EMERGENCY CARCASS MANAGEMENT
DESK REFERENCE GUIDE

FAD PReP
Foreign Animal Disease Preparedness & Response Plan

USDA

United States Department of Agriculture

United States Department of Agriculture • Animal and Plant Health Inspection Service • Veterinary Services

JUNE 2017

Contents

Applicability Statement I
Acknowledgements II
USDA Response Process III

SECTION 1: RESPONSE PROCESS

Operations Procedures 1-1

SECTION 2: DECISION TOOL

Information Needed for Carcass Management Decisions 2-1
Definitions 2-2
HPAI Carcass Management Decision Tool 2-4
Carcass Management Decision Cycle 2-7
Carcass Management Options Checklist 2-8

SECTION 3: IN-HOUSE COMPOSTING

Overview of In-House Composting Process 3-1
Carcass Management: In-house Composting Checklist 3-2
Job Aid: Overview of the HPAI Composting Process 3-3
Finding Carbon Source: What to Say When Calling Potential Vendors 3-5
Carbon Sources for Windrow Construction 3-7
Pre-Compost Windrows for Avian Influenza Infected Flocks 3-8
Windrow Construction Protocol for Avian Influenza Infected Flocks 3-9
Compost Windrow Construction Approval Checklistfor Avian Influenza Infected Flocks 3-11
Temperature Monitoring Protocol of Avian Influenza Infected Flocks 3-13
Calibration of Analog Thermometers 3-15
Phase 1 Windrow Evaluation Checklist Days 1–14 for Avian Influenza Infected Flocks 3-17
Phase 2 Windrow Evaluation Checklist Days 14–28 for Avian Influenza Infected Flocks 3-19
Planning for In-house Poultry Composting 3-21
Operations for In-house or Outdoor Poultry Composting 3-22
Procedures for In-House Composting of AI-Infected Poultry Carcasses 3-24

SECTION 4: OUTDOOR COMPOSTING

Carcass Management: Outdoor Composting Checklist 4-1
Planning for Outdoor Composting for Livestock Other than Poultry 4-3
Operations for Outdoor Composting for Livestock other than Poultry 4-4
Procedures for Outdoor Composting of AI-Infected Poultry Carcasses 4-7

SECTION 5: OPEN BURNING

Carcass Management: Open Air Burning Checklist 5-1
Procedure for Open Air Burning of AI Infected Poultry Carcasses 5-2
SOP: Open Air Burning 5-3

SECTION 6: BURIAL

Carcass Management: On-Site Burial Checklist 6-1
Burial Effect on Environment 6-2
Land Area or Excavation Volume Required for Trench Burial 6-3
SOP: Unlined Burial 6-5

SECTION 7: MOBILE TREATMENT

Carcass Management: Mobile Treatment Checklist 7-1
Overview of Mobile Treatment Technologies 7-2

SECTION 8: LANDFILLS

Carcass Management: Off-Site Permitted Landfill Checklist 8-1
Landfill Disposal Guidance—Recommended Waste Acceptance Practices for Landfills 8-2
CDC Interim Guidance for Landfill Workers in the United States Disposing of Poultry Carcasses During Outbreaks of Highly Pathogenic Avian Influenza 8-6
SOP: Landfilling 8-10

SECTION 9: RENDERING

Carcass Management: Rendering Checklist 9-1
SOP: Rendering 9-2
SOP: Transport 9-4
Example Rendering Plant Biosecurity Protocol 9-6

SECTION 10: INCINERATORS

Carcass Management: Off-Site Incineration Checklist 10-1
SOP: Fixed Incineration 10-2
SOP: Air-Curtain Incineration 10-4

SECTION 11: SECURE TRANSPORT

Loading Procedures 11-1
Permit Requirements 11-4
Overview of the Eight Steps in Interstate Permitted Movement 11-5
Transport Methods in Order of Risk and Containment Types and Risk 11-6

SECTION 12: BIOSECURITY

Safety, Health & Environmental Protection 12-1
Personal Protective Equipment 12-3
PPE Requirements 12-4
Go-Bag Checklist 12-5
Temporary Vehicle Wash Station Draft Standard Operating Procedure 12-7
Work Zones and Control Areas 12-9
Ready Reference Guide—Overview of Zones 12-12

SECTION 13: REFERENCES

HPAI—A Guide To Help You Understand the Response Process 13-1
FEMA Recovery Division Factsheet—Debris Removal Authorities of Federal Agencies 13-4
National Veterinary Stockpile: Ready for Animal Disease Emergencies 13-11
The National Veterinary Stockpile and the 24 Hour Push Pack 13-13
The National Veterinary Stockpile and 3D Response Support Services 13-15
Producer Information Sheet: USDA AI Response: Mass Depopulation and Carcass Disposal 13-17
Timeline, Eligibility, and Approval for Restocking 13-21

SECTION 14: APPENDICES

Mortality Composting Protocol for Avian Influenza Infected Flocks 14-I-2
Landfills and Highly Pathogenic Avian Influenza (HPAI) Response 14-II-1
National Renderers Association Directory 14-III-1
Permitted Movement 14-IV-1
University of Minnesota Risk Assessment 14-V-1

Applicability Statement

This guide is intended to be used by the Disposal Group Supervisor or designee on a USDA APHIS Incident Management Team during an animal health emergency response.

Contact the National Incident Coordination Group Disposal Technical Specialist for additional guidance (see current Incident Action Plan).

Acknowledgements

The compilation of the Disposal Guidebook was a collaborative effort. Many individuals contributed their time and talents to this project. We wish to thank the following people who made this manual possible:

PROJECT MANAGEMENT

Elizabeth Clark
Nicola L. Ritter, MEd, PhD
Jodi Korich, DVM
Danelle Weaver
Michelle Wiederhold, MEd

CONTENT AUTHOR

Lori P. Miller, PE
Senior Staff Officer/Environmental Engineer
USDA-APHIS
4700 River Road, Unit 41, Room 5D-03.2
Riverdale, MD 20737
301-851-3512

CREATIVE TEAM

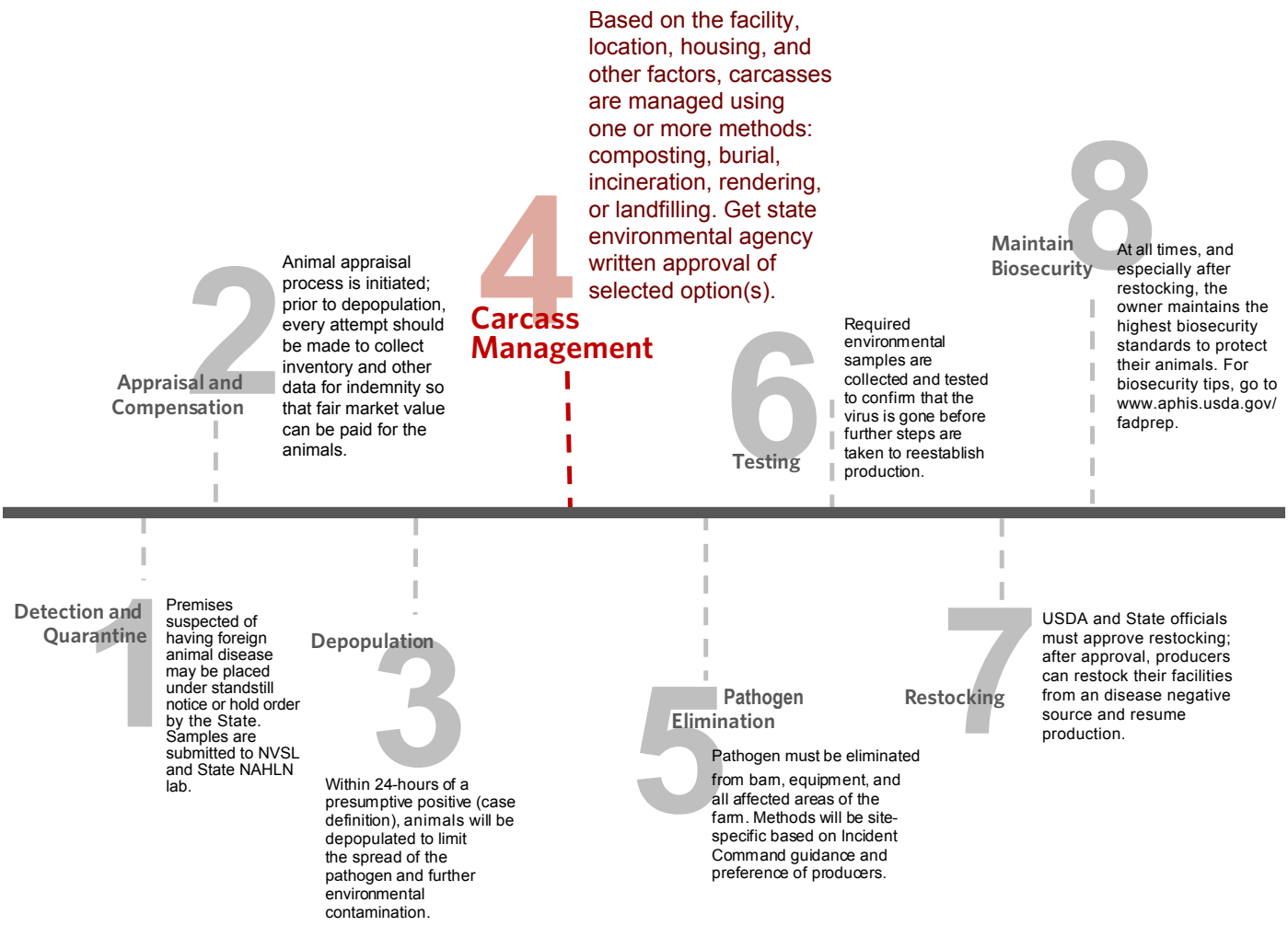
Suzanne Kabat
Vince Chihak
Tim Ponder
Dan Shuta

REVIEWERS

Joanna Davis, DVM
Tyler McAlpin, DVM, MS
Julie Gauthier, DVM, MPH

This guidebook was compiled by Texas A&M University, College of Veterinary Medicine & Biomedical Sciences through a cooperative agreement with the United States Department of Agriculture, under Agreement No. 15-9100-1492-CA.

Carcass Management



Note: NAHLN = National Animal Health Laboratory Network; NVSL = National Veterinary Services Laboratories.

Source: United States Department of Agriculture

Operations Procedures

Ensure state environmental agency has approved disposal method in writing (see list of state contacts available at go.usdatraining.com/agencies).

OPERATIONAL TIMELINE FOR DISPOSAL

Perform disposal as approved by the state environmental agency, ensuring all regulations are followed. → Promptly discuss significant impacts to the schedule with the Operations Chief. → Ensure the rate of depopulation does not exceed the rate of storage and disposal to avoid attracting vectors.

QUALITY ASSURANCE/QUALITY CONTROL

SITE/CASE MANAGER

Step 1: Monitor disposal operations at the frequency specified by the Disposal Group Supervisor. →

DISPOSAL GROUP SUPERVISOR

Step 2: Verify that all activities are in accordance with the Site Specific Disposal Plan and all applicable regulatory approval or permit conditions. ↓

Step 3: Take immediate action to rectify significant deviations from the approved plan or state/federal environmental regulations. ↓

Step 4: Gain approval to change the plan if the deviations are needed to accommodate field conditions from Operations Chief or state environmental officials. ←

Step 5: Follow finalized disposal procedures to expedite outbreak control and minimize environmental contamination.

DEMOBILIZATION

Remove miscellaneous debris, equipment, excess materials, disposal byproducts, and other waste in accordance with the Site Specific Disposal Plan. → Leave the facility in broom-clean condition in preparation for subsequent activities.

Developed by Texas A&M University *Source: USDA FADPReP Disposal SOP go.usdatraining.com/SOP_disposal*

Information Needed for Carcass Management Decisions

Name of Facility	
Address:	
USDA Case Manager Name and Cell:	
Disposal Team Leader Name and number	
Euthanasia Team Leader Name and number	
Best Airport to Fly Into:	
# Hours from airport to premises:	
Depopulation Date:	

Disposal Method (approved by state environmental agency. If no method identified, use MLCh tool and get state environmental agency approval):	
Attach sketch of premises with following information:	

If Composting, who will build piles (farmer or need us to contract)?	

Barn No.	Ceiling Height	Width	Length	Door Height and Width	Type of Barn	Type of Operation	No. Animals	Type/Age of Animal	Avg. Wt.	Depth of Litter
1										
2										
3										
4										
5										

Fresh Bedding Available on Premises:	Y/N: Type =				
Pile No.	Height	Length	Width		Comments:
1					
2					
3					
4					
5					

Acres available for composting:
Acres availalbe for burial:

Source: L.P.Miller, USDA (2015)

Definitions

Biomass	The total quantity or weight of livestock/poultry carcasses and associated biodegradable material requiring management.
Capacity	Equal to throughput times availability where throughput is the amount of biomass that can be processed per day per system and availability is the number of systems available.
Composting	A natural biological decomposition process that takes place in the presence of oxygen (air). Composting process control parameters include the initial ratios of carbon and nitrogen rich materials, the amount of bulking agent added to assure air porosity, the pile size, moisture content, and turning frequency.
Depopulation	(also known as culling, destruction, and/or euthanasia) is a method by which large numbers of diseased and/or suffering animals are killed quickly and efficiently with as much consideration given to the welfare of the animals as practicable. It may be practiced during an animal health emergency, such as a major disease outbreak to eliminate animal suffering or help prevent or mitigate the spread of the disease through the elimination of infected, exposed, or potentially exposed animals. It also serves to remove contaminated livestock from the food supply, protect the nation's agricultural and national economy, and safeguard public health. Animals should not be depopulated until a disposal plan is in place.
Grinding	An operation that reduces biomass particle size. Grinding implies that particles are broken apart largely by smashing and crushing rather than tearing or slicing.
Groundwater	Water below the land surface in a zone of saturation.
Leachate	Any liquid material that drains from land, waste, or stockpiled material and contains significantly elevated concentrations of contamination derived from the material that it has passed through.
Off-site (Fixed-facility) incinerators	Include (a) small on-farm incinerators, (b) small and large incineration facilities, (c) crematoria, and (d) power plant incinerators. Unlike open-air burning and air-curtain incineration, fixed-facility incineration is wholly contained and, usually, highly controlled.
On-site Burial	In the context of this document refers to excavating a trench or pit into the earth, placing carcasses in the trench, and covering with the excavated material (backfill).
Open-air burning	Includes burning carcasses (a) in open fields, (b) on combustible heaps called pyres, and (c) with other burning techniques that are unassisted by incineration equipment.
Pathogens	Any organism capable of producing disease or infection
Permitted Landfills	Modern Subtitle D landfills that are highly regulated operations, engineered and built with technically complex systems specifically designed to protect the environment and include liners and leachate controls. These landfills are distinguished from older landfills in the U.S. (sometimes called small arid landfills) which were constructed before Subtitle D regulations were effective, and therefore were not constructed with sophisticated containment systems.
Premises	Geographically and epidemiologically defined locations, including a ranch, farm, stable, or other establishment.

Pyres	Structures, usually made of wood, for burning carcasses.
Rendering	The process by which purified fat and protein products are recovered from inedible portions of animals by cooking at high temperatures.
Slaughter	The killing of an animal or animals for human consumption.
Stamping out	The depopulation of clinically affected and in-contact susceptible animals.
Waste	loosely defined as material that cannot be used for its intended purpose.
Vaccination to Live	The depopulation of clinically affected and in-contact susceptible animals and vaccination of at-risk animals, without subsequent depopulation of vaccinated animals.
Vaccination to Slaughter	The depopulation of clinically affected and in-contact susceptible animals and vaccination of at-risk animals, with subsequent depopulation of vaccinated animals.

HPAI Carcass Management Decision Tool

Matrix, Decision **L**oop, **Ch**ecklist (**MLCh**)

Developed by USDA APHIS in collaboration with the DHS S&T Depopulation, Disposal, and Decontamination (3D) Program and federal interagency 3D Integrated Product Team (IPT)

CONTACT:
Lori.p.miller@aphis.usda.gov
Lori P. Miller, PE
USDA APHIS
4700 River Road, Unit 41, Room 5D-03.2
Riverdale, MD 20737
301-851-3512

APHIS website for training modules and online interactive tool: go.usdatraining.com/Disposal

Weighting	Criteria	Off-Site Landfill	Rendering	Off-Site Incineration	Composting	Open Air Burning	On-Site Burial
Most Important (x3)	Pubic Health Risk[1]	9	9	9	9	6	3
	Biosecurity[2]	6	6	6	3	3	3
	Pathogen Inactivation[3]	3	6	9	6	9	3
	Environmentally Sustainable[4]	9	9	9	9	3	3
Important (x2)	Need to Transport Carcasses Offsite[5]	2	2	2	6	6	6
	Volume Reduction[6]	4	6	6	4	6	4
	Availability[7]	6	4	2	4	4	4
	Throughput[8]	6	6	2	4	4	4
	Speed to Implement[9]	6	4	4	4	4	4
	Public Acceptance[10]	6	4	6	4	2	4
Less Important (x1)	Cost Effectiveness[11]	3	2	1	1	1	3
	Efficiency[12]	3	3	3	2	1	2
	Operability[13]	3	3	3	2	1	3
	Regulatory limitations[14]	2	3	2	2	1	1
	Denial of use[15]	3	2	2	2	2	1
	Total Points	71	69	66	62	53	48
	Average Score	4.7	4.6	4.4	4.1	3.5	3.2

Color Key and Matrix Explanation

IDEAL	Green technologies were scored 3 points	NOT IDEAL	Yellow technologies were scored 2 points	NOT SUITABLE	Red technologies were scored 1 point

Scores were weighted according to the importance of the criteria. Scores for each column were totaled then averaged to obtain the ranking.

Developed by USDA APHIS in collaboration with the DHS S&T Depopulation, Disposal, and Decontamination (3D) Program and federal interagency 3D Integrated Product Team (IPT)

Matrix Footnotes

Mobile, new, or innovative technologies are not included in this matrix, but a separate table for such technologies is under development.

Values in matrix may be incident specific.

1. **Public health risk** – based on the UK 2001 human health qualitative risk assessment which excluded composting and mobile technologies. The rankings are consistent with the public health risks tabulated by the United Kingdom (UK) Department of Health (now the Department for Environment, Food and Rural Affairs), in "*A Rapid Qualitative Assessment of possible risks to Public Health from current Foot & Mouth Disposal Options, Main Report*," June 2001.

2. **Biosecurity** – if process can be contained and easily disinfected = 3, if process is somewhat contained, but the processing area is difficult to disinfect = 2, if process is not contained = 1

3. **Pathogen Inactivation** – If process completely inactivates pathogen = 3, partial inactivation = 2, no inactivation = 1

4. **Environmental sustainability** – low risk of environmental contamination and useful end product = 3, low risk of contamination or useful end product = 2, risk of environmental contamination and no useful end product = 1

5. **Transport carcasses offsite** – Yes = 1, No = 3

6. **Volume reduction** – process reduces volume of biomass = 3, same volume = 2, increases volume = 1

7. **Availability** – option is widely available = 3, regional or somewhat available = 2, very limited availability = 1

8. **Throughput** – the amount of biomass that can be processed per day. If >200K lbs/day = 3, between 200K lbs/day - 50K lbs/day = 2, <50K lbs/day = 1. *Note: Throughput X Availability = Capacity*

9. **Speed to implement** – how quickly can option begin taking first carcasses including obtaining regulatory approval where immediately = 3, <5 days = 2, more than 5 days = 1

10. **Public acceptance** – likelihood of public protests where low = 3, medium = 2, and high = 1

11. **Cost effectiveness** – cost to perform option from *K State Carcass Disposal: A Comprehensive Review* where <$100/ton = 3, $100/ton - $250/ton = 2, > $250/ton = 1

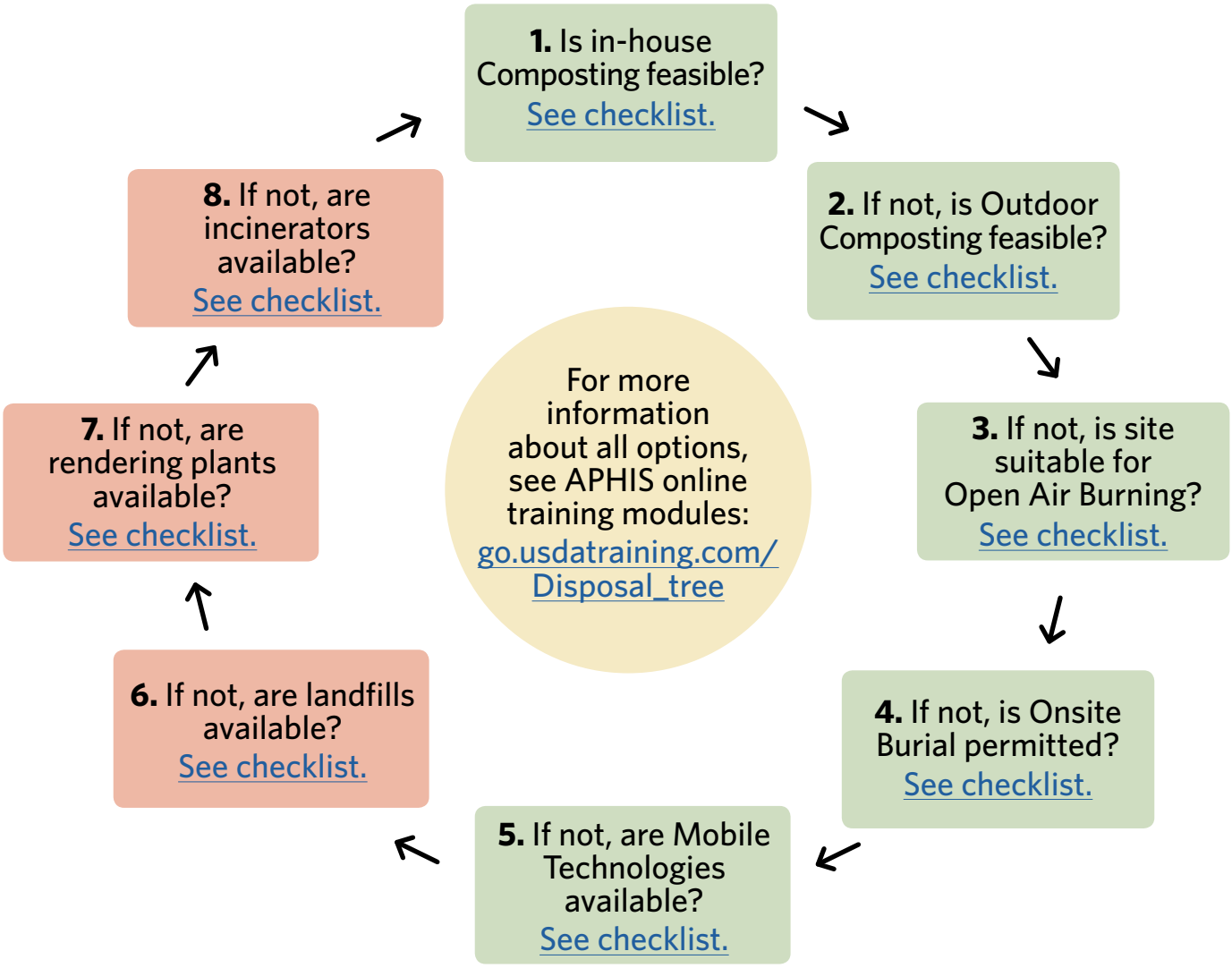
12. **Efficiency** – amount of inputs (utilities, chemicals, fuel, carbon source) to contain and stabilize biomass over a short period of time

13. **Operability** – ease of implementation, for example simple to do, operators readily trained and available

14. **Regulatory limitations** – permits or regulator exemptions would have to be obtained in order to utilize this disposal method

15. **Denial of use** – land or equipment is no longer able to be used for its intended purpose due to disposal method

Carcass Management Decision Cycle



NOTE: The order of options in the Carcass Management Decision Cycle differs from the Matrix because on-site options are preferable to disease management officials.

Carcass Management Options Checklists

First Option - Is in-house composting feasible?

Clear Checklist

- [ ] **Based on the opinion of an animal mortality composting subject matter expert (SME) from the APHIS roster, are the site conditions suitable for in-house composting of the number of animals affected?**
  - [ ] See USDA Mortality Composting Protocol for Avian Influenza Infected Flocks (also at go.usdatraining.com/HPAI)
  - [ ] Poultry houses have sufficient interior space to maneuver composting equipment and construct windrows (e.g., enough open space and ceiling height to allow loaders to construct windrows 6-8 feet high and 12 feet wide. Houses with columns, such as double-deck houses, restrict such formations.)
  - [ ] Poultry houses are located in an area that is accessible by trucks delivering carbon source and equipment removing compost
  - [ ] Poultry houses can be secured against vandals, scavengers, and disease vectors such as wild birds
- [ ] **If the poultry houses are suitable, consider the duration of time it takes to fully compost and determine if the following issues can be overcome:**
  - [ ] Personnel required to ensure proper construction, maintenance, and temperature monitoring of windrows.
  - [ ] Need for pest management.
  - [ ] Denial of use of poultry houses while composting (at least 30 days).
- [ ] **If so, is there a sufficient local supply of carbon source such as wood chips (1-2 pounds carbon source per pound of biomass)?**
  - [ ] Check with local agencies and organizations to determine if stockpiles of carbon source are available (e.g., parks department and landfills). Ensure that the carbon source is free of any pests or pathogens which could threaten local species. (See Carbon Sources for Windrow Construction)
- [ ] **If so, have you arranged for the necessary personnel, equipment and supplies to be delivered to the site?**
  - [ ] Mortality composting subject matter expert
  - [ ] Composting supplies and carbon source
  - [ ] Personal protective equipment
  - [ ] Cleaning and disinfecting (biosecurity) supplies
  - [ ] Hand tools
  - [ ] Heavy equipment (mid-size skid-steer loaders, tractors with bucket loaders)
  - [ ] Qualified equipment operators
- [ ] **If in-house composting is an option, see In-House Composting training module at go.usdatraining.com/Disposal and implement composting. If not, continue to Second Option.**

Second Option – Is outdoor composting feasible?

☐ **Identify a suitable site on premises or in a centralized location in accordance with the checklist items below.**

- ☐ If off-site consider the need for secure transport

☐ **Based on approval of the state environmental agency and the composting SME from the APHIS roster, are the site conditions suitable for composting the number of animals affected?**

- ☐ See USDA Mortality Composting Protocol for Avian Influenza Infected Flocks (also at go.usdatraining.com/HPAI)
- ☐ Adequate land area to build compost piles (assume (237) 1000-pound cows per acre, (1,185) 200-pound swine or sheep per acre, or (47,500) 5-pound poultry per acre).
- ☐ Required distance from water wells, surface water bodies (lakes, streams, rivers, etc.), sinkholes, seasonal seeps or other landscape features that indicate the area is hydrologically sensitive, based on guidance from state environmental officials.
- ☐ Consider all groundwater pathways including the presence of drain tiles, soil characteristics, depth to groundwater, use of groundwater etc.
- ☐ Located away from neighbors and/or out of sight.
- ☐ Located downwind from neighbors and/or houses.
- ☐ Located away from environmentally-sensitive areas.
- ☐ Located close to the livestock or poultry facility or have clear access for transport.
- ☐ Clear of overhead utility lines.
- ☐ Void of excess water.
- ☐ Located on a gentle slope (1%-3%) so there will be no water ponding.
- ☐ Consider the need for an impermeable base and/or protective cover to prevent leachate generation and migration.

☐ **If the site is suitable, consider the duration of time it takes to fully compost and determine if the following issues can be overcome:**

- ☐ Personnel required to ensure proper construction, maintenance, and temperature monitoring of windrows.
- ☐ Need for pest management.
- ☐ Potential for extreme weather (e.g., hurricane) to disturb pile.
- ☐ Denial of use of land area while composting (minimum 30 days).

☐ **If so, is there a sufficient local supply of carbon source such as wood chips (1-2 pounds carbon source per pound of biomass)?**

- ☐ Check with local agencies and organizations to determine if stockpiles of carbon source are available (e.g., parks department and landfills). Ensure that the carbon source is free of any pests or pathogens which could threaten local species. See Carbon Sources for Windrow Construction.

- [ ] **If so, have you arranged for the necessary equipment and supplies to be delivered to the site?**
  - [ ] Personnel
  - [ ] Composting supplies and carbon source
  - [ ] Personal protective equipment
  - [ ] Cleaning and disinfecting (biosecurity) supplies
  - [ ] Hand tools
  - [ ] Heavy equipment (mid-size skid-steer loaders, tractors with bucket loaders, trucks, containers and covers if transporting, leak-resistant material for lining carcass transport containers)

- [ ] **If composting is an option see Outdoor Composting training module at** go.usdatraining.com/Disposal **and implement composting. If not, continue to Third Option.**

Third Option - Is site suitable for open air burning?

- [ ] **Will local and state agencies allow open burning at the site?**
  - [ ] Local Fire Department
  - [ ] State Department of Agriculture, Animal Health
  - [ ] State Department of Environment or Natural Resources
  - [ ] USDA-APHIS
  - [ ] USEPA

- [ ] **Will open burning release air pollutants in excess of public health standards?**

- [ ] **If so, can the permit conditions, such as measures to control the spread of fire, distance to occupied buildings etc. be met?**
  - [ ] What environmental testing (e.g., water, ash, soils) are required and at what frequency?
  - [ ] How and where would the ash be disposed of?
  - [ ] Are weather conditions (e.g., wind and drought) suitable for open are burning?

- [ ] **If so, will burning be publically unacceptable?**

- [ ] **If so, have you arranged for the necessary personnel, equipment and supplies to be delivered to the site?**
  - [ ] Adequate source of combustible material and fuel to keep the fire going. Verify that type of fuel is acceptable to regulatory agencies.
  - [ ] Other equipment including mechanical chains and lifting equipment.
  - [ ] Personnel properly trained in the use of this equipment.
  - [ ] Fire safety equipment also should be readily available.

- [ ] **If open air burning is an option, see On-Site Treatment/Burial training module at** go.usdatraining.com/aphis_tools **and implement on-site open air burning. If not, continue to Fourth Option.**

Fourth Option - Is site suitable for on-site burial?

- [ ] **Will state environmental agency permit burial at the site?**
  - [ ] Consider soil suitability (see USDA NRCS online Web Soil Survey at go.usdatraining.com/WSS based on guidance from state environmental officials?)
  - [ ] Consider potential for leachate to contaminate groundwater
  - [ ] Consider all groundwater pathways including the presence of drain tiles, soil characteristics, depth to groundwater, use of groundwater etc.
  - [ ] Consider potential for the burial site to create a stability or explosion hazard in nearby structures from production of methane.
- [ ] **If so, is adequate land available for on-site burial? (assume 1.42 acres per 1000 half-ton cows , 0.28 acres per 1000 swine or sheep, and 0.01 acres per 1000 poultry)**
- [ ] **If so, will land owner accept on-site burial, associated environmental liabilities, and potential loss of property value or use?**
- [ ] **If on-site burial is an option, see the On-Site Treatment/Burial training module at** go.usdatraining.com/Disposal **and implement on-site burial. If not, continue to Fifth Option.**

Fifth Option - Are mobile treatment technologies available for your area?

- [ ] **Contact all appropriate mobile treatment technology vendors.**
  - [ ] Verify the units are available for deployment to your site.
  - [ ] Verify your ability to meet all site/utility requirements.
  - [ ] Verify units can be fully disinfected after use.
  - [ ] Verify the units have adequate capacity to meet your needs.
  - [ ] If the capacity is less than needed, can the carcasses be stored/refrigerated while awaiting disposal?
  - [ ] Verify the availability of skilled operators and spare parts to keep the units operational.
  - [ ] Verify the unit can be set-up on the site (e.g., the site has appropriate grading)
- [ ] **If so, is the technology permitted by the state environmental agency?**
- [ ] **If so, can the permit conditions be met?**
- [ ] **If so, can the process byproducts be readily disposed?**
- [ ] **If mobile treatment is an option, see On-Site Treatment/Burial training module at** go.usdatraining.com/Disposal **and implement. If not, continue to Sixth Option.**

Sixth Option - Can off-site permitted landfill be used?

- [ ] **Consult with state environmental agency for landfill advice.**

- [ ] **Access a comprehensive list of landfills using the I-WASTE Tool at** go.usdatraining.com/I-WASTE**.**
  - [ ] Log on to the I-WASTE Tool and obtain a password if you do not currently have one.
  - [ ] Enter userid and password.
  - [ ] Choose treatment and disposal facilities button on the lower left.
  - [ ] Enter filter criteria such as "facility type (e.g., rendering, incinerators, or landfill)"
  - [ ] Note that construction debris landfills are not suitable for carcass disposal, and hazardous waste landfills are not necessary unless the carcasses are contaminated with a hazardous material causing them to be classified as hazardous
  - [ ] Enter State or EPA region, and click "View List of Facilities" button.

- [ ] **Contact facilities and determine if they will accept your livestock or poultry and meet some or all of your capacity needs.**
  - [ ] If there is insufficient capacity, consider fast-tracking expansion of existing landfill or permitting of new landfill for this purpose.
  - [ ] Consider potential environmental and biosecurity concerns.
  - [ ] Verify landfill has no outstanding permit violations
  - [ ] Procure landfill services through appropriate Incident Management Team branch.

- [ ] **If the landfill will accept the material, arrange for biosecure transport.**
  - [ ] Obtain controlled movement permit for transport of infected carcasses
  - [ ] Determine type of transport vehicles required. If the waste must travel on public roads, it should be transported in closed, leak-resistant trucks or dumpsters. Secondary containment may be needed, depending on the type of waste being transported. See Landfill Disposal Guidance
  - [ ] Work with Depopulation Group Supervisor within the Incident Command System to determine how many animals can be depopulated per day and how many trucks will be needed for transport per day, ensuring the rates are about the same. If not, arrange for covered, leak-resistant storage.
  - [ ] Pre-identify transport routes to minimize exposure to susceptible premises.

- [ ] **If permitted landfilling is an option, see the Secure Transport and Off-Site Treatment/Burial training modules at** go.usdatraining.com/Disposal **and implement off-site permitted landfilling. If not, continue to Seventh Option.**

Seventh Option - Is rendering available?

- [ ] **Will state environmental agency approve rendering?**

- [ ] **If so, see a complete list of renderers at** go.usdatraining.com/NRA **or the EPA database at** go.usdatraining.com/I-WASTE**.**
  - [ ] Log on to the I-WASTE Tool and obtain a password if you do not currently have one.
  - [ ] Enter userid and password.
  - [ ] Choose treatment and disposal facilities button on the lower left.
  - [ ] Enter filter criteria such as "facility type (e.g., rendering, incinerators, or landfill)"
  - [ ] Enter State or EPA region, and click "View List of Facilities" button or map facilities.

- [ ] **Contact facilities and determine if they will accept your livestock or poultry and meet some or all of your capacity needs.**
  - [ ] If the capacity is less than needed, can the carcasses be stored/refrigerated while awaiting disposal?

- [ ] **If so, arrange for storage and transport to rendering facility for disposal.**
  - [ ] Determine if any permits are required for transport of infected carcasses.
  - [ ] Determine type of transport vehicles required. If the waste must travel on public roads, it should be transported in closed, leak-proof trucks or dumpsters. Secondary containment may be needed, depending on the type of waste being transported. Contact National Veterinary Stockpile.
  - [ ] Work with Depopulation Group Supervisor within the Incident Command System to determine how many animals can be depopulated per day and how many trucks will be needed for transport per day, ensuring the rates are about equal. If not, arrange for leak-resistant, covered storage.
  - [ ] Pre-identify transport routes to minimize exposure of susceptible premises.

- [ ] **If rendering is an option, see Secure Transport and Off-Site Treatment/Burial training modules at** go.usdatraining.com/Disposal **and implement rendering. If not, continue to Eighth Option.**

Eighth Option - Can off-site incinerator be used?

- [ ] **Will state environmental agency approve incineration?**

- [ ] **If so, see a complete list of incinerators at the EPA database at** go.usdatraining.com/I-WASTE**.**
  - [ ] Log on to the I-WASTE Tool and obtain a password if you do not currently have one.
  - [ ] Enter userid and password.
  - [ ] Choose treatment and disposal facilities button on the lower left.
  - [ ] Enter filter criteria such as "facility type (e.g. rendering, incinerators, or landfill)"
  - [ ] Enter State or EPA region, and click "View List of Facilities" button or map facilities.

- [ ] **Contact air authorities to verify operations are not in violation of their air permits.**

- [ ] **If the facilities are compliant, contact them and determine if they will accept your livestock or poultry and meet some or all of your capacity needs.**

- [ ] **If so, arrange for transport to off-site incineration facility for disposal.**
  - [ ] Determine if any permits are required for transport of infected carcasses.
  - [ ] Determine type of transport vehicles required. If the waste must travel on public roads, it should be transported in closed, leak-proof trucks or dumpsters. Secondary containment may be needed, depending on the type of waste being transported. See University of Minnesota Risk Assessment
  - [ ] Work with Depopulation Group Supervisor within the Incident Command System to determine how many animals can be depopulated per day and how many trucks will be needed for transport per day, ensuring the rates are about equal. If not, arrange for leak-resistant, covered storage.
  - [ ] Pre-identify transport routes to minimize exposure of susceptible premises.

- [ ] **If off-site incineration is an option see the Secure Transport and Off-Site Treatment/Burial training modules at** go.usdatraining.com/Disposal **and implement off-site incineration. If not, and you still need to dispose of animals, inform Operations Chief and discuss alternate strategies such as vaccination. Return to First Option and repeat cycle until all carcasses can be managed.**

Overview of In-House Composting Process

STEP 1: Deploy compost SME from APHIS roster (contact Disposal Cell)

↓

STEP 2: Conduct the Farm Assessment

↓

STEP 3: Arrange for Necessary Equipment, materials and supplies
- Finding Carbon Source: What to Say When Calling Potential Vendors
- Job Aid: Carbon Sources for Windrow Construction
- At least 2 skid steers with operators

↓

STEP 4: Construct Compost Windrows
- Job Aid: Pre-Compost Windrows for AI-Infected Flocks
- Job Aid: Windrow Construction Protocol for AI-Infected Flocks
- Compost Windrow Construction Approval Checklist for AI-Infected Flocks

↓

STEP 5: Monitor Temperature
- Job Aid: Temperature Monitoring Protocol of AI-Infected Flocks
- Job Aid: Calibration of Analog Thermometers

↓

STEP 6: Turn the Windrows
- Phase 1 Windrow Evaluation Checklist Days 1-14 for AI-Infected Flocks
- Phase 2 Windrow Evaluation Checklist Days 14-28 for AI-Infected Flocks

Review the following for a detailed explanation for each step in the Composting Process:

- Job Aid: Overview of the Composting Process
- Appendix I: Mortality Composting Protocol for AI Infected Flocks

SAFETY NOTICE

Composting materials within enclosed structures may contain harmful levels of air contaminants. Before entering the structure wear appropriate personal protective equipment and maximize natural ventilation by opening the doors and curtains to all the houses containing compost piles. Allow enough time for the houses to air out before entering them. Close the doors and curtains after completing the temperature readings.

Use the buddy system. Entering a barn with active compost or dead birds requires a two-person team. One person, with a cell phone, stays outside the house to monitor the person inside. Before anyone enters the barn, the monitor writes down the location so it can be given quickly to a 911 dispatcher is case of an emergency.

If the person inside is overcome, the monitor immediately calls 911 for assistance. Under no circumstances does the monitor enter the barn without Self Contained Breathing Apparatus (SCBA). Do anything possible to increase ventilation inside the building while waiting for rescue personnel.

Developed by Texas A&M University Sources: Job Aid: Overview of the Compositing Process , Appendix I: Mortality Composting Protocol for AI Infected Flocks , and HPAI Outbreak 2014-2015 Safety, Health & Environmental Protection

Carcass Management: In-house Composting Checklist

- [ ] **Based on the opinion of an animal mortality composting subject matter expert (SME) from the APHIS roster, are the site conditions suitable for in-house composting of the number of animals affected?**
  - [ ] See USDA Mortality Composting Protocol for Avian Influenza Infected Flocks (also at go.usdatraining.com/HPAI)
  - [ ] Poultry houses have sufficient interior space to maneuver composting equipment and construct windrows (e.g., enough open space and ceiling height to allow loaders to construct windrows 6-8 feet high and 12 feet wide. Houses with columns, such as double-deck houses, restrict such formations.)
  - [ ] Poultry houses are located in an area that is accessible by trucks delivering carbon source and equipment removing compost
  - [ ] Poultry houses can be secured against vandals, scavengers, and disease vectors such as wild birds
- [ ] **If the poultry houses are suitable, consider the duration of time it takes to fully compost and determine if the following issues can be overcome:**
  - [ ] Personnel required to ensure proper construction, maintenance, and temperature monitoring of windrows.
  - [ ] Need for pest management.
  - [ ] Denial of use of poultry houses while composting (at least 30 days).
- [ ] **If so, is there a sufficient local supply of carbon source such as wood chips (1-2 pounds carbon source per pound of biomass)?**
  - [ ] Check with local agencies and organizations to determine if stockpiles of carbon source are available (e.g., parks department and landfills). Ensure that the carbon source is free of any pests or pathogens which could threaten local species. (See Carbon Sources for Windrow Construction)
- [ ] **If so, have you arranged for the necessary personnel, equipment and supplies to be delivered to the site?**
  - [ ] Mortality composting subject matter expert
  - [ ] Composting supplies and carbon source
  - [ ] Personal protective equipment
  - [ ] Cleaning and disinfecting (biosecurity) supplies
  - [ ] Hand tools
  - [ ] Heavy equipment (mid-size skid-steer loaders, tractors with bucket loaders)
  - [ ] Qualified equipment operators
- [ ] **If in-house composting is an option, see In-House Composting training module at go.usdatraining.com/Disposal and implement composting. If not, continue to Second Option.**

Developed by USDA, DHS, and the 3D IPT

Job Aid: Overview of the HPAI Composting Process

May 12, 2016

Note: The purpose of this document is to provide a summary of the USDA APHIS *Mortality Composting Protocol for Avian Influenza Infected Flock s* and is not a substitute for that document. All appendices referenced below can be found in that Protocol located at www.aphis.usda.gov/fadprep.

Conducting the Farm Assessment

In order to plan for windrow construction at the affected premises, a Farm Assessment is required. The Farm Assessment may be provided by the Site Manager or may be developed by a composting Subject Matter Expert (SME) recognized by APHIS. The following components found within the assessment must be completed.

- Evaluate the 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 (*see Appendix A)*.
- Evaluate the type and quantity of infected materials to be composted, including
  - carcass: type, size, number, and condition;
  - in-barn manure/litter: volume, moisture content, and density;
  - stored manure/litter: volume, moisture content, and density;
  - routine mortality method, location, and physical condition of mortalities;
  - feed: quantity and location;
  - eggs: quantity and condition;
  - clean bedding; and
  - paper products.
- Calculate the amount of carbon needed for composting (*see Appendix B).*
- Evaluate premises for supplemental water and include the source and application method.
- Evaluate on farm equipment availability and determine any supplemental equipment needs.
- Ensure all overhead lines and poultry house equipment are removed or out of the way. Be sure all loose cords cables or hoses are secured so that they will not become entangled by equipment.
- Ensure ventilation is balanced to reduce the risk of disease transmission while maintaining air quality for worker safety.

Arranging for Necessary Equipment

Following a Farm Assessment, the SME coordinates with the Site Manager and requests additional resources from the Incident Management Team (IMT) Logistics Branch. The resource list includes, but is not limited to:

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

Constructing Compost Windrows

When constructing compost windrows, the SME should ensure that the following key elements are incorporated into the construction of the compost windrows:

- windows formed outside of poultry houses are sited in consultation with State and local officials to minimize environmental impacts;
- windrows (finished dimensions not to exceed 6 to 8 feet high and 12 to 15 feet wide) are constructed on adequate and uniform base layer (10 to 15 inches thick) of sufficiently porous carbon material;

- base layer and windrow are not compacted with equipment;
- feed from the feed bins and pans is distributed evenly into the compost mix;
- good carcass to carbon contact is achieved by creating a core with a minimum of 1:1 mix volume of carcasses and other infected materials (manure, egg shells, feed, etc.) and carbon;
- windrows are constructed to ensure adequate distribution of moisture throughout; and
- windrows are capped with carbon material (minimum 8 to 12 inches thick) to ensure that no carcasses are exposed.

Temperature Monitoring

Once windrow construction has been approved by the SME, daily temperature monitoring for 14 days can begin following the standard operating procedure (SOP) for temperature monitoring (*see Appendix D*). Temperature data should be recorded on the temperature log (*see 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,* and any other safety procedures required by the Incident Command (IC) or employer.

Turning the Windrows

After the evaluation and approval of the temperature data collected during the initial 14-day compost cycle, the windrow is eligible for turning. The SME or appointed designee will signal approval using the *Phase 1 Windrow Approval Checklist* (*see Appendix G*). Unless obvious problems are noted (leachate, exposed birds, poorly mixed piles, or excessive vector activity), windrows should not be disturbed before the end of the 14-day period. Physical mixing or rebuilding of the windrows will require restarting the 14-day period. Adding or replacing the cap materials or placement of clean carbon sources around the windrow base will not require restarting of the 14-day period. Turning must provide homogenization of the core, base and cap materials, and windrows must maintain adequate porosity and structure after turning. Following a second successful 14-day compost period, the SME or appointed designee will signal approval for releasing the windrow from quarantine by using the *Phase 2 Windrow Approval Checklist* included in *Appendix G*. If soft tissue is observed on the windrow surface, a 2 to 4 inch carbonaceous cap needs to be applied. See *Appendix H* for turning equipment and methods.

Troubleshooting Problems

In the event that windrows fail to perform in the required manner, the following table offers some of the most common composting problems and possible solutions that may be implemented. The advice and council of an SME should be sought in identifying and prescribing remedies for underperforming compost processes.

Problem	Issue	Solution
Excessive flies or odor	Exposed carcasses	Add additional cap material
Leachate from windrow	Mixture too wet	Add additional carbon material, mix and cap
Temperature does not reach 131ºF	Mixture too dry (< 40%) moisture)	Add water to pile, mix if necessary
Temperature does not reach 131ºF	Mixture too wet (> 60%) moisture)	Add additional carbon material, mix if necessary
Temperature drops early	Not enough oxygen	Aerate or mix pile

Finding Carbon Source: What to Say When Calling Potential Vendors

December 2016

Note: The purpose of this document is to serve as a guide or script to follow when calling companies who may be able to provide carbon material for emergency mortality composting.

PLANNING THE CALL

The caller needs to be familiar with the Carbon Source Job Aid.

Use as reference during discussion:

- Carbon Source Job Aid
- Procuring DUNS and SAM numbers for federal contracting, or state contracting information.

Please check this website for any quarantines on the carbon material to ensure the shipment doesn't violate Plant Protection and Quarantine restrictions go.usdatraining.com/PPQ

IDENTIFY YOURSELF AND ASK FOR THE OWNER/MANAGER

Hello, I'm (name) with the (organization). We are preparing for potential animal disease outbreaks in our state and composting is one of our options for carcass disposal. (Stress this point)—There is no disease currently going on, this is only for planning purposes. To adequately compost, we will need wood chips, shavings, and similar carbon materials, and your company has been suggested as a potential supplier. We wanted to find out if you have this ***material*** and if you might be interested in providing it in an emergency? (If they are interested, what kind of materials can they provide?) _____

_____

The ***material*** must meet certain specifications to be effective. Reference APHIS Carbon Source Job Aid, e-mail if possible. (If owner/manager can meet the specification, continue; otherwise thank them for their time and ask if they know any other potential suppliers, then end call.)

Depending on the size of an infected farm, we might need to order the material by the truckloads for delivery within 48 to 72 hours so the carcasses can be quickly composted. This is only for livestock and poultry. Transportation could be contracted if you do not have the vehicles to move large quantities of materials.

(If the owner/manager can meet the need, continue; if not, thank them for their time and ask if they know any other potential suppliers, then end call.)

We will not be able to guarantee that you will be contacted, and we are currently collecting this information for planning purposes only. Any order would be placed by contracting officials at the time of the emergency if funds are available. If you're interested in helping, we could put you in

Developed by J. Davis, USDA, 2016

contact with someone that could give you more details on contracting with the state or federal government. You would be paid fair market price for the materials and this would be negotiated at the time of the emergency.

We hope that we would never have to face the situation in (their State), but if you're interested, may we add you to our list of potential suppliers? ☐ No ☐ Yes If yes, continue. If no, thank them and ask if they have any other recommendations, and end call. _____

_____

Thank you for your help. We would like to verify we have your accurate contact information and would like to ask a few questions, if that's OK with you?

Plant name:

_____

Physical address: _____ Mailing address: _____

_____ _____

_____ _____

GPS coordinates, if known (for mapping over agricultural areas): _____

_____

Contact names (at least two people)

Name: Name:

_____ _____

Phone numbers Phone numbers:

Cell: Work: Cell: Work:

After hours: _____ After hours: _____

_____

What products could they supply? _____

_____

_____

Do they have trucks capable of delivering the product? ☐ No ☐ Yes—How many trucks could they make available in an emergency?_____

_____

How far away could they travel to deliver product? _____

Would they be willing to allow someone to inspect the product for suitability in advance?
☐ No ☐ Yes

_____

Provide (your contact information) for further questions or (their State or federal contact information).

Thank you for your help. (End the call.)

Developed by J. Davis, USDA, 2016

Mortality Composting: Carbon Sources for Windrow Construction

May 9, 2016

Please note: These procedures may be revised as the situation develops; *this is a list of generally acceptable carbon sources for windrow composting of HPAI related mortalities. The carbon source resource needs for the premises, i.e. quantity and type, should be determined by a compost Subject Matter Expert and will depend on site-specific (typically poultry house-specific) conditions and circumstances.*

Suitable carbon sources:

- Wood chips about 2” or less in size
- Wood shavings
- Yard/brush trimmings 2” or less in size
- Partially composted leaf and yard waste (still hot)
- Sawdust (not used alone)
- Chopped hay/straw
- Chopped corn stover
- Oat/Sunflower hulls
- Dry mammalian manure
- Ground pallets (2” or less) if fasteners have been removed
- Class A Biosolids, in accordance with local and state requirements for land application
- Other material listed in APHIS Composting Protocol or as recommended by APHIS-recognized Subject Matter Expert and approved for use on agricultural land by the state

Materials not suitable within a carbon source:

- Rocks
- Glass
- Plastic
- Large logs/branches
- Grass clippings >5%
- Ground construction and demolition debris (CDD)
- Regulated pests (Emerald ash borer, etc.)
- Rubber
- Metal/baling wire
- Chemicals
- Concrete
- Painted/pressure treated wood
- Soil/sand
- Carbon source with free liquid or excessive leachate

Mulch from yard trimmings/waste

Wood chips

Chopped corn stover

Oat hulls

Mixed wood with logs/large lumber pieces

Wood chips with rocks/gravel

Construction demolition debris

Mortality Composting: Pre-Compost Windrows for Avian Influenza Infected Flocks

May 11, 2016

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

Pre-Compost Windrows (Prep Piles)

Applicability: This method can be used after poultry have been euthanized to stabilize the carcasses while awaiting arrival of a composting subject matter expert to guide construction of the final windrows.

Description: This method, which increases the amount of carbon material mixed within the windrow core, involves forming two pre-compost windrows, capping them, and then forming one final windrow at a later time. 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.

Building Pre-Compost Windrows

- Move litter and carcasses from along sidewalls and the center of the house, forming two pre-compost windrows extending the length of the house (see top right photo).
- Cap each window with 8–12 inches of suitable carbon material.

Pre-compost windrows (photo by Josh Payne)

Building Final Windrow from Two Pre-Compost Windrows

- In the center of the house, construct a 12–15 foot wide base that is 10–15 inches deep.
- Combine both capped pre-compost windrows onto the base, mixing litter, carcasses, and added carbon material.
- Cap the final windrow with 8–12 inches of suitable carbon material (see bottom right photo).

Final windrow (photo by Josh Payne)

Mortality Composting: Windrow Construction Protocol for Avian Influenza Infected Flocks

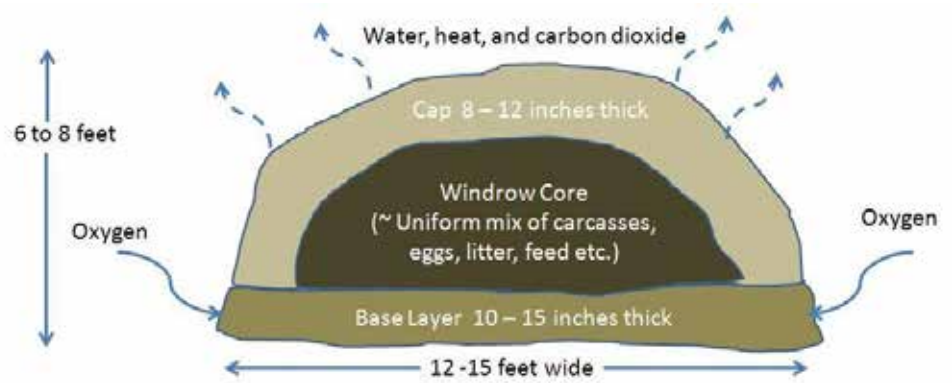
May 9, 2016

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

Typical Windrow Construction Protocol

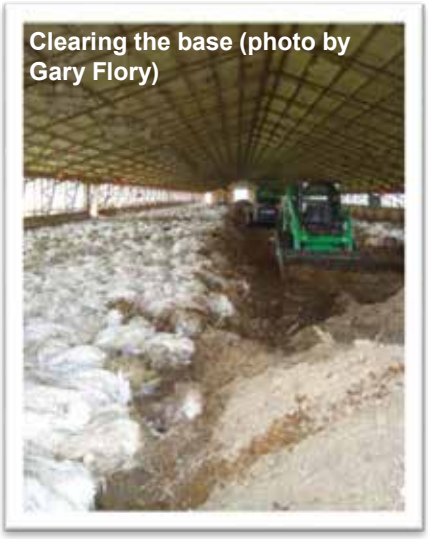
Three critical elements of windrow construction are: 1) a porous base layer, 2) a uniformly mixed windrow core, and 3) an adequate cap (see Figure 1). These steps may be done concurrently or as separate steps.

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.)


Clearing the base (photo by Gary Flory)

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. Base will compress over time.

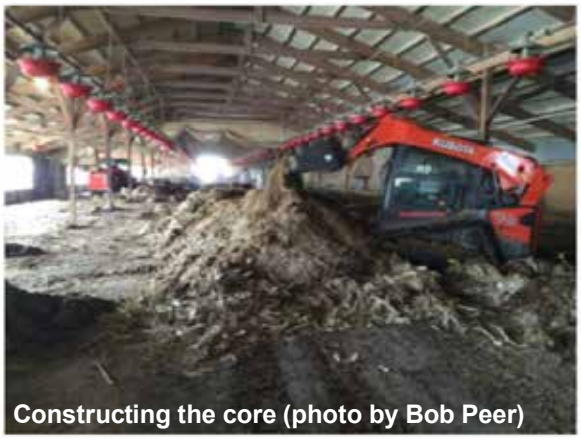
Carbon material for the base should be porous and bulky enough to allow adequate air flow into and through the windrow. Ideal materials for the base include bark mulch or coarse wood chips. Other acceptable materials include: straw, wood shavings, active compost, small grain hulls, and corn stover. Also, 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.

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.

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

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 poultry litter, 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.

Mortality Composting: Compost Windrow Construction Approval Checklist for Avian Influenza Infected Flocks

May 11, 2016

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

INITIAL COMPOST WINDROW CONSTRUCTION APPROVAL CHECKLIST

Premises County and #:			**Farm Name:**		
Farm Address:					
Farm Contact:			**Contact Phone:**		
Windrow #(s):		**Date Windrows Started:**		**Date Windrows Completed:**	
Who Constructed Windrow(s)?			**Contact Phone:**		

		Yes	*No*	*N/A*	*Comments/Description*
	WINDROW DESIGN				
1	Height between 6 and 8 feet tall.				
2	Width between 12 and 15 feet wide				
3	Base between 10 and 15 inches thick				
4	Dome shaped without significant irregularities				
5	No soft tissue visible on the surface of the windrow				
6	A minimum of 8 inches of carbon cover material				
7	Photos taken				
8	Sketch of flag locations with dimensions attached				

RECOMMENDATIONS:

☐ I have observed 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 observed 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:

_____

_____

_____

Signature of Composting SME: _____ Date: _____

Print name of Composting SME: _____

Developed by USDA APHIS Composting Technical Team

The corrective actions recommended above were completed on (date): _____

Signature of Composting SME: _____ Date: _____

Print name of Composting SME: _____

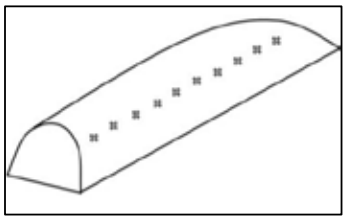
Mortality Composting: Temperature Monitoring Protocol of Avian Influenza Infected Flocks

May 9, 2016

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

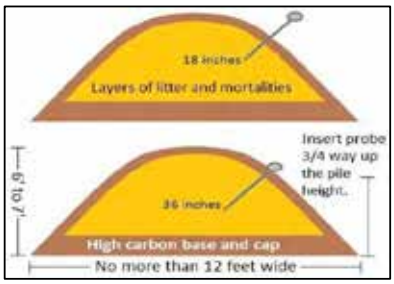
Temperature Monitoring Procedure

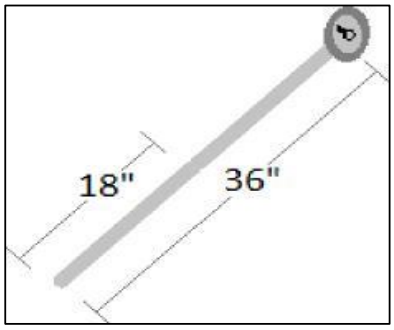
Monitor temperatures of the windrow daily at a minimum of 10 locations flagged by the Subject Matter Expert (SME). The temperature monitoring locations should be spaced equidistantly the length of each windrow. Take two temperature readings at each flagged location within a foot of the flag; one reading 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 inches. Place the temperature probe ¾ 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 first use and weekly thereafter (see Calibration of Analog Thermometers Job Aid). Calibration dates can be recorded on the Composting Temperature Log attached.



Example temperature monitoring locations

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 at 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 temperatures for each pile by averaging the 18-inch readings for all flags for that day then averaging the 36-inch readings for all flags for that day and noting the two averages on the Composting Temperature Log
- Windrows should reach an average temperature of 131°F for a minimum of 72 consecutive hours at both the 18 inch and 36 inch depths or be assessed by a SME for possible corrective measures.
- Disinfect the thermometer and return it to its protective case.
- Each thermometer will be kept at the respective premises being monitored. Do not take a thermometer from one premise to another.
- If by the third day after initial windrow construction, compost temperature **averages** remain below 100°F or greater than 160°F, a SME should be consulted immediately.
- During Phase 2, a SME should be consulted immediately if **any** monitoring location is consistently (more than 3 consecutive days) below 100°F or greater than 160°F.

Developed by USDA APHIS Composting Technical Team

TEMPERATURE MONITORING LOG SHEET

COMPOSTING TEMPERATURE LOG				
County:	Site Number:			
Street address, city, state:				
Farm Name:				
House/Windrow Number:		Date Started:	Date Finished:	Date Turned:

Use the cells below to record the temperatures each day, for 14 consecutive days, at 18 and 36 inches.

Date	Depth	Flag #1	Flag #2	Flag #3	Flag #4	Flag #5	Flag #6	Flag #7	Flag #8	Flag #9	Flag#10	Avg
	18”											
	36”											
	18”											
	36”											
	18”											
	36”											
	18”											
	36”											
	18”											
	36”											
	18”											
	36”											
	18”											
	36”											
	18”											
	36”											
	18”											
	36”											
	18”											
	36”											
	18”											
	36”											
	18”											
	36”											

Calibration Week 1 (Name): _____ Date: _____
Calibration Week 2 (Name): _____ Date: _____
Calibration Week 3 (Name): _____ Date: _____

Developed by USDA APHIS Composting Technical Team

Calibration of Analog Thermometers

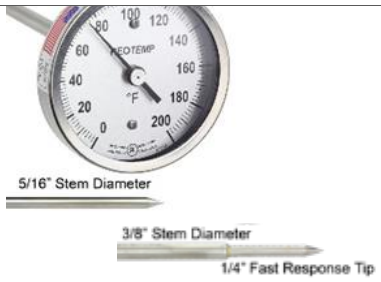
March 22, 2016

Routine calibration of Compost Thermometers Maintains Equipment Accuracy

The purpose of windrow composting of HPAI related poultry carcass mortality is inactivation of avian influenza virus. Compost pile temperature measurements are a critical indicator of effectiveness of the compost process for virus inactivation. Temperature monitoring is performed by a compost subject matter expert (SME), regulatory monitoring staff, contractors, or farm personnel. Accurately monitoring and recording daily temperatures is vital to demonstrating that the composting process meets time and temperature requirements designated by USDA-APHIS. *These time and temperature requirements must be met as part of the process to release quarantine on the infected premises.*

The calibration process described below is appropriate for most commercially available dial-type compost thermometers. Compost thermometers commonly in use for HPAI response are 36" or 48" length bimetal dial industrial compost thermometers (such as the $^{5}/_{16}$" stem heavy duty, or $^{3}/_{8}$" stem with ¼" fast response tip super duty) manufactured by Reotemp Instruments.

Common bimetal dial compost thermometers



The Thermometer Should be Calibrated Before First Use and, at a Minimum, Weekly

Calibration should also be performed if any of the following occurs:

- It is dropped on a hard surface or subjected to severe shock
- It is subjected to forces causing excessive pressure or bending of the stem
- It is subjected to prolonged vibration
- It is exposed to extreme temperatures outside the range of the dial
- The calibration screw on the back of the dial is turned accidentally

Safety: The pointed stem of the thermometer is very sharp. Take care when handling and use a protective sheath when the thermometer is not in use.

Note: If the stem of the thermometer is bent or the dial is un-sealed or broken, the thermometer should be discarded and another procured. It is recommended that, where possible, thermometers be purchased with and fitted with a "probe handle" or "probe guard" for safer handling and protection of the stem and dial.

Developed by USDA APHIS Composting Technical Team

Materials Needed to Perform calibration:

- Sturdy pail or bucket
- Cold water
- Ice (crushed or small cubed)
- Flathead screwdriver
- Compost temperature log or calibration form
- Pen or pencil

Calibration Instructions:

1. Assemble a water bath of *known temperature*, typically an ice bath 32°F (0°C). Place enough ice in the bucket to have at least 6" depth, adding just enough water to fill spaces between the ice pieces. Let sit for one to several minutes.
2. Agitate (stir) the bath just before and occasionally during calibration.
3. Immerse thermometer tip *at least 4" into bath,* as the sensitive portion of the thermometer is the last 2-3" of the stem. Be sure tip does not touch sides or bottom of bucket.
4. Leave thermometer in the bath for at least one minute.

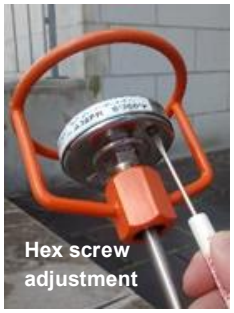
Probe tip

Ice bath

32º F Calibration temperature

5. If the dial does not read 32°F, using the flathead screwdriver, turn the small ($^1/_4$") hex screw head on the back of the dial case of the thermometer until the pointer is at 32°F. Turn the screw counter-clockwise to increase temperature or clockwise to decrease temperature.

Hex screw


Hex screw adjustment

6. When adjustment is complete, re-check the thermometer in ice water. Repeat adjustment if necessary.
7. Each time a thermometer is calibrated it is to be documented that calibration was completed. Information can be recorded on the compost temperature log or a separate calibration form. Include an equipment identifier, date, reference temperature (32°F), and name of the individual performing the calibration.

Mortality Composting: Phase 1 Windrow Evaluation Checklist Days 1–14 for Avian Influenza Infected Flocks

May 11, 2016

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

PHASE 1 WINDROW APPROVAL CHECKLIST

Applicability: This checklist is to be used 14 days after windrow construction to verify that they have been constructed in accordance with the protocol and have reached temperatures necessary for virus inactivation.

Premises County & Number:			**Farm Name:**		
Farm Address:					
Farm Contact:			**Contact Phone:**		
Windrow No.(s):		**Date Windrow(s) Started:**		**Date Windrow(s) Completed:**	
Who constructed windrow/s?			**Contact Info:**		

		Yes	*No*	*N/A*	*Comments/Description*
	PHASE 1 WINDROW EVALUATION—Days 1–14				
1	Height between 6 and 8 feet tall				
2	Width between 12 and 15 feet wide				
3	Dome shaped without significant irregularities				
4	No soft tissue visible on the surface of the windrow				
5	A minimum of 8 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 72 consecutive hours				
13	Photos taken				

PHASE 1 RECOMMENDATIONS OF STATE ANIMAL HEALTH, APHIS OR IMT OFFICIAL:

☐ I have observed 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 consecutive hours. The 14-day initial composting cycle is complete.

☐ I have observed 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 (SME) to recommend corrective actions if necessary.

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

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

Print name of signing official: _____

Phase 1 Recommendations of Subject Matter Expert (for Underperforming Windrows):

☐ I have observed the windrows at this site and based on their construction and my review of the temperature logs, the windrows have performed in a manner demonstrated to inactive the avian influenza virus. The 14-day initial composting cycle is complete.

☐ I have observed the windrows at this site and based on their construction and my review of the temperature logs, the windrows have **NOT** performed in a manner demonstrated to inactive the avian influenza virus. The following corrective actions are recommended:

_____

_____

Date of windrow evaluation: _____

Signature of Composting SME: _____ Date: _____

Print name of Composting SME: _____

The corrective actions recommended above were completed on: _____

Phase 1 was completed on: _____

Signature of Composting SME: _____ Date: _____

Mortality Composting: Phase 2 Windrow Evaluation Checklist Days 14–28 for Avian Influenza Infected Flocks

May 11, 2016

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

PHASE 2 WINDROW APPROVAL CHECKLIST

Applicability: This checklist is to be used 14 days after Phase 1 was completed to verify that the compost windrows may be moved without restriction on the premises or may leave the premises with appropriate permits.

Premises County & No:			**Farm Name:**		
Farm Address:					
Farm Contact:			**Contact Phone:**		
Windrow No.(s):		**Date Windrow(s) Started:**		**Date Windrow(s) Completed:**	
Who constructed windrow(s)?			**Contact Info:**		

		Yes	*No*	*N/A*	*Comments/Description*
	PHASE 2 WINDROW EVALUATION—Days 14–28				
1	Height between 6 and 8 feet tall				
2	Width between 12 and 15 feet wide				
3	Dome shaped without significant irregularities				
4	No soft tissue visible on the surface of the windrow				
5	A minimum of 8 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 72 consecutive hours				
13	Photos taken				

PHASE 2 RECOMMENDATIONS OF STATE ANIMAL HEALTH, APHIS OR IMT OFFICIAL:

☐ I have observed 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 consecutive hours during the second composting phase. The windrows may be moved without restriction on the premises or may leave the premises with appropriate permits.

Developed by USDA APHIS Composting Technical Team

☐ I have observed 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 (SME) to recommend corrective actions if necessary.

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

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

Print name of signing official: _____

PHASE 2 RECOMMENDATIONS OF SUBJECT MATTER EXPERT (FOR UNDERPERFORMING WINDROWS):

☐ I have observed the windrows at this site and based on their construction and my review of the temperature logs, the windrows have performed in a manner demonstrated to inactive the avian influenza virus. The windrows may be moved without restriction on the premises or may leave the premises with appropriate permits.

☐ I have observed the windrows at this site and based on their construction and my review of the temperature logs, the windrows have **NOT** performed in a manner demonstrated to inactive the avian influenza virus. The following corrective actions are recommended:

_____

_____

Date of windrow evaluation: _____

Signature of Composting SME: _____ Date: _____

Print name of Composting SME: _____

The corrective actions recommended above were completed on: _____

Phase 2 was completed on: _____

Signature of Composting SME: _____ Date: _____

STANDARD OPERATING PROCEDURES: 14. DISPOSAL

Attachment 14.A Composting[12]

PLANNING FOR IN-HOUSE POULTRY COMPOSTING

1. Identify service providers for:
   a. Mortality composting. Personnel should be trained on operational procedures, composting procedures, and the proper disposal and composting of animal carcasses. Contact APHIS Disposal Cell for roster of Composting SMEs.
   b. Heavy equipment operations.
   c. Carbon source production and delivery (assume 2–3 pounds of carbon source per pound of carcass).
2. Identify regulatory requirements and obtain pre-approval.
3. Identify a facility that
   a. has sufficient space to maneuver composting equipment and construct windrows. The facility should contain enough open space and ceiling must be high enough to allow the loader to construct windrows 6 feet high and 12 feet wide. Facilities with columns, such as double-deck houses, restrict such formations;
   b. is located in an area that is accessible by the composting equipment. This facilitates the delivery of carbon source and compost removal; and
   c. offers access doors that can be secured against vandals, scavengers, or disease vectors.
4. Obtain all necessary equipment, supplies, materials, personnel, and services identified in the Site Specific Disposal Plan and as required by the Biosecurity and Health and Safety/PPE SOPs, such as PPE, carbon source, skid-steer or front-end loaders, long-stemmed thermometers, pH meters, bulk-density testing devices, and log books.
5. Ensure all compost team members are trained on proper procedures for composting infected carcasses, biosecurity procedures, work safety issues, and the use of PPE. If they are not, see below.
6. Train personnel on biosecurity, work safety issues, and the use of PPE based on the Site Specific Disposal Plan, the NAHEMS Guidelines: Biosecurity and Biosecurity SOP, and NAHEMS Guidelines: Health and Safety, NAHEMS Guidelines: PPE, and the Health and Safety/PPE SOP.
7. Identify a qualified disposal Contracting Officers Representative to oversee the composting operations.

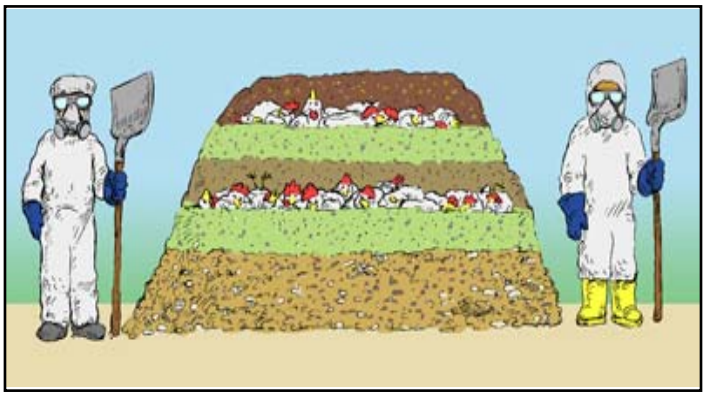
[12] Content and all photos in this attachment are courtesy of Cornell Waste Management Institute. http://cwmi.css.cornell.edu/composting.htm.

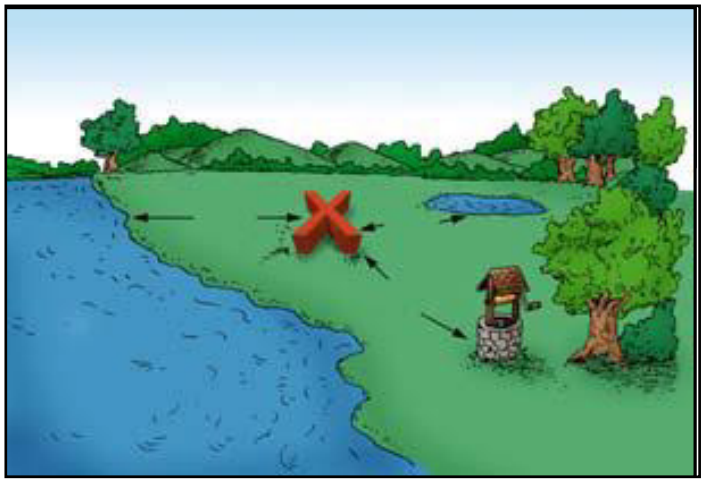
STANDARD OPERATING PROCEDURES: 14. DISPOSAL

Attachment 14.A Composting

OPERATIONS FOR IN-HOUSE OR OUTDOOR POULTRY COMPOSTING

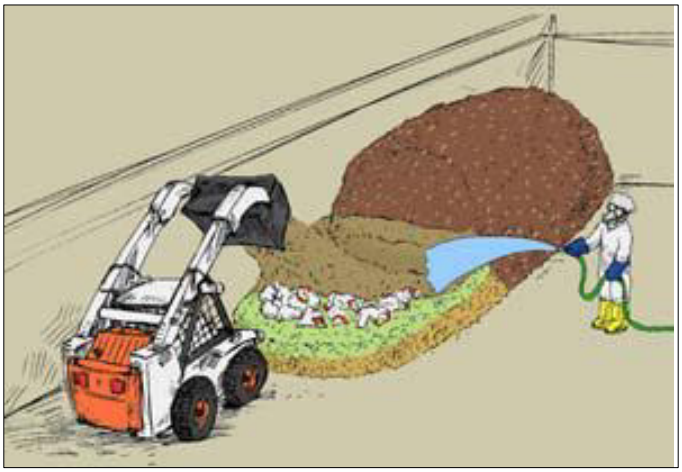
1. Don all required PPE as detailed in the Site-Specific Health and Safety/PPE Plan.
2. Select a site that is well drained and not subject to flooding. Keep piles away from homes and businesses and from water courses, sinkholes, seasonal seeps or other landscape features that indicate the area is hydrologically sensitive.
3. When implementing in-house composting the poultry house will be vented naturally but mechanical ventilation should be turned off.
4. Site cleanliness is an important aspect of composting; it deters scavengers, helps control odors, and helps maintain good neighbor relationships.
5. Push litter and feed off to the side of the barn. Lay an 10-15 inch deep bed of coarse wood chips, 8–12 feet wide (depending upon structure and equipment constraints) and as long as space permits.
6. Add a 12–15 inch layer of litter and birds, then cover with a 12–15 inch layer of wood chips or other carbon sources.
7. Add another layer of litter and birds until the windrow is two or three layers high and as long as needed.
8. If your birds and litter are not separate, put a carbon base down (as in step 5), add birds mixed with litter and bedding to 4-5 feet high and continue as follows.
9. Cover with 1-2 feet of wood chips or other carbon sources to create a bio-filer. The finished section should be 6–8 feet high.





Adapted from Cornell Waste Management publication

11. Make sure all mortalities are well-covered to keep odors down, generate heat and keep vermin or unwanted animals out of the windrow.
12. Monitoring is the only activity that will occur. Temperature probes will be used to record temperatures and should range from 131°–150°F or 55°–65°C during most of this time period.
13. The primary process in-house, where it reaches thermophilic temperatures, will take 10–14 days. During this time, no turning, agitating, or active aeration should occur.
14. If litter is very dry, add moisture to the layers as you are building them. The compost feedstock should be at 30–40% moisture.
15. After the required time/temperature duration, windrows can be moved outside the buildings for the curing process. Testing for the presence of the disease will be required.



Adapted from Cornell Waste Management publication

Carcass Management: Outdoor Composting Checklist

- [ ] **Identify a suitable site on premises or in a centralized location in accordance with the checklist items below.**
  - [ ] If off-site consider the need for secure transport

- [ ] **Based on approval of the state environmental agency and the composting SME from the APHIS roster, are the site conditions suitable for composting the number of animals affected?**
  - [ ] See USDA Mortality Composting Protocol for Avian Influenza Infected Flocks (also at go.usdatraining.com/HPAI)
  - [ ] Adequate land area to build compost piles (assume (237) 1000-pound cows per acre, (1,185) 200-pound swine or sheep per acre, or (47,500) 5-pound poultry per acre).
  - [ ] Required distance from water wells, surface water bodies (lakes, streams, rivers, etc.), sinkholes, seasonal seeps or other landscape features that indicate the area is hydrologically sensitive, based on guidance from state environmental officials.
  - [ ] Consider all groundwater pathways including the presence of drain tiles, soil characteristics, depth to groundwater, use of groundwater etc.
  - [ ] Located away from neighbors and/or out of sight.
  - [ ] Located downwind from neighbors and/or houses.
  - [ ] Located away from environmentally-sensitive areas.
  - [ ] Located close to the livestock or poultry facility or have clear access for transport.
  - [ ] Clear of overhead utility lines.
  - [ ] Void of excess water.
  - [ ] Located on a gentle slope (1%-3%) so there will be no water ponding.
  - [ ] Consider the need for an impermeable base and/or protective cover to prevent leachate generation and migration.

- [ ] **If the site is suitable, consider the duration of time it takes to fully compost and determine if the following issues can be overcome:**
  - [ ] Personnel required to ensure proper construction, maintenance, and temperature monitoring of windrows.
  - [ ] Need for pest management.
  - [ ] Potential for extreme weather (e.g., hurricane) to disturb pile.
  - [ ] Denial of use of land area while composting (minimum 30 days).

- [ ] **If so, is there a sufficient local supply of carbon source such as wood chips (1-2 pounds carbon source per pound of biomass)?**
  - [ ] Check with local agencies and organizations to determine if stockpiles of carbon source are available (e.g., parks department and landfills). Ensure that the carbon source is free of any pests or pathogens which could threaten local species. See Carbon Sources for Windrow Construction.

☐ **If so, have you arranged for the necessary equipment and supplies to be delivered to the site?**

- ☐ Personnel
- ☐ Composting supplies and carbon source
- ☐ Personal protective equipment
- ☐ Cleaning and disinfecting (biosecurity) supplies
- ☐ Hand tools
- ☐ Heavy equipment (mid-size skid-steer loaders, tractors with bucket loaders, trucks, containers and covers if transporting, leak-resistant material for lining carcass transport containers)

☐ **If composting is an option see Outdoor Composting training module at** go.usdatraining.com/Disposal **and implement composting. If not, continue to Third Option.**

STANDARD OPERATING PROCEDURES: 14. DISPOSAL

Attachment 14.A Composting

PLANNING FOR OUTDOOR COMPOSTING FOR LIVESTOCK OTHER THAN POULTRY

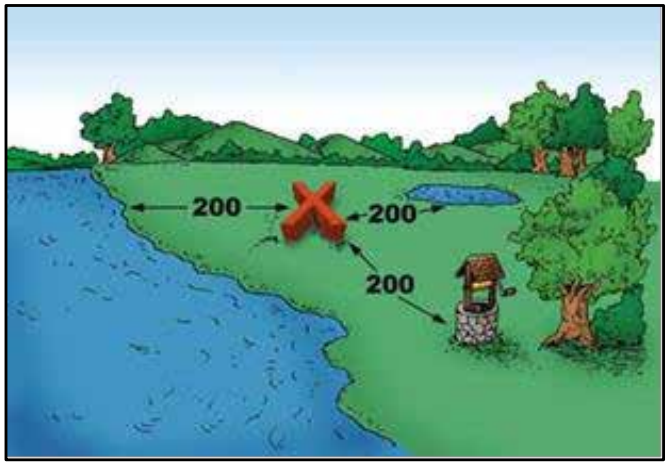
1. Identify service providers for:
   a. Mortality composting. Personnel should be trained on operational procedures, composting procedures, and the proper disposal and composting of animal carcasses. See Attachment 14.K Compost SMEs.
   b. Heavy equipment operations.
   c. Carbon source production and delivery (assume 2–3 pounds of carbon source per pound of carcass). See Carbon Sources for Windrow Construction
2. Identify regulatory requirements and obtain pre-approval from state environmental agency.
3. Identify a composting site that is
   a. large enough to accommodate the windrows (assume 24 feet wide including buffer space and 6 feet high by required length plus staging and access areas);
   b. located away from neighbors and out of sight;
   c. at least 200 feet from drinking water wells, surface water, and environmentally sensitive areas;
   d. downwind of homes and other dwellings;
   e. accessible in all weather;
   f. clear of underground and overhead utilities;
   g. not interfering with traffic;
   h. on a crowned grade where storm water will not accumulate;
   i. void of excess water; and
   j. capable of being dedicated to composting for several months.
4. Obtain all necessary equipment, supplies, materials, personnel, and services identified in the Site Specific Disposal Plan and as required by the Biosecurity and Health and Safety/PPE SOPs, such as PPE, carbon source, skid-steer or front-end loaders, long-stemmed thermometers, pH meters, bulk-density testing devices, and log books.
5. Ensure all compost team members are trained on proper procedures for composting infected carcasses, biosecurity procedures, work safety issues, and the use of PPE. If not,
6. Train personnel on biosecurity, work safety issues, and the use of PPE based on the Site Specific Disposal Plan, the NAHEMS Guidelines: Biosecurity and Biosecurity SOP, and NAHEMS Guidelines: Health and Safety, NAHEMS Guidelines: PPE, and the Health and Safety/PPE SOP.
7. Identify a qualified disposal Contracting Officers Representative to oversee the composting operations.

STANDARD OPERATING PROCEDURES: 14. DISPOSAL

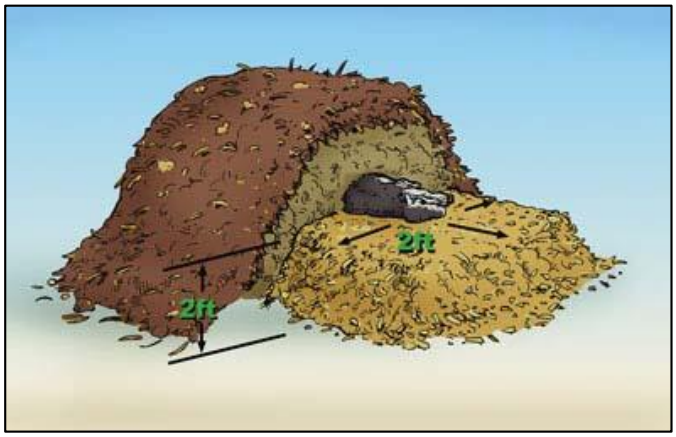
Attachment 14.A Composting

OPERATIONS FOR OUTDOOR COMPOSTING FOR LIVESTOCK OTHER THAN POULTRY

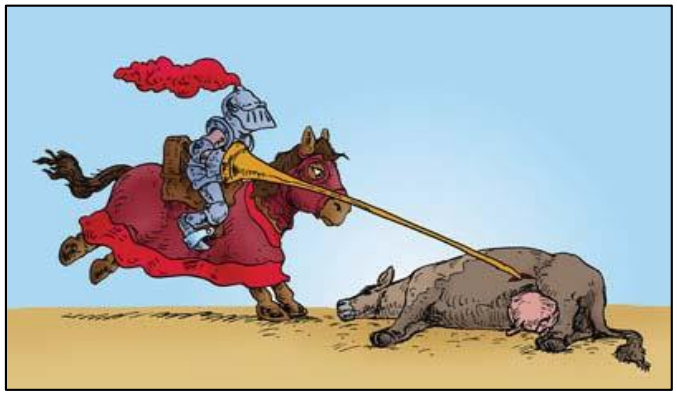
1. Don all required PPE as detailed in the Site-Specific Health and Safety/PPE Plan.
2. Select site that is well drained, at least 200 feet from water courses, sinkholes, seasonal seeps or other landscape features that indicate the area is hydrologically sensitive.
3. Fence the area if desired, and install measures to prevent water run-on and run-off if needed.



4. Construct an impermeable pad if excess leachate production is a concern to the approving authority. The pad could consist of a low-permeability soil base, pavement, or a suitable liner material beneath the pile if the liner will not cause the compost material to slip during inclement weather.
5. Place a 24-inch bed of bulky, absorbent organic material such as 3-inch wood chips over the pad. Ensure the base is large enough to allow for 2-foot clearance around the carcass.

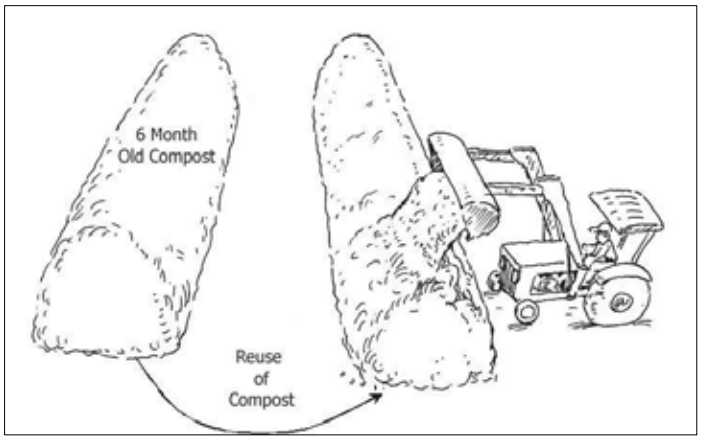


6. Lay animal in the center of the bed. Lance the rumen to avoid bloating and possible explosion. Explosive release of gases can result in odor problems and it will blow the cover material off the composting carcass.
7. Cover carcass with dry, high-carbon material, old silage, sawdust or dry stall bedding (some semi-solid manure will expedite the process). Do NOT stack medium-sized, large, or very large carcasses on top of one another. For young animals, layer mortalities no more than 1 foot thick with a minimum of 2 feet of carbon material between layers.

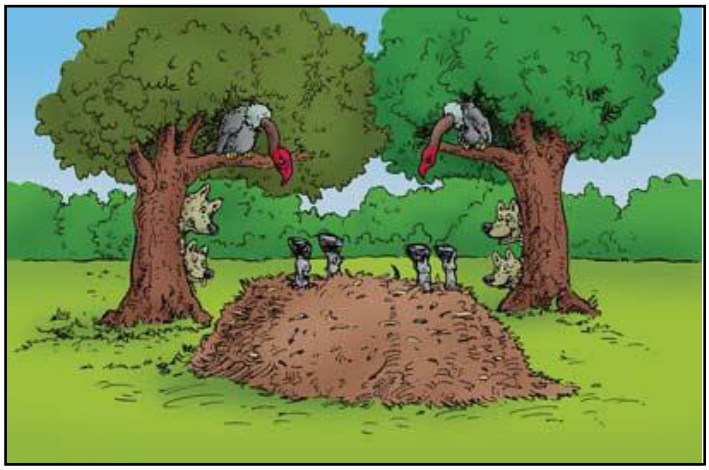


Adapted from Cornell Waste Management Institute

8. Let sit for several months, then check to see if carcasses are fully degraded. Do not turn piles for at least 3 months.



9. Remove large bones before using the finished compost.



10. After building the compost piles, disinfect all tools, equipment and other items that may harbor pathogens, and maintain site cleanliness to deter scavengers, control odors, and help good neighbor relations.

11. Maintain a log of temperature, moisture, content, odor, vectors (any unwanted animals), leachate (liquid that comes out of the pile), spills and other unexpected events.

Adapted from Cornell Waste Management Institute

12. Monitor the internal compost pile temperatures daily with 3–4 foot long compost thermometers. The optimal temperature range for composting is between 104°F and 140°F (40°C and 60°C). During periods of extremely cold weather, piles may need to be larger than usual to minimize surface cooling. As decomposition slows, temperatures will gradually drop and remain within a few degrees of ambient air temperature. Don appropriate PPE equipment such as disposable gloves.
    a. Insert a temperature probe carefully and straight down into each quadrant of the pile to allow daily and weekly monitoring of internal temperatures at depths of 10, 20, 30, and 40 inches.
    b. Use the averages to represent the compost pile temperature.
13. If the compost pile does not rise to expected temperature levels within the first 2 weeks of composting, evaluate the initial pile formulation for proper carbon-to-nitrogen ratio (30:1) and the mixture of co-composting materials and carcasses.
14. If building an aerated static pile, the pile must be insulated (covered with a layer of bulking material or finished compost) and maintained at a temperature of not less than 131°F (55°C) for at least 3 consecutive days, monitored 6–8 inches from the top of the pile, to meet pathogen reduction standards typically used for land-applied sewage sludge.
15. Periodically test the moisture content of the compost. Use analytical equipment or the hand-squeeze method. For the hand-squeeze method:
    a. Don appropriate PPE (see the Health and Safety/PPE SOP).
    b. Squeeze a handful of compost material firmly several times to form a ball.
    c. The characteristics of the ball indicates the moisture content:
        i. If it falls apart, the moisture content is much less than 50 percent.
        ii. If it remains intact after being gently bounced three or four times, it is nearly 50 percent.
        iii. If the ball texture is slimy with a musty, soil-like odor and liquid squeezes out, the moisture content is more than 50 percent.
    d. If the moisture content is low and the pile temperature is very high (150° F), rake back the compost cover layer (up to 1 foot) and add enough water to bring the moisture content in the pile up to 50 percent.
    e. If liquid begins to leach out of the pile, spread an absorbent organic material such as sawdust around the pile.
16. Thoroughly clean and disinfect all of the disposal equipment. See the C&D and Biosecurity SOPs.
17. When the compost is finished (typically 4–9 months for a static mortality compost pile, depending on weather and other conditions), it can be used for
    a. a base for the next compost pile,
    b. land application on non-edible crops, and
    c. landfill daily cover.

Procedures for Outdoor Composting of AI-Infected Poultry Carcasses

Determine Compost Site Availability

Space needed

- ✓ Windrow composting
  - ❑ Windrow width = 12 feet
  - ❑ Buffer width = 6 feet on each side (12 feet total)
  - ❑ Total width = 24 feet
  - ❑ Height = 6 feet
  - ❑ Length = 1 foot per 300 lbs
- ✓ Bin composting
  - ❑ Impractical for large numbers of animals
  - ❑ Usually 160 ft^3 needed for every 1000 lb of animals

Area should be:

- ✓ Located away from neighbors and/or out of sight
- ✓ Located downwind from neighbors and/or house
- ✓ Close to barn or ability to transport
- ✓ Void of excess water
- ✓ Clear of underground and overhead utility lines
- ✓ Clear of surface water and environmentally sensitive areas
- ✓ Can be out of commission (for crops, pasture, etc.) for a given period of time

Logistics

Conduct farm evaluation

- ✓ Inventory available supplies, equipment, materials
- ✓ Collect site specific data
  - ❑ Bird species and age
  - ❑ Average bird weights
  - ❑ Production type
  - ❑ Litter depth in each part of the house
  - ❑ Location of carcasses
  - ❑ Litter moisture and condition
  - ❑ Ability to remove carcasses
  - ❑ Number of avian carcasses
  - ❑ Least material/handling needs
- ✓ Determine carbon source needs
  - ❑ Pounds of broiler meat = number of birds in house x average weight of bird
  - ❑ Total litter required = pounds broiler meat/ area of windrow or bin planned x 2.5 – 3 lbs. of carbon
  - ❑ Average litter depth = sum of litter depths in each part of house/number of parts of house
  - ❑ Litter available = average litter depth x area of house
  - ❑ Amount of carbon material to obtain = total litter required – litter available
  - ❑ Amount of carbon material to obtain (in cubic yards) = lbs needed x (1/bulk density)

Logistics (Cont.)

- ✓ Determine location of windrow or bin
  - ❑ Identify an area that is sensitive to the surroundings
  - ❑ Consider location of drinking water supplies
  - ❑ Close to material that will be composted and/or ability to transport compost without causing contamination in all weather conditions with minimal interference with other operations and traffic
  - ❑ Avoid sites where excess water will enter
  - ❑ Does not interfere with underground or overhead utilities
  - ❑ Make sure the land is able to be out of commission for the entire compost period
  - ❑ Seldom is it possible to find a site that is ideal in all of the factors—select the location that will have the least impact
- ✓ Choose composting method
  - ❑ Layering: if depopulation concentrates carcasses in a small section of the house
  - ❑ Mixing and piling: Where carcasses are distributed more evenly over the litter service; least labor and cost
  - ❑ Shredding and piling: This method is not recommended for highly pathogenic organisms, and should be avoided when composting birds infected with HPAI
- ✓ Determine security needs
  - ❑ Can compost pile be protected from vandals, scavengers, and disease vectors?
  - ❑ Dust and wind must be taken into account
- ✓ Obtain resources
  - ❑ Personnel
  - ❑ Supplies: carbon source, PPE, hand tools, personal needs
  - ❑ Equipment: loader, truck, pressure washer, dumpster, compost bag equipment
- ✓ Prepare for composting
  - ❑ Let birds consume all feed
  - ❑ Raise the feeders and drinking lines
  - ❑ Depopulate
- ✓ Transport
  - ❑ Lay polyethylene liner onto the ground outside house where truck will be loaded
  - ❑ Load mortalities onto truck with a front loader if possible, or else load manually
  - ❑ Minimize dust generation during loading
  - ❑ Cover truck to seal carcasses and material in and prevent any material from escaping
  - ❑ Transport to windrow site and unload onto site of compost pile
  - ❑ After transporting, dispose of plastic
  - ❑ After last load, thoroughly disinfect the truck

USDA APHIS online Emergency Management Tools, 2007.

Composting Birds and Byproducts

Prepare the site

- ✓ For bin composting, the bin should be constructed from any material that will confine the compost pile material and resist lateral loads
- ✓ Lay down a layer of plastic the width and length of your anticipated windrow or on the bottom of your constructed bin
- ✓ Lay down 12-24 inches of carbon source as a base (use thicker end of range if low evaporation and high precipitation)

Till litter

- ✓ If euthanized carcasses are confined to a portion of the house and caking is extensive, tilling the litter in the house prior to building windrows will enhance composting, which prevents leachate and improves oxygen entry into the pile

Build compost units (windrows)

- ✓ Mixing and piling method: method used if no additional carbon source is needed; involves mixing the carcasses with the existing litter base
- ✓ Layering method: leave no carcasses or bird parts exposed
- ✓ Shredding and piling method: not recommended for use with HPAI; may create increased risk of exposure to virus and cause increased utilization of equipment that then needs to be disinfected

Byproducts

- ✓ Contaminated litter: place excess contaminated litter in windrows to compost and deactivate pathogens
- ✓ Feed: place excess contaminated litter in windrows to compost and deactivate pathogens

Finishing the Site

- ✓ Cover windrow with compost fleece or another suitable porous fabric to protect from scavengers; do not use a cover that does not allow some air to circulate as this will cause condensation and may negatively affect the composting process
- ✓ Secure the material using dirt and soil on the edges or some other means to restrict scavengers from accessing the windrows

After Composting

Disinfection

- ✓ Disinfect all tools and equipment used after forming windrows
- ✓ Disinfect house

Maintenance

- ✓ Monitoring
  - ❑ Temperature
  - ❑ Viral
  - ❑ Vector
  - ❑ Moisture
- ✓ Turning
  - ❑ Can relocate the pile to another site or another bin or simply turn in place
  - ❑ Turn compost in place by shifting windrows towards the ends
  - ❑ Scrape along the edges of the turned windrow and deposit material on the pile
  - ❑ If the pile is moved, pick up the material and drop in a cascading manner—do not merely push the material from one place to another
  - ❑ Add water when needed
  - ❑ Cap the turned pile with a minimum of 4 inches of litter or sawdust to cover any exposed tissue on the surface
  - ❑ Re-cover with appropriate cover
  - ❑ Continue to monitor temperature

Disposal

- ✓ Land application
- ✓ Landfilled
- ✓ Stored and aged

USDA APHIS online Emergency Management Tools, 2007.

Carcass Management: Open Air Burning Checklist

- [ ] **Will local and state agencies allow open burning at the site?**
  - [ ] Local Fire Department
  - [ ] State Department of Agriculture, Animal Health
  - [ ] State Department of Environment or Natural Resources
  - [ ] USDA-APHIS
  - [ ] USEPA
- [ ] **Will open burning release air pollutants in excess of public health standards?**
- [ ] **If so, can the permit conditions, such as measures to control the spread of fire, distance to occupied buildings etc. be met?**
  - [ ] What environmental testing (e.g., water, ash, soils) are required and at what frequency?
  - [ ] How and where would the ash be disposed of?
  - [ ] Are weather conditions (e.g., wind and drought) suitable for open are burning?
- [ ] **If so, will burning be publically unacceptable?**
- [ ] **If so, have you arranged for the necessary personnel, equipment and supplies to be delivered to the site?**
  - [ ] Adequate source of combustible material and fuel to keep the fire going. Verify that type of fuel is acceptable to regulatory agencies.
  - [ ] Other equipment including mechanical chains and lifting equipment.
  - [ ] Personnel properly trained in the use of this equipment.
  - [ ] Fire safety equipment also should be readily available.
- [ ] **If open air burning is an option, see On-Site Treatment/Burial training module at** go.usdatraining.com/aphis_tools **and implement on-site open air burning. If not, continue to Fourth Option.**

Developed by USDA, DHS, and the 3D IPT

Procedure for Open Air Burning of AI Infected Poultry Carcasses

Open Air Burning

- ✓ Open-air burning involves combustion of waste at high temperatures, converting the waste into heat, gaseous emissions, and ash
- ✓ The gaseous emissions are vented directly into the atmosphere in the human breathing zone without passing through a stack or chimney
- ✓ Open-air burning includes burning carcasses in open fields, and on combustible open heaps, or pyres
- ✓ On-farm preprocessing may be required prior to open-air burning, which could include the grinding of carcasses which can be transported in sealed containers, or fermentation or freezing
- ✓ Open-air burning operations are strictly regulated--a permit is usually required to perform open-air burning, if it is allowed at all

Advantages

- ❑ Combines sterilization and carcass destruction into one operation
- ❑ Can be relatively inexpensive to construct
- ❑ Can be used anywhere a permit can be obtained and there is sufficient distance from other combustible materials
- ❑ No specialized equipment or personnel are needed

Disadvantages

- ❑ Can be inefficient and time-consuming
- ❑ Can be difficult to accomplish because of the high water content of carcasses
- ❑ May cause significant air emissions
- ❑ Dependent on favorable weather conditions
- ❑ Can spread pathogens by dispersing partially-combusted particles into the air
- ❑ Labor and fuel intensive
- ❑ Can generate significant public opposition which may make obtaining a permit difficult

USDA APHIS online Emergency Management Tools, 2007.

STANDARD OPERATING PROCEDURES: 14. DISPOSAL

Attachment 14.F Open Air Burning

This method involves burning on open land and above ground, in a pit, or on pyres.

Planning

1. Obtain approval from state environmental agency.
2. Calculate the amount of material required to accomplish the open-air burning. One adult bovine carcass is equivalent to five finishing pigs or five adult sheep. One adult bovine carcass will require[16]
   a. 3 bales of straw or hay,
   b. 3 pieces of untreated heavy lumber,
   c. 50 pounds of kindling wood,
   d. 100 pounds of coal pieces that are 6–8 inches in diameter, and
   e. 1 gallon of liquid fuel. Do not use gasoline. The type and amount of fuel used for incineration will be influenced by local fuel availability and conditions. For effective burning, fuel should be as dry as possible.
3. Other equipment includes mechanical chains and lifting equipment. Identify personnel properly trained in the use of this equipment. Fire safety equipment also should be readily available.
4. Build a fire bed that is perpendicular to the prevailing wind.

Operations

1. Don all required PPE detailed in the Site-Specific Health and Safety/PPE Plan.
2. Prepare the bed:
   a. Stake out and fence the selected burning site for the fire-bed construction.
   b. Allow a fire-bed length of 3 feet for each adult cattle carcass, five swine carcasses, or five sheep carcasses. The team may find it helpful to convert the number of carcasses in need of disposal into bovine-equivalent carcasses as seen in Table 14.F-1.[17]

Table 14.F-1. Estimating Bovine—Equivalent Carcasses

Animal	Bovine Equivalent Carcasses
1 adult cow or bull	1 bovine-equivalent carcass
5 adult swine	1 bovine-equivalent carcass
5 adult sheep	1 bovine-equivalent carcass

16 Recommended incineration materials include straw or hay, untreated heavy timber, kindling wood, coal, and liquid fuel.

17 To estimate the number of bovine-equivalent carcasses, first list the number and species of carcasses to be incinerated, then convert these figures into a number representing bovine-equivalent carcasses.

c. Lay three rectangular rows of straw or hay bales lengthwise along the line of the fire bed. Rows should be 12 inches apart and each bale should be separated by a 12-inch gap.

d. Place loose straw in the spaces between the rows and bales to provide natural air flow.

e. Place large pieces of lumber lengthwise on top of each row. Distribute large and medium-sized pieces of lumber across the fire bed, leaving 6 to 12 inches of space between them.

f. Place small kindling wood on the fire bed and cover loosely with straw.

g. Spread 6- to 8-inch-diameter coal evenly at the rate of 500 pounds per square yard, or use a liquid field such as diesel or furnace oil over the wood mixture to make a level bed.

h. Lay the carcasses on the fire bed.

i. Position carcasses on their backs with their feet in the air and alternately head to tail.

j. Two goats, sheep, or swine carcasses can be placed on top of each bovine carcass and burned without additional fuel.

k. Place loose straw on top of the carcasses and all spaces in between.

l. Spray liquid fuel over the fire bed with a pump, or use sprinkling cans or buckets.

m. Soak rags in kerosene oil or waste oil and place them every 30 feet along the fire bed for a better and more harmonized ignition.

n. Make sure that people and equipment are at least 25 feet from the burning pile.

o. Have fire equipment readily available.

p. Ignite the fire bed.

q. Occasionally stir the burning pile with front-end loaders.

r. Add more fuel as needed.

s. Bury the ash after all carcasses have been burned completely and the fire has been extinguished.

3. Thoroughly clean and disinfect all disposal equipment.

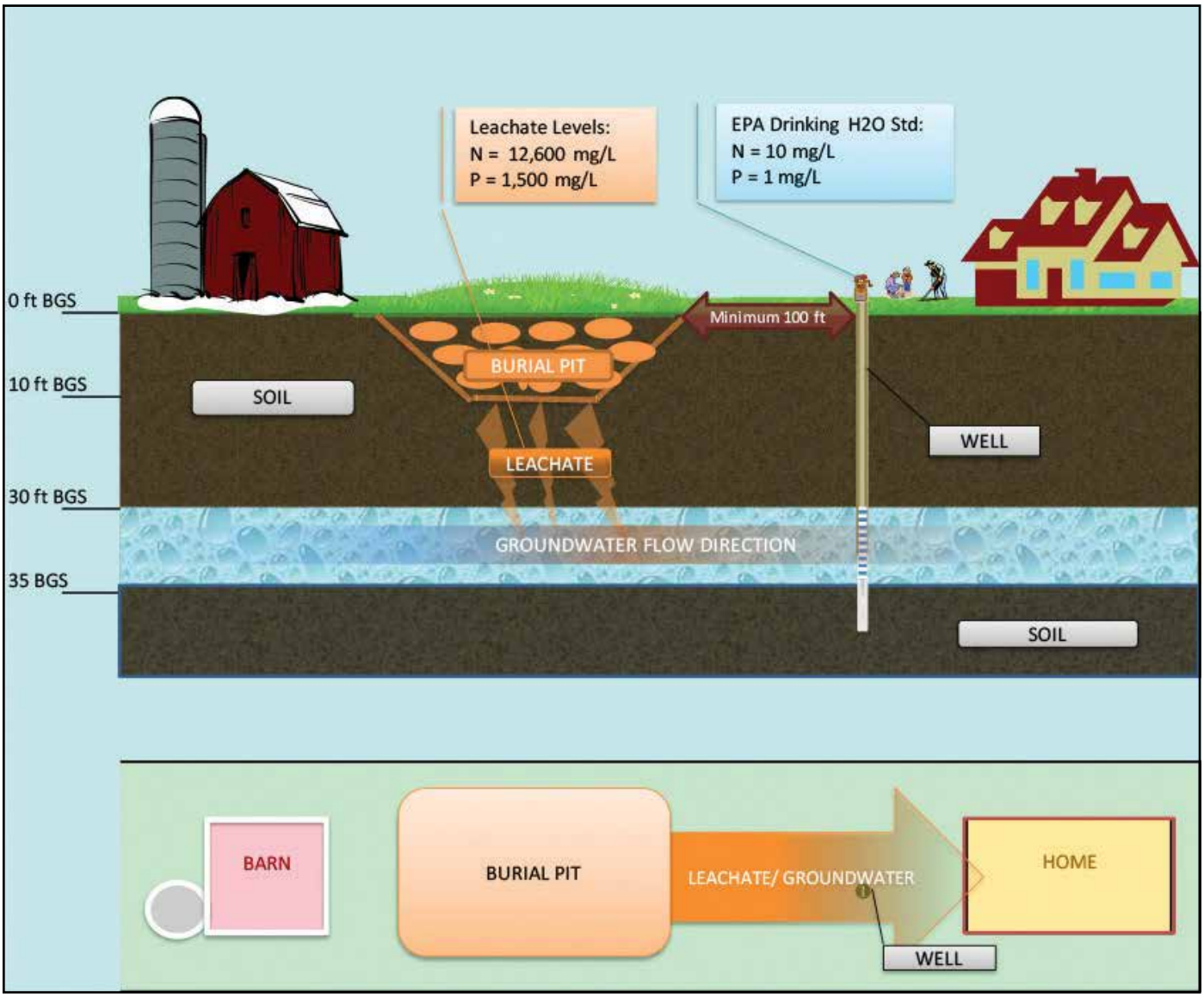
   See the Cleaning and Disinfection SOP: go.usdatraining.com/SOP_CD and the Biosecurity SOP: go.usdatraining.com/SOP_Biosecurity

Carcass Management: On-Site Burial Checklist

- [ ] **Will state environmental agency permit burial at the site?**
  - [ ] Consider soil suitability (see USDA NRCS online Web Soil Survey at go.usdatraining.com/WSS based on guidance from state environmental officials?)
  - [ ] Consider potential for leachate to contaminate groundwater
  - [ ] Consider all groundwater pathways including the presence of drain tiles, soil characteristics, depth to groundwater, use of groundwater etc.
  - [ ] Consider potential for the burial site to create a stability or explosion hazard in nearby structures from production of methane.
- [ ] **If so, is adequate land available for on-site burial? (assume 1.42 acres per 1000 half-ton cows , 0.28 acres per 1000 swine or sheep, and 0.01 acres per 1000 poultry)**
- [ ] **If so, will land owner accept on-site burial, associated environmental liabilities, and potential loss of property value or use?**
- [ ] **If on-site burial is an option, see the On-Site Treatment/Burial training module at go.usdatraining.com/Disposal and implement on-site burial. If not, continue to Fifth Option.**

Developed by USDA, DHS, and the 3D IPT

Burial Effect on Environment



Why is nitrogen a problem?

- EPA standard for nitrates in drinking water is 10.0 mg/L
- Carcass burial sites generate over 1000 times the standard
- Causes Methemoglobinemia (blue baby syndrome) which can be fatal to infants
- Toxic to aquatic life
- Depletes dissolved oxygen in receiving waters
- Stimulates aquatic plant growth (eutrophication)

Developed by L.P. Miller, USDA, 2014

Land Area or Excavation Volume Required for Trench Burial

Jurisdiction/ Source	Total Trench Depth (D)	Carcass Depth	Depth Cover	Trench Width (W)	Trench Length (L)	Est. Area or Volume Required	Carcass Equivalents	Other Notes
Literature								
NC (Wineland & Carter, 1997)						50-55 ft3 (~2.0 yd3) per 1,000 broilers or commercial layers 100 ft3 (3.7 yd3) per 1,000 turkeys		Note that the volume estimates were based on a disposal pit design, rather than trench burial.
Australia (Atkins & Brightling, 1985)	~3.5 m (11.5 ft)	1.5 m (5 ft)	2.0 m (6.5 ft) to ground level	3-5 m (10-16.5 ft) determined by equipment used	--	1 m3 (~35 ft3 or 1.3 yd3) per 8-10 mature sheep (off-shears)	--	To calculate the necessary pit volume, including an allowance for cover, a value of 0.3 m3 of excavation per sheep was used.
Australia (Lund, Kruger, & Weldon)	2.6 m (8.5 ft)	--	1 m (3.3 ft)	4 m (13 ft)	6.7 km (~4.2 mi) for 30,000 cattle	30,000 head of cattle requires trench of 70,000 m3 (2.5 million ft3, or 92,000 yd3)	--	Equates to excavation volume of 2.3 m3 (82 ft3 or 3 yd3) per cattle carcass.
N/A (McDaniel, 1991)	9 ft	3 ft	6 ft	7 ft	--	14 ft2 at bottom of pit for each adult bovine (assuming 3 ft depth, equates to ~42 ft3 or ~1.2 yd3 per adult bovine)	1 adult bovine = 5 mature sheep or hogs	For every additional 3 ft of trench depth, the number of carcasses per 14 ft2 can be doubled. Due to bulky feathers, poultry require more burial space per unit of weight than cattle, hogs, or sheep. Estimate space required for poultry by counting carcasses that fill a space of known volume (i.e. truck).
N/A (Sander, Warbington, & Myers, 2002)	9 ft	--	3-4 ft	7 ft	--	14 ft2 per mature cow	--	
N/A (Anonymous, 1973)	--	--	--	--	--	Assume 40 lbs of poultry carcasses per 1 ft3	--	Equates to approximately 1,080 lbs/yd3.

Jurisdiction/ Source	Total Trench Depth (D)	Carcass Depth	Depth Cover	Trench Width (W)	Trench Length (L)	Est. Area or Volume Required	Carcass Equivalents	Other Notes
Regulatory Agencies								
AL (USDA, Natural Resource Conservation Service, Alabama)	8 ft (for deep soils where bedrock not a concern)	1 ft max small animals 1 carcass max large animals	2 ft mounded	--	--	--	--	Max size of burial excavation should be 0.1 acre (~4,400 ft2) Excavations over 3.5 ft deep should be sloped on sides at least 1.5 (horiz) to 1 (vert)
TX (USDA, Natural Resources Conservation Service, Texas, 2002)	3 ft min 8 ft max	1 ft small animals 1 carcass large animals	2 ft	4 ft	Adequate for mortality	Total mortality weight ÷ 62.4 lb/ft3 = ~volume of mortality in ft3 Pit excavation = 2-4 times the mortality volume to allow for voids and fill soil Spreadsheet avail on request	--	Pits 6 ft or greater in depth – perform soil tests to a depth two ft below lowest planned excavation Multiple pits – separate by 3 ft of undisturbed or compacted soil For deep soils, carcasses and soil can be placed in multiple layers up to a total depth of 8 ft 62.4 lb/ft3 suggests a density of approximately 1,680 lbs/yd3
APHIS (USDA, 1980)	9 ft or Greater	--	--	7 ft or greater	--	14 ft2 at bottom of pit for each adult bovine	1 adult bovine = 5 mature sheep or hogs	For every additional 3 ft of trench depth, the number of carcasses per 14 ft2 can be doubled. Trench site should be mounded over and neatly graded. Do not pack the trench – decomposition and gas formation will crack a tightly packed trench causing it to bubble and leak fluids.
APHIS (USDA, 2001a)	--	--	--	--	--	42 ft3 (~1.2 yd3) required to bury 1 bovine, 5 pigs, or 5 sheep	--	
Australia (Agriculture and Resource Management Council of Australia and New Zealand, 1996)	~5 m (~16.5 ft)	--	2 m (6.5 ft)	~3 m (~10 ft)	--	1.5 m3 (~53 ft3 or ~2 yd3) per each adult beast or 5 adult sheep	--	Example: Trench 5 m deep x 3 m wide filled with carcasses to within 2.5 m of ground level will accommodate 5 cattle or 25 sheep per linear meter (2.5 x 3 x 1 = 7.5 m3; 7.5/1.5 = 5 cattle or 25 sheep)
Alberta, Canada (Ollis, 2002)	4-5 m (13-16.5 ft)	--	2 m (6.5 ft)	2 m (6.5 ft)	10 m (33 ft)	31 adult cattle carcasses require trench 4 x 2 x 10 m (DxWxL) (80m3, 2,800 ft3, or 105 yd3 per 31 adult cattle) (~2.6 m3, 92 ft3, or 3.5 yd3 per carcass) 46 adult cattle carcasses require trench 5 x 2 x 10 m (DxWxL)	1 bovine = 5 adult hogs or sheep 1 bovine = 40 broiler chickens (market-ready weight)	

STANDARD OPERATING PROCEDURES: 14. DISPOSAL

Attachment 14.G Unlined Burial[18]

Planning

1. Review State and local regulations regarding burial. Individual States regulate the parameters for burial (e.g., quantity of carcasses, depth to water table, and distance to wells, surface water, and property lines).
2. Obtain information from the USDA NRCS Web Soil Survey such as soil maps, drainage, and seasonal water table data.
3. If the Web Soil Survey data indicates the site is suitable for carcass burial, obtain the services of a qualified environmental professional such as a Professional Geologist or Professional Engineer to collect at least three soil borings of the site to the water table. Trench burial has the potential to impact groundwater and generate offensive odors, requiring the water table to be deep and the soil impermeable. Using the soil logs, perform hydrogeological and contaminant transport modeling to assess the likelihood of the burial site contaminating drinking water aquifers.
4. Consult with appropriate State regulatory agencies about permits for potential sites before initiating operations.
5. Verify the site is large enough for on-site burial of the carcasses based on Attachment 14.I Land Area or Excavation Volume Required for Trench Burial, and the FAD/PReP Guidelines: Disposal.(go.usdatraining.com/SOP_disposal).
6. Verify the site is accessible to carcass hauling trucks and heavy equipment.
7. Design the excavation size, depth, and side slope angles to prevent cave-ins.
8. Prepare and maintain a list of names and contact information for heavy machinery operators, fire department personnel, law enforcement, public works departments, departments of transportation, and regulatory agencies.
9. Contract with local heavy equipment suppliers and operators to deliver, operate, fuel, and maintain needed heavy equipment. Contract for carcass storage equipment and/or services if needed.
10. Ensure that personnel who will be operating the heavy equipment are properly certified in the use of the equipment.
11. Train disposal personnel on safety, biosecurity, and operational procedures in accordance with the Site Specific Plan.

Operations

1. Obtain all appropriate permits and approvals, including landowner's permission and acceptance of long-term environmental liability, to begin burial.

[18] Mukhtar, S., Boadu, F.O., Jim, Y.H., Shim, W., Vestal, T.A., & Wilson, C.L. (2012). *Managing Contaminated Animal and Plant Materials: Field Guide on Best Practices*.

2. Don all required PPE as detailed in the Site-Specific Health and Safety/PPE Plan.
3. Fence and stake the burial site.
4. Obtain the heavy equipment and machinery (backhoe, scraper, bulldozer, or other equipment) required for excavating.
5. Excavate the appropriate sized trench based on the excavation design parameters.
6. Puncture/vent the carcasses by stabbing the area posterior to the ribs and the thoracic and abdominal cavities, on the left side for ruminants.
7. Place carcasses in the trench.
8. Cover the carcasses with the excavated earth, being sure to grade the surface soil to facilitate runoff.
9. Seed the surface of the excavated area to minimize soil erosion.
10. Thoroughly clean and disinfect all of the disposal equipment. See the Cleaning and Disinfection SOP: go.usdatraining.com/SOP_CD and the Biosecurity SOP: go.usdatraining.com/SOP_Biosecurity
11. Regularly inspect and maintain the site by adding additional backfill to prevent pooling of water if necessary.
12. Highly recommended: monitor groundwater quality down gradient of the burial site(s) to ensure the ongoing safety of ground water.

Note on Mass Burial

Mass burial involves collecting carcasses from multiple affected premises and placing them in a large burial unit. The disposal unit must meet the criteria for a Subtitle D landfill, including leachate and landfill gas collection and management systems. During the 2001 FMD outbreak in the UK, approximately 20 percent (1.3 million carcasses) of FMD-infected carcasses were disposed using mass burial. Siting, permitting, designing, and constructing a Subtitle D landfill requires extensive site assessment, professional engineering design, and rigorous quality control during construction. The process takes a significant amount of time and funds, and the closed disposal unit requires long-term monitoring and acceptance of future environmental liability by the property owner. It is likely more cost-effective and efficient to establish an agreement with an existing Subtitle D landfill than to site, permit, design, and build a new one in the face of an emergency.

Carcass Management: Mobile Treatment Checklist

- [ ] **Contact all appropriate mobile treatment technology vendors.**
  - [ ] Verify the units are available for deployment to your site.
  - [ ] Verify your ability to meet all site/utility requirements.
  - [ ] Verify units can be fully disinfected after use.
  - [ ] Verify the units have adequate capacity to meet your needs.
  - [ ] If the capacity is less than needed, can the carcasses be stored/refrigerated while awaiting disposal?
  - [ ] Verify the availability of skilled operators and spare parts to keep the units operational.
  - [ ] Verify the unit can be set-up on the site (e.g., the site has appropriate grading)
- [ ] **If so, is the technology permitted by the state environmental agency?**
- [ ] **If so, can the permit conditions be met?**
- [ ] **If so, can the process byproducts be readily disposed?**
- [ ] **If mobile treatment is an option, see On-Site Treatment/Burial training module at** go.usdatraining.com/Disposal **and implement. If not, continue to Sixth Option.**

Developed by USDA, DHS, and the 3D IPT

Overview of Mobile Treatment Technologies

Mobile treatment technologies can offer alternative, innovative, and immediate approaches to disposing of animal carcasses on-site, particularly in response to emergency situations. There are several types defined below:

INCINERATION

Air-curtain incineration: blowing high velocity air across and down at an optimum angle into a firebox pit, creating an air curtain on top and a rotational turbulence within the firebox

Gasification: the waste mass is destroyed in multiple chambers including a primary (combustion) chamber followed by a secondary (gasification)

RENDERING

The process of converting animal carcasses into carcass meal (protein-based solids), melted fat or tallow, and water

ALKALINE HYDROLYSIS

Involves processing carcasses at high temperature, high pressure, and high pH to convert the proteins, nucleic acids, and lipids of the tissues to a sterile aqueous solution and solid by-products

STEAM OR MICROWAVE STERILIZATION

Uses the direct application of steam or multiple, high-energy microwave generators to treat the disposal waste

ADVANTAGES

- Easy to implement due to portability of units
- Inactivates pathogens
- Reduces the risk of disease spread due to limited movement and limited handling of infected material
- Environmentally favorable
- Self-contained units are generally acceptable to the public

DISADVANTAGES

- Availability of resources and equipment may be limited
- Accessibility to equipment may be impeded depending on vendor proximity to the on-site location
- May need specially skilled operators who can keep equipment running and who are trained in biosafety and biosecurity
- Level, paved areas may be needed to set up equipment and stage materials
- Availability and/or sources of spare parts for back-up equipment may be limited
- Extensive utilities may be required, such as fuel and electric for operations and support equipment
- Some methods may be limited by the volume of carcasses they can accommodate
- Some technologies may require preprocessing of carcasses and disposal of byproducts

Carcass Management: Off-Site Permitted Landfill Checklist

- [ ] **Consult with state environmental agency for landfill advice.**

- [ ] **Access a comprehensive list of landfills using the I-WASTE Tool at go.usdatraining.com/I-WASTE.**
  - [ ] Log on to the I-WASTE Tool and obtain a password if you do not currently have one.
  - [ ] Enter userid and password.
  - [ ] Choose treatment and disposal facilities button on the lower left.
  - [ ] Enter filter criteria such as "facility type (e.g., rendering, incinerators, or landfill)"
  - [ ] Note that construction debris landfills are not suitable for carcass disposal, and hazardous waste landfills are not necessary unless the carcasses are contaminated with a hazardous material causing them to be classified as hazardous
  - [ ] Enter State or EPA region, and click "View List of Facilities" button.

- [ ] **Contact facilities and determine if they will accept your livestock or poultry and meet some or all of your capacity needs.**
  - [ ] If there is insufficient capacity, consider fast-tracking expansion of existing landfill or permitting of new landfill for this purpose.
  - [ ] Consider potential environmental and biosecurity concerns.
  - [ ] Verify with state environmental agency that landfill has no outstanding permit violations.
  - [ ] Procure landfill services through appropriate Incident Management Team branch.

- [ ] **If the landfill will accept the material, arrange for biosecure transport.**
  - [ ] Obtain controlled movement permit for transport of infected carcasses
  - [ ] Determine type of transport vehicles required. If the waste must travel on public roads, it should be transported in closed, leak-resistant trucks or dumpsters. Secondary containment may be needed, depending on the type of waste being transported. See Landfill Disposal Guidance at go.usdatraining.com/HPAI_landfill.
  - [ ] Work with Depopulation Group Supervisor within the Incident Command System to determine how many animals can be depopulated per day and how many trucks will be needed for transport per day, ensuring the rates are about the same. If not, arrange for covered, leak-resistant storage.
  - [ ] Pre-identify transport routes to minimize exposure to susceptible premises.

- [ ] **If permitted landfilling is an option, see the Secure Transport and Off-Site Treatment/Burial training modules at go.usdatraining.com/Disposal and implement off-site permitted landfilling. If not, continue to Seventh Option.**

Developed by USDA, DHS, and the 3D IPT

Landfill Disposal Guidance—Recommended Waste Acceptance Practices for Landfills

April 18, 2016

Background

Highly pathogenic avian influenza (HPAI), commonly known as bird flu, is a foreign animal disease caused by influenza A viruses. These viruses are found naturally in wild bird populations. Wild birds act as reservoirs, circulating these viruses between each other, sometimes with no clinical signs. However, HPAI can be transmitted to domestic chickens and turkeys, which may result in an outbreak. The USDA is the lead federal agency in responding to foreign animal diseases, such as HPAI.

Purpose

The intent of this guidance is to provide recommended waste acceptance practices for landfill disposal of HPAI infected carcasses. In an outbreak, all carcasses must be disposed of in a timely, biosecure, aesthetically acceptable, and environmentally responsible manner. Permitted landfills are an important option for disposal during an outbreak. These landfills must have necessary environmental controls to manage carcasses. In addition, strict biosecurity procedures must be followed during transportation and disposal.

Protection of Landfill Operators

While the Centers for Disease Control and Prevention (CDC) has determined that risk for human infection from the 2014–2015 HPAI outbreak strains is low (see the *CDC Interim Guidance for Landfill Workers in the United States Disposing of Poultry Carcasses During Outbreaks of HPAI)*, the CDC does recommend landfill operators take appropriate precautions for those involved in disposal operations. If landfills are used to dispose of carcasses during an HPAI outbreak, landfill operators should follow CDC's guidelines, which are available in this section or by visiting go.usdatraining.com/HPAI_landfill

General Landfilling Process

All HPAI landfill operations will be supervised by personnel from USDA or State Departments of Agriculture. Contractors can be hired through the USDA to provide roll offs and other equipment at farms, CDL truck drivers (to transport roll offs to and from landfills), and personnel to perform cleaning and disinfection (C&D) of all conveyances. Contracted workers may also instruct truck drivers onsite, under the direction of landfill management.

The landfill will determine the amount of carcasses and waste materials they will accept from an infected farm. Waste materials may include manure, eggs, litter, left over feed, egg flats, pallets, used PPE, and C&D supplies. The landfill will also control the frequency of deliveries. Communication will be established between landfill management, State or federal site managers and/or case managers at an infected premises, and the USDA APHIS contracting office. Deliveries to and from the landfill are coordinated in advance between the landfill and the State or federal site manager on an infected premises.

Landfill Reimbursement

USDA APHIS may pay or reimburse landfills for operations that occur in addition to the normal course of business. This *could* include the following expenses, which will be negotiated at the time services are required:

- building temporary roads and entrances/exits dedicated to HPAI operations,
- purchasing additional liability insurance policies,
- hazing scavenger birds, and
- managing predators, pests, and odors related to HPAI waste disposal.

These items have been covered in the past, and will be negotiated with the landfill in advance, when farms have tested positive and emergency funding is made available. Any interested landfills should register as a federal contractor by:

1. Obtaining a DUNS number by visiting http://www.dnb.com/get-a-duns-number.html.
2. Registering at www.sam.gov (select "register/update entity" in the middle of the screen).

All entities must register in SAM to be paid. It takes an hour or two to register and then several days for the system to update.

Producers may choose to contract directly with landfills. Producers should check with their APHIS representative regarding reimbursement at the time of an outbreak prior to any expenditures.

Guidelines for State Regulators

State Departments of Environmental Protection or Natural Resources typically determine the guidelines for containment liners, leachate management, grey water management, timelines for covering contaminated materials, the depth of covering, modifications to working faces, and permits for landfill burial. The USDA can provide suggestions and brief the landfill regulatory agencies, but ultimately it is the landfill's responsibility to follow their State's rules and regulations. An example of what preparations could be made in advance by State regulatory agencies can be found below.

1. Technical requirements and procedures for landfilling of HPAI wastes are established by the State-level regulatory agency responsible for permitting of landfills (State environmental agency). These requirements are designed to be protective of human health and the environment, to not jeopardize the structural or operational integrity of the landfill, and to allow the facility to operate in compliance with their land disposal facility permit. Federal/State agencