Cornell Waste Management Institute

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Composting Road Kill

Road Kill — Current Situation

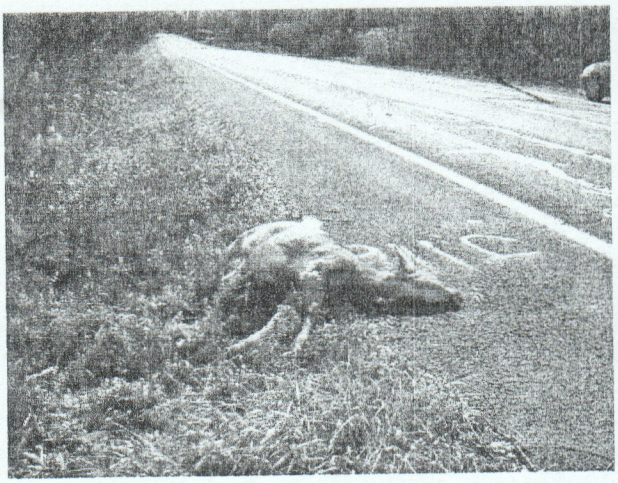
Over 25,000 dead deer and numerous carcasses of other animals, such as raccoon, coyote and fox are managed annually by the New York State Department of Transportation (NYSDOT). NYSDOT maintains and operates a 15,656 mile highway system of interstates, expressways and collectors which comprises about 15 percent of New York State's (NYS) 111,000 miles of highway. The 25,000 dead deer managed annually by NYSDOT do not account for deer killed on county and local roads that must be managed by local highway departments.

Current disposal practices include contracting with service providers to pick up and dispose of the animals, dragging animals further off the road or placing them in pits and depressions off roadsides. These methods are becoming less acceptable as rural areas become more populated and there is increased concern for environmental quality. Water quality can be compromised when animals decompose on or below ground and it could become a public health issue as pets and people may come in contact with the carcasses. Collection services are costly. Contractors are paid between $30 and $125 per deer for pick-up and disposal. Landfills often either do not accept or restrict carcasses. Disposal options are thus limited.

The Need: Consider Static Pile Composting

Composting provides an inexpensive alternative for disposal of dead animals in many cases. Composting animal carcasses is not new; chickens, pigs, calves, cows and even whales have been composted.

Passively aerated static pile composting in which piles are not turned and natural processes result in high temperatures is proving to be a viable method of managing carcasses. It is quick and simple, uses



equipment and materials used in daily road maintenance operations and is cost effective. This method helps protect ground and surface water by keeping the carcasses out of contact with water. Composting also reduces pathogens, nuisance to neighbors and odors in properly managed piles.

In many states, including NYS, mortality composting is a legal and accepted way of disposal. Composting and compost use can be accomplished in compliance with environmental regulations in many states, but check regulations before you start. The temperatures and microbial processes achieved during composting will kill or greatly reduce most pathogens, reducing the chance to spread wildlife disease. Properly composted material is an acceptable soil amendment for use where public contact is low, such as roadside projects.

Regulations

In NYS, composting of any material, except sludges, generated by a private or public entity on their own property is exempt from regulation. This includes road killed animals that are collected and composted on the agency's land. However, the agency is responsible for

Why Compost Road Kill?

- Pathogen kill occurs in thermophilic composts
- Can be done any time of the year, even when the ground is frozen
- Can be done using common highway equipment and readily available materials
- Relatively odor free
- All sizes of animals can be composted
- Relatively low labor and management needed
- Low cost

siting and implementing composting practices that do not cause air or water pollution or create a general nuisance. Use of the end product is not subject to regulation in NYS, however it is recommended that the product be used in applications with low public contact such as roadside revegetation projects so that an unknowing person would be unlikely to come into contact with the compost.

Carcass Handling

For proper handling of carcasses, and to ensure worker health and safety, please refer to NYSDOT Safety Bulletin on Handling Animal Carcasses (see Common Questions on page 8).

Composting

Static pile composting of dead deer, bear, moose, raccoon, fox and more is a practice that can fit into the daily operations of those responsible for road maintenance. Road managers have all the components for successful composting: trained personnel, equipment, wood chips and the animals killed by vehicles. The practice requires space to construct the compost piles and takes from four to six months for the animals to decompose and a year to make a useable end product. Many people are skeptical that road kill composting will manage road kill but become convinced when they see it working.

Static pile mortality composting is an easily managed technique. Air flow through the pile is key (Figure 1). By properly constructing the compost pile to allow for adequate natural aeration, mortality composting can be completed on intact animals with little or no turning. An adequate bed of chips beneath the pile and surrounding the carcasses is important. The process is effective if the animals are enveloped in chunky carbonaceous material such as wood chips (see CWMI fact sheet #5, Compost Bulking Materials: http://cwmi.css.cornell.edu/compostfs5.pdf). Make sure there are enough chips!

