Virginia Tech
VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Virginia Cooperative Extension
Knowledge for the CommonWealth

VIRGINIA STATE UNIVERSITY

Composting as a Large Animal Mortality Disposal Option in Shenandoah County

October 2005

Robert A. Clark
Extension Agent, Agriculture

Acknowledgements

A special thank you to Dr. Dee Whittier, Dr. Greg Evanylo, Eric Bendfeldt, Henry Mikus, Bob Peer, Jacob Stegner, Peter Truban, Randy Kibler, Karla Funkhouser, Roger Matthews, Shenandoah County Farm Bureau, the Shenandoah County Landfill, and the Pure Water 2000 Forum for their assistance with this project.

Financial support provided by Pure Water 2000 Forum.

Introduction

Shenandoah County livestock farmers have expressed concern regarding the disposing of livestock mortality. Within the last three years, disposal options for large animal mortality have changed. Approximately three years ago, cattle mortalities were picked up at no charge by Valley Proteins, either from Linville, VA, or Winchester, VA. If farmers delivered mortalities to Valley Proteins, they would receive some payment. Currently, farmers are being charged $0.01 per pound to dispose of the mortalities. The cost for loading and hauling an animal to Valley Proteins from Shenandoah County is about $30. This means the total cost of disposal of a 1,000 pound animal would be about $40. The fee, if Valley Proteins picks up mortality from the farm, is:
1) Cattle - $40 for one to three head; after three, it is $20 extra per head; and
2) Horses - $125 per head. Valley Proteins will accept cattle, horses, chickens, and deer mortalities delivered to their Winchester or Linville sites. Valley Proteins will not accept sheep or goat mortalities.

Alternative disposal options are desirable due to the following:

1. Farmers fear that renderers may soon quit accepting large animal mortality due to concerns of Mad Cow Disease.
2. While on-farm burial is an option in Shenandoah County, there is a concern that burial in the wrong location might contaminate groundwater.
3. Improper animal disposal (e.g., dumping in sinkholes and wooded areas or burial in shallow soil) may increase if an economic and simple alternative disposal option is not identified.
4. USDA rules no longer allow downer cows to be processed.

In lieu of this situation, the Shenandoah County Landfill agreed to begin accepting large animal mortality in July 2004. During the first 11 months, the landfill accepted 130 dead animals of which 80 have been animals weighing 400 pounds or more. The policy for disposing of mortality at the county landfill is listed in Attachment #1.

While disposal in the landfill has offered relief for many farmers, there are limitations to this option. First, regulations limit the landfill to accepting only occasional mortality. In addition, the landfill has great difficulty accommodating large numbers of animal mortalities during rainy/snowy weather. For example, the snowstorm of February 2003 caused an estimated loss of over 1,000 head of livestock in Shenandoah County. Shenandoah County farmers still need additional mortality disposal options.

Composting as an Option for Mortality Disposal

One option for handling large animal mortality is composting. Composting can be done on-farm or at a centralized facility. Composting material needs include: 1) mortality; 2) a carbon source (e.g., straw, old hay, or woodchips) to serve as a base and an insulating blanket over the animal; and 3) a feedstock to initiate the composting process (e.g., bed pack, corn silage, manure, or chicken litter). Composting conditions require proper moisture content (i.e., 50 - 60 percent), an adequate carbon to nitrogen ratio (between 20:1 and 40:1), and adequate oxygen. When composting animal mortality in a static pile, it is recommended that the piles reach and sustain temperatures of at least 131°F for three consecutive days to kill pathogenic disease organisms. Neither Mad Cow Disease nor Scrapie is destroyed by composting. Specific references on large animal composting can be located in the Reference Section of this report.

Mortality Compost Demonstrations in Shenandoah County

Large animal mortality composting was demonstrated on three farms. Table 1 provides general parameters of each of these demonstrations. An analysis of the feedstock used on each farm is listed in Table 2.

