metres**

(2) For a new operation using the above example:

MSD to nearest neighbouring dwelling = **300** (Table D.2, base distance for 0-100 animal units) x **1.16** (expansion factor for new operations as shown in Table D.3) x **1.0** (manure system factor in Table D.4) x**0.8** (livestock factor in Table D.5) =**278 metres**

TABLE D.6

Animal Units (AU): Number of Animals Required to Produce the Nitrogen to Fertilize 0.4 Hectares
(One Acre) of Hay

Animal Type	Animals/Ac (@110 kg N/ha or 44 kg/ac)
Layers	144
Broilers	240
Pullets	505
Roasters	141
Broiler Breeders	68
Replacement Broiler Breeders	166
Turkey Broilers	159
Heavy Hens	122
Heavy Toms	61

APPENDIX E

Nitrogen Loss Summary

TABLE E.1
Nitrogen Loss Summary for Liquid Systems

Storage	% Loss
Enclosed	10-20
Open	10-30
Earthen	30-50
Application	**% Loss**
Broadcast	20-30
Broadcast and Incorporate Within 24 Hrs	1-5
Sprinkler	25-35

Source: Farm Practice Guidelines for Poultry Producers in Manitoba.

TABLE E.2
Nitrogen Loss Summary for Solid Systems

Storage	% Loss
Enclosed	15-35
Open	20-40
Earthen	40-60
Application	**% Loss**
Broadcast	15-30
Broadcast and Incorporate Within 24 Hrs	1-5

1. Losses can vary widely depending on the climatic and management factors. The values in this table are based on typical practices.

2. Nitrogen losses after fall applications will be approximately 20% greater than spring or summer applications.

Source: Farm Practice Guidelines for Poultry Producers in Manitoba.

APPENDIX F

SAFETY

As manure decomposes, gases are released. The types of gases produced depend upon how the manure is stored. Under aerobic conditions (with oxygen present) the gases produced are not dangerous. However, when manure is stored anaerobically (no oxygen present), some of the gases produced are dangerous. When liquid manure is stored for a period of several weeks in an enclosed space, the dangerous gases can accumulate in the head space of the tank and in bubbles and dissolved gases within the manure itself. The greatest danger occurs when the manure is agitated, when this happens, the gases held in the manure are released and the concentrations can reach lethal levels within several minutes. Numerous deaths have occurred as a result of farm workers entering manure tanks and storages.

The gas that is most dangerous is hydrogen sulphide. Although it is readily detectable at low concentrations, at higher levels the gas paralyses the sense of smell, so it is possible to unknowingly encounter a dangerous situation. As the concentration increases, the hydrogen sulphide paralyses the nerves that control the diaphragm causing a person to stop breathing. When concentrations are high, a single breath of the gas can be fatal. The other gases considered to be dangerous are listed in the following table (Table F.1).

Good design and safe habits can prevent accidents from happening. Long-term storage should not be in the same air space as the animals or workers. The agitation required to remove the manure from the barn can increase gas concentrations to lethal levels very rapidly. Connections between the barn and long term storage must be separated by a gas trap to prevent the gases from returning to the barn. Design the facility so that all servicing can be performed without entering the storage.

When agitating manure in an in-barn storage, be certain to provide maximum ventilation. All personnel should work in pairs. All people should be evacuated from the air space above the storage, animals should be evacuated if possible. Begin by pumping without agitation to create several feet of head space for the gases. Agitate below the surface and do no more agitation than is necessary.

Never enter a manure tank without proper respiratory equipment that is designed for the purpose. A purpose-built breathing apparatus with full face mask and remote air tank and hose are required-SCUBA equipment is not adequate. Always work in pairs.

