BEST MANAGEMENT PRACTICES

Deadstock Disposal

Canada

Ontario

OFA Ontario Federation of Agriculture

What is a Best Management Practice or "BMP"?

▶ a proven, practical and affordable approach to conserving soil, water and other natural resources in rural areas

Who decides what qualifies as a BMP?

▶ a team that represents many facets of agriculture and rural land ownership in Ontario, including farmers, researchers, natural resource managers, regulatory agency staff, extension staff and agribusiness professionals

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METRIC–IMPERIAL CONVERSION FACTORS

Convert		To		Metric
%	▶	kg/1000 L	multiply by	10
%	▶	kg/tonne	multiply by	10
mg/L	▶	%	divide by	10,000

Convert		To		Imperial
%	▶	lbs per 1000 gallons	multiply by	100
%	▶	lbs per ton	multiply by	20
ppm	▶	%	divide by	10,000

Note: 1 m^3 = 1000 L

UNITS OF MEASURE

While Canada "went metric" over 30 years ago, many commonly used measurements such as land area are still expressed using imperial units. Acres of land are a good example: landowners seldom, if ever, refer to the size of their property in hectares. For your convenience, most of the measurements used in this manual are provided in both metric and imperial units. However, where common usage, common sense, space limitations or regulatory concerns dictate, one or the other may appear exclusively.

CONVERSION FROM…	FACTOR	EXAMPLE
METRES TO FEET	1 metre = 3.281 feet	A 20.6-m tall tree is 67.6 ft (20.6 x 3.281)
FEET TO METRES	1 foot = .3048	A 100-ft buffer is 30.48 m (100 x .3048)
ACRES TO HECTARES	1 acre = .405 ha	A 35-acre field is 14.16 ha
HECTARES TO ACRES	1 ha = 2.47 ac	A 1.4-ha plot is 3.5 ac

CONVERSIONS – METRIC AND IMPERIAL

Common Conversions

1 gallon	=	4.546 litres	1 acre	=	0.405 hectare
1 gallon	=	1.201 US gallons	1 acre	=	43,560 $feet^2$
1 gallon	=	0.161 ft^3	1 lb/ac	=	1.12 kilogram/hectare
1 US gallon	=	3.785 litres	1 ton/ac	=	2.25 tonnes/hectare
1 US gallon	=	0.833 Imp gallon	1 gal/ac	=	11.2 litre/hectare
1 ton	=	0.907 tonne	1000 gal/ac	=	11200 litre/hectare
1 pound	=	0.454 kilogram	1000 gal/ac	=	11.2 $metre^3$/hectare
1 tonne	=	2205 pounds	1 metre	=	3.28 feet
1 $foot^3$	=	6.229 gallons	1 metre	=	39.4 inches

Application Rate Conversions

Metric to Imperial (Approximate)			Imperial to Metric (Approximate)		
Litres per hectare x 0.09	=	gallons per acre	Gallons per acre x 11.23	=	litres per hectare (L/ha)
Litres per hectare x 0.36	=	quarts per acre	Quarts per acre x 2.8	=	litres per hectare (L/ha)
Litres per hectare x 0.71	=	pints per acre	Pints per acre x 1.4	=	litres per hectare (L/ha)
Millilitres per hectare x 0.015	=	fluid ounces per acre	Fluid ounces per acre x 70	=	millilitres per hectare (mL/ha)
Grams per hectare x 0.015	=	ounces per acre	Tons per acre x 2.24	=	tonnes per hectare (t/ha)
Kilograms per hectare x 0.89	=	pounds per acre	Pounds per acre x 1.12	=	kilograms per hectare (kg/ha)
Tonnes per hectare x 0.45	=	tons per acre	Ounces per acre x 70	=	grams per hectare (g/ha)
Kilograms per 1000 L x 10	=	lbs per 1000 gallons	Pounds per ton x .5	=	kilograms per tonne (kg/t)

CONTENTS

INTRODUCTION

THIS CHAPTER INCLUDES:

- **a brief discussion of causes of on-farm livestock and poultry losses**
- **an overview of disposal options**
- **results of a recent Ontario survey.**

On-farm livestock mortalities – referred to as deadstock throughout this book – are unwanted for many reasons. Livestock producers do whatever they can to avoid them, reviewing production and handling practices regularly. Today's livestock and poultry are genetically superior, receive proper care and nutrition, and are housed and managed to protect them from predators. As a result, deadstock, as a percentage of the total numbers on farms, is low.

Safeguarding animal health is an integral part of livestock agriculture.

Despite best efforts, mortalities are inevitable and must be dealt with to safeguard everyone's well-being. The alternative poses risks to environmental quality, animal health, and public health – including the farm family's. Improper disposal of deadstock is also a sensitive public relations issue.

Proper disposal takes knowledge, planning tools, and technology. This book begins by examining the environmental, health and legal issues involved in the disposal of deadstock. We'll then examine the options in detail, and review provincial regulations.

You will also find what you need to know to decide which disposal method or methods best suit your operation.

Mortality rates can be reduced by following strict biosecurity protocols.

In most cases, mortality rates are highest at birth.

In extreme cases, catastrophes – such as disease or power failures – will require mass disposal.

The highest mortality rates occur at birth or shortly after. Birthing deaths can be managed similarly to deaths where physical injury is the cause.

However, if the cause of death involves pathogens or infectious disease, caution is required to prevent the spread of disease to other livestock and, in some cases, humans. Handling and disposal methods in these cases are critical for the biosecurity of the operation and neighbouring farms, as well as for wildlife.

"Catastrophic mortality" is the term used to describe the conditions when an epidemic or natural disaster causes a massive die-off of animals in a short period of time. There may also be situations when an entire herd or flock has to be destroyed to prevent the spread of infectious disease in animals and protect human health.

If a foreign animal disease or a reportable disease is suspected, it is necessary to contact the Canadian Food Inspection Agency. See the back cover for contact information.

For disposal of catastrophic mortalities, special procedures must be followed to prevent the spread of infectious disease and water contamination.

OPTIONS FOR DISPOSAL IN ONTARIO

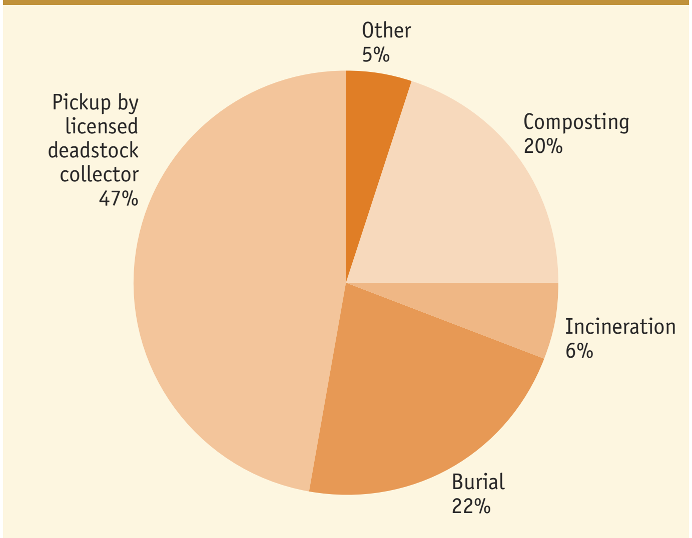
A recent survey revealed that the majority of Ontario's farmers currently prefer to use a single method of disposal, but at least 25% choose multiple methods, depending on the circumstance.

Deadstock removal to rendering plants is an option many livestock producers take advantage of where available. Deadstock are rendered into tallow, meat meal and bonemeal. These finished products after rendering are still used in many products on the market today. As greater restrictions are placed on the use of rendered products, the costs increase for deadstock pickup. In some cases, restrictions are placed on the species allowed for use in rendering.

Composting of deadstock is a management-intensive option that can reduce the pathogen count and also provide a valuable soil amendment.

Burial is a solution to predator and odour problems. It involves more time on the farmer's part and is difficult to do in the winter months when the ground is frozen.

DISPOSAL METHODS IN ONTARIO



This chart shows data from an Ontario survey of the methods chosen for disposing of deadstock. Pickup by a licensed deadstock service is the most commonly used and preferred method. Composting and burial are also employed with some frequency.

Incineration of deadstock on the farm is a viable option with the proper equipment and management.

Disposal vessels restrict predator access while allowing natural decomposition inside a watertight (but not airtight) vessel. Odours are a factor with this method, which makes site selection for vessels so important.

Research continues and results are being used to develop disposal guidelines and regulations. The intent of this work is to balance a need to protect animal and public health and the environment with the need to reduce management and economic implications for livestock producers. In the next chapter we'll examine the issues more closely.

ISSUES

THIS CHAPTER EXPLORES CONCERNS ASSOCIATED WITH DEADSTOCK DISPOSAL, INCLUDING:

- **specified risk material from infected animals**
- **risks associated with natural disposal**
- **biosecurity**
- **expense**
- **transportation**
- **availability of services.**

SOCIETAL CONCERNS

BOVINE SPONGIFORM ENCEPHALOPATHY (BSE) AND RENDERING

Following the discovery of BSE, consumer confidence stayed high and consumption of beef actually increased. Consumers can rest assured that specified risk material (SRM) is removed from the human food chain and that rendered ruminant materials cannot be used as a food source for ruminant animals.

For more information, see the Canadian Food Inspection Agency factsheet: **http://www.inspection.gc.ca/english/anima/heasan/disemala/bseesb/enhren/enhrene.shtml**

SPECIFIED RISK MATERIAL (SRM)

The Government of Canada has implemented an enhanced feed ban that prohibits specified risk material (SRM) from use in feed, fertilizer and pet food. The removal of SRM from the human and animal food chain is an essential component of the feed ban. It will eliminate the chance of cross-contamination and also speed up the process of eliminating BSE from our cattle herds.

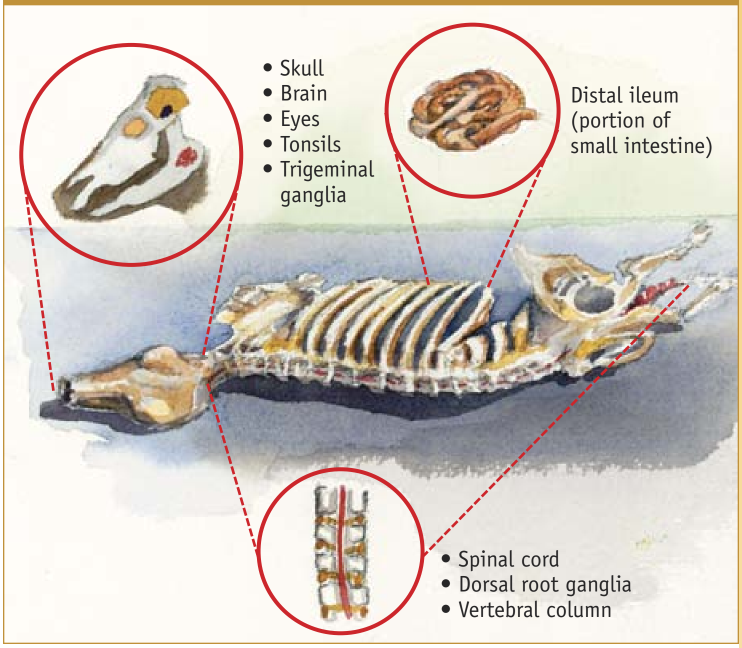
In an infected animal, SRM harbours the BSE prions (causative agents). Removal of SRM eliminates the potential threat of infectivity in the human and animal food chain. SRM includes: distal ileum (portion of small intestine) from cattle of all ages, and the skull, brain, eyes, tonsils, spinal cord, trigeminal and dorsal root ganglia from cattle 30 months of age and older. The SRM regulations require the permitting of the material (entire carcasses or parts thereof) and site for each time the SRM is conveyed, processed, controlled, or destroyed.

The SRM enhancements are a nationwide commitment to meet international requirements. For more information, see the Canadian Food Inspection Agency factsheet cited above this textbox.

In cattle 30 months of age and older, certain tissues are designated Specified Risk Material.

Specified Risk Material (SRM) is excluded from the human and animal food chain by law. For more information, contact the Canadian Food Inspection Agency.

SRM SOURCES



NATURAL DISPOSAL

Natural disposal is illegal. Any practice that involves leaving deadstock in natural areas for predation by scavengers or placing deadstock on manure piles is against the law. It attracts unwanted scavengers, predators, flies and disease – and creates odours as well.

Wildlife biologists argue that this practice actually trains predators, such as coyotes, to look to domestic ruminants, alive or dead, as a local food source.

Tossing deadstock in manure piles or in liquid manure storages is not a proper disposal method. Deadstock will not decompose thoroughly prior to field application.

Natural disposal is illegal. It attracts predators, scavengers and disease.

Exposed deadstock can be a source of odour. Best management practices for disposal will avoid this problem.

Best management practices for removal, storage, cleaning and disposal form part of a biosecurity plan for livestock operations.

BIOSECURITY

Deadstock infected with contagious pathogens can be a hazard to animals on and off the farm – and in some cases, to human handlers. Some pathogens can contaminate housing facilities as well as nearby soil and water resources.

Proper removal, storage, cleaning and disposal methods can minimize biosecurity risks. Check the section on BMPs for handling before disposal for further information.

WATER CONTAMINATION

Groundwater and surface water can be contaminated by improperly sited and poorly managed disposal systems. In some cases, nutrients, organic debris, and pathogens can leach from poorly sited burial sites to groundwater used for drinking water. Poorly managed or located static or windrow composting systems can potentially contaminate surface waters.

Poorly sited and managed deadstock disposal sites are at risk of contaminating groundwater or surface water.

ON-FARM CONCERNS

COSTS

Complying with new regulatory requirements, investing in new technology, and using rendering services have costs associated with them. In many cases, these costs have not been integrated into the cost of production, and are not easily passed on to consumers. Some agri-environmental cost-share programs will cover a portion of the costs of disposal BMPs.

AVAILABILITY OF DISPOSAL SERVICES

Collection services are not readily available in all parts of Ontario, such as northern Ontario.

In the recent past, restrictions were in place for the collection of certain livestock and diseased animals. This changed in July 2007. Consult your service provider for more information.

TRANSPORTATION OF CARCASSES

Regulations under the Nutrient Management Act, 2002 require that any vehicle used to transport deadstock on a public highway must be designed and equipped to prevent leakage and allow for effective cleaning and disinfecting. Deadstock must be kept from public view. Movement of bovine carcasses as well as specific treatment activities require federal SRM permitting.

PRINCIPLES

THIS CHAPTER INTRODUCES BASIC SCIENTIFIC PRINCIPLES CONCERNING THE DECOMPOSITION PROCESS, AND ITS IMPLICATIONS FOR THE ENVIRONMENT. WE WILL LOOK AT EACH OF THE MAJOR DISPOSAL METHODS IN THIS LIGHT, INCLUDING:

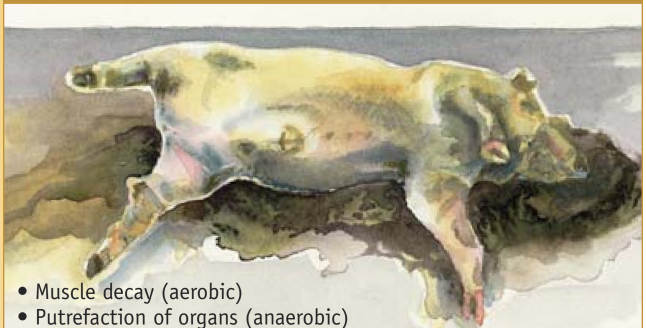
- **burial**
- **disposal vessels**
- **composting**
- **incineration**
- **rendering.**

It's important to understand some of the processes that pose risks related to on-farm deadstock. Knowing what can happen and why will help you manage risk and make better choices among options. It will help you appreciate why some practices are poor, and understand the rationale for BMP options described in detail further on.

Animals die due to predation, injury, illness and, in some cases, old age. Irrespective of the cause, it is important to be prepared and act quickly to reduce the risk of spreading disease, predation by scavengers, and environmental contamination.

DECOMPOSITION

EARLY DEGRADATION



- Muscle decay (aerobic)
- Putrefaction of organs (anaerobic)
- Leakage of body fluids
- Bloating
- Carcass <10% volume loss

MIDDLE STAGES OF DEGRADATION

- Decay of skin, hair
- Putrefaction of fat, cartilage
- Reduction in fluid loss
- Carcass <50% volume loss

LATTER DEGRADATION

- Decay of bones, horns, hooves
- No fluid loss

Soft tissues degrade first, releasing bodily fluids. Nutrients and pathogens in the fluids can attract predators and also pose the greatest risk of water contamination.

ANIMAL CARCASS DECOMPOSITION – THE FIRST STAGES

Decomposition of the carcass starts at the time of death. The rate of degradation is strongly influenced by biological and environmental factors.

Soft tissue is degraded by the processes of putrefaction (anaerobic degradation) and decay (aerobic degradation). Putrefaction results in the gradual dissolution of tissues into gases, liquids, and salts as a result of the actions of bacteria and enzymes. The putrefaction process emits odours and attracts scavengers.

A carcass is degraded by micro-organisms both from within (e.g., inside the gastrointestinal tract) and from outside, meaning the surrounding atmosphere or soil.

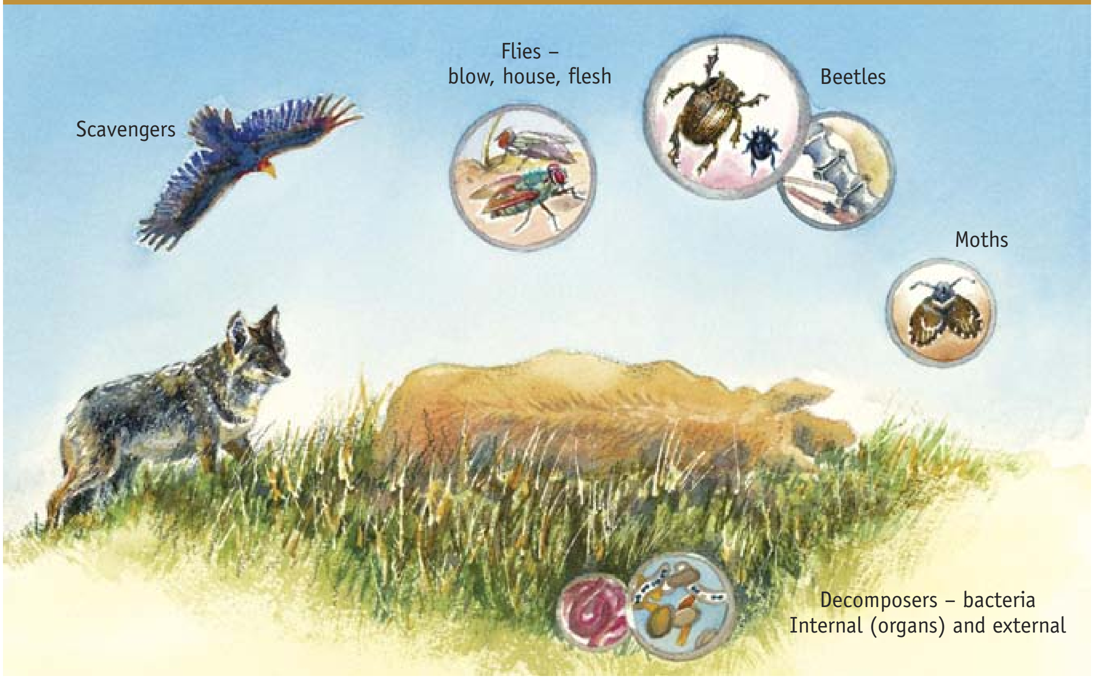
Generally body fluids and soft tissues other than fat (i.e., brain, liver, kidney, muscle and muscular organs) degrade first, followed by fats, then skin, cartilage and hair or feathers, with bones, horns, and hooves degrading slowest.

A deadstock is an ecosystem of its own in which various fauna arrive and depart from the corpse at different times. In warm weather, maggots can consume 60% of a carcass in less than a week.

Many kinds of organisms live by feeding on deadstock. Their activities result in the decomposition of the carcass and the recycling of nutrients. The groups of organisms involved in decomposition are bacteria, flies, beetles, mites and moths. Other insects, mainly parasitoid wasps, predatory beetles and predatory flies, feed on the organisms that feed on the corpse.

Nutrients and possible pathogens living within the leached body fluids may pose risks to surface water and groundwater, and promote the spread of disease and predation. This is why special precautions are necessary when handling deadstock before proper disposal.

DECOMPOSITION OF EXPOSED CARCASSES – KEY LIFE FORMS AT EACH STAGE



Bloat begins within 48 hours of death. Cell breakdown will accompany this bloating stage. Decay involving anaerobic bacteria can be subdivided into early, mid and advanced decay. Each stage of decomposition will have specific insects involved, starting with flies, then beetles and finally moths.

The blowflies are the first to arrive and lay eggs. Then come the houseflies and fleshflies. Flies will lay eggs in the body openings and at wound sites if they are exposed and environmental conditions are suitable for fly activity. Maggots will consume the flesh and spread bacteria throughout the carcass.

Now beetles come into the picture, where they feed both on the maggots and the flesh. The remaining dried flesh, skin and tendons will be consumed by certain families of beetles and Tineid moths.

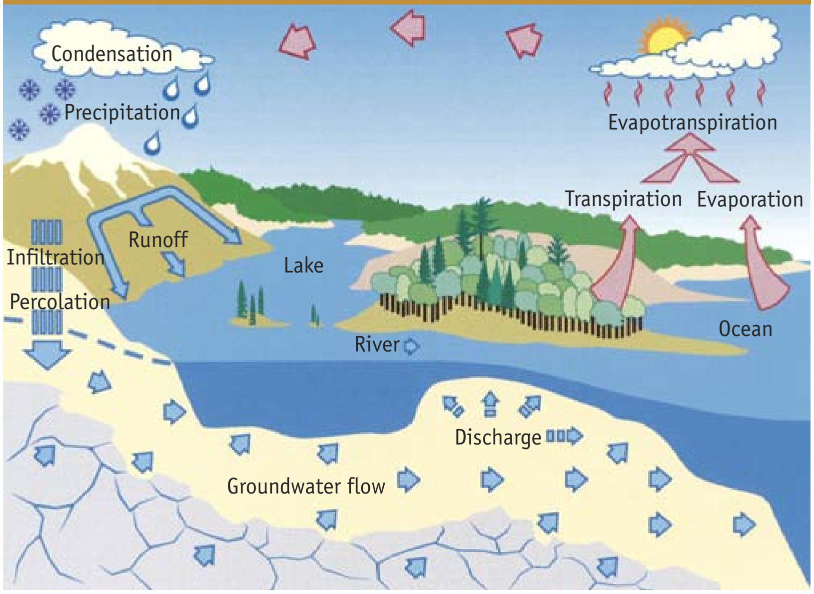
The decay process will depend on the environment, and may not occur at all if flies are excluded from the site.

Farm operations are part of the overall water cycle. They have an impact on the quantity and quality of both surface water and groundwater.

RISKS TO WATER QUALITY

Water is a universal carrier and its properties enable it to dissolve many substances and carry them with its flow. Pollutants can be carried with water through all phases of the water cycle.

THE WATER CYCLE



Water is in constant motion, continually recycling through the environment in a series of pathways called the water cycle. Precipitation, mostly in the form of rain or snow, falls on land, buildings and bodies of water. Precipitation can be temporarily stored in ponds, lakes and rivers, held by snow and vegetation, or stored as ice and snow.

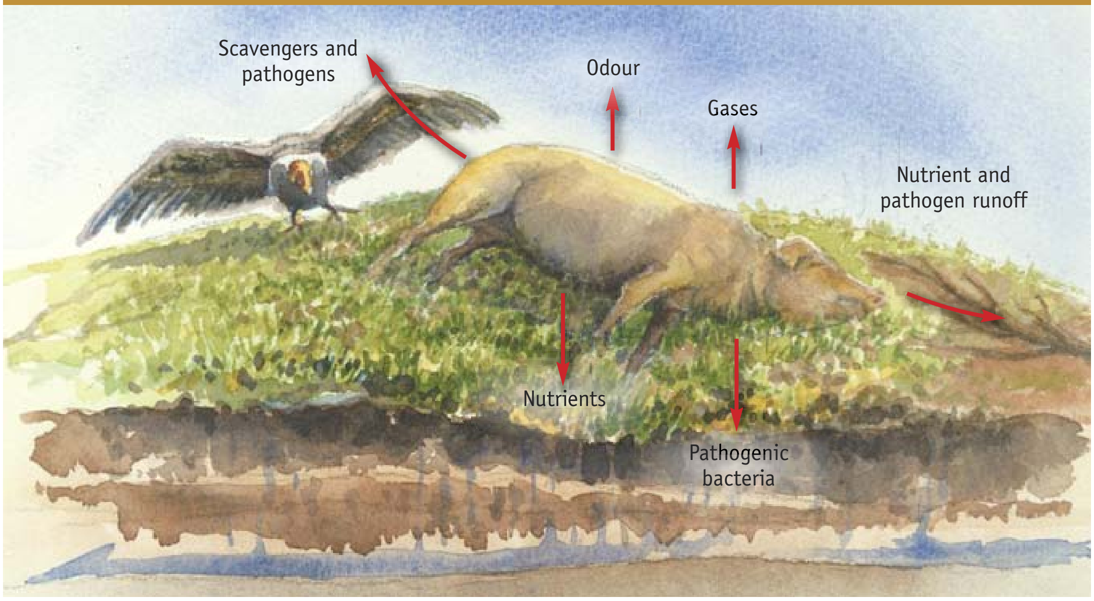
Some of the water falling on land and buildings flows overland as runoff to bodies of surface water (e.g., lakes and rivers). Some of the water that is held by soil or vegetation will infiltrate soil materials, to be stored as groundwater. Groundwater can then move to lakes, rivers, ponds, wetlands, wells, or to the soil surface. Groundwater flowing to the surface, or small surface-water bodies, form part of a larger surface-water system called a watershed. At the soil surface, water can be evaporated directly to the atmosphere, or transpired (evapotranspiration) when plants release moisture during rapid growth.

The amount of water in the soil under or near any disposal site depends on soil characteristics (properties and quality), length and degree of slope, temperature and weather conditions, and the condition of the soil or yard area near the deadstock disposal site.

The decomposition of deadstock releases pathogens, nutrients (in both mineral and organic form) and gases. If not controlled, these can be potential pollutants. They can move into surface water by being attached to sediment eroded from agricultural land, or dissolved in runoff. They can also infiltrate soil to contaminate groundwater.

Pathways to surface water and groundwater have to be identified and controlled. This is done by establishing physical barriers. Soil can be considered a physical barrier if conditions are right.

WATER CONTAMINATION



Improperly disposed deadstock can be a source of water contamination and greenhouse gases. Nutrients, organic debris, and pathogens can leach to groundwater or run off to surface waters. Exposed deadstock are a source of odours and greenhouse gases as they decompose.

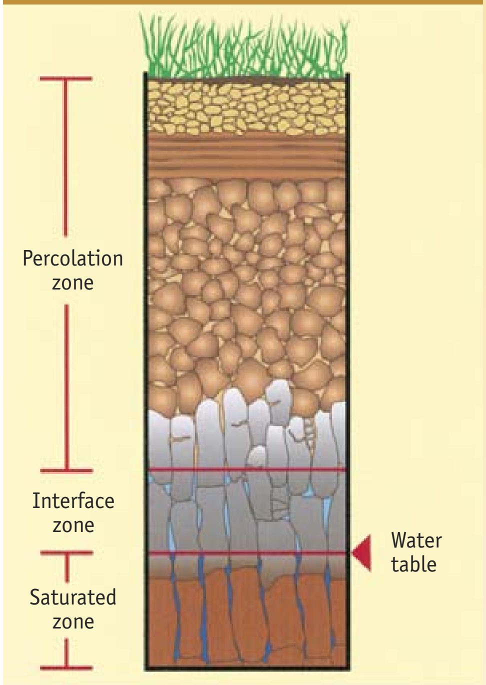
RISKS TO SURFACE WATER

When water falls on a bare soil in late spring, the majority evaporates. One-quarter runs off to ponds, watercourses, lakes and other depressional areas, and the remainder infiltrates the soil.

Most of the water falling on hard-top or compacted sites will run off.

Excessive runoff is of particular concern, since it can take soil, nutrients and bacteria from deadstock disposal sites with it.

SURFACE WATER TABLE ZONES



Water moves – or percolates – through soil pores and cracks to a saturation zone known as the water table.

RISKS TO GROUNDWATER

Site selection is important when planning a deadstock disposal site. The following factors can be significant in selecting sites.