Timing

Mortality composting can be done at any time during the year. However, when you are learning how to compost it is best to start piles in forgiving weather. In southern climates it will not matter, but in climates that experience freezing temperatures, planning is important. Get piles started before the cold temperatures set in so you experience the learning curve when temperatures are warm and the pile is more likely to get hot. This will also set the process up to keep composting through the winter months since there will be heat in the pile to warm the carcasses and keep the composting process going. Piles can be started in the winter, but it may take months for the composting process to begin during warm weather.

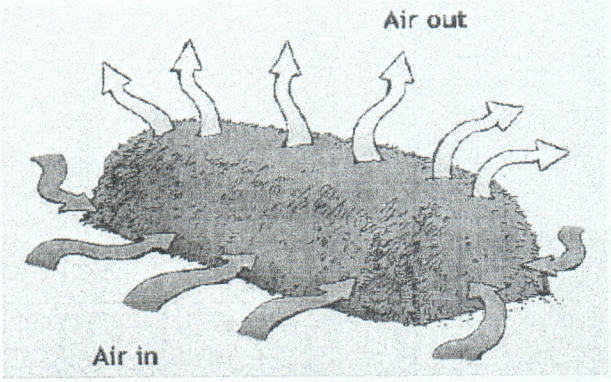


Figure 1. Natural air flow through compost windrow.

Road kill compost windrows in NYSDOT yard.

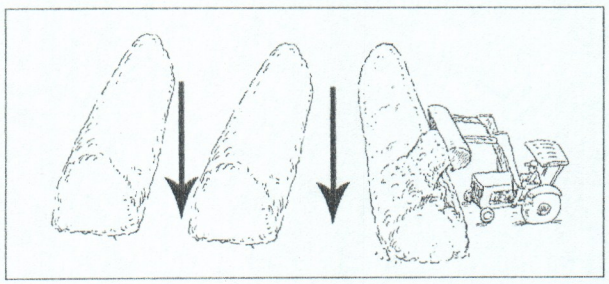


Figure 2. Pad slope.

Choosing a Compost Site

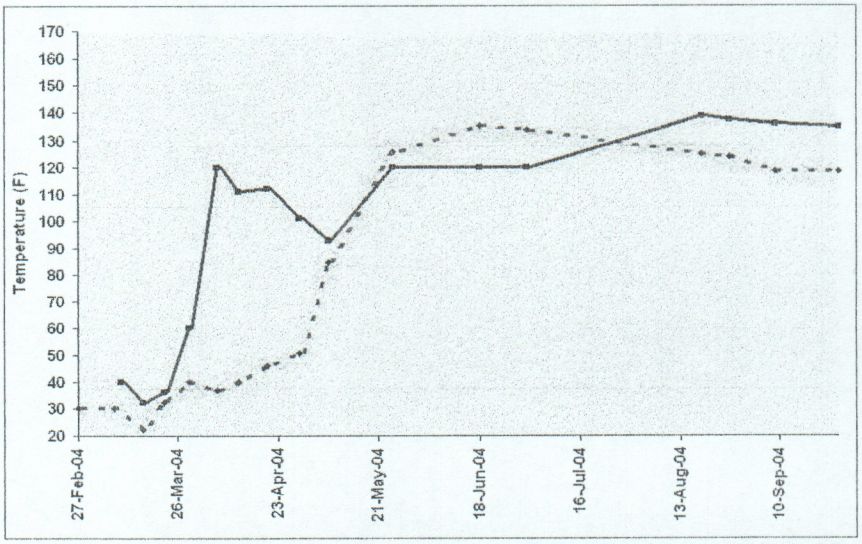
Highway yards are often good sites for composting if space allows. They have compacted or improved surfaces and public and animal access is often limited by fencing. NYSDOT personnel can contact their Maintenance Environmental Coordinator for advice.

Consideration of water flow is important. Sites should be selected that are unlikely to receive water running onto the site. They should be well away from surface water bodies and swales to reduce the chance that runoff from the site will enter surface water. Moderate to well-drained, hard-packed soils with gentle slopes are well suited. A slope of about two percent is desirable to prevent ponding of water. Steep slopes are not satisfactory because of potential problems with erosion, vehicular access, and equipment operation. Compost windrows should run up and down a minimal slope, rather than across, to allow runoff water to move between the piles rather than through them (Figure 2).