TABLE F.1

Characteristics of the Most Dangerous Manure Gases

Gas	Symbol	Density	Odour	Concentration (ppm) [1]	
				TLV-TWA [2]	Effects on Humans
Hydrogen Sulphide	H_2S	1.19	Rotten Eggs, Nauseating	10	5 - Offensive odour 150 - Olfactory paralysis, death in 30 minutes. 700 - Rapidly fatal (fatal levels commonly observed)
Carbon Dioxide	CO_2	1.53	None	5,000	30,000 - Increased breathing rate 40,000 - Drowsiness, headache 300,000 - May be fatal in 30 min. (fatal levels seldom observed)
Ammonia	NH_3	0.60	Sharp, Pungent	25	100-150 - Irrigation of eyes, nose and throat in 30 min. 5,000 - Respiratory spasm, may be fatal (fatal levels rarely observed)
Methane	CH_4	0.55	None		500,000 - Could asphyxiate (fatal levels rarely observed)

1. Ppm (parts per million) of a gas in atmospheric air; to convert to percentage by volume, divide ppm by 10,000.

2. TLV-TWA (Threshold Limit Value, Time-weighted Average), the concentration under which nearly all workers may be repeatedly exposed for an 8 h work-day and 40 hr work week without apparent adverse effects. Established by the American Conference of Government Industrial Hygienists, P. O. Box 1937, Cincinnati, OH 45201, U.S.

Source: Canada Plan Service Plan M-8710 “Manure Gas”.

APPENDIX G

Soil and Manure Sampling

Soil testing for total nitrogen, phosphorous and potassium is preferably done each year to determine the kind and rate of fertilizersto be applied to get good plant growth and to prevent over application and consequently "nutrient loading" of the soil, especially nitrogen. Sampling depths of 150 mm (6 in.) for vegetable and forage production and 4 inches for blueberries is usually adequate. Soils in Newfoundland and Labrador are not analyzed for nitrate-nitrogen given the rapid volatization of nitrate-nitrogen and the non-availabilityof on-site testing (by the time the sample has been received by the lab, most of the nitrate-nitrogen is lost from the sample).

G.1 Soil Sampling

Reliable results can only be made if the samples are fully representative of the field or area from which they were taken. In addition, proper sampling and handling procedures must be followed.

G.1.1 When to Sample

Soil sampling can be done at any time, but the fall of the year is generally considered the best time for the following reasons:

- spring sampling tends to leave one short when requiring fertilizer and limestone recommendations for planting that year;
- fall samplingassures you that your results are returned in time for your next planting and allows for planning: and,
- early fall sampling allows you to receive results for the fall liming.

G.1.2 Selecting Areas to Sample

Soil sampling is normally done on an individual field basis with a single composite sample representing the whole field. Individual fieldsthat are not uniform should be divided into smaller sampling units with a single composite sample representing each unit. The soil in each of these sampling units should have the same colour, texture, cropping history and fertilizer or manure treatments. Look for differences in slope, erosion, crop growth and yield. Any area that is different in these features and large enough to have manure applied at a different rate should be sampled separately.

Problem areas should not be sampled unless they represent a significant portion of the field. If they do, obtain separate samples. Examples of these areas include:

- bottom and uplands soil;
- large low or poorly drained areas;

- soils of different color and texture; and,

- soils for different liming, fertilizing or cropping practices.

All abnormal areas such as old manure piles, dead furrows, areas close to trees or fence lines, haystacks, corrals, fencerows or farmstead sites should also be avoided as well as locations of past chemical or fertilizer spills. Samples should not be taken along headlands, within 15 metres (50 ft) of field borders or shelterbelts or within 45 metres (150 ft) of built up roads.

If the field has been cultivated, take the sample from the compacted soil in the wheel track.

A minimum of 15 sample locations per individual field or sampling unit should be taken. A single composite sample is then formed from 15 or more samples.

G.1.3 Equipment and Supplies

Special augers or probes designed for soil sampling may be used (sample bags and information sheets are available from your local Agriculture Representative's office). However, a clean shovel or garden trowel are both equally effective.

Use two clean, labeled plastic pails for collecting samples. Information sheets, sample containers and shipping boxes are available from the lab conducting the analysis.

If a shovel is used, follow these directions:

- Dig a V-shaped hole in the soil and take care to clear away the surface litter;

- Take a 12 mm (½ in.) slice down one side of the hole to a depth of 150 mm (6 in.). Anywhere from 50 to 75 mm (two to three in.) is suitable for sod crops; and,

- Trim both sides of the slice to leave a one inch width of soil. This is an individual sample to be placed in a clean pail. Take 5 to 10 such samples and mix them thoroughly to make a representative, composite sample.