SITE FEATURE	DESCRIPTION	SIGNIFICANCE
DEPTH TO BEDROCK	• soil depth to unfractured bedrock and bedrock-controlled aquifers	• shallow soils have less soil volume to treat potential organic materials below disposal sites • less depth means less distance to groundwater
DEPTH TO WATER TABLE	• depth of soil to zone of permanent saturation in soil • soils with an imperfect or poorly drained drainage classification experience high water tables (<1 m or 3.25 ft)	• filtering and treatment of contaminated water by natural processes primarily take place in soil above the water table in the unsaturated zone of soil • in a naturally occurring, high water table, water and contaminants have little time to move through unsaturated soil before reaching shallow aquifers
SOIL TEXTURE	• soil texture is the relative fineness or coarseness of the soil (e.g., sandy loam, clay, silty clay loam)	• the ease and speed with which water and contaminants can move through the soil to groundwater is partially dependent on soil texture • water moves quickly through coarse (sandy and gravelly) soils and slowly through fine (clayey) soils
POROSITY	• pores are the spaces between soil particles and clumps (peds) of soil	• soils with fine- and medium-sized pores retain more water and drain less • water moves quickly through soils with many large pores, cracks and tunnels – created by roots and soil fauna
SOIL LAYERS	• soils often contain layers of different textures, porosities and densities	• soils with layers of various-textured soils (known as "stratified") will slow the speed with which water moves downward through the soil profiles • in uniform soils, the water table will move up and down with the seasons • if a layer of soil occurring naturally or caused by cultivation restricts water movement, a perched water table may be present

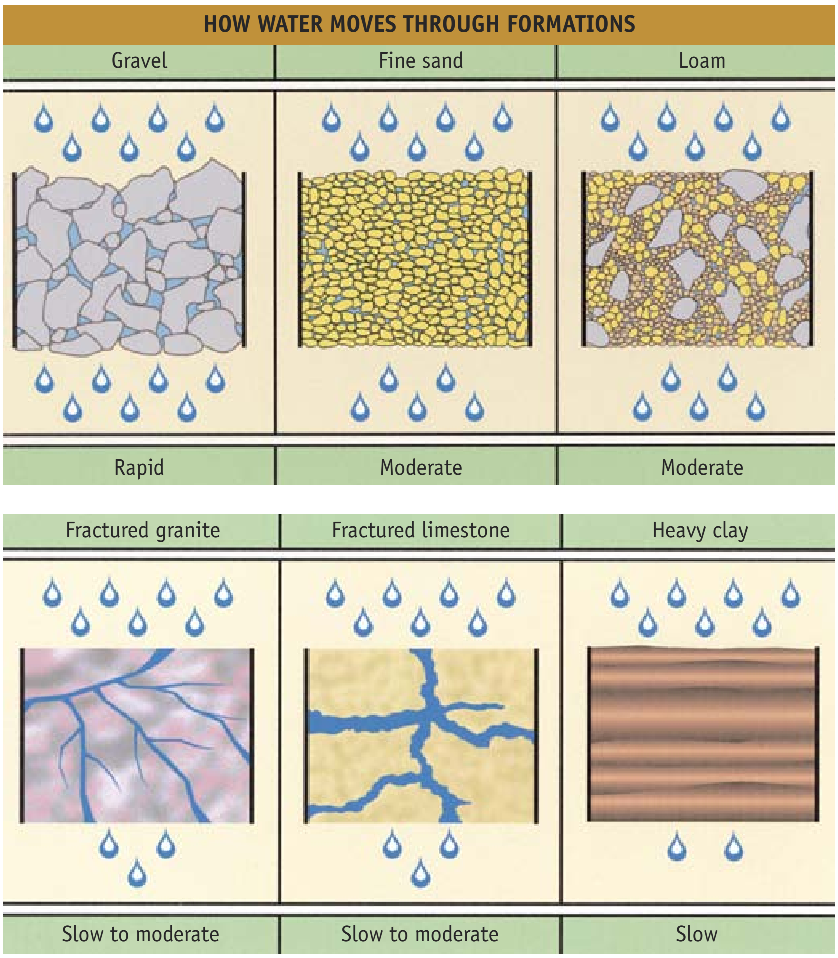
NUTRIENT LEACHING

Pathogens and nutrients in solution will move with soil water. Leaching occurs when these pathogens and nutrients (e.g., nitrates [NO_3^-]) move through soil pores and large cracks below the root zone. The amount of leaching is related to:

- **the concentration of pathogens and nutrients in the soil solution**
- **the overall supply of available nutrients in the soil**
- **soil texture – water moves quickly through sandy soils and cracked clay soils**
- **soil layering or stratification – this will slow the movement of water though the soil profile**
- **coarse fragments – soils with large volumes of stones and gravels are more prone to leaching**
- **soil depth to bedrock or water table – less soil depth means quicker travel time.**

Water percolates quickly through sands and gravels and very slowly through clays.

Most bedrock types are not impenetrable. Water moves through cracks and fissures to shallow water tables.



BURIAL AND DECOMPOSITION

The time required for buried deadstock to decompose depends on many factors:

- species and size
- air temperature and humidity
- soil type and texture
- drainage
- burial depth
- how many deadstock are packed in the hole.

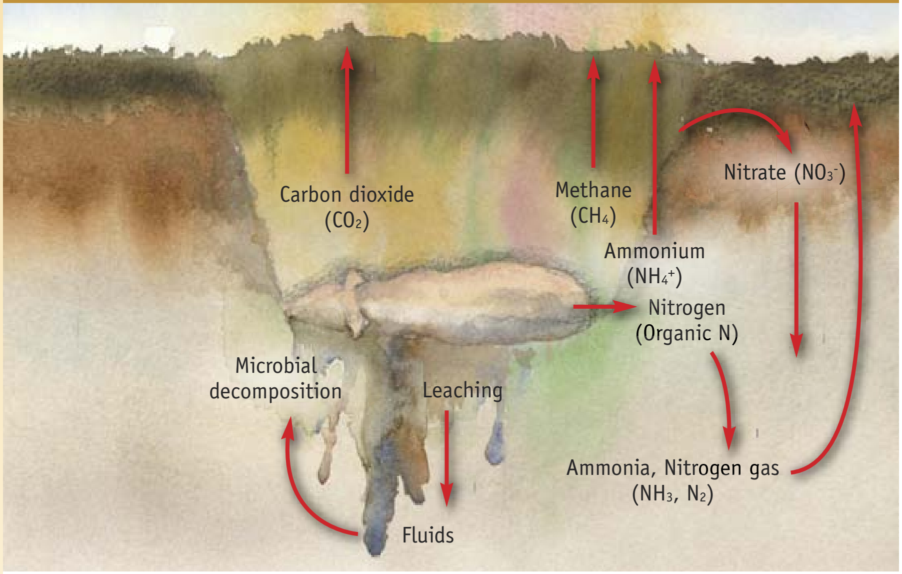
Deadstock left exposed on the soil surface can become skeletonized in two to four weeks during spring, summer or fall. However, deadstock buried 2 metres (6.5 ft) deep can take at least 10 years to reach the same state, depending on conditions.

Most pollutants such as nitrates are released during the earlier stages of decomposition, but very large mass burial sites could continue to release pollutants for many, many years. This is one reason it is important to limit the number of buried deadstock in one hole.

Buried deadstock are subjected to anaerobic and aerobic decomposition.

As previously noted, anaerobic decomposition (putrefaction) is a natural process involving decomposition of organic material by microbes in the absence of oxygen. This begins immediately after burial within soft tissues where fluid content limits the amount of available oxygen. Putrefaction is usually accompanied by objectionable odours of hydrogen sulphide and other reduced organic compounds that contain sulphur.

EARLY DECOMPOSITION – BURIAL SITES



Nutrient-rich body fluids escape during the early stages of decomposition. In the mid stages, buried deadstock are further decomposed by soil microbes, and assimilate into the microbes' living biomass.

Aerobic decomposition of tissue by soil fauna takes place in the presence of oxygen. Carcass tissues exposed to well-aerated soil surfaces will undergo aerobic decomposition, which should not create odours.

It's estimated about 50% of the total available fluid volume "leaks out" the first week following death and nearly all within the first two months. Fluids can leach from the site and pose a risk to surface water and groundwater – particularly on sites that are highly permeable, shallow to bedrock, or shallow to the soil water table.

Remaining fluids and carcass tissues are then subjected to decomposition by soil microflora and fauna. Microbial decomposers assimilate nutrients from tissues to form their body mass. Methane is released in soils with little oxygen available (anaerobic) and carbon dioxide in soils with lots of oxygen available (aerobic).

The fate of nitrogen released during decomposition is also affected by soil oxygen levels. Ammonium and ammonia are produced under both anaerobic and aerobic conditions. The amount that is then converted to nitrate, nitrous oxide, and nitrogen gas is dictated by changes in soil oxygen levels.

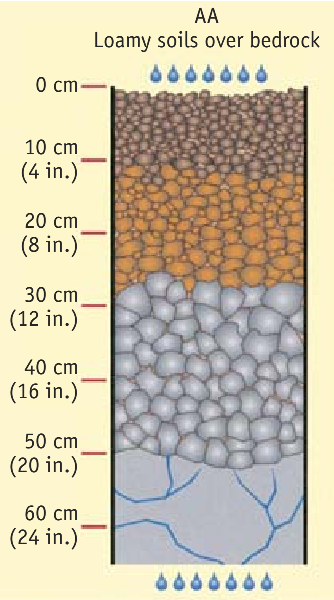
POTENTIAL ENVIRONMENTAL RISKS OF BURIAL

Groundwater Contamination

Nitrates from the later stages of decomposition could leach from burial sites. However, this risk is site-specific and is closely related to the amount of nitrate-nitrogen in the burial area and the speed at which water moves downward to the groundwater.

The potential risk of N-leaching increases on sites with:

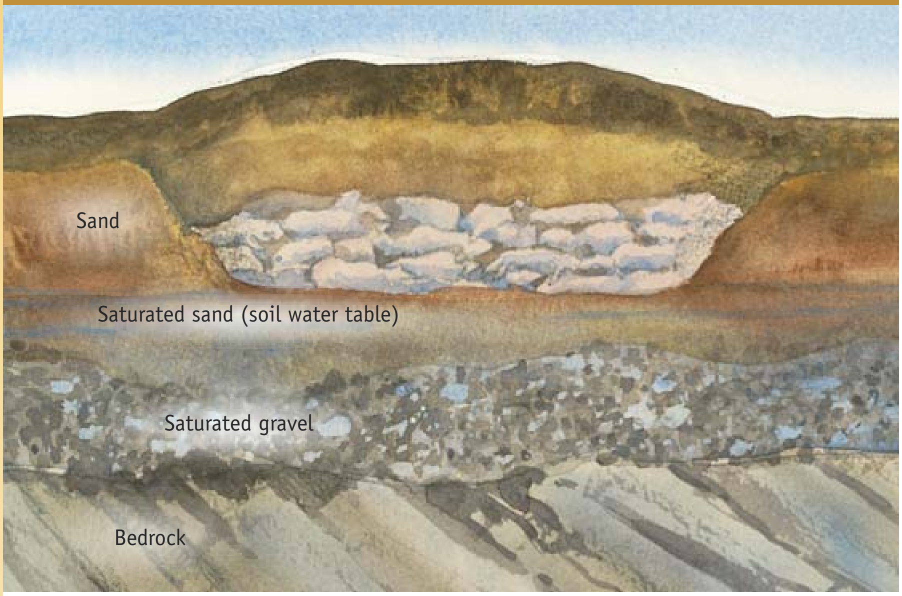
- ▶ shallow depths to bedrock
- ▶ shallow water tables or surface aquifers
- ▶ high sand and gravel content.



Sites such as this with bedrock or a water table close to the soil surface are unsuitable for burial.

The greatest risk for nitrate-nitrogen contamination is from sites with many deadstock buried in a small area, and with a shallow distance to bedrock or with a coarse-textured soil that has a permanent water table within 1 metre (3.25 ft) of the soil surface.

HIGH-RISK BURIAL SITE



Sites with the greatest potential risk are shallow to bedrock, and have large quantities of deadstock located in freely draining soils with shallow water tables.

ENVIRONMENTAL IMPACTS OF MASS BURIAL – THE U.K. EXPERIENCE

Considerable attention was paid to the potential environmental, human and animal health risk during and following the 2001 outbreak of foot-and-mouth disease (FMD) in the United Kingdom. The potential hazards associated with burials included body fluids, chemical and biological leachate components, and hazardous gases.

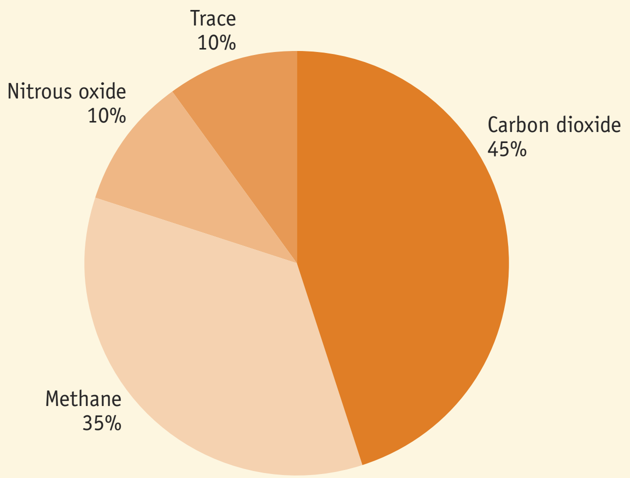
Precipitation amount and soil permeability are key to the rate at which contaminants leach from mass burial sites. Therefore the surrounding soils' natural ability to weaken or attenuate the decomposing materials is also key to reducing the risk to groundwater.

The U.K. experts found that the best soil type for maximizing natural attenuation properties was loam. Soil investigations revealed high levels of ammonia, total dissolved solids (TDS), biochemical oxygen demand (BOD), and chloride in a monitoring well closest to the burial site (within 0.6 m). Average ammonia and BOD concentrations were very high for 15 months following burial. Little evidence of contaminant migration was observed farther away. However, researchers cautioned that groundwater contamination could occur when large numbers of deadstock were buried in high-risk sites.

Greenhouse Gas (GHG) Release

Burial sites release two greenhouse gases of concern: methane and nitrous oxides.

GREENHOUSE GAS RELEASE FROM BURIAL SITES



There is limited research on GHG release from burial sites. One report estimated composition at about 45% carbon dioxide, 35% methane, and 10% nitrous oxide. Trace amounts of other gases (e.g., hydrogen sulphide) comprise the remainder.

TSE = transmissible spongiform encephalopathy
BSE = bovine spongiform encephalopathy
CWD = chronic wasting disease

Pathogen Contamination

Risks from microbiological contaminants are believed to be minimal as these organisms generally have short lifespans and/or are filtered by soil or aquifer material. However, the presence of preferential pathways, such as cracks in the soil, may increase the risks.

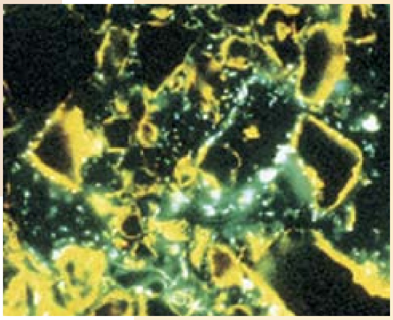
PATHOGEN SURVIVAL

A pathogen is any virus, bacterium, or protozoa capable of causing infection or disease in other animals or humans. Pathogens range from bacteria such as salmonella and E. coli, to protozoa such as Cryptosporidium parvum and Giardia.

Most livestock viruses are not passed to humans. With the exception of prions, few pathogens survive more than a few days when outside a livestock host and in the natural, aerobic environment, such as the earth's surface. Prions, the reported causative agent of TSEs (BSE, scrapie, CWD) are very stable and can remain infectious for an extended period of time outside the body.

Soil is good at trapping bacteria and other organisms, filtering out most protozoa and bacteria. Soils with high organic matter and clay content are more effective at filtering viruses.

However, pathogens can bypass soil filters by following macropore flow or preferential flow to shallow aquifers, or through tile drainage systems.



FACTORS AFFECTING PATHOGEN SURVIVAL			
FACTOR	**IMPACT**	**SOIL SURFACE**	**IN BURIAL PIT**
TEMPERATURE	• high temperatures denature pathogen tissues	• high temperatures at soil surface during growing season	• few temperature fluctuations in pit; moderate conditions may allow survival
FREEZING + FREEZE-THAW CYCLE	• this causes cell membrane fracture plus desiccation	• freeze-thaw conditions prevail beyond growing season	• pit depth could be below frost line
EXPOSURE TO DRY CONDITIONS	• this causes cell membrane fracture plus desiccation	• dry conditions experienced throughout growing season	• subsoils may be moist and humid most of the time
pH	• pH extremes cause desiccation from salt effect	• surface soils often have neutral pH	• acidic or basic conditions found in certain parent materials could reduce survival
OXYGEN LEVELS	• most pathogens require partially aerobic conditions	• surface conditions are most often aerobic	• subsurface conditions highly variable ○ well-drained, sandy soils are mostly aerobic ○ poorly drained clays are often anaerobic at depth

DISPOSAL VESSELS AND DECOMPOSITION

The time required for deadstock to decompose within a disposal vessel depends on many factors:

- ► species and size of carcass
- ► air temperature and humidity
- ► vessel depth
- ► how many carcasses were added at one time.

Decomposition of deadstock inside a disposal vessel is not much different than if they were left exposed on the soil surface. Skeletonization would occur in two to four weeks during spring, summer or fall. The major improvement, though, is that four-legged scavengers cannot get at the deadstock, and any body fluids released during the early stages are unable to leach into surrounding soil or groundwater.

Like carcasses buried in soil, carcasses in disposal vessels are also subjected to aerobic and anaerobic decomposition.

Anaerobic decomposition (putrefaction) is a natural process involving decomposition of organic material by microbes in the absence of oxygen. In vessels, this can occur if many deadstock are added at one time, or if very large carcasses are added that limit the availability of oxygen for carcasses deeper within the pile.

Aerobic decomposition of tissue takes place in the presence of oxygen. Carcass tissues exposed on top of the pile in the vessel to aerobic conditions should not create odours.

As with soil burial, it's estimated about 50% of the total available fluid volume leaks out the first week following death and nearly all within the first two months. Because these fluids remain in the vessel, most evaporate over time and research has shown the remaining mass of material becomes very dry and dense.

Remaining carcass tissues are then subjected to decomposition by a vast array of beetles and insects such as blowflies. Research has also shown a tremendous amount of heat is released during the decomposition process.

Deadstock become skeletonized in a short period under the right conditions inside a disposal vessel.

POTENTIAL ENVIRONMENTAL RISKS

Groundwater Contamination

There is little risk of groundwater contamination from disposal vessels if they are installed correctly, because leachate is fully contained. Steel vessels will deteriorate over time, but by the time this occurs, the vessel has long since been decommissioned and its contents will become essentially biologically inactive.

During Ontario research, a tile drain was installed near the base of one disposal vessel to demonstrate the vessel was leakproof. It drained water very seldomly over the five-year project. Sampling demonstrated the drained water contained no contaminants.

Greenhouse Gas (GHG) Release

Although there is no known research on GHG released from disposal vessels, it is likely that methane and nitrous oxides are released during decomposition.

Pathogen Contamination

Risks from microbiological contaminants are believed to be minimal as these organisms generally have short lifespans and are contained within the vessel.

Insect Movement

Insects, larvae and beetles can and do both enter and leave disposal vessels. There is a risk that the increase in fleshfly populations may increase the likelihood of fly-strike (myiasis) for surrounding livestock. However, this risk is considered minimal – especially with the new regulation's required setbacks from neighbouring livestock operations.

COMPOSTING AND DECOMPOSITION

Composting is a form of managed aerobic decomposition similar to the natural process that occurs near the surface of a forest floor. When managed properly, it's nearly odourless and risk-free.

Composting is a managed biological procedure that controls the environmental conditions and therefore the rate of aerobic decomposition.

Improperly constructed, uncovered and otherwise poorly managed compost piles may experience unfavourable anaerobic conditions.

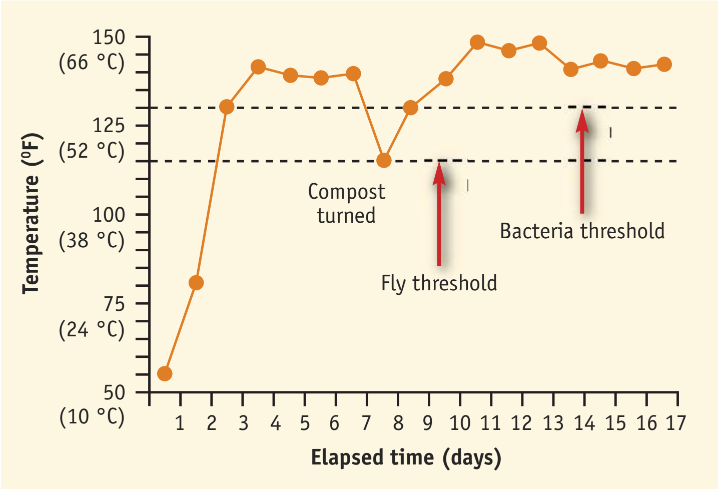
In aerobic decomposition, living organisms (which use oxygen) feed upon the organic matter. They use the nitrogen, phosphorus, some of the carbon, and other required nutrients. Much of the carbon serves as a source of energy for the organisms and is burned up and respired as carbon dioxide (CO_2). Since carbon serves both as a source of energy and as an element in the cell protoplasm, much more carbon than nitrogen is needed. Generally about two-thirds of carbon is respired as CO_2, while the other third is combined with nitrogen in the living cells.

If the excess of carbon over nitrogen (C:N ratio) in organic materials being decomposed is too great, biological activity diminishes. Several cycles of organisms are then required to burn most of the carbon.

When organisms die, their stored nitrogen and carbon become available to other organisms. Other organisms use the nitrogen from the dead cells to form new cell material, once more excess carbon is converted to CO_2. Thus, the amount of carbon is reduced and the limited amount of nitrogen is recycled.

Finally, when the ratio of available carbon to available nitrogen is in sufficient balance, nitrogen is released as ammonia. Under favourable conditions, some ammonia may be converted to nitrate. Phosphorus, potash, and various micronutrients are also essential for biological growth. These are normally present in more than adequate amounts in compostable materials and present no problem.

Initially, mesophilic organisms, which live in temperatures 20–46 °C (68–115 °F), colonize in the materials. When the temperatures exceed approximately 49 °C (120 °F), thermophilic organisms, which grow and thrive in the temperature range of 46–71 °C (115–160 °F), may flourish and replace the mesophilic bacteria in the decomposition material. Only a few groups of thermophiles carry on any activity above 71 °C (160 °F).



Oxidation at thermophilic temperatures takes place more rapidly than at mesophilic temperatures and, hence, a shorter time is required for decomposition (stabilization). The high temperatures will destroy pathogenic bacteria, protozoa (microscopic one-celled animals), and weed seeds.

Aerobic oxidation of organic matter produces no objectionable odour. If odours are noticeable, either the process is not entirely aerobic or some special conditions or materials are present that are creating an odour. Aerobic decomposition or composting can be accomplished in pits, bins, stacks or piles, if adequate oxygen is provided. Turning the material at intervals or other techniques for adding oxygen are useful in maintaining aerobic conditions.

Compost piles under aerobic conditions attain a temperature of 60–71 °C (140–160 °F) in one to five days depending on the material and the condition of the composting operation. This temperature can also be maintained for several days before further aeration. In time, the material will become anaerobic unless it is aerated by turning.

In contrast to aerobic decomposition, heat is not produced under anaerobic conditions. The lack of heat generated in the anaerobic destruction of organic matter is a disadvantage if contaminated materials are used.

High temperature is an important factor in the destruction of pathogens and parasites.

In anaerobic decomposition, the pathogenic organisms do eventually disappear in the organic mass, as a result of the unfavourable environment and biological antagonisms. The disappearance is slow, and the material must be held for periods of six months to a year to ensure relatively complete destruction of pathogens.

Contaminated water (leachate/ wastewater) is any water that has come into contact with composting areas.

POTENTIAL ENVIRONMENTAL RISKS

Groundwater and Surface Water

Compost leachate contains:

- organic carbon
- organic nitrogen
- nitrates and ammonia
- phosphates
- miscellaneous other nutrients and salts – potassium, magnesium, chlorides, etc.

Clean rainfall from outside the composting area needs to be excluded so that it does not flow through the area and become contaminated. All runoff from within the operational areas needs to be collected and managed as it is likely to be contaminated with debris, nutrients and possibly pathogens.

The composting process may generate leachate that can pollute surface water, stormwater and groundwater if not managed effectively. All activities involving receiving, processing, composting and storing the final product should be conducted on a paved or compacted area (e.g., compacted quarry rubble, concrete or asphalt) capable of withstanding heavy equipment.

The pad needs to be designed and constructed to ensure that leachate flows to a low point for collection and subsequent storage, treatment, disposal or reapplication onto compost piles or windrows. Suitable collection devices include concrete sumps, while suitable storage, treatment and disposal facilities include appropriately sized tanks or lagoons.

Greenhouse Gas

Composting stabilizes carbon and nitrogen, but how much ammonia and carbon dioxide are lost during this process?

In theory, more aeration will lead to aerobic decomposition and CO_2 production, rather than methane. However, poorly managed composting processes result in increased methane and ammonia generation. It has been documented that during the composting process, ammonia and methane are emitted at the initial phases and nitrous oxides during the mid-phases.

Adherence to composting guidelines will ensure proper moisture levels, aeration and temperatures – which will make for more effective composting and a net-positive scenario for greenhouse gas emissions, as methane is more harmful than CO_2.

Follow composting guidelines to ensure proper moisture levels, aeration and temperatures. This will lead to more effective composting and a net-positive scenario for GHG-emissions, as methane is more harmful than CO_2.

Pathogen Risks

During active composting (first phase), pathogenic bacteria are inactivated by high thermophilic temperatures, with inactivation a function of both temperature and length of exposure.

The heat generated during carcass composting results in some microbial destruction. However, it may not be sufficient (in terms of temperature and exposure) to completely sterilize the end product. This means some potential exists for survival and growth of pathogens. The levels of pathogenic bacteria remaining in the end product depend on the heating processes of the first and second phases, and also on cross-contamination or decontamination of the end product.

In order to maximize pathogen destruction, it's important to have uniform airflow and temperature throughout the compost pile. Because deadstock compost is an inconsistent, non-uniform mixture, pathogen survival may vary within different areas of the compost.

Temperature uniformity is facilitated by proper aeration, and reduces the probability of microbes escaping the high temperature zone. In spite of non-uniform temperatures, pathogenic bacterial activity is reduced when the temperature in the middle of the pile reaches 65 °C (149 °F) within one to two days. That is, a high core temperature provides more confidence for the deadstock composting pasteurization process.

Achieving an average temperature of 55–60 °C (131–140 °F) for a day or two is generally sufficient to reduce pathogenic viruses, bacteria, protozoa (including cysts), and helminth ova to an acceptably low level. It is important to note that under no composting conditions are temperatures reached that inactivate prions. Nor will these conditions inactivate the endospores produced by spore-forming bacteria.

In this context, pasteurization refers to managed heating of the decomposing carcass by microbes.

Endospores are highly resistant bacterial cells formed when an organism is under stress.

INCINERATION

Incineration refers to fuel-assisted cremation of deadstock. Specially designed on-farm incineration units use fuel, temperature controls and enclosed environments to reach high temperatures and secondary combustion (afterburner on flue) – to reduce gaseous emissions.

Open-air burning includes burning deadstock in open fields or on combustible heaps called pyres.

POTENTIAL ENVIRONMENTAL RISKS

It's generally accepted that large-scale open-air burning pollutes. Large deadstock-burning pyres can release toxic gases, carcinogens and particulate matter. For this reason, open-air burning is not permitted.

Properly operated fixed-facility incineration units pose fewer pollution concerns. Properly operated afterburner-equipped incinerators should not pose serious problems for the environment.

The regulation for deadstock disposal under the Nutrient Management Act, 2002 requires that an operator must not use an incinerator to incinerate deadstock unless the incinerator is a type that has been issued a Verification Certificate by Environmental Technology Verification (ETV) Canada Incorporated. The incinerator must have a secondary chamber capable of maintaining the gases that enter it from the primary chamber for at least 1 second at a temperature of 1,000 °C (1,832 °F) or higher, or at least 2 seconds at a temperature of 850 °C (1,562 °F) or higher.

DISEASE AGENT CONSIDERATIONS

Regardless of incineration method used, bacteria (including spore-formers), and viruses should not survive incineration. There has, however, been much speculation that open-air burning can help spread the foot-and-mouth (FMD) virus. Several studies have examined this question, and while the theoretical possibility cannot be eliminated, there is no such evidence.

Prions, the disease agents responsible for TSEs (e.g., scrapie, BSE, and CWD) are highly durable.

RENDERING

The process of rendering deadstock reduces the carcasses to meat and bonemeal (proteinaceous solids), tallow, and water. The recycling and processing services of renderers reduce the massive problems of disposal from farms/feedlots, slaughterhouses, food processors, restaurants, and institutions.