Siting is very important to help avoid neighbor complaints. Compost processing can generate odors, though these should be minimal in well-run operations. Odor is likely the main reason neighbors may complain about the operation. Determine the dominant wind direction, and if most air flow is directed toward populated areas, look for another site. In NYS, permitted compost facilities need to be at least 500 feet away from the closest dwelling. They cannot be sited in a floodplain or wetland, where the seasonal high groundwater is less than 24 inches from the ground surface, or where bedrock lies less than 24 inches below the ground surface, unless provisions have been made to protect water quality. Although road kill composting piles operated by highway personnel are not required to have New York State Department of Environmental Conservation (NYSDEC) permits, it is advisable to use existing regulations as guidelines and to keep piles as far as possible from neighbors.

Managing Frozen Deer--Don't Wait Until They Thaw!

In late February 2004, NYSDOT in Washington County had a pile of frozen deer that they had collected. They had heard about composting through the NYSDOT Maintenance Environmental Coordinator and Washington County Cornell Cooperative Extension and were interested in trying it. On a very cold day compost piles were built with the frozen deer. The pile temperature read 30° F and then dropped (see graph below). The insulation from the wood chips kept the deer frozen until May. When the outside temperatures warmed in April and May, the deer thawed in the piles and the compost process started. It is easier to place frozen deer in compost piles before they thaw and let nature work out the rest. When managing frozen piles, the process clock starts when the pile gets hot (110°).



Carcass Pile Temperature Curves, NYSDOT, Washington County.
Dotted line: pile built with frozen deer. Solid line: pile built with recently killed deer.

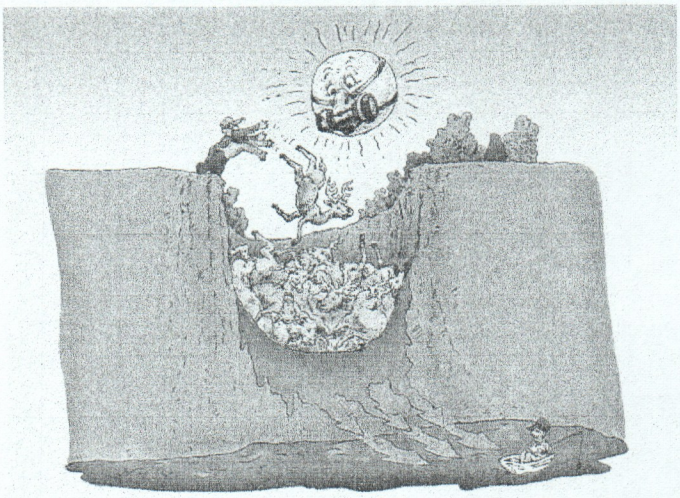
Potential Environmental and Biosecurity Risk of Dead Animal Disposal

Lowest Risk

- Composting - minimizes risk and produces a soil amendment.
- Landfill - acceptable if landfill will accept carcasses.

- Buried in a pit - carcasses "mummify" and do not break down (NYSDOT is allowed to bury 10 animals in a 3 foot deep pit above groundwater and at least 50 feet from a water body or water course).
- Carcass is left outside for scavengers or to decay. Because of the cost of disposal, it will be tempting to dispose of carcasses by leaving them to be scavenged. This is very risky from an environmental standpoint and encourages wild animals and house pets to come close to roads to become road-kill themselves.
- Placed in ravines and low areas to degrade - pollute ground and surface water.

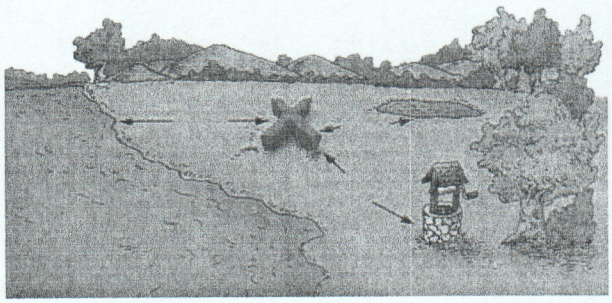
Highest Risk



Adapted from NYS Agriculture Environmental Management (AEM) Tier II Worksheet on Farm Waste Disposal, Revised Sept 2000.

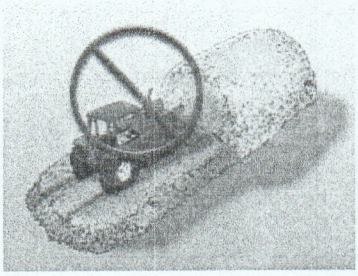
Key Points of Static Pile Carcass Composting

•Select a site that is well drained and not subject to flooding. Depending on site topography, keep piles away from water courses, sinkholes, seasonal seeps or other landscape features that indicate the area is hydrologically sensitive (see CWMI fact sheet #6 Compost Pads: http://cwmi.css.cornell.edu/compostfs6.pdf).