Table 1: Overview of Compost Demonstrations

	Number of Large Animals Composted	Date Initiated	Supplementary Feedstock
Farm 1	6	November 2004	Wood Chips, Rotten Corn Silage, and Cow Manure
Farm 2	3 (also several deer carcasses and a coyote)	November 2004	Wood Chips, Aged Cow Manure, and Corn Silage
Farm 3	3	March 2005	Wood Chips, Corn Silage, and Poultry Litter

Table 2: Analysis of Feedstock Used on Farms

	Moisture Percent	Total Nitrogen Percent*	Total Carbon Percent*	C:N Ratio
All Farms				
Woodchips	51	0.74	45.7	62
Farm Two				
Corn Silage	78	2.23	53.2	24
Aged Manure	62	2.39	28.0	12
Farm Three				
Corn Silage	76	1.38	54.9	40
Poultry Litter	42	3.40	43.6	13

* Percent dry weight basis

Farm 1

Farm 1 began composting beef mortalities in November, 2004, and has composted six large animals. The system consisted of round bales of hay placed in a "U" shape surrounding a woodchip mulch layer as the foundation (see Photograph 1). Mortality was placed on the woodchip base and covered with a layer of rotten corn silage or cow manure and then covered with a blanket of woodchips. Photograph 1 shows the composting system after one animal had been covered and a second Animal had recently been placed on top of the woodchips.

Photograph 1, Farm 1:
Animal Number 1 composting (background) and Animal Number 2 (foreground) to be covered. Note that the blanket of woodchips covering Animal Number 1 is not deep enough.

Temperature readings for these first two animals are shown in Figures 1 and 2, respectively. The recommendation for killing diseases and pathogens is that compost in a static pile maintains a temperature of 131°F for at least three days. Both piles attained temperatures of 135°F. However, temperature readings taken one week after on both piles were below 131°F. So, it is not certain that these piles maintained temperatures above 131°F for three days. The compost pile temperature might have been maintained for a longer time period if: 1) the blanket of woodchips covering the animals was increased from three to four inches deep to 18 inches deep; and 2) if more corn silage was used to increase the volume of the piles.

Figure 1.

