Livestock Mortality Composting

FOR LARGE AND SMALL OPERATIONS IN THE SEMI-ARID WEST

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Why Compost Animal Mortalities?

Many livestock producers are concerned about proper mortality disposal and management. Proper management of animal mortalities on the farm/ranch has important implications for nutrient management, herd and flock health, as well as farm/ranch family and public health. The purpose of proper mortality disposal is to prevent the spread of infectious, contagious and communicable diseases and to protect air, water and soil quality. Also, there are legal issues and requirements related to nutrient management and the permitting of animal feeding operations. To best ensure human health and safety, reduce regulatory risks, and protect environmental resources, livestock producers should become familiar with best management practices (BMPs) for dealing with dead animals. They should also be aware of state laws related to proper disposal or processing of mortalities.

Disposal of routine operational mortalities and catastrophic mortalities must be defined in a comprehensive nutrient management plan. In addition, zoos and other facilities that house large animals (or many animals) may benefit from the techniques and resources provided in this manual.

Mortality composting is an increasingly popular and viable alternative compared to other disposal practices because of cost savings, reduced environmental risks, and the generation of a useful end-product. This manual is designed to provide livestock producers in Montana, Wyoming, Colorado, New Mexico and surrounding states with the knowledge, tools, and resources to develop a mortality management; with specific focus on the composting option.

Unacceptable Animal Mortality Disposal

Abandonment

Though dragging off a carcass to the "boneyard" has been a historic practice, abandonment is **strongly discouraged.** Abandonment is likely **illegal** in most states. Examples of abandonment include: carcasses abandoned on the surface, in open pits, ditches, water features and sinkholes or in wells. Abandonment promotes extreme biological and disease hazard, threats to water quality, odors, flies, scavengers, rodents, and visual pollution.

Methods of Animal Mortality Disposal

Burning

Disposing of animal mortalities by open pyre burning is discouraged. Most producers have difficulty finding proper fuel to maintain temperature and flame, and struggle to obtain complete consumption of the carcass or carcasses in a timely manner. Air emissions are uncontrolled and likely dangerous, depending on the fuel source. Burning should only be considered in emergency situations, and with proper advisement and permission from the appropriate regulatory agency.

Incineration

Incineration is a safe method of carcass management from a bio-security standpoint. Incineration is different from burning because when practiced correctly, the entire carcass is quickly and completely consumed by fire and heat. This practice must be done in an approved device with air quality and emissions controls. Incineration is primarily utilized for disposing of small carcasses (such as poultry). The cost of fuel may limit adoption of this practice because it can be an energy intensive process.

Burial

Burial is probably the most common method of dead animal disposal, although some states have outlawed it. Most states have regulatory burial guidelines outlining site location, distance from waterways, depth to groundwater, etc. If proper procedures are used, burial is safe; however, certain portions of carcasses can persist for years in an anaerobic (low oxygen) environment and there is no assurance of pathogen reduction. During construction projects on former poultry farms, old burial pits have been discovered that contain intact birds. Sites with a high water table and sandy soil do not allow proper depth or cover of burial without threatening ground water. Burial pits are considered mass graves and, if not managed properly, may pose additional risks through the spread of disease and other environmental contamination.

Land Filling

Disposing of carcasses at a licensed landfill is considered an acceptable method of burial. Land filling may be an option in some areas; however, the legality of this will be based on the classification of the facility, local regulations, and the policy of the individual site. Even if the landfill is classified to accept carcasses, the management must also grant permission. It is a good idea to have a written agreement with the landfill service if you plan to regularly use this method of disposal. Drawbacks to landfill disposal may include additional handling of the mortality, transportation and tipping fees, and potential disease transmission.

Rendering

Rendering is a heat-driven process that takes place at a special facility in which waste animal tissue is separated and converted into value-added materials. Rendering is a relatively simple method of mortality management for the farmer/rancher, and it leaves no lasting legacy on the farm. However, there are very few rendering facilities across the U.S., and there are often fees associated with a rendering service. This is a recommended practice for those with access to a rendering service. The cost of rendering should be weighed against time management, input cost, and possible bio-security breaches when compared to other available methods. Local livestock or poultry producers and Extension staff may be the best resource for determining if this service exists in your area.

Livestock Mortality Composting

For many species, carcass composting (i.e., the biological process of converting organic matter into fine-particle humus-like material) is an environmentally preferable method for managing mortalities. When performed correctly, the end-product may be reused in future mortality composting, and under certain conditions, applied to animal feed crops and forest crops. Poultry composting is a common practice and much information is available that describes how to dispose of birds in this way.

Composting is practical for larger carcasses. Many operations, even in cold climates, successfully compost larger stock including sows, cattle and horses.. Composting large carcasses can save labor and land. This practice allows a dedicated area to be used and reused for carcass management; it is done above ground, thereby reducing the number of labor-intensive burial pits created as well as minimizing the number of buried carcasses on the property.

Technical procedures on composting cattle carcasses are available and continue to be studied and refined; this appears to be a viable option which will be described further in this manual. Most composting requires storm water protection, and possibly covering. Additional management and monitoring is required to refine the process, maintain temperatures, attain proper decomposition and prevent scavengers. Nutrients and organic matter in finished carcass compost can benefit forest and crop land; however, nutrient management guidelines should be followed.

Composting Principles

Composting is the "managed, biological, oxidation process that converts heterogeneous organic matter into a more homogeneous, fine-particle humus-like material" (Field Guide to On-farm Composting, 1999). This definition includes many important principles that need to be considered when composting.

Managing a compost pile can really be viewed as "farming microorganisms" to provide optimum conditions for the bacteria and fungi that do the real work of composting. The microorganisms need four things: carbon (C), nitrogen (N), water, and oxygen. Generally, the carbon and nitrogen need to be provided in balance, and we usually aim for a C:N ratio of about 30:1 at the beginning of the composting process. To achieve this, it is important to know the C:N ratios of your composting feedstocks (i.e., carbon materials such as straw, sawdust, animal bedding, etc.) and devise a good "recipe" or mixture. However, departure from this common wisdom for mortality composting will be discussed in this manual as C:N ratios exceed the recommendation (much greater carbon) when dealing with dead animals. Likewise, in the early stages of carcass composting mixing is not feasible.

As noted above, true composting must take place in the presence of air or "under aerobic conditions". The bacteria and fungi that break down organic wastes in the pile require oxygen to achieve a compost end product. If oxygen is inadequate due to high moisture levels, waste will still degrade, but it will degrade by rotting or fermenting rather than composting.

Water and oxygen also have to be provided for the microorganisms and are related to each other. If the compost is too wet, the oxygen levels will be too low. In most composting scenarios best success is attained with a moisture level at about 50 percent. The moisture content can be determined by weighing a sample, drying it and then reweighing, but it can also be estimated from a "squeeze test." Just squeeze the compost mix in your hand. It should be wet enough to stay together in a ball, and you should only be able to squeeze a little trickle of water out in between your fingers. To achieve this moisture level, watering and shaping the pile to accept moisture is often necsary.

The oxygen content in a compost pile should be about 5-20 percent. Some operators purchase hand-held oxygen meters to periodically measure that level. A drop in compost pile temperature after the start of the process is often a sign that there is an inadequate level of oxygen. Turning the pile is a management practice that is commonly used both to mix the ingredients and to add oxygen into the pile. The use of bulking material (a coarse-textured organic waste like wood chips) also aids in aeration of a compost pile. Turning should only be done after the active stage of composting for poultry you can turn after two to three weeks, for large livestock generally three to six months.

Though composting of medium to large carcasses and land applying the material is proving to be feasible, careful consideration must be given for goats and sheep due to the prevalence of scrapie, a prion disease, in flocks across the U.S. This disease is a transmissible spongiform encephalopathy (TSE) similar to BSE (i.e., mad cow disease) and the human Creutzfeldt-Jakob disease. If compost from diseased animals were used as fertilizer, it would create a serious bio-security threat. Fate of compost from sheep and goats should be carefully considered. Be sure to seek expert advice prior to disposal of these species. If a producer has a certified scrapie free flock, then they could proceed with practice in relative safety.

Incorporating Animals into the Composting Process

Influence of Animal Size

Size and volume of mortalities will directly influence the physical footprint of the pile or volume of bin space designed, amount of carbon material required, and the time required to fully compost the carcass(es). Smaller carcasses have more surface area relative to mass; this provides for more carbon material to carcass interaction. Similarly, cutting or breaking apart large carcasses can speed up the composting process, if necessary. While properly constructed and layered poultry mortality compost will process in a matter of a few short weeks, cattle will take months (6-12) under average conditions (in static piles; i.e., no turning).

Bones remaining at 3 months, skull on left, spine on right. These will nearly breakdown completely when recovered for 3 more months, credit: Schauermann

Preparation and Placement

For larger livestock, the carcass should be laid on its side on the middle of the base material with the body cavity opened and the rumen punctured for cattle, sheep and goats. This is done to prevent bloating and bursting which will displace cover and result in additional odor and nuisance. The carcass should be covered completely with material on all sides (as described in the next section). The finished pile may reach up to six feet in height, in the example of a large cow. Small carcasses should be layered and arranged to maintain carbon margins around each dead animal. Small carcasses can also be stacked in tiers with carbon layers in between.

Calves on base, credit: Dafoe

Cows on base, credit: TX A&M Agrilife Extension

Base and Cover

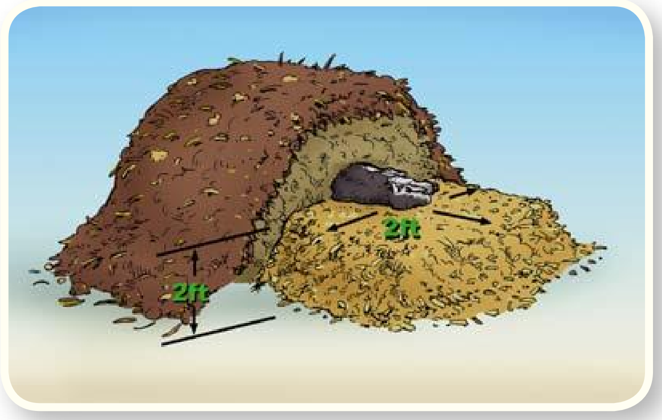
Considering that a large carcass is very high in moisture and nitrogen, adding too much carbon likely will not be a threat to composting success. In the case of mortality composting, proper pile construction will result in gross C:N, considerably higher than the common 30:1 ratio and this does not appear to inhibit composting of large carcasses. Moisture distribution will be uneven throughout the pile and there are likely to be pockets of anaerobic decomposition immediately around the mortality. While much of the external carbon does not interact with the composting center, it serves a larger role in biofiltration and insulation. The extra carbon material is also valuable in absorbing excess moisture from the mortality. Conventional turning and C:N balance comes into play at the end of this process, weeks after the mortality has been consumed by the process.

Anecdote: **Winter Tip –** surrounding the carcasses in warm or active compost will give them a quicker start, especially for winter or early spring mortalities. In Montana, producers have been successful with attaining necessary temperatures by placing non-frozen carcasses in the pile and building the core with silage, warm compost or manure solids. The pile should always be capped with a "clean" material such as sawdust or chopped straw. Likewise, getting carcasses started in compost before they freeze in the field helps the pile attain and maintain desirable temperatures.

Successful composting of mortalities has been reported with base thicknesses between 12 to 24 inches. The base should be comprised of a material that is both absorbent and bulky, such as wood chips and shreds with sizable pieces being 4 to 6 inches in length. This composting material is important for achieving satisfactory porosity for aeration. Material that packs tightly or is excessively wet is not recommended. The base material should not be excessively dry but moist like a damp, wrung-out sponge. To save time, always have a couple bases ready to accept animal mortalities. The carcass can be placed once a satisfactory base is established.

Core material can now be placed around the mortality. This is an opportunity to use a variety of materials found onsite or regionally. Please refer to Table 1 for a list of materials that have been used in the Rocky Mountain region. The material added directly around the sides and top of the carcass does not need to be as porous as the base; also, if the carbon source has some odor associated with it, the core around the carcasses is the ideal place for its use. Manure, silage, and other active materials, with a low C:N ratio may be ideal for this layer. Finally, the cap may also be a finer material than the base, and should be low odor carbon. Core and cap materials such as silage or moist sawdust in the 50-60 percent moisture range are ideal. The addition of the cap should bring the final margin around the carcass to a range of 18-24 inches, as illustrated below. Estimates of total material needed to fully compost a full grown cow are 12 cubic yards, or for 1,000 lbs of carcass, 7.4 cubic yards (200 ft^3). The difference in the estimates can be attributed to the thicker base recommended by some experts. Practically speaking, for a mature cow, a proper base will be about 9 feet wide by 10 feet long. Once the mortality is placed in the middle of the base, 24 inches of cover in all directions should be attained. Considering side slope, material on top will likely be more than 24 inches above the mortality to achieve the proper margin. When layering smaller carcasses, or parts of carcasses, an 8 to 12 inch margin should be maintained around each carcass. Bins and bunkers can reduce height and foot print of piles.

Layered small carcasses, credit: Cornell Waste Management Institute



Cow position in pile, credit: Cornell Waste Management Institute

Carbon Options

Table 1. Unique or locally utilized carbon materials of the Rocky Mountain corridor; sources, pros, and cons of each. Ideal pile construction will have coarse material base, with other materials in core around carcass(es) and an inert material for a cap such as sawdust or compost.

Material	Source(s)	Pros	Cons
Fruit wastes	Orchards, vineyards, wineries	For core; may need to be mixed w/ drier material	Very wet (60-90% water)
Chile skins	Chile processors	Bulking agent	excess water directly from processor, nuisance factor
Cotton gin waste	Cotton gins	Aerates well, holds moisture, good pore space	Hauling costs, varies by region, 14:1 C:N
Garment processing fibers	garment processor	46:1 C:N	Wet product, hauling, very poor pore space
Paper mill waste	pulp and paper plants	95:1 C:N	Distance
Pecan cleanings	pecan processors	Bulking agent	Possible odor issues
Pecan trimmings	pecan farms	Bulking agent	Post processing

Bin and base, credit: Dafoe

Table 2. Most commonly used carbon material in the Rocky Mountain Corridor; sources, pros, and cons for each. Ideal pile construction will have coarse material base, with other materials in core around the carcass material and an inert material for a cap such as sawdust or compost.

Material	Source(s)	Pros	Cons
straw & hay (common)	local farms, onsite, zoos	availability	compresses, pore space diminishes quickly; C:N 17:1
hay (alfalfa)	Local farms, onsite, zoos	availability	compresses, pore space diminishes quickly;12:1 C:N
wood chips	timber mill, inert landfill, municipal yard waste, beetlekill	good pore space, especially for base of pile; 300:1	may be expensive
saw dust	timber mill, wood based industry, beetlekill	good cap material for odor control, green saw dust has good moisture for composting; 300:1	may be expensive
compost	onsite, compost distributors	active material, best for core	low pore space
manure (various species)	onsite	active material, best for core	odor, leaching potential, low pore space
horse manure	racetracks, boarding facilities	45:1 C:N	Low pore space, limited by region
separated manure solids	neighbors, onsite	active material, best for core	may still be too wet
silage	onsite	active material, best for core; 40:1 C:N	odor, leaching potential, low/medium pore space
grain residues/hulls	local mills/granaries	best for core	low pore space, oil seed residues may lead to odors
waste feed	onsite, feed lanes, storage	Active material	Possible odors, variable composition
cull potatoes	Potato farms	Best for core; could be mixed with dry material	High moisture (~80%)
biosolids	City waste management companies, municipalities	Good N source	Possible heavy metals, pathogens
yardwaste	Homeowners, landscape companies, municipalities	Can be good for base or cap	Variable C/N ratio and irregular flow; 15:1 C:N; potential trash

Windrows, Wooden Bins, or Hay Bale Bins/Bunkers—Footprint and Sizing

As previously mentioned, the size of a compost pile can be reduced through the use of bins or bunkers. Windrows and piles will have the largest physical footprint and may pose the greatest attraction to scavengers if the area is not appropriately fenced. The use of some type of structure to contain the area and reduce physical footprint is recommended. This also provides visual screening. This decision will also be based on carcass size and volume of mortality. Temporary bins may be constructed by arranging hay bales to contain the compost. Permanent, slatted wooden or metal walls can also be constructed for large carcasses, though it represents a greater expense. However, windrows and piles will offer the best passive air flow to the sides of the materials.

Poultry carcasses are commonly composted in wooden bins under the roof of specially designed litter stack houses. Large square hay bales can be placed around the pile's perimeter to exclude pests and absorb any possible run-off. Round bales can be used for building a retaining wall around the pile (figure #); for small ruminants, pigs or other stock, bins could be built with small square bales. Temporary fencing or stock panels can be used to bar the front of the mortality compost bin and exclude nuisance and scavenger animals. Carcasses should remain completely covered throughout the process.

Monitoring and Management

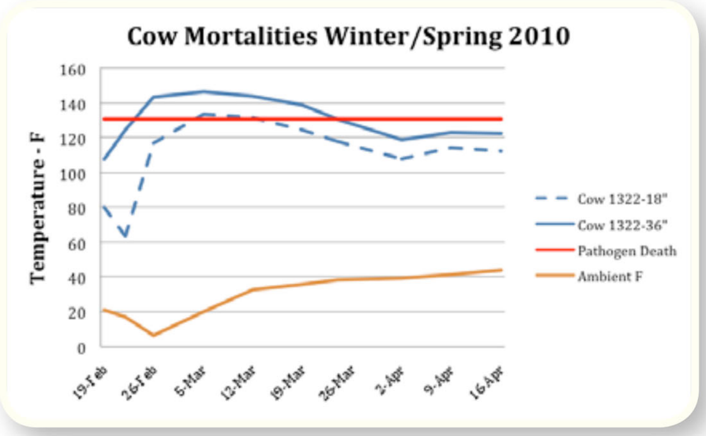
Composting

Now that the mortality are properly enveloped or incorporated the process of composting takes 4-12 months depending on mortality size and mixture. During this phase it is a good practice to monitor your piles and intervene at the appropriate times, i.e.: when additional cover is needed or pile is emitting odor. Some operations will leave marker where the last mortality is located to avoid accidentally disturbing the active site. The process of composting mortality is a passive process. This phase of the process should not be disturbed for three to six months depending on animal size. During this time microbial activity from bacteria and fungi are performing their function by reducing the carcass to a homogenous organic material. Most of the easily decomposed tissue is virtually "gone" within six weeks. Fungi need the extra time to continue working on the remains. The pile can be disturbed for mixing, watering and stockpiling for curing after four to six months in the passive phase.

Temperature

Temperature management is a critical component of successful composting. Monitoring involves both taking and recording the temperature of your compost piles and making observations about their condition. A long-stem thermometer inserted into the pile after construction is the first step in monitoring. Reaching thermophilic temeratures,120-150 F, assures the operator of pathogen destruction and effective composting. A compost thermometer has a long probe (18-60 inches long) in order to measure the internal temperature of a compost pile.

Temperature is an important indicator of how your compost pile is doing, because it is a reflection of the activity of the microorganisms that are doing all the work of composting material in the pile. When microbes feast, they multiply and give off heat. Thus, measuring temperature is a way to check-up on them to ensure that they are alive and functioning optimally. If temperatures are cool ($<80^{o}$ F), there is some reason why the microbes are not thriving. Temperature should be checked every couple days during the first week to 10 days after covering the mortality. Thereafter it is wise to check on temperatures at least weekly. Graph the temperature as a function of time and you'll see it rise quickly up to about 130-160^{o} F and then decline gradually. Under normal composting conditions, when temperature declines for a week or more, it is time to turn the pile in order to aerate it. This typically results in mounting temperatures again, if conditions remain optimum. Temperatures in the 140 to 160 degree range, held for 48-72 hours are necessary to sterilize weed seeds and destroy pathogens.



However, when composting mortalities, the piles need to sit, undisturbed for a few weeks or months; temperatures will be quite variable during this time. Because of the high moisture content of a large carcass, there will be pockets of wet anaerobic degradation around animal; a proper pile will naturally correct this. Once the pile is turned it should be evaluated for water content (see below) and temperatures tracked for another month. Times in the Rocky Mountain west to achieve this status may range from four to eight months. This final period after turning should continue composting prior to curing. Bones will continue to break down in this phase, which follows more traditional composting recommendations.

Moisture Content

You can use the squeeze test described previously to evaluate whether your compost piles in the post-turning final stage have adequate moisture. If piles entering the final stage do not have enough moisture, the best time to add water is at the time of turning. In static piles (the beginning stage of mortality composting), turning and watering do not typically take place unless there is a problem (lack of temperature rise, for example). Because of this, it is even more important to get the moisture content right from the start. Moisture of 50-60 percent in the carbon based compost materials is ideal. If necessary, add water to the compost material you are using to bury the carcasses in a few days prior to or on the day you start the carcass composting (prior to adding the cap). The cap will reduce evaporation from the piles and help to maintain optimum water levels.

Moisture Management

If carbon is very dry, add moisture to the layers as you are building the pile. The compost feedstock should be at 40- 60 percent moisture (this has proven to be a good range for arid climates). Piles/ windrows can be shaped to shed moisture or include it depending on climate and weather conditions. Piles with peaked tops will shed moisture in high precipitation areas. Creating a flat top will allow moisture that falls on the pile to soak in. Creating a trough will allow moisture to collect and soak in. When piles are working efficiently it is hard to add moisture, as much of it is released into the atmosphere.