Note: All mechanical and hydraulic samplers may yield poor samples on very dry or very wet soils. In all cases, avoid getting the topsoil in the subsoil samples, or subsoil in the topsoil samples. For example, in very dry soils, be careful not to let topsoil spill into the hole before taking deeper samples.

G.1.4 Handling Samples

Take care to keep samples clean and uncontaminated. Clean the sampler and take a couple of dummy samples between fields.

Send samples to the laboratory as soon as possible. If a delay of more than a week is anticipated air-dry the samples. Follow these steps to dry samples:

- Mix the soil in each thoroughly, breaking lumps less than 12 mm (½ in);

- Remove about 0.6 litre (1 pint) of soil and spread on a piece of clean paper;
- Completely dry at a temperature of not more than 30ºC. Do not dry in an oven at a high temperature since this can change the phosphorus, potassium, and sulphur levels;
- Care should be taken to avoid contamination of the samples with foreign materials such as commercial fertilizer, manure salt, baking soda, water, dust, etc. Samples should not be dried on old fertilizer or feed bags or in areas where fertilizers have been handled; and,
- A fan may be used to ensure constant air flow over samples and enhance drying.

Once the sample is thoroughly dry, fill the soil sample containers. Label each container with the correct field number and sample depth. Complete an information sheet for each field.

G.1.5 Keeping Records

It is wise to keep past records on fields sampled. The records should include:

- fertilizer and manure application rates;
- previous soil test results;
- soil condition at sampling (temperature, moisture, crop cover, etc.);
- a map of where the soil samples were taken in each field; and,
- production information.

These records may give clues to variations in lab results from year to year, and allow for customizing manure application recommendations.

G.2 Manure Sampling

The most important part of testing manures is getting a representative sample. For liquid manures, agitate or mix the manure in the pit, lagoon, slurry store, or other storage structure before taking samples. If complete mixing is not possible, combine samples taken from 10-15 different areas within the storage pit, combine samples taken at 10-15 different times during the removal of the manure.

Mix these composites and fill a clean 0.6 litre (1 pint) plastic bottle about three-quarters full. Before sealing the bottle with its lid, squeeze the bottle to remove some of the excess air. This allows room for gas expansion during the shipment without excess pressure building up.

For solid manures, take samples from 10-15 different locations of the manure stack or pile or take samples from 10-15 loads of manure when removing and applying manures in the field. Mix thoroughly and place about 0.6 litre or 0.5 kg (1 lb) of the composite manure sample into a clean, heavy duty plastic bag and seal.

For either type of sample, refrigerate the sample overnight or longer and send to one of the provincial

laboratories. It is preferable to ship early in the week and with boxes containing adequate packing to protect the sample containers during handling. Labs will provide sample bottles upon request. Do not use glass bottles.

APPENDIX H
A Method to Determine Manure Application Rates
(Adapted from MWPS-18, Livestock Waste Facilities Handbook)

* Please note this methodology takes into account residual nitrogen in the soil from manure applications for the three previous years.

Section A. Manure Composition and Soil Information

1. Manure composition:

a. Values from chemical analysis of manure.

Composition		Your Farm
Laboratory data are often given in ppm. To convert ppm to percent, divide by 10,000. If composition data are not available, use Table H.1 or H.2.	Total N Ammonium N Nitrate N P_2O_5 K_2O	_____% _____% _____% _____% _____%

b. Determine the amount of each nutrient per ton of solid manure or per 1,000 gal. of liquid manure. If nutrient contents are given in percent:

- % nutrient in manure x 20 = lb nutrients/ton; or,
- % nutrient in manure x 100 = lb nutrients/1,000 gal. (e.g., 0.5% Total N = 10 lb/ton or 42.5 lb/1,000 gal.).

Composition	Example (Table H.2)	Your Farm
Total N	36 lb/ 1,000 gal.	_____ lb/ ____
Ammonium N*	26 lb/ 1,000 gal.	_____ lb/ ____
Nitrate N*	-- lb/ --	_____ lb/ ____
P_2O_5	27 lb/ 1,000 gal.	_____ lb/ ____
K_2O	22 lb/ 1,000 gal.	_____ lb/ ____

* If only total N is determined, assume 50% ammonium N and 5% nitrate N.