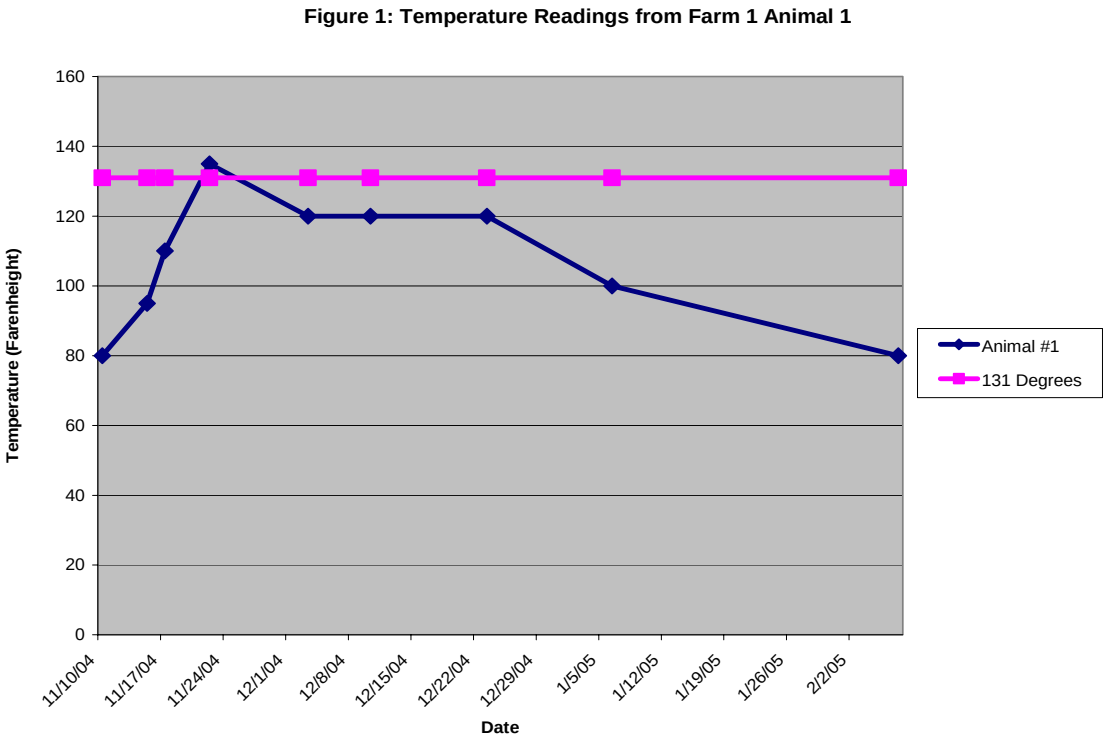
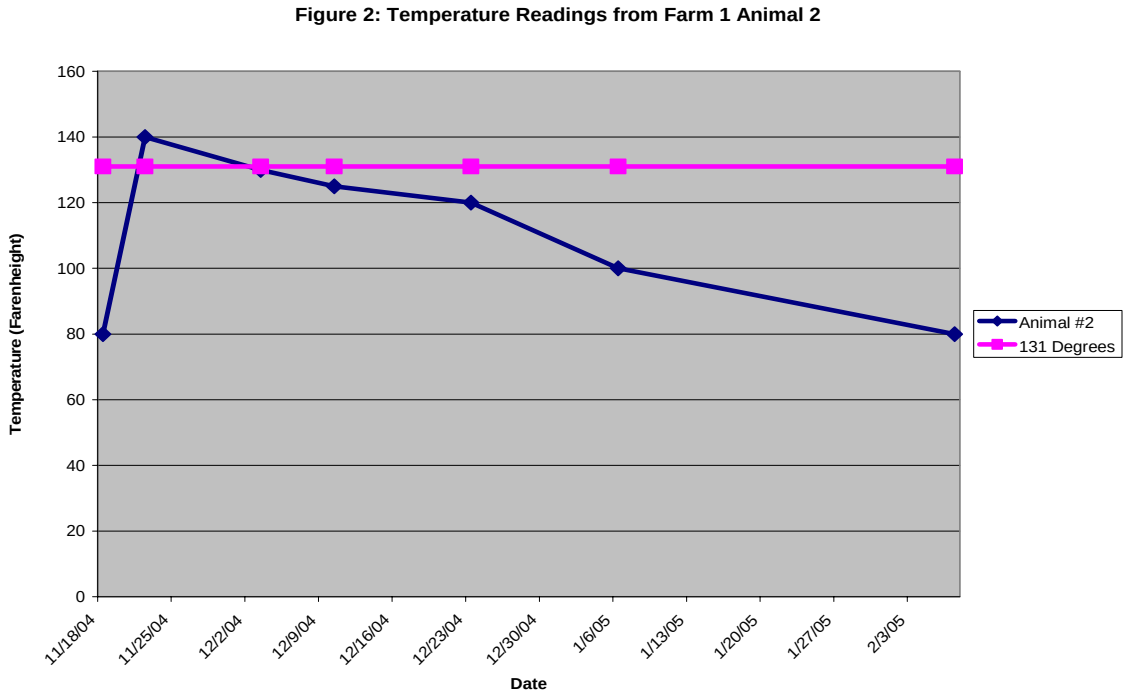


Figure 2.



Fly larvae were evident on pile #3 (the third mortality on Farm 1) about one week after the pile was constructed. Temperature readings (data not shown) indicated the pile had reached temperatures of 120°F. Therefore, fly larvae should not have been able to survive. This animal died and was not covered for several days. It is assumed that flies had laid their eggs in the carcass prior to composting. The pile heated slowly enough that eggs could have developed into larvae and the larvae had simply migrated to the zone where the temperature was adequate for maturation (the interior of the pile was above 120°F while the exterior was warm and damp).