Other

In addition to temperature and moisture content, it is important to monitor your piles regularly for scavenger activity, odors, and flies. These issues are addressed in the *Issues* section of this document.

Curing and Storage

Curing is the stage of composting that occurs after the thermophilic (hot) process has ended and mesophilic (warm) conditions are established. Curing usually takes place by simply allowing the compost to sit for an additional period of time on-site. Winter conditions can potentially prolong this phase of the composting process because very cold conditions may prevent adequate microbial activity.

There must be sufficient aeration and moisture during this phase as oxygen loving organisms are at work to further breakdown the organic material. Anaerobic conditions can still occur so it may be necessary to turn or mix the pile during this phase. Curing also gives organisms more time to breakdown some of the larger bones to a more brittle and smaller form that is easier to incorporate into the soil. Bones can be screened out of compost that will be land applied, or introduced into new piles to continue breaking down. There should not be a large increase in temperature after this mixing but some increase in temperature is expected and is a good sign of microbial activity and the curing phase is underway. Observe the pile temperature after mixing with a long-stem thermometer to assure the pile is proceeding according to plan. The pile should be left for another 4 to 8 months. By this time very few bones will remain visible, large bones will be brittle, and the material can be appropriately used. Screening before land application will avoid large bones from being applied to the ground.

Storage of compost increases the size, or footprint, of the composting site. However, it is a necessary component to the system that provides maximum flexibility in the end use of the material. Compost should only be stored within the protected composting area after the curing phase when little to no risk of continued heating will occur. Slightly more storage area may be needed if active composting occurs during the winter months when potentially less mass is lost during composting as compared to summer. The goal with storage is keep it from becoming a nuisance but accessible for land application, or recycling into new mortality piles when the time is right.

Site Selection and Environmental Management

Good stewardship of the land means taking the necessary steps to prevent possible problems that could negatively impact water, air, and soil quality. Most states have regulations regarding management practices for handling wastes; often dependent on type of waste, and size or tonnage of the operation. However, best management practices are encouraged for all composting operations even if exempt from specific regulations. The information below can help identify some best management practices that should be considered.

Site Selection

When choosing an appropriate site for composting there is a variety of general characteristics that should be considered. An appropriate site will:

- Help to protect water and soil quality,
- Protect bio-security,
- Prevent complaints and negative reactions of neighbors,
- Decrease nuisance problems, and
- Minimize the challenges in operating and managing the composting operation.
- In addition, the location of the composting site should be:
- Easily accessible (in most weather),
- Require minimal travel,
- Be convenient for material handling, and
- Maintain an adequate distance from live production animals to help reduce the risk of the spread of disease.

Although specific site selection requirements may vary from state to state, the location should have all-weather access and allow for storage of co-composting materials, and should also have minimal interference with other operations and traffic. The site should also allow clearance from underground or overhead utilities for safe maneuvering of equipment.

Consideration of visibility and location of traffic patterns required for moving dead animals, adding amendments (i.e., co-composting materials), and removing finished compost. An adjacent storage area for compost materials (i.e., sawdust, straw, crop residue, etc.), will eliminate the need to transport amendments from a distance. In the arid west, moisture may be needed in the final composting steps, once the mortality has been consumed. Consider how you may get water to the site for this purpose.

A compost site should be located in a well-drained area (but not well drained soils) that is at least three feet above the high water table level, at least 300 feet from sensitive water resources (e.g., streams, ponds, wells, etc.), and that has adequate slope (one to three percent) to allow proper drainage and prevent pooling of water.

The base of the compost site should consist of soil with low permeability. If the predominant soils are well-drained and close to ground water, a compacted layer of sand or gravel about 15 cm (6 in) thick could be used. In some situations, a constructed concrete pad or imported clay pad may be necessary. Seek local guidance regarding soil type, groundwater issues, and related management options. Engineered types of pads pay for themselves during periods of extreme weather conditions and are better than compacted sand or gravel. Similar recommendations would apply to where cured and finished compost is stored.

Runoff from the composting operation should be treated through a vegetative filter strip or infiltration area before it reaches a water resource. Diverting water away from the compost pile with a berm minimizes the amount of runoff generated by the compost site, especially in the arid west.

Composting areas should be located downwind of nearby residences to minimize potential odors or dust being carried to neighboring residences by prevailing winds. Although composting does not usually generate odors, regular handling and composting of dead animals may be offensive to neighbors.

Stormwater Management

Most states have recommendations or requirements for stormwater management, especially under permitted facilities. There are three basic principles to consider in site management regarding runoff: 1) prevention, 2) collection, 3) distribution. Preventing water from running onto the composting site helps keep the site manageable and is likely the law in many states. Orienting windrows (when used) perpendicular to the slope of the site allows the windrows to absorb moisture and prevents erosion in-between. Situate your compost site to avoid water ponding, and facilitate collection/movement of excess water to a buffer, filter strip or collection structure if the run-off will be significant. If a composting area uses a run-off collection pond, the effluent should be treated in accordance with the laws and best management practices associated with land application of liquid animal waste.

Big Rain Events—Permitting Issues, Applicable Rules

Big rains can bring big problems even for small operation. Adopting conservation practices that lessen the effects of big rains can decrease non-point source pollution of nearby streams or shallow groundwater, reduce impact of odors, and decrease the likelihood of the spread of disease or pathogens. The National Oceanic and Atmospheric Administration has developed different time scale maps for storm events such as the 24-hour, 25-year precipitation maps that can help with planning. USDA-NRCS can also assist with assessing conservation practice needs for the area that would produce runoff (http://hdsc.nws.noaa.gov/hdsc/pfds/index.html).

Dust Control

Evaporation generally exceeds precipitation, in the arid west, on a yearly basis; traffic in the composting areas may generate dust. Dust from soil can be avoided by maintaining a work area surface that is either compacted or uses a layer of compost or other carbon material that is not as prone to becoming airborne. A short-term fix to excess dust is to use water trucks with a water delivery system to moisten the work area. Otherwise, equipment traffic should be limited when conditions for airborne dust are favorable.

Take steps to be prepared for fires as well. Mistakes in moisture control can lead to fires at compost sites. The smoke can travel a very long way and can lead to nuisance complaints. Assuring that adequate water supplies are near the compost pile and having a fire intervention plan in place will make all the difference in managing the compost site. It is not advisable to water a compost fire; this starts a dangerous cycle that will actually lead to greater combustion potential. Instead, spread out the materials that are reaching high temperatures. You should not see temperatures in mortality compost much over 160 degree F. Charring and fire potential becomes serious when piles approach 180 degrees F.

Equipment Decisions

Since the goal of animal mortality composting is environmentally sound, labor-efficient disposition of animal carcasses and related waste, and not a fully functional comprehensive composting program for manure and other organic materials, equipment choices are easier to make. For a full discussion and overview of equipment for a comprehensive composting program, please reference: Compost Fact Sheet #7 from the Cornelll Waste Management Institute, "Compost Equipment" 2004/2005. At a minimum, carcass composting will require a front-end loader, but a probe thermometer and screen are also recommended.

A tractor with a bucket or skid-steer loader are imperative for building the pile or loading the bin, in addition to easily moving and placing larger mortalities. The size and number of carcasses to be encountered throughout the year will dictate the needed loader size. A poultry facility will obviously be able to utilize smaller equipment than a beef feedlot or dairy. A dairy may have up to eight percent operational mortalities throughout the year with Holsteins weighing as much as 1,400 pounds. Beef steers may be smaller, in the 500 to 1,000 pound range; sows on a hog operation can also be quite large, requiring appropriate sized equipment.

Probe thermometers will help in finishing the compost once the bulk of the carcass material is degraded. Reaching benchmark temperatures in the final product will help destroy pathogens and sterilize weed seeds. These temperatures are discussed in the *Composting Principles* section of this document. Probe thermometers are available in dial or digital format (insert picture analog dial thermometer). A 36" dial probe thermometer can be found at several agricultural and natural resource supply companies for under $100. They are often listed as "dial soil and compost probe thermometer." Digital versions are also available, at a higher price, and may be part of comprehensive packages that also measure oxygen and moisture.

A screen is also helpful in improving final product quality, especially if the compost will be land applied. A screen allows for the separation of compost fines from residual bones and other trash such as bailing twine, ear tags or other material. The simplest screen, ideal to have near the mortality compost site, is a frame of angle iron with an expanded metal face. The face should be angled at 45 degrees or more, and elevated one to five feet off of grade with the top of the screen appropriate to the reach of the loader being used. The width should also be relative to the width of the bucket on the operation's loader. For example, screen area should be five to six feet wide by six to eight feet long, angled and elevated as previously described. More discussion of bones and screening is found in the *Issues* section of this document.

Home-made screen, credit: Bass

Effect of Climate

Temperature and Precipitation

Composting can occur practically all year, even in the cold and semi-arid climates of the upper plains and Rocky Mountains. Winter temperatures usually slow the process down, and can prevent adequate initial heating. It has been documented in southern Canada to lower the amount of decomposition by 20 percent during the thermophilic (hot) and mesophilic (warm) stages of composting. However, research in Montana has shown temperatures at 18" and 36" deep in a mature cow compost bin to reach above 130 degrees F within days of start, even during winter conditions. As previously mentioned, some tips for mitigating ambient temperature affect include: incorporating the carcass before it freezes, using an active material (silage, manure solids, warm compost) around the carcass and core of the pile, and capping the pile with extra insulating material such as sawdust. The curing stage is often slowed by extremely cold conditions.

Though carcass moisture will be sufficient to start the process, proper moisture in the co-composting materials (carbon sources) is also important. Fresh or green sawdust and shavings are excellent. The arid western climate can inhibit complete composting and curing. After several weeks (or months) of static composting, the pile should be turned and watered to finish off the process moving into the curing phase. Warm weather increases the amount of water that is lost to evaporation; curing piles should be monitored more closely to assure adequate moisture, assuring that sufficient microbial activity can occur during this phase of the process.

While much of the northern plains and Rocky Mountains are dry for most of the year, there are periods when moisture can become excessive. Excess moisture is not so much an issue with the piles themselves but with traffic lanes and carbon sources. Carbon sources should be properly stored or covered if precipitation could saturate them. Carbon sources in the previously mentioned 40-60 percent moisture range are very ideal for mortality composting and continue to absorb moisture, preventing leaching. Excessively dry compost piles will actually shed water for a time before they begin to absorb moisture. Snow does not seem to affect the pile and may serve as an insulating blanket during periods of extreme cold. Bad weather, of course, can increase mortality and base piles should be constructed ahead of time in expectation of weather-related deaths.

Snow on pile/bin, credit: Dafoe

Issues To Watch Out For

Bones

Bones and miscellaneous trash can impact quality of material for end use, especially if moving off-farm. Shards of un-degraded large bones such as long leg bones and hip girdles can even puncture tires on farm equipment. Therefore, screening is advised to remove bones or other trash from the compost. Bones may be reincorporated to new mortality compost piles, for further break-down; residual bone can be used in the base of a new pile adding pore space for air circulation.

Small vs. Large Operations: Issues of Scale

A primary issue with scale will be selecting the site and sizing the area dedicated to mortality composting. General site recommendations are previously covered in the *Site Selection* section of this document; however, sizing for a small livestock operation will be different than a large dairy. Consider the operation's operational mortalities. A single large cow may require a compost pile with a base of 10 by 12 feet if not contained in a bin or bunker of some sort, whereas one could compost several small animals in the same space. Likewise, the amount of carbon material needed to incorporate large carcasses will be greater for more and larger animals. This is discussed in the *Incorporating Dead Materials into the Carbon Process* section of this document. Finally, scale affects equipment selection, such as the size of a loader or tractor needed to haul, lift into place, and cover mortalities with material. Equipment selection is discussed in the *Equipment Decisions* section of this document.

Scavengers

Proper coverage and capping of mortality compost piles is vital to discouraging scavengers. Also, fencing around mortality compost is advisable for the same reason. At two sites in rural Montana with known dog and coyote populations, little to no scavenger activity has been noted. In some areas, the practice of composting, in general, should be carefully considered and protected in order prevent attraction of dangerous scavengers such as grizzly bears.

Odors

Properly managed compost, even mortality compost, should not produce great odor. Some materials available for composting may cause more odor than the mortality itself. This may be the case with silage, manure or some crop residues, especially oil seeds or spoiled feed. An adequate cap on the pile of inert material such as sawdust or finished compost will help reduce, if not eliminate, odor.

Nuisance

The greatest nuisance associated with mortality compost is likely to be flies and other insects. Additionally, longer term compost piles may harbor noxious weeds whose seeds are introduced to the pile by carbon materials used or from the surrounding environment. Moisture and temperature will play a role in managing both. High moisture can lead to better breeding for flies. Turning the compost towards the end of the process and allowing re-heating to around 140° F after the bulk of the carcass is degraded will help sterilize most weed seeds. An overall weed control program and knowledge about the carbon sources will also help control this potential problem. Herbicides used on or near compost, or on source materials can persist in the final product. Therefore, their use should be carefully considered.

Neighbor Relations

Proper management of the previously listed issues is important for neighbor relations. While it is discussed in this publication that mortality compost sites should have good all-season access, they should also be visually screened from public roads and neighboring properties. Likewise good management practices to prevent scavengers from distributing carcasses, prevention odors, and reduction of flies and nuisances are all imperative for maintaining good neighbor relations.

Prion Diseases and Composting

This science on this issue is still inconclusive; composting suspect animals should be avoided. Prion diseases, such as scrapie (sheep), chronic wasting disease (CDW; deer and elk) and bovine spongiform encephalopathy (BSE; cattle), are diseases that cause a degeneration of the central nervous system. Prion diseases appear to be extremely durable in the environment, likely because of their ability to bind with soil minerals. For example, in an experiment, scrapie remained infectious after burial in garden soil for three years and anecdotal evidence suggests that the disease persisted for 16 years in an abandoned sheep barn.

One recent study suggests that composting may have the potential to degrade the part of the protein responsible for causing infection, called PrPSc. In this study, the PrPSc in samples of scrapie-infected sheep tissues (i.e., central-nervous-system, lymphoid system, and various organs) experimentally composted in a static-pile passive-aeration system were demonstrated to have degraded after 108 days; however, this study did not specifically measure infectiousness of composted tissues.

Another study, which simulated a natural scenario in which an infected animal dies and remains at ordinary physiological and ambient temperatures, indicated that the N-terminus of brain-derived PrPSc, a section of the protein vulnerable to cleavage, was lost after 7-35 days(3). While this study demonstrated that PrPSc can be degraded in certain environmental conditions, it did not determine the infectivity of the resulting, damaged protein.

Based on this recent work, it appears that composting conditions that include high heat and bacteria may degrade PrPSc, but that these conditions are not typical of natural environments. The risk of disease transmission appears to be most heavily influenced by the degree of by-pass, which is the compost that does not reach critical temperature because of its location in the pile. A United Kingdom investigation of BSE concluded that composting and compost spread on pasture were safe when a 2-tier (primary and secondary) composting system was used together with a 2-month grazing ban for the treated pasture.

Because prion diseases are transmissible between mammalian species, are incurable, and are highly infectious, extreme caution should still be used when disposing of infected carcasses. Incineration and burial in landfills, practices often used to dispose of infected carcasses, may create air and water contamination risks and may be publically unpalatable. Certification of flocks for scrapie free status can be done and may open up composting as safe mortality management tool.

Compost Quality, Use and Other Considerations

Mortality Compost Quality and Use

The practice of mortality composting has been explained in this document as an alternative to other management methods. There are environmental and financial benefits to the practice compared to alternative disposal methods and composting may result in value added product. Mortality composting has also been discussed here as a stand-alone process and not necessarily part of a larger compost business that may also be related to the livestock or poultry operation. At this time, *mortality* composting should be considered a management option and not something that would be highly marketable. This is especially true where there are other composting operations going on. The benefits are reaped from use on-farm.

Mortality compost is finished when the soft tissues, odors, and most of the bones are no longer present in the bins, piles or windrows. Since safe animal disposal is the goal, the compost quality would not necessarily be that of retail quality compost. Large bones and fragments can persist, as well as vet waste, implants, ear tags or other non-degradable materials. The appearance of these items in material sold or given away could be a liability against the producer. Finally, even with well-managed mortality composting, there is a possibility that not all pathogens were destroyed. Even if cause of death was not known to be the result of disease, exporting mortality can be a great bio-security risk (please see *Prions* section, particularly if you are considering composing of small ruminants).

The best recommendation for use of mortality compost is to re-incorporate it into the mortality management process. Finished compost can be used for core and cap, though old exposed bones may attract unwanted attention. Reusing the compost in this manner will continually break down residuals from the last batch and often help jump-start the next mortality pile. If this compost is land applied, it should be used carefully on the producer's property. As a final precautionary measure, avoid using mortality compost on crops or plants such as vegetables that are for direct human consumption. Have the material tested for nutrient value before using it as fertilizer or a soil amendment.

Emergency Situations

Emergency Response Plan

All livestock operations need to have an emergency response plan (ERP, sometimes an emergency action plan {EAP}) developed that describes how to deal with catastrophic mortality loss. This is also a requirement in nutrient management plans for permitted animal feeding operations. Local Emergency Management Coordinators and County Extension Agent should be consulted prior to developing that plan, as they have access to resource materials and are acquainted with the local, state, and federal officials who will need to be contacted following a catastrophic mortality event. In addition, in many major livestock production areas, the Emergency Management Coordinator will have already developed an ERP for the county that a livestock operation may be able to "piggyback" onto.

Catastrophic Mortality Loss

Routine mortality losses are relatively simple to deal with. However, a livestock operation may encounter a catastrophic mortality loss at some point. In this situation, a producer is faced with the death of many animals as a result of one incident or event. Some examples could be a barn fire, flooding, tornado, ventilation failure in a building, poisoning, animal disease, heat stress, or a blizzard.

Carcass disposal following a catastrophic mortality loss can be a daunting task and may pose a unique set of issues. Typical carcass disposal regulations are designed with the intent of routine on-farm losses, where as one or two animals are lost from time to time. A catastrophic mortality event may require disposal of more animals than what current regulations will allow. Therefore, special permitting may be required. In addition, the circumstances of death may require that the mortalities be disposed of in a specified fashion. As an example, if a large number of cattle are poisoned; those animals would not be disposed of via a rendering service; as there could be potential of contaminating pet foods.

Having an ERP in hand will speed the response to catastrophic losses and do so in a fashion that will hopefully help to limit liability and public health and safety concerns. Often times a catastrophic mortality loss is the result of a major news event, such as a tornado striking a community including five beef cattle feedlots. The ability to quickly and efficiently execute a well planned, environmentally friendly, humane, and health conscious response can help avoid poor public perceptions and negative press.

Many of the people tasked with responding to a catastrophic mortality event have expressed a preference for composting, especially when the land space and resources are available. When proper precautions are taken, composting can help protect water quality and air quality when compared to mass burial or incineration.

High Water Events and Your Compost Pile

Compost piles, no matter how they are constructed, should never be situated in a flood plain. Should a heavy water event occur, the compost operation should be inspected as soon as possible, to ensure that erosion of the compost has not occurred. Damaged compost piles may require reforming or even complete reconstruction. Although rare in the Rocky Mountains, for areas that receive more than 40 inches of annual rainfall, it is recommended that compost bins/pits be covered by a roof if possible.

Tornado/High Winds and Your Compost Pile

Tornados and/or excessively high winds may cause damage to a compost operation. Following high-wind events, compost piles should be inspected to determine if recovering or reforming of the pile is necessary. In addition, in some cases carcasses may have been removed from the compost and transported elsewhere by a tornado. In this type of situation, the local Emergency Management Coordinator should be contacted and informed in order to manage any possible public health risks.

Economics of Livestock Mortality Disposal

Mortality Composting, a Viable Option

Mortality composing is becoming a viable option for many farmers and ranchers out of sheer economic necessity. For many years, rendering services were the preferred choice for disposal of animal mortalities and, in many cases, is still a preferred method if the price is right. However, these services have become so few and far between that their fees are usually too expensive to justify. As in any enterprise, necessity and expense are great incubators of invention. This turn of events, along with an improved understanding of composting principles, have led many to turn to composting as a viable alternative for disposal. As composting practices have become more widely researched and implemented, they have emerged as a viable and economically smart solution for livestock operations interested in an alternative to expensive processes such as rendering, incineration, burning and land filling.

Equipment and Facility Needs

The equipment required to conduct composting on an individual operation will vary with size of operation and volume of mortality losses. In general, many medium to large operations may already have the needed equipment. A front-end loader with capacity to move the types of carcasses encountered, and composting material, will serve basic equipment needs for most operations. Those also composting manure or other materials in windrows have specialized equipment dedicated exclusively to composting activities. The cost of a new commercial compost turner or windrow machine may range from $30,000 in excess of $100,000. Although used equipment and leases are available; this type of equipment is not necessary for mortality composting, and not recommended for bin and single pile composting. A fuller discussion of equipment is included in the section titled "Equipment Decisions."