The rendering process is accomplished by eight steps.

Step 1

Remove undesirable parts

↓

Step 2

Cook and separate fat and protein materials

↓

Step 3

Dry and grind the concentrated protein

↓

Step 4

Treat to refine gases, odours, and wastewater

↓

Step 5

Separate the three end-product portions (proteinaceous solids, melted fat, and water)

↓

Step 6

Dry the proteinaceous solids to be used as an animal feed if permitted

↓

Step 7

Discharge the water as sludge

↓

Step 8

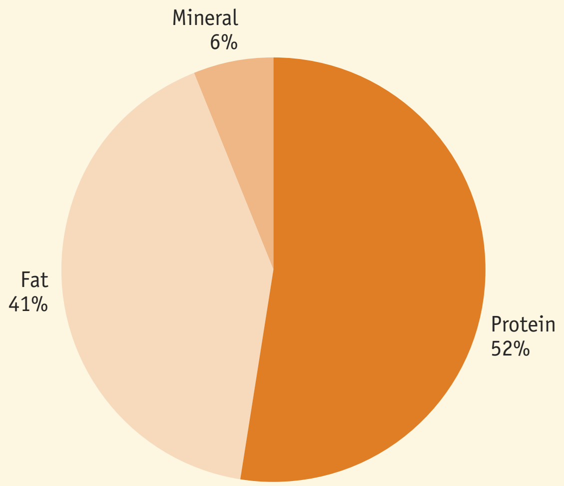
Store fats for refining

Fresher carcasses make better by-products because of less deterioration.

The use of carcasses in advanced stages of decomposition is undesirable because hide removal and carcass cleaning are very difficult. As well, the fat and protein resulting from such carcasses is generally of low quality.

If prohibited for animal feed use, the product will be classified as inedible and may only be used as a fertilizer. Tallow can be used in livestock feed and production of fatty acids, and can be manufactured into soaps.

FRESH CARCASS COMPOSITION – 32% DRY MATTER



A typical fresh carcass contains approximately 32% dry matter, of which approximately 52% is protein, 41% is fat, and 6% is mineral. Rendering provides a hygienic means of disposing of deadstock if proper processing conditions are adhered to. The end products have economic value and can be stored for long periods of time.

PLANNING

THIS CHAPTER WILL WALK YOU THROUGH THE PLANNING PROCESS, WHICH INCLUDES:

- **estimating mortalities in your operation**
- **selecting the most suitable methods based on your site and needs**
- **following protocols and keeping records.**

Most livestock producers would like to have a 0% mortality rate. But the reality is that animals die, and advance planning for dealing with deadstock is your best option. In terms of planning for catastrophes, thought should be given to how to handle mass disposal.

To get started, break the planning process into seven steps.

1. Estimate numbers and weights of deadstock, based on history and industry standards.
2. Examine the management options. Consider species, site suitability and costs.
3. Select the most suitable method.
4. Conduct a detailed site investigation – including soils and separation distances.
5. Implement the method.
6. Follow protocols for removal and biosecurity.
7. Keep records.

Make sure everyone involved in your farm operation is aware of your plan of action.

Having an estimate of expected deadstock allows for the next stages of planning.

STEP 1 ESTIMATE NUMBERS AND WEIGHTS OF DEADSTOCK

The estimation of the number and weight of deadstock for different livestock operations is difficult. Some factors affecting mortality include:

- ► management skills and practices
- ► breed
- ► disease resistance
- ► birthing ease.

The following chart was compiled from industry standards for various livestock operations in Ontario, and can be used for estimation purposes. Estimates can also be made from previous farm records if available.

The number and weight of an operation's deadstock are largely related to breed characteristics and management practices.

OPERATIONS AND SIZES[a c]	NUMBER IN HERD OR FLOCK	WEIGHT RANGE (kg)	AVERAGE[b] WEIGHT (kg)	NUMBER OF DEAD PER YEAR	CARCASS WEIGHTS (kg)	TOTAL DEAD/YEAR TOTAL CARCASS WEIGHT/YEAR TOTAL KG/UNIT/YEAR (or per animal placement)
100 BEEF COW–CALF						**13 dead/year**
COWS, PLUS 4% BULLS	104	500–770	590	3	1,770	**3,050 kg/year**
STILLBORN TO WEEK-OLD CALVES		40	40	4	160	**30.5 kg/beef cow/year**
CALVES (week-old to 7 months)	90	40–260	113	4	453	
REPLACEMENT HEIFERS (7 months to fresh)	15	250–500	333	2	667	
Example totals and kg/unit/year/placement calculations >>>>				13 dead/ year	3,050 kg/ year	3,050 kg deadstock/year ÷ 100 cows = 30.50 kg/beef cow/year
1,000 BEEF FEEDERS (1 cycle/year) – 2% DEATH LOSS						**20 dead/year** **7,253 kg/year**
FEEDERS PLACED/CYCLE (7 to 16 months)	1,000	260–568	363	20	7,253	**7.25 kg/beef feeder/year**
100 DAIRY COWS (large-frame Holsteins)						**14 dead/year** **2,786 kg/year**
MILKING-AGE COWS	100	522–860	635	3	1,904	**27.86 kg/dairy cow/year**
CALVES (week-old to 5 months)	20	45–182	91	3	272	
STILLBORN TO WEEK-OLD CALVES		45	45	7	315	
HEIFERS (5 months to fresh)	80	182–522	295	1	295	
100 DAIRY GOAT DOES						**20 dead/year**
MILKING-AGE DOES, PLUS 4% BUCKS	104	60–70	63	4	253	**458 kg/year**
KIDS BORN/YEAR (includes stillborns)	175	5–25	12	15	175	**4.58 kg/dairy goat doe/year**
REPLACEMENT DOELINGS (2 months to fresh)	13	14–60	29	1	29	
100 RIDING HORSES						**4 dead/year**
MEDIUM-FRAMED (1 to 10 years; 50% mares)	100	364–635	454	2	910	**1,260 kg/year** **12.61/riding horse/year**
COLTS/FILLIES (birth to 12 months)	20	82–364	176	2	350	
1,000 BREEDING FEMALE MINK (not including pelting losses)						**399 dead/year** **321 kg/year**
BREEDING FEMALES, PLUS 20% MALES	1,200	1.6–2.2	1.8	24	43	**0.32 kg/breeding female mink/year**
KITS/YEAR (5 born/litter)	5,000	0.01–2.2	0.74	375	278	
100 BREEDING RABBITS (does)						**678 dead/year**
BREEDING DOES, PLUS 5% MALES	105	4.0–5.4	4.5	5	22	**523 kg/year**
REPLACEMENTS – 30% (12 to 22 weeks)	32	2.3–5.4	3.33	1	3	**5.23 kg/breeding doe/year**
KITS/YEAR (8/litter x 7 litter/yr x 80% conception)	4,480	0.01–2.2	0.74	672	497	
100,000 CHICKEN BROILERS (6 cycles/year)[d] – 4% DEATH LOSS						**24,000 dead/year** **18,240 kg/year**
BROILERS PLACED/40-day growing cycle	100,000	0.04–2.2	0.76	24,000	18,240	**0.03 kg/chicken broiler/year**
10,000 BROILER-BREEDER HENS						**900 dead/year**
HENS	10,000	2.2–3.5	2.63	800	2107	**2,457 kg/year**
ROOSTERS (10% of hens)[e]	1,000	2.8–4.9	3.50	100	350	**0.25 kg/broiler-breeder hen/year**

OPERATIONS AND SIZES[a c]	NUMBER IN HERD OR FLOCK	WEIGHT RANGE (kg)	AVERAGE[b] WEIGHT (kg)	NUMBER OF DEAD PER YEAR	CARCASS WEIGHTS (kg)	TOTAL DEAD/YEAR TOTAL CARCASS WEIGHT/YEAR TOTAL KG/UNIT/YEAR (or per animal placement)
10,000 LAYER HENS **(not including spent hens, end of cycle)**	10,000	1.3–1.7	1.43	550	788	**550 dead/year** **788 kg/year** **0.08 kg/layer hen/year**
10,000 TURKEY HENS (4 cycles/year) – 6% DEATH LOSS						**2,400 dead/year** **6,392 kg/year** **0.16 kg/turkey hen/year**
HENS PLACED/CYCLE (day-old to market)	10,000	0.06–7.87	2.66	2,400	6,392	
10,000 TURKEY TOMS (3 cycles/year) – 10% DEATH LOSS						**3,000 dead/year** **14,920 kg/year** **0.50 kg/turkey tom/year**
TOMS PLACED/CYCLE (day-old to market)	10,000	0.06–14.8	4.97	3,000	14,920	
1,000 SOW SEGREGATED EARLY WEANING (SEW)						**4,412 dead/year** **22,602 kg/year** **22.60 kg/sow/year**
SOWS AND GILTS	1,000	136–227	166	72	11,976	
BORN/YEAR (12 born/litter; 2.3 litters/sow)	27,600	1.1–5.5	2.6	4,140	10,626	
1,000 SEW WEANERS (6.5 cycles/year) – 2.3% DEATH LOSS						**150 dead/year** **1,875 kg dead/year** **0.29 kg/weaner space/year**
WEANERS PLACED/CYCLE	1,000	5.5–26.5	12.5	150	1,875	
Example totals and kg/unit/year/placement calculations >>>>				150 dead /year	1,875 kg/ year	1,875 kg dead/year ÷ (1000 x 6.5 cycles) = 0.29 kg/weaner space/year
1,000 GROWER–FINISHERS (3 cycles/year) – 2% DEATH LOSS						**60 dead/year** **3,460 kg/year** **1.15 kg/grower-finisher/year**
GROWER–FINISHERS PLACED/CYCLE	1,000	26.5–120	58	60	3,460	
100 MEAT EWES						**25 dead/year** **700 kg/year** **7.00 meat ewe/year**
EWES, PLUS 4% RAMS, AND REPLACEMENTS	120	69–100	79	5	397	
LAMBS BORN/YEAR (includes stillborns)	175	5–25	12	17	198	
FEEDER LAMBS (born over the year)	140	25–55	35	3	105	
1,000 GRAIN-FED VEAL CALVES (1 cycle/year) – 7% DEATH LOSS						**70 dead/year** **9,403 kg/year** **9.40 kg/grain-fed veal calf/year**
CALVES PLACED/CYCLE (week-old to market)	1,000	45–313	134	70	9,403	
1,000 MILK-FED VEAL CALVES (2.5 cycles/year) – 4% DEATH LOSS						**100 dead/year** **10,167 kg/year** **4.07 kg/milk-fed veal calf/year**
CALVES PLACED/CYCLE (week-old to market)	1,000	45–215	102	100	10,167	

a: For operations with more than one cycle/year, death losses appear high (e.g., 100,000 chicken broilers × 6 cycles/year × 4% mortality rate = 24,000 dead/year).
b: Average weights are used as in NMAN software, and are skewed toward the smaller weights in the range.
c: Some operation sizes may seem too small or too large, but they are in multiples of 10 so it is easier to scale up/down.
d: Includes industry standard "2% extra" day-olds delivered to farm.
e: Does not include spiking with new roosters when older ones are shipped/euthanized because of breeding problems.

Deadstock can be composted effectively with minimal capital and operating costs.

STEP 2 EXAMINE THE OPTIONS

There are several BMP methods for deadstock disposal. In most cases, livestock operations use more than one method.

Consider the following criteria when exploring options:

- species suitability
- site limitations
- capital costs
- operating costs.

INCINERATION

- Neighbours live more than 100 metres (330 ft) from the candidate site. Smoke and odours should not be a nuisance to these neighbours.
- Carcasses are smaller than 200 kg (440 lb).
- Farmer has an incinerator that meets the regulation requirements and that has a Verification Certificate by Environmental Technology Verification (ETV) Canada.

Burial of dead farm animals is a common and legal practice, but it is not risk-free.

BURIAL

- Soil conditions are suitable – dry, well-drained, medium-fine materials.
- Site is far enough from production facilities, wells, tile drains, surface water, and neighbours.
- Farmer has access to backhoe or other earth-moving equipment.

COMPOSTING

- Site is suitable – proper soil, separation distances.
- Effective substrate is available – e.g., sawdust, wood chips.
- Necessary equipment is at hand – substrate chopper, loader, turning equipment etc.
- Labour is available to process carcasses and turn compost.
- Solid manure spreader is available to land-apply compost.
- Land is available for spreading finished compost.

COLLECTION

- Collection service is available.
- Biosecurity concerns are identified and addressed.
- Storage and collection areas are properly sited and screened from public view.

DISPOSAL VESSELS

- ▶ Soil conditions are suitable – deep, no shallow water table, no shallow bedrock.
- ▶ Site is far enough away from production facilities, wells, tile drains, surface water, and neighbours.
- ▶ Land is available and accessible year round.
- ▶ The vessel is suitable, low-cost, and liquid-tight – designed to withstand external soil pressures if necessary.

STEP 3 SELECT THE MOST SUITABLE METHOD

Once you have a firm estimate of expected mortalities and have considered the options, it's time to select one, or more, disposal options that suit your operation and site conditions.

First, look at the costs of disposal methods that otherwise fit a specific situation. Factors that influence costs are the total weight of deadstock, management, site layout, and size of the production unit.

Logistics will influence your choice – including location of production facilities, soil type, topography, amount of labour available, and access to equipment.

The estimated cost of alternative disposal methods for your operation, environmental risks and management preferences are important considerations. For more details, read the chapters on each BMP option further on in this book.

STEP 4 CONDUCT A DETAILED SITE INVESTIGATION

You can prevent deadstock management problems with proper siting.

Choosing sites as far from residences and public lands as possible can prevent nuisance challenges from odour and flies.

For soil-dependent BMPs such as burial, choose sites that pose minimal risk to groundwater contamination.

Site selection is a two-step process of picking the right location and selecting the right site.

The chart on the next page outlines the legally required setbacks for each disposal option.

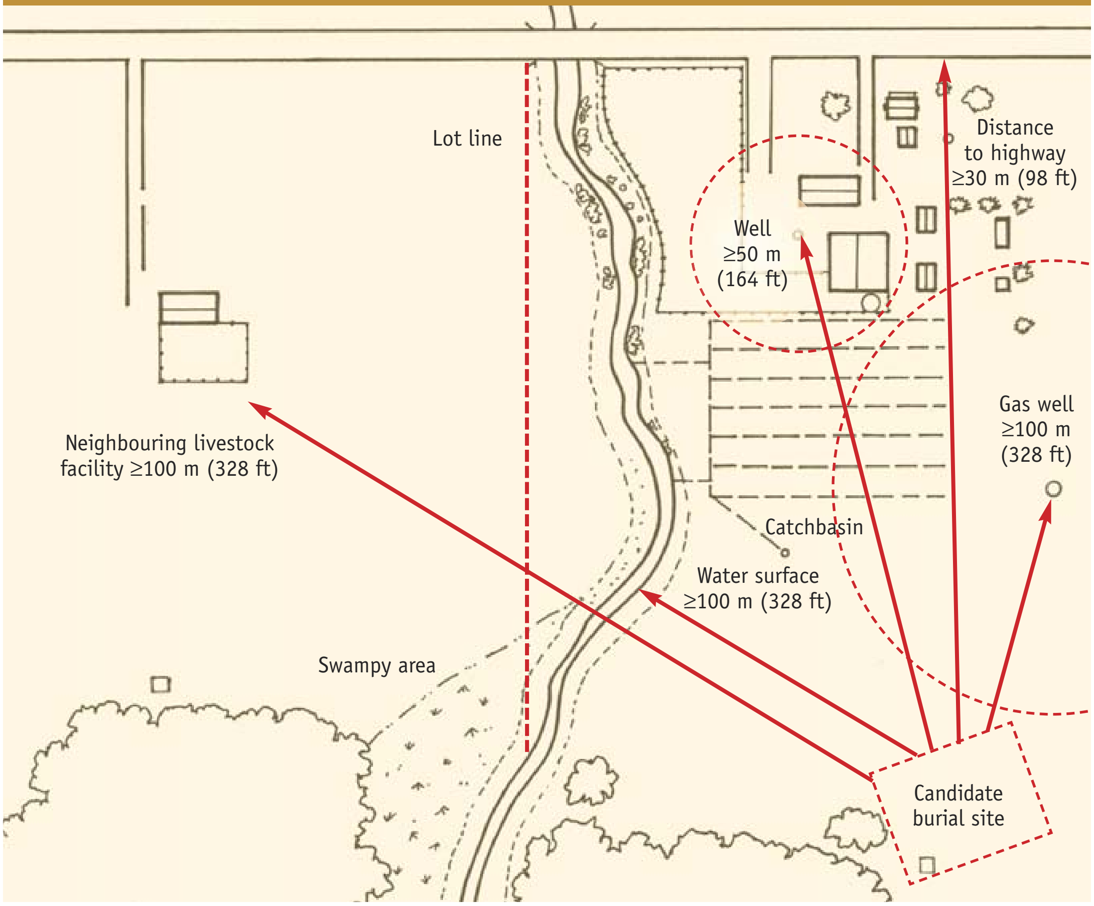
You should create a strategy of where and how deadstock will be disposed of on your farm over time.

DISPOSAL SITES MUST BE SET BACK FROM FEATURES BELOW		MINIMUM SETBACK DISTANCES FOR DEADSTOCK DISPOSAL OPTIONS			
		BURIAL PIT	**DISPOSAL VESSEL**	**COMPOSTING**	**INCINERATOR**
FEATURES ALONG WHICH SETBACK **LINES** CAN BE DRAWN	1. Highway	30 m (98 ft)	30 m (98 ft)	30 m (98 ft)	30 m (98 ft)
	2. Lot line of land on which the disposal site is located	15 m (49 ft)	15 m (49 ft)	15 m (49 ft)	15 m (49 ft)
	3. Flow path to the top of the bank of the nearest surface water or tile inlet	100 m (328 ft)	100 m (328 ft)	50 m (164 ft)	No restriction
	4. Field drainage tile	6 m (20 ft)	15 m (49 ft)	6 m (20 ft)	No restriction
	5. Lot line of land that has an industrial or parkland use	100 m (328 ft)	100 m (328 ft)	100 m (328 ft)	100 m (328 ft)
	6. Lot line of land in a residential area, or from land that has a commercial, community, or institutional use	200 m (656 ft)	200 m (656 ft)	200 m (656 ft)	200 m (656 ft)
POINT FEATURES AROUND WHICH SETBACK **CIRCLES** CAN BE DRAWN	7. Every part of a municipal well	250 m (820 ft)	250 m (820 ft)	100 m (328 ft)	No restriction
	8. Every part of a drilled well with depth at least 15 m (49 ft) and watertight casing to depth at least 6 m (20 ft)	50 m (164 ft)	50 m (164 ft)	15 m (49 ft)	No restriction
	9. Every part of any other well (e.g., gas well, other types of water wells)	100 m (328 ft)	100 m (328 ft)	30 m (328 ft)	No restriction
	10. Every livestock housing facility, outdoor confinement area, and residential structure located on land not part of the land on which disposal site is located (includes any neighbour's house)	100 m (328 ft)	100 m (328 ft)	100 m (328 ft)	100 m (328 ft)
	11. Every point of another similar disposal site on the same registered parcel of land (e.g., burial site to another burial site, or disposal vessel to another disposal vessel, or composting site to another composting site)	60 m (197 ft) when the other burial pit is open or has been closed for less than 10 years	15 m (49 ft)	100 m (328 ft) except if composting takes place in a fully enclosed structure with: concrete floor; no more than three composting sites in the structure; and each of the composting sites is at least 0.5 m (1.6 ft) apart	No restriction
FEATURES ALONG WHICH SETBACK **FREEHAND** LINES CAN BE DRAWN	12. Lowest point of disposal site above the top of the uppermost identified bedrock layer or aquifer	0.9 m (3 ft) from bottom of burial pit	0.9 m (3 ft) if vessel is fully or partially buried; if vessel is above or on surface of ground, see regulation	0.9 m (3 ft)	No restriction
	13. Areas subject to flooding once or more every 100 years	Not acceptable	Not acceptable	Not acceptable	No restriction
	14. Organic soil, or soil that is hydrologic soil group AA and/or A	Not acceptable on organic and AA soils	No restriction	Not acceptable on organic, AA or A soils (unless placed on an impervious pad)	No restriction

PICKING THE RIGHT LOCATION

Picking the right location is easiest by first eliminating areas **not** suitable.

MINIMUM SETBACKS FOR BURIAL SITES



Here are steps for locating suitable burial sites based on the table on page 32.

1. **Obtain aerial photo of farm, to a scale at least 1:5,000 if possible (1 mm = 5 m).**
2. **Using a ruler, draw LINES on photo away from features in lines 1 to 6.**
3. **Using a compass, draw CIRCLES on photo away from features in lines 7 to 11.**
4. **Draw FREEHAND lines on photo around burial exclusion areas you have identified in lines 12 to 14.**
5. **Locate a spot(s) on the map where future burial(s) might be located that makes sense both from a legislative and practical access point of view.**

The site suitability criteria for burial sites are listed in Ontario Regulation 106/09 under the Nutrient Management Act, 2002: Disposal of Dead Farm Animals. It includes information on dealing with soil types, water table and bedrock depths, setbacks to neighbours, wells, and more.

Use a soil map, legend and report to shortlist candidate sites on your property. First, identify soil type(s) on your farm. Next, use the soil legend and report to eliminate soils that are too shallow, wet, organic or difficult to dig. Finally, note all sandy loam to clay soils that are well to imperfectly drained. This is your short list.

SELECTING THE RIGHT SITE(S)

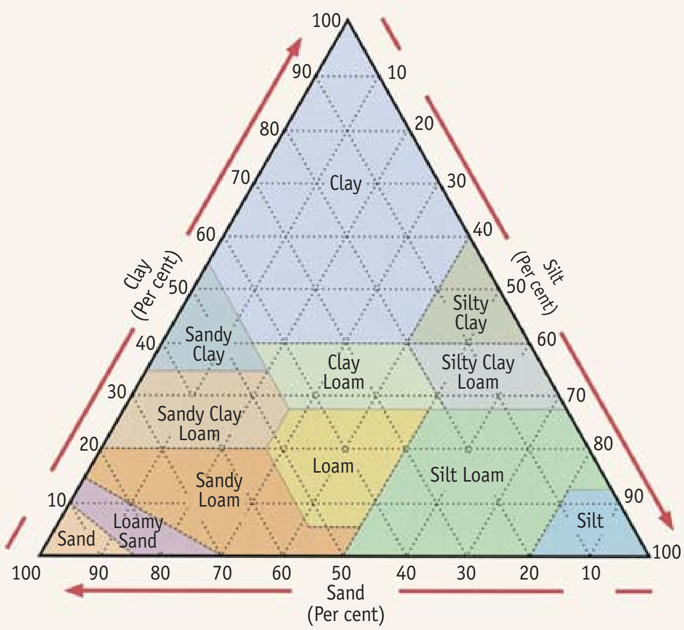
Not all soils are suitable for burial or other disposal BMPs.

Some, such as soils that are shallow to bedrock, don't have sufficient space. Wet or poorly drained soils are often too anaerobic for normal below-ground decomposition to take place. Wet soils can pose access problems for other BMPs such as composting and vessels.

Other soils are difficult to dig – such as stony or compacted soils. There are some soils that are composed of porous (gravelly, sandy) soil materials that could pose a risk to groundwater contamination.

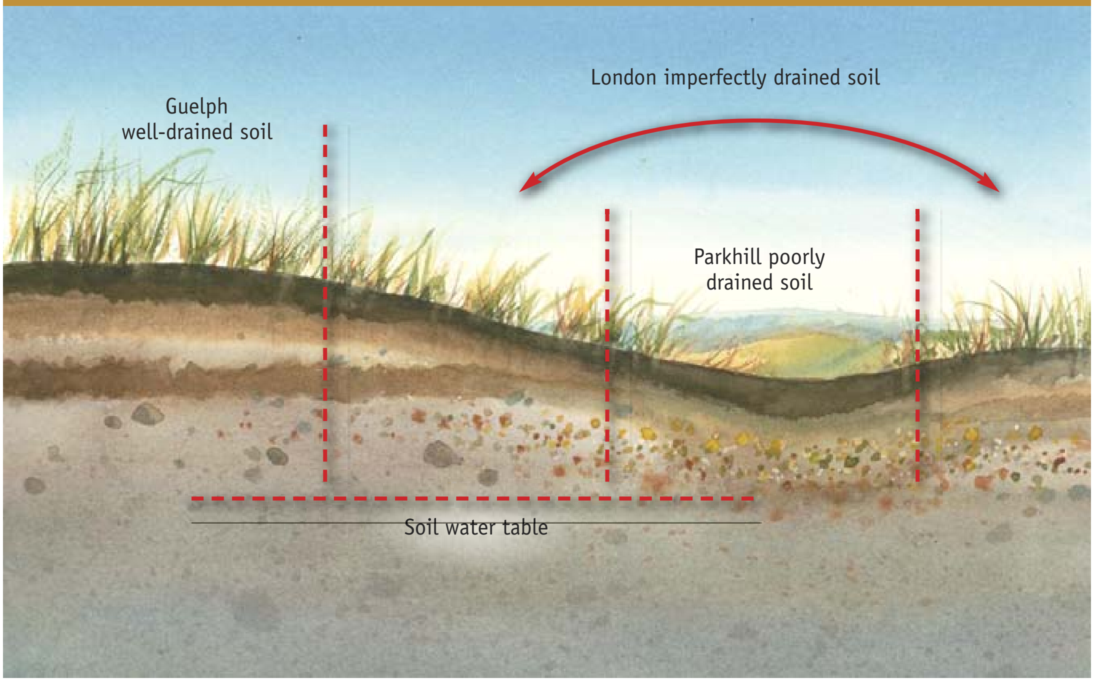
Generally, soil materials ranging from sandy loams to clays that are well to imperfectly drained should be suitable for on-farm burials.

THE SOIL TEXTURE TRIANGLE



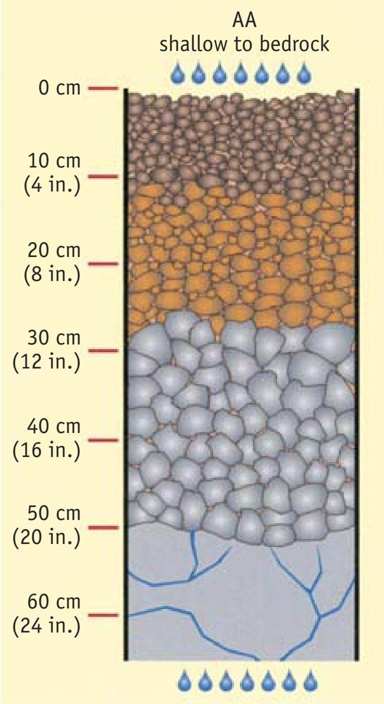
Most soil texture materials (except non-mineral or muck soils) are suitable for burial, provided the soil is deep, well-drained and relatively stone-free.

TOPOSEQUENCE OF SOILS – GUELPH LOAM CATENA (GUELPH–LONDON–PARKHILL)



Along with minimum setback criteria, soil drainage is a critical site-suitability factor. Drainage is related to soil material (texture) and depth to soil water table. Water table depth is usually tied to slope position – lower slope position soils are usually poorly drained.

Soils that are shallow to bedrock (< 0.9 m [3 ft.]) are unsuitable for burial and for below-ground disposal vessels.



HOW TO CHECK FOR SOIL TYPE

Select candidate sites that meet or exceed minimum setback criteria and that are not mapped as shallow, wet or gravelly soils. Check your local soil map.

1. Excavate one check pit per candidate site with a shovel, post-hole auger or backhoe. The check pit depth should be at least 1 m (3.25 ft) – and up to 2 m (6.5 ft) if burial site is for cattle or horses.
2. Verify soil depth to bedrock from soil surface. For burial or vessel sites, you need a minimum of 2.0 m (6.5 ft) depth.
3. Verify depth to water table. Check depth to standing water (saturated soil) in June or check soil-colour features any time of year. Wet sites often have standing water, saturated conditions and water-loving plants – such as willows, dogwood, cattails and sedges. After digging, wait at least 15 minutes and then look for standing water in the pit or auger hole. If standing water is not present, look for the presence of dull, bluish-grey (gley) colours with or without rust spots (mottles). Gley colours indicate zones of prolonged saturation (i.e., depth to soil water table). Mottles indicate temporary saturation. Avoid sites with gley colours in the top 50 cm (20 in.) from the soil surface for burial.
4. Verify soil material. Look for coarse-textured soil materials. For burial, avoid sites with >50% content of coarse soil materials – such as very coarse sands, gravels, and stones that have >1 mm particle size.

Mottles (rust blotches) and gley (grey colours) in the same profile indicate generally wet soil conditions, with a fluctuating soil water table. Gley colours alone usually mean a permanently high water table.

STEP 5 IMPLEMENT THE OPTION

Once the option has been chosen and the most suitable site selected, it's time for action.