N.B. Figures in Section A.1.b needs to be consistent with what's in Table H2. Also Section B - "Nutrient Needs of Crop" needs to have figures consistent with Table H.4.

N.B. Original report Tables J1 - J4 should be I.1 - I.4.

2. Soil information:

Soil Information	Example	Your Soil
Texture	Sandy loam	
Soil pH	6.2	
Available P	- lb/acre	lb/acre
Exchangeable K	- lb/acre	lb/acre

Section B. Nutrient Needs of Crop

	Example	Your Crop
Crop to be grown	Timothy	
Expected yield/acre	2.5 T	
Nutrients required/acre	N = 100 lb/acre	lb/acre
(based on soil test report or	P_2O_5 = 55 lb/acre	lb/acre
Table H.4)	K_2O = 250 lb/acre	lb/acre

Section C. Annual Rate of Manure Application

1. Calculate amount of organic N in manure (either per ton or per 1,000 gal):

lb total N - (lb ammonium N + lb nitrate N) = lb organic N

Example:

36 - (26 + -) = 10 lb organic N/1,000 gal.

Your manure:

_____ - (_____ + -) = _____ lb organic N/_____

2. Calculate amount of organic N in manure made available the first year.

lb organic N/(ton or 1,000 gal) x mineralization factor (Table J.3) =
lb available organic N/(ton or 1,000 gal)

Example:

10 x 0.35 + 3.5 lb available organic N/ 1,000 gal.

Your farm:

_____ x _____ = _____ lb available organic N/_____

3. Calculate amount of plant-available N in manure (use either a or b below).

a. Incorporated application of manure (assume 25% of ammonium N is lost by identification if knifed-in; assume no loss if immediately incorporated by other methods):

Available organic N (sec C.2) + [Ammonium N (Sec A.1.b) x 0.75] + Nitrate N (Sec A.1.b) = lb plant - available N/(ton or 1,000 gal)

Example:

__3.5__ + [__26__ x 0.75] + __-__ = __23__ lb available N/1,000 gal.

Your farm:

_____ + [_____ x 0.75] + _____ = _____ lb available N/_____

b. Surface application of manure (assumes 50% of ammonium N is lost by ammonia volatilization):

Available organic N (Sec C.2) + [Ammonium N (Sec A.1.b) x 0.50] + Nitrate N (Sec A.1.b) = lb plant-available N/(ton or 1,000 gal)

Your farm:

_____ + [_____ x 0.50] + _____ = _____ lb available N/_____

4. Adjust N fertilizer recommendation to account for residual N from manure applications in the last 3 years.

a. Manure applied to field 1 year ago (if none, proceed to b):

lb organic N/(ton or 1,000 gal) of manure x (mineralization factor x 0.50) x tons or 1,000 gals applied/acre = lb residual N/acre

Example:

10 lb/1,000 gal x (0.35 x 0.50) x 6,000 = 10.5 lb residual N/acre

Your farm:

_____ x (_____ x 0.50) x _____ = _____ lb residual N/acre

b. Manure applied to field 2 years ago (if none, proceed to c.):

lb organic N/(ton or 1,000 gal) or manure x (mineralization factor x 0.25) x tons

or 1,000 gal applied/acre = lb residual N/acre

Your farm:
_____ x (_____ x 0.25) x _____=_____ lb residual N/acre

c. Manure applied 3 years ago (if none, proceed to d.):

lb N/(ton or 1,000 gal) of manure x (mineralization factor x 0.125) x tons or 1,000 gal applied/acre = lb residual N/acre

Your farm:

_____ x (____ x 0.125) x _____ =_____ lb residual N/acre

d. Total residual N:

Sec C.4.a + Sec C.4.b + Sec C.4.c = total lb residual N/acre

Example:

_10.5_ + _-_ + _-_ =10.5 total lb residual N/acre

Your farm:

_____+_____ +____=____ total lb residual N/acre

e. Adjust N requirement of crop:

lb N required by crop (Sec B) - lb residual N (Sec C.4.d) = lb N required/acre

Example:

_100_ - _10.5_ = _89.5_ lb N required/acre

Your farm:

____ - ____ =____lb N required/acre

5. Annual manure applications based on amount of N required by crop:

Adjusted N required (Sec C.4.e) ÷ lb available N/(ton or 1,000 gal) (Sec C.3.a or C.3.b) = tons of manure/acre or number of 1,000 gal units of manure/acre

Example:

_89.5_ ÷ _23_ = _3.891_ tons of manure/ac or 1,000 gal units of manure/ac

Your farm:

____ ÷ ____ = ____ tons of manure/ac or 1,000 gal units of manure/ac

6. Annual manure application based on amount of P_2O_5 required by crop:

P_2O_5 required by crop (Sec B) ÷ lb P_2O_5/(ton or 1,000 gal) (Sec A.1.b) = tons manure/acre or number of 1,000 gal units of manure/acre

Example:

_55_ ÷ _27/lb/1,000 gal_ = _2.037_ tons of manure/ac or 1,000 gal units of manure/ac

Your farm:

____ ÷ ____ = ____ tons of manure/ac or 1,000 gal units of manure/ac

7. Select annual rate of manure to be applied. If manure is to supply all N and P_2O_5 needs of the crop, select the HIGHER of the two values (Sec C.5 or Sec C.6) as your application rate per acre. If your aim is to maximize use of nutrients in animal manure, select the LOWER of the two values, then supplement with commercial fertilizer to supply the remainder of the nutrients required by the crop.

Rate of manure to be applied is:

Example:

_2.037_ tons of manure/acre

Your farm:

_____ tons of manure/acre

Section D. Additional Fertilizer Required

1. Nitrogen (do not complete if manure rate selected in Sec C.7 supplies all of the required N).

a. Available N added in manure:

Tons or 1,000 gal units of manure added/acre (Sec C.7) x lb availableN/(ton or 1,000

gal) (Sec C.3.a or C.3.b) = lb available N applied

Example:

_2.037_ x _23 lb/1,000 gal_ = _46.9 lb_ available N applied

Your farm:

_____ x _____ = _____ available N applied

b. Additional fertilizer N required:

Adjusted N requirement (Sec C.4.e) - lb N applied (D.1.a) = lb fertilizer N required

Example:

_89.5_ - _46.9_ = _42.6_ lb fertilizer N

Your farm:

_____ - _____ = _____ lb fertilizer N

2. Phosphorus (do not complete if manure rate selected in Sec C.7 supplies all of the required amount of P_2O_5 added in manure:

Tons or 1,000 gal units of manure/acre (Sec C.7) x lb P_2O_5/(ton or 1,000 gal) (Sec A.1.b) = lb P_2O_5 applied

Your farm:

_____ x _____ = _____ lb P_2O_5 applied

b. Additional fertilizer P_2O_5 required:

P_2O_5 required by crop (Sec B) – lb P_2O_5 applied (Sec D.2.a) = lb fertilizer P_2O_5 required

Your farm:

_____ – _____ = _____ lb fertilizer P_2O_5 required

3. Potassium:

a. K_2O added in manure:

Tons or 1,000 gal units of manure/acre (Sec C.7) x lb K_2O/(ton or 1,000 gal) (Sec A.1.b) = lb K_2O applied

Example:

_ 2.037 _ x _ 22 lb/1,000 _ = _ 44.8 _ lb K_2O added

Your farm:

_____ x _____ = ____ lb K_2O added

b. Additional K_2O required:

K_2O required by crop (Sec B) - lb K_2O applied (Sec D.3.a) = lb fertilizer K_2O required

Example:

_ 250 _ - _ 44.8 _ = _ 205.2 _ lb fertilizer K_2O required

Your farm:

_____ - _____ = _____ lb fertilizer K_2O required

TABLE H.1

Nutrients in Solid Manure at the Time of Land Application

Species	Bedding or Litter	Dry Matter	Ammonium N	Total N	P_2O_5	K_2O
		%	lb/ton manure			
Poultry	No	45	26	33	48	34
	Yes	75	36	56	45	34
	Deep Pit	76	44	68	64	45
Turkey	No	22	17	27	20	17
	Yes	29	13	20	16	13

Source: MWPS-18, Livestock Waste Facilities Handbook.