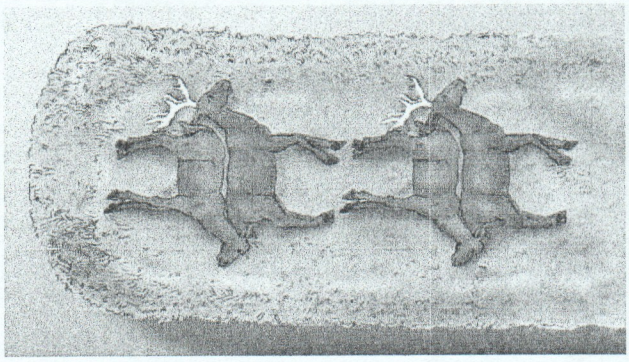


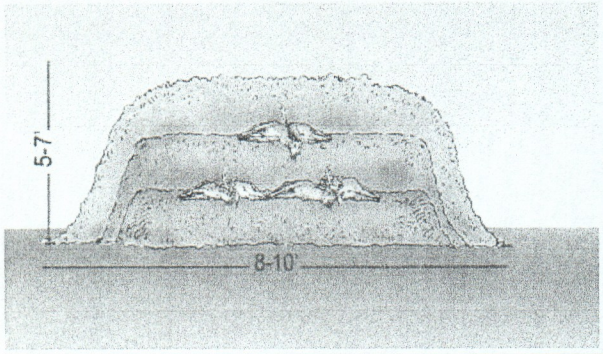
•Start with a hard surface made of asphalt, concrete or millings. Obtain a sufficient supply of fresh wood chips. Buy a compost thermometer. Have loader nearby. NYSDOT personnel should contact their Maintenance Environmental Coordinator.

•Lay a 24-inch bed of bulky, absorbent organic material; chips from tree chipping operators 2-inches or larger work well. Ensure the base is large enough to allow for a 2-foot clearance around the carcasses on all sides. To promote air flow, do not drive on the compost bed or pile.

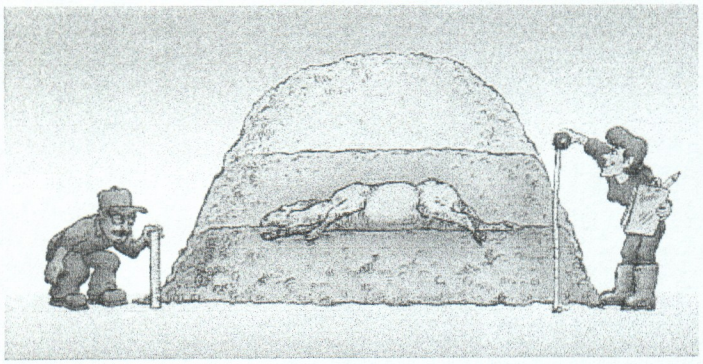


•Lay animal(s) in the center of the bed. Lance the stomach if the carcass is bloated. Lancing to avoid bloating and possible explosion of the body cavity is optional. Explosive release of gases can result in odor problems and it would blow the cover material off the composting carcass. Place animals as shown. When adding a new animal to the windrow, pull back some of the wood chips that are covering the previously placed animal and place the new animal near the others. Small animals should be layered similar to stair steps.





•With animals under 150 pounds, there can be two layers of animals with a 12-inch layer of wood chips in between. This seems to create conditions where the carbon and nitrogen levels are in balance and provides the mass needed to reach thermophilic temperatures. Animals over 150 pounds will be difficult to layer and they have enough mass to compost when enveloped in one layer of wood chips.



• When layering, position one layer of animals then cover with a 12-inch layer of wood chips, add another layer of animals and cover with 2 feet of wood chips. The finished height should be 5-7 feet high. A pile too wide or too high prevents good air flow.

• With large animals (over 150 pounds or too heavy to lift to a second layer), cover a single layer of carcasses with 24 inches of wood chips.

• Check temperatures to be sure the composting process is active. If carcasses are not frozen and the pile built properly, the temperatures should reach 120°-150° F (49°-65° C) in the first few days (Figure 3).

• Let sit for 4-6 months after the last carcass is added and the pile has gotten hot (110° F), then check to see if the animal is degraded. If the compost process worked well you should find clean bones and some hair.