Review the specific BMP section in this book for design and management considerations.

Also check the OMAFRA deadstock website for information on licensed contractors and suppliers of deadstock disposal technologies and services.

STEP 6 FOLLOW PROTOCOLS FOR REMOVAL AND BIOSECURITY

Proper handling of deadstock is part of making the selected disposal option work. All deadstock need to be handled safely and efficiently immediately following death. This will reduce the risks related to the spread of disease and to environmental contamination.

Read the next section for information regarding the proper procedures for deadstock removal, storage, cleaning and biosecurity.

STEP 7 KEEP RECORDS

You must record the following important information:

- species, age and weight of animal
- date and time of death where it is known
- cause of death
- date and disposal method
- location of disposal.

When disposal methods such as burial, composting or incineration are used, other records could be maintained that might be helpful from a management standpoint, even if they are not required from a regulatory standpoint, such as identifying soil type for burial, temperature of compost pile, and temperature of incineration unit.

Proper recording of deadstock is important and will be necessary for compliance with the regulation. Animals may die of disease, injury, or other causes, and the recording of this data provides another tool for decision-making in the management of the herd.

The Nutrient Management Act requires records be kept for two years, or for 10 years if specified risk material (SRM) is involved.

Producers who keep records are better positioned to make informed management decisions on corrective measures if necessary.

SAMPLE MORTALITY RECORD

TIME AND DATE OF DISPOSAL	ANIMAL SPECIES	AGE AND WEIGHT	CAUSE OF DEATH	TIME AND DATE OF DEATH (when known)	DISPOSAL METHOD	DISPOSAL LOCATION	OTHER INFORMATION
8:00 pm Feb. 2, 2008	Chicken	6 wks 2 kg	Inadequate ventilation	8:00 pm Feb. 2, 2008	Sent to lab	NA	NA
12:00 noon Feb. 14, 2008	Beef cow	4 yrs 1500 lb	Died of heart failure. Not found for 2 days.	Feb. 12, 2008	Buried	(see attached map for location)	NA
5:01 am Sept. 3, 2008	Calf	Newborn 95 lb	Died during birth	5:01 am Sept. 3, 2008	Compost pile	Compost pile	NA

HANDLING BEFORE DISPOSAL

THIS CHAPTER DESCRIBES PROPER PROCEDURES FOR:

- **deadstock removal**
- **storage**
- **cleaning**
- **biosecurity.**

Regardless of disposal method, all deadstock must be handled safely, efficiently and immediately to reduce risks related to disease and environmental contamination.

REMOVAL

Removing deadstock from the housing facilities can sometimes present a problem with larger animals. Ideally, this problem was taken into consideration during the facility's design, but it is occasionally overlooked.

If there are areas that may present problems (e.g., maternity pens in the back corner of a barn, box stalls for horses, etc.), give some thought to possible extrication methods, and discuss them with everyone involved.

Under the Nutrient Management Act, 2002, Reg. 106/09, the livestock operation in most cases must dispose of deadstock within 48 hours of death by using the services of a licensed deadstock collector, composting, incineration, disposal vessels, or burial.

Deadstock can also be delivered to an approved anaerobic digester, an approved waste disposal site, a licensed disposal facility under the Food Safety and Quality Act, 2001, or to a veterinarian for post-mortem activity. As with all bovine carcass movement, this activity would require a federal SRM permit.

Large-animal deaths in confined areas can be challenging to remove properly. Plan facility layout and equipment carefully to prevent or minimize difficult removal conditions.

STORAGE

Under very specific conditions, livestock producers can store their deadstock for more than 48 hours prior to disposal. This can provide both producers and deadstock collectors with some cost-savings and flexibility by allowing deadstock to be:

- ► moved and stored on another farm property owned by the producer, or
- ► moved to another farmer's property pending pickup by a licensed collector.

At the chosen location, deadstock may be stored:

- ► in a refrigerated state, up to 14 days, or
- ► in a frozen state, up to 240 days.

Stored deadstock must be hidden from public view and stored under conditions that protect them from scavengers and other pests. Any stored deadstock that begins to decompose must be disposed of immediately as set out in the regulation.

COLD STORAGE

Being able to store deadstock at cold temperatures may be helpful in making collection or any other disposal method more efficient in terms of labour, resources, and cost. This option allows for much more flexibility than the maximum 48 hours between death and disposal requirement when cold storage is not used.

Minimum requirements for a cold or frozen storage facility

- **prevent any leakage**
- **prevent all scavenging and insect activity**
- **conceal deadstock from public view**
- **maintain refrigeration (cold storage) or maintain the deadstock in a frozen state**

Walk-in coolers are a high-cost yet effective method to store deadstock prior to disposal.

Mechanical Refrigeration

An on-farm refrigeration unit provides benefits to both the producer and the renderer. It will reduce the need for frequent disposal or pickups by a collector, who may be more accommodating in making a pickup because the refrigeration unit guarantees a larger quantity of better quality carcasses.

A refrigeration unit for producers with units larger than 500 sows farrow-to-finish or equivalent deadstock production would have exterior dimensions of about 2.4 m × 2.4 m × 2.2 m (8 ft × 8 ft × 7 ft 6 in.). Such a unit is quite large and provides great flexibility in moving deadstock within the unit.

Walk-in Coolers

The use of a walk-in cooler or freezer is also possible, and may allow for the collection of deadstock in larger containers. This is likely the highest-cost option, but may provide excellent labour benefits as deadstock can be handled on pallets or in totes.

Commercial Freezer Units

Specialty commercial freezers are available. These units should be placed on an insulated slab of concrete, and ideally would enable mechanized emptying.

The operational cost is extremely variable and depends on the amount of deadstock, its temperature when placed, how frequently the freezer is opened, and the temperature at which the unit is maintained.

Household Chest Freezers

Commercial freezers may be too costly for the amount of deadstock generated. A household-sized freezer may be adequate.

The cost of purchasing and operating several household freezers may be more economical than the large units. They could be operated as necessary, depending on the number of deadstock. Larger household freezer units range from 0.71 to 0.76 cubic metres (25–27 ft^3).

The greatest problem with freezers is removing animals from the unit. A hand-operated crane of the type used for lifting engines can lift the deadstock out of a chest freezer.

Also required are tapered containers that fit into the freezer so that the entire contents will slide out more easily. An ideal container is a tapered, plastic recycling box or tapered plastic pail.

A household freezer can be used to temporarily store frozen deadstock.

For most producers, only one freezer is necessary. Due to the density of deadstock, a freezer can only realistically accommodate 400 kg of carcass per cubic metre (25 lbs of carcass per ft^3) of stated volume capacity.

A freezer should be cleaned and disinfected each time it is emptied.

Commercial reefer bins ease the handling of frozen deadstock.

CLEANING

When deaths are attributed to or suspected to be caused by pathogens, cleaning and disinfecting the areas contacted by the animal is important in order to decrease the chance of spreading disease. Any equipment used to transport the deadstock and storage areas should also be cleaned and disinfected.

Remove all manure and bedding if a death is suspected to be caused by pathogens that might spread a disease.

Here are some important cleaning tips:

- remove all manure and bedding
- clean and dust ceiling, walls, posts and equipment
- scrape and sweep floors
- clean out any leftover feed from feeders
- for best results, thoroughly wash area with a cleaning solution before disinfecting
- soak heavily soiled areas for 30 minutes, then scrape or brush off the organic matter.

Clean and dust all surfaces.

Wash all surfaces prior to disinfection.

Disinfectants only work on surfaces that are clean and free of soil or organic debris.

Also note that:

- disinfectants cannot work in the presence of organic matter
- cleaning may get 85–95 % of the microbes.

Here are some common disinfectants:

- citric acid
- acetic acid (2%)
- chlorine (bleach)
- sulphamic acid
- Virkon® (potassium monopersulfate 21.4%)
- Germ Kill® (and other acidic iodophors).

BIOSECURITY

Biosecurity BMPs reduce mortality rates.

Deadstock can be a hazard to people and other animals. Diseased animals – if not isolated and handled carefully – can spread the pathogens to other animals. During decomposition, they have the potential to contaminate soil, air and water, and require special handling.

To minimize property contamination and risk of spreading disease:

- dispose of deadstock within 48 hours of death
- call a licensed collector to remove deadstock, or select an appropriate method of disposing of it on-farm
- clean and disinfect the area after deadstock removal
- wear protective clothing when handling deadstock
- secure deadstock in pest-proof container until disposal.

DEADSTOCK COLLECTION

THIS CHAPTER DESCRIBES REQUIREMENTS AND BMPs FOR DEADSTOCK COLLECTORS, INCLUDING:

- licensing and transport requirements for licensed collectors
- advantages and disadvantages of the service
- storage prior to collection
- collection systems and biosecurity.

Ontario farms produce approximately 80,000 tonnes of deadstock annually, 60–65% of which are collected.

Many areas across Ontario with significant livestock density have access to a reliable and cost-effective deadstock removal service. The degree and cost of the service depends on the number of animals in a specific region or area, the distance travelled by the collector, and the type and species of deadstock being collected.

For the average livestock producer, deadstock collection requires minimal management responsibilities and handling facilities. For many producers, deadstock collection continues to be the most effective and convenient way of dealing with regular death loss.

Only those licensed under the Food Safety Quality Act, 2001 Regulation 105/09 may engage in the business of collecting deadstock. The rules and regulations pertaining to deadstock collection can be found at **www.omafra.gov.on.ca/english/food/inspection/ahw/licencing.htm**

Collection of deadstock by a collector for further processing is recognized as the most effective and sustainable disposal method.

LICENSED DEADSTOCK COLLECTORS

LICENSING AND TRANSPORT

Roles and Responsibilities

All deadstock collectors require renewable licences under s.23 of the Food Safety Quality Act (FSQA), 2001, Reg. 105/09 to pick up deadstock from Ontario farms. Fees are generally charged for the disposal service and as already noted, will vary.

Collectors are required to deliver deadstock to an approved facility promptly. All deadstock collected must be delivered to a disposal facility licensed under FSQA Regulation 105/09, namely:

- ► salvage, rendering, or composting facilities
- ► transfer stations
- ► an equivalent facility located outside Ontario, or
- ► an approved waste disposal site.

Collectors are required to ensure that the vehicles they use to collect deadstock are maintained in good working condition. Equipment and structures coming into contact with deadstock that may be contaminated with disease-producing organisms must be cleaned and sanitized.

Deadstock may not be transported together with live animals. After delivery, the transport vehicle must be thoroughly cleaned and sanitized before leaving the licensed premises.

Vehicles, trailers and transport containers used to collect deadstock must meet a specified standard and are required to carry evidence that the vehicle is licensed under FSQA Regulation 105/09. The collector must display evidence of a licence in the windshield of the vehicle.

Vehicles used to collect deadstock must meet the following conditions:

- **designed to prevent leakage of materials**
- **surfaces that come into contact with deadstock are impervious and capable of withstanding repeated cleaning and sanitizing**
- **deadstock are not visible to the public during transport.**

This link – **www.omafra.gov.on.ca/english/food/inspection/ahw/deadstock operators.htm** – will provide a list of licensed persons and companies who provide deadstock collection service.

Although the service is widely available, the number of collectors involved in on-farm collection has decreased over the past few years. Deadstock collectors continue to offer pickup service from farms, abattoirs and sales barns located in most areas of southern and eastern Ontario. However, generally speaking, northern Ontario does not have access to this option.

The discovery of BSE in cattle (May 2003) had a considerable impact on the deadstock collection and rendering industry, which traditionally processed the deadstock into a number of valuable, marketable recycled products. In response, the deadstock collection and rendering industry was forced to implement a number of changes to their operations and increase collection fees.

Many believe deadstock collection provides the best protection against disease transmission and wildlife scavenging. Other avoided risks include the potential for pollution of air, soil, surface water and groundwater when deadstock are disposed of on the farm. There are a number of pros and cons related to deadstock removal.

Advantages

Recycling

- hides are removed, treated and sold
- collector can salvage meat for use as pet food, wildlife bait, and food for captive wildlife
- most of the deadstock collected end up in the rendering stream where high-heat treatment (to destroy disease organisms) is used to create useful products such as tallow (fat) and meat and bonemeal (proteins)
  - these may be marketed directly or further processed if permitted into animal feed, fertilizer, feedstock for energy, and lubricants

Less on-farm disposal

- reduces the potential for soil, air and water contamination
- few further costs associated with disposal beyond the collector's fee
- minimal on-farm risk to human and animal health

Low management input required / cost-effective

- other management options require more intensive on-farm management and supervision (e.g., site selection, active management, monitoring)
- simple from producer's perspective
- collection of large animals and high volumes is feasible
- less expensive than other disposal options for most types of animals
- generally favoured by public and environmentally concerned citizens
- requires minimal monitoring for predators, odours and leaching

An advantage of collection is it requires minimal monitoring for predators, odours or leaching.

Disadvantages

Cost/Availability

- fees based on changing market prices for recyclables
- often more expensive in underserviced areas and for species associated with disease concerns: bovine spongiform encephalopathy (BSE) in cattle, scrapie in sheep and chronic wasting disease (CWD) in deer and elk
- collection service not always available in remote areas of the province
- collection fees often higher in areas of the province where livestock numbers are less dense
- livestock identification may be required by regulations (e.g., CCIA for cattle)

Biosecurity

- while collectors' vehicles are cleaned and sanitized after delivering their load to a receiving or rendering plant each day, they collect from more than one farm daily
  - collecting deadstock poses a higher risk potential for the presence of disease organisms – the risk increases that these organisms could be carried to other farms

Most renderers no longer accept dead swine that were treated with a product containing sulfamethazine and died before the drug withdrawal time was complete.

Current enhanced restrictions on using specified risk material (SRM) in any animal feed – not just those destined for ruminants – will further reduce the recycling value of deadstock, particularly bovines. This could lead to even higher collection costs.

STORAGE PRIOR TO PICKUP

Storage is an important component of a deadstock collection system. The condition of the deadstock is extremely important to the deadstock collection and carcass processing industry if they are to derive marketable end products from the materials collected. Therefore, farmers must always take steps necessary to keep deadstock from decaying during storage, and arrange for prompt collection when a deadstock is discovered.

Nutrient Management Act, 2002 (NMA) Regulation 106/09 requires carcass decomposition be minimized prior to collection. If the deadstock is too decomposed, the collector may refuse to collect the carcass because the rendering industry can no longer use it.

This is particularly a problem in the heat of summer when the general requirement to dispose of deadstock within 48 hours after death may be too long to maintain it in an acceptable state. The following rules and recommendations apply to deadstock storage prior to pickup.

REFRIGERATION AND FREEZING

Deadstock can be stored under frozen conditions for up to 240 days before disposal.

As touched on in the previous chapter, there are provisions in the Nutrient Management Act, 2002 Reg. 106/09 that allow for storage of deadstock beyond 48 hours if the carcass is held in a refrigerated or frozen state.

If held in a refrigerated state, deadstock can be held for up to 14 days before disposal.

If frozen, deadstock must be held in an area that has a continuous temperature sufficient to maintain it in a frozen-solid state. Under frozen conditions, deadstock can be held for as long as 240 days before disposal.

OUT OF PUBLIC VIEW

The Nutrient Management Act, 2002 Reg. 106/09 also requires that prior to collection, deadstock must be hidden from view and protected from scavengers and vermin.

Deadstock left at the road for collection in full public view are perceived as an environmental hazard by the public and complaints are inevitable.

A number of methods are used to keep deadstock out of public view, including plastic drums for poultry, bins or covers for hogs, and solid enclosed areas for larger species.

Place covers in designated areas for pickup.

BIN SYSTEM

In parts of the province, bin collection has become the norm in the hog industry. This has benefits for both the collector and the producer.

Bins can be moved easily, and can normally be obtained directly from the collector at minimal cost. In this way, deadstock can be added to the bin at the barn, and then the bin can be transferred to a pickup site away from the buildings – thus avoiding the need for the collector's vehicle to access farm yards. In addition, when the collector picks up the bin, the vehicle operator does not need to leave the vehicle. Both these factors contribute to a reduced biosecurity risk.

While the bin system is an effective tool, the bin must be cleaned regularly, particularly in the summer months. This will help reduce the risk of the bin itself becoming a source of disease organisms.

BIOSECURITY

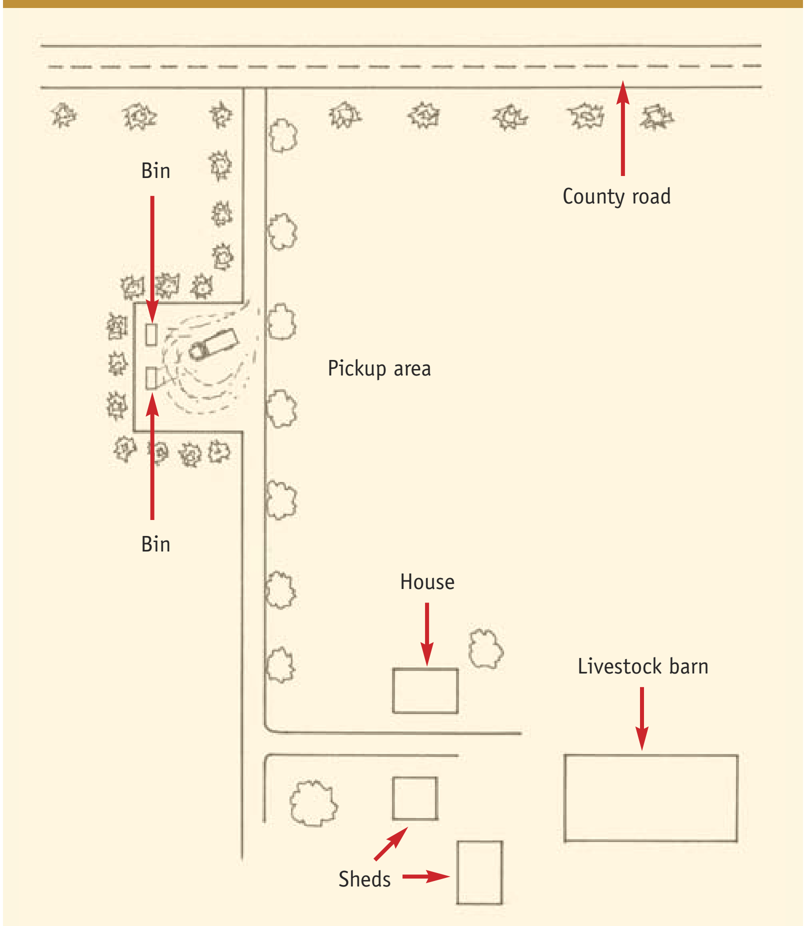
While biosecurity is a risk factor when using the services of a deadstock collector, there are ways to reduce the risks.

SEPARATE PICKUP AREA

Creating a pickup area away from animal housing and away from high traffic areas means the collector's vehicle will be kept away from these areas. This will result in less opportunity for any disease organisms to be brought into the vicinity of livestock.

The NMA regulation allows for a farm operation to have only one collection area or point on the farm, and at no time can the weight of deadstock exceed 3,000 kg (6,614 lb) at the collection point.

PICKUP AREA ON A LIVESTOCK FARM



A well-designed pickup area will help to make service more efficient for all.

SEPARATE ENTRANCE IS BEST

The ideal solution for reducing risk is to use or create a separate or lesser-used entrance. A storage area with adequate turnaround facilities and easy access for collection vehicles will promote prompt service with minimal time spent on-site.

STORAGE SYSTEMS

Any method that can be employed to reduce the vehicle driver's contact with deadstock will reduce the biosecurity risk both to your farm and other farms on the route.

The aforementioned bin system used in the swine industry is ideal, since the driver doesn't need to leave the vehicle cab. Drums used in the poultry industry also help reduce driver contact with dead birds.

Options for larger species are more limited. However, easy access will reduce the time spent on-farm by the collection vehicle and driver.

SEVEN FRIENDLY TIPS FOR DEADSTOCK COLLECTION

1. Most deadstock collectors operate their services 5–6 days a week. Call the moment you have a dead animal! Maintain a good relationship with the collector: pay collection fees on time and keep your account in good standing.
2. Develop a protocol with your collector for the handling, storage and pickup of deadstock with biosecurity and environmental awareness in mind.
3. Provide one permanent site out of public view for deadstock pickup that allows for all-season access. Maintain the site in clean condition.
4. If required by regulation, ensure that each dead animal is identified with applicable ear tag (e.g., national ID tags) prior to collection.
5. Cool/freeze smaller deadstock in containers. Use barrels or buckets.
6. Where necessary or preferred by both parties, defer collection by storing deadstock, thereby keeping your costs down and benefiting the collector.
7. Work with the collector to find ways to improve your collection and reduce disposal costs, with the goal of ensuring service will continue.

Establish a rigid protocol for handling, storing and disposing of deadstock – with biosecurity and environmental awareness in mind.

Call your deadstock collector as soon as possible when you discover a dead animal on your farm.

COMPOSTING

THIS CHAPTER REVIEWS ALL ASPECTS OF COMPOSTING INCLUDING:

- **the process**
- **advantages and disadvantages**
- **substrate types**
- **siting**
- **sizing**
- **equipment**
- **management**
- **windrows**
- **in-vessel composting**
- **what to do with finished compost**
- **troubleshooting**
- **sizing bin composting units.**

Modern commercial in-vessel composting units can handle all sizes of farm animals.

Composting is managed decomposition. The process is quite similar to what happens in natural environments.

During composting, micro-organisms, in the presence of oxygen, break down organic matter to produce a stable, dark, soil-like material that has very little odour. Compost contains nutrients and organic matter useful for plant growth.

Composting deadstock is much like following a recipe – with a carbon-rich substrate as the other key ingredient. With time and attention to detail, both the deadstock and the substrate break down and the end product is compost.

Scale is an important consideration for this option. Deadstock-composting systems can be designed for an individual farm or a centralized facility servicing several farms.

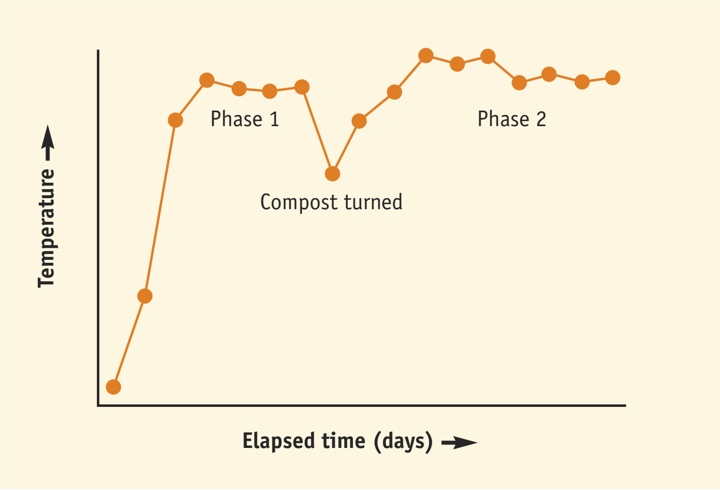
Livestock producers are not unfamiliar with composting. Until a few years ago, most of the mortality compost systems were designed to handle small animals, such as chickens and piglets. However, since the mid-1990s, more swine operations have adapted the process to manage for larger pigs. In recent years, more cattle producers have been using composting. Systems now exist to successfully compost all sizes of farm animals.

ADVANTAGES	DISADVANTAGES
• improved biosecurity because no external vehicles enter property • minimal to moderate start-up costs, depending on the chosen system • relatively easy, if a few simple rules are followed • end product has value as a soil amendment • immediate disposal of deadstock is possible • animals of all sizes can be handled • natural heating process significantly reduces numbers of any pathogens • recycles on-farm nutrients	• labour involved to manage composting process – more than some alternatives • capital cost and substrate costs – higher than some alternatives • potential for scavengers and predators to dig in piles – proper management can greatly reduce the potential • the largest bones take longer to break down – screening may be needed to avoid possible inadvertent land application, resulting in neighbour concerns • movement and land application of finished compost from cattle carcasses to property not connected to the site where the compost was generated require federal SRM permits

Some bones, especially large ones, may not be decomposed by the time the composting process has been completed.

The heat generated by microbial decomposition in the composting process destroys most pathogens.

THE COMPOSTING PROCESS



WHAT HAPPENS DURING DEADSTOCK COMPOSTING

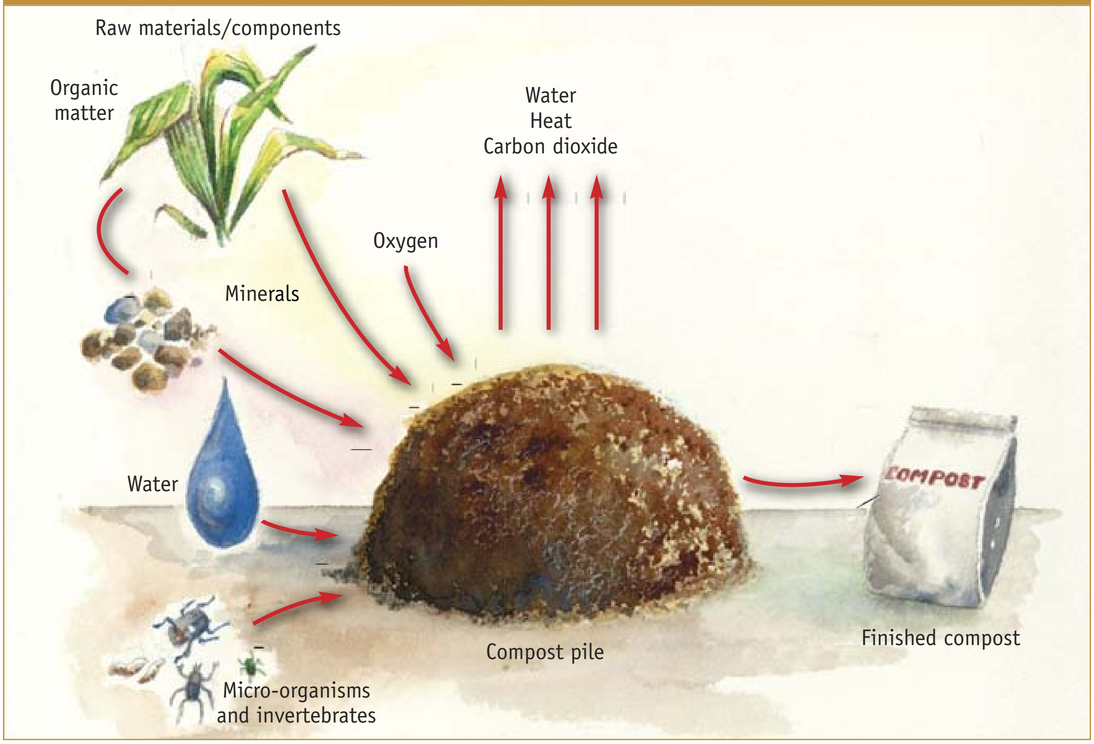
The composting process is dynamic. This managed ecosystem and its physical, chemical, and biological components change dramatically over time.

Most compost researchers agree there are two main phases of composting:

1. The first phase (the developing or heating phase) is characterized by high oxygen-uptake rates, and thermophilic (high) temperatures, from 46 °C to nearly 71 °C (115–160 °F). Here, thermophilic micro-organisms degrade fats, hemicelluloses, cellulose, and some lignins.
2. The second phase (the maturation or curing phase) may require one month or longer for completion. In this phase, aeration is not a determining factor for proper composting, and therefore it's possible to use a lower-oxygen composting system. A series of retarding reactions, such as the breakdown of lignins, occurs during this maturation or curing stage and requires a relatively long time. The maturation phase could be as long as five months at temperatures below 40 °C (104 °F).

Not all composting systems work equally well. Effective composting depends on managing the factors that affect the environmental and nutritional requirements for the microbes inhabiting the compost ecosystem. Some of the most important factors to ensure successful composting are summarized in the next chart.

ON-FARM COMPOST – KEY FACTORS



The key management factors for effective composting are: oxygen, carbon:nitrogen ratio, temperature, moisture and time.