TABLE H.2

Nutrients in Liquid Manure at the Time of Land Application

Species	Waste Handling	Dry Matter	Ammonium N	Total N	P_2O_5	K_2O

		%	lb/ton manure			
Poultry	Liquid Pit	13	64	80	36	96

Source: MWPS-18, Livestock Waste Facilities Handbook.

TABLE H.3

Amount of Nitrogen Mineralized or Released from Organic Nitrogen Forms in Manure to Plant Available Forms During the Growing Season

Manure Type	Manure Handling	Mineralization Factor
Poultry	Deep pit	0.45
	Solid with litter	0.30
	Solid without litter	0.35

TABLE H.4

Estimated Removal of Plant Nutrients By Various Crops

Crop	D.M. Yield (t/ha)	Kilograms per hectare				
		Nitrogen N	Phosphorus P_2O_5	Potassium K_2O	Calcium Ca	Magnesium Mg
Oat Grain	3.1	56	22	17	3	4
Oat Straw	4.5	28	11	67	9	10
Barley Grain	3.2	56	28	17	2	3
Barley Straw	3.4	22	11	50	13	3
Wheat Grain	2.7	56	28	17	1	7
Wheat Straw	3.4	22	5	39	7	3
Corn Silage	12.3	112	56	151	12	21
Alfalfa Hay	8.9	213	50	275	132	27
Timothy Hay	8.9	151	39	163	20	11
Red Clover Hay	8.9	168	39	179	121	29

Source: Atlantic Provinces Field Crop Guide.

APPENDIX I

Guidelines for Pesticide Use

You must successfully complete a Pesticide Application Examination, Agriculture Category, within Newfoundland and Labrador. Currently, no person shall store, use or apply a pesticide without an existing license of a prescribed class for that purpose and except exempt under the conditions for storing, use or application prescribed for the pesticide or unless exempted under the regulations.

Use non-chemical methods for pest control where effective and possible. For example, sanitation, biological control, crop rotation or resistant varieties may be used as part of an integrated pest management plan. Before purchasing a pesticide, you should obtain a label and become familiar with the product. Ensure that:

- you have correctly identified the pest;
- the product is registered for the intended use;
- the pesticide is suitable for use with the application equipment on your farm;
- the pesticide will work effectively under your specific farm conditions and for that specific pest;
- you know when the pesticide should be applied to be most effective;
- you have the appropriate protective clothing and equipment; and
- you calculate and purchase only the correct amount of pesticide needed for no more than one year of use.

The following sections outline accepted guidelines for transporting, storing, applying and disposing of pesticides.

Farmers must have a Pesticide Applicator's Licence to purchase or apply commercial or restricted pesticides.

TRANSPORTING

When transporting pesticides you must:

- transport them in their original containers with the original labels attached;
- cap and pack containers securely to prevent them from leaking or being punctured or broken;
- place pesticides in a metal or plastic storage box or on a waterproof tarp to prevent leaks;
- not transport pesticides on a wooden truck bed which will absorb spilled pesticides and contaminate future loads;

- never transport pesticides with food, animal feed, fertilizer, clothing, household goods or living plants which could lead to contamination;
- lock your vehicle as you are responsible during transport if anyone is accidentally poisoned by pesticides you have left unattended;
- protect paper or cardboard containers from rain;
- never transport pesticides in the passenger compartment of the vehicle where you or any other passenger is at risk from fumes or residues of spilled containers;
- placard your vehicle or sprayer and carry shipping papers as per the Transportation of Dangerous Goods Act for loads more than 500 kilograms (1,100 lb) of solid material, liquid formulations in containers greater than 100 litres (22 gallons) each or if carrying fumigants; and
- carry protective clothing and gloves, clean-up materials (such as kitty litter, peat moss or some other absorbent material), plastic bags and a shovel and bucket in case of a spill.