Photograph 2, Farm 1:
Remnants of Animals 1 and 2 after turning the pile in mid-May. Notice that bones are still evident.

In mid-December 2004, the compost piles were inspected by Dr. Lewis Carr of the University of Maryland. Dr. Carr recommended that the woodchips covering the mortality should have been extended completely to the hay bales in a peaked shape to promote water runoff and provide additional volume for maintaining heat. In early April 2005, an inspection was made by hand-digging into the piles. Not all of the biodegradable material had completely composted and the piles had become very wet over the winter. In mid-May 2005, the piles were turned to complete the composting process. Following mid-May pile-turning to homogenize and aerate the pile, all of the carcasses (except the bones) were completely composted by May 20 (Photograph 2).

Farm 2

Farm 2 began composting animal mortalities in November 2004. The same "U" shaped round hay bale arrangement was used (Photograph 3). Woodchips were again used as a base. The initial compost pile consisted of one cow (Photograph 4). Aged cow manure (Photograph 5) was used as a nitrogen source to facilitate the composting process. As with Farm 1, too few woodchips were placed over the cow, and the pile temperature did not rise above 80°F.

Photograph 3, Farm 2:
Bale arrangement prior to composting.

Because the moisture content and C:N ratio of the aged cow manure was adequate, we suspected that either poor aeration or readily available energy may have been limiting to the composting process. The aged cow manure was well decomposed prior to use and thus likely had little available energy for composting. Also, the aged cow manure was very fine material which tends to pack tightly and prevent air flow.

Photograph 4, Farm 2:
Animal Number 1 composting. Note that the animal is not adequately covered.

Photograph 5, Farm 2:
Aged cow manure used on Farm 2.

In March 2005, this farm had two additional cows die. These cows were covered with woodchips until a suitable carbon source could be located to initiate the composting process. Approximately 10 days after the cows died (March 26), they were uncovered (Photograph 6), then re-covered with old corn silage (Photograph 7) and a blanket of woodchips (Photograph 8).

Photograph 6, Farm 2:
Uncovered cows from Farm 2.

Photograph 7, Farm 2:
Corn silage covering cows on Farm 2.

Photograph 8, Farm 2:
Blanket of woodchips over cows on Farm 2. (Note the peaked arrangement of woodchips.)