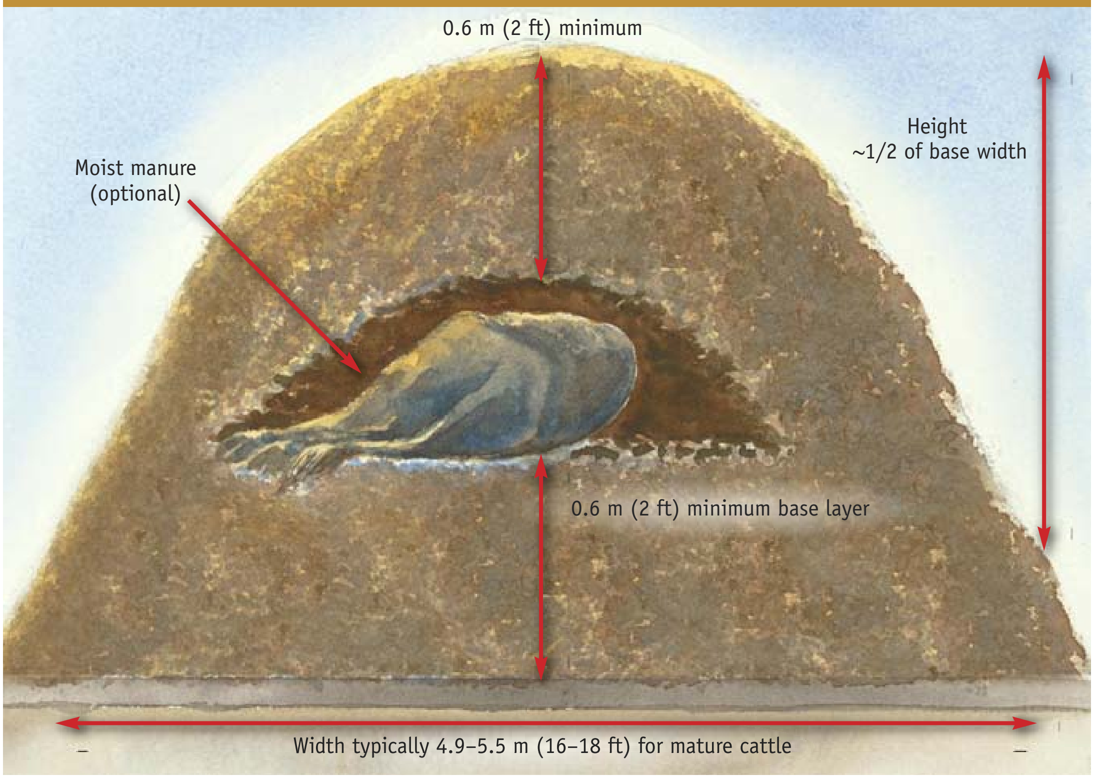
FACTOR	FUNCTION	MANAGEMENT IMPLICATIONS
OXYGEN	• composting is an aerobic process • microbes need oxygen to breathe • air (oxygen) must penetrate pile for effective composting • dense substrate and high moisture contents will cause anaerobic conditions	• anaerobic decomposition is slower and produces more odour and greenhouse gases (nitrous oxides and methane) • compost requires aeration – by mechanical turning or moving of piles, or with ventilation systems
CARBON AND NITROGEN	• carbon is required by micro-organisms for energy and cellular tissue • nitrogen is needed for enzymes and proteins • a balance is needed between carbon and nitrogen for optimal microbial function • ideal ratio of carbon to nitrogen (the C:N ratio) should be close to 25:1	• C:N of animal carcass = 4:1 • C:N of corn silage = 40:1 • combining these inputs in the correct proportions results in the proper final C:N ratio • if the C:N ratio is too low, there is a greater risk of odour problems • if the C:N ratio is too high, the composting process will take too long
TEMPERATURE	• composting generates heat – the composting environment, condition of materials, and type of microbes present will dictate the amount of heat produced • higher temperatures are required to break down complex materials (e.g., lignins) and pathogens	• ideal temperatures ○ phase 1: 46–71 °C (115–160 °F) ○ phase 2: below 40 °C (104 °F) • low temperatures will slow the composting rate – little composting takes place if conditions are frozen • extremely high temperatures can destroy composting microbes • substrates must be managed for insulating properties
MOISTURE	• microbial and chemical processes critical to composting require water • excess moisture can cause anaerobic conditions • dry conditions will slow composting rate	• ideal moisture content should be 40–60% • covered piles may require added moisture • uncovered piles may absorb rain and require more substrate or turning to maintain aerobic conditions • controlling factors also include volume and type of animals and substrate
TIME	• process requires proper ingredients and time to complete each phase	• small animals and fewer numbers compost quickly (2 months) • larger deadstock can take up to a year

The preceding list of factors applies to any composting of well-mixed materials. What happens with deadstock is somewhat different, however, at least for part of the process.

Unless the deadstock is ground (broken up) before mixing with the substrate, we are normally dealing with a non-homogeneous material. Typically, the deadstock are added to a bed of substrate and covered with substrate (this has been referred to as "above-ground burial"). The deadstock begin to break down anaerobically. Liquids move into the substrate. Any odours generated are captured by the covering material, which acts as a biofilter.

It may not be until the material is mixed that active composting begins throughout the pile. For this reason, it is not wise to turn the pile too soon in the process.

STATIC PILE – CROSS-SECTION



Composting larger deadstock is more effective when they are laid on a thick base of substrate and covered by enough material to maximize aeration and insulation.

COMPOSTING METHODS

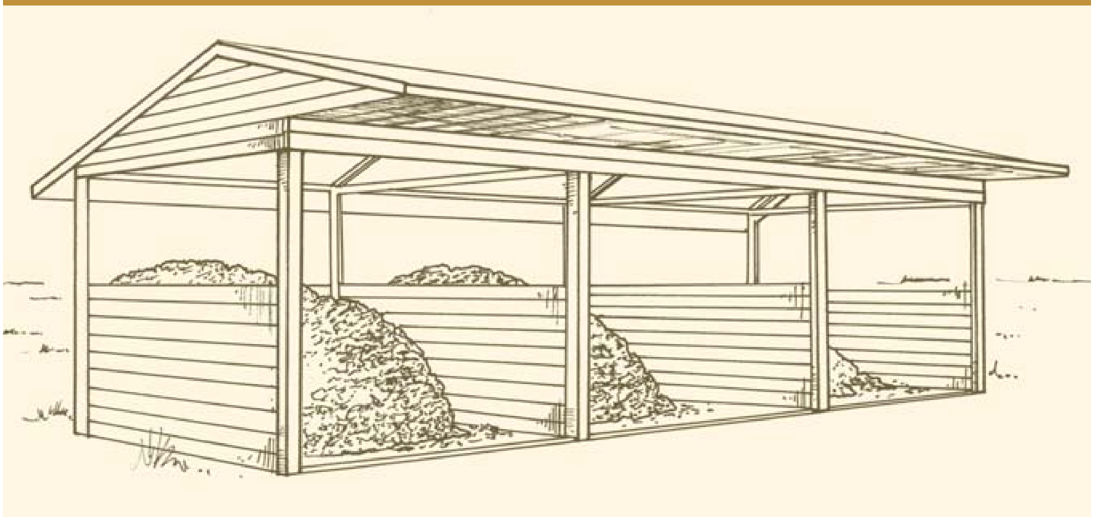
There are two broad groupings of compost systems: those designed for ongoing deadstock and those intended for large volumes or batches.

Large-volume or "catastrophic" losses of animals are often associated with a fire, with suffocation as a result of a power failure, or as a result of a disease outbreak. For example, when avian influenza was confirmed in British Columbia in 2004, many of the infected carcasses and birds of no value (e.g., spent hens) were composted.

The issue of cause of death has an impact on the selection of the most appropriate compost strategy. Some compost systems ensure higher and more uniform compost temperatures, which are more effective in controlling or destroying pathogens. If spread of disease is a concern, a system that ensures higher temperatures throughout the entire compost volume is desirable.

A number of composting strategies can be adopted. The most common of these are described here, along with a description of the main options for each.

STATIC PILE METHOD OF COMPOSTING



A static pile is the most common system currently in use. It's fairly easy to set up and operate. At its simplest, it's a pile of material on bare ground. A more complex version is a covered building with a concrete floor where the composting takes place in a series of bins.

If the static pile system will be loaded, mixed and emptied with a tractor or skid-steer loader, a concrete floor is preferred for ease of use, cleanliness, and runoff management.

Roofed or covered static piles reduce the risk of runoff or leachate, and make moisture content easier to manage.

Walls can be made of bales, wood or concrete. They must be 1.2–1.8 m (4–6 ft) high – tall enough to encourage desirable temperatures and low enough to discourage anaerobic conditions.

Windrow systems can be more practical for operations with ongoing deadstock. The windrow is extended and turned as needed.

Composting is possible in long plastic tubes, such as those more commonly used to store corn silage or haylage. For deadstock, a fan blows air into the tube at one end and the air exits at the other end. This system is better suited to batch conditions, where it can be filled at one time.

In-vessel systems such as the horizontal drum can compost small volumes more quickly with less substrate. They are more expensive.

COMPARISON OF COMPOSTING SYSTEMS					
FEATURE	**STATIC – UNCOVERED**	**STATIC – COVERED**	**WINDROW**	**IN-VESSEL (DRUM)**	**PLASTIC TUBE**
STRUCTURE	• *base* natural soil, clay or concrete • *walls* 1.2–1.8 m (4–6 ft) high, hay, straw, wood, concrete • no cover	• *base* concrete • *walls* wood or concrete • *cover* roof structure or heavy-duty tarp	• *base* concrete or natural soil • elongated mound on field – located in accessible area (e.g., near fencerow, headlands)	• long insulated drum with rotation by electric motor • typically 9.1 m (30 ft) by 1.2 m (4 ft) diameter	• similar to tubes or bags used for ensilage • fan attached to one end to reduce incidence of anaerobic conditions
HOW IT WORKS	• substrate added to cover deadstock • piles left intact – no turning of piles	• batch system – 3–4 bins with substrate on one end and finished product on other end • may need to add water	• windrow is elongated with substrate and fresh deadstock • material is turned regularly	• continuous flow – substrate and deadstock can be added and finished product removed daily • reaches high temperature within 14–28 days	• batch system – substrate and deadstock added at once to bag • fans aerate the bagged material • material emptied from bag when completed
RUNOFF MANAGEMENT	• need adequate substrate base layer below carcasses	• minimal risk of leaching or runoff	• regular turning and substrate management can reduce risk	• minimal risk of leaching or runoff	• minimal risk of leaching or runoff
RUNOFF/ LEACHING POTENTIAL	• high	• low	• high	• low	• low
CAPITAL COST	• low	• high	• low	• high	• high
OPERATING COSTS	• moderate	• moderate	• moderate	• low	• low
LABOUR	• low	• low	• low	• low	• low
AMOUNT OF SUBSTRATE	• high	• high	• high	• low	• low
TIME TO COMPOST	• long	• long	• moderate	• short	• moderate
SUITABLE FOR	• small operations (e.g., cow-calf)	• most operations	• large operations with ongoing need to manage deadstock • flexible to handle catastrophic events	• operations with daily deadstock – normally small ones (e.g., swine, poultry) • may need to cut up larger deadstock to fit into unit	• only suitable for small deadstock or where deadstock are ground and then blended with substrate • no further mixing

Continuous mechanical turning is not practical for on-farm deadstock composting. It would only cause partially decomposed carcasses and bones to resurface. This approach is more suitable for the roofed, channel systems normally designed for centralized composting. In centralized units, deadstock from many farms (or catastrophic losses from a single farm) would ensure a faster loading of the channel.

CHOOSING THE SUBSTRATE

A vital part of the compost process is the substrate (also known as "carbon source" or "co-composting material"). The substrate serves several useful purposes:

- provides the energy source for ensuing microbial activity
- surrounds the carcasses so they're less accessible to scavengers
- serves as a biofilter to prevent the release of any odour originating inside the compost mass
- soaks up any liquids released as the carcass decomposes, thus reducing the potential for runoff or leaching
- provides the bulking agent that allows air to move within the compost
- insulates the pile, helping to hold the heat that's generated.

Below are some useful selection criteria for substrates:

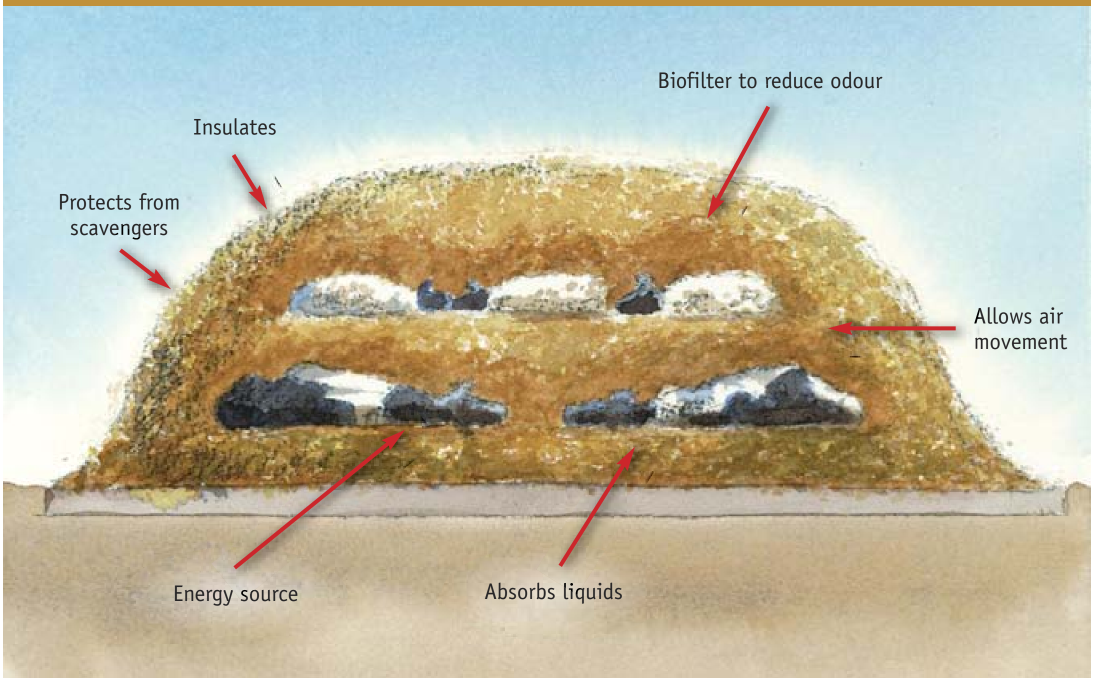
- C:N ratio – total carbon to total nitrogen, needed for nutrient balance
- moisture content
- ash content – how much non-organic material the feedstock contains
- total nitrogen – expressed as either a dry or wet weight
- pH – the acidity or alkalinity of the substrate, which should be between 5 and 9
- bulk density – the weight per unit volume (too dense leads to anaerobic conditions)
- particle size – if too small, anaerobic conditions prevail; if too large, there is poor surface-area contact and reduced capacity to absorb liquids.

TYPICAL PROPERTIES OR RANGES OF PROPERTIES FOR A VARIETY OF POTENTIAL SUBSTRATE MATERIALS

MATERIAL	NITROGEN (%, dry weight)	C:N RATIO (weight to weight)	MOISTURE CONTENT (%)	BULK DENSITY (kg/cubic metre)	pH	PARTICLE SIZE (cm)
CORN COBS	0.6	98	15	330	7.6	3–10
CORN STALKS	0.6–0.8	60–73	12	20	7.6	10–25
CORN SILAGE	1.2–1.4	38–43	65–68	550–685	3.8	1–6
HAY	0.7–3.6	15–32	8–10	160	–	5–30
STRAW	0.3–1.1	48–150	4–27	35–225	7.6	5–30
SAWDUST	0.06–0.8	200–750	19–65	210–270	6.0	0.1–0.8
WOOD CHIPS – HARDWOODS	0.06–0.11	451–819	40	445–620	7.6	1–4
WOOD CHIPS SOFTWOODS	0.04–0.23	212–1,313	40	445–620	6.0	1–4
BROILER LITTER	1.6–3.9	12–15	22–46	450–610	8.5	1–4
BEDDED CATTLE MANURE	1.5–4.2	11–30	67–87	785–990	7.9–8.2	5–30
BEDDED SHEEP MANURE	1.3–3.9	13–20	60–75	440–650	8.0–8.3	5–30
TURKEY LITTER	2.6	16	26	465	5.6–7.5	1–4

Readily available materials such as old corn silage and sawdust can be suitable substrates for composting.

COMPOST PILE CROSS-SECTION SHOWING FUNCTIONS OF SUBSTRATE



Composting substrate materials provide the following functions: energy and air for microbes, insulation to maintain temperatures, absorption of liquids, filtering of odours, and protection from scavengers.

MANAGEMENT IMPLICATIONS OF SUBSTRATE MATERIAL

The best choice for substrate goes beyond the physical and chemical properties highlighted in the preceding table. Other factors include:

- availability – sometimes quantities of spoiled feed or bedding are available on-site and these make obvious choices as substrate
- cost – of materials, transporting, storage and handling are obvious considerations
- contaminants – when using substrates from off-farm, make sure that they do not contain foreign material such as metal, glass or chemical contaminants
- mixtures with finished compost – it's also possible to use a portion of the "finished" compost as substrate material
  - this reduces the amount of substrate needed, and helps to inoculate the fresh materials – thus accelerating the process
  - amounts of up to 50% of the substrate volume may be used, but levels this high are only practical if the C:N ratio of the finished compost is higher than 30:1.

Some materials provide more insulation, so more of the heat is trapped within the pile. While this may not have a big impact on the compost process, it promotes more effective destruction of pathogens, which are a concern for some producers.

Substrate particles need to be large enough to allow for airflow through the compost but small enough to decompose effectively. An ideal particle length is in the range from 3 to 13 mm ($^1/_8$–$^1/_2$ in.). Some materials (e.g., corn stalks, corn cobs, straw) will compost better if they are first chopped to the desired length.

Enzyme and microbial products are being marketed as compost accelerants. They may help to speed up the composting process, especially when using materials that have low background levels of bacteria, such as old litter or dry leaves. Whether or not these products will help the composting process depends on individual circumstances.

SITING

Choosing the most appropriate composting site is critical.

✔ Select a location that is out of view of neighbours and the public.

✔ Comply with any environmental or building regulations for your area by checking with the chief building official and bylaw officer in your municipality.

✔ Choose an area away from wells, watercourses and tile drains.

✔ Avoid areas with seasonally high water tables, unless composting takes place on an impermeable surface with leachate collection and a means to prevent stormwater runoff.

✔ Locate the composting site away from animal feed, housing units and wildlife habitat.

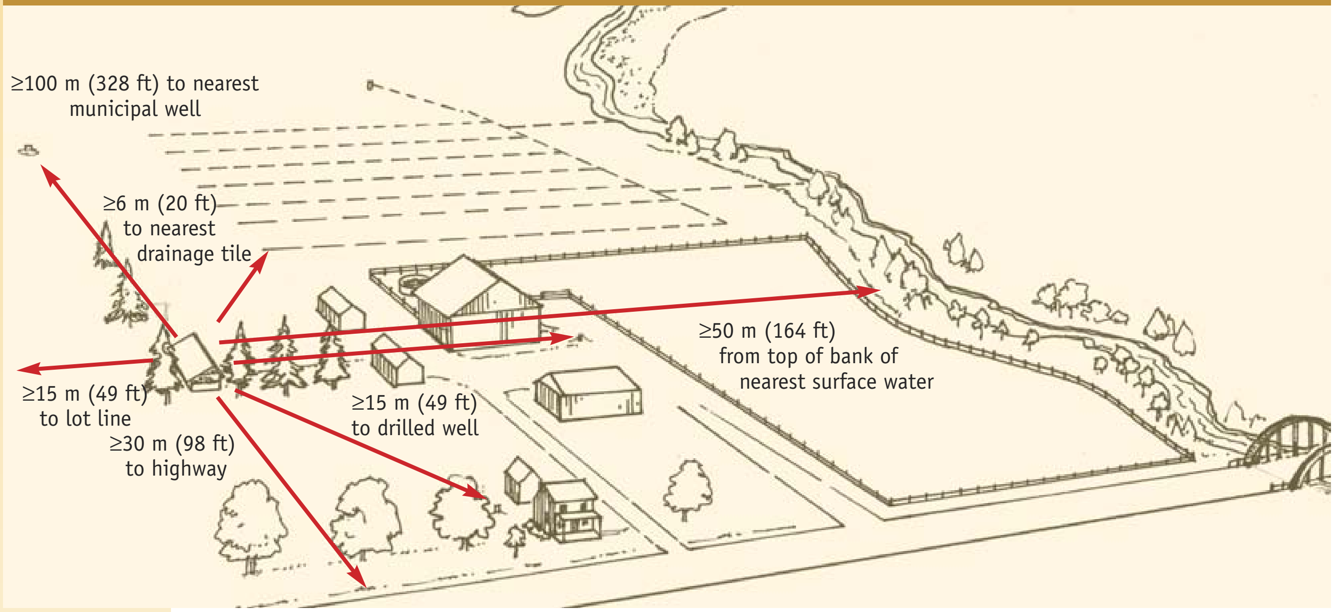
✔ Avoid any biosecurity risks (e.g., traffic patterns or vermin access) and make necessary changes to reduce the risk of spreading disease.

✔ Allow space for handling deadstock, substrate and finished compost.

✔ Ensure the site is convenient, with easy access for managing and monitoring the system.

✔ Ensure convenient access to a water supply so that water can be added to compost if needed.

LOCATION OF COMPOSTER AND TYPICAL SEPARATION DISTANCES



The composting process generates leachate that can pollute surface water, stormwater and groundwater if not managed effectively. Compost leachate can contain organic matter, organic nitrogen, nitrate and ammonia, phosphate, other nutrients and salts. This should be strongly considered when siting facilities and planning risk prevention. Clean rainfall from outside the composting area needs to be excluded so that it does not flow through the area and become contaminated. All runoff or leachate from within the operational areas must be collected and managed.

SIZING

The size of the compost unit will depend on the size of the livestock enterprise, the average animal size, the typical mortality rate, and the type of compost unit to be used.

The total annual amount of substrate needed can be estimated based on the typical annual mortality rate (considering size, number and species of deadstock) and the types of substrate available. It is important to be able to access the desired quantities of substrate throughout the year.

Some of the systems described earlier are commercially available units, and it's reasonable to expect the supplier will take a lead role in sizing the unit.

The following will focus on the sizing considerations for the static-pile systems, which are usually designed by the livestock producer.

For each static-pile composting unit, plan for at least three composting bins. Two bins are needed for the primary stage of composting (first-heat stage), and a third one is needed for the secondary stage of composting (second-heat stage).

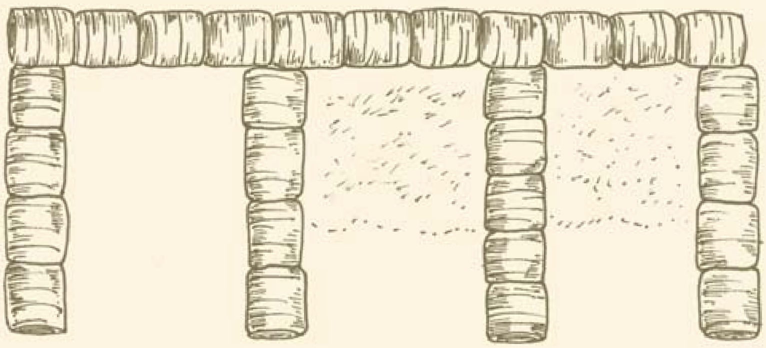
Some larger operations will need more than one composting unit. One or more bins may also be needed for storing the substrate or the finished compost.

The size of bins required must be calculated for each individual operation. Each primary composting bin needs at least 1.25 m^3 (44.14 ft^3 or 1.63 yd^3) for every kg (2.2 lb) of "average daily deadstock" that will be composted, if sawdust is the substrate. However, the composting bins should be 50% larger than this to allow for an unexpected increase in mortality rate or expanded production.

If you plan to use less dense substrates, such as straw and corn silage, you will need more bin space per kilogram of deadstock. Each secondary bin should be at least two-thirds the size of the primary bin.

In general, a storage bin for substrate should equal the volume of two primary bins. If a storage bin for finished compost is desired, it should be equal in volume to one primary bin.

SIMPLE LARGE-BALE COMPOSTING UNIT



Consider all management and site factors when planning a compost system for on-farm deadstock.

Three separate bins are recommended: two for the primary stage and one for the secondary stage.

EQUIPMENT LIST

A COMPOST THERMOMETER is the way to keep track of compost temperatures. It should be constructed of stainless steel with a 6-mm ($^1/_4$ -in.) diameter shaft and measuring at least 1 m (39 in.) in length. Take the internal temperature of the pile at several locations, including close to the last deadstock added. Temperatures should remain between 55 °C and 65 °C (130–150 °F) for at least seven consecutive days.

LOADING EQUIPMENT is needed to move substrate and deadstock, to move finished compost, and depending on the system, to mix composting materials. In many cases, a tractor-mounted front-end loader or skid-steer loader is used. The most suitable equipment will depend on the compost system design, equipment available on-farm, frequency of use, amount of material being handled, location of the composting system, and available labour.

It's possible that pieces of the larger bones will remain after the bulk of the deadstock has completed composting. These bone fragments are easily broken down and pose no health risk or hazard to tractor tires or other equipment. However, they can be unsightly when spread onto the land. Remaining bones can be added back into the input end of the system where they will be further composted.

MANAGEMENT

A complete composting cycle has three main stages: loading, the primary heating stage, and the secondary heating stage.

In situations of catastrophic losses where the compost pile can be built in a very short period of time, the loading stage can be either reduced or eliminated, thus reducing the total composting cycle by up to one-third.

Space deadstock evenly when loading.

Typically in a bin system, deadstock under 25 kg (55 lb) take 45 days for each stage, for a total of 135 days for the complete cycle. For deadstock 25 kg and over, allow 90 days for each stage, giving a total of 270 days.

However, it may take a year to completely compost deadstock over 200 kg (440 lb).

LOADING PRIMARY BIN

1. Fill one of the primary bins over a period of 45 to 90 days, depending on the average weight of the deadstock.
2. Spread 0.6 metre (2 ft) of substrate to make a base to absorb any leachate.
3. Place the deadstock on the substrate, at least 0.3 m (1 ft) from the edge of the bin. Space the deadstock evenly on the substrate. Place larger deadstock on their sides to maintain the recommended pile height of less than 1.8 m (6 ft). If needed, cut the ligaments and tendons in the legs and fold them down. Cutting open the body cavity of larger deadstock will reduce bloating and promote increased microbial activity.
4. Immediately cover the deadstock with at least 0.6 m (2 ft) of substrate. Ensure all parts of the deadstock are covered with substrate.
5. When adding more deadstock, skim off a portion of the top layer of substrate and add new deadstock to the pile, being sure to cover them properly.
6. Once the primary bin is filled, leave the material to compost for an additional 45 to 90 days. While one primary bin is composting, another primary bin can be filled.
7. Make sure all deadstock are completely covered with 0.6 m (2 ft) of appropriate cover material. Settling of the pile or wind action may reduce the depth of substrate over time.

Heat and steam are generated during the primary stage.

Mix and fluff materials when moving to secondary bin.

LOADING SECONDARY BIN

1. Move the pile from the primary bin to the secondary bin after 45–90 days from the last addition of deadstock, and the second primary bin has been filled.
2. The secondary bin represents a second heating stage. When moving the material, try to mix and fluff it to create a more uniform blend of materials and to increase the air space within the pile. This optimizes the second heating stage.
3. Cover surface with a fresh layer of substrate to act as a biofilter.

Specialized equipment is available to turn compost windrows.

COMPOST WINDROWS

1. Follow a loading process similar to the bin system, except there are no containment walls around the pile. A base of substrate is established, substrate and deadstock are layered into the windrow, and the entire pile is capped with substrate.
2. Instead of transferring material to a secondary bin, the pile is turned using a front-end loader or specialized equipment to introduce oxygen and re-blend the material.

MAINTAINING MOISTURE

For a pile or windrow with a roof or cover, the top layer of substrate may be left flat or concave (dished) so that any added moisture will be more easily absorbed.

A convex or peaked shape may be appropriate for any uncovered piles to limit the amount of rain or snow that will soak into the pile. Although a peak may be desirable during a wet period, the pile may need to be flattened or dished to capture moisture during a dry period.

You could also use a rain-shedding tarp system over the piles. These must be breathable to allow oxygen transfer.

Build peaked piles to shed rain and snow. This will help keep the pile aerobic.

MONITORING

Any composting system should have a basic level of monitoring, especially when you're starting out. Check the pile regularly to monitor the substrate cover, temperature and moisture. Record the information.

Throughout the composting cycle, watch for and take steps to prevent scavenging by animals.

Excessive leachate/runoff and odour from a pile are indicators of a problem with the compost recipe or pile management.

A simple record-keeping system should include:

- ▶ dates
- ▶ details about deadstock added
- ▶ substrate used
- ▶ pile temperature
- ▶ pile moisture.

Good records will help you make decisions for future improvements to the system, and demonstrate due diligence.

If tarps are used to cover a windrow compost pile, the tarps need to be held down in a secure manner.

SAMPLE COMPOSTING RECORD SHEET (USE ONE SHEET PER BIN)

BIN TYPE (Primary, Secondary)	BIN # (1, 2, 3...etc)	DATE INITIATED	COMMENTS:

DATE	TEMPERATURE	MOISTURE LEVEL	DEADSTOCK ADDED (species and weight)	SUBSTRATE ADDED (amount and type)	OBSERVATIONS/COMMENTS
June 2, 2009	62°C	45%	1 calf, 45 kg	Sawdust, 70 kg	

WINTER COMPOSTING

As the air temperature drops, it's more difficult to establish microbial activity in a composting pile, especially in uncovered piles. If possible, avoid starting a new pile from December to February. If a new pile must be started in the winter, consider using finished compost from the previous year as part (up to 50%) of the starter substrate, since the appropriate micro-organisms will already be present to kick-start the heating process. **If the deadstock is frozen, it should be thawed before being added to the pile.** Some in-vessel units are equipped with supplemental heaters to help start the process in cold weather.