Facility needs for a successful composting operation primarily includes open space to place windrows of composted material. This space should be sufficient to place windrows of composted material for a period of at least six months without need to remove. Sufficient room to maneuver equipment in and around compost windrows is also necessary. A complete discussion of site and facility needs is included in the section titled "Site Selection."

Making the Decision

The decision to move away from conventional disposal methods and towards mortality composting requires some thought into the benefits and costs of such a change. All producers can use the partial budgeting principle to compare various benefits and costs associated with making a change in their mortality management procedures. This process will help producers visualize the potential savings and/or costs of one method over another in real numbers.

The partial budget form provided in this manual is designed to help produces look at adjustments in a portion of any business enterprise and evaluate whether it is a desirable option. Because partial budgeting only looks at incremental changes that come with a change of business practices, only the items specific to the decision are considered.

Key to the process of partial budgeting is the concept that changes in a business will result in one or more of the following: additional returns (+), additional costs (-), reduced costs (+), and reduced returns (-). As designated by the +/- symbol behind each of these results (Figure 1), offsetting effects of positive and negative result in a final result when all figures are totaled. If the net result of the above figures is positive, the change is thought to be positive to the bottom line of the business.

Partial Budgeting and Avoided Cost

Partial budgeting is a form of budgeting that looks at potential changes in an operation to gauge whether the proposed change(s) would be a benefit to the profitability of the enterprise. While many portions of a business are fixed in the short run, partial budgeting looks at changes in resources that are not fixed, often times looking at long-term structural changes to a business practice. Only items that change from one alternative to the next are considered in the calculations.

The partial budgeting example in Figure 1 illustrates some items that might be considered in evaluating the financial feasibility of transitioning to composting versus continuing to use a rendering service. In the left column, positive returns to the operation after the proposed change are totaled. These items include **Additional Returns** to the operation and **Reduced Costs.** If it is possible to sell compost, this might be an example of an additional return, while reduced rendering fees would be an example of reduced costs.

The right column of the partial budget totals negative returns to the operation after the proposed change. **Additional Costs** and **Reduced Returns** comprise these negative financial aspects of a proposed change. An example of additional costs is additional equipment, labor, and repairs specific to the composting operation.

After all items are accounted for in the partial budgeting process (Additional Returns, Reduced Costs, Additional Costs, and Reduced Returns), the negative column (B) is subtracted from the positive column (A) to show the final result of the partial budget. If the result of this calculation is positive, the proposed change is considered to be a financial benefit to the operation. In the above example, the result is a positive $400 ($1,250 - $850 = $400). This means that, assuming all items are accounted for, the operation would be $400 better off by switching to a composting operation.

Of course, the result of this calculation will vary depending on operation size, location and resources. The intent of the partial budgeting process is to "clear the smoke" of all aspects of the operation that will not be changed under the proposed change. By only considering the items relevant to the proposed change, the true effects on an operation's profitability are highlighted.

Partial Budget Form

Proposed Change: Composting Livestock Mortalities Vs. Rendering Service (10 Cows Annually)

Additional Returns		Additional Costs	
Compost/Fertilizer		Equipment Repairs	150.00
		Carbon Source	200.00
		Equipment Labor	500.00
Total Additional Returns	$ -	Total Additional Costs	$ 850.00
Reduced Costs		Reduced Returns	
Rendering Charges	1,250.00		
10 @ $125			
Total Reduced Costs	$ 1,250.00	Total Reduced Returns	$ -
A. Total Additional Returns & Reduced Costs	$ 1,250.00	**B. Total Additional Costs & Reduced Returns**	$ 850.00
		Net Income Change (A Minus B)	$ 400.00

Figure 1. Example of a partial budget comparing composting and a rendering service.

Partial Budget Form

Proposed Change: ______________________________

Additional Returns		Additional Costs	
Total Additional Returns	$ -	Total Additional Costs	$ -
Reduced Costs		Reduced Returns	
Total Reduced Costs	$ -	Total Reduced Returns	$ -
A. Total Additional Returns & Reduced Costs	$ -	**B. Total Additional Costs & Reduced Returns**	$ -
		Net Income Change (A Minus B)	$ -

Figure 2. Blank partial budget form.

State Regulations and Permitting

The following discussions are based on state level regulations at the time of publishing. Local county or city regulations need to be researched before beginning your compost operation because they can place additional constraints on a composting operation. Likewise, consult the regulatory agency directly, or an Extension specialist knowledgeable on the subject.

Montana

State Regulations

Montana Code Annotated (MCA) 75-10-213 regards dead animal disposal. Animal composting facilities are listed as approved disposition of dead animals; there is also reference to the required use of permitted composting facilities. However, in the exclusion that follows, it states that a person cannot be prohibited from disposing of waste generated in reasonable association with the person's agricultural operation upon land owned or leased, as long as no public nuisance or health hazard is created.

The Montana Department of Environmental Quality (MT-DEQ) reserves the right to revoke such privileges or exclusions if a proper plan for construction, operation, and maintenance of the composting facility is not followed, thereby resulting in a nuisance or public health hazard. Generally, the exclusion would not apply to divided land with tracts of land five acres or less in area. An alternate interpretation for permitted animal feeding operations (CAFOs with an MPDES Permit) is that mortality management practices defined and approved through that process would be authorized. In conclusion, properly designed and managed mortality composting can be done on property under the producer's legal control with said producer's animals without permit, unless a nuisance or health hazard is declared.

Permitting Considerations

The MT-DEQ Solid Waste Division issues permits for composting operations in the state. They have a two-tiered system differentiating between large composters, that require a Class II Solid Waste Management System Permit, and small composters, which require a Small Composter Facility License. However, on-site mortality composting with that producer's animals may be done without permit under the conditions referenced in State Regulations for Montana. Contact the Montana Department of Environmental Quality - Solid Waste Division at 406.444.5300 for more information.

Wyoming

Regulations

Regulations that would apply to mortality management with composting are tied to Wyoming's Department of Water Quality. Section 14 of the state's water quality guidance states that dead animals or solid waste shall not be placed or allowed to remain in Wyoming surface waters. Compost is generally considered to be part of the solid waste stream and as such must stay out of the state's surface waters.

Animal feeding operations have specific regulations that require the preservation of water quality. Animal feeding operations must be sized to contain precipitation and runoff from a 100-year, 24-hour storm. Any activity that would jeopardize water quality is not allowed. All Wyoming surface waters which have the natural water quality potential for use as an agricultural water supply shall be maintained at a quality which allows continued use of such waters for agricultural purposes. Unless otherwise demonstrated, all Wyoming surface waters have the natural water quality potential for use as an agricultural water supply.

Permitting

A permit to compost dead animals associated with a livestock operation is likely not needed. Those considering composting in Wyoming are encouraged to read Solid Waste Guideline #17 from the Wyoming Department of Environmental Quality and Wyoming Department of Agriculture. Questions should be directed to the WDEQ ((307) 777-7752).

Colorado

Regulations

In Colorado, there are two regulatory bodies involved in composting, the Colorado Department of Public Health and Environment (CDPHE) and the Colorado Department of Agriculture (CDA). The CDPHE's focus is on protecting public health and the environment at the composting site, while the CDA's focus is on protecting consumers from poor quality compost and guiding compost uses. The CDPHE regulations will be summarized in the Permitting Considerations section, and the CDA regulations will be described in the Compost Fate section.

Permitting Considerations

The CDPHE is responsible for the Solid Waste Regulations in Colorado as they apply to composting facilities (Section 14). There is, however, an agricultural exemption that is granted under certain conditions:

- The composting feedstocks are all agricultural wastes (from crop or animal production) generated onsite.
- The only feedstocks allowed to be imported onto the composting site from off-farm are wood chips and tree branches. They can only be brought on-farm in quantities necessary for effective composting, and they can only be stored for a maximum of nine months. In the case where off-farm feedstocks are brought on-farm for composting, the finished compost can only be applied to agriculturally zoned land.

Detailed information describing these requirements is found online in the regulation itself (www.cdphe.state.co.us/hm/sw/section14/basispurpose.pdf).

New Mexico

Regulations

In New Mexico, the primary regulatory body that addresses composting is the Solid Waste Bureau with the New Mexico Environment Department. Secondary authority is found in the Groundwater Quality Bureau for protection of water resources in, around, and below a composting site. Regulations are applicable based on tonnage per year. The regulations are summarized in the Permitting Considerations section.

Permitting Considerations

The New Mexico Administrative Code requires any person operating or proposing to operate a composting facility that accepts greater than 25 tons per day annual average compostable material or greater than five tons per day annual average of material that would otherwise become special waste (e.g., sludge, offal), shall submit a permit request and plans outlined in the administrative code. Much of the language is intended for those that intend to accept mortality or offal from outside sources. An individual that generates less than five tons per day of what would be considered special waste (i.e., offal, mortality, etc) would not be subject to regulation but should follow best management procedures and be especially mindful of nuisance ordinances and any county regulations. For more detail and information please visit the Title 20 website at www.nmcpr.state.nm.us/nmac/parts/title20/20.009.0003.htm

or the Solid Waste Bureau's website at www.nmenv.state.nm.us/swb/

DEPARTMENT OF
PRIMARY INDUSTRIES

On-Farm Composting of Dairy Cattle Mortalities

Why Consider Composting?

As knackery and rendering services have declined in many parts of Victoria over the last five or so years, the question of what to do with dead stock has become increasingly problematic for some dairy farmers. There are stringent guidelines for the burial of dead stock (see EPA Victoria Publication 660, www.epa.vic.gov.au). Unfortunately, a few desperate farmers have been known to leave their animals in the ‘back paddock’ or even dump them in waterways (Fig 1). Dumping of farm animals in this manner is a biosecurity and environmental hazard – it is also illegal and EPA Victoria has prosecuted those responsible for it in the past.

Composting of dead farm animals is a relatively simple and effective process for the routine disposal of dead stock of all sizes (i.e. from poultry to mature cattle). Some farmers have been composting for a long time. The resulting compost can be applied to cultivated land, as top dressing on pastures, or on non-grazed farm areas such as shelterbelts. Compost is a soil conditioner that is able to improve a range of different soil properties, e.g. organic matter content, and provide slow release nutrients

Figure 1: Illegal dumping of stock is a biosecurity and environmental hazard

What is mortality composting?

Composting is a biological process in which naturally occurring microorganisms and soil animals convert organic materials into a soil-like material called compost. More specifically, mortality composting can be described as the above-ground burial of dead stock in a mound of sawdust, shavings or similar supplemental carbon material. Sufficient supplemental carbon is required around the carcass to absorb bodily fluids and to prevent odours from escaping from the pile.

Mortality composting is generally conducted in 3 stages. In the first stage of composting, the pile is left undisturbed as soft tissue decomposes and bones partially soften. The compost is usually then moved, turned or mixed to begin the second stage, during which time the remaining materials (mainly bones) break down further. Following completion of the second stage, the composting process is completed during a curing or storage phase.

The first (and sometimes second) stage of composting is characterised by high temperatures (>55°C); these conditions result in the elimination of nuisance odours and destruction of pathogens (disease-causing organisms) and weed seeds.

Warning!
If there is suspicion that the animal may have died from a notifiable or exotic disease, the carcass must not be composted but disposed of under the direction of the Victorian Department of Primary Industries. If in doubt, a vet should be contacted.

Victoria The Place To Be
DairyingForTomorrow
EPA VICTORIA
Australian Government
Department of Agriculture, Fisheries and Forestry
National Landcare Program

Selecting the Site for Composting

The site should be located in an elevated area with soils that have low permeability. It may be possible to use an existing hardstand area or a disused concrete pad for composting dead farm animals. If neither is available, a hardstand area that provides all-weather access may need to be established. Instructions for constructing a hardstand are available on the Internet (e.g. www.epa.sa.gov.au/pdfs/cattle.pdf).

Additional requirements include the following:

- The watertable at the site must be at least 1–2 m below the surface;
- The site must not be within 100 m of surface waters (e.g. streams, lakes, wells etc);
- The site should have an adequate slope (1–3%) to allow proper drainage and prevent pooling of water following a rain event;
- Run-off from the composting facility (e.g. during a heavy rainfall event) should be directed to an effluent pond or a vegetative filter strip / infiltration area;
- The site should have all-weather access and have minimum interference from other traffic;
- Consideration should be given to prevailing winds and the location and proximity of the site in relation to the farm house and neighbours in order to prevent potential odour problems;
- Fence off the site to help eliminate scavenging animals and other livestock accessing the piles.

Figure 2: Establish 45-60 cm base layer of carbon material

Figure 3: Place the carcass in the centre of the base

Figure 4: Cover the carcass with 60 cm carbon material

How is Composting Done?

These instructions are for composting dairy cattle using the open pile method, which is likely to be the method of choice for most farmers.

Constructing the Pile

The construction of the pile requires considerable quantities of carbon material; about 10 - 12m^3 is needed to establish a composting pile for a 450-kg carcass. Up to 50% of carbon material can be comprised of finished compost from previous composting piles.

Follow this process for constructing a mortality composting pile:

Step 1. Establish a base layer of relatively dry carbon material at the composting hardstand area (Fig. 2). The depth of the base layer should range between approximately 45 cm for small carcasses and 60 cm for large carcasses. The dimensions of this base layer must be large enough to accommodate the carcasses with >60 cm space around the edges.

Step 2. Place the carcass in the centre of the base layer (Fig. 3).

Step 3. Cover the carcass with carbon material to a depth of about 60 cm (Fig. 4). The material used to cover the animal should be damp to enhance the composting process. The material must feel moist but not be too wet. Composting material is too wet when water can be squeezed from it (droplets appear between fingers).

Step 4. Leave the pile undisturbed for at least 4 months. Provided that the animal is covered well enough, scavengers should not be attracted to the pile.

Step 5. When the soft tissue has completely decomposed after 4-6 months the pile can be turned and watered (Fig. 5) to complete the composting process.

Step 6. When the pile starts to cool down, leave it to cure for at least another 4 weeks before using the compost. It is not necessary to turn the pile during the curing stage.

Although the composting process is complete, large bones of adult cattle such as the skull, the spine, shoulder blades or leg bones may still be present. However, they are usually 'clean' (free of soft tissue) and have become brittle, starting to disintegrate (Fig 6).

Figure 5: Watering the compost at turning

Figure 6: Bones remaining after 4 months composting

Monitoring the Composting Process

1. Monitor compost pile temperatures (> 60 cm depth) weekly for the first four weeks after establishing the pile and after turning (Fig. 7). Subsequently, fortnightly measurements should be sufficient. Take temperature readings (three are suggested) from several points in the pile and record them down for future reference.
2. After establishing the pile, visit the pile daily for the first week, to ensure there is no odour or liquid running from the base of the pile, and no dogs or foxes have dug into the pile to get access to the carcass. Add more carbon material if needed to cover the animal or to mop up seeping fluids.
3. From about 4 months (less for younger, smaller animals), periodically check for signs of remaining soft tissue. If none remains, the pile can be turned and watered as described above.

Figure 7: Monitoring temperature during composting

Biosecurity

Composting is known to control nearly all pathogens - viruses, bacteria, fungi, protozoa (including cysts) and helminth ova to acceptably low levels. Exceptions to this are some spore-forming bacteria (e.g. *Bacillus anthracis,* 'anthrax') and prions like BSE (bovine spongiform encepalopathy). Prions are highly resistant to both physical and chemical means of inactivating pathogens and for this reason it is assumed that composting will be ineffective in reducing infectivity of prion-infected carcasses.

Pathogens are killed during composting by multiple means, such as high temperatures, the direct and indirect effects of other microorganisms and the presence of organic acids and ammonia in the compost. Not only is temperature considered to be the most important factor in killing pathogens, it is also relatively easy to measure during composting.

The heat required for the inactivation of pathogens is a function of both temperature and length (time) of exposure. Exposure to an average temperature during composting of 55 to 60°C for a couple of days is usually sufficient to kill the vast majority of pathogens.

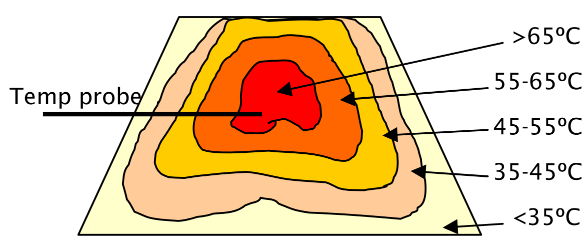


Figure 8: Temperature variation within a typical pile

To achieve efficient pathogen kill, <u>all</u> materials in a compost pile must be exposed to high temperatures for prolonged periods. In piles, there is great variation in the temperature profile from the cool outside layers to the hot central mass (Fig. 8). As a result, piles are usually turned periodically to expose the outer layers of the pile to high temperature composting. In mortality composting, piles are turned after the soft tissue has decomposed (stage 2).

Risk Management

Proficient design and operation of mortality composting systems is very important to ensure that all material achieves adequate temperatures for long enough to kill pathogens. This is achieved for mortality composting piles provided that temperature is monitored.

The current state of knowledge suggests that taking the following factors into consideration will reduce the potential biosecurity risk associated with mortality composting:

- Attention to site design and layout to minimise scavenging and contamination of ground and surface water with pathogens;
- Using a minimum two-stage composting system followed by the use of a curing phase to properly complete the composting process;
- Where possible, fully encapsulating mortalities in 'clean' carbon source; use sufficient carbon source to absorb liquids and odorous gasses produced during composting;
- Monitor and manage the composting process to maximise progress towards the full completion of composting (e.g. temperature, monitoring, watering and turning);
- Attention to basic standards of hygiene (e.g. minimising pooling of water at the site, regular sanitising of equipment and keeping it separate from production facilities, use of personal safety equipment by compost operators).

Health and Safety

A compost pile contains living microorganisms including moulds, bacteria, fungi and protozoa. These microorganisms can cause adverse reactions, particularly in people with a weakened immune system, asthma or a punctured ear-drum, or if somebody takes antibiotics or adrenal cortical hormones. Dust particles or bioaerosols released from the pile during handling of the compost on rare occasions may cause skin irritations, eye infection or respiratory illness.

The following precautions should always be followed when handling dead stock or compost materials:

- Wear gloves;
- Wash hands after handling dead stock or compost;
- Avoid breathing dusts or mists;
- Wear particulate mask;
- Wear dust resistant eye protection;
- Wash work clothing regularly;
- Prevent injury when operating machinery.

Further information

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Detailed instructions for mortality composting available on the Dairying for Tomorrow website (www.dairyingfortomorrow.com)

Published by: Department of Primary Industries
Future Farming Systems Division
PO Box 4166, Parkville, Victoria, 3052.
September, 2007

Authorised by: Victorian Government
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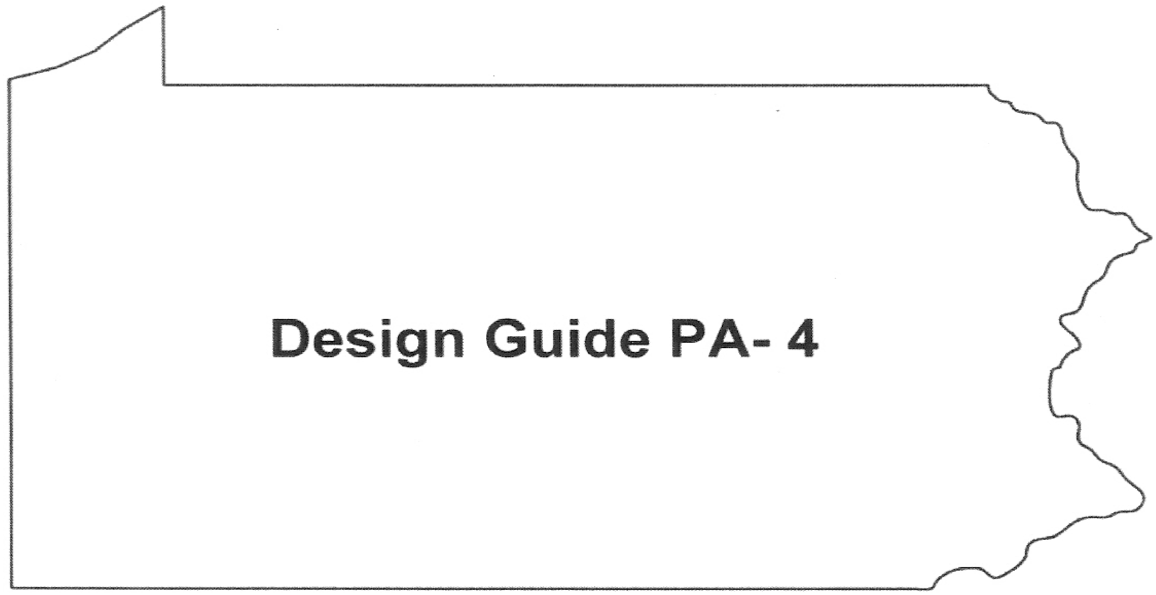
Melbourne, Victoria 3000, Australia

For more information about DPI visit the website at www.dpi.vic.gov.au or call the Customer Service Centre on 136 186.