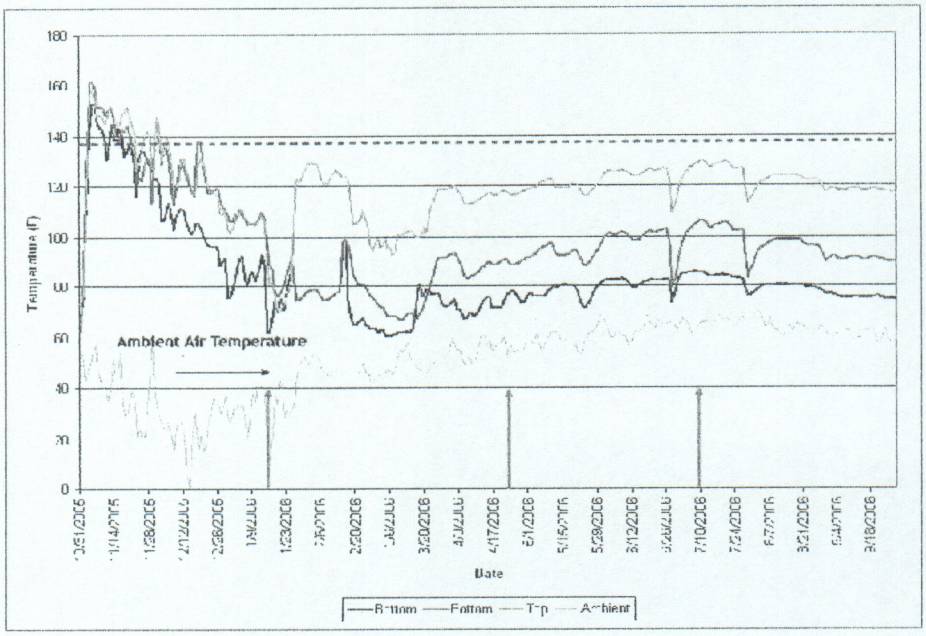
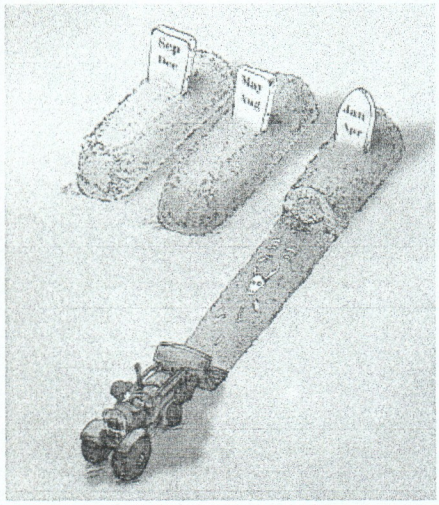


Figure 3. Pile temperatures over time.



• Reuse the material as a bed for additional carcass compost piles or allow it to age for a year after the last carcass was added and the pile got hot. Then remove large bones and use the compost in roadside maintenance or establishment projects. The bones can be used in the base of the next pile. Keep track of the pile start date and when the last carcass is added and the pile has gotten hot (110° F).

• Site cleanliness is an important aspect of composting; it deters scavengers, helps control odors and keeps good neighbor relations.

Signage on Compost Sites

Be sure to place signs on the piles so that those managing road kill know the difference between active piles, unused wood chips, and storage piles and to prevent people from taking the material for personal use. Also, use flags or signs to indicate when the last carcass was added and when the pile got hot (110° F).

Monitoring Compost Piles or Windrows

A log of temperature, odor, unwanted animal visitors, leachate (liquid that comes out of the pile), carcass fluid spills and other unexpected events should be kept as a record of the process (Table 1). Temperatures should be taken in several spots towards the center of the most recently constructed portion of the pile. Thermometers with a 3-4 foot probe are available and should be inserted close to the middle of the pile (Thermometer sources on page 11). The temperature log will allow the composter to see if sufficiently high temperatures have been reached and adjust the process if there is any problem.

Internal compost pile temperatures affect the rate of decomposition as well as the destruction of pathogenic bacteria, fungi and many seeds. The temperature at which active composting begins is 110° F (43° C). Compost pile temperatures depend on how much of the heat, produced by the microorganisms that are decomposing the organic matter, is lost through aeration or surface cooling. During periods of extremely cold weather, piles may need to be larger to minimize surface cooling. As decomposition slows, temperatures will gradually drop and remain within a few degrees of ambient air temperature (Troubleshooting Chart on page 10).

Thermometer showing elevated temperatures.

Odor can be an issue and compost piles are an easy target for complaints. If an odor event occurs, add an additional 12 inches of wood chips or finished compost on top of the pile to act as a biofilter (Figure 4).

Moving the Compost

Carcass piles should not be turned early in the process. Odor is a big issue and if liberated would be problematic. After a minimum of 4-6 months after the last carcass is added and the pile has gotten hot (110° F), turning is an option that may speed the curing process and further reduce pathogens. Piles shrink as they compost, so they can be combined for aging 4-6 months after the last carcass is added. This saves space and will help aerate the pile.