IN-VESSEL COMPOSTING

Composting "in-vessel" refers to a closed vessel, usually with continuous mixing.

Vessels can be in the configuration of a rotating cylinder that rotates slowly and tumbles the mixture. Other types rely on mixing augers to keep the material aerated. The vessels are insulated to retain heat generated from the process. The continuous mixing ensures constant temperatures throughout the compost and thus speeds the process.

The enclosed system does not require the extra cover to act as a biofilter, and can reduce the substrate volume substantially. These systems are suitable for smaller animals. Large animals would require cutting into smaller pieces.

An in-vessel composter is more expensive to own and operate than a static-pile system, but greatly reduces the composting time to produce a product of uniform consistency.

Properly finished compost resembles potting soil and should not contain any recognizable parts of deadstock.

FINISHED COMPOST

Properly finished compost has a slight earthy smell. In colour and texture, it resembles a rich potting soil. As mentioned earlier, if fragments of bones remain, they should be screened out.

In most cases, the best way to use the finished compost is through land application. It represents a source of nutrients and organic matter that can be put to use for improving soil health and plant growth.

If there are large enough quantities, be sure to get a nutrient analysis of the finished compost and include it in your nutrient management plan or strategy. The finished compost is best spread on the property where generated.

TYPICAL NUTRIENT CONTENT OF FINISHED COMPOST FROM DEAD CATTLE	
Dry Matter (%)	30
Nitrogen (%, as is)	0.74
C:N Ratio	25
Phosphorus (%, as is)	0.20
Potassium (%, as is)	0.36

TROUBLESHOOTING GUIDE

Even though composting is a relatively simple practice, problems can occur.

Sometimes, a rather easy fix may mean the difference between successful composting and giving up on the practice altogether. The table below contains tips on the causes and solutions of some of the more common problems that have been encountered when composting deadstock.

PROBLEM / SYMPTOM	PROBABLE CAUSE	POSSIBLE SOLUTIONS
TEMPERATURE TOO LOW	• too dry (less than 40% moisture) • too wet (more than 60% moisture) • improper C:N ratio • inadequate mixing of ingredients • adverse environment	• add water • add substrate and mix pile • evaluate substrate and adjust as necessary • layer ingredients appropriately • ensure adequate cover
FAILURE TO DECOMPOSE	• C:N ratio too high • deadstock layered too thickly • deadstock on outside edges • frozen carcasses	• evaluate substrate and adjust as necessary • ensure thinner layers (or single layer) of deadstock • maintain 0.3 m (1 ft) between deadstock and edges • thaw deadstock before adding
ODOUR	• too wet • C:N ratio is too low • inadequate cover over deadstock	• add substrate and turn/mix compost • evaluate substrate and adjust as necessary • cover with 0.6 m (2 ft) of substrate
FLIES	• inadequate cover over deadstock • poor sanitation conditions • too wet • failure to reach proper temperature	• cover with 0.6 m (2 ft) of substrate • avoid leaching from pile • turn pile and add substrate • assess C:N ratio and layering
SCAVENGING ANIMALS	• inadequate cover over deadstock	• maintain 0.6 m (2 ft) cover • install a fence or barrier

WORKSHEET FOR SIZING BIN COMPOSTING UNITS

A. Determine the annual weight of deadstock on your farm.

LINE	STEPS	SAMPLE FARM	YOUR FARM
1	Enter the number of deadstock per year.	60 head	______________ deadstock/year
2	Enter the average weight of the deadstock.	125 kg	______________ kg/deadstock
3	Enter the kg of deadstock per year.	$60 \times 125 = 7{,}500$ kg/year	______________kg/year

B. Determine the volume needed for a composting unit consisting of two primary bins and one secondary bin, and the number of units required.

LINE	STEPS	SAMPLE FARM	YOUR FARM
4	Calculate volume of one primary bin: divide the total weight of annual deadstock (calculated in Line 3) by a conversion factor to account for substrate density and deadstock size (under 25 kg or 25 kg and over). Conversion factors for common materials are listed in the chart at the bottom of the page.	Example is based on deadstock 25 kg and over, using sawdust as a substrate. $7{,}500 \div 703 = 10.7\ m^3$	____________ $\div$ ____________ $=$ ____________ m^3
5	Calculate the volume of one secondary bin: multiply the volume of one primary bin (Line 4) by 0.67*.	$10.7\ m^3 \times 0.67 = 7.17\ m^3$	____________ $\times$ ____________ $=$ ____________ m^3
6	Calculate the number of units: divide the volume of one primary bin (Line 4) by the proposed pile height (1.4–1.8 m) and divide by a maximum floor area of 6 m^2 per bin. (Note: floor area may be greater if bins are no more than 2.45 m wide.)	$10.7\ m^3 \div 1.8\ m \div 6\ m^2$ $= 1.00$	____________ m^3 $\div$ ____________ m $\div$ ____________ m^2 $=$ ____________

C. Determine the approximate volume of a storage bin needed for an annual supply of substrate.

LINE	STEPS	SAMPLE FARM	YOUR FARM
7	Calculate the approximate volume of substrate storage bin: multiply the volume of one primary bin (Line 4) by 2**	$10.7\ m^3 \times 2 = 21.4\ m^3$	_________ $\times 2 =$ _________ m^3

* The volume of the secondary bin should be at least two-thirds the volume of one primary bin.

** Generally, the volume of substrate required for one year of composting will equal the combined volume of two primary bins. A larger bin may be necessary if a very coarse and low-density substrate is used.

CONVERSION FACTORS

SUBSTRATE	DEADSTOCK UNDER 25 kg	DEADSTOCK 25 kg and OVER
SAWDUST	1,406	703
STRAW	730	365
CORN STALKS	595	297
CORN COBS	1,784	892
CORN SILAGE	2,677	1,338

INCINERATION

THIS CHAPTER DESCRIBES WHAT'S INVOLVED IN PROPER INCINERATION, AND:

- **its advantages**
- **equipment – types, sizing, siting**
- **costs of purchase and operation.**

Incineration is a legal option for disposal of deadstock. If done properly with the right equipment, it can reduce the carcasses to an inert ash.

Outdoor furnaces are not suitable for incineration.

The initial expense of the incinerator, the cost of fuel, and maintenance of the incinerator make this an expensive option. The poultry industry has used this method for disposal of deadstock occurring in their regular operation. However, the size and cost of units capable of incinerating large quantities of poultry or large carcasses should be considered relative to other disposal options.

In the past, more nuisance complaints were generated by improper combustion practices than by any other means of disposal. Piling deadstock, dousing them with fuel, and igniting the pile is not an acceptable method of incineration. Nor is feeding them into an outdoor furnace.

Homemade incinerators, usually constructed from 45-gallon barrels or other drums, are unsatisfactory because they do not adequately control the emission of contaminants to the air.

WHAT'S INVOLVED

Incineration refers to fuel-assisted cremation of deadstock. Specially designed on-farm incineration units use fuel, temperature controls, and enclosed environments to reach high temperatures, and secondary combustion (afterburner on flue) to reduce gaseous emissions.

An incineration unit must have the capacity for secondary combustion to be effective and safe.

Regulation 106/09 for deadstock disposal under the Nutrient Management Act, 2002 requires that an operator must not use an incinerator unless it has been issued a Verification Certificate by the Environmental Technology Verification Program (ETV Canada). This means it has a secondary chamber capable of maintaining the gases entering it from the primary chamber for:

- ▶ at least 1 second at a temperature of 1,000 °C (1,832 °F) or higher, or
- ▶ at least 2 seconds at a temperature of 850 °C (1,562 °F) or higher.

This reduces the particulate and gas emissions, thus reducing odour and smoke.

ADVANTAGES

Using fuel-assisted incineration equipment to dispose of deadstock has definite advantages. On-farm incineration is biosecure. It gets the deadstock out of public view and reduces the potential for attraction of scavengers and flies. Modern incineration equipment can reduce the deadstock to a fraction of their original weight, leaving just an inert ash behind.

Properly maintained, the equipment is easy to operate and does not have excessive labour requirements. The deadstock is simply loaded into the incinerator and the controls are set for complete burning. Only periodic observation, routine maintenance, and cleanout of ash are required.

Incineration can be used as an alternative in areas where drainage is poor (making burial unacceptable) or where rocky soil makes digging expensive.

It's one of the most biologically safe methods of disposal and does not create water pollution problems. The comparatively small amount of waste by-products (ash) can be disposed of easily.

The main environmental concern with units not equipped with the secondary burner is the emission of particulates that are generated during the burning process.

Commercial incineration units operate on propane, diesel, or natural gas.

Homemade incineration units are unsuitable for incinerating on-farm mortalities.

TYPES OF INCINERATORS

Commercially available and approved incinerators are the best equipment to ensure proper burn and to avoid creating pollution.

Incinerators usually operate on diesel, natural gas, or propane. The discharge stacks must be fitted with afterburning devices in order to be approved. Diesel-fuelled incinerators require from 4 to 12 litres (0.9–2.7 Imp gal) of fuel per 45 kg (99 lb) of carcass.

Large deadstock are more difficult to burn and awkward to handle, and require more fuel per weight of carcass to reduce them to ash.

When purchasing an incinerator, consider the following features:

- sturdiness – the unit should be able to operate under heavy loading conditions and withstand high operating temperatures
- automatic controls – a unit that can be loaded, ignited, and allowed to run on a timer is a real convenience
- capacity – the livestock operation must estimate the expected daily mortality rate and consider animal size when calculating the incinerator capacity needed
  - the incinerator should be able to accommodate normal daily deadstock
  - when heavy, unexpected losses occur, alternative methods of disposal should be considered.

Selecting an appropriately sized unit will avoid overloading and ensure proper operation for a longer period of time. Commercial incinerators are typically marketed with specific burn rates (kg/hour).

Before choosing incineration, carefully consider the start-up and ongoing cost of operating an incineration unit relative to other disposal options.

SIZING OF UNIT

Incinerators are a more viable option for smaller deadstock. Providing low and consistent volumes of deadstock is the most practical way of operating an incinerator. As the weights and volumes being incinerated increase, the required fuel-per-weight ratio increases.

This is why keeping the deadstock in cold storage and only operating the incinerator once a week makes sense in terms of labour – but requires more fuel. The prompt incineration of deadstock, as they occur, reduces the size of the unit required.

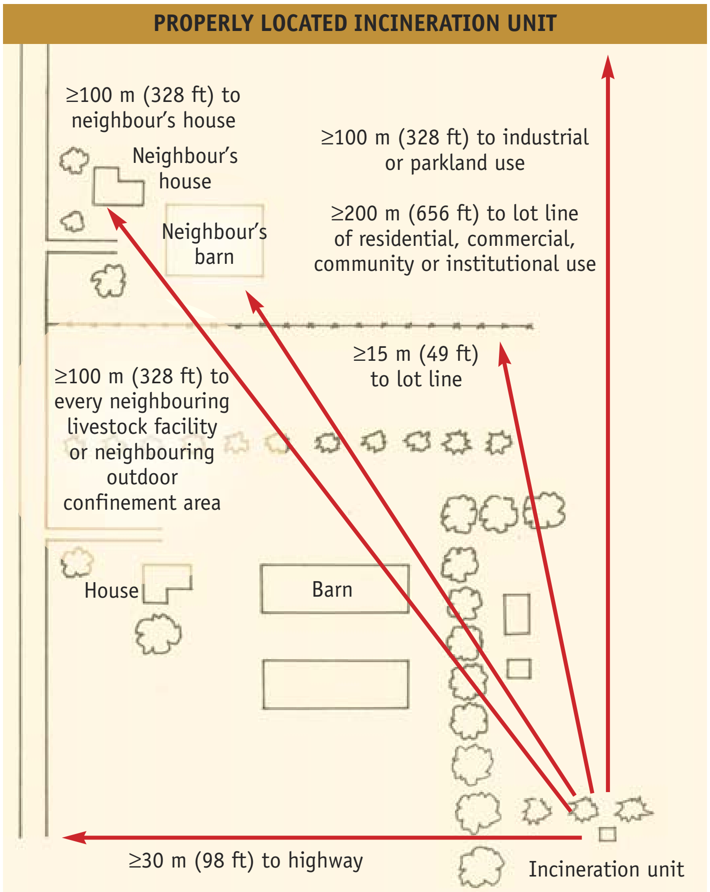
Under the regulation, a maximum of 1,000 kg (2,205 lb) of deadstock can be incinerated in a 24-hour period. A unit for poultry incineration will not require as large a chamber as one used for swine or cattle.

It is imperative that recommended procedures for locating and operating the unit are adhered to, and the units maintained to proper operating specifications.

LOCATION OF UNIT

Placing the incinerator in a convenient location is very important. Care must be taken to avoid potential problems such as odour complaints from neighbouring properties and even family. Ideally, the unit should be downwind from operations, farm residences, and neighbours.

To protect the incinerator from the forces of nature and extend its life, place the incinerator on a concrete slab under a shelter. Because of the intense heat that's generated, clearance between the discharge stack and any wooden structure must be maintained in accordance with the Building Code. Any combustible roof parts must be at least 45 cm (18 in.) from the incinerator chimney.



A properly sited incineration unit will prevent issues with neighbours. Follow the procedures in the earlier Planning chapter (pg. 32) to choose the most suitable location.

Sturdiness, ease of loading, and control systems are key considerations when selecting a commercial unit.

ASSOCIATED COSTS

The capital costs of incineration equipment vary among different manufacturers and with incinerator capacity and operational features.

Other associated costs are:

- hookup to the fuel source and inspection
- specialized equipment necessary for handling the deadstock and ash
- site preparation
- the construction of a concrete slab and shelter
- fuel storage.

Some considerations in evaluating the cost of operating incinerators include the burn rate and price of fuel. Incineration costs can vary depending on weight, moisture, and fat content of the deadstock, and the loading capacity of the unit. As the size of the deadstock increases, so does the burn time.

Maintenance costs can be significant. Expendable parts and grates need to be replaced every two or three years. The entire unit may require complete refurbishment or replacement every five to seven years.

DISPOSAL VESSELS

DISPOSAL VESSELS CAN BE A GOOD DISPOSAL OPTION FOR SMALLER DEADSTOCK. THIS CHAPTER COVERS:

- **how and why they work**
- **desired depth, materials, orientation, accessibility, size**
- **considerations for excavation and decommissioning**
- **how to estimate costs.**

HOW AND WHY DISPOSAL VESSELS WORK

Disposal vessels have been used in the past for dead poultry in the United States and Canada. They are also known as disposal units, burial pits, dead pits, or mortality pits. They are scavenger-proof, leak-proof containers into which deadstock are placed to decompose naturally.

The use of disposal vessels is simple.

1. Open the secured hatch.
2. Place deadstock inside.
3. Close and secure hatch.
4. Let natural processes proceed.

Decomposition occurs by a variety of mechanisms:

- aerobic and anaerobic breakdown by micro-organisms
- consumption by insects such as blowflies
- evaporation of water
- release of gases such as carbon dioxide.

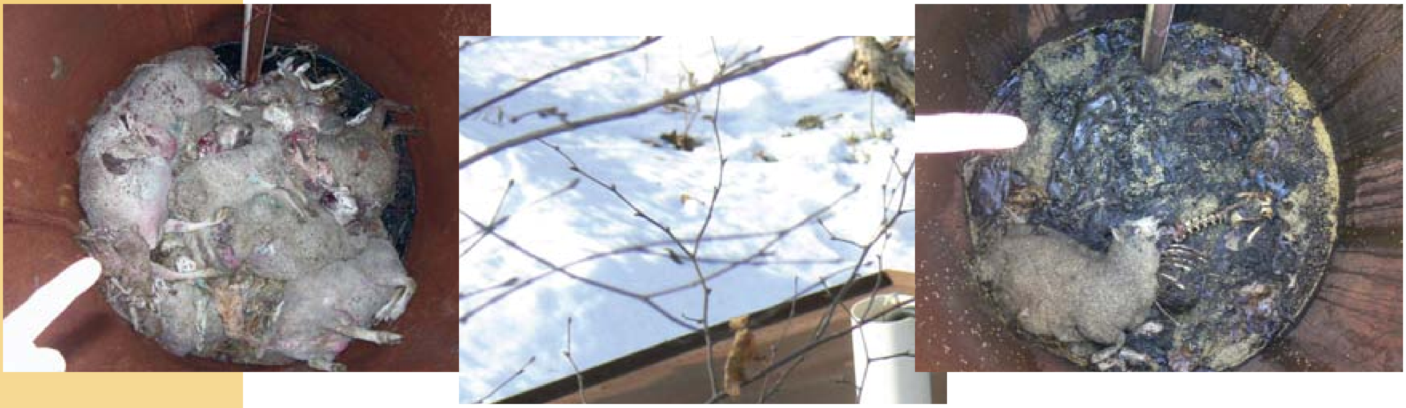
Many things happen when livestock die and are placed in a disposal vessel. Deadstock flesh is opened by insects, exposing it to micro-organisms. Decomposition occurs aerobically on top of the pile, but may also decompose anaerobically when buried by other deadstock. Air temperatures in the vessel will fluctuate over the day, the season, and when deadstock are added. The rate of water evaporation and release of gases fluctuates. Although the mass of deadstock placed in a vessel can be measured, it is difficult to measure how much mass exits the system through evaporation of water, movement of insects and micro-organisms, and exchange of gases.

Carcass decomposition is faster during warm weather than cold. However, if vessels are buried mostly underground, decomposition continues during the cool fall or early spring because air temperatures inside the vessel remain high enough (usually above freezing) throughout the year.

Options for installing disposal vessels:

- **above ground on a supporting structure**
- **on the ground, or slightly below ground**
- **partially or fully below ground**

This disposal vessel was used for a recent on-farm trial for disposal of dead sheep.



The photo series shows sequential pictures in the same vessel over a few months. In April, carcasses show little decomposition because several deadstock were added over a short period and air temperatures were cool over the winter and spring. In July, prolific maggot and insect activity occur because of higher air temperatures. In November, considerable decomposition can be seen after a summer and fall of high temperatures, with a tough mat-like crust remaining between carcasses.

Previous disposal vessels had no bottoms, allowing liquids released during decomposition to drain downward with little regard for groundwater quality. In soils with high permanent or temporary water tables, water could also rise into these former vessels – clearly an undesirable situation.

Recent Ontario on-farm research has demonstrated the effectiveness of watertight disposal vessels, offering assurance that water quality is maintained.

ADVANTAGES AND DISADVANTAGES OF DISPOSAL VESSELS

ADVANTAGES	DISADVANTAGES
• provide disposal option where few options exist (sheep)	• impractical to empty when full, so vessels must be decommissioned
• simple and practical to use	• require proper siting with respect to water table/bedrock
• environmentally friendly, if done according to the new regulation	• can be difficult to lift deadstock into
• use readily available materials and equipment	• can be more difficult to decommission when installed mostly above ground
• relatively inexpensive to install and operate	• can "float like a boat" if not installed properly
• keep deadstock on farm – promoting biosecurity	• require precautions during installation – especially when installing disposal vessels deeper than 1.2 m (4 ft)

SUITABLE DEADSTOCK FOR DISPOSAL VESSELS

Disposal vessels will work with any type or size of deadstock, but they make more sense for operations with deadstock that **individually weigh up to about 75 kg (165 lb)** such as: sheep, goats, poultry, smaller swine, calves and furbearing animals. The smaller carcass size allows them to decompose quickly. Feathers do not decompose quickly so it is not recommended to dispose of poultry in a disposal vessel. It might be more practical and cost-effective to use one of the other allowable disposal options for poultry, such as storing them in a large chest freezer for periodic pickup by a licensed deadstock collector, or composting.

Disposal vessels also make more sense for **operations with no more than about 70 kg (154 lb) of deadstock per week** to manage. Biological activity fluctuates in a vessel, but adding too many deadstock at once can overwhelm the system, slow decomposition, and cause odours. For example, this could occur if large volumes of furbearing deadstock after fall pelt harvest were disposed of all at once in a vessel. Research shows a 10 cubic metre (353 ft^3) disposal vessel (maximum size allowable under the new regulation) will ultimately hold up to about 15,000 kg (33,000 lbs). Assuming this disposal vessel was filled over a four-year period, this requires an average of about 70 kg (154 lb) per week. Operations with more than this amount of weekly deadstock might consider more cost-effective options such as pickup by a licensed deadstock collector where that service is available.

Some operations have few viable deadstock options, such as sheep or goat farms:

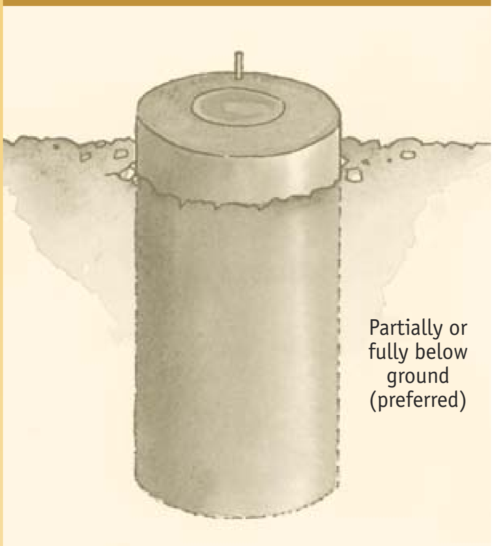
- **licensed deadstock collection** may be cost-prohibitive, and unavailable in some areas
- **burying** in winter is impossible because of frost in most areas and many operations are located on soils that are shallow to bedrock
- **composting** does not generate high enough temperatures to destroy proteins responsible for scrapie, a fatal brain disease in sheep – producers do not want to spread the resulting compost on their fields due to fear of possible spread of this disease
- **incineration** is more difficult because of the wool in sheep, and it is a very costly option.

INSTALLING DISPOSAL VESSELS

You have three options for installing disposal vessels: above the ground on a supporting structure; on the ground or slightly below ground; or partially or fully below ground.

Installing a disposal vessel **above the ground** on a supporting structure is **not recommended** for several reasons. The supporting structure would need designing to withstand the weight of materials inside when it becomes full and ready for decommissioning. The vessel itself may not be designed for the possible unbalanced weight of the decomposing and decomposed materials inside. Also, it would be costly, difficult and hazardous to place deadstock inside, and decommissioning would be time-consuming, costly and possibly hazardous.

VERTICAL ORIENTATION



Installing a disposal vessel **on the ground or slightly below ground** is better and may be the only viable option if there is a shallow bedrock or aquifer issue. The new regulation requires the lowest point of a disposal vessel that is partially or fully below ground to be at least 0.9 m (3 ft) above the top of the uppermost identified bedrock layer or aquifer, unless the disposal vessel is placed on an impervious pad.

However, the farther out of the ground a disposal vessel is, the more difficult it is to place deadstock inside and the more difficult it is to decommission. If possible, placing at least part of the vessel below ground will assist in anchoring it.

Installing a disposal vessel **partially or fully below ground** is preferred for several reasons. It's easier to lift deadstock into the vessel, especially if you place it so the access hatch is about 0.6 m (2 ft) above ground. Hatches more than 1.2 m (4 ft) above ground are not recommended. It keeps the vessel warmer in winter because of heat from the surrounding soil, aiding in the decomposition. It's easier and less costly to decommission the vessel because it's already mostly underground.

For safety reasons, it's a good idea to place a flag near a below-grade disposal vessel to warn people it is there. Be sure to take into account the possible depth of snow around the vessel in winter.

DISPOSAL VESSEL MATERIAL

Disposal vessels can be made from steel, concrete, plastic, or fibreglass, as long as they are designed for external soil pressures when installed below grade, or for internal pressures from the deadstock when installed above grade.

Purchasing new disposal vessels, regardless of material type, could be cost-prohibitive. However, used vessels, such as cylindrical steel fuel tanks could be used, provided they are **thoroughly emptied and cleaned of residual fuels** because of the environmental risk and safety concerns of fire and/or explosion. Steel vessels might even be preferred since they will deteriorate long after the disposal vessel has been filled and its contents have long since decomposed and become a mass of essentially biologically inactive organic materials.

It's important that once a disposal vessel is installed, it be filled to capacity and decommissioned properly, because a partially filled underground steel tank will cave in over time through rusting and could pose a safety risk. However, properly filled with deadstock and properly decommissioned, this should pose little safety risk. Over time, the vessel contents are little different than if several deadstock were simply buried in the soil at one time.

Where possible, plan the vessel size to correspond with needs over a few years, remembering the regulation states the interior volume of a vessel must not exceed 10 cubic metres (353 ft^3). Inspect above-ground vessels yearly for signs of corrosion or damage, and take corrective action.

DISPOSAL VESSEL ORIENTATION

Recent and continuing Ontario on-farm research has compared vertical (like standing a pop can on end) versus horizontal orientation (like lying a pop can on its side) of equally sized, cylindrical disposal vessels.

COMPARATIVE ADVANTAGES	
BELOW-GRADE, VERTICALLY ORIENTED VESSELS	**BELOW-GRADE, HORIZONTALLY ORIENTED VESSELS**
• deeper, so soil is warmer, assisting decomposition in colder weather	• shallower, so fewer bedrock or groundwater concerns
• easy to install hatches on flat end	• can install more hatches
• easier to fill vessel as deadstock distribute more uniformly	• lower installation costs, as less excavation required

ACCESS HATCHES AND AIR VENTS

Access hatches don't need to be airtight, since loosely fitting ones encourage entry of flies and insects. However, hatches need to be large enough to manoeuvre awkwardly shaped, large, bloated, or rigored deadstock.

More than one hatch may be necessary on long, horizontally oriented disposal vessels to ensure the entire vessel gets filled. Hatches 0.9 metres (3 ft) square are large enough for 75 kg (165 lb) deadstock. However, large steel hatches are very heavy.

Simple all-weather hinges should be installed and hatches should have large handles – allowing them to open easily and widely. For safety reasons, hatches should be locked between uses.

Disposal vessels should have at least one air vent or duct large enough to allow flies and other insects to enter and to allow air movement in and out of the vessel. In field tests, a 10 × 10 cm (4 × 4 in.) duct was found to be sufficient. Make sure the duct is above the surface of the ground and above expected snow levels. Except for this duct, the vessel must be impervious and leakproof when the hatch is closed.

Hatches do not need to be elaborate, but must be large, strong, easy to open during any kind of weather, and locked between uses. Air vents on top only need to have openings large enough to encourage flies that scavenge on deadstock to find their way into the vessel.

SIZING OF DISPOSAL VESSELS

Every deadstock has a different shape and weight. The mass of deadstock in a disposal vessel has an **effective density** defined as the weight of deadstock placed over time divided by the volume they take up in the disposal vessel over time.

Because of the exodus of flies, other insects, moisture and gases, the mass of decomposed deadstock becomes denser over time. Ontario research showed the effective density over four years rose from 640 kg/m^3 to 1,600 kg/m^3 (40–100 lbs/ft^3).

Shorter filling times will result in a lower effective density; longer periods will result in a higher effective density. For planning purposes, use 1,600 kg/m^3. Individual results may vary.

In Ontario, Regulation 106/09 under the Nutrient Management Act, 2002: Disposal of Dead Farm Animals states that individual disposal vessels can be no larger than 10 m^3 (10,000 litres, 353 ft^3).

Ontario research has demonstrated that the top remaining 10% of the vessel will be unusable – so that only 90%, or 9 m^3, is available. If we assume the disposal vessel is planned to be filled over a five-year period with an eventual effective density reaching 1,600 kg/m^3, this means that this size of vessel will hold up to: **9 m^3 × 1,600 kg/m^3 = 14,400 kg of deadstock**. This is about 55 kg (120 lb) per week over the five-year period.

BEFORE EXCAVATING

Regardless of the type of material a disposal vessel is made of (even concrete), it can float like a boat under certain water table conditions – or when surface water is allowed to run into disturbed soil outside a vessel perimeter.

The regulation specifies that the bottom of the vessel must be at least 0.9 m (3 ft) above the uppermost identified aquifer or bedrock layer. Excavating one or two test pits in the vicinity of the proposed disposal vessel site is a good idea to confirm aquifer or bedrock layer. Test pits can show if there are rust spots (mottles) and grey (gley) colours in the subsoil, indicating there might be a seasonal high water table, even if there is no water present in the hole during excavation. Even so, be absolutely certain that high water table problems will not occur before excavating the hole or after the vessel is installed.

Soil must be uniformly backfilled and compacted around the vessel in layers, then sloped against the vessel to shed surface water. Otherwise, surface water could run down the outside of the vessel and still create a floating problem. Keep excavated soil nearby for future decommissioning.

