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Please note: These procedures may be revised as the situation develops.

## EXECUTIVE SUMMARY OF THE METHOD

Composting is a biological heating process that results in the natural degradation of organic resources (such as poultry carcasses) by microorganisms. Composting has been successfully used throughout the United States for nearly two decades to control outbreaks of low pathogenicity avian influenza (LPAI) and highly pathogenic avian influenza (HPAI). Composting can be effective with most bird types and poultry house designs.

Microbial activity within a well-constructed compost pile can generate and maintain temperatures sufficient to inactivate the avian influenza virus. The effectiveness of this virus inactivation process can be assessed by evaluating compost temperatures and the shape of the time and temperature curve, visual observation of carcass decomposition, and the homogeneity of the compost mix.

**Successful mortality composting requires the following:**

- 1. A qualified composting expert to guide windrow construction.**
- 2. Trained equipment operators.**
- 3. Sufficient carbon, water, and space.**

**If any of these components is lacking, composting is NOT recommended.**

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Completed windrow (photo by Gary Flory)

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## KEY ELEMENTS FOR SUCCESSFUL COMPOSTING

The role of the Subject Matter Expert (SME) is to ensure that these key elements are followed in the construction of compost windrows:

1. Windrows (6 to 8 feet high and 12 to 15 feet wide) are constructed on an adequate and uniform base layer (10 to 15 inches thick) of a sufficiently porous and absorbent carbon material.
2. The base layer and windrow are not compacted with equipment.
3. Good carcass to carbon contact is ensured by creating a core with a minimum 1:1 mix, by volume, of carcasses, carbon, and other infected material (manure, egg shells, feed, etc.). **DO NOT GRIND/CRUSH/MACERATE THE CARCASSES DURING CONSTRUCTION!**
4. Windrows should be constructed to ensure adequate distribution of moisture throughout; the windrows are capped with carbon material (8 to 12 inches thick) to ensure that no carcasses are exposed and to minimize odor.
5. Windrow dimensions, including the base and cap, may be reduced for smaller carcasses.



Pay loader used for clearing the base (photo by Josh Payne)

## LABOR, EQUIPMENT, AND SUPPLIES

- Skilled equipment operators and general laborers;
- skid loader(s), pay loaders, dump trucks, rakes, and scoops;
- sawdust, litter, wood shavings, corn stover, active compost, seed and nut hulls, woodchips, or other carbon material; and
- compost thermometers (36" or 48" stem length).

## PROTOCOL

### Prior to Windrow Construction

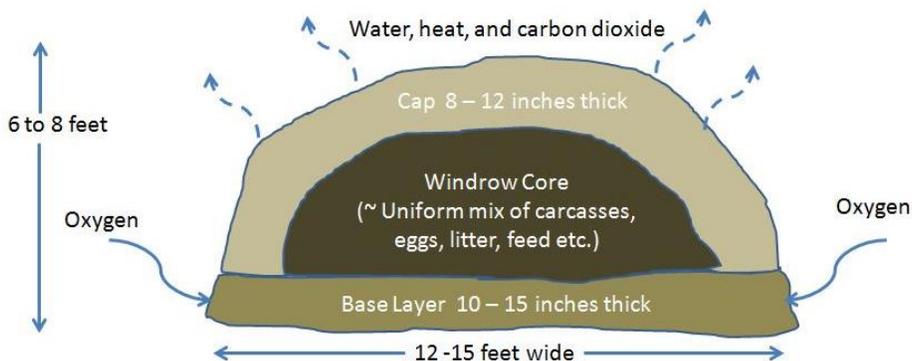
- Evaluate barn configuration to determine if space is adequate for windrow(s) construction within the poultry barns. If not, assess other on-site structures or outside compost sites.
  - To assess outside sites, see [Appendix A](#).
- Evaluate type and quantity of infected materials to be composted:
  - Carcass: type, size, number and condition
  - In-barn manure/litter: volume, moisture content, density

- Stored manure/litter: volume, moisture content, density
- Feed: quantity, location
  - Empty feed from feed bins and pans, distribute evenly into the mix.
- Eggs: quantity and condition
- Clean bedding
- Paper products
- Non-infected manure compost.
- Calculate the amount of carbon needed for composting:
  - See [Appendix B](#) for calculations.
  - The characteristics of various materials are listed in [Appendix I](#).
- Evaluate premise for supplemental water:
  - Source
  - Application method.
- Evaluate on-farm equipment and determine supplemental equipment needs.
- Ensure all overhead lines and poultry house equipment are removed or out of the way. Secure any loose cords, cables or hoses so that they will not become entangled by equipment.
- Minimize ventilation to reduce the risk of disease transmission while balancing air quality for worker safety.
- Transfer all infected on-site materials into compost windrows.

### Typical Windrow Construction Protocol

Three critical elements of windrow construction are: 1) a porous base layer, 2) a uniformly mixed windrow core, and 3) an adequate cap (see Figure 1). These steps may be done concurrently or as separate steps.

*Figure 1. Cross Section of Compost Windrow*



### **Windrow Base Construction**

- Before in-house composting, clear carcasses and litter from the windrow location(s) of the poultry house to create a 12–15 foot wide work area for construction of the windrow base(s). Distribute the material from on either side of the pathway. (See [Appendix C](#) for in-house variations.)
- Before outside composting, an adequate site must be identified (see [Appendix A](#)). Site modifications and approval from State and local agencies may be required.
- Using the largest loader possible, begin building the windrow base.
- The windrow base should be 12–15 feet wide with a depth of 10 to 15 inches.



Clearing the base (photo by Gary Flory)

- Carbon material for the base should be porous and bulky enough to allow adequate air flow into and through the windrow. Ideal materials for the base include bark mulch or coarse wood chips. Other acceptable materials include: straw, wood shavings, active compost, small grain hulls, and corn stover. Also, coarse woody material in excess of 2 inches in size should be avoided to ensure that the resulting compost can be land applied as a soil amendment.
- If these materials are not available, poultry litter may be used for the windrow base if it is sufficiently dry, porous, and bulky.
- To maintain the base's porosity and to avoid compaction, do not drive equipment on the base.

### **Construction of the Core**

- The windrow core should consist of a uniform mix of carcasses and litter. The easiest way to get a uniform mix throughout the windrow is to scoop litter and birds together in each bucket load and add it to the windrow in a manner that thoroughly mixes the contents of the bucket. If additional carbon material is needed, the material should support heat generation (i.e., composting). Suitable materials include fresh wood shavings, active compost, poultry litter, straw, corn stover, and small grain hulls. In many instances this material may need to be blended with the existing litter and carcasses to be suitable.