Figure 3: Temperature Readings from Farm 2 Animals 2 and 3

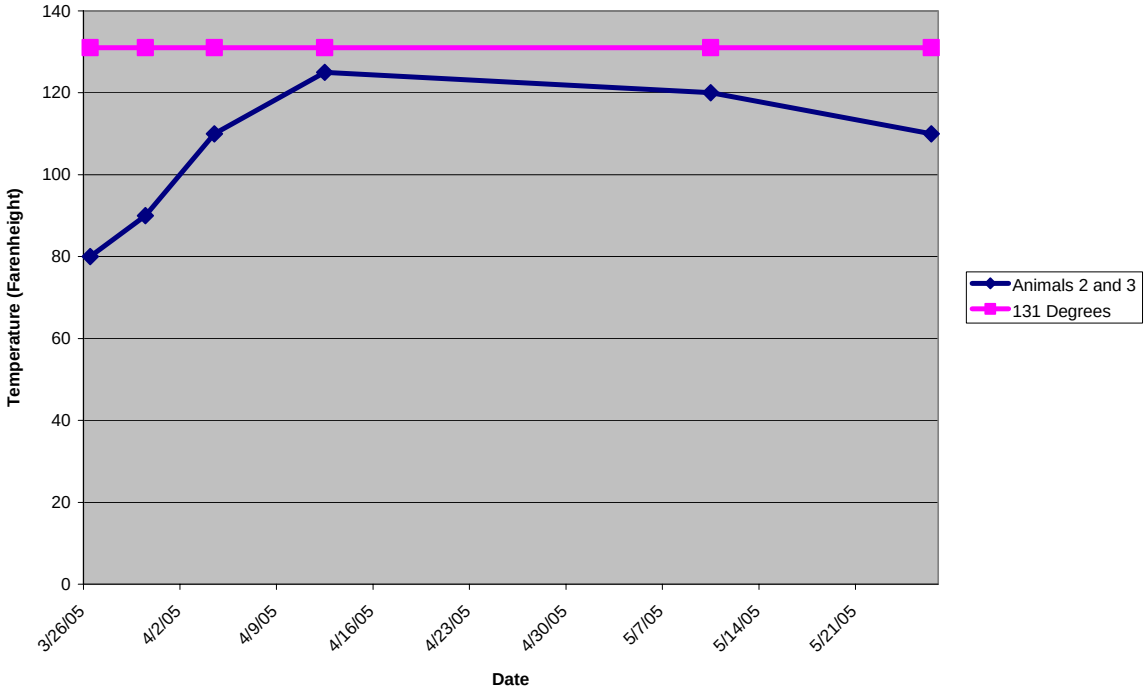


Figure 3 shows the temperatures recorded in these piles. Inspection of the contents by digging into the piles on April 4 and May 10 was performed to determine the decomposition effectiveness. The animal hide was difficult to puncture on April 4, but the animals were almost fully composted by May 10. Fly larvae were detected in both early December and in early April at this compost site. In both cases, the larvae were found where the mortality had not been covered adequately. A final inspection was made of these two cows on May 26. By May 26, the piles were noticeably reduced in volume (Photograph 9), and only bones and a small amount of hide remained (Photograph 10).

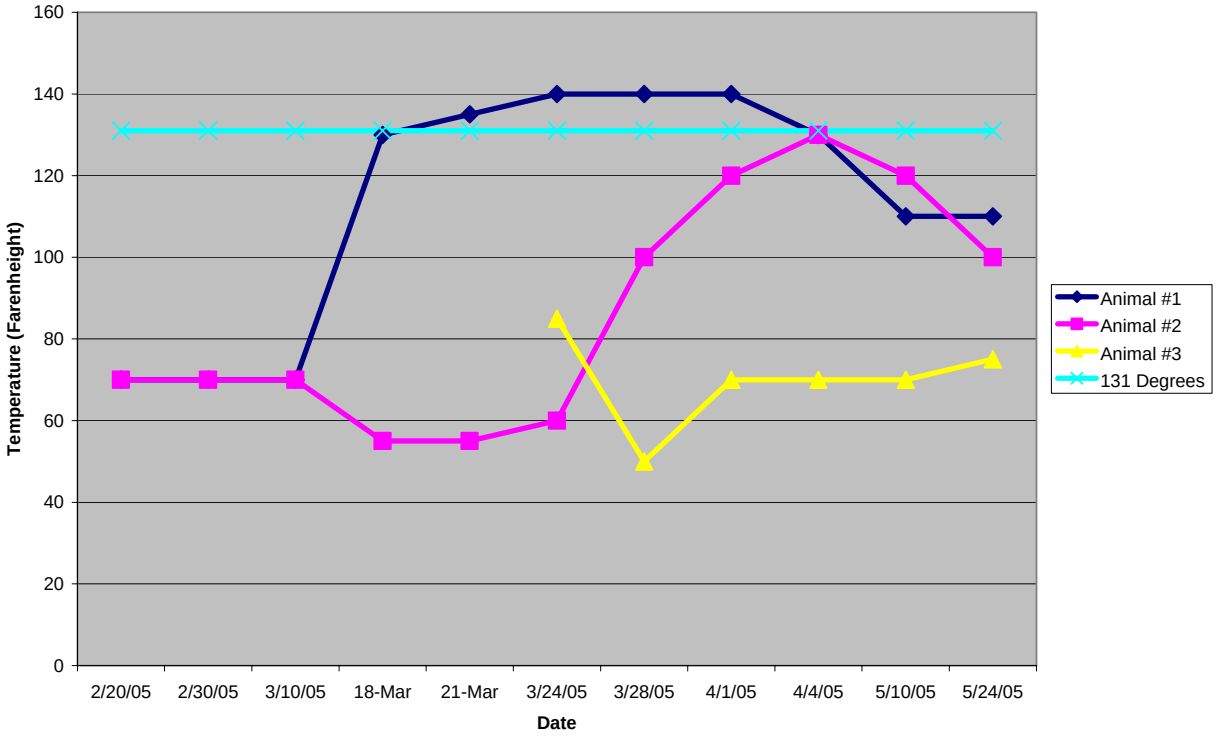
Photograph 9, Farm 2:
Compost piles in May 2005. Note the height difference between this photograph and Photograph 8.