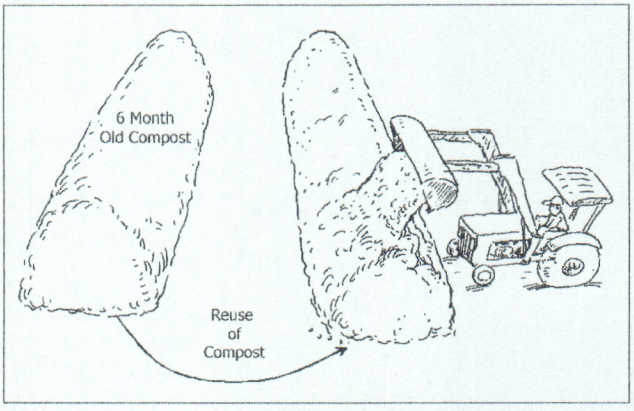


Figure 4. Aged compost or wood chips can be used as a biofilter to help contain orders.

Date	Pile Location	PileTemperature	# of Carcasses	Comments	Person Recording

Table 1. Sample chart.

Pathogen Control

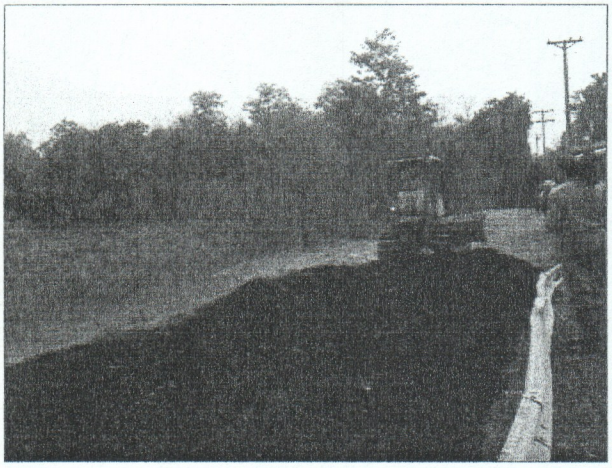
Pathogens are organisms that have the potential to cause disease. There is a wide array of pathogens found in our environment and pathogens may be elevated in animal carcasses. There are currently no temperature or pathogen regulations for mortality composting in NYS.

Very little work has been done on documenting pathogen kill in composting of road kill. The Cornell Waste Management Institute conducted a research project with NYSDOT to assess pathogen levels in passively aerated static piles of composting deer. In this study, which included three research piles and three field piles throughout NYS, significant pathogen reduction was observed after a year.

For information on the CWMI/NYSDOT project, see: http://cwmi.css.cornell.edu/tirc/tirc.htm.

Chronic Wasting Disease

Chronic Wasting Disease (CWD) is a prion disease that is of concern in deer populations. There are no data to show whether CWD would be disabled in the composting process. Compost temperatures are not high enough to inactivate prions, but it is possible that microbial and enzymatic activity could have an effect on disabling prions. Disposal of prion-diseased animals and animals from the containment area identified by the NYS Department of Environmental Conservation (NYS DEC) in Oneida and Madison counties is restricted and composting is not an acceptable option at this time.



Roadside spreading of compost by NYSDOT.

Use of the End Product and Bones

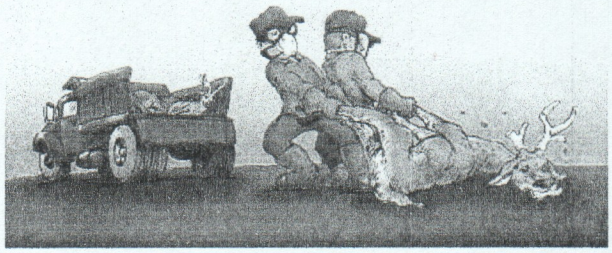
Use of the material as the base for the next pile is recommended and can be done 4-6 months after the last carcass is added and pile has gotten hot (110° F). The remaining bones add structure to the base material for improved aeration. After a year of composting, the end product can also be used on roadside construction and maintenance projects. Testing to prove the safety of carcass compost materials would be a very expensive undertaking, and would require the testing of essentially every pile. It is, therefore, appropriate to limit the use of these products to the highway right-of-way where there is low human or pet traffic. Applying this compost to "table-top" crops directly consumed by people or distributing the compost material for public use is not recommneded. In addition, all compost materials may contain environmental microbes and decomposition products, such as mold spores, which may pose an inhalation, ingestion or contact risk to some individuals.

Common Questions

Q Are there worker health and safety issues?

A Proper precautions including personal protective gear, hygienic practices like hand washing and tick inspections will minimize risks.

More information on worker safety and health is available at: NYSDOT Safety Bulletin on Handling Animal Carcasses (https://www.nysdot.gov/portal/page/portal/divisions/operating/employee-health-safety/repository/sb-05-1.pdf). A NYSDOT Safety Bulletin on Carcass Composting is under development.



Workers wearing personal protective gear.

Q Are animals attracted to the windrows?