Animal Mortality Composting



Design Guide PA- 4

Natural Resources Conservation Service
Pennsylvania

February 2006

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PREFACE

Composting livestock and poultry mortality in agricultural operations is a legal option for disposal in Pennsylvania. This design guide, used in conjunction with the Pennsylvania Technical Guide standards PA316, Animal Mortality Composting, and PA317, Composting Facility, make it possible to safely and legally compost livestock mortality. This technology expands the options for animal mortality disposal and improves the efficiency and profitability of agricultural enterprises. Material will be appended as additional information becomes available, and as new procedures are developed and approved.

The Pennsylvania Department of Agriculture, Bureau of Animal Health and Diagnostic Services, administers the regulations that determine allowable methods of livestock disposal, such as incineration, burial, rendering or composting.

This design guide includes information applicable to composting of routine and catastrophic mortality losses, except those resulting from infectious diseases. If a dangerously infectious disease is discovered on any farm, PDA will determine the allowable method of disposal.

This design guide was adapted from the Ohio Livestock and Poultry Composting Manual.

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ANIMAL MORTALITY COMPOSTING PRINCIPLES AND OPERATION

Composting of animal mortalities differs from composting of most other materials which are processed in a consistent, thoroughly mixed pile. A pile in which animal mortalities are com posted is an inconsistent mixture. Therefore composting animal mortalities must be approached in a different way and with greater care.

Figure 1 is a schematic showing the process followed for composting animal mortalities. This approach has been successful on thousands of farms throughout the United States. The compost pile (either open or in a bin) is an inconsistent mixture with a large mass of material (the animal) having a low C/N ratio, a high moisture content, and nearly zero porosity surrounded by a material (the carbon amendment) with a high CIN ratio, moderate moisture levels, and good porosity. The animal and amendments are layered into the pile and no mixing is done in this process until after the high rate stage of composting has occurred and the animal has fully decomposed. Composting livestock mortalities (primary stage) can be described as "above ground burial in a bio-mass filter with pathogen kill by high temperature."

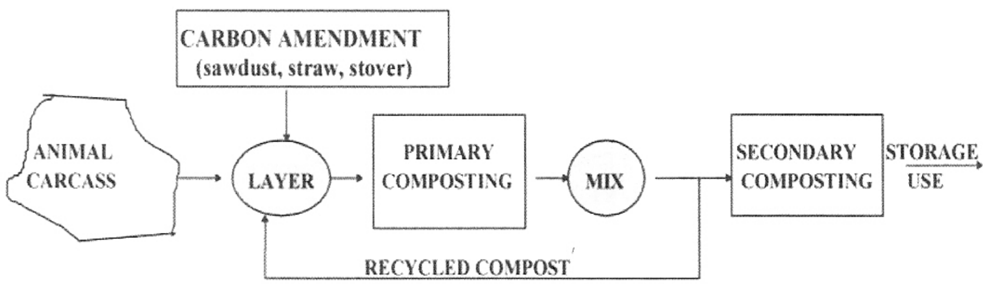


Figure 1. Material flow in livestock mortality composting. Forced aeration is not used. Materials are not mixed until flesh of the animal body is completely decomposed. Time can vary from 10 days (poultry) to over 100 days (large animals).

Figure 2 is a cross section of the compost pile for animal mortality. The decomposition process is anaerobic (lacking oxygen) in and around the animal mortality. But as gasses are produced and diffuse away from the mortality, they enter an aerobic zone. Here the gasses are trapped in the surrounding material, ingested by the microorganisms, and degraded to CO_2 and H_20. Thus the surrounding material supports bacteria to form a biological filter, or a biofilter.

With this scenario, turning the pile is to be avoided until the mortality has been decomposed. For small to moderate size animals (poultry, pigs, sheep, etc.) this period is generally less than three months after the last mortality has been placed into the pile. After this time the compost is moved to a secondary area where it is allowed to compost for an additional time period of 10 days to several months. Moving the pile for secondary composting and storage introduces air back into the pile and mixes the contents of the pile, leading to more uniformity in the finished compost. The secondary pile is then turned and placed in a storage/curing pile for 30 days or more. When composting large mature animals, bones sometimes remain after completion of the secondary/storage process. These are usually quite brittle and pose no health risks or danger to equipment when land applied. In some instances it may be desirable to recycle the larger bones back into the compost to allow more decomposition.

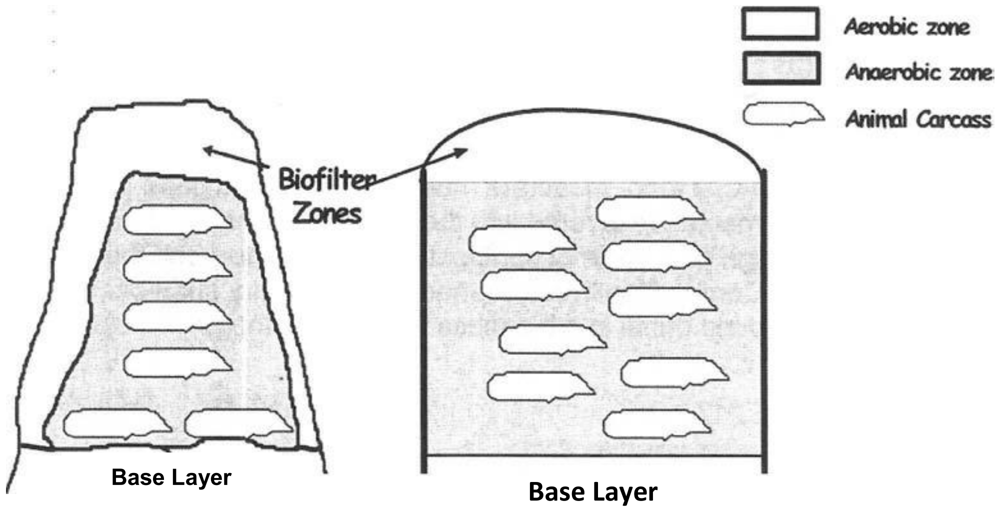


Figure 2. Cross-Section Views of Composting in a Windrow (Pile) or Bin for Animal Mortality. Layering of animal mortalities surrounded by material which not only provides carbon (energy) for the microorganisms, but also acts as a Biofilter. Pile is not turned until animals are decomposed. Pile shape will depend on whether done in the open or in a bin.

Data Collection

In order to monitor the composting process, it is necessary to measure and record temperatures of the compost pile. Pathogen kill can be monitored by measuring the internal pile temperature. Progress of the pile can also be assessed from temperature records. Temperatures should be taken at several points near the animals in the pile. Temperature recording can be done easily with a three foot probe thermometer (1/4 inch probe diameter is recommended). Data recorded should include date, size, number of animals added, and the internal temperature of the pile.

Managing the Composting of Livestock/Poultry Mortality

There are two general approaches to livestock mortality composting: enclosed or bin systems and open windrow or pile systems. The following discussion of the overall management illustrates some of the basic ideas involved in either approach. More details are given later for each species.

Sawdust is widely used for composting animal mortality. It works well as a biofilter, allows high temperatures to be achieved and sustained during the primary stage, and promotes bone breakdown when doing large (>400 lb.) animals. Because of its ability to shed rainwater, sawdust works well for outside piles where exposure to rain and snow could result in high moisture levels leading to leachate or odors. When using sawdust, it is recommended 25-50% of the material be recycled compost from the storage pile as this reduces cost, improves the composting process, and leads to a higher quality finished compost. Recycle rates should not exceed 50% as this may limit carbon availability, thus interfering with the composting process.

Studies in Ohio have shown that (1) mixtures of sawdust and straw (or cornstover) can be used both under cover or in outside piles and (2) straight straw or cornstover can be used in roofed piles, but require periodic water addition during composting to prevent inhibiting the process. If straw or corn stover are used in the mix, the amount of recycled material will need to be reduced. For poultry mortality, poultry litter and straw work very well.

The following table lists potential materials for use in composting animal mortality. Discussion of materials suitable for each species is detailed In the later chapters of this manual.

Table 1. Carbon sources/carbon amendments identified for possible incorporation into animal mortality composting operations.

Corn Stover	Chopped Soybean Stubble
Peanut Hulls	Wood Shavings/Chips
Sawdust	Recycled Paper/Cardboard
Yardwaste	Leaves
Hay	Chicken Litter
Rice Hulls	Manure & Bedding (Horse, Sheep, Swine)
Straw	

Source: National Pork Producers Handbook

Practices of composting animal mortalities are very simple. The recommended methods are:

1. Construct a base layer of dry sawdust, finished compost, or other acceptable absorbent material. Sawdust, compost or similar fine textured material can be mixed with equal amounts of chopped straw, corn stover, or soybean stubble. This base layer should be at least 1 ft. thick for carcasses weighing 50 pounds or less, 18 inches thick for carcasses between 50 and 250 pounds, and 2 ft. thick for carcasses over 250 pounds. The base layer in a windrow or pile system should extend 2 ft. beyond the area to be covered with carcasses. It will collect liquids that are released during mortality decomposition. It also permits air movement and microbial action underneath the mortality. If liquids

begin to leach out of the pile, spread sawdust around the pile to absorb the liquids, and increase the depth of the base when constructing new piles.

2. Place a layer of animals on the base layer. A single layer of animals should be centered on and evenly spaced across the base. Do not stack animals on top of one another (with the exception of very small animals where mortalities can be layered up to 4 inches thick). Space animals larger than twenty pounds at least six inches apart in the layer. Four to six inches of amendment is necessary between layers of mortality for the compost system to work effectively.
3. Cover the animals with 2 ft. of damp sawdust or other amendment from Table 1. This cover acts as the biofilter for odor control around the pile and insulates the pile to retain heat. Odors may be released when an inadequate cover is used or when it is too dry or too wet. The released odors may also attract scavenging animals and pets to the pile. Maintaining a 2-ft. cover prevents this.

When additional animals are placed in the pile the following steps should be followed.

4. Hollow out a hole in the 2 ft. of cover material. Maintain 4 to 6 inches of amendment over animals already in the pile.
5. Place a new layer of animals in the pile.
6. Cover new layer of animals with 2 ft. of damp amendment.

Pile (bin) management is a simple cycle, based on a primary stage (primary stage compost time = T1), secondary stage (T2), and storage stage (T3). A minimum of two primary piles (bins) is required. The secondary pile (bin) is the same volume as the primary pile (bins). The storage pile size is dictated by the longer of 30 days or how long the compost will be stored before land application.

Each pile is constructed for T1 days, composted for T1 days after the last animal is added, and then is turned and composted for T2 days. Finally the material is placed in the storage area where it is kept for T3 days. Each primary bin gets filled at (2 * T1) intervals.

ANIMAL MORTALITY COMPOSTING FACILITY ALTERNATIVES

This section was adapted from OSUE Extension Factsheet AEX 712-97 Swine Composting Site Selection by Mescher, Wolfe, Stowell and Keener, 1997; OSUE Extension Factsheet AEX 713-97, Swine Composting Facility Design by Mescher, Wolfe, Foster and Stowell, 1997; and the NPPC Composting Module, McGuire (ed), 1997.

Mortality composting is commonly conducted in one of two primary facility types: a bin or windrow. Each facility type has unique advantages and disadvantages and producer choice is driven by a number of concerns. including:

1. Ability to meet the objectives of a compost system.
2. Type of production unit serviced.
3. Economic costs associated with startup and operation of the bin or windrow.
4. State regulations and/or restrictions on facility type and design specifications.
5. Access to economical sources of carbon amendment.
6. Access to appropriate loading, unloading and handling equipment.
7. Appropriate land area for application of compost material.

Given these driving factors. producers must make informed decisions based upon the specific advantages of each facility option.

Bin Composting

Composting in a bin usually involves construction of a facility with a concrete floor, wood sidewalls on at least 3 sides, and a roof over the facility to eliminate water infiltration and leachate.

Advantages to Bin Composting

+ Reduced risk of weather affecting the compost process.
+ More aesthetically pleasing appearance.
+ Reduced risk of scavening animals.
+ Compost moisture content is consistent and controllable.
+ Many carbon amendments can be used in the process.
+ Leachate risk is reduced and easily contained.
+ Existing facilities, barns, etc. may be easily modified to meet the needs.

Disadvantages to Bin Composting

- Initial investment in facilities.
- Difficult to load lar e animals into bins

Windrow Composting

Windrow composting is established on a concrete, geo-textile fabric lined gravel base or low permeability soil to control water infiltration. In this system, walls and roofs are not used, so the windrow is accessible from all sides to load, unload and mix the compost material. Producers can load the animal mortalities for a specific time period while continually extending the length of the compost windrow and mound the compost material to shed rainfall, control moisture loss and maintain adequate biofilter cover. Turning of any portion of the pile is delayed until that portion has met acceptable times for stage 1 (T1) or stage 2 (T2) or storage(T3). Specific size and number of windrows and management will be based on animal sizes, loading rates, and site parameters of layout. These topics are discussed in greater detail below.

Pile composting is a variation of windrows except the pile is not extended in length. Turning of any pile is delayed until it has met acceptable times for stage 1 (T1) or stage 2 (T2) or storage (T3). With pile composting there will be three active piles in operation at any given time. (2 primary and 1 secondary).

Advantages to Windrow and Static Pile Designs

+ Low initial investment in facilities.
+ Better suited to large animals

Disadvantages to Windrow and Static Pile Designs

- Exposure of the compost to the elements (wind and rain) increases risk of leachate and runoff.
- Acceptable carbon amendment more limited than bin system.
- Scavenging animals, if present, may be difficult to eliminate.

ANIMAL MORTALITY COMPOST FACILITY SIZING

This section presents the formulas along with worksheets and tables for sizing and specifying the design of composting facilities for poultry and livestock enterprises.

Sizing Guidelines

Sizing of a mortality composting facility is critical for its successful operation. Composting facilities that are undersized will lead to problems with odor and flies, and possibly scavengers and leachate. Proper sizing will make the management and operation of the composting process easier. Sizing is based on:

- Three stages for composting mortality - primary, secondary, and storage;
- Weight of the largest animal in the primary composting stage;
- Daily mortality rate and composting time determining total loading for each
- primary pile (bin);
- All systems having a minimum of two primary piles (bins) or equivalent; and
- All primary piles (bins) using a biofilter cover of 2 ft. and a thickness of base material suitable for the animal size.

Analysis of the mixing ratios and specific volumes of materials and livestock mortalities, based on the guidelines for C/N ratio and biofilter cover as described under Animal Mortality Composting Principles and Operation, were analyzed by Keener et al. (1999) for poultry, swine and cattle. From that analysis equations were developed for primary stage time and volume, secondary stage time and volume, and storage time and volume. Those equations are shown on the next page, and are incorporated into the worksheets at the end of this section.

Table 2 summarizes the steps in sizing of a composting facility. For large animals and low average daily loss (ADL), the volumes needed for primary, secondary and storage are better calculated using equations 2a, 4a and 6a.

Design of the composting facility is easy, but requires knowledge of death losses. Table 3 summarizes the average death losses for poultry, swine, cattle/horse and sheep/goats and can be used in the design process for new facilities. **However, actual death loss data from the operation should be used in sizing the composting facilities whenever possible for existing facilities.**

Worksheets for calculating the poundage of annual and ADL are PA-ENG-316a for poultry, PA-ENG-316b for swine, and PA-ENG-316c for other livestock.

Dimensions of windrows and the size of the composting area for a windrow system are determined using worksheet PA-ENG-316d. For a bin composting system, sizes and numbers of bins are determined using PA-ENG-316e. If animal size and mortality rate (lb/day) are known, Tables 4, 5, and 6 can be used directly to find required stage times and windrow or bin volumes.

Annual volume of sawdust or other amendment, assuming no recycling of material, is based on the equation: V_a = lbs. loss/yr. x 0.0069 = cu. Yd./yr.

In practice, up to 50% of the amendment can come from finished compost.

Equations for Primary. Secondary and Storage Stage Time and Volume

Primary stage time, T_1 , is calculated using

$$T_1 = 5 \text{ x } \overline{\qquad} \geq 10 \text{ days} \qquad (1)$$

W_1 is the design (usually largest) body weight of mortality (lb). ADL is average daily loss (lb) and is calculated using mortality rates, animal numbers and batches per year.

Primary com poster volume, V_1 , is calculated using

$$V_1 \geq 0.2 \text{ x ADL x } T_1 \text{, ft}^3 \qquad (2)$$

With large animals and infrequent deaths, equation 2 will sometimes underestimate the primary volume needed. Equation 2a is a modification of equation 2 that correctly calculates primary volume and is applicable for any animal size.

The modified version of equation 2 is

$$V_1 = 0.2 \text{ x } W_1 \text{ x Integer(ADL x } T_1 / W_1 \text{) , ft}^3 \qquad (2a)$$

where Integer(ADL x T_1 /W_1) is the product of (ADL x T_1 /W_1) rounded up to the next whole number.

Studies (Brodie and Carr, undated; Elwell et al., 1998) on composting mortality indicated secondary composting time does not need to be equivalent to the primary stage time.Instead, it should be based on heating and cooling of the pile. Usually, this stage lasts from 10 to 30 days. For design and operational purposes, an estimate of secondary stage time, T_2 and volume, V_2, is calculated using

$$T_2 = 1/3 \text{ x } T_1 \geq 10 \text{, days;} \qquad (3)$$

$$V_2 \geq 0.2 \text{ x ADL x } T_2 \text{ , ft}^3 \qquad (4)$$

The use of a minimum of 10 days or 1/3 the primary time is based on approximating minimum times found in poultry mortality composting and the times of sustained re-heating in the secondary bin for larger animals. A modified version of equation 4 for use with large animals or infrequent mortality cases is

$$V_2 = 0.2 \text{ x } W_1 \text{ x Integer (ADL x } T_2 / W_1 \text{) , ft}^3 \qquad (4a)$$

Equation 4a avoids underestimating windrow or bin size. One secondary bin can often handle the contents from up to three primary bins, due to reduced volumes and holding time. The secondary bin should not be smaller than a primary bin.

Because land application may not be feasible at all times, storage time for compost needs to be considered. A minimum of 30 days is recommended. Volume of storage, V_3, can be calculated using

$$T_3 \geq 30 \text{, days;} \qquad (5)$$

$$V_3 \geq 0.2 \text{ x ADL x } T_3 \text{, ft}^3. \qquad (6)$$

A modified version of equation 6 for use with large or infrequent mortality cases is

$$V_3 = 0.2 \text{ x } W_1 \text{ x Integer (ADL x } T_3/W_1 \text{), ft}^3. \qquad (6a)$$

Equation 6a will avoid underestimating windrow size. The storage bin is always equal to or larger than the size of the secondary bin.

Table 2 Design procedures for animal mortality composting system

Step	Description
1	Determine the average daily weight of animal mortalities to be composted: 1. Multiple livestock species can be com posted together, unless a dangerously contagious or reportable disease is suspected. Bio-security measures must be considered in the sitting and operation to prevent disease transmission. 2. Use farm records for building capacity, animal sizes and livestock production values and loss records when possible; or calculate the livestock mortality rates (from PA-ENG-316a, 316b, or 316c). 3. For swine facilities the following assumptions should be used if operator records are not available: • Each sow yields 2.5 litters of pigs per year • Each litter = 10 pigs • For finish operations, the number of hogs = 2.7 x farm building capacity 4. The average daily death loss should be determined for each growth stage on the farm. 5. Pounds of mortality produced from operations in one year using "**average weight**". 6. Average daily loss in pounds per day to be composted. For some livestock operations the mortality rate is not constant throughout the year. See PA-ENG-316c.
2	Determine the Composting Stage times for the "**design weight**" to be com posted in each windrow or bin. Note that the time for Primary Composting as well as the needed composting volume increases as the animal weight increases. For an operation with different growth stages, segregated bins or windrows should be evaluated for feasibility. Consider separate facilities for animals within these weight ranges: less than 50 lb., 50 to 250 lb., and greater than 250 lb. For animals exceeding 500 to 600 pounds the windrow composting method is preferred because individual primary bins would be large and the placement of animals would be difficult. For mature cattle or horses, a pile on a composting pad for each individual animal is preferred. The following equations are solved in section 1 of PA-ENG-316d (for windrows) or PA-ENG-316e (for bins). 1. Primary Stage Time (in days) = 5 x (Design Animal Weight)$^{1/2}$, Minimum Time ≥ 10 days 2. Secondary Stage Time (in days) = 1/3 Primary Stage Time, Minimum Time ≥ 10 days 3. Storage Time ≥ 30 days (Needs to be considered when land application is not feasible immediately following completion of secondary stage)
3	Determine the needed com poster volumes using the following equations in PA-ENG-316d or 316e. 1. Primary Com poster volume (in ft^3) = 0.2 x Average daily loss (ADL, in lb/day) x Primary Stage Time (days) 2. Secondary Composter Volume = 0.2 x ADL (in lb/day) x Secondary Stage Time (days) 3. Storage Volume =0.2 x ADL x 30 days Note: For large animals use alternate equations in PA-ENG-316d or 316e.
4	Determine the dimensions of the compost facility, bin dimensions, and windrow size or number of bins using PA-ENG-316d or *316e.* Note, in a bin system, the minimum front dimension (width) should be 2 ft. greater than the loading bucket width. Also as an alternative to building individual secondary bins, a large area to accommodate more than one primary bin can be used. This bin is generally directly behind the primary bins.
5	Determine the annual sawdust requirement for the composting system using PA-ENG-316d or *316e.* This calculation assumes all sawdust needs are met with fresh sawdust. In practice, it is recommended that up to 50% of the fresh sawdust needs be met with compost that has completed the secondary cycle.

Table 3. Livestock mortality rates and design weights.

Poultry[1]	Average Weight[3] (pounds)	Loss Rate (%)	Flock Life	Design Weight[4] (pounds)
Broiler (mature)	4 - 8	4.5 - 5	42 - 49 days	Up to 8
Layer	4.5	14	440 days	4.5
Broiler, breeding hen	4 - 8	10 - 12	440 days	8
Turkey, female (meat)	15 - 25	6 - 8	95 - 120 days	25
Turkey, male (meat)	25 -42	12	112 -140 days	35
Turkey, breeder replace.	15 (birth - 30)	5 - 6	210 days	20
Turkey, breeding hen	28 - 30	5 - 6	180 days	30
Turkey, breeding tom	70 - 80	30	180 days	75

Swine[2]	Average Weight[3]	Loss Rate (%)			Design Weight[4]
Growth Stage	(pounds)	Excellent	Good	Poor	(pounds)
Birth to Weaning	6	<10	10 - 12	>12	10
Nursery	24	<2	2 - 4	>4	35
Growing - Finishing	140	<2	2 - 4	>4	210
Breeding Herd[5]	350	<2	2 - 5	>5	350

Cattle / Horses[6]	Average Weight[3]	Loss Rate (%)			Design Weight[4]
Growth Stage	(pounds)	Excellent	Good	Poor	(pounds)
Birth	70 - 130	<8	8 - 10	>10	130
Weanling	600	<2	2 -3	>3	600
Yearling	900	<1	1	>1	900
Mature[5]	1400	<0.5	0.5 - 1	>1	1400

Sheep / Goats[6]	Average Weight[3]	Loss Rate (%)			Design Weight[4]
Growth Stage	(pounds)	Excellent	Good	Poor	(pounds)
Birth	8	<8	8 - 10	>10	10
Lambs	50-80	<4	4 - 6	>6	80
Mature[5]	170	<2	3 - 5	>8	170

[1]Adapted from Ohio Poultry Association Information; [2]Adapted from Pork Industry Handbook - 100 [3]Average weight used to calculate pounds of annual mortality; [4]Design weight used to calculate composting stage periods; [5] For mature animals the % loss is an annual rate for the average number of head on the farm; [6]The design weight and mortality rates for cattle, horses, sheep and goats need to be verified with the producer, the table figures are estimates from OSU livestock specialists. The mortality rate for these species will not likely be constant throughout the year.

Table 4. Primary volume (ft^3) vs. body size and mortality rate

body size (lb)	3.0	4.5	10	35	50	100	150	220	300	350	500	1000	1500
Stage time (days)	10	11	16	30	35	50	61	74	87	94	112	158	194
mortality rate (lb/day)	Vol.[1]												
1	2	2	3	**7**	**10**	**20**	**30**	**44**	**60**	**70**	**100**	**200**	**300**
5	10	11	16	30	35	50	61	74	87	94	112	**200**	**300**
10	20	21	32	59	71	100	122	148	173	187	224	316	387
25	50	53	79	148	177	250	305	371	433	468	559	791	968
50	100	106	158	296	354	500	610	742	866	935	1118	1581	1936
75	150	159	237	444	530	750	915	1112	1299	1403	1677	2372	2905
100	200	212	316	592	707	1000	1220	1483	1732	1871	2236	3162	3873
150	300	318	474	887	1061	1500	1830	2225	2598	2806	3354	4743	5809
200	400	424	632	1183	1414	2000	2440	2966	3464	3742	4472	6325	7746
300	600	636	949	1775	2121	3000	3660	4450	5196	5612	6708	9487	11619
400	800	849	1265	2366	2828	4000	4880	5933	6928	7483	8944	12649	15492
750	1500	1591	2372	4437	5303	7500	9150	11124	12990	14031	16771	23717	29047
1000	2000	2121	3162	5916	7071	10000	12200	14832	17321	18708	22361	31623	38730
1500	3000	3182	4743	8874	10607	15000	18300	22249	25981	28062	33541	47434	58095

[1] Shaded values are minimum volumes based on animal size.

Table 5. Secondary volume (ft^3) vs. body size and mortality rate

body size (lb)	3.0	4.5	10	35	50	100	150	220	300	350	500	1000	1500
Stage time (days)	10	10	10	10	12	17	20	25	29	31	37	53	65
mortality rate (lb/day)	Vol.[1]												
1	2	2	2	7	**10**	**20**	**30**	**44**	**60**	**70**	**100**	**200**	**300**
5	10	10	10	10	10	**20**	**30**	**44**	**60**	**70**	**100**	**200**	**300**
10	20	20	20	20	24	33	40	49	**60**	**70**	**100**	**200**	**300**
25	50	50	50	50	59	83	100	124	144	156	186	264	323
50	100	100	100	100	118	167	200	247	289	312	373	527	645
75	150	150	150	150	177	250	300	371	433	468	559	791	968
100	200	200	200	200	236	333	400	494	577	624	745	1054	1291
150	300	300	300	300	354	500	600	742	866	935	1118	1581	1936
200	400	400	400	400	471	667	800	989	1155	1247	1491	2108	2582
300	600	600	600	600	707	1000	1200	1483	1732	1871	2236	3162	3873
400	800	800	800	800	943	1333	1600	1978	2309	2494	2981	4216	5164
750	1500	1500	1500	1500	1768	2500	3000	3708	4330	4677	5590	7906	9682
1000	2000	2000	2000	2000	2357	3333	4000	4944	5774	6236	7454	10541	12910
1500	3000	3000	3000	3000	3536	5000	6000	7416	8660	9354	11180	15811	19365

[1] Shaded values are minimum volumes based on animal size.

Table 6. Storage volume (ft^3) vs. body size and mortality rate

12

Table 6. Storage volume (ft^3) vs. body size and mortality rate

body size (lb)	3.0	4.5	10	35	50	100	150	220	300	350	500	1000	1500
Stage time (days)	30	30	30	30	30	30	30	30	30	30	30	30	30
mortality rate (lb/day)	Vol.[2]												
1	6	6	6										
5	30	30	30	30	30	30	30						
10	60	60	60	60	60	60	60	60	60				
25	150	150	150	150	150	150	150	150	150				
50	300	300	300	300	300	300	300	300	300				
75	450	450	450	450	450	450	450	450	450				
100	600	600	600	600	600	600	600	600	600				
150	900	900	900	900	900	900	900	900	900				
200	1200	1200	1200	1200	1200	1200	1200	1200	1200				
300	1800	1800	1800	1800	1800	1800	1800	1800	1800				
400	2400	2400	2400	2400	2400	2400	2400	2400	2400				
750	4500	4500	4500	4500	4500	4500	4500	4500	4500				
1000	6000	6000	6000	6000	6000	6000	6000	6000	6000				
1500	9000	9000	9000	9000	9000	9000	9000	9000	9000				

[2] Shaded area is minimum volume based on animal size.

Examples of Design

Examples for Poultry, Swine and Cattle are presented here to illustrate the use of the equations 1-6 and Worksheets PA-ENG-316d and 316e.

Example 1- Poultry (bin).

Given: W1 = 3 lbs. and Average Daily Loss (ADL) is 30 lbs/day. Design a composting bin system.

Solution: From equations 1-6 find:

T1 = 10 days, T2 = 10 days and T3 = 30 days; and

V1 = 60 ft^3, V2 = 60 ft^3 and V3 = 180 ft^3.

From Worksheet PA-ENG-316e for bin depth = 5 ft select a bin volume of 80 ft^3. (A bin of 4 ft x 4 ft x 5 ft).

Solving for bin numbers following procedure in step 2 gave: two primary bins, one secondary bin of 4 ft x 4 ft x 5 ft and one storage bin (or multiply bins) > 180 ft^2.

Example 2· Swine (bin)

Given: W1 = 450 Ibs. and ADL is 75 Ibs/day. Design a composting bin system.

Solution: From equations 1-6 find:

T1 = 106 days, T2 = 35 days; and T3 = 30 days; and

V1 = 1590 ft^3, V2 525 ft^3 and V3 = 450 ft

Equations 2a, 4a and 6a give:

V1 = 1620 ft^3, V2 = 540 ft^3 and V3 = 450 ft^3.

From PA-ENG-316e for bin depth = 5 ft select a bin volume of 800 ft^3 (16 ft x 10 ft x 5 ft). Solving for bin numbers following procedure in step 3 gave: three primary bins and one secondary bin 16 ft x 10 ft x 5 ft and one storage bin of 16 ft x 10 ft x 5 ft.

Example 3· Swine (windrow)

Given: W1 = 450 Ibs. and ADL is 75 Ibs/day. Design a composting windrow system.

Solution: From Equations 1-6 find:

- T1 = 106 days, T2 = 35 days and T3 = 30 days; and
- V1 = 1590 ft^3, V2 = 525 ft^3 and V3 = 450 ft^3 .
- From PA-ENG-316d for windrow height = 7 ft., find windrow section area = 56 ft^3 and base width is 15 ft.

This implies the primary windrow length = 28 ft; secondary windrow length = 10 ft (assuming 56 ft^2 cross section) and storage windrow length = 8 ft. The design windrow length would be 28 ft. Therefore, pad length is 38 ft. Pad width is = 60 ft (10 ft + 15 ft + 10 ft + 15 ft + 10 ft). Compost pad area is (38 ft x 60 ft) 2280 ft^2 or 0.052 acres.

Example 4- Cattle (windrow)

Given: W1 = 1400 Ibs. and ADL is 20 Ibs/day. Design a composting windrow system.

Solution: From Equations 1-6 find:

- T1 = 187 days, T2 = 62 days and T3 = 30 days; and
- V1 = 748 ft^3, V2 = 248 ft^3 and V3 = 120 ft^3.

Equations 2a, 4a and 6a give:

- V1 = 840 ft^3, V2 = 280 ft^3 and V3 = 280 ft^3.

Use alternate volumes from equations 2a, 4a and 6a. From PA-ENG-316d for a windrow height = 7 ft, find windrow Section area = 56 ft^2 and base width = 15 ft. This implies: primary windrow length = 15 ft; secondary windrow length = 5 ft (assuming 56 ft^2 cross section); and storage windrow length = 5 ft. The design windrow length is 15 ft. Therefore, pad length is 25 ft. (15 ft + 10 ft). Pad width is 60 ft. (10 ft + 15 ft + 10 ft + 15 ft + 10 ft). Compost pad area is 1500 ft^2 (25 ft x 60 ft).

Comments: Composting large animals requires additional evaluations to ensure adequate sizes. In this problem, over a 187 day time period, 3 (2.7 calculated) animals would need to be composted. Using the alternate calculation for primary bin volume gave 840 ft^3 which translated to a total pad size of 25 ft x 60 ft.

Poultry production and death loss calculations. PA-ENG-316a

Designer: ____________ Checker: ____________
Date: __________ Date: __________

Typical Mortality Losses for Poultry Production (%)

Poultry[1]	Average Weight[3] (pounds)	Loss Rate (%)	Flock Life	Design Weight[4] (pounds)
Broiler (mature)	4 - 8	4.5 - 5	42 - 49 days	Up to 8
Layer	4.5	14	440 days	4.5
Broiler, breeding hen	4 - 8	10 - 12	440 days	8
Turkey, female (meat)	15 - 25	6 - 8	95 - 120 days	25
Turkey, male (meat)	25 -42	12	112 -140 days	35
Turkey, breeder replace.	15 (birth - 30)	5 - 6	210 days	20
Turkey, breeding hen	28 - 30	5 - 6	180 days	30
Turkey, breeding tom	70 - 80	30	180 days	75

Source: Ohio Poultry Association Information

Poultry Type: ____________________

B = Number of birds on farm (or farm building capacity) = ____________________

M = Anticipated mortality for flock (as a decimal) = ______________

T = Life of flock (days) = ________________________

W_b = Weight of birds near maturity (lb)= ________________

ADL = Average Daily Loss during flock life (lb/day) = B x [(M/T) x W_b]

ADL = _________ x [(_______ / ________) x ________] = ___________ lb/day

Go to form PA-ENG-316e to size the bins (*poultry compost bins should have a roof*)

Recipe of Material Proportions for Poultry Composting

Material	Parts by Weight
Poultry Carcasses	1.0
Poultry Litter	1.2
Straw	0.1
Water	0.75

Swine production and death loss calculations. PA-ENG-316b

Designer: ____________ Checker: ____________
Date: __________ Date: __________

Typical Mortality Losses for Swine Production (%)

Stage of Growth	Average Wt. (Lbs.)	Design Wt (Lbs.)	Excellent	Good	Poor
Birth to Weaning	6	10	Under 10	10 - 12	Over 12
Nursery	24	35	Under 2	2 – 4	Over 4
Growing / Finishing	140	210	Under 2	2 – 4	Over 4
Breeding Herd	350	350	Under 2 / yrs.	2 – 5 / yrs.	Over 5 //yrs.

Source: Pork Industry Handbook - 100

PRODUCTION

NUMBER OF PIGS BORN PER YEAR (Pre-Weaning):

__________ X __________ X __________ = __________
(#sows) (litters/yr.) (pigs/litter) #pigs born/year

NUMBER OF NURSERY PIGS PER YEAR:

__________ - (__________ x __________) = __________
(#pigs born/yr.) (#pigs born/yr.) (% loss/100) #nursery pigs/yr.

NUMBER OF FINISHING HOGS PER YEAR

__________ - (__________ x __________) = __________
(#nursery pigs/yr.) (#nursery pigs/yr.) (% loss/100) #finishing hogs/yr.

TOTAL POUNDS DEATH LOSS PER YEAR (use "**average weight**" to calculate death loss)

__________ x __________ x __________ = __________
(# sows) (Avg. Wt.) (% loss/100) (Lbs. loss/year)

__________ x __________ x __________ = __________
(# pigs born/ yr.) (Avg. Wt.) (% loss/100) (Lbs. loss/year)

__________ x __________ x __________ = __________
(# nursery pigs/ yr.) (Avg. Wt.) (% loss/100) (Lbs. loss/year)

__________ x __________ x __________ = __________
(# finish hogs/ yr.) (Avg. Wt.) (% loss/100) (Lbs. loss/year)

TOTAL LBS DEATH LOSS/YEAR = __________

AVERAGE DEATH LOSS PER DAY = __________ / 365 = _______ (LBS DEATH LOSS/DAY)
(TOTAL LBS DEATH LOSS/YEAR)

Mortality calculations for general livestock.[1]

PA-ENG-316c
Sheet 1 of 2

Designer: ____________ Checker: ____________
Date: __________ Date: __________

Cattle, Horses, Sheep, Goats, Other (list)__________ (Poultry use 233a, Swine use 233b)

Complete one form for each livestock species. When the composting facility will include multiple livestock species, calculate daily losses by animal growth stage for each species, then sum the species worksheets to determine daily farm loss (see bottom of this form).

TOTAL POUNDS DEATH LOSS PER YEAR (use "**average weight**" to calculate death loss)

BIRTH STAGE:

(______________) X (______________) X (______________) = ______________
Number of Births — Average Weight — (% loss/100) — Lbs. of annual mortality

WEANLING STAGE:

(______________) X (______________) X (______________) = ______________
Number of Animals — Average Weight — (% loss/100) — Lbs. of annual mortality

YEARLING STAGE:

(______________) X (______________) X (______________) = ______________
Number of Animals — Average Weight — (% loss/100) — Lbs. of annual mortality

MATURE STAGE:

(______________) X (______________) X (______________) = ______________
Number of Animals — Average Weight — (% loss/100) — Lbs. of annual mortality

TOTAL SPECIES ANNUAL MORTALITY / YEAR (AM) = __________ lb

AVG DAILY LOSS[1] (ADL) = ANNUAL MORTALITY / 365= ______ / 365 = _______ lb/ day

Note:
For animals weighing less than 500 to 600 pounds, a bin composting system should initially be evaluated. For larger animals a windrow or compost pile for an individual mature animal will likely be the most practical.

[1] For poultry and swine, normal daily death loss can be assumed as a constant throughout the year. However in some livestock operations, high seasonal death rates are the norm (during calving and lambing), where the majority of annual death loss occurs during a short period of time. The other circumstance is where specific growth stages are moved off the farm at less than a year old (lambs sold at 120 days). In these instances, the average daily death loss calculation is modified as shown on page 2:

PA-ENG-316c
Sheet 2 of 2

DAILY DEATH LOSS (ADL) = [(AM x P) / t] = ___________ lb/day

AM = total annual mortality, for species or growth stage (lb)
t = duration of seasonal high loss period, or duration, less than a year, species are on the farm (days)
P= percentage of total annual loss that occurs during seasonal peaks (decimal)

OPTIONAL ADL CALCULATION METHOD
(select largest ADL from either method)

BIRTH STAGE:
(ADL) = [(_______ X _______) / _______] = ___________ lb/day
AM P t

WEANLING STAGE:
(ADL) = [(_______ X _______) / _______] = ___________ lb/day
AM P t

YEARLING STAGE:
(ADL) = [(_______ X _______) / _______] = ___________ lb/day
AM P t

MATURE STAGE:
(ADL) = [(_______ X _______) / _______] = ___________ lb/day
AM P t

TOTAL ADL / SPECIES = ___________ lb/day

Total Farm ADL (complete for last form used)

Species	Daily Mortality (ADL) from forms 316a, 316b or 316c
Cattle/ Dairy	lb/day
Goats	lb/day
Poultry	lb/day
Sheep	lb/day
Swine	lb/day
Horses	lb/day
Other (list)	lb/day
Sum (total farm)	lb/day

Go to forms PA-ENG-316d (windrow) orPA-ENG-316e (bin) to size the composting facility

Composting worksheet for windrows. PA-ENG-316d

Designer: ______________ Checker: ______________
Date: __________ Date: __________

1. Calculate Primary, Secondary & Storage Volumes (or use Tables 3.7 to 3.9):

Primary Volume = 0.2 x ______________ (lbs. Loss / Day) x ______________ (Primary Stage Time) = ______________ Cu Ft

Secondary Volume = 0.2 x ______________ (lbs. Loss / Day) x ______________ (Secondary Stage Time) = ______________ Cu Ft

Storage Volume = 0.2 x ______________ (lbs. Loss / Day) x 30 days = ______________ Cu Ft

Alternate: (use with large animals)

Primary Volume = 0.2 x W1 (lbs.) x Integer (ADL * T1/ W1) = __________ Cu Ft

Secondary Volume = 0.2 x W1 (lbs.) x Integer (ADL * T2/ W1) = __________ Cu Ft

Storage Volume = 0.2 x W1 (lbs.) x Integer (ADL * T3/ W1) = __________ Cu Ft

2. Indicate the windrow height and resulting windrow area used.

Assume a windrow height of 7 ft. and continue. Windrow Height = ______________ Ft
Windrow Section area and base width assume 1 ft. top width and 1:1 side slopes

Windrow Height (Ft)	Windrow Section Area (Sq. Ft.)	Windrow Base Width (ft)	Pad Width (ft)
5	30	11	52
6	42	13	56
7	56	15	60

3. Calculate the length of the Primary, Secondary and Storage windrows. **<u>The Design Windrow Length is longer of the primary windrow length or sum of the secondary and storage windrow lengths</u>. Then calculate the pad length.

Primary Windrow Length = (______________ (Primary Volume))/(______________ (Primary Windrow Area)) = ______________ Ft (nearest ft.)

If the composting windrow length is less than twice the windrow height, reduce the height and go back to step 2. This indicates the composting configuration will be a compost pile versus a windrow.

Secondary Windrow Length =(______________ (Secondary Volume))/(______________ (Primary Windrow Area)) = ______________ Ft (nearest ft.)

Storage Windrow Length =(______________ (Storage Volume))/(______________ (Primary Windrow Area)) = ______________ Ft (nearest ft.)

Pad Length = **Design Windrow Length + 10 ft. = ______________ Ft (nearest ft.)

4. Calculate Composting Pad Area

Pad width = 10 ft + primary windrow base + 10 ft. + secondary windrow base + 10 ft (See Table in step 3)

Compost Pad Area = __________ (Pad Length) x __________ (Pad Width) = ______________ Sq. Ft.

5. Calculate annual sawdust requirements. (This assumes no reintroduction of finished compost to the primary windrow, however it is recommended that up to 50% of fresh sawdust requirements be met with finished compost.)

Cubic Yards Sawdust = ______________ (lbs. Loss / Yr.) x 0.0069 = __________ Cu. Yds. / Yr.

Composting worksheet for bins.

PA-ENG-316e
Sheet 1 of 2

Designer: ______________
Date: __________

Checker: ______________
Date: __________

1. Calculate Primary & Secondary Times:

Primary cycle $T1 = 5 \times \sqrt{\_\_\_\_\_\_\_\_\_\_}$ = ____________ $days$ time

Design Weight (W_1,) largest animal anticipated — (10 day min)

Secondary stage time (T_2) = 1/3 x ____________ (Primary stage time) = ________ days (10 day min)

2. Calculate Primary, Secondary & Storage Volumes (or use Tables 1 through 3):

Primary Volume = 0.2 x ____________ (lb loss / day (ADL)) x ____________ (Primary Stage Time (T_1)) = ____________cu ft

Secondary Volume = 0.2 x ____________ (lb loss / day(ADL)) x ____________ (Secondary Stage Time (T_2)) = ____________cu ft

Storage Volume = 0.2 x ____________ (lb loss / day (ADL)) x 30 days (T_3) = ____________cu ft

Alternate: (use with large animals): W_1 = weight of largest animal[1]

Primary Volume = 0.2 x W_1 (lb) x Integer (ADL * T_1/ W_1) = ____________cu ft

Secondary Volume = 0.2 x W_1 (lb) x Integer (ADL * T_2/ W_1) = ____________cu ft

Storage Volume = 0.2 x W_1 (lb) x Integer (ADL * T_3/ W_1) = ____________cu ft

[1] Bins should not be used to compost large animals, and should be considered cautiously with animals over 250 pounds

3. Calculate number of bins with a minimum of <u>two</u> primary, one secondary, and one storage bin required. *In doing calculations always round up to whole number, i.e. 2.1 bins = 3 bins (or) increase the bin size and refigure.*

Bin Volumes versus width and length. Depth of compost = 5 ft.

Width / Length	4	6	8	10	12	14	16
	Bin Vol. (ft^3)						
4	80	120	160				
6	120	180	240	300	360		
8	160	240	320	400	480	560	640
10		300	400	500	600	700	800
12		360	480	600	720	840	960
14		420	560	700	840	980	1120
16		480	640	800	960	1120	1280

Number of Primary Bins - Choose bin dimensions within the capability of the loading equipment. Also account for the size of the animals to maintain 6" to 12" clearance between the carcasses and the bin walls (Minimum vol.). The bin width should be at least 2 ft greater than the loader bucket width. The minimum bin width should be at least 2 feet larger than the length of the largest animal. The equation for calculating the number of primary bins includes one additional bin to allow placing additional carcasses during the primary curing stage. *A minimum of two primary bins is required.*

Trial Bin Volume = ________ x ________ x 5 ft = __________ cu ft
Width (ft) length (ft)

Number of Primary Bins = ______________ / ___________ + 1 Bin = ___________ Bins
Primary Volume (step 2) Trial Bin Volume

Number of Secondary Bins - Select secondary bin volume. *Each secondary bin must be ≥ to the volume of the primary bin since volume reduction during the compost stage is neglected.* Minimum of 1 secondary bin per 3 primary bins (The 3:1 ratio requires immediate utilization or separate storage of compost following the secondary stage.)

Number of Secondary Bins = Secondary volume (step 2) / selected secondary bin volume

Number of Secondary Bins = ______________ / ______________ = ___________ Bins
Secondary Volume. (step 2) Secondary Bin Volume

Number of Storage Bins - Select storage bin size. *Volume of each storage bin must be ≥ to secondary bin volume.*

Number of Bins for Compost Storage = Storage volume (step 2) / selected storage bin volume

Number of Storage Bins = _______________ / _______________ = ___________ Bins
Storage Volume (step 2) Storage Bin Volume

4. Calculate annual sawdust requirements. (This assumes no reintroduction of compost that has completed the secondary cycle to the primary bin, however it is recommended that up to 50% of fresh sawdust requirements be met with this compost.)

Cubic Yards Sawdust = ____________ x 0.0069 = __________cu. yd. / yr.
lb. loss / yr.

Additional bin(s) for fresh sawdust storage = _________

Summarize Bin Sizes and numbers:

	Primary	Secondary	Compost Storage	Sawdust Storage
Number of Bins				
Size (w x l)				

MANAGEMENT OF THE COMPOST FACILITY

This section presents the procedures to follow in operating and maintaining the mortality composting facility, either bin or windrow systems.

Successful mortality composting is dependent on the operation and maintenance of the process. As with any composting, the right combination of ingredients goes a long way toward assuring this success.

Sawdust is the best amendment for use in animal mortality composting, and is essential for windrow composting. Generally dry sawdust is better since dryer sawdust can absorb more water and contains more air space. Producers have reported success using green sawdust for some or all of the fresh sawdust requirements. Sawdust containing excessive moisture may freeze in the winter, making it difficult to handle and place around the animals. A compost windrow with greater than 60% moisture content increases the risk of leachate, anaerobic activity, and fly production. Aged sawdust of 40-50% moisture content is recommended, especially for windrow composting.

The following pages contain separate sample operation and maintenance plans for windrow and bin composting operations. The sample plan for bins includes a section on poultry composting, which uses poultry litter and straw instead of sawdust as the standard amendments.

SAMPLE OPERATION & MAINTENANCE PLAN
for
LIVESTOCK MORTALITY COMPOSTING
Windrow Composting With Sawdust

Owner ___________________________________ County______________________ Date __________

Type of Livestock: Dairy/Cattle· Horses Poultry Sheep/Goats Swine

Design Mortality (lb/day): _________________ Design Carcass Weight (lb): _____

Primary Stage ______days (10 day min) Secondary Stage _____ days (10 day min)

1. Composting is a controlled natural process in which beneficial microorganisms reduce and transform organic wastes into a useful end product (compost). It is an aerobic process that does not produce offensive odors, and does produce a final product that is safe and is valuable as a crop fertilizer:

2. This method utilizes sawdust as the carbon amendment and allows the dead animal to supply the necessary nitrogen and water for the composting process to take place. This will satisfy the requirements of certain readily available bacteria and fungi to convert these materials to an inoffensive and useful product. The volume of the mass will be reduced 25 to 30 percent by the process. The composting process consists of a primary and secondary stage. The primary stage is to reduce the carcass to where only larger bones remain. The secondary stage is to allow complete decomposition of the carcass and for the compost to stabilize.
The composting time is dependent upon the size of the carcass. Therefore it is best to group similar sized carcasses into the same windrow. The time for secondary composting should generally be about *1/3* the time of primary composting. The following table can be used to estimate the stage times for various sized animals.

Carcass size (lbs).	4	10	50	100	220	350	500	1000	1500
Primary stage (days)	10	16	35	50	75	95	115	160	195
Secondary stage (days)	10	10	12	15	25	30	40	55	65

3. Start a composting windrow by placing a minimum one foot of sawdust on the base of the area for the windrow; if the carcass weight exceeds 200 Lbs, use at least 1 ½ feet of sawdust at the base. Carcasses placed directly on soil, gravel, or concrete floors will NOT compost. Place one layer of dead animals on the sawdust and cover with a minimum of 2 foot of sawdust. Place no animals closer than 2 foot from the sides of the windrow. The 2 foot cover on the sides and on top is important to eliminate scavenging animals and minimize odors. Most problems in animal mortality composting arise when insufficient sawdust is used in covering carcasses. Small animals less than 20 pounds may be grouped. Larger animals may need to be recovered as the sawdust settles around the carcass. Shape or round the windrow so that it will shed rainfall. Do not allow pockets to form in the windrow and eliminate any areas that will trap water. As large carcasses begin to decompose the windrow will settle and form pockets; as this occurs the windrow must be reshaped. To place additional carcasses, "hollow-out" a cavity in the existing windrow, place the carcasses one animal thick and cover with a minimum 2 foot sawdust. If finished compost is available, it should be used to cover the carcass to provide additional heat and bacteria to start the process. Sawdust should then be used to provide the final cover. Use a pointed dowel or rod to measure the thickness of the sawdust cover. Do not put carcasses on top of carcasses. Maintain *1/2* to 1 foot between carcasses to prevent a large anaerobic mass.

4. It is recommended to monitor the temperature in the windrow with a long stem, dial type thermometer. When composting is proceeding properly, temperatures will reach 130 to 160 ° F. Other than testing, this is the best way to prove pathogen kill and identify problems. Primary windrows started during cold weather may not begin composting immediately. As temperatures warm up, composting will begin. There is usually enough heat in active compost to continue composting through cold weather, regardless of the ambient temperature. If sawdust is used as recommended, the insulation effect is sufficient to minimize the effects of ambient temperature. However during cold weather, incorporate mortalities into the compost as soon as possible. *Frozen carcasses will take very long to compost*.

5. After the primary windrow has composted for the "primary stage time" (after adding the last animal), turn the contents into the secondary windrow. This step provides mixing and aeration of the material so it will reheat and compost through the secondary stage. When composting animals in excess of 600 Ib each, it is recommended that a separate pile be managed for each mortality to assure that the primary stage time is reached before the pile is turned.

6. After the secondary stage has completed, the compost should appear as a dark humus type material with very little odor. Some resistant parts such as teeth may still be identifiable, but should be soft and easily crumbled. If not, reintroduce them to the primary windrow. After completion of the secondary stage, the compost can be restaged. or spread as per the utilization plan. Storage of compost for at least 30 days following completion of the secondary stage will give additional management flexibility. This is particularly important where the primary plus secondary stage is less than 90 days since land application may not be possible immediately following the secondary stage.

7. Use the finished compost for a starter material over the new carcasses being com posted in the primary area. This provides heat and bacteria to kick start the process. Experience has shown that up to 50% of the sawdust requirements can be filled using recycled, finished compost. However, plan to use sawdust in the amounts noted for starting up the operation until sufficient finished compost is available. It is important to recognize that as finished compost becomes available, 50% of the fresh sawdust requirement must be maintained for the system to function effectively.

8. Keep sawdust relatively dry. Generally, sawdust between 40 and 50 percent moisture works best. Sawdust will shed rainfall reasonably well if the windrow is mounded, with no pockets or depressions. Positive drainage must be maintained. All leachate and runoff must be collected and stored or treated in a manure storage system or filter area. However in a properly maintained windrow leachate will generally be absorbed into the sawdust surrounding the carcass. During dry periods of the year the surface of the windrow can become too dry and sawdust can easily be blown off by the wind. A water source needs to be available to re-hydrate the windrow to prevent sawdust loss. If other carbon amendments such as corn stover or chopped straw are used in the windrow, moisture loss will be more prevalent than with sawdust. A supplemental water source will be necessary to maintain the proper moisture content necessary for composting.

9. Keep the area around the windrows mowed and free of tall weeds and brush. Watch for any leaching that may occur. Using sawdust for the foundation of the primary windrow will help eliminate leaching.

10. Finished compost should be applied to supply N, P_20_5 and K_20 requirements. The nutrient requirements for any particular crop should be based on a current soil test. Compost application rates should be calculated on its nutrient content according to a recent laboratory analysis. In the absence of a laboratory analysis the nutrient content of the compost is estimated to be:

estimated to be:	Total Nitrogen -	20 lbs/ton
	Ammonia Nitrogen -	4 lbs/ton
	Phosphorus	2 lbs/ton
	Potassium	6 lbs/ton

Finished compost shall be applied as per the compost utilization plan.

11. In order to assure desired operation of the composting facility, daily records should be kept during the first several compost batches. This can be helpful in identifying problems that may occur. Record keeping can be discontinued when a desirable level of operation has been achieved. It is suggested to record daily, the amount of sawdust added, the weight of the dead animals, and the temperature of the compost.
12. Occasionally, com posters will not heat up, or will produce odors or seepage. Composting is a biological process that depends on providing nutrients and an environment favorable for vigorous bacterial growth. Common mistakes are, failure to provide all the materials needed for energy and aeration, sloppy loading, insufficient cover over the animals, insufficient sawdust between the animals. These mistakes typically result in a dense, anaerobic mass and one in which energy is limiting. Turning the pile and adding DRY sawdust will remedy these problems. An exposed windrow will not need additional water. Daily records are the best way to diagnose problems.
13. Maintain a DRY, well drained, solid base for the windrow for two reasons; the base of the windrow will not turn anaerobic, and an all weather access can be maintained for daily loading. A wet compost area will be prone to failure.
14. Animals digging into the compost windrow CAN be a problem. Measures must be taken if this occurs to maintain bio-security and a positive public perception. The easiest way to prevent this from occurring is to maintain two feet of cover over all dead animal parts. It may become necessary to fence or build a structure to eliminate scavengers from the windrow if they cannot be kept out. It is easier to maintain two feet of cover than to incur the additional cost of a fence or structure. Operation and management will determine the needs of the system.
15. Inspect compost area or structure when the structure is empty. Replace any broken or badly worn parts or hardware. Patch concrete floors, curbs, or gravel areas as necessary to assure proper operation and integrity. Examine roofed structures for structural integrity and leaks.
16. Keep all trees, shrubs, and flowers healthy in order to maintain a positive rural image.

The following is an acknowledgement by the landowner and operator of the operation and maintenance requirements.

Signature(s)

Landowner ____ Date _____________

Operator ____ Date _____________

SAMPLE OPERATION & MAINTENANCE PLAN
for
LIVESTOCK MORTALITY COMPOSTING
Bin Composting With Sawdust
(Includes poultry composting section)

Owner ___________________________________ County______________________ Date __________

Type of Livestock: Dairy/Cattle· Horses Poultry Sheep/Goats Swine

Design Mortality (lb/day): _________________ Design Carcass Weight (lb): _____

Primary Stage ______days (10 day min) Secondary Stage _____ days (10 day min)

1. Composting is a controlled natural process in which beneficial microorganisms reduce and transform organic wastes into a useful end product (compost). It is an aerobic process that does not produce offensive odors, and does produce a final product that is safe and is valuable as a crop fertilizer:

2. This method utilizes sawdust as the carbon amendment and allows the dead animal to supply the necessary nitrogen and water for the composting process to take place. This will satisfy the requirements of certain readily available bacteria and fungi to convert these materials to an inoffensive and useful product. The volume of the mass will be reduced 25 to 30 percent by the process. The composting process consists of a primary and secondary stage. The primary stage is to reduce the carcass to where only larger bones remain. The secondary stage is to allow complete decomposition of the carcass and for the compost to stabilize.
The composting time is dependent upon the size of the carcass. Therefore it is best to group similar sized carcasses into the same windrow. The time for secondary composting should generally be about *1/3* the time of primary composting. The following table can be used to estimate the stage times for various sized animals.

Carcass size (lbs).	5	10	25	100	220	350	500	1000	1500
Primary stage (days)	10	16	25	50	75	95	115	160	195
Secondary stage (days)	10	10	12	15	25	30	40	55	65

3. Start a composting bin by placing a minimum one foot of sawdust on the floor of the primary bin; if the carcass weight exceeds 200 Lbs, use at least 1 ½ feet of sawdust at the base. Carcasses placed directly on soil, gravel, or concrete floors will NOT compost. Place one layer of dead animals on the sawdust and cover with a minimum of 1 foot of sawdust. Place no animals closer than 1 foot from the side of the bin. The 1 foot cover on the sides and on top is important to eliminate scavenging animals and minimize odors. Most problems in animal composting arise when insufficient sawdust is used in covering carcasses. Small animals less than 20 pounds may be grouped. Larger animals may need to be recovered as the sawdust settles around the carcass.

   To place additional carcasses, "hollow-out" a cavity in the existing compost, place the carcasses one animal thick and cover with a minimum 1 foot sawdust. If finished compost is available, it should be used to cover the carcass to provide additional heat and bacteria to start the process. Sawdust should then be used to provide the final cover. Use a pointed dowel or rod to measure the thickness of the sawdust cover. Do not put carcasses on top of carcasses Maintain 1/2 to 1 foot between carcasses to prevent a large anaerobic mass.

4. It is recommended to monitor temperatures in the bin with a long stem, dial type thermometer. When composting is proceeding properly, temperatures will reach 130 to 160° F. Other than testing, this is the best way to prove pathogen kill. Primary bins started during cold weather

may not begin composting immediately. If carcasses are buried with the proper amounts of sawdust, they will begin composting as temperatures warm up. There is usually enough heat in active compost to continue composting through cold weather, regardless of the ambient temperature. If sawdust is used as recommended, the insulation effect is sufficient to minimize the effects of ambient temperature. However during cold weather, incorporate mortalities into the compost as soon as possible. Frozen carcasses will take very long to compost.

5. After the primary bin has composted for the "primary stage time" (after adding the last animal), turn the contents into the secondary bin. This step provides mixing and aeration of the material so it will reheat and compost through the secondary stage.

6. After the secondary stage has completed, the compost should appear as a dark humus type material with very little odor. Some resistant parts such as teeth may still be identifiable, but should be soft and easily crumbled. If not, reintroduce them to the primary bin. After completion of the secondary stage, the compost can be recycled. or spread as per the utilization plan. Storage of compost for at least 30 days following completion of the secondary stage will give additional management flexibility. This is particularly important where the primary plus secondary stage is less than 90 days since land application may not be possible immediately following the secondary stage.

7. Use the finished compost for a starter material over the new carcasses composted in the primary area. This provides heat and bacteria to kick start the process. Experience has shown that up to 50% of the sawdust requirements can be filled using recycled, finished compost. However, plan to use sawdust in the amounts noted for starting up the composting operation until sufficient finished compost is available. It is important to recognize that as finished compost becomes available, 50% of the sawdust requirement must be maintained for the system to function effectively.

8. Keep fresh sawdust as dry as possible. Sawdust in the range of 40 to 50 percent moisture is recommended. If other bulking agents such as corn stover or chopped straw are used in the bin, moisture loss will be more prevalent than with sawdust. A supplemental water source will be necessary to maintain the proper moisture content necessary for composting.

9. Keep the area around the bins mowed and free of tall weeds and brush. Watch for any leaching that may occur. Using sawdust for the foundation in the primary bins will help eliminate leaching. There should be no leaching in a covered bin composting system.

10. Finished compost should be applied to supply N, P_20_S and K_20 requirements. The nutrient requirements for any particular crop should be based on a current soil test. Compost application rates should be calculated on its nutrient content according to a recent laboratory analysis. In the absence of a laboratory analysis the nutrient content of the compost is estimated to be:

Total Nitrogen	-20 lbs/ton
Ammonia Nitrogen	-4 lbs/ton
Phosphorus	- 2 lbs/ton
Potassium	- 6 lbs/ton

Finished compost shall be applied as per the compost utilization plan.

11. In order to assure desired operation of the composting facility, daily records should be kept during the first several compost batches. This can be helpful in identifying problems that may occur. Record keeping can be discontinued when a desirable level of operation has been achieved. It is suggested to record daily, the amount of sawdust added, the weight of the animals, and the temperature of the compost.

12. Occasionally, com posters will not heat up, or will produce odors or seepage. Composting is a biological process that depends on providing nutrients and an environment favorable for

vigorous bacterial growth. Common mistakes are, failure to provide all the materials needed for energy and aeration, sloppy loading, insufficient cover over the animals, insufficient sawdust between the animals. These mistakes typically result in a dense, anaerobic mass and one in which energy is limiting. Turning the compost and adding DRY sawdust will remedy these problems. Daily records are the best way to diagnose problems.

13. Maintain all runoff control to keep the site high and dry. A wet composting facility will be prone to failure.
14. Animals digging into the compost CAN be a problem although usually not a problem in bins. Measures must be taken if this occurs for bio-security reasons and maintaining a positive public perception. Maintaining 1 of cover over all animal parts in the bin will eliminate scavenging animals. NEVER allow animal parts to be exposed. Once an animal finds an exposed part, they are more likely to come back and dig into the compost. It is important to maintain continuous cover. Operation and management will determine the needs of the system.
15. Inspect the compost structure when it is empty. Replace any broken or badly worn parts or hardware. Patch concrete floors and curbs as necessary to assure proper operation and integrity. Examine roofed structures for structural integrity and leaks.
16. Keep all trees, shrubs, and flowers healthy in order to maintain a positive rural image.

Additional Considerations for Poultry Mortality. Composting

1. The process uses a simple mixture of poultry manure, poultry carcasses, straw, and water. This will satisfy the requirements of certain readily available bacteria and fungi to convert these materials to an inoffensive and useful compost. The volume of the mass will be reduced 25 to 30 percent by the process.

Recipe of Material Proportions for Poultry Composting

Material	Parts by Weight
Poultry Carcasses	1.0
Poultry Litter	1.2
Straw	0.1
Water	0.75

2. Once the weight of a day's poultry carcasses is determined, the other elements can be weighed out according to the recipe. The elements should be weighed in buckets on scales for the first few batches. For subsequent batches, a loader can be used once the weight of a full loader bucket has been determined for each element except water. A hose can be used to deliver the correct amount of water based on the time necessary to deliver the required weight of water through the hose. The moisture content must be maintained between 40 and 60 percent, equivalent to that of a "damp sponge." This is an important part of the composting process, since a mixture that is too wet can become anaerobic and cause severe odor problems. Additional water may not be needed if sufficient moisture is available from other recipe ingredients.

3. For primary composting, the material is placed in the bins in layers in the following sequence: (Note: see Figure 1)

a. One foot of dry poultry manure should be placed on the concrete floor to absorb the excess moisture that is added. This manure weight is not part of the recipe.

b. A 6-inch layer of loose straw is placed on top of the manure layer to allow aeration under the carcasses.

c. Add a layer of carcasses. Do not mound the birds. Use a rake to spread the birds in a single layer. Keep birds at least 6 in. away from the walls so the carcasses are not exposed.

d. Add water to each layer of carcasses. Add water only when needed to ensure the mixture is damp. The mixture should be about as moist as a damp sponge. Proper water content is important to success. Less water may be needed as the birds approach maturity. DO NOT ADD TOO MUCH WATER.

e. A layer of manure is placed over the carcasses according to the recipe. The manure must completely cover the chickens. This completes the first batch.

f. The second and each subsequent batch continues by repeating steps b through e above until the bin is full.

g. When the last layer of chickens is added to a bin, cap the pile with an extra layer of manure. The extra layer will insulate the pile and will also help prevent scavenging animals from digging into the top.

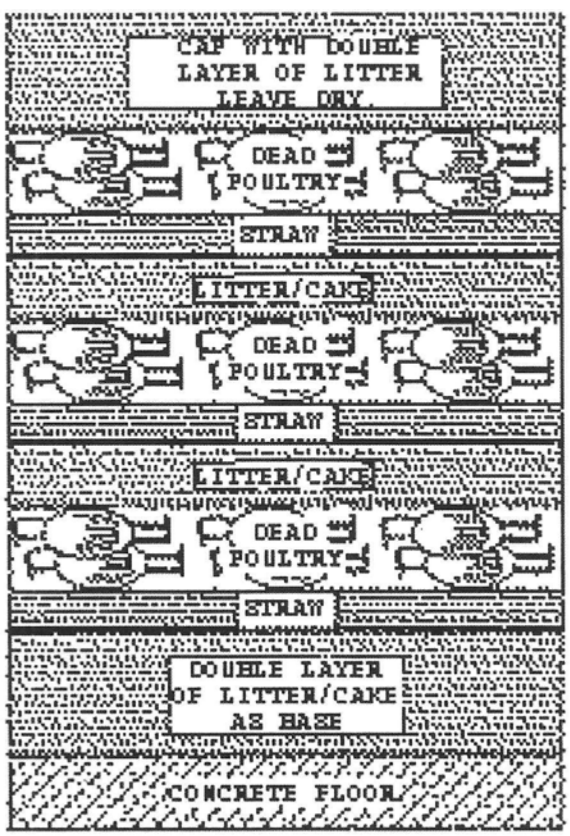


Figure 1

4. Temperature shall be monitored on a daily basis using a 36-inch probe-type thermometer with a rigid protective covering. Temperatures should peak at 130 to 140° F after 5 to 7 days of composting. If temperatures of 130 o are not achieved during the composting process, the resulting compost shall be incorporated immediately after land application. If temperatures exceed 160° F, the compost shall be removed from the composting bin, spread on the ground to a depth not to exceed six inches in an area away from buildings, and saturated with water to prevent spontaneous combustion.
5. The primary com poster shall be unloaded as peak temperatures begin to decline after 5 to 7 days, optimally at 10 days for chickens. For larger birds such as mature male turkeys the primary composting stage will take from 25 to 30 days (see table on page 1). Unloading the primary composter and loading the secondary com poster shall be done in a manner that assures maximum mixing of the composting material.. Moving the material aerates the mixture and revives the bacteria, allowing them to begin another stage of heating. Temperature should rise again and peak in about 7 days.
6. Moisture and temperature requirements discussed in paragraphs 4 and 5 above, also apply to the secondary composting process. The compost removed from the secondary composting process should be stored for 30 days before land application. Storage depth shall not exceed seven feet to reduce the potential for spontaneous combustion (see Preventing Fires in Litter Storage Structures discussion). In addition, the compost should not come in contact with any manure stored in the same facility. Storage will allow the compost to dry allowing greater ease in handling.
7. Compost shall be applied to supply N, P205 and K20 requirements. The nutrient requirements for any particular crop should be based on a current soil test. Compost application rates should be calculated on its nutrient content according to a recent laboratory analysis. In the absence of a laboratory analysis the nutrient content of the poultry compost is estimated to be:

Total Nitrogen	40lbs/ton
Organic Nitrogen	281bs/ton
Phosphorus	20lbs/ton
Potassium	251bs/ton

8. To utilize the nutrients in compost for crop production in an environmentally safe manner, it is important to follow the waste utilization details outlined in your Waste Utilization Plan.

9. Inspect compost structure at least twice annually when the structure is empty. Replace any broken or badly worn parts or hardware. Patch concrete floors and curbs as necessary to assure water tightness. Examine roof structures for structural integrity and leaks.

10. As discussed in paragraph 3 above, maintaining the moisture content between 40 and 60 percent is vitally important. The primary and secondary com posters and the storage or "resting" area should be protected from outside sources of water such as rain or surface runoff.

11. In order to assure desired operation of the composting facility, daily records should be kept during the first several compost batches. This can be helpful in identifying problems that may occur. Record keeping can be discontinued when a desirable level of operation has been achieved. It is suggested that daily records be kept on the attached "Poultry Composting Record Worksheet."

Occasionally, com posters will not heat up, or produce odors or produce seepage. Composting is a biological process that depends on providing nutrients and an environment favorable for bacterial metabolism. Common mistakes are failure to provide all the materials needed for food and aeration, or sloppy loading of primary boxes so that materials are not "sandwiched." Too little straw (or alternate carbon source" results in a dense, anaerobic mass and one in which energy (from cellulose) is limiting. Too much water is a common problem. Saturated compost piles are anaerobic and will not support the desired aerobic, thermophilic metabolism needed for rapid, odorless digestion of carcasses. If the mixture is too wet or too dry, the decomposition rate is greatly reduced. Too-wet, too dry, improperly mixed or incomplete mixes of compost materials can be amended. When primary compost is turned, dry manure or straw may be added to too wet compost, water can be added to "dusty-dry" compost, and improperly mixed materials can be remixed. A little experience and perseverance usually give good results in a short time.

The following is an acknowledgement by the landowner and operator of the operation and maintenance requirements.

Signatures

Landowner ____ Date _________________

Operator ____ Date _________________

REFERENCES

Brodie, H.L. and L. E. Carr. undated. Composting animal mortalities on the farm. Fact Sheet 717. Cooperative Extension Service, University of Maryland.

Composting Council. 1994. Composting Facility Operating Guide. The Composting Council, Alexandria, Virginia.

Composting Swine and Poultry Mortality in Ohio. 1997. Ohio State University Extension, Columbus, Ohio.

Elwell, D.L., S.J. Moeller and H.M. Keener. 1998. Composting large swine mortalities in three amendment materials. In: Proceedings of Animal Production Systems And The Environment. Des Moines, Iowa. pp15-20.

Epstein, E. 1997. The Science of Composting. Lancaster, PA: Technomic Publishing Company, Inc.

Fulhage, C. and C. E. Ellis. 1994. Composting Dead Swine. WQ 225. University of Missouri Extension.

Fulhage, C. and C. E. Ellis. 1996. Composting Dead Swine. WQ 351. University of Missouri Extension.

Glanville, T.D. and D .. W. Trampel. 1997. Composting alternative for animal mortality disposal. JAVMA 210(8). pp. 1116-1120.

Haug, RT. 1993. The Practical Handbook of Compost Engineering. Lewis Publications, Ann Arbor, Michigan.

Hansen, RC., K.M. Mand, H.M. Keener and H.A.J. Hoitink. 1995. The Composting Process. Bulletin 792. OSUE, The Ohio State University.

Rynk, 1992. On Farm Composting Handbook.

Keener, H.M., C. Marugg, RC. Hansen and H.A.J. Hoitink. 1-993. Optimizing the efficiency of the composting process. *In:* Hoitink, H.A.J. and H.M. Keener (eds.). Science and Engineering of Composting. Renaissance Publications, Worthington, Ohio. pp. 55-94.

Keener, H., D. Elwell and T. Mescher. 1997. Composting swine mortality. Extension Factsheet AEX 711-97. Ohio State University Extension, Columbus, Ohio.

LIFE. 1996. Composting dead livestock. Livestock Industry Facilities & Environment, Iowa State University.

Mescher, T., K. Wolfe, R Stowell and H. Keener. 1997a. Swine composting site selection. Extension Factsheet AEX 712-97. Ohio State University Extension, Columbus, Ohio.

Mescher, T., K. Wolfe, S. Foster and R Stowell. 1997b. Swine composting facility design. Extension Factsheet AEX 713-97. Ohio State University Extension, Columbus, Ohio.

Morris, J., 1. O'Connor and F. Kains. 1995. A method for bio-degradation of dead pigs. In: Proceedings of the Seventh International Symposium on Agricultural and Food Processing Wastes, pp.373-382. ASAE, St. Joseph, MI.

Murphy, D.W., and L.E. Carr. 1991. Composting dead birds. Fact Sheet 537. Cooperative Extension Service, University of Maryland System.

NPPC. 1997. Swine mortality composting module. National Pork Producers Council, Clive, IA.

OH-ENG-233a. 1999. Ohio NRCS Engineering Job Sheet. USDA-Natural Resources Conservation Service. 200 N. High Street, Columbus, Ohio.

OH-ENG-234a. 1999. Ohio NRCS Engineering Job Sheet. USDA-Natural Resources Conservation Service. 200 N. High Street, Columbus, Ohio.

OH-ENG-235a. 1999. Ohio NRCS Engineering Job Sheet. USDA-Natural Resources Conservation Service. 200 N. High Street. Columbus, Ohio.

Ohio Livestock Mortality Handbook. 1999. Extension Publication. Ohio State University Extension. Columbus, Ohio. (In Review)

Rynk, R.(Ed.) 1992. *On-farm Composting Handbook, NRAES-54.* Northeast Regional Agricultural Engineering Service, Ithaca. N.Y.

White, D.G., J.M. Regenstein, 1. Richard and S. Goldhor. 1989. Composting Salmonid fish waste: A waste disposal alternative. Sea Grant publication. Cooperative Extension NY State. Cornell University. Ithaca, N.Y.

LIVESTOCK CARCASS COMPOSTING BEST PRACTICES

Composting of livestock carcasses is a biological process in which naturally occurring microorganisms convert organic materials into a soil-like material called compost. More specifically, mortality composting can be described as the above ground burial of dead stock in a mound of combined plant/carbon material (like sawdust or shavings) and manure. Sufficient supplemental carbon is required around the carcass to absorb bodily fluids and prevent odors from escaping the mound.

Mortality composting is generally conducted in 3 stages. In the first stage of composting, the pile is left undisturbed as soft tissue decomposes and bones partially soften. The compost is usually moved, turned, or mixed to begin the second stage, during which time the remaining materials break down further. Following completion of the second stage, the final composting process is completed with the curing/storage phase. The result can be a high-quality compost that can be sold or utilized on-site. Small fragments of bone might still be present in the final product, which can be sifted or highlighted as part of the natural process.

Select An Appropriate Composting Site

The site should be located in an area with low soil permeability and be protected from run-on/run-off precipitation.

Additional considerations:

- **Functional compost piles will not have leachate or effluent around the base.**
- **Construct piles and windrows to run in parallel with the land's slope.**
- **The water table at the site should be at least 6ft below the surface.**
- **The site should not be located within a 100-year floodplain.**
- **The site should not be within 300ft of surface water (canals, rivers, streams, wells).**
- **Run-off from the composting facility during a heavy rainfall event should be directed to an effluent pond.**
- **Well-functioning compost piles should have minimal odor. However, consideration should be given to prevailing winds and proximity to neighbors in order to prevent potential odor problems.**
- **Actions should be taken to shield composting site from public view**

Step-By-Step Carcass Composting

Construction of the pile requires large quantities of a carbon material, such as manure. A minimum of 13-16 cubic yards is recommended to establish a composting pile for a 1000 lb carcass: approximately 12 feet wide by 6 feet tall, with length depending on the animal(s).

The following process for conducting a mortality composting pile are recommended:

Step 1: Establish a 5-12" deep base layer of relatively dry carbon material such as wood chips or yard trimmings. The width of the base layer should be wide enough to accommodate the carcass with a minimum 24" of space.

Step 2: Cover the carcass with a combination of homogenized plant material and manure/bedding to a depth of 24" or greater. The material used to cover the animal should be damp to enhance the composting process. The material should feel moist but not be too wet. Composting material should be considered too wet when water can be squeezed from it. Similar to building a fire, there also needs to be some permeability and air flow through the pile for the reactions to occur.

Step 3: Leave pile undisturbed for a minimum of 4 months (in ideal conditions, a 1000# carcass can be fully composted in 4 weeks). Now that the carcass is properly enveloped, the process of composting takes 4-12 months depending on the size and mixture. Throughout this period, the pile should be monitored regularly, adding more cover when necessary. During this time, microbial activity from bacteria and fungi are reducing/decomposing the carcass and tissue to a homogenous organic material.

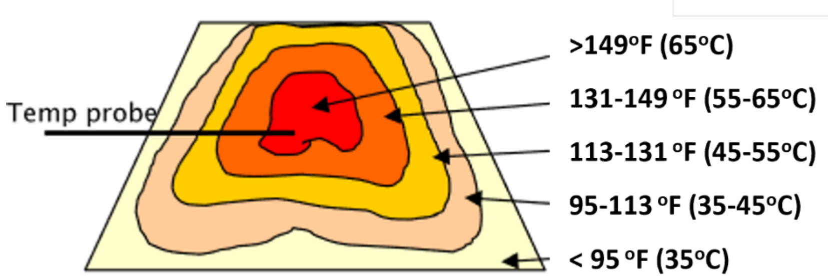
Step 4: When the soft tissue has completely decomposed (ideally 4-6 weeks) the pile can be turned to complete the composting process. This will likely result in a second heating process.

Step 5: Leave it to cure for a minimum of 4 weeks before harvesting the compost.

Additional Note: Although the composting process is complete, fragments of large bones of adult cattle may still be present, but the bones should be free of soft tissue and harmful pathogens.

Monitoring Process

- Composting temperatures should be monitored daily from several points at depths of 1 ft and 3 ft. Multiple sites within the pile should be marked and used for daily readings.
- The heat required for the inactivation of pathogens is a function of both temperature and length of time. Temperatures must reach 132-145°F (55-65°C) for approximately 3 days or 110°F for 10 days to sufficiently kill most pathogens. To achieve an effective pathogen kill, all materials in the compost pile must be exposed to high temperatures for prolonged periods.
- Visit the composting rows frequently to ensure there is no odor or liquid leaking from the pile. Add more carbon material or manure, if needed, to cover the carcass(es).
- After several days of high temperatures (131- 145°F), check for remaining soft tissue. If none, the pile can be turned as described above.



Health and Safety

A compost pile contains living microorganisms including molds, bacteria, fungi and protozoa. These microorganisms can cause adverse reactions, particularly in people with a weakened immune system. The following precautions should be followed when handling dead stock or compost materials.

- Wear gloves
- Wash hand after handling
- Avoid breathing dusts or mists created by the composting process
- Wash work clothing regularly

02.04.17 Rules Governing Dead Animal Movement and Disposal
Minutes of April 6, 2022, 9:00 am

Host/Facilitators: Lloyd Knight, ISDA
Dr. Scott Leibsle, ISDA
Chanel Tewalt, ISDA

Stakeholders Present: Tricia Hebdon, IDFG
Marvin Patton, Milk Producers
Mary Anne Nelson, IDEQ
Bob Nearabout, Idaho Dairymen's Association
Garret Visser, Wildlife Federation
Cameron Mulrony, ICA
Steve Maggard, Simplot
David Callister, U of I Extension
Sawyer Fonnesbeck, U of I Extension
Joel Packham, U of I Extension

Department Staff: Dallas Burkhalter
Scott Barnes, DVM
Katy DeVries
Pamm Juker

Lloyd Knight called meeting to order. Will be taking comments until April 29th. Look forward to all comments.

Dr. Leibsle stated no comments have been received. Has been misunderstandings of what constitutes composting as opposed to just a pile of dead's. Three references on composting have been posted including NRCS Composting Guide, Colorado State University Composting Manual and Victoria Composting Guide. Need to incorporate a protocol so people have something to follow. Opened for discussion as to whether needed or not.

Bob Nearabout - How will they be referenced?

Dr. Leibsle - In Dairy standards there are requirements for best management practices. A protocol will just be added as guidance, not a requirement.

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Dr. Leibsle - Have had no complaints on improper composting.

Cameron Mulrony – Guidance would be the way to go rather than a standard.

David Callister - Like the idea of guidance.

Dr. Leibsle – Will create a short general checklist.

Marv Patton – As State Veterinarian is that appropriate with disease control?

Dr. Leibsle – Depends on protocol. Elevate internal temperature to denature pathogens. Will be added to "Incorporate by Reference" section. Once developed, will post guidelines for comments.

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Bob Nearabout – Same as in composting, not dead composting?
Dr. Leibsle – No, they are not. Nutrient composting is different from dead composting.
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Mary Anne Nelson – Recommend moving Section 10, a, b, and c to introduction section.

Bob Nearabout – Who is in charge of enforcing transporting dead animals?
Dr. Leibsle – ISDA

Any questions on language in the rule to discuss?

Last meeting it was mentioned that Idaho has CWD in wild cervids. Issue is if disposing of carcasses with CWD, wild or domestic, what are acceptable methods of disposal. Two landfills are approved to accept, Pocatello and Burley. Plan for now is to add language "must be disposed of by method approved by Administrator" and work on developing a protocol. It can be modified in the future.

Tricia Hebdon – Fish & Game is looking at development of different type of landfill design in southern half of state to accept carcasses. Working with waste managers in north Idaho, carcasses are currently going to Montana. Looking at putting dumpsters on landscape areas for disposal.

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Dr. Leibsle - Main intent is ISDA be notified. Then discuss case by case, acceptable method of disposal.

Open for discussion.

All rule drafts, proposed and pending, meeting minutes, guidelines, are posted and will remain posted.

Garrett Visser - How will hunters know where to dispose of carcass?

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Meeting adjourned.

02.04.17 – RULES GOVERNING DEAD ANIMAL MOVEMENT AND DISPOSAL

000. LEGAL AUTHORITY.
This chapter is adopted under the legal authority of Sections 25-203 and 25-237, Idaho Code. ( )

~~001. TITLE AND~~ SCOPE.

~~**01. Title**. The title of this chapter is "Rules Governing Dead Animal Movement and Disposal." ( )~~

0~~2~~1. ~~Scope.~~ These rules govern the management, movement and disposal of dead animals. ( )

~~**002. WRITTEN INTERPRETATIONS.**~~
~~There are no written interpretations of these rules. ( )~~

~~**003. ADMINISTRATIVE APPEAL.**~~
~~Hearing and appeal rights are set forth in Title 67, Chapter 52, Idaho Code. There is no provision for administrative appeal before the State Department of Agriculture under these rules. ( )~~

001~~004~~. INCORPORATION ~~BY REFERENCE~~.
IDAPA 02.04.17 does not incorporate any materials by reference. ( )

Commented [LK1]: Discuss – is there a composting method for citation?

~~**005. ADDRESS, OFFICE HOURS, TELEPHONE, FAX NUMBERS, WEB ADDRESS.**~~
~~The Idaho State Department of Agriculture central office is located at 2270 Old Penitentiary Road, Boise, ID 83712-8298. The office is open from 8 a.m. to 5 p.m., except Saturday, Sunday, and legal holidays. The mailing address is PO Box 7249, Boise, Idaho 83707. The phone number is (208) 332-8500 and the fax number is (208) 334-2170. The Department web address is https://agri.idaho.gov/. ( )~~

~~**006. PUBLIC RECORDS ACT COMPLIANCE.**~~
~~These rules are public records and are available for inspection at the State Department of Agriculture and on the internet. Official copies may be obtained from the Department of Administration, Office of Administrative Rules. ( )~~

002~~007~~. -- 009. (RESERVED)

010. DEFINITIONS.

01. Abandon. To desert or intentionally leave a dead animal without proper disposal as provided in these rules. ( )

02. Air Curtain Incineration. A mechanical process of incineration by which super-heated air is continuously circulated to enhance combustion. ( )

~~**03. Burial**. Interment of a dead animal below the natural surface of the ground. ( )~~

03~~04~~. Burning. The act of consuming or destroying by fire with or without the use of an accelerant. ( )

04~~05~~. Composting. The biological decomposition of organic matter under controlled conditions. ( )

05~~06~~. Dead Animals. Carcasses and parts of carcasses from dead animals including domesticated livestock, sheep, goats, poultry, pets, and commercial fish. ( )

Commented [LK2]: Combine w/ domesticated livestock?