Constructing the core (photo by Bob Peer)

- Any remaining feed should be blended and mixed with the carcasses and litter before windrow construction. Be sure to move infected material as little as possible.
  - The mix of carcasses and litter should be added from both sides of the windrow. This allows the operators to reach the center of the windrow and avoid compacting the base with the tires or tracks of the loader.
  - The windrow core should be constructed such that 1 foot of base material is exposed on both sides of the windrow.
  - Add water as needed.
  - The core should be dome-shaped and of sufficient height to include the litter and carcass mix from the area adjacent to the windrow. At this stage, the windrow height should not exceed 6 feet.
- Continue building the core until all of the litter and carcasses have been placed on the base.
  - An alternate method of using pre-compost windrows is described in [Appendix C](#).

### **Capping the Windrow**

- Prior to capping the windrow, remove any carcasses that are near the edge of the windrow base and include them in the core of the windrow.
- Cap the windrow with 8 to 12 inches of a suitable carbon material. Carbon material for the cap should prevent flies from contacting carcasses, serve as an insulating blanket, and allow air to flow out of the piles. This material may be finer in texture than the base. Suitable material includes small grain hulls, sawdust, new bedding, and wood chips. Straw, corn fodder, or similar material may also be suitable; however, experience has shown that these products can blow off the windrow and may need to be thicker to serve this purpose than other materials.
- Ensure that the entire core is uniformly covered with cap material with no carcasses exposed.
- Avoid compacting the windrow. Do not operate the loader's tires or tracks onto the sides of the windrow while capping.
- The completed windrow should be approximately 6 to 8 feet high.



Smoothing the cap on an outside windrow  
(photo by Gary Flory)

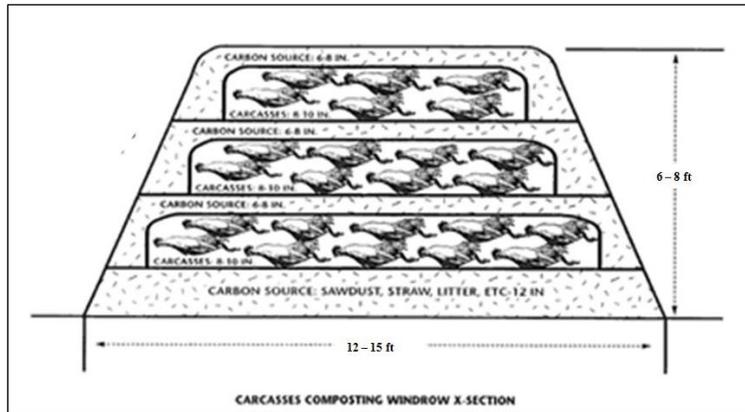
## Layering Method

As an alternative to the core construction method described previously, the windrow core can be constructed by layering carcasses and carbon material. Base and cap construction is the same as in the standard protocol. Following base construction, proceed in the following manner:



Layering method (photo by Mary Schwarz)

- Add a 12–15 inch layer of litter and birds, then cover with a 12–15 inch layer of wood chips or other carbon source.
- Add another layer of litter and birds until the windrow is two or three layers high and as long as needed.
- Cover the windrow with an 8–12 inch layer of wood chips or other carbon sources. The finished pile should be 6 to 8 feet high.



The SME may choose to use either or both of these construction techniques depending on site conditions.

## Approval of Windrow Design

SMEs should evaluate the windrows to ensure that they have been constructed consistently with this protocol. Approval will be documented on the Compost Approval Checklist in [Appendix G](#).

## Temperature Monitoring

Once the windrow construction has been approved by the SME, daily temperature monitoring can begin following the standard temperature monitoring SOP found in [Appendix D](#). Temperature data should be collected on the temperature log included in [Appendix E](#) or in a comparable electronic document. The health and safety of the individual conducting the temperature monitoring should be protected by following the ammonia safety procedures outlined in [Appendix F](#).

## Turning the Windrows

After the State Animal Health Official (SAHO), APHIS Official, Incident Management Team (IMT) Official, or SME has provided their approval based on windrow design and an evaluation of the temperature data collected during the initial 14-day compost cycle, the windrow is eligible for turning. Approval will be documented on the Compost Approval Checklist in [Appendix G](#). No turning is allowed before the end of the 14-day period. Turning needs to provide for the homogenization of the core, base, and cap materials. Windrows need to maintain adequate porosity and structure after turning. If soft tissue is observed on the windrow surface, a 2 to 4 inch carbonaceous cap should be applied. See [Appendix H](#) for turning equipment and methods.

## Release of the Compost

After the SAHO, APHIS Official, IMT Official, or SME has provided their approval based on windrow design and an evaluation of the temperature data collected during the second 14-day compost cycle, the compost may be moved without restriction on the premises or may leave the premises with appropriate permits. Approval will be documented on the Compost Approval Checklist in [Appendix G](#).

## Composting Egg-Layer Manure and Waste Feed

During an HPAI outbreak, there may be a need to compost layer manure and waste feed. This may be because the producer has chosen to dispose of their poultry mortalities by a method other than composting—such as on site burial, incineration, or landfilling—or because there was more manure on the farm than could be practically composted with the poultry carcasses. In general, the compost process used for these materials is identical to the windrow construction process described above. However, because of the density of the manure and feed, it is imperative that the material be thoroughly blended with carbonaceous materials to help ensure proper porosity within the windrows. Generally, manure can be composted with a 1:1 mix of manure and carbonaceous material. Often, layer manure has a high moisture content or is extremely dry depending on manure management, and the moisture content of the windrows may need to be adjusted.

## TROUBLESHOOTING

The table below describes some of the most common composting problems and possible solutions.

| <b>Problem</b>          | <b>Issue</b>      | <b>Solution</b>                             |
|-------------------------|-------------------|---|
| Excessive flies or odor | Exposed carcasses | Add additional cap material                 |
| Leachate from windrow   | Mixture too wet   | Add additional carbon material, mix and cap |

*Mortality Composting Protocol for Avian Influenza Infected Flocks*

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|                                   |                                   |  |
|-----------------------------------|-----------------------------------|--|
| Temperature does not reach 131 °F | Mixture too dry (< 40% moisture)  | Add water to pile, mix if necessary              |
| Temperature does not reach 131 °F | Mixture too wet (> 60 % moisture) | Add additional carbon material, mix if necessary |
| Temperature drops early           | Not enough oxygen                 | Aerate or mix pile                               |

## APPENDIX A

### SITING A COMPOST LOCATION FOR DISPOSAL OF POULTRY CARCASSES

Selection and siting of environmentally suitable and appropriate locations for composting of poultry carcasses infected with avian influenza is an important consideration in the disease management process. Because of the virulent nature of this disease, it is important to locate such sites within or in close proximity to the infected premises. The site access should be able to handle heavy truck traffic and allow for biosecurity around the site's perimeter, securing access to and from the site. Additionally, due to the relative putrescibility of the carcasses and associated litter, it is critical to choose sites that will not be adversely impacted by potential releases of nutrient-laden leachate nor will result in nuisance complaints in the event that odors, flies, or scavengers begin to appear on-site.



HPAI compost site (photo by Mark King)

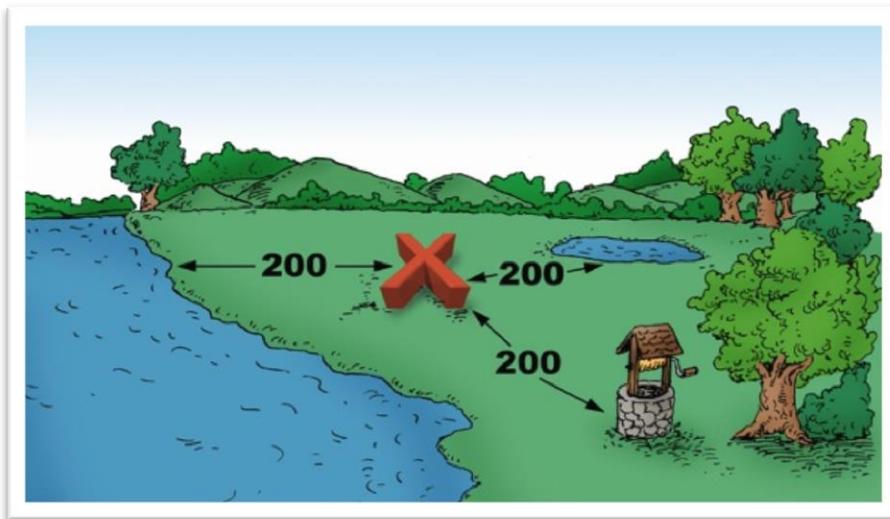
In general, emergency poultry mortality compost sites should be large enough to accommodate all of the generated carcasses, litter, waste feed, and other contaminated materials, as well as have the ability to store any additional amendment materials that may be needed for successful composting. Along with the criteria noted above, ideal HPAI compost sites should

- be located such that the prevailing wind directions do not travel to nearby residences (whenever possible),
- be located at the top of the slope of the field, on moderately-well to well drained soils (usually land that is used for crop production),
- have a gentle 2%–4% slope to encourage on-site drainage,
- contain on-site soil depths in excess of 24 inches to seasonal high water tables,
- contain on-site soil depths in excess of 36 inches to bedrock,

## *Mortality Composting Protocol for Avian Influenza Infected Flocks*

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- not be located on a flood plain,
- be constructed or designated for the current emergency,
- have (or construct) diversion ditches, terraces, or berms to direct surface water flows and storm water away from active compost piles. (Note that if piles are located between production houses, then roof and surface drainage should be directed away from the compost area), and
- the edges of the identified site should have these following minimum setbacks, including:
  - 200 feet from a water supply well used for drinking;
  - 200 feet from water bodies, including: ponds, lakes, streams, rivers;
  - 200 feet from a nearby residence (not owned by the premises);
  - 50 feet from a drainage swale that leads to a water body (see above); and
  - 25 feet from a drainage swale that does not lead to a water body.



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## APPENDIX B

### METHODS OF ESTIMATING CARBON (BULKING AGENT) NEEDS

#### Methodology

Described below are three approaches to estimating the amount of additional carbonaceous materials needed to compost poultry carcasses. All three require estimating the volume of litter in a building. To do this:

1. Obtain the length and width of the building.
2. Estimate the average depth of existing litter.
3. Calculate cubic feet of existing litter = length (in feet) × width (in feet) × depth (in inches) /12.
4. Convert to cubic yards: volume of litter in cubic feet/27 = cubic yards of litter.
5. Modify the estimate based on the condition of litter (volume should be reduced if there is a large volume of 'cake' or of very wet litter).

Once an estimate of the existing litter has been made, an estimate of the total amount of carbonaceous material is needed. Below are three approaches for estimating the total.

#### **Method 1. Weight Based Estimate**

- a. Effective in-house composting must have a minimum of 1.5 pounds of carbon material (based on bulk density of 30 pounds/cubic foot material) per pound of bird, (1 pound of carbon per pound of bird for the base and cover and the remaining carbon for the mix).
- b. Determine total pounds of birds
  - i. Pounds of birds = number of birds × average weight in pounds.
- c. Determine total pounds carbon needed
  - i. Total carbon = pounds of birds (from above) × 1.5.
- d. Determine pounds of litter in house
  - i. Cubic feet of litter in house (see above)
  - ii. Pounds of litter = cubic feet of litter × weight of a cubic foot of litter (Average bulk density = 30 pounds; Range = 25 to 35 pounds).
- e. Determine amount of additional carbon needed
  - i. Cubic yards of additional carbon needed = ((total pounds of carbon needed- pounds of litter in house)/(weight per cubic feet of carbon material))/(27)
    1. wood chips, litter or wet sawdust = 30 pounds/cubic foot
    2. dry sawdust = 15 pounds/cubic foot.

## **Method 2. Volume Based Estimate**

- a. Assume bulk density of litter is 30 pounds/cubic foot or approximately 800 pounds/cubic yard. This means the following:
  - i. Each 20 pound bird requires 30 pounds or 1 cubic foot of carbon material
  - ii. Each 40 pound bird requires 60 pound or 2 cubic feet of carbon material.
- b. To calculate total carbon material needs, perform the following calculations:
  - i. Multiply number of 20 pound birds by 1 to get cubic feet then divide by 27 for cubic yards.
  - ii. Multiply number of 40 pound birds by 2 to get cubic feet then divide by 27 for cubic yards.
- c. To estimate additional volume needed, subtract the total volume of litter in the building (see above) from the total volume of carbon material required.

## **Method 3. Computerized Estimator**

- a. First, use the Spartan Emergency Animal Tissue Composting Planner v1.03 to estimate the total amount of amendment needed.
- b. Then use the Spartan Compost Recipe Optimizer v1.04 to estimate the amounts/proportions of amendments needed; given the availability of amendments (poultry manure, poultry litter, sawdust, bark, etc.).
- c. Go to this site: [http://msue.anr.msu.edu/program/info/managing\\_animal\\_mortalities](http://msue.anr.msu.edu/program/info/managing_animal_mortalities) and then select "Composting Tools."

## APPENDIX C VARIATIONS ON TYPICAL WINDROW CONSTRUCTION PROTOCOL

### Variations Based on House Design

The three critical elements of a porous base layer, a uniformly mixed windrow core, and an adequate cap, must be maintained for successful virus inactivation regardless of variations in house design, bird size, or available carbon material.



Typical pole house design (photo by Bob Peer)

### Pole Supported Houses

- Although the support poles may limit the maneuverability of the loaders, the windrow construction protocol remains the same.
- Avoid constructing windrows against wooden support poles.
- Additional time will be required to construct windrows in this type of house due to space and structural constraints.
- Depending on the width of the house and the pole configuration, two windrows may need to be constructed instead of a single windrow in the center of the house.
- Due to structural constraints and limited maneuverability, experienced and skilled loader operators are required to minimize damage to the building and equipment.



Pole house with 2 windrows (photo by Josh Payne)

## **Turkey Breeder Houses**

- Although designs of turkey breeder houses may vary, generally the nests and other equipment can be moved to the center and sides of the house to make space for the construction of two windrows.
- Because of limited operating space, windrows may need to be shorter (5 feet tall) and narrower (10 feet wide). This will allow the loader operator to construct the windrow core and place the cap from one side of the windrow.
- Eggs and feed should be evenly distributed onto the core of the windrow.
- Eggs should be broken with the loader bucket to facilitate decomposition and inactivation of virus.



Windrow in a turkey breeder house  
(photo by Gary Flory)

## **Breeder Turkey Toms**

- Breeder toms can weigh between 60 and 80 pounds.
- Due to their size, more carbon material may be required to maintain good carcass to carbon contact.
- Handling and placing the carcasses in the windrow may be difficult due to their size and the tendency of the carcasses to roll to the edge of the windrow. Additional labor may be necessary to appropriately position the carcasses on the windrow.
- Additional capping material may be needed to ensure that all carcasses are adequately covered.

## **Broiler-Breeder Houses with a Center Scratch Area**

- Slats and nests need to be moved outside the house after depopulation.
- Carcasses and litter in scratch area should be scooped up with a loader(s) and dumped onto the middle of the manure which was under the slats. Place equal amount of carcasses on both manure piles.
- Dump any feed onto the manure.
- Bring in carbon material to build a base 10 inches deep and 12 foot wide in the scratch area. Ensure that the base does not touch the wooden slat supports.



Typical broiler-breeder house with center  
scratch area (photo by Bob Peer)

- Using the loader(s), mix the carcasses, manure and feed, and place this core mix on the base, maintaining 8 to 10 inches around the edge of the base. Work from both sides as you progress down the house making sure there is enough core mix placed on the base to evenly distribute the material the length of the house.
- Using the loader(s), place 8 to 10 inches of woodchips or bark mulch on top of the core mix, making sure that this cap does not touch the wooden slat support and that all carcasses are covered.

### **Broiler-Breeder Houses with Scratch Areas on the Sides**

- The manure from under the center slats will be placed on the carcasses in the side scratch areas.
- Follow same procedure as above for building the windrow in the area under the center slats.

### **Variation of the Standard Core Construction Technique**

#### **Pre-Compost Windrows**

An alternative construction method, which increases the amount of carbon material mixed within the windrow core, is to form 2 pre-compost windrows, cap, and then form 1 final windrow. This is especially useful when dealing with large amounts of carcass material relative to litter, creating a significant C:N imbalance, or when additional carbon material will increase porosity. Forming pre-compost windrows also stabilizes the tissue and begins a heating process until a single windrow can be constructed.

- Remove litter and carcasses along sidewalls and the center of the house, forming 2 pre-compost windrows extending the length of the house.
- Cap each windrow with 8–12 inches of suitable carbon material.
- In the center of the house, construct a 12–15 feet wide base that is 10–15 inches deep.
- Combine both capped windrows onto the base, mixing litter, carcasses, and added carbon material.
- Cap the final windrow with 8–12 inches of suitable carbon material.



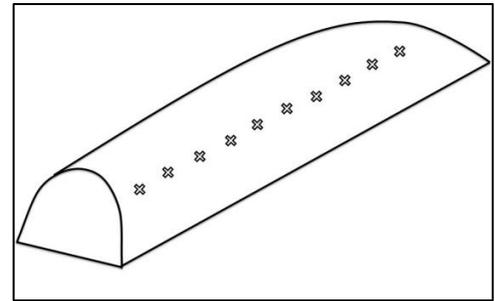
Pre-compost windrows (photo by Josh Payne)



Final windrow (photo by Josh Payne)

## APPENDIX D TEMPERATURE MONITORING PROCEDURE

Monitor temperatures of the windrow daily at 10 to 12 flagged locations. The temperature monitoring locations should be spaced equidistantly the length of each windrow. Take two temperature readings at each flagged location; one reading at a depth of 18 inches and another reading at a depth of 36 inches. To ensure consistent temperature monitoring to the same depth, mark the thermometer probe at 18 inches and 36

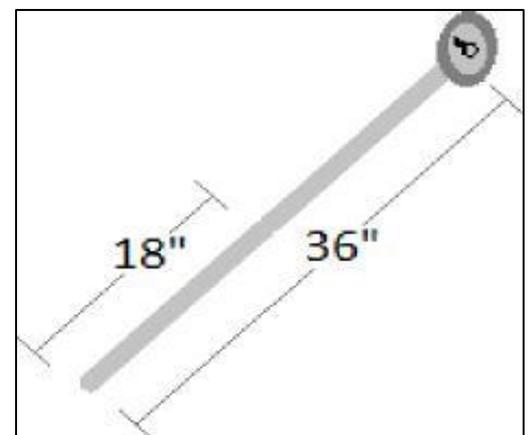
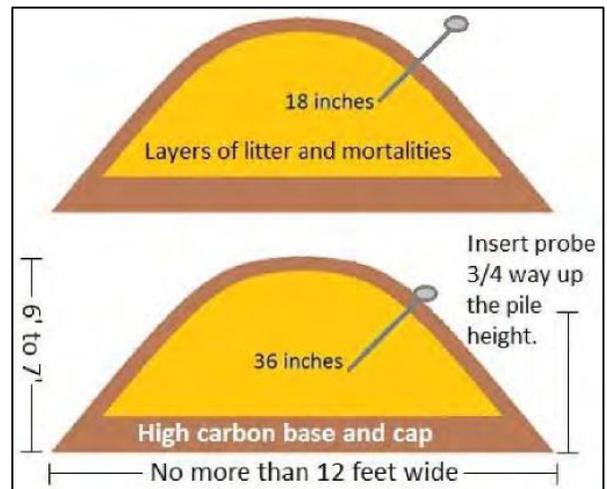


Example temperature monitoring locations

inches. Place the temperature probe  $\frac{3}{4}$  of the way up the windrow at a 45 degree angle. Ideally, temperatures should be monitored by a single individual for consistency. Temperature probes should be calibrated before use.