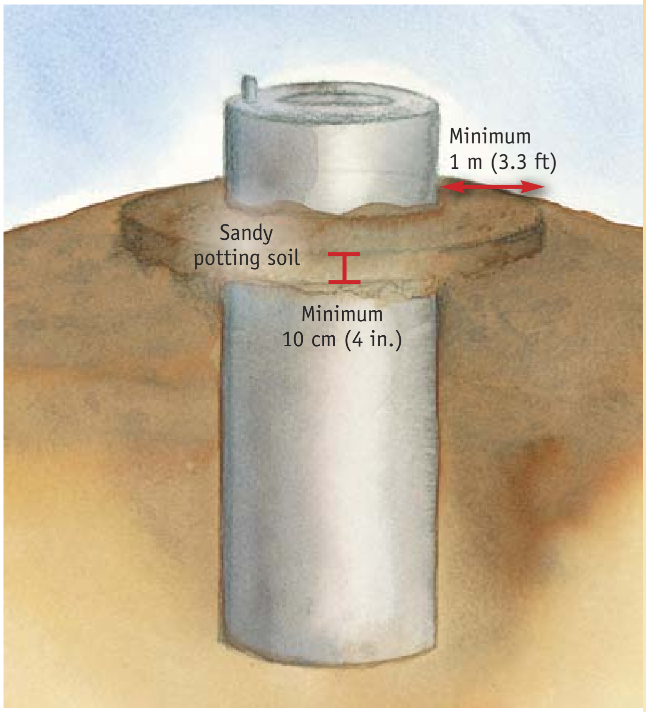
It is beyond the scope of this book to describe all the steps for safe excavation to install a disposal vessel. Several site suitability criteria are listed in Ontario Regulation 106/09 made under the Nutrient Management Act, 2002: Disposal of Dead Farm Animals. Information is included on dealing with soil type, water table and bedrock depths, setbacks to neighbours, wells, and more.

FILLING THE DISPOSAL VESSEL

Although it may seem easy to put deadstock into a disposal vessel, it should be placed with care – because once it is placed, it should not be moved.

For safety reasons, you should never go inside the vessel to move deadstock. You wouldn't want to anyway because of the odours, flies, maggots, and noxious gases. Where possible, do not install the vessel higher than 1.2 m (4 ft) above grade since this makes it difficult to lift deadstock into it. Avoid ladders and steps, and use good lifting techniques. At times it will not be a pretty sight inside a disposal vessel, especially during hot weather when deadstock are added. It is unavoidable to have some larvae find their way out of the vessel, wriggling away as they prepare to find a place to pupate.

- Keep the hatch closed and locked between uses and keep the surrounding area clean, picking up materials if they fall off deadstock.
- Backfill the vessel with a small amount of sandy potting soil, or similar loose soil (not clay) in a ring outside and around the vessel giving a place for larvae to pupate. Make this pupating area at least 1 m (3.3 ft) wide and at least 10 cm (4 in.) deep. For a 10 m^3 (353 ft^3) vessel with a diameter of 2 m (6.5 ft), this would be at least 1 m^3 (35 ft^3) of sand.
- Locate vessels at least 100 m (328 ft) from residences, according to the regulation. Stay farther away if possible. There will be strong odours within 25 m (82 ft) of vessels. Anecdotal evidence suggests most wildlife avoid going near disposal vessels.



Backfilling with sandy potting soil at depth of about 10 cm (4 in.) and in a ring 1 m wide (3 ft) outside and around a disposal vessel gives a place for larvae to pupate.

DECOMMISSIONING

Under the new Ontario regulation, "A disposal vessel must be promptly closed once it is no longer used for the disposal of dead farm animals."

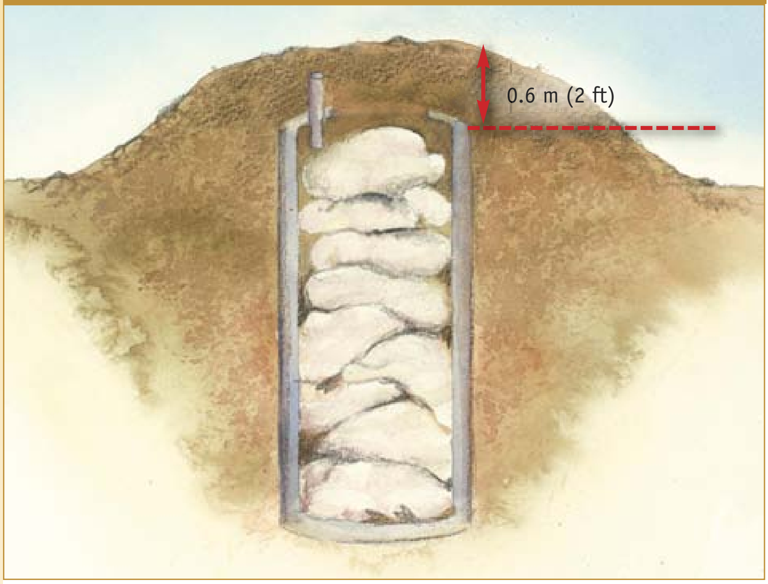
The purpose of closing a disposal vessel is to render it no longer usable or accessible. It's also important to make the site safer. One way to do this is to:

1. Open the hatch to allow access for filling the remainder of the vessel with soil, then compact that soil where possible.
2. Add another layer of at least 0.6 m (2 ft) soil on top.
3. Taper the soil away from the vessel no steeper than 2:1 (2 m horizontally for every 1 m vertically).

This may seem quite steep, but the purpose of the soil is to:

- ► create a steep "hill" to help prevent tractors and other equipment from getting too close in future (barriers such as large stones would also help)
- ► allow for settling both into and around vessel
- ► help prevent any scavenging
- ► keep the vessel out of sight
- ► encourage rapid surface drainage of clean rainfall away from the disposal vessel.

DECOMMISSIONED DISPOSAL VESSEL



The purpose of closing a disposal vessel is to make it no longer usable or accessible. It's also important to make the site safer.

The higher the vessel was originally installed above grade, the higher the resulting final pile. **Regardless, there is unlikely to be enough extra soil from the original excavation, so additional soil will be needed.** Soil from vessel 2 could be used to decommission vessel 1; soil from vessel 3 could be used to decommission vessel 2, and so on.

Depending on time of year, place topsoil as a top-dressing on the decommissioned pile, then plant quick-growing grasses to help stabilize the soil.

Bright flagging should be installed to warn people about the decommissioned vessel location. Obviously it's simpler to decommission a disposal vessel that was originally more below than above ground.

What remains in the ground is a mass of essentially biological inactive materials not unlike well-cured compost with scattered bones – all inside a vessel that may deteriorate over a long period of time, depending on material.

ESTIMATING THE COST OF A DISPOSAL VESSEL

Joanne has a 100-ewe operation and anticipates about 600 kg of dead sheep annually. She'd like the vessel to last 10 years, so it must eventually contain 6,000 kg of dead sheep.

Assuming the eventual effective density is 1,600 kg/m^3, this means the vessel must be at least 6,000 kg ÷ 1,600 kg/m^3 = 3.75 m^3 (3,750 L) in volume.

She can purchase a strong used 5,000-L steel fuel tank which should be large enough, considering it can only be filled to 90% of its volume (4,500 L). The vessel dimensions are 1.5 m diameter by 2.7 m long. She will ensure it has been cleaned of residual fuels.

Joanne has done a site investigation and verified there is no identifiable bedrock layer or aquifer within 0.9 m of the proposed bottom of her disposal vessel. She plans to install the vessel vertically, with 2.1 m of the tank below grade and 0.6 m of the tank above grade. The 1.5 m diameter should give room to install a 0.9×0.9 m hatch.

The used vessel will cost $200 from a scrap yard, $250 to truck it to her farm, $250 to modify it with an access hatch and air vent, $250 to install it, and $250 to decommission it, for a total life cost of $1,200.

So if the ultimate weight of sheep that can be placed in the disposal vessel is 6,000 kg (possibly more), then the cost of disposal is about $0.20/kg ($0.09/lb), not including labour to transport and fill the disposal vessel.

BURIAL

DEADSTOCK BURIAL INVOLVES DIGGING A HOLE, PLACING DEADSTOCK IN IT, THEN COVERING WITH EXCAVATED SOIL. THIS CHAPTER EXPLAINS:

- **site selection**
- **trench and hole types, and how to estimate what type and size to dig**
- **deadstock placement procedures**
- **how to calculate costs.**

HOW AND WHY BURIAL WORKS

Farmers have buried deadstock for generations, but that does not necessarily mean it was always done properly or in the right place. Scavengers can exhume poorly buried carcasses. Burial on inadequate sites – such as those shallow to bedrock or a shallow water table – poses a higher risk for groundwater contamination.

Decomposition of buried deadstock is like a slow batch-composting process. Deadstock compost best when mixed well with a good carbon substrate under favourable moisture, aerobic and temperature conditions.

Similarly, buried deadstock decompose best under optimum conditions, such as:

- ► soils that are well-drained
- ► soils that are more aerobic (meaning with oxygen)
- ► placement in the biologically active part of soil
- ► lots of soil-to-deadstock contact
- ► soils that are warmer.

Decomposition can occur in a few months under favourable soil conditions. But in unfavourable conditions, it can take several years, especially if deadstock are packed tightly in a large mass.

Burial is a traditional deadstock disposal method.

ADVANTAGES AND DISADVANTAGES OF BURIAL	
ADVANTAGES	**DISADVANTAGES**
• burial is simple and requires little training • burial uses readily available equipment • burial is relatively inexpensive, if you own a backhoe • most farms have several suitable locations available • biosecurity is maintained as deadstock stay on the farm	• burial is limited to deep, well-drained, aerated soils • site-limiting factors such as depth to water table can be difficult to predict • burial is virtually impossible in frozen winter soil • there can be human safety issues with digging deep holes • can be costly if you don't own a backhoe – or labour-intensive • it is not convenient to haul heavy, awkward deadstock to remote burial sites, especially in bad weather

SELECTING THE RIGHT SITES

Choosing the right burial site is critical to promote good deadstock decomposition and to protect the environment. Generally, soil materials ranging from sandy loams to clays that are well-drained to imperfectly drained are suitable for burial.

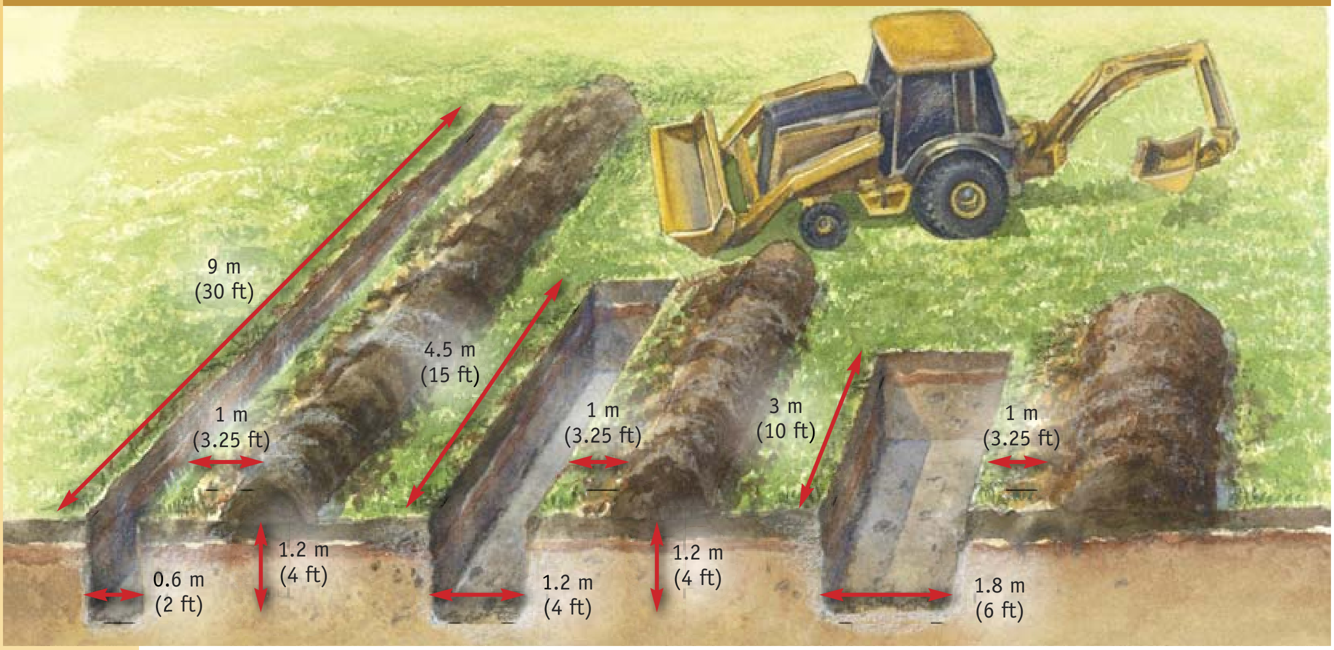
However, the regulation does **not** permit burial of deadstock in soils where there is a higher risk of polluting groundwater. These soils include:

- organic soils – more commonly known as peat, muck, bog or fen soil, and
- soils considered as hydrologic soil group AA, which have a combination of rapid infiltration rates (e.g., gravel) and a depth to the uppermost identified bedrock layer of less than 0.9 m (3 ft)
  - these conditions are not common in Ontario.

The regulation does not permit the burial of deadstock in areas subject to flooding once or more every 100 years. To find out if you are in such an area, contact your local conservation authority or municipality. The regulation requires the lowest point of a burial pit to be at least 0.9 m (3 ft) above the top of the uppermost-identified bedrock layer or aquifer.

DEADSTOCK SIZE	AVERAGE WEIGHT PER ANIMAL – kg (lb)	NO. OF DEADSTOCK TO FILL BURIAL PIT TO MAX. ALLOWABLE TOTAL OF 2,500 kg (5,512 lb)
SMALL DEADSTOCK – e.g., poultry, mink	2.5 kg (5.5 lb)	1,000
MID-SIZE DEADSTOCK – e.g., sheep, veal, goats, swine	50 kg (110 lb)	50
LARGE DEADSTOCK – e.g., cattle, horses	500 kg (1,102 lb)	5

DIMENSIONS (TRENCH/HOLE) FOR LARGE AND SMALL DEADSTOCK



Each of these burial pits is 1.2 m (4 ft) deep and each has the same overall excavated volume. Each will hold about 2,500 kg (5,512 lb) of deadstock. Smaller deadstock might be buried in the narrower pits to maximize soil-to-deadstock contact, while larger deadstock might be buried in the wider pits to accommodate their more awkward body dimensions.

The regulation allows up to 2,500 kg (5,512 lb) of deadstock per pit. This limitation means you should not dig very large or deep pits. In fact, unless there is a good reason to do so, digging deeper than about 1.2 metres (4 ft) makes little sense. Going no deeper than 1.2 metres is preferable because:

- deadstock are placed in the biologically active part of the soil
- groundwater is better protected
- shallower trenches are safer than deep ones.

The Construction Safety Association (CSA) describes trenches (pits) as excavations where the depth exceeds the width of the pit. The CSA states that anyone digging trenches needs to be aware of factors such as soil type, moisture content, weather, and excessive weight like heavy equipment beside a trench that might cause cave-ins.

There are safety concerns with deep pits, so never climb into any pit deeper than 1.2 m (4 ft) **unless it is properly sloped, shored, or protected by a trench box,** which is impractical for burying deadstock.

TYPES OF PITS

The regulation specifies that a burial pit must be immediately closed when 120 days have elapsed since the day the pit was first opened, or when 2,500 kg (5,512 lb) of deadstock have been buried in the pit, whichever comes first. There are three types of pits: single-use, multiple-use, and auger pits.

The type of soil determines the strength and stability of pit walls, and this is especially important for pits that will remain open for up to 120 days. Suitable soils that will allow pit walls to be stable for an extended period include:

- ► Type 1 soils – compacted loamy and clayey soils, dense loamy glacial tills, and
- ► Type 2 soils – well-structured loam, clay loam, clay.

Unsuitable soils that might have unstable pit walls over an extended period include:

- ► Type 3 soils – sand, granular materials, and silty or wet clays, and
- ► Type 4 soils – silty clays with high moisture content.

Once a pit is dug, its sides are exposed to drying. The longer the exposure, the greater the risk of cave-in. Rain, melting snow, thawing earth, and surface water all produce changes in soil conditions that can severely affect pit stability. Heavy equipment beside a pit can affect its stability, so stay as far away as possible. Soil excavated from the pit should be at least 1 m (3.25 ft) from the edge of the excavation.

TYPE	SUITABILITY
SINGLE-USE PIT	• death of one or more animals at same time (e.g., sickness, heat stress), or for deadstock stored over time so burial is done all at once (e.g., freezer full of dead chicken broilers) • single-use pits are usually open only a few hours
MULTIPLE-USE PIT	• operations with daily to weekly deadstock (weaner pigs, poultry) • because all deadstock placed must be covered at all times with 0.6 m (2 ft) of soil, these pits should be dug oversized since soil is being constantly added as deadstock are placed – this takes a lot of room • pits should be flagged as open and/or fenced • frozen soil may make covering difficult in winter
AUGER PIT	• smaller deadstock on smaller farms with a few periodic death losses

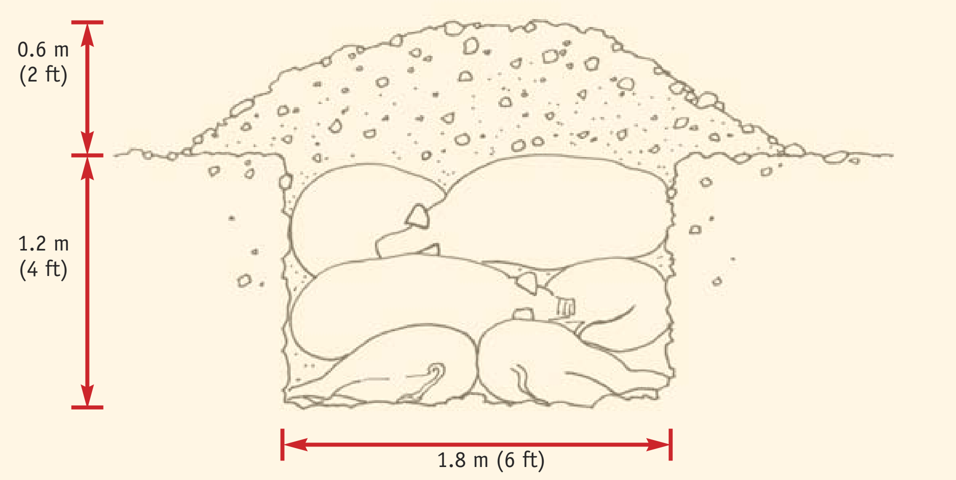
Auger holes are dug quickly using a large-diameter post-hole auger. However, even a hole that is 0.9 m (3 ft) in diameter and 1.8 m (6 ft) deep will only hold about 450 kg (1,000 lb) of deadstock.

HOW BIG SHOULD THE BURIAL PIT BE?

Deadstock have odd shapes, making them difficult to bury, especially if they have begun to bloat or rigor. The **effective burial bulk density** (EBBD) of deadstock is the **weight of a deadstock carcass at death divided by the effective volume it takes up in a burial pit.** The effective volume is difficult to establish because different animals have different profiles, have awkward shapes when buried, and there are unavoidable air pockets.

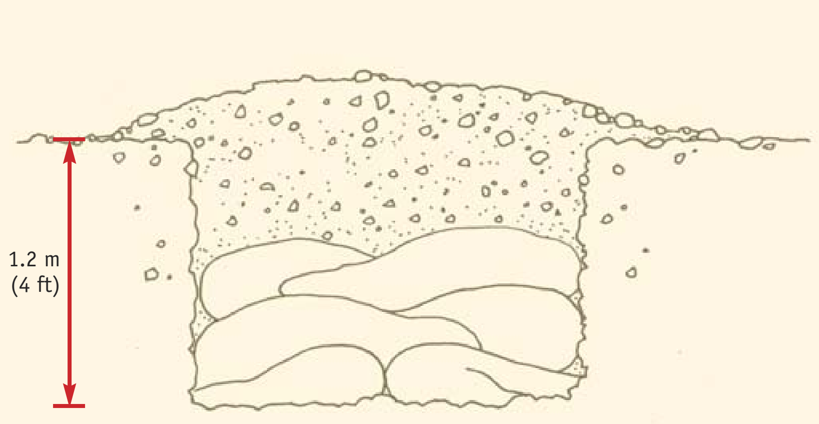
EBBD of deadstock is estimated in the broad range of 175 to 1,000 kg/m³ (10.9–62.4 lb/ft³). For planning, use 400 kg/m³ (25 lb/ft³). When soil is placed on deadstock, it fills some air pockets, and as deadstock decomposes, soil settles into body cavities.

MOUNDED SOIL AFTER CLOSING BURIAL PIT



When closing a burial hole or trench, add enough soil to the top to allow for eventual settling and to help shed surface water.

MOUNDED TRENCH – AFTER SETTLING



Use the table below as a guide for burial pit dimensions dug by backhoe. Modify dimensions as necessary based on the shape of your deadstock. **It is better to over-dig than under-dig,** because once deadstock are in the pit, they should not be moved again. For multiple-use pits, the pit length may have to be increased because deadstock must at all times be covered with at least 0.6 m (2 ft) of soil between burial placement events.

The assumptions in the table below are:

- **EBBD** is 400 kg/m^3 (25 lbs/ft^3)
- pits are minimum 0.9 m (3 ft) deep, maximum 1.2 m (4 ft) deep
- pits are narrow to maximize soil-to-carcass contact, using standard backhoe bucket width 0.6, 1.2, 1.8 m (2, 4, 6 ft)
- top of each deadstock is below original grade level.

EBBD = effective burial bulk density

The formula for calculating **length** of pit in metres is:
L = Total kg of carcasses ÷ EBBD (kg/m^3) ÷ Width of pit (m) ÷ Depth of pit (m).

APPROXIMATE DIMENSION OF BURIAL PITS BASED ON TOTAL WEIGHT OF DEADSTOCK TO BURY AND THE RELATIVE SIZE OF ANIMAL
e.g., 40 dead feeder lambs weighing a total of 1,000 kg require a burial pit at least 1.2 m wide x 1.2 m deep x 1.8 m long (4 x 4 x 6 ft)

DEADSTOCK SIZE AND TYPE	BURIAL PIT SIZE		
	250 kg (551 lb)	1,000 kg (2,204 lb)	2,500 kg
SMALL – poultry, mink	0.6 m (2 ft) wide 0.9 m (3 ft) deep 1.2 m (4 ft) long	0.6 m (2 ft) wide 1.2 m (4 ft) deep 3.6 m (12 ft) long	0.6 m (2 ft) wide 1.2 m (4 ft) deep 9.0 m (29.5 ft) long
MID-SIZE – sheep, veal, goats, swine	1.2 m (4 ft) wide 0.9 m (3 ft) deep 0.6 m (2 ft) long	1.2 m (4 ft) wide 1.2 m (4 ft) deep 1.8 m (6 ft) long	1.2 m (4 ft) wide 1.2 m (4 ft) deep 4.5 m (15 ft) long
LARGE – cattle, horses	n.a. n.a. n.a.	1.8 m (6 ft) wide 1.2 m (4 ft) deep 1.2 m (4 ft) long	1.8 m (6 ft) wide 1.2 m (4 ft) deep 3.0 m (10 ft) long

Similarly, use the next table as a guide for determining how many kilograms of deadstock you can bury in augered holes of a fixed diameter and depth. Unless augered holes have a large diameter and are deep, they will not hold many deadstock, but may still be a viable option for some operators.

APPROXIMATE DIMENSIONS OF BURIAL PITS BASED ON TOTAL WEIGHT OF DEADSTOCK TO BURY IN AUGER PITS AND RELATIVE SIZE OF ANIMAL
e.g., 8 dead feeder lambs weighing 200 kg total require an auger burial pit at least 1.2 m deep x 0.75 m diameter (4 x 2.5 ft)

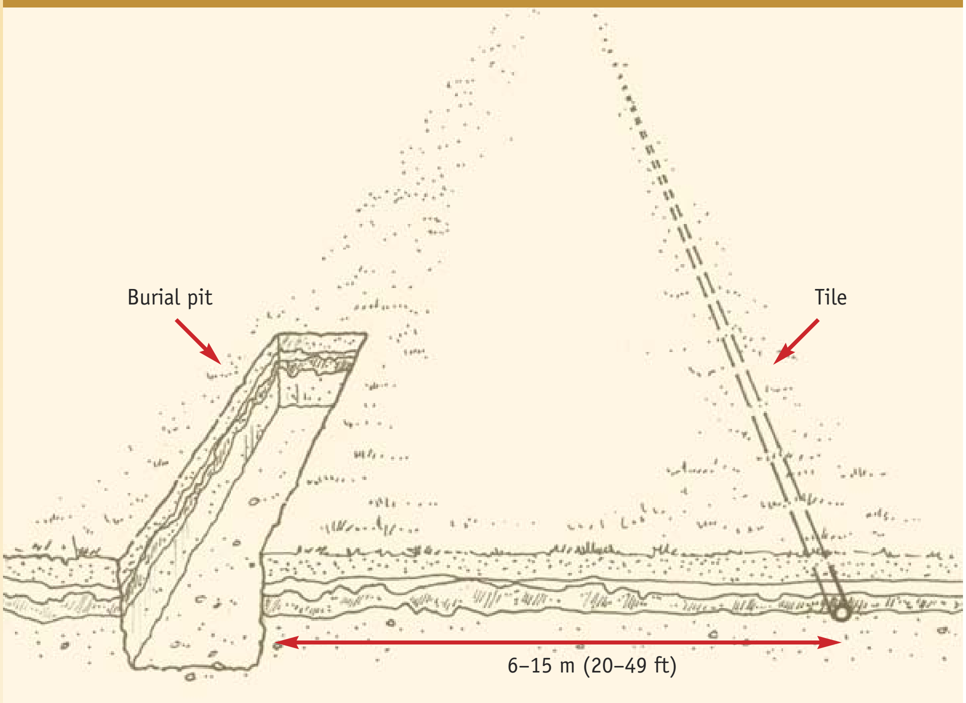
DEADSTOCK SIZE AND TYPE	50 kg (110 lb)	200 kg (440 lb)
SMALL – poultry, mink	1.8 m (6 ft) depth 0.3 m (1 ft) diameter	1.8 m (6 ft) depth 0.6 m (2 ft) diameter
MID-SIZE – sheep, veal, goats, swine	0.9 m (1 ft) depth 0.45 m (1.5 ft) diameter	1.2 m (4 ft) depth 0.75 m (2.5 ft) diameter

DIGGING NEAR FIELD DRAINAGE TILES

Field drainage tiles are prevalent on Ontario farms. Great care must be taken to avoid burying deadstock near tiles so as to prevent leachate reaching them. The regulation specifies every part of a burial pit must be at least 6 m (20 ft) from a field drainage tile. Further, if any part of the burial pit is less than 15 m (49 ft) from a field drainage tile, deadstock must be placed so that the highest point of the uppermost deadstock is lower than the lowest point of the nearest field drainage tile. The reason is if there is any leachate from the burial pit, it should not be able to reach the tile since the leachate would be below the level of the tile.

Deadstock must be buried below the depth of any tile drains that are within 6–15 m (20–49 ft) of the burial pit.

DISTANCE TO TILE



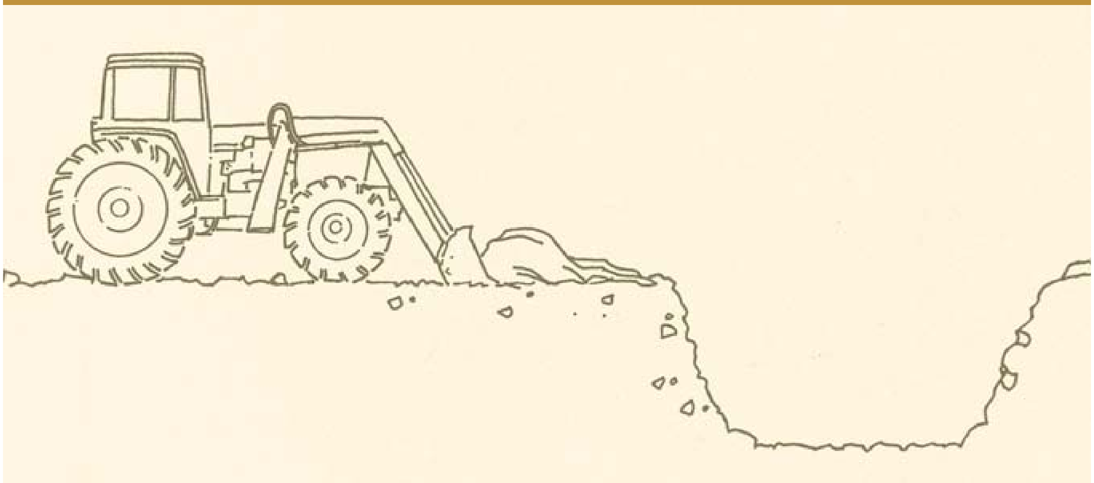
DEADSTOCK PLACEMENT

Within about 48 hours of death, some deadstock begin to bloat due to retained gases, so sometimes lancing (puncturing or venting) larger deadstock (>100 kg) is necessary. Use a bale spear to make a deep stab wound posterior to the ribs to vent the thoracic and abdominal cavities. Lancing should be done just before placing deadstock in the pit. Noxious gases and bodily fluids are likely to escape.