Photograph 10, Farm 2:
Bones, hair, and animal tissue remaining in May 2005.

Farm 3

Farm 3 began composting animal mortalities in February 2005. The farmer placed two 700-lb. steers in the woodchip piles and covered the animals. One of the animals was partially frozen prior to being placed in the pile. Temperatures were recorded on several occasions during the ensuing weeks (Figure 4).

Figure 4: Temperature Readings from Farm 3



Photograph 11, Farm 3:
Uncovered animal on Farm 3.

The mortalities never started composting and were uncovered on March 14 (Photograph 11). One animal was covered with two front-end loader buckets of corn silage (about 1 ½ cubic yards) and the other animal was covered with 800 pounds of broiler litter (Photographs 12, 13, 14, 15, and 16). As shown in Figure 4, the temperature of the pile containing the animal covered with corn silage rose rapidly. The temperature of the pile containing the animal covered with broiler litter was extremely slow to begin increasing. This animal was still partially frozen when uncovered. It is assumed that the temperature initially dropped

because the partially frozen animal actually cooled the litter prior to composting. A third animal mortality that was buried in the woodchip pile in late March 2005 (listed as Animal 3 in Figure 4) never properly composted.

Photograph 12, Farm 3:
Covering Animal Number 1 with corn silage (one scoop of silage had already been placed on the steer).

Photograph 13, Farm 3:
Corn silage covering Animal Number 1.

Photograph 14, Farm 3:
Animal Number 2 covered with broiler litter.

Photograph 15, Farm 3: Placing a blanket of wood mulch over Animal Number 1.

Photograph 16, Farm 3: Moisture condensation on pile containing corn silage about one week after corn silage was added. The heat produced during composting causes water to evaporate in the pile. Some of this water vapor condenses when it reaches the cooler outer surface of the pile. Note the peaked arrangement of the pile.

The compost piles were inspected on April 4 and on May 24 by digging into the piles containing the first two mortalities (photographs 17, 18, and 19). By May 24, the interior of both piles was very dry and the temperature of both piles was still above 100°F. There were still remnants of hide (probably half of the hide and hair still remained) in both piles and the bones were still evident. In order for these piles to finish composting, they would need to be turned and some moisture added (the moisture could partially come from mixing the damp exterior of the pile with the dry interior).

Photograph 17, Farm 3:
Rib and paunch of Animal Number 1 three weeks after corn silage was placed on top of the steer.

Photograph 18, Farm 3:
Bones and hide remaining after 70 days of active composting.

Photograph 19, Farm 3:
Bones and hide remaining after about 70 days of active composting.

Summary of Composting Large Animal Mortality Demonstration

The following is a list of ideas and observations for future composting of large animal mortality.