### Instructions

- Turn on fans or open the doors and curtains to all the houses containing compost piles to allow them to air out and to maximize ventilation.
- **USE THE BUDDY SYSTEM.** Entering a barn with active compost or dead birds requires a two person team.
- Place the stem of the thermometer approximately 18 inches and then 36 inches into the compost pile half way up the pile at a 45 degree angle.
- Leave the thermometer at each depth and point for at least 60 seconds.
- Log the reading from the thermometer from each flag and at both depths.
- Compare readings to previous day's readings.
- After completing the house readings, close the doors and curtains.
- Calculate the average temperature for each pile and note it on the Composting Temperature Log.
- Windrows should reach an average temperature of 131°F for a minimum of 72 hours or be assessed by a SME for possible corrective measures.
- Disinfect the thermometer and return it to its protective case.



### *Mortality Composting Protocol for Avian Influenza Infected Flocks*

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- Each thermometer will be kept at the respective premises being monitored. Do not take a thermometer from one premise to another.
- If 3 days after initial windrow construction, compost temperature **averages** are consistently (more than 3 days) below 100°F or greater than 160°F, a SME should be consulted immediately.
- During the second 14-day composting phase, a SME should be consulted immediately if **any** monitoring location is consistently (more than 3 days) below 100°F or greater than 160°F.

APPENDIX E  
TEMPERATURE MONITORING LOG SHEET

| <b>COMPOSTING TEMPERATURE LOG</b>   |              |               |   |   |                |   |   |              |   |    |     |
|---|--------------|---------------|---|---|----------------|---|---|--------------|---|----|-----|
| County:   | Site Number: |               |   |   |                |   |   |              |   |    |     |
| Street address, city, state:  |              |               |   |   |                |   |   |              |   |    |     |
| Farm Name:  |              |               |   |   |                |   |   |              |   |    |     |
| House Number:   |              | Date Started: |   |   | Date Finished: |   |   | Date Turned: |   |    |     |
| <b>Use the cells below to record the temperatures each day at 18 inches and at 36 inches.</b> |              |               |   |   |                |   |   |              |   |    |     |
| Date<br>Depth   | 1            | 2             | 3 | 4 | 5              | 6 | 7 | 8            | 9 | 10 | Avg |
| 18"   |              |               |   |   |                |   |   |              |   |    |     |
| 36"   |              |               |   |   |                |   |   |              |   |    |     |
| 18"   |              |               |   |   |                |   |   |              |   |    |     |
| 36"   |              |               |   |   |                |   |   |              |   |    |     |
| 18"   |              |               |   |   |                |   |   |              |   |    |     |
| 36"   |              |               |   |   |                |   |   |              |   |    |     |
| 18"   |              |               |   |   |                |   |   |              |   |    |     |
| 36"   |              |               |   |   |                |   |   |              |   |    |     |
| 18"   |              |               |   |   |                |   |   |              |   |    |     |
| 36"   |              |               |   |   |                |   |   |              |   |    |     |
| 18"   |              |               |   |   |                |   |   |              |   |    |     |
| 36"   |              |               |   |   |                |   |   |              |   |    |     |
| 18"   |              |               |   |   |                |   |   |              |   |    |     |
| 36"   |              |               |   |   |                |   |   |              |   |    |     |
| 18"   |              |               |   |   |                |   |   |              |   |    |     |
| 36"   |              |               |   |   |                |   |   |              |   |    |     |

## APPENDIX F IN-HOUSE COMPOSTING AMMONIA SAFETY

### Background

Ammonia is produced naturally from decomposition of organic matter, including plants, animals and animal wastes and can become concentrated in enclosed structures. This guidance is for ammonia produced from these natural sources, NOT from compressed gas cylinders or other sources which may produce very high air concentrations.

### Signs of Exposure to Ammonia

Strong odor provides adequate early warning of its presence, but prolonged exposure can be hard to detect due to olfactory fatigue and adaptation. High concentrations can cause airway destruction resulting in respiratory distress or failure. Signs of exposure include the following:

- burning of the nose, throat and respiratory tract;
- coughing; and
- skin and eye irritation.

### How to Reduce Ammonia Exposure

- Increase ventilation when possible.
- Reduce the amount of time spent in areas where levels of ammonia are high.
- Wear proper PPE (personal protective equipment)
  - gloves,
  - half face with goggles or a full face respirator with at least a particulate/ammonia cartridge (green) or a multigas cartridge, and
  - cloth coveralls or disposable coveralls (Tyvek).
- If possible, measure levels of ammonia in work area with an air gas meter before entering, or know recommended exposure times based on the ammonia levels in work area.

| <b>Exposure Guidelines (NIOSH)</b> |        |
|------------------------------------|--------|
| Long term exposure (8 hours)       | 25 ppm |
| Short term exposure (15 minutes)   | 35 ppm |
| Short term exposure (5 minutes)    | 50 ppm |

If exposed:

- Seek fresh air.
- Flush irritated skin or eyes with water.
- If needed, seek immediate medical attention.
- Contact your supervisor or the Safety Officer if irritation of skin, nose, throat, or respiratory tract is persistent.

APPENDIX G  
COMPOST APPROVAL CHECKLIST

**COMPOST APPROVAL CHECKLIST**

|                               |  |                                 |  |
|-------------------------------|--|---------------------------------|--|
| <b>Farm Name:</b>             |  | <b>County:</b>                  |  |
| <b>Farm Address:</b>          |  |                                 |  |
| <b>Farm Contact:</b>          |  | <b>Contact Phone:</b>           |  |
| <b>Date Windrows Started:</b> |  | <b>Date Windrows Completed:</b> |  |

|                       |  | Yes | No | N/A | Comments/Description |
|-----------------------|--|-----|----|-----|----------------------|
| <b>WINDROW DESIGN</b> |  |     |    |     |                      |
| 1                     | Height between 6 and 8 feet.                         |     |    |     |                      |
| 2                     | Width between 10 and 15 feet                         |     |    |     |                      |
| 3                     | Dome shaped without significant irregularities       |     |    |     |                      |
| 4                     | No soft tissue visible on the surface of the windrow |     |    |     |                      |
| 5                     | A minimum of 6 inches of carbon cover material       |     |    |     |                      |
| 6                     | Photos taken   |     |    |     |                      |

**Recommendations:**

I have evaluated the windrows at this site and in my professional judgment they have been constructed consistent with the criteria outlined in the Mortality Composting Protocol for Avian Influenza Infected Flocks.

I have evaluated the windrows at this site and in my professional judgment they have **NOT** been constructed consistent with the criteria outlined in the Mortality Composting Protocol for Avian Influenza Infected Flocks. The following corrective actions are recommended:

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Signature of Composting SME: \_\_\_\_\_ Date: \_\_\_\_\_

Print name of Composting SME: \_\_\_\_\_

*Mortality Composting Protocol for Avian Influenza Infected Flocks*

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|   |  | Yes | No | N/A | Comments/Description |
|---|--|-----|----|-----|----------------------|
| <b>PHASE 1 WINDROW EVALUATION—Days 1–14</b> |  |     |    |     |                      |
| 1   | Height between 4 and 8 feet                          |     |    |     |                      |
| 2   | Width between 10 and 15 feet                         |     |    |     |                      |
| 3   | Dome shaped without significant irregularities       |     |    |     |                      |
| 4   | No soft tissue visible on the surface of the windrow |     |    |     |                      |
| 5   | A minimum of 6 inches of carbon cover material       |     |    |     |                      |
| 6   | Moisture adequate                                    |     |    |     |                      |
| 7   | Leachate present                                     |     |    |     |                      |
| 8   | Excessive flies                                      |     |    |     |                      |
| 9   | Vector activity observed                             |     |    |     |                      |
| 10  | Odor observed: VOA, putrid                           |     |    |     |                      |
| 11  | Temperature measured at 18 inches and 36 inches      |     |    |     |                      |
| 12  | Temperatures reached 131° F for 3 consecutive days   |     |    |     |                      |
| 13  | Photos taken   |     |    |     |                      |

**Recommendations for Phase 1:**

I have evaluated the windrows at this site and in my professional judgment they have been constructed consistent with the criteria outlined in the Mortality Composting Protocol for Avian Influenza Infected Flocks. Additionally, windrow temperatures have reached the average temperature of 131°F for a minimum of 72 hours. The 14-day initial composting cycle is complete.

I have evaluated the windrows at this site and in my professional judgment they have **NOT** been constructed consistent with the criteria outlined in the Mortality Composting Protocol for Avian Influenza Infected Flocks. The windrows should be evaluated by a composting Subject Matter Expert to recommend corrective actions if necessary.

Windrow temperatures have **NOT** reached the average temperature of 131°F for a minimum of 72 hours. The windrows should be evaluated by a composting Subject Matter Expert to recommend corrective actions if necessary.

Signature of State Animal Health  
 Official, APHIS Official or IMT Official: \_\_\_\_\_ Date: \_\_\_\_\_

Print name of signing official: \_\_\_\_\_

*Mortality Composting Protocol for Avian Influenza Infected Flocks*

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|  |  | Yes | No | N/A | Comments/Description |
|--|--|-----|----|-----|----------------------|
| <b>PHASE 2 WINDROW EVALUATION—Days 14–28</b> |  |     |    |     |                      |
| 1  | Height between 4 and 8 feet                          |     |    |     |                      |
| 2  | Width between 10 and 15 feet                         |     |    |     |                      |
| 3  | Dome shaped without significant irregularities       |     |    |     |                      |
| 4  | No soft tissue visible on the surface of the windrow |     |    |     |                      |
| 5  | A minimum of 6 inches of carbon cover material       |     |    |     |                      |
| 6  | Moisture adequate                                    |     |    |     |                      |
| 7  | Leachate present                                     |     |    |     |                      |
| 8  | Excessive flies                                      |     |    |     |                      |
| 9  | Vector activity observed                             |     |    |     |                      |
| 10   | Odor observed: VOA, putrid                           |     |    |     |                      |
| 11   | Temperature measured at 18 inches and 36 inches      |     |    |     |                      |
| 12   | Temperatures reached 131° F for 3 consecutive days   |     |    |     |                      |
| 13   | Photos taken   |     |    |     |                      |

**Recommendations for Phase 2:**

I have evaluated the windrows at this site and in my professional judgment they have been constructed consistent with the criteria outlined in the Mortality Composting Protocol for Avian Influenza Infected Flocks. Additionally, windrow temperatures have reached the average temperature of 131°F for a minimum of 72 hours during the second composting phase. The windrows may be moved without restriction on the premises or may leave the premises with appropriate permits.

I have evaluated the windrows at this site and in my professional judgment they have **NOT** been constructed consistent with the criteria outlined in the Mortality Composting Protocol for Avian Influenza Infected Flocks. The windrows should be evaluated by a composting Subject Matter Expert to recommend corrective actions if necessary.

Windrow temperatures have **NOT** reached the average temperature of 131°F for a minimum of 72 hours during the second composting phase. The windrows should be evaluated by a composting Subject Matter Expert to recommend corrective actions if necessary.

Signature of State Animal Health  
 Official, APHIS Official or IMT Official: \_\_\_\_\_ Date: \_\_\_\_\_

Print name of signing official: \_\_\_\_\_

## APPENDIX H WINDROW TURNING EQUIPMENT AND METHODS

Windrow turning should occur at 14 days after the windrow construction is completed. There are several methods for turning windrows, both for in-house and outside windrows. The windrows constructed in-house may be turned inside the house or moved outside and reformed.

### Methods for Turning Windrows In-House

1. Use skid loaders or telehandlers with high-capacity buckets to turn windrows. Starting at the end of the windrow, scoop up all compost, turn machine around and drop the mixture forming a new windrow. It needs to be dumped in a manner that provides maximum aeration.



Turning in-house with a skid loader (photo by Josh Payne)

2. Use small dozer to roll over windrows.
  - a. Requires a skilled operator to avoid damaging equipment and building.
  - b. Requires building the original windrow off center to allow space to turn the pile.
  - c. Only feasible in larger houses.

### Methods for Turning Windrows Outside

1. Use large articulated loader(s).
  - a. Skid loaders have too small a bucket for this method (too slow and they don't mix the material as well).
2. Use dozer to roll over windrow.
  - a. Does not mix material as well as other methods.
3. Use tractor attached mechanical compost turner.
  - a. Thoroughly mixes and shreds material but may be slower than using large loaders or straddle type windrow turners.

- b. Requires 2 passes for larger windrows.



Brown Bear compost turner (photo by Gary Flory)



Brown Bear compost turner (photo by Bob Peer)

4. Straddle-type windrow turner (tractor pulled).

- a. Windrows should be constructed far enough apart to allow the tractor and turner to operate (width of tractor approximately 10 to 12 feet).
- b. Mixes material well.
- c. Need a large unit to turn 12–15 foot windrows (at least 14 foot wide)—the “toe” of the windrows can be removed by a loader to reduce the width of larger windrows.



Self-propelled compost turner  
(photo by Gary Flory)



Tractor-pulled compost turner  
(photo by Mark King)

APPENDIX I  
CHARACTERISTICS OF RAW MATERIAL<sup>1</sup>

| Material  | Type of value | % N (dry weight) | C:N ratio (weight to weight) | Moisture content % (wet weight) | Bulk density (pounds per cubic yard) |
|---|---------------|------------------|------------------------------|---------------------------------|--------------------------------------|
| <b>Crop residues and fruit/vegetable-processing waste</b> |               |                  |                              |                                 |                                      |
| Apple filter cake   | Typical       | 1.2              | 13                           | 60                              | 1,197                                |
| Apple pomace  | Typical       | 1.1              | 48                           | 88                              | 1,559                                |
| Apple-processing sludge                                   | Typical       | 2.8              | 7                            | 59                              | 1,411                                |
| Cocoa shells  | Typical       | 2.3              | 22                           | 8                               | 798                                  |
| Coffee grounds  | Typical       | —                | 20                           | —                               | —                                    |
| Corn cobs   | Range         | 0.4–0.8          | 56–123                       | 9–18                            | —                                    |
|   | Average       | 0.6              | 98                           | 15                              | 557                                  |
| Corn stalks   | Typical       | 0.6–0.8          | 60–73 <sup>a</sup>           | 12                              | 32                                   |
| Cottonseed meal   | Typical       | 7.7              | 7                            | —                               | —                                    |
| Cranberry filter cake                                     | Typical       | 2.8              | 31                           | 50                              | 1,021                                |
| (with rice hulls)   | Typical       | 1.2              | 42                           | 71                              | 1,298                                |
| Cranberry plant (stems, leaves)                           | Typical       | 0.9              | 61                           | 61                              | —                                    |
| Cull potatoes   | Typical       | —                | 18                           | 78                              | 1,540                                |
| Fruit wastes  | Range         | 0.9–2.6          | 20–49                        | 62–88                           | —                                    |
|   | Average       | 1.4              | 40                           | 80                              | —                                    |
| Olive husks   | Typical       | 1.2–1.5          | 30–35                        | 8–10                            | —                                    |
| Potato-processing sludge                                  | Typical       | —                | 28                           | 75                              | 1,570                                |
| Potato tops   | Typical       | 1.5              | 25                           | —                               | —                                    |
| Rice hulls  | Range         | 0–0.4            | 113–1120                     | 7–12                            | 185–219                              |
|   | Average       | 0.3              | 121                          | 14                              | 202                                  |
| Soybean meal  | Typical       | 7.2–7.6          | 4–6                          | —                               | —                                    |
| Tomato-processing waste                                   | Typical       | 4.5              | 11 <sup>a</sup>              | 62                              | —                                    |
| Vegetable produce   | Typical       | 2.7              | 19                           | 87                              | 1,585                                |
| Vegetable wastes  | Typical       | 2.5–4            | 11–13                        | —                               | —                                    |
| <b>Fish and meat processing</b>                           |               |                  |                              |                                 |                                      |
| Blood wastes (slaughterhouse waste and dried blood)       | Typical       | 13–14            | 3–3.5                        | 10–78                           | —                                    |
| Crab and lobster wastes                                   | Range         | 4.6–8.2          | 4.0–5.4                      | 35–61                           | —                                    |
|   | Average       | 6.1              | 4.9                          | 47                              | 240                                  |
| Fish-breading crumbs                                      | Typical       | 2.0              | 28                           | 10                              | —                                    |
| Fish-processing sludge                                    | Typical       | 6.8              | 5.2                          | 94                              | —                                    |

<sup>1</sup> Reprinted with permission from the Cornell Waste Management Institute.

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| <b>Material</b>                              | <b>Type of value</b> | <b>% N (dry weight)</b> | <b>C:N ratio (weight to weight)</b> | <b>Moisture content % (wet weight)</b> | <b>Bulk density (pounds per cubic yard)</b> |
|--|----------------------|-------------------------|-------------------------------------|--|---|
| <b>Fish wastes (gurry, racks, and so on)</b> | Range                | 6.5–14.2                | 2.6–5.0                             | 50–81                                  | —   |
|  | Average              | 10.6                    | 3.6                                 | 76                                     | —   |
| <b>Mixed slaughterhouse waste</b>            | Typical              | 7–10                    | 2–4                                 | —                                      | —   |
| <b>Mussel wastes</b>                         | Typical              | 3.6                     | 2.2                                 | 63                                     | —   |
| <b>Poultry carcasses</b>                     | Typical              | 2.4 <sup>b</sup>        | 5                                   | 65                                     | —   |
| <b>Paunch manure</b>                         | Typical              | 1.8                     | 20–30                               | 80–85                                  | 1,460                                       |
| <b>Shrimp wastes</b>                         | Typical              | 9.5                     | 3.4                                 | 78                                     | —   |
|  |                      |                         |                                     |  |   |
| <b>Manures</b>                               |                      |                         |                                     |  |   |
| <b>Broiler litter</b>                        | Range                | 1.6–3.9                 | 12–15 <sup>a</sup>                  | 22–46                                  | 756–1,026                                   |
|  | Average              | 2.7                     | 14 a                                | 37                                     | 864   |
|  |                      |                         |                                     |  |   |
| <b>Cattle</b>                                | Range                | 1.5–4.2                 | 11–30                               | 67–87                                  | 1,323–1,674                                 |
|  | Average              | 2.4                     | 19                                  | 81                                     | 1,458                                       |
| <b>Dairy tie stall</b>                       | Typical              | 2.7                     | 18                                  | 79                                     | —   |
| <b>Dairy free stall</b>                      | Typical              | 3.7                     | 13                                  | 83                                     | —   |
|  |                      |                         |                                     |  |   |
| <b>Horse-general</b>                         | Range                | 1.4–2.3                 | 22–50                               | 59–79                                  | 1,215–1,620                                 |
|  | Average              | 1.6                     | 30                                  | 72                                     | 1,379                                       |
|  |                      |                         |                                     |  |   |
| <b>Horse-race track</b>                      | Range                | 0.8–1.7                 | 29–56                               | 52–67                                  | —   |
|  | Average              | 1.2                     | 41                                  | 63                                     | —   |
|  |                      |                         |                                     |  |   |
| <b>Laying hens</b>                           | Range                | 4–10                    | 3–10                                | 62–75                                  | 1,377–1,620                                 |
|  | Average              | 8.0                     | 6                                   | 69                                     | 1,479                                       |
|  |                      |                         |                                     |  |   |
| <b>Sheep</b>                                 | Range                | 1.3–3.9                 | 13–20                               | 60–75                                  | —   |
|  | Average              | 2.7                     | 16                                  | 69                                     | —   |
|  |                      |                         |                                     |  |   |
| <b>Swine</b>                                 | Range                | 1.9–4.3                 | 9–19                                | 65–91                                  | —   |
|  | Average              | 3.1                     | 14                                  | 80                                     | —   |
|  |                      |                         |                                     |  |   |
| <b>Turkey litter</b>                         | Average              | 2.6                     | 16 a                                | 26                                     | 783   |
|  |                      |                         |                                     |  |   |
| <b>Municipal wastes</b>                      |                      |                         |                                     |  |   |
| <b>Garbage (food waste)</b>                  | Typical              | 1.9–2.9                 | 14–16                               | 69                                     | —   |
|  |                      |                         |                                     |  |   |
| <b>Night soil</b>                            | Typical              | 5.5–6.5                 | 6–10                                | —                                      | —   |
|  |                      |                         |                                     |  |   |