Plan carefully how to place deadstock in the pit. For safety reasons, do not drop them in from a tractor front-end loader bucket unless your front wheels are well back from the pit. Push large, heavy carcasses such as cows into the pit from the side. Always stay as far away as possible from the pit with the tractor.

Adding lime on top of carcasses is not recommended. In the past, lime was added to discourage scavengers, prevent odours, and slow decomposition. If buried correctly, scavengers and odours are not an issue.

PUSHING DEADSTOCK INTO BURIAL PIT



Pushing a large deadstock into a pit is safer than getting too close to the pit with a tractor and loader while dropping the deadstock in.

COVERING DEADSTOCK WITH SOIL

Place as much soil as possible in the air pockets between deadstock to encourage quicker decomposition. Push in soil rather than dumping it in to reduce the chance of cave-in.

The regulation specifies that to close a burial pit, an operator must fill it with enough soil so that the top of the fill soil forms a mound that is higher than the level of the ground at the perimeter of the pit by the greater of:

- half of the depth of the pit measured with reference to its lowest point and
- 0.6 m (2 ft).

This ensures enough soil on top of the deadstock to reduce the chance of scavenging, but also allows for settling as the deadstock decompose and soil falls into the voids between them. Depending on pit depth, the **minimum** amount of soil required **above ground** after closing the pit varies. See the table below.

Lightly compact the soil using a front-end loader or backhoe bucket. For safety reasons, don't drive over the pit. Mark the area with a flag for a period of time so you can find the location again and monitor it for scavenger problems, uneven settling, or leaching.

See the regulation about required record-keeping regarding deadstock, including the location. GPS coordinates of the site would be helpful.

MINIMUM AMOUNT OF SOIL REQUIRED ABOVE GROUND TO CLOSE A PIT – VARIES, DEPENDING ON ORIGINAL PIT DEPTH	
DEPTH OF PIT	**MINIMUM SOIL DEPTH REQUIRED ABOVE GROUND**
1.8 m (6 ft)	0.9 m (3 ft)
1.5 m (5 ft)	0.75 m (2.5 ft)
1.2 m (4 ft)	0.6 m (2 ft)
0.9 m (3 ft)	0.6 m (2 ft)
0.6 m (2 ft)	0.6 m (2 ft)

ESTIMATING THE COST OF BURIAL

Joe grows 25,000 chicken broilers per crop on a 9-week cycle and produces 6 crops per year. His death loss is 4% and the average carcass weight is 0.76 kg. Joe wants to use chest freezers holding 0.71 m^3 each (25 ft^3) to collect and freeze dead birds as they occur. He proposes to bury all the birds from the freezers once every 6 months, or about every 180 days, in May and November when the freezers are full.

QUESTIONS

1. How many freezers does Joe need?
2. How big a burial pit should the hired backhoe operator dig each time if the bucket is 0.6 m (2 ft) wide?
3. What is the cost per year per kg of deadstock?

ANSWERS

1. 25,000 birds × 6 crops × 4% death loss × 0.76 kg/bird = 4,560 kg/year (2,280 kg every 6 months)
   - ▸ EBBD is 400 kg/m^3, so freezers hold 0.71 m^3 × 400 kg/m^3 = 284 kg each
   - ▸ 2,280 kg ÷ 284 kg/freezer = 8 freezers
2. From the table on page 89 under the columns for small animals and 2,500 kg, the pit must be at least 0.6 m wide × 1.2 m deep × 9.0 m long (2 × 4 × 29.5 ft.)
3. New freezers of this size cost about $1,000 each, so 8 freezers amortized over a 10-year life is $800/year (8 × $1000/freezer/10 years). Assuming a hired backhoe and operator costs $80/hour, and 5 hours' travel to and from the farm, dig the pit, push the birds in, then cover and close the pit, this is $400 twice annually, or $800/year.

   The burial pit costs per year are:

   - ▸ $800 for freezers
   - ▸ $800 for hired backhoe labour
   - ▸ $1,600 total yearly cost.

   The cost to bury (not including labour to transport and empty freezers of deadstock to the burial pit) is:

   $1,600/4,560 kg = $0.35/kg ($0.16/lbs)

ANAEROBIC DIGESTION

Anaerobic digestion is the process by which organic materials are decomposed by micro-organisms in an airtight vessel. This process produces biogas, a green energy fuel used to operate a generator that in turn generates energy used either on or off the farm. An anaerobic digester (AD) is the large liquid-containing vessel in which the organic material is heated and exposed to bacteria.

In general, a farm will need several economic drivers to build an AD system. Most systems are built to produce electricity from the biogas to sell back to the provincial electricity grid. On a livestock farm, if the AD system is already in place and has a sustainable input recipe (including manure, other agricultural or food by-products), then the addition of some deadstock material may make sense.

The biogas produced by anaerobic digestion units can be burned for heat or used to generate electricity.

There are few if any AD systems designed to manage large quantities of deadstock, although technically such a system could be viable. On-farm AD systems do often manage other meat-based by-products in limited quantities relative to the amount of manure typically added. Experience from adding meat by-products can be useful in considering digestion of deadstock.

A key technical consideration to adding deadstock to an on-farm AD will be particle-size reduction to ensure that the organic material is fully accessible to the anaerobic bacteria, and to minimize risk of plugging pumps and pipes. Pre-processing to a size of less than 2.5 cm (1 in.) in diameter may be necessary before adding material to the AD system, although on-farm pre-processing may be undesirable. Even if pipes and pumps are of sufficient diameter, adding a whole carcass directly to the digester presents challenges such as length of time for bones to break down and skin that can block or damage pumps or pipes.

Another key consideration will be the digester's biological ability to accept regular or irregular additions of energy-rich meat products like a carcass. Keeping the quantity of deadstock material limited relative to the total quantity of inputs will minimize the risk of an upset to the biological process. Establishing a digester to handle primarily deadstock would require a high level of design expertise and a superior biological monitoring program to ensure effective design and operation of the system.

Size reduction is important. Otherwise, vectors such as dogs, skunks and vultures may be drawn to the excess meaty material.

Receiving deadstock from neighbouring facilities may be technically viable and present an economic opportunity. Again, careful design, operation, and material security will be necessary. Unlike a common reception bin for deadstock located near the road, typically an AD is located near the barn and is connected through various pipes or equipment to the barn – increasing the risk of biosecurity breakdowns. In addition, by receiving deadstock from neighbouring facilities, the total quantity of meaty carcass inputs rises relative to the manure inputs, increasing the risk of biological upset. Receiving large quantities of deadstock related to a catastrophic event is not recommended in a conventional farm-based AD system.

There are several considerations to managing the digestate (the liquid end-product) from a digester receiving deadstock. Cattle-derived digestate should not leave the farm property due to concerns relating to BSE and specified risk material (SRM) from the carcass material. If such movement is to occur, a federal permit is required. Size reduction is important, without which the excess meaty material may attract vectors. The use of a solid-liquid separator and post-composting and curing of solid digestate material may reduce such a risk.

EMERGENCY LOSSES

THIS CHAPTER WILL HELP PRODUCERS PREPARE FOR SUDDEN LARGE-SCALE LOSSES, BY ADDRESSING:

- **possible causes and their implications for disposal options**
- **who to notify and call for service**
- **disposal options**
- **how to draft an emergency loss plan.**

No livestock or poultry producer wants to foresee the day when all or a large number of animals die in an emergency situation. While it is human nature to avoid thinking about such a possibility, the fact remains that every year a number of producers in Ontario suddenly lose their entire herd or flock.

At the end of this chapter is a form for an emergency loss plan. Preparing this plan is your best ally in safe, efficient deadstock disposal after a crisis.

POSSIBLE CAUSES OF AN EMERGENCY LOSS

Emergency losses can result from a number of situations. A few of the more obvious causes are listed here.

BARN FIRE

Statistics from the Ontario Fire Marshal's office show that losses to farm properties in recent years ranged as follows:

- ► 2004 – 196 farm fires ($30.1 million loss)
- ► 2005 – 223 farm fires ($25.3 million loss)
- ► 2006 – 205 farm fires ($34.4 million loss)
- ► 2007 – 241 farm fires ($57.6 million loss).

When a barn fire is underway, of course the immediate concern is to do as much as possible to save the animals and property without risking human life. Because the suffering of animals in a fire may be very traumatic for producers, they may make irrational decisions in an attempt to save animals. Preplanning for a catastrophe of this nature is difficult, but may help to ensure that more rational decisions are made in the event of a fire.

Barn fires are a prime cause of emergency loss of livestock in Ontario.

Ventilation system failures during hot weather can lead to herd or flock loss.

SYSTEM FAILURE

Many of today's livestock and poultry barns rely heavily on automated systems for delivering feed, water and ventilation. Failure of these systems can very quickly lead to significant loss of livestock or poultry.

Ventilation systems are particularly critical, especially during hot weather. In many cases producers have only minutes to resolve a ventilation problem before animals or birds begin to die.

DISEASE

In recent years, other jurisdictions have dealt with the destruction and disposal of large numbers of livestock and poultry due to foreign animal diseases. In the United Kingdom, 12 million animals were destroyed and disposed of due to the foot-and-mouth outbreak. The Netherlands has dealt with both swine fever and foot-and-mouth disease since the late 1990s. In 2004, an outbreak of avian influenza in British Columbia infected 1.2 million birds and resulted in the culling of 18 million.

HEAT STRESS

Animals are adaptable to temperature changes. However, when changes occur suddenly there can be higher than average losses. This is particularly evident in the poultry and swine industries where sudden heat waves in the spring and summer months can result in a high level of deaths despite proper ventilation.

BARN COLLAPSE

Farm buildings collapse for various reasons. When climatic loading is exceeded (by wind, snow or ice), structures are compromised or destroyed. Buildings also collapse because of lack of maintenance or inadequate design.

Caution is needed when using equipment to clean up after a barn collapse or fire. Fully slatted floors may not be capable of carrying vehicle loading. Deadstock can often be removed using an excavator with a relatively long boom (or stick), and reaching in from both sides. Be careful not to undermine remaining structural components.

Using very heavy equipment too close to an in-barn manure tank wall can result in structural damage or collapse.

NATURAL DISASTER

The Eastern Ontario ice storm of January 1998 is an example of a natural disaster with devastating effects on livestock agriculture.

The ice storm of 1998 is one example of the difficulties that can occur while caring for livestock when normal equipment and services are unavailable. Other disasters such as tornadoes or floods can also lead to deadstock – and the need for emergency disposal of large numbers of carcasses.

BORDER CLOSURE

Because of Ontario's dependence on export markets (particularly for swine and beef), a border closure would inevitably lead to a surplus of livestock in Ontario that our domestic market could not absorb. This could potentially create the need for welfare slaughter of healthy animals because they have no market and no housing.

IMMEDIATE STEPS

In the event of an emergency loss of a large number of livestock and poultry, several items will need immediate attention.

DEALING WITH TRAUMA

First and foremost is the need to recognize that livestock and poultry producers have a strong sense of responsibility for the welfare of the animals they care for. This means that the loss of animals under their care can be very traumatic.

Producers and family members need to be aware that this stress can lead to uncharacteristic behaviour. If an individual has trouble dealing with the situation at hand, support from close family, friends or even health professionals may be required.

ANIMAL WELFARE

Euthanizing Animals

In the event of an emergency loss situation, there may be animals who survive the initial event but have been debilitated to the extent that they will never recover. These animals may be better served by being euthanized.

For more detailed information on acceptable methods, consult with a veterinarian. The OMAFRA livestock web page also has information on euthanizing compromised animals: **http://www.omafra.gov.on.ca/english/livestock/index.html**

Temporary Shelter

If the barn structure and systems have been compromised, then animals will need to be moved to temporary facilities. Since alternative facilities are often not readily available in the vicinity, producers should investigate possible options as part of their contingency planning.

REPORTING

KEY CONTACTS IN CASE OF EMERGENCY DEADSTOCK DISPOSAL

CONCERN	CONTACT	CONSIDERATIONS
REPORTABLE DISEASE	Canadian Food Inspection Agency (CFIA)	• contact if any reportable disease is suspected or confirmed
ENVIRONMENTAL RISK	Ministry of the Environment (MOE)	• contact if emergency carries potential for environmental impacts to soil, water or air
COMPLIANCE WITH NUTRIENT MANAGEMENT ACT	Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA)	• contact if emergency conditions exist that make it impractical to comply with NMA regulations • apply to OMAFRA for approval to dispose of the deadstock in a manner that would otherwise not be permitted under NMA regulation • request information on the regulatory requirements and technical aspects of disposal
INSURANCE / ADJUSTMENT LOSS	Your insurance company / adjuster	• consult with an insurance adjuster to ensure that costs for the disposal option will be covered • be aware that the final option chosen may depend on the adjuster's assessment of liability risk

DEADSTOCK DISPOSAL

CHALLENGES

Emergency loss situations can pose unique disposal problems for a number of reasons:

- volumes may be large and exceed the capacity of available equipment, disposal facilities or disposal sites
- deadstock may be in an unsalvageable condition for rendering because of issues such as fire degradation or chemical residues
- it may be unsafe or difficult to remove deadstock from the barn
  - examples include the aftermath of a barn fire where the structural integrity of the building is in question, or a situation where dangerous gases are present.

OPTIONS

In determining the most appropriate disposal method for an emergency loss situation, consider seeking advice from agencies including MOE, OMAFRA, the local licensed deadstock collector (if service in that area is available), and your insurance company.

The following options are legal in Ontario.

Licensed Deadstock Collector/Rendering

This is the preferred option since it recycles the deadstock into useful by-products. However, please take into account the following factors:

- collection is often not a viable option due to the volume, condition and accessibility of deadstock
- renderers run their operations at or near capacity and therefore may not be able to manage a sudden influx of a large number of deadstock
- deadstock must be in good condition in order to meet the renderer's finished product standards
- pickup should be arranged with the renderer directly or through the deadstock collector.

If rendering is not an option, a deadstock collector may be able to transport deadstock to a landfill or other approved disposal site. However, this must be prearranged with the landfill or disposal site. Most landfills do not routinely accept deadstock and very few accept large numbers of deadstock.

Composting

This is an effective, viable option. Again, you should take into account a number of factors:

- ▶ composting requires good management and routine monitoring
  - ▷ depending on the cause of the emergency loss, a producer may not have the time to properly manage and monitor a compost pile – e.g., in the aftermath of a barn fire, other considerations such as cleanup and rebuilding of the barn, and caring for animals in off-site alternative facilities may leave little time for overseeing an effective compost pile
- ▶ quick access to a potentially large volume of high-carbon material such as wood shavings will be needed in order for proper composting to take place
  - ▷ it may be difficult to obtain the necessary quantity in a timely manner – investigate sources as part of a contingency planning process
- ▶ siting needs careful consideration to minimize potential environmental risks – see guidelines on page 32
  - ▷ make sure you'd be able to deliver water to the site if the pile needs additional moisture
  - ▷ also make sure you can turn the pile to ensure complete composting.

Burial

While burial is not the preferred option, it is legal and often becomes the only reasonable alternative after other options have been fully explored. Consider:

- ▶ it may be very difficult to meet some of the burial requirements when larger numbers of livestock and poultry are involved
- ▶ it's important to research the site fully to establish a safe burial site – regulatory requirements including soil type and setback distances must be followed
- ▶ if burial is the only realistic option and it is impractical to comply with regulatory burial requirements under the Nutrient Management Act, then OMAFRA must be informed and a director must give authorization before burial can proceed
- ▶ access to equipment needed to transport deadstock, dig hole and bury.

Other Options

The nature of the losses would overwhelm the capacity of disposal vessels and incinerators.

DEVELOP AN EMERGENCY LOSS PLAN

In the event of an emergency loss of livestock and poultry, many issues will require immediate decisions. Having an emergency loss plan in place will not only alleviate some of the stress of the situation, but will likely mean that the list of disposal options will be expanded.

PLAN ELEMENTS

Emergency Contact Numbers

- human support services
- animal welfare
- reporting
- contact numbers for sourcing equipment, materials and services

Develop Deadstock Disposal Contingency Plans

- choose preferred disposal method in consultation with appropriate agencies and businesses (MOE, OMAFRA, deadstock collector, renderer, insurance)
- identify site(s) – based on method chosen, use siting guidelines as described elsewhere in this publication
  - map the location of potential disposal sites for future reference
- work out details for accessing the use of necessary equipment, including location and contact numbers
- make a list of needed resources and details for sourcing – including names and contact information

EMERGENCY LOSS PLAN

In the event of a large loss of animals or birds, it is crucial to have a pre-established plan in place to deal quickly and effectively with the deadstock. Having the info you need at hand for each disposal option is key to dealing with the problem quickly, and in a secure manner.

If the suspected cause of mortality is disease, contact your veterinarian and/or the CFIA immediately.

Complete the contact information for all services applicable to your emergency loss plan(s). Keep this information readily available in case of large numbers of deadstock.

EMERGENCY CONTACT LIST

Service Name	Phone, day	Phone, evenings & weekends
Service Name	Phone, day	Phone, evenings & weekends
Service Name	Phone, day	Phone, evenings & weekends

DISEASE If a reportable disease is suspected, call your local CFIA office during normal business hours. Evenings and weekends, call 1-877-814-2342.

Veterinarian

CFIA

GENERAL

Alternative Livestock Facilities

OMAFRA	1-877-424-1300	email: ag.info.omafra@ontario.ca website: www.omafra.gov.on.ca
MOE	1-800-565-4923	email: picemail@ene.gov.on.ca website: www.ene.gov.on.ca

Conservation Authority

Municipality

Mobile Wash Service

Disinfectant Supplier

Livestock or Poultry Board

Processor

Feed Supplier

Human Support Services

COLLECTION AND RENDERING

Licensed Deadstock Collector

Rendering Company

COMPOSTING

High-Carbon Material Supply

Equipment

Trucking

Water

Composting Service

BURIAL

Excavation Equipment

Trucking

Excavation Contractor

OTHER

Personnel

DISPOSAL PLANS

Disposal Method Chosen

On-Farm Disposal Site Chosen (if applicable) – based on siting regulations for preferred method

Estimate Volume if All Animals Lost (use to determine amount of carbon material – 3:1 by volume if composting, or size of hole if burying)

RESOURCES REQUIRED

Equipment (type, source, location)

Materials (type, source, location)

Personnel (skills required, names and contact information)

REGULATION OF ON-FARM DEADSTOCK

THIS CHAPTER SETS OUT ROLES, RESPONSIBILITIES, AND MINIMUM REQUIREMENTS IN LEGISLATION AFFECTING DEADSTOCK DISPOSAL IN ONTARIO.

While this publication promotes best management practices for the disposal of livestock and poultry that die on the farm, producers also need to be aware that there are minimum requirements set out in legislation. This chapter will highlight some of the key requirements.

NUTRIENT MANAGEMENT ACT, 2002 (NMA)

In general terms, the regulation of **on-farm** deadstock disposal falls under the Nutrient Management Act, 2002. Ontario Reg. 106/09 covers requirements for all the disposal options as well as transportation, record-keeping, and what to do in case of emergency conditions.

The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) and Ministry of the Environment (MOE) jointly manage a comprehensive program to support the NMA.

OMAFRA RESPONSIBILITY

- ► education and extension
- ► where emergency conditions make it impractical to comply with the NMA regulation, authorization of deadstock disposal in a manner not otherwise permitted under the NMA regulation

OMAFRA has Environmental Specialists located in various resource centres throughout the province who can assist producers in understanding and meeting the requirements set out under the NMA.

MOE RESPONSIBILITY

- ► compliance, including inspections and complaint response
- ► investigations and enforcement

MOE's compliance program is staffed with Agricultural Environmental Officers (AEOs), who are provincial officers with specialized agricultural training. An AEO may visit your farm for a number of reasons, including:

- ► to perform an inspection to assess compliance with legislative requirements
- ► to respond to a complaint received either from the public or through referral from another agency
- ► to respond to a report of an environmental incident or spill.

AEOs are also responsible for compliance with the Environmental Protection Act and the Ontario Water Resources Act. The MOE's on-farm compliance approach engages farmers actively to resolve issues, and AEOs work directly with farmers to achieve compliance with the law.

NMA REQUIREMENTS

Species Affected

Deadstock regulations under the NMA apply to the following farm animals:

- alpacas, bison, cattle, deer, elk, goats, llamas, sheep and yaks
- pigs and other porcine animals
- chickens, turkeys, geese, ducks, guinea fowl, quails, pigeons, pheasants and partridges
- ratites
- horses, ponies and donkeys
- rabbits, other than rabbits kept as pets
- fur-bearing animals.

Disposal Options

Any deadstock must be disposed of within 48 hours after death, or sooner if the deadstock begins to putrefy – except if held for purposes of post-mortem activity as specified in the regulation. Deadstock may be stored in cold storage for as long as 14 days or in frozen storage for as long as 240 days before final disposal.

The NMA allows for a number of disposal options including:

- collector service
- composting
- disposal vessel
- incineration
- burial
- delivery to an approved anaerobic digester
- delivery to an approved waste disposal site
- delivery to a licensed disposal facility under Reg. 105/09 of the Food Safety and Quality Act (FSQA)
- delivery to a veterinarian for post-mortem.

Setback Distances

Each on-farm disposal option has specific requirements under NMA, including a series of **minimum setback distances** listed on the chart on page 32. In addition, each option has rules specific to that option.

Option-Specific Requirements

Collection

Deadstock may be picked up at the farm or delivered to the collector.

Deadstock must be stored so that:

- liquids cannot escape
- it is protected from scavengers
- it is concealed from public view.

The pickup area is to be kept clean of animal matter after pickup.

Composting

Only the following materials can be used:

- sawdust, shavings or chips from clean, uncontaminated, untreated wood
- straw from grain, corn or beans
- livestock bedding with at least 30% dry matter and containing only allowable composting materials – see Reg. 106/09, section 16(2) (4)
- clean hay or silage
- poultry litter.

Mixture must not be more than 25% deadstock and no less than 75% substrate by volume if done by a method other than in-vessel composting.

Mixture must not be more than 50% deadstock and no less than 50% substrate by volume for in-vessel composting.

Piles must be covered with at least 0.6 metres (2 ft) of substrate or a non-compostable, retractable covering that minimizes odours and prevents scavenging. Allowable substrate materials for the cover include clean wood chips, hay or straw, and poultry litter if composting takes place in a fully enclosed structure that has a concrete floor.

Composting must continue until, upon visual inspection, there is no soft animal tissue at all, no bone fragments greater than 15 cm (6 in.), no other animal matter larger than 25 mm (1 in.), and no offensive odour.

Also:

- maximum 600 cubic metres (21,189 ft^3) of compost or compost material per site
- maximum 600 square metre footprint (6,458 ft^2) per disposal site
- no composting directly on organic soil or hydrologic soil groups AA or A
- cannot be placed on a floodplain.

Disposal Vessels

- cannot exceed 10 cubic metres (353 ft^3)
- must be protected from scavenging
- must be impervious and leakproof except for at least one vent (duct)
- can be kept on surface of the ground, partially buried or fully buried

Incineration

- incinerator type must have been issued a Verification Certificate by ETV Canada certifying that it has a secondary chamber that can maintain the temperatures of the gases entering it for at least 1 second at 1,000 °C (1,832 °F) or 2 seconds at 850 °C (1,562 °F)
- on visual inspection, no soft animal tissue at all, no bone fragments greater than 15 cm (6 in.) and no other animal matter larger than 25 mm (1 in.) can remain at the end of incineration
- a maximum of 1,000 kg (2,205 lb) can be incinerated per 24-hour period
- the incinerator must not be used to incinerate any other material

Burial

- no burial in organic soil or hydrologic soil group AA
- 2,500 kg (5,512 lb) maximum weight per burial pit
- deadstock kept covered with at least 0.6 metres (2 ft) of soil at all times
- burial pit closed by mounding to a height above ground equivalent to half the pit depth or 0.6 metres (2 ft), whichever is higher
- pit regularly monitored for one year to check for depressions or signs of scavenging

TRANSPORTATION

Owners or collectors may transport deadstock on public highways, provided the deadstock are delivered to a site that is allowed under the NMA. The deadstock must be kept hidden from public view and the vehicle must be designed to prevent leakage. The vehicle must have surfaces that can be cleaned and sanitized after each time deadstock is transported.

Owners wishing to transport dead cattle are required to obtain a SRM permit for transport. Contact the CFIA at 1-800-442-2342.

Record-Keeping

When a farm animal dies, a record of disposal must be made. The record needs to include:

- ▶ the species and age of the animal
- ▶ the animal's weight
- ▶ time and date of death if known
- ▶ cause of death
- ▶ time and date of disposal
- ▶ place of disposal
- ▶ date record was made
- ▶ for incineration, a record of temperatures in the combustion chambers throughout the incineration process.

Records must be kept for a period of at least two years.

Canadian Cattle Identification Agency (CCIA) tag numbers for deadstock must be reported to CCIA for removal from the system within 30 days of the animal's death.

HEALTH OF ANIMALS ACT (SPECIFIED RISK MATERIAL)

For those producers who deal with species affected by BSE (cattle), there are additional requirements regarding the handling of deadstock.

Dead cattle or bison cannot be moved off the farm where they died without a permit to transport from the Canadian Food Inspection Agency (CFIA). For more information, view OMAFRA's factsheet on *Managing Specified Risk Material Under the Enhanced Feed Ban* at:

http://www.omafra.gov.on.ca/english/livestock/beef/news/vbn0707a2.htm

Agencies and Offices

Canadian Food Inspection Agency – Animal Health
Ontario Area Office
174 Stone Road West
Guelph, ON N1G 4S9
ph: 519-837-9400
For a complete list of local offices in Ontario, see:
www.inspection.gc.ca/English/anima/heasan/offbure.shtml

Ontario Federation of Agriculture
Ontario Agricentre
100 Stone Road West, Suite 206
Guelph, ON N1G 5L3
ph: 1-800-668-3276
email: inquiries@ofa.on.ca
web: www.ofa.on.ca

Ontario Ministry of Agriculture, Food and Rural Affairs
Agricultural Information Contact Centre
1 Stone Road West
Guelph, ON N1G 4Y2
ph: 1-877-424-1300
email: ag.info.omafra@ontario.ca
web: www.omafra.gov.on.ca

Ontario Ministry of the Environment
Public Information Centre
1st flr., 135 St. Clair Avenue West
Toronto, ON M4V 1P5
ph: 1-800-565-4923
email: picemail.moe@ontario.ca
web: www.ene.gov.on.ca

For More Information

The Ontario Ministry of Agriculture, Food and Rural Affairs has numerous factsheets and other information pertaining to deadstock disposal, including:

- new deadstock disposal regulations
- options for on-farm disposal
- licensed deadstock collectors for off-farm disposal.

For a complete and up-to-date list of publications, please see: **http://www.omafra.gov.on.ca/english/livestock/deadstock/index.html**

or call the Agricultural Information Contact Centre at 1-877-424-1300.

The following American document is an excellent resource for more detailed information on the principles underlying various deadstock disposal options.

Carcass Disposal: A Comprehensive Review, National Agricultural Biosecurity Center Consortium, Kansas State University, 2004

A number of books in the Best Management Practices series pertain to facets of on-farm soil and water quality. For a complete list of titles and information on how to obtain your copies, please see page i.

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CONTRIBUTORS

Task Team Chairperson – Ontario Ministry of Agriculture, Food and Rural Affairs: Ben Hawkins

Task Team and Authors (in alphabetical order) – Ontario Ministry of Agriculture, Food and Rural Affairs: Hugh Fraser, Bill Groot-Nibbelink, Ben Hawkins, Kevin Joynes, Ted Taylor, Christoph Wand; Ontario Pork: Sam Bradshaw; University of Guelph Ridgetown Campus: Ron Fleming

Photographers – Jake DeBruyn, Ron Fleming, Hugh Fraser, Bill Groot-Nibbelink, Ben Hawkins, Harold House, Kevin Joynes, Kerry Little, H.J. Smith, Christoph Wand

Technical and Visuals Coordinators – Ontario Ministry of Agriculture, Food and Rural Affairs: H.J. Smith, Ted Taylor

Editor – Alison Lane

Watercolour Illustrations and Sketch Artist – Irene Shelton, Winduncroft Studio, Belwood

Graphic Designer – Neglia Design Inc.

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OFA Ontario Federation of Agriculture