A If built properly, it is unlikely that animals and flies will be attracted to the piles. If the site is messy with blood and animals parts spilled on the ground, animals will be attracted and investigate further. Make sure that all parts of the carcasses in the piles are well covered.

Q Can road kill be composted in turned windrows?

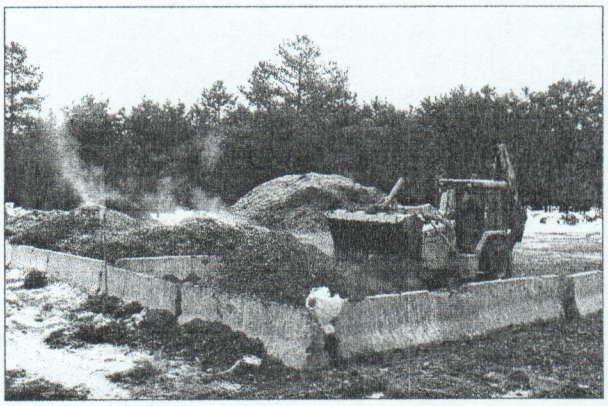
A Turning is not recommended. Composting mortalities in turned piles requires more labor, machinery and management than static pile composting, thus increasing costs. It also provides the potential for release of odors if turned too early in the process.

Montana Experience: Montana started composting road kill in the spring of 2005. The facility handles mostly white-tailed deer from about 60 miles of highway in the Bitterroot Valley. One site near Victor has processed 1,800 deer in 21 months of operation. Another site in Clearwater Junction has handled 90 deer and 10 elk in two months of operation.

Source: Patrick Crowley

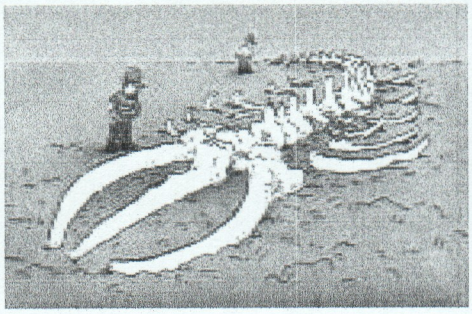
A Note on Fire Danger

As with any collection of woody waste, be aware of potential fire danger. In the compost piles, temperatures can reach 170° F and with that there can be spontaneous combustion. Carcasses supply a lot of moisture to mortality piles therefore the occurrence is unlikely. Take basic precautions by keeping piles not too wide or tall, separated from each other for fire department access and not driving machinery on piles or smoking around piles.



Elk and deer composting in Montana.

A Whale of a Tale!



In 1999, a Northern Right Whale in the North Atlantic became severely entangled in fishing equipment. About six months later the whale was found dead off the coast of New Jersey. The US Coast Guard hauled the 30,000 pound whale to shore. Since there are only approximately 300 individuals left, a call went out to museums to see if there was interest to preserve the whale in some way. The Paleontological Research Institute (PRI) in Ithaca, NY said they would take it. They cut some of the flesh and blubber off the carcass and hauled it on a flat bed truck to Ithaca. Behind PRI, next to the Cayuga Medical Center, the whale was laid in a large bed of horse manure and completely covered and left to compost in a large pile. The pile was left for six months (October-April) and gently uncovered so the bones could be tagged and turned by hand. The bones, bits of flesh and skin were again covered and left until October. With many volunteers, the bones were cleaned and weighed and ready to be assembled. If you are ever in Ithaca, come to PRI and visit the whale skeleton that was composted on their site. (Note: in one year the bones actually showed signs of pitting and degradation, for preservation purposes it could have come out of the pile a bit sooner.)

Source: Jean Bonhotal, Cornell Waste Management Institute

Troubleshooting Table

Symptoms	Problems	Recommendations
Pile fails to reach temperature.	Material is dense. Not enough air circulation.	Rebuild pile with more chunky carbon. *If it is in an odor sensitive area and the pile can not be moved, let process run its course and turn in 4-6 months.
	Pile too small.	To heat, pile needs to be greater than 4'x4'x4'.
	Frozen carcasses placed in pile.	May need to wait until warmer weather to reach temperature.
Insects and other animals attracted to pile.	Carcasses not covered well.	Cover carcass or residual well with carbon.
	Leachate puddling on pad surface.	Pad should have 1-2% slope and holes should be filled to avoid standing water.
Carcass uncovered.	May not have lanced rumen (stomach area) resulting in carbon cover material being thrown off the pile.	Lance rumen of bloated carcasses before animal is put into pile.
	May have insufficient cover.	Use plenty of wood chip cover material.
Standing water/surface ponding.	Inadequate slope.	Establish 1-2% slope with proper grading.
	Improper windrow/pile alignment.	Cover standing water with wood chips.
		Improve drainage, add an absorbent such as wood chips. Run windrows/ piles down slope, not across.
	Depressions in high traffic areas.	Fill and grade.
Odors	Ponded water.	Regrade the site to make sure there is no standing water.
	Insufficient cover.	Make sure piles are covered with at least 2 feet of wood chips.
		Add a cover blanket of fresh chips or finished compost.
	Anaerobic conditions.	Build piles that are not too wide or too dense so that air flow can keep the piles aerobic. DO NOT turn or disturb piles for 4 months (depending on the size of the animals). Turning can release odors, especially early in the process.

Other Mortality Composting Resources

(Fact Sheets, DVD/VHS and Posters are available at:
http://cwmi.css.cornell.edu/naturalrendering.htm)

Fact Sheets:

- Composting Road Kill (2007) – Jean Bonhotal, Ellen Z. Harrison, and Mary Schwarz
- Avian Influenza (coming in 2007)
- Composting Livestock Mortality and Butcher Waste (2002) – Jean Bonhotal, Lee Telega, and Joan Petzen

DVD/VHS:

- Composting Road Kill (2007) – 10-minute DVD produced by Insights International (http://hdl.handle.net/1813/7870)
- Composting Livestock Mortality and Butcher Waste (2002) – 20-minute VHS video (A Spanish DVD will be available soon). Produced by Insights International.

Posters:

- Composting Road Kill (2007)
- Key Points of Static Pile Butcher Residual Composting (2002) (English or Spanish)
- Key Points of Static Pile Carcass Composting (2002) (English or Spanish)
- Potential Environmental and Biosecurity Risk of Dead Animal Disposal (2002) (English or Spanish)

NYSDOT:

- NYSDOT Road Kill Composting Operation and Maintenance Manual (https://www.nysdot.gov/portal/page/portal/divisions/engineering/environmental-analysis/repository/deer_c_manual.pdf)
- NYSDOT Safety Bulletin on Handling Animal Carcasses (https://www.nysdot.gov/portal/page/portal/divisions/operating/employee-health-safety/repository/sb-05-1.pdf).
- NYSDOT Safety Bulletin on Carcass Composting (in press)

Suppliers — Temperature Probes

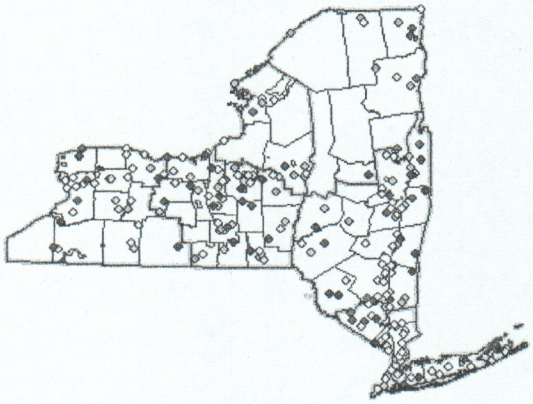
• Meriden Cooper Corporation	Meriden, CT 06450	203-237-8448
• Morgan Scientific	Haverill, MA 01832	508-521-4440
• Omega Engineering, Inc.	Stanford, CT 06907	203-359-1660
• Reotemp Instruments	Strong, ME 04983	800-648-7737
• Spectrum Technologies	Plainfield, IL 60544	800-248-8873
• Trend Instruments	Westchester, PA 19380	800-431-0002

CWMI Compost Fact Sheet Series

#1 Marketing Composts and Meeting Consumer Needs	(http://cwmi.css.cornell.edu/compostfs1.pdf)
#2 Regulation and Certification of Composts	(http://cwmi.css.cornell.edu/compostfs2.pdf)
#3 Improving and Maintaining Compost Quality	(http://cwmi.css.cornell.edu/compostfs3.pdf)
#4 Testing Composts	(http://cwmi.css.cornell.edu/compostfs4.pdf)
#5 Compost Bulking Materials	(http://cwmi.css.cornell.edu/compostfs5.pdf)
#6 Compost Pads	(http://cwmi.css.cornell.edu/compostfs6.pdf)
#7 Compost Equipment	(http://cwmi.css.cornell.edu/compostfs7.pdf)
#8 Composting Liquids	(http://cwmi.css.cornell.edu/compostfs8.pdf)

Maps and database of NYS Compost Facilities can be accessed at: http://compost.css.cornell.edu/maps/simple-search.asp.

NYS Compost Facilities Search



Select a Map to View Facilities:

- All Compost Facilities
- Yardwaste Compost Facilities
- Manure Compost Facilities
- Foodscrap Compost Facilities
- Biosolids Compost Facilities
- Compost Research Farms
- Small Scale Compost Demo Sites

Special Thanks to Contributors and Supporters

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