*Mortality Composting Protocol for Avian Influenza Infected Flocks*

| <b>Material</b>                              | <b>Type of value</b> | <b>% N (dry weight)</b> | <b>C:N ratio (weight to weight)</b> | <b>Moisture content % (wet weight)</b> | <b>Bulk density (pounds per cubic yard)</b> |
|--|----------------------|-------------------------|-------------------------------------|--|---|
| <b>Paper from domestic refuse</b>            | Typical              | 0.2–0.25                | 127–178                             | 18–20                                  | —   |
| <b>Pharmaceutical wastes</b>                 | Typical              | 2.6                     | 19                                  | —                                      | —   |
| <b>Refuse (mixed food, paper, and so on)</b> | Typical              | 0.6–1.3                 | 34–80                               | —                                      | —   |
| <b>Sewage sludge</b>                         | Range                | 2–6.9                   | 5–16                                | 72–84                                  | 1,075–1,750                                 |
| <b>Activated sludge</b>                      | Typical              | 5.6                     | 6                                   | —                                      | —   |
| <b>Digested sludge</b>                       | Typical              | 1.9                     | 16                                  | —                                      | —   |
| <b>Straw, hay, silage</b>                    |                      |                         |                                     |  |   |
| <b>Corn silage</b>                           | Typical              | 1.2–1.4                 | 38–43 <sup>a</sup>                  | 65–68                                  | —   |
| <b>Hay-general</b>                           | Range                | 0.7–3.6                 | 15–32                               | 8–10                                   | —   |
|  | Average              | 2.10                    | —                                   | —                                      | —   |
| <b>Hay-legume</b>                            | Range                | 1.8–3.6                 | 15–19                               | —                                      | —   |
|  | Average              | 2.5                     | 16                                  | —                                      | —   |
| <b>Hay-non-legume</b>                        | Range                | 0.7–2.5                 | —                                   | —                                      | —   |
|  | Average              | 1.3                     | 32                                  | —                                      | —   |
| <b>Straw-general</b>                         | Range                | 0.3–1.1                 | 48–150                              | 4–27                                   | 58–378                                      |
|  | Average              | 0.7                     | 80                                  | 12                                     | 227   |
| <b>Straw-oat</b>                             | Range                | 0.6–1.1                 | 48–98                               | —                                      | —   |
|  | Average              | 0.9                     | 60                                  | —                                      | —   |
| <b>Straw-wheat</b>                           | Range                | 0.3–0.5                 | 100–150                             | —                                      | —   |
|  | Average              | 0.4                     | 127                                 | —                                      | —   |
| <b>Wood and paper</b>                        |                      |                         |                                     |  |   |
| <b>Bark-hardwoods</b>                        | Range                | 0.10–0.41               | 116–436                             | —                                      | —   |
|  | Average              | 0.241                   | 223                                 | —                                      | —   |
| <b>Bark-softwoods</b>                        | Range                | 0.04–0.39               | 131–1,285                           | —                                      | —   |
|  | Average              | 0.14                    | 496                                 | —                                      | —   |
| <b>Corrugated cardboard</b>                  | Typical              | 0.10                    | 563                                 | 8                                      | 259   |
| <b>Lumbermill waste</b>                      | Typical              | 0.13                    | 170                                 | —                                      | —   |
| <b>Newsprint</b>                             | Typical              | 0.06–0.14               | 398–852                             | 3–8                                    | 195–242                                     |

*Mortality Composting Protocol for Avian Influenza Infected Flocks*

| Material                                    | Type of value | % N (dry weight) | C:N ratio (weight to weight) | Moisture content % (wet weight) | Bulk density (pounds per cubic yard) |
|---|---------------|------------------|------------------------------|---------------------------------|--------------------------------------|
| Paper fiber sludge                          | Typical       | —                | 250                          | 66                              | 1140                                 |
| Paper mill sludge                           | Typical       | 0.56             | 54                           | 81                              | —                                    |
| Paper pulp                                  | Typical       | 0.59             | 90                           | 82                              | 1403                                 |
| Sawdust                                     | Range         | 0.06–0.8         | 200–750                      | 19–65                           | 350–450                              |
|   | Average       | 0.24             | 442                          | 39                              | 410                                  |
| Telephone books                             | Typical       | 0.7              | 772                          | 6                               | 250                                  |
| Wood chips                                  | Typical       | —                | —                            | —                               | 445–620                              |
| Wood-hardwoods (chips, shavings, and so on) | Range         | 0.06–0.11        | 451–819                      | —                               | —                                    |
|   | Average       | 0.09             | 560                          | —                               | —                                    |
| Wood-softwoods (chips, shavings, and so on) | Range         | 0.04–0.23        | 212–1,313                    | —                               | —                                    |
|   | Average       | 0.09             | 641                          | —                               | —                                    |
| <b>Yard wastes and other vegetation</b>     |               |                  |                              |                                 |                                      |
| Grass clippings                             | Range         | 2.0–6.0          | 9–25                         | —                               | —                                    |
|   | Average       | 3.4              | 17                           | 82                              | —                                    |
| Loose                                       | Typical       | —                | —                            | —                               | 300–400                              |
| Compacted                                   | Typical       | —                | —                            | —                               | 500–800                              |
| Leaves                                      | Range         | 0.5–1.3          | 40–80                        | —                               | —                                    |
|   | Average       | 0.9              | 54                           | 38                              | —                                    |
| Loose and dry                               | Typical       | —                | —                            | —                               | 100–300                              |
| Compacted and moist                         | Typical       | —                | —                            | —                               | 400–500                              |
| Seaweed                                     | Range         | 1.2–3.0          | 5–27                         | —                               | —                                    |
|   | Average       | 1.9              | 17                           | 53                              | —                                    |
| Shrub trimmings                             | Typical       | 1.0              | 53                           | 15                              | 429                                  |
| Tree trimmings                              | Typical       | 3.1              | 16                           | 70                              | 1,296                                |
| Water hyacinth-fresh                        | Typical       | —                | 20–30                        | 93                              | 405                                  |

<sup>a</sup> Estimated from ash or volatile solids data.

<sup>b</sup> Mostly organic nitrogen.