1. Dead animals need to be covered with enough material to provide adequate insulation.
2. Piles need to be structured in a pyramid fashion to shed water and snowmelt.
3. Woodchips are a good foundation (i.e., base) and a good insulating material (i.e., blanket).
4. The feedstock used to initiate the composting process needs to have the proper C:N ratio and moisture content. In these demonstrations, the corn silage and broiler litter worked well, but the aged cow manure did not generate adequate heat.
5. An adequate volume of feedstock is needed. Whereas 1.5 cubic yards of corn silage per animal was adequate, 0.5 yards of corn silage per animal was insufficient. It appears that one cubic yard of rotten corn silage per animal would work well. Also, I speculate that if 1,200-1,500 pounds of broiler litter (about 1 to 1.5 cubic yards) had been used on Farm 3 instead of 800 pounds, this pile would have heated quicker and produced a higher temperature.
6. Piles should be turned at least one time (generally no sooner than two months after the composting process is initiated) to complete the composting process.
7. When attempting to turn the compost piles with loaders, equipment operators have a tendency to simply push the material. Better mixing and pile porosity (porosity enhances airflow into the pile) is achieved when the material is fully lifted and moved with the loader.
8. Large animal mortalities can be successfully composted without sectioning the animal prior to composting.
9. The hay bales used to contain the piles were not necessary. In some instances, the hay bales impeded the farmer's ability to properly cover the animals and arrange the pile into a proper peak.
10. It is important to quickly achieve and maintain temperatures above 131°F. Slow temperature rise increases the risk of attracting small animals that may break into the piles and fly larvae development.
11. When composting large animal mortality, no matter how good the composting process, there are still bones present when the process is complete.
12. There was some odor associated with a few of the composting piles. However, it could only be detected within 10-20 feet of the piles.
13. There were fly larvae found at two of the sites. However, this problem could have been easily avoided by adding the appropriate depth of blanket (in this case, woodchips) over the mortality and initiating a more rapid composting process.
14. There was no leachate seeping out of any of the piles.

References

Composting Animal Mortalities on the Farm. H. Brodie and L. Carr. Department of Biological Resources Engineering, University of Maryland, College Park. Fact Sheet 717. http://www.agnr.umd.edu/MCE/Publications/

Composting Livestock Mortality and Butcher Waste. (video) Natural Resource, Agriculture, and Engineering Service. Ithica, NY. 607-255-7654. www.nraes.org

Composting Swine Mortality Principles and Operation. Harold Keener, David Elwell, and Terry Mescher. Food, Agricultural, and Biological Engineering, Ohio State University Extension Fact Sheet, Columbus, Ohio. http://ohioline.osu.edu/aex-act/0711.html

ATTACHMENT #1

Office of the
Director

Recycling
Works!

Telephone:
540)+984-8573

Facsimile:
(540)+984-4591

Department of Solid Waste Management

Of Shenandoah County, Virginia
349 Landfill Road
Edinburg, Virginia 22824

June 30, 2004

Guidelines for Receiving Dead Farm Animals

1) Arrangements must be made in advance. We will not take "show-ups" at the gate.

2) Upon receiving a call from the carcass owner we will schedule a delivery time. It is anticipated appointment times will be 8 AM, 10 AM, 12 Noon, and 2 PM. We will accept no carcasses after 2 PM.

3) We will take cattle, horses, goats, sheep, pigs/hogs. We will NOT take poultry.

4) Carcass owners are responsible for delivery to the landfill and back to the tipping area. We will assist in unloading as much as is practical.

5) There will be tip fees charged as follows: $5 for each animal up to and including 400 pounds and $10 for each animal over 400 pounds.

6) There will be a limit of two (2) smaller-than-400-pound animals per appointment or one (1) larger-than-400-pound animal per appointment.

7) Callers may be turned away if our daily capacity is reached or if weather conditions are not conducive to burying animals. The potential for disease outbreak shall also be reason to deny burials.

8) Landfill staff will record the carcass owner's name, address, SSN, date, time, quantity, and type of animal for each visit.