~~**07.** **Dead Animal Emergencies**. Those situations involving dead animals that may require extenuating disposal measures as determined by the Administrator. ( )~~

06~~08~~. **Decomposition**. The decay of dead animals under natural conditions. ( )

07~~09~~. **Digestion**. A process by which organic matter is hydrolyzed. ( )

~~**10.** **Disposal**. The management of a dead animal. ( )~~

08~~11~~. **Domesticated Livestock**. Bovidae, suidae, equidae, captive cervidae, camelidae, ratitidae, gallinaceous birds and captive waterfowl. ( )

09~~12~~. **Harvested**. Domesticated livestock killed by a person if any portion of the carcass is salvaged. ( )

10~~13~~. **Incineration**. The controlled and monitored combustion of dead animals for the purposes of volume reduction and pathogen control. ( )

11~~14~~. **Pets**. Cats, dogs, and other non-human species of animals that are kept as household companions. ( )

12~~15~~. **Rendering**. The process or business of recycling dead animals and animal by-products. ( )

13~~16~~. **Sanitary Landfill**. A solid waste disposal site permitted or approved by the Idaho Department of Environmental Quality. ( )

011. EXCLUSIONS.
The following establishments and animals ~~shall be~~ are excluded from the provisions of these rules. ( )

01. **Slaughter Establishments**. Establishments that slaughter livestock for human consumption. ( )

02. **Free-Ranging Wildlife**. Non-captive wildlife or wild fish. ( )

03. **House Pets**. House pets less than one hundred (100) pounds in weight. ( )

04. **Pets Buried in a Licensed Pet Cemetery**. Pets of any weight buried in a licensed pet cemetery. ( )

012. -- 019. (RESERVED)

020. ABANDONMENT OF DEAD ANIMALS.
No person who owns or is caring for an animal that has died ~~shall~~ may abandon the dead animal. Animals that are being disposed of by decomposition in accordance with these rules ~~shall~~ are not ~~be~~ considered abandoned. ( )

021. -- 029. (RESERVED)

030. DISPOSAL OF DEAD ANIMALS.
Dead animals shall be disposed of within seventy-two (72) hours, by one of the following methods, after knowledge of the death of the animal or as provided by the Administrator. No person shall dispose of a dead animal on the land of another without the permission of the property owner. ~~Disposal shall be by one (1) of the following methods:~~ ( )

01. **Dead Animals on Federally Managed Land**. Animals that die on federally managed rangeland from causes other than significant infectious or contagious diseases or agents shall be disposed of as provided by the ~~rules and~~ regulations of the responsible land management agency. ( )

02. **Disposal Methods Determined by the Administrator**. The Administrator may determine the appropriate method of disposal for animals that die of significant infectious or contagious diseases or agents. ( )

03. **Rendering**. If a licensed and approved rendering facility accepts the dead animal, rendering is an approved method of disposal. ( )

a. When carcasses are held for pickup, the site shall be screened from public view, in a dry area and not in a water runoff or drainage area. ( )

b. Run-off from the holding area must be contained. ( )

04. **Burial**. Dead animals shall be buried to such a depth that no part of the dead animal ~~shall~~ may be nearer than three (3) feet to the natural surface of the ground. Every part of the dead animal shall be covered with at least three (3) feet of earth. The location of a burial site shall be: ( )

a. At least three hundred (300) feet from any wells, surface water intake structures, and public or private drinking water supply lakes or springs. ( )

b. At least three hundred (300) feet from any existing residences. ( )

c. At least fifty (50) feet from property lines. ( )

d. At least one hundred (100) feet from public roadways. ( )

e. At least two hundred (200) feet from any body of surface water such as a river, stream, lake, pond, intermittent stream, or sinkhole. ( )

f. Burial sites shall not be located in low-lying areas subject to flooding, or in areas with a high water table where the seasonal high water level may contact the burial pit. ( )

05. **Disposal in an Approved Sanitary Landfill**. Arrangements shall be made with a city, county, regional, or private landfill official in order to dispose of a dead animal in a city, county, regional, or private landfill. ( )

Commented [LK3]: Discuss prion management guidelines?

06. **Composting**. ( )

a. Composting of dead animals ~~shall~~ may be ~~accomplished~~ allowed in a manner approved by the Administrator. ( )

b. No composters that have been approved by other agencies shall begin composting dead animals without the approval of the Administrator. ( )

07. **Digestion**. Digestion of dead animals ~~shall~~ may be accomplished in a properly designed and sized dead animal digester approved by the Administrator. ( )

08. **Incineration**. ( )

a. Incineration of dead animals shall be accomplished in an approved incineration facility, or by a mobile air curtain incinerator at a site approved by the Administrator. ( )

b. The incineration shall be thorough and complete, reducing the carcass to mineral residue. ( )

09. **Burning**. Open burning of dead animals is not allowed, except as authorized by the Administrator, in coordination with the Department of Environmental Quality. ( )

10. **Decomposition**. Animals that die on private or state rangeland, except domesticated livestock that are harvested, from causes other than significant infectious or contagious diseases or agents may be left to decompose naturally provided that: ( )

a. They are at least one thousand three hundred twenty (1,320) feet from any wells, lakes, ponds, streams, surface water intake structures, public or private drinking water supply lakes, springs or sinkholes. ( )

b. They are at least one thousand three hundred twenty (1,320) feet from any public roadways. ( )

c. They are at least one thousand three hundred twenty (1,320) feet from any residence not owned by the owner of the dead animal. ( )

~~**11.** **Allowance for Variances by the Administrator**. The Administrator may grant written variances to the requirements of Section 030 on a case-by-case basis. ( )~~

031. -- 039. (RESERVED)

040. MOVEMENT OF DEAD ANIMALS.

No dead animals ~~shall~~ may be loaded into the same vehicle with live animals. ( )

01. **Vehicles Used for Transporting Dead Animals**. Vehicles used for transporting dead animals shall be constructed and maintained, or be prepared prior to receiving dead animals into the vehicle, so that no liquid or fluid from the dead animals is allowed to drip or seep from the vehicle during transport. ( )

02. **Dead Animals Concealed from View**. Dead animals shall be concealed from public view during transportation. ( )

03. **Direct to Destination**. Vehicles hauling dead animals shall travel to their destination directly. ( )

04. **Disinfection**. Vehicles that have hauled dead animals off an owner's property shall not be used to haul live animals, feeds or similar commodities to the property of another person until they have been thoroughly cleaned and disinfected. ( )

05. **Transport of Dead Animals**. No person ~~shall~~ may transport a dead animal across or through the property of another person without the landowner's permission. ( )

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Dead animal emergencies are those situations involving dead animals that have been determined by the Administrator to require extraordinary disposal measures. ( )

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02. **Administrator to Determine Disposal Methods**. The Administrator may employ exceptional or extraordinary methods of dead animal disposal as necessary to protect the health and welfare of the human and animal populations of the state of Idaho. Such methods may include, but not be limited to: ( )

a. Open burning; ( )

b. Pit burning; ( )

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e. Air curtain incineration; ( )

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g. Natural decomposition. ( )

051. -- 999. (RESERVED)

02.04.17 – RULES GOVERNING DEAD ANIMAL MOVEMENT AND DISPOSAL

000. LEGAL AUTHORITY.
This chapter is adopted under the legal authority of Sections 25-203 and 25-237, Idaho Code. ( )

001. ~~TITLE AND~~ SCOPE.

~~**01. Title**. The title of this chapter is "Rules Governing Dead Animal Movement and Disposal." ( )~~

0~~2~~1. ~~**Scope**.~~ These rules govern the management, movement and disposal of dead animals. ( )

~~**002. WRITTEN INTERPRETATIONS.**~~
~~There are no written interpretations of these rules. ( )~~

~~**003. ADMINISTRATIVE APPEAL.**~~
~~Hearing and appeal rights are set forth in Title 67, Chapter 52, Idaho Code. There is no provision for administrative appeal before the State Department of Agriculture under these rules. ( )~~

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02. Disposal Methods Determined by the Administrator. The Administrator may determine the appropriate method of disposal for animals that die of significant infectious or contagious diseases or agents.

a. The owner of any dead animal known to be infected with a prion disease must notify the Administrator prior to disposing of the carcass. ( )

03. Rendering. If a licensed and approved rendering facility accepts the dead animal, rendering is an approved method of disposal. ( )

a. When carcasses are held for pickup, the site shall be screened from public view, in a dry area and not in a water runoff or drainage area. ( )

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051. -- 999. (RESERVED)

Idaho State Department of Agriculture
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BRAD LITTLE, GOVERNOR

CELIA GOULD, DIRECTOR

"(8) The requirements of this section shall apply to the director's promulgation of new rules as well as the amendment, extension, or renewal of rules in effect on the effective date of this act."

1. Is this a ☐ new rule or ☑ amendment to current rule?

2. Is the proposed rule broader in scope or more stringent than federal law or regulations, or does it propose to regulate an activity not regulated by the federal government? ☑ Yes ☐ No
   a. If yes, which portions of the proposed rule?

      IDAPA 02.04.17 "Rules Governing Dead Animal Movement and Dispoal" regulates an activity that is not regulated by the federal government, therefore the entire rule is broader in scope or more stringent than federal law.

3. Is the proposed rule pursuant to:
   a. Title 22, Chapter 49 (Beef Cattle Environmental Control Act)? ☐ Yes ☑ No
   b. Title 25, Chapter 38 (Ag Odor Management Act)? ☐ Yes ☑ No
   c. Title 37, Chapter 4 (Sanitary Inspection of Dairy Products) ☐ Yes ☑ No
   d. Title 37, Chapter 6 (Dairy Environmental Control Act) ☐ Yes ☑ No
   e. If yes to any of the above:
      i. List the peer-reviewed science and supporting studies (conducted in accordance with sound and objective scientific practices) utilized by the agency.

      ii. List the data that the agency utilized including site-specific, local, statewide, and regional data, including economic information.

iii. Explain how the rules are consistent with applicable legislative findings, policy, and intent; (for example, provide legislative bills or intent language).

iv. Has the agency made available for public review and comment, all scientific studies, (listed in subsection i. above) including underlying methodology, that have been relied upon by the director?

v. Have interested parties submitted economic feasibility data? ☐ Yes ☐ No
(Please attach data when submitting this document.)

4. Does the proposed rule propose a standard necessary to protect human health and the environment?
☑ Yes ☐ No   If yes, Please complete subsections a-e. If no, please proceed to question 4.

a. Identify each population or receptor addressed by an estimate of public health effects or environmental effects.

The decomposition of carcasses releases nutrients into soil and the environment such as P, nitrogen (N) and carbon (C), of which P has the greatest potential to impact the environment. Although P is not directly toxic, the continued application of P to agricultural land and its subsequent movement to surface waters in runoff can accelerate eutrophication. This can impair water use for industry, recreation, drinking, and fisheries, due to the increased growth of undesirable algae and aquatic weeds. Although N and C are also associated with accelerated eutrophication, most attention has focused on P, due to the difficulty in controlling the exchange of N and C between the atmosphere and a water body, and fixation of atmospheric N by some blue-green algae. Thus, P is often the limiting element and its control is of prime importance in reducing the accelerated eutrophication of surface waters. As many years are required to bring about a significant reduction in soil P levels by crop removal, once eutrophication of a body of water is accelerated, it is usually not cost effective to treat the water body, in addition the internal recycling of sedimentary P can support the growth of aquatic biota even if external inputs are discontinued.

In areas of intensive crop and livestock production, continual P applications as mineral fertilizer and manure have been made at levels exceeding crop uptake (Sharpley, 1995). As a result, surface soil accumulations of P have occurred to such an extent that the loss of P in surface runoff has become a priority management concern if/when transported from the site of application by runoff and erosion. P

b. Identify the expected risk or central estimate of risk for the specific population or receptor.

The greatest risk to environmental or public health is from phosphorus release from the decomposing carcass that may potentially reach surface or groundwater sources and initiate a series of events that could lead to eutrophication. Eutrophication is defined as an increase in the fertility status of natural waters that can causes accelerated growth of algae or aquatic plants. Undesirable aquatic plant growth results from additions of phosphorus, increases the demands of oxygen by microorganisms and depleted the level of oxygen in the water. Specific health risks may appear when fresh water, extracted from eutrophic areas, is used for the production of drinking water. However, cyanotoxins are not currently regulated for public water systems.. Cyanotoxins have been reported in Idaho's surface waters and in July 2018, one public drinking water system was impacted by a harmful algal bloom; however, cyanotoxin levels in the treated (finished) water were below health advisory levels. Unregulated private drinking water sources that receive drinking water from surface water sources are also at risk from cyanotoxins.

c. Identify each appropriate upper bound or lower bound estimate of risk.

In Idaho, approximately 400,000 people are not served by regulated public water systems, but rely on private domestic wells to withdraw ground water for drinking water. The potential or absolute risk of this possibility is not quantified. Harmful algal blooms have been reported in Idaho during the summer months for the past several years. (Idaho DEQ)

d. Identify each significant uncertainty identified in the process of the assessment of public health effects or environmental effects and any studies that would assist in resolving the uncertainty.

The processes associated with cadaver decomposition in outdoor settings, particularly those that occur during the extended postmortem interval (PMI), beyond 30 days, are poorly understood. Thus, few methods are currently available to accurately estimate the extended postmortem interval (Benninger, 2008). Of these methods, a soils-based approach has the potential to address the postmortem interval between which entomology and anthropology are the most valuable. Although the validity of soil-based methods has previously been established, little work has been conducted to explain the processes that have been designated for forensic application. The dynamics of carbon, nitrogen, and phosphorus-based compounds in soil beneath pig cadavers (gravesoil) that were placed on the soil surface over a period of 100 days and decomposition was assessed through the physical characteristics of the cadaver, soil pH, soil moisture content, and the concentration of total carbon, total nitrogen, soil-extractable phosphorus, and lipid-phosphorus in soil. Cadaver decomposition did not result in a significant difference in soil carbon and moisture content. However,

e. Identify studies known to the agency that support, are directly relevant to, or fail to support any estimate of public health effects or environmental effects and the methodology used to reconcile inconsistencies in the data.

Benninger LA, Carter DO, Forbes SL. 2008. The biochemical alteration of soil beneath a decomposing carcass. Forensic Science International. 180:70-75.

Bhandari, A.B., N.O. Nelson, D.W. Sweeney, C. Baffaut, J.A. Lory, G.M.M.M.A. Senaviratne et al. 2017. Calibration of the APEX model to simulate management practice effects on runoff, sediment, and phosphorus loss. J. Environ. Qual. doi:10.2134/jeq2016.07.0272

Brathen KA, Danell K and Berteaux D. 2002. Effect of muskox carcasses on nitrogen concentration in tundra. Arctic 55:389–394.

5. Does the notice for the proposed rule include information that the rule is boarder in scope or more stringent than federal law or regulations, or does it propose to regulate an activity not regulated by the federal government?

Yes ☑ No ☐

This rule regulates an activity not regulated by the federal government.

Information Compiled by: Dr. Scott Leibsle

Title: Administrator - Animal Industries

Date: 9.8.21

02.04.17 – RULES GOVERNING DEAD ANIMAL MOVEMENT AND DISPOSAL

000. LEGAL AUTHORITY.
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09~~12~~. Harvested. Domesticated livestock killed by a person if any portion of the carcass is salvaged. ( )

10~~13~~. Incineration. The controlled and monitored combustion of dead animals for the purposes of volume reduction and pathogen control. ( )

11~~14~~. Pets. Cats, dogs, and other non-human species of animals that are kept as household companions. ( )

12~~15~~. Rendering. The process or business of recycling dead animals and animal by-products. ( )

13~~16~~. Sanitary Landfill. A solid waste disposal site permitted or approved by the Idaho Department of Environmental Quality. ( )

011. EXCLUSIONS.

The following establishments and animals ~~shall be~~ are excluded from the provisions of these rules. ( )

01. Slaughter Establishments. Establishments that slaughter livestock for human consumption. ( )

02. Free-Ranging Wildlife. Non-captive wildlife or wild fish. ( )

03. House Pets. House pets less than one hundred (100) pounds in weight. ( )

04. Pets Buried in a Licensed Pet Cemetery. Pets of any weight buried in a licensed pet cemetery. ( )

012. -- 019. (RESERVED)

020. ABANDONMENT OF DEAD ANIMALS.

No person who owns or is caring for an animal that has died ~~shall~~ may abandon the dead animal. Animals that are being disposed of by decomposition in accordance with these rules ~~shall~~ are not ~~be~~ considered abandoned. ( )

021. -- 029. (RESERVED)

030. DISPOSAL OF DEAD ANIMALS.

Dead animals shall be disposed of within seventy-two (72) hours, by one of the following methods, after knowledge of the death of the animal or as provided by the Administrator. No person shall dispose of a dead animal on the land of another without the permission of the property owner. ~~Disposal shall be by one (1) of the following methods:~~( )

01. Dead Animals on Federally Managed Land. Animals that die on federally managed rangeland from causes other than significant infectious or contagious diseases or agents shall be disposed of as provided by the ~~rules and~~ regulations of the responsible land management agency. ( )

02. Disposal Methods Determined by the Administrator. The Administrator may determine the appropriate method of disposal for animals that die of significant infectious or contagious diseases or agents.

a. The owner of any dead animal known to be infected with a prion disease must notify the Administrator prior to disposing of the carcass. ( )

03. Rendering. If a licensed and approved rendering facility accepts the dead animal, rendering is an approved method of disposal. ( )

a. When carcasses are held for pickup, the site shall be screened from public view, in a dry area and not in a water runoff or drainage area. ( )

b. Run-off from the holding area must be contained. ( )

04. Burial. Dead animals shall be buried to such a depth that no part of the dead animal ~~shall~~ may be nearer than three (3) feet to the natural surface of the ground. Every part of the dead animal shall be covered with at least three (3) feet of earth. The location of a burial site shall be: ( )

a. At least three hundred (300) feet from any wells, surface water intake structures, and public or private drinking water supply lakes or springs. ( )

b. At least three hundred (300) feet from any existing residences. ( )

c. At least fifty (50) feet from property lines. ( )

d. At least one hundred (100) feet from public roadways. ( )

e. At least two hundred (200) feet from any body of surface water such as a river, stream, lake, pond, intermittent stream, or sinkhole. Elevated or up-gradient surface waters are not subject to this setback. ( )

f. Burial sites shall not be located in low-lying areas subject to flooding, or in areas with a high water table where the seasonal high water level may contact the burial pit. ( )

05. Disposal in an Approved Sanitary Landfill. Arrangements shall be made with a city, county, regional, or private landfill official in order to dispose of a dead animal in a city, county, regional, or private landfill. ( )

06. Composting. ( )

a. Composting of dead animals ~~shall~~ may be ~~accomplished~~ allowed in a manner approved by the Administrator. ( )

b. No composters that have been approved by other agencies shall begin composting dead animals without the approval of the Administrator. ( )

07. Digestion. Digestion of dead animals ~~shall~~ may be accomplished in a properly designed and sized dead animal digester approved by the Administrator. ( )

08. Incineration. ( )

Commented [DSL1]: This provision is per Marv's request….what do you think?

Commented [LK2R1]: Does DEQ have setbacks that recognize elevated or up-gradient surface waters?

a. Incineration of dead animals shall be accomplished in an approved incineration facility, or by a mobile air curtain incinerator at a site approved by the Administrator. ( )

b. The incineration shall be thorough and complete, reducing the carcass to mineral residue. ( )

09. Burning. Open burning of dead animals is not allowed, except as authorized by the Administrator, in coordination with the Department of Environmental Quality. ( )

10. Decomposition. Animals that die on private or state rangeland, except domesticated livestock that are harvested, from causes other than significant infectious or contagious diseases or agents may be left to decompose naturally provided that~~:~~ they are at least one thousand three hundred twenty (1,320) feet from any surface water (public or private), wells, springs, public roadways and residences. ( )

~~**a.** They are at least one thousand three hundred twenty (1,320) feet from any wells, lakes, ponds, streams, surface water intake structures, public or private drinking water supply lakes, springs or sinkholes. ( )~~

~~**b.** They are at least one thousand three hundred twenty (1,320) feet from any public roadways. ( )~~

~~**c.** They are at least one thousand three hundred twenty (1,320) feet from any residence not owned by the owner of the dead animal. ( )~~

~~**11. Allowance for Variances by the Administrator**. The Administrator may grant written variances to the requirements of Section 030 on a case-by-case basis. ( )~~

031. -- 039. (RESERVED)

040. MOVEMENT OF DEAD ANIMALS.

No dead animals ~~shall~~ may be loaded into the same vehicle with live animals. ( )

01. Vehicles Used for Transporting Dead Animals. Vehicles used for transporting dead animals shall be constructed and maintained, or be prepared prior to receiving dead animals into the vehicle, so that no liquid or fluid from the dead animals is allowed to drip or seep from the vehicle during transport. ( )

02. Dead Animals Concealed from View. Dead animals shall be concealed from public view during transportation. ( )

03. Direct to Destination. Vehicles hauling dead animals shall travel to their destination directly. ( )

04. Disinfection. Vehicles that have hauled dead animals off an owner's property shall not be used to haul live animals, feeds or similar commodities to the property of another person until they have been thoroughly cleaned and disinfected. ( )

05. Transport of Dead Animals. No person ~~shall~~ may transport a dead animal across or through the property of another person without the landowner's permission. ( )

041. -- 049. (RESERVED)

050. DEAD ANIMAL EMERGENCIES.

Dead animal emergencies are those situations involving dead animals that have been determined by the Administrator to require extraordinary disposal measures. ( )

01. Situations Requiring Extraordinary Disposal Measures. These situations include, but are not limited to, the following: ( )

a. Situations where one (1) or more animals die of an infectious or contagious disease or agent that may pose a significant threat to humans or animals; ( )

b. Situations wherein the number of dead animals is large enough to require extraordinary disposal measures. ( )

02. Administrator to Determine Disposal Methods. The Administrator may employ exceptional or extraordinary methods of dead animal disposal as necessary to protect the health and welfare of the human and animal populations of the state of Idaho. Such methods may include, but not be limited to: ( )

a. Open burning; ( )

b. Pit burning; ( )

c. Burning with accelerants; ( )

d. Pyre burning; ( )

e. Air curtain incineration; ( )

f. Mass burial; or ( )

g. Natural decomposition. ( )

051. -- 999. (RESERVED)