STORAGE

Safe pesticide storage must include the following:

- by law, you are required to store all restricted and commercial pesticides in a shed, room or locker which is locked, well ventilated, has warning signs and a source of water in or near the storage area;
- alert emergency agencies (such as the fire department) as to the location and type of hazardous chemicals stored on your farm;
- store pesticides in their original containers with original labels;
- keep herbicides separate from insecticides and fungicides;
- never store pesticides near livestock, food, animal feed, wells, water supplies, or in your home;
- ensure there is an approved fire extinguisher for chemical fires located nearby (but not in the storage area); and
- store protective clothing and equipment near, but not in, the storage area.

MIXING AND LOADING

Spills are more likely to occur when you are mixing or loading pesticides. During mixing and loading, you must:

- put on protective clothing and safety equipment such as coveralls, rubber gloves, a

waterproof hat and rubber boots, a face shield or goggles, a waterproof apron and, if necessary, a respirator (the label on the pesticides container will give you a list of the necessary protective clothing for safe mixing);

- choose a mixing site away from other people, livestock, pets and water sources when outdoors;
- ensure there is good ventilation and lighting when mixing indoors;
- always let someone know what you are mixing and make sure they are familiar with poisoning symptoms, first aid treatment and have emergency phone numbers on hand;
- keep soap, water, emergency first aid equipment and a spill clean-up kit nearby;
- mix and weigh pesticides on a sturdy level bench or table made of non-absorptive material;
- mix in still or low wind conditions outside and stand upwind of mixing areas;
- cut bags rather than tearing;
- mix only the amount you will use immediately;
- label and use all measuring and mixing equipment for pesticide use-only;
- pre-mix wettable powders with a small amount of water before adding to the spray tank to prevent lumps and airborne dust;
- fill the sprayer half full with water, turn on the agitator and then slowly add the pesticide;
- rinse pesticide containers as soon as they are empty-rinse three times for empty containers which held liquids and rinse bags with solids once and then pour the rinse water into the sprayer;
- rinse all measuring equipment and replace container caps and close bags before returning them to the storage area;
- stop mixing and clean up immediately if you splash or spill any pesticide;
- use clean water with the correct pH (take a sample to your local laboratory) since alkaline spray water leads to chemical breakdown of many organophosphates and carbamates (pesticides work best at a pH of 5.0 to 7.0); and
- leave an air gap between the end of your fillinghose and the water in your spray tank to avoid contamination of the water supply.

APPLICATION

Many horticulture operators in Newfoundland and Labrador have fields which are small and fragmented. Consequently, windy conditions may cause problems related to spray drift. Some pesticides also work better under specific environmental conditions. For example, synthetic pyrethroids are considered more effective in cool temperatures while others such as carbamates and organophosphates work best in warmer conditions.

During outside application, you must:

- use a calibrated sprayer suited to your needs;
- wear protective clothing;
- watch the weather and do not spray in winds stronger than a gentle breeze or no more than 2-15 kilometres per hour (for example, in the early morning or early evening);
- never apply pesticides just before a heavy rain;
- post warning signs if necessary to keep people out of treated areas;
- make sure no livestock are in the area;
- consider when honey bees or other beneficial insects are most active;
- apply the pesticide at the recommended rates;
- shut off spray nozzles when you turn unless you have calculated this into your spray area and want to control the pest on headlands;
- use and maintain the correct tractor speed chosen during calibration;
- plan the spray route through your field so you avoid passing through airborne spray or freshly treated areas;
- leave a buffer zone when the spraying area is next to sensitive crops or water bodies (30 metres [100 ft] around drinking wells and 10 metres [33 ft] for field boom sprayers along fish-bearing waters);
- reduce spray drift by:
  - adding a drift control agent in the spray mix;
  - setting the boom only as high as necessary for good coverage;
  - using the correct nozzle and replace worn nozzles;
  - using low pressures to produce large droplets that will still cover the plant;
- never spray when the temperature exceeds 25ÄC or if the humidity is below 50%;
- spray downwind from sensitive areas such as houses or beehives; and,

- clean application equipment well before switching pesticides (use an ammonia based bleach to the rinse water to neutralize most pesticide residue).

Be courteous to your neighbours. Where nuisance complaints are anticipated, notify neighbours of your intention to spray prior to pesticide application. This is very importantwhere neighbours with sensitivities live nearby (such as an asthmatic neighbour).

During inside application (for example, in greenhouses or barns), you must:

- follow the same appropriate safety precautions as listed for outdoor use;

- seal treated areas for the time specified on the label, then thoroughly ventilate before re-entry and keep people and animals away from exhaust fans during ventilation; and,

- place a warning sign at all entrances to the building.

APPENDIX J

REFERENCE MATERIAL

1. The Provincial Environment Act, 1995.

2. Environmental Guidelines for Producers, Province of B.C., Ministry of Agriculture and Food, 1998.

3. Pesticides Control Act, 1990.

4. Pesticide Control Regulations, Newfoundland and Labrador.

5. Public Health Regulations, 1991.

6. Guidelines for Preparing Development Plans for Agricultural Operations Within Protected Water Supply Areas, Government of Newfoundland and Labrador, Department of Environment and Lands, Water Resources Management Division, February 1994.

7. Soil Organic Matter, J.B. Whalen, Soils Specialist, Agrifoods Branch, Newfoundland and Labrador Forest Resources and Agrifoods.

8. Disposal of Household and Farm Wastes, Department of Forest Resources and Agrifoods, 1997.

9. Environmental Farm Practices Guidelines for Horticultural Producers for Newfoundland and Labrador.

10. Protected Road Zoning Regulations, under the Urban, Rural Planning Act, Newfoundland Gazette, March 27, 1997.

11. Farm Practices Guidelines for Poultry Producers in Manitoba.

12. Manure Management Guidelines for New Brunswick, New Brunswick Agriculture and Rural Development, November 04, 1996.

13. Eastern Canada Soil and Water Conservation Centre in Grand Falls, New Brunswick (506-475-4040).

14. Agriculture Department of McGill University in Ste. Anne de Bellevue, Quebec.

15. Pest Management Practices: A Manure Management Program, Ohio State University Extension, Dept. of Horticulture and Crop Science.

16. Farm Residential Sewage Disposal Systems, Jan Van de Hulst, Dept. of Forest Resources & Agrifoods, Draft, April 1996.

17. Canada Plan Service, Plan M-8710 “Manure Gas”.

18. MWPS - 19, Livestock Waste Facilities Handbook.

APPENDIX K

GLOSSARY OF TERMS

Pollution

Pollution is a situation where naturally occurring substances and/or contaminants in water (surface water and groundwater), soil or the air (odor and noise) exceed allowable levels and adversely affect their uses. The Provincial Environment Act (1995) defines pollution as including an alteration of the physical, chemical, biological or aesthetic properties of the air, soil or waters of the province, including a change of temperature, taste or odor, or the addition of a liquid, solid, radio-active, gaseous or other substance to the air, soil or waters, or the removal of those substances from the air, soil or waters which will render or is likely to render the air, soil or waters of the province harmful to public health, safety or welfare, or harmful or less useful for domestic, agricultural, industrial, power, municipal, navigational, recreational or other lawful uses, or for animals, birds, or aquatic life.

Groundwater

Refers to water below the surface of the ground.

Watercourse

A place that perennially for intermittently contains surface water, including a lake, brook, stream, river, spring, ravine, swamp, marsh or bog, including any drainage ditch leading into any of the foregoing.

Runoff

Overland flow of precipitation, snow melt or other liquid.

Overburden

A layer of soil, rock or other materials that ties above an aquifer and where rainwater and runoff seep into the soil to replenish the ground water.

Aquifer

A layer of rock or soil able to hold or transmit enough water to supply the needs for a water development.

Mortalities

Refer to dead poultry that are not marketable for human consumption.

Pesticides Control Act, 1990

The categories of pesticide licenses include: agriculture, aquatic, forestry, greenhouse, industrial

vegetation, landscape, mosquito and biting fly, fumigation, structural and aerial. Farmers must have an Applicator's License to purchase or apply commercial or restricted pesticides. As of the writing of this document, the use of agricultural class pesticides on an individual's own property is exempt from the requirement for an operator's license (licensing to undertake an operation designed to use a pesticide to control a pest). Individuals applying pesticides must be licensed applicators with the exception of those exempt under the Pesticide Control Regulations. For more information contact the Agrifoods Branch or the Department of Environment.

Volatilization

The process of solids or liquids turning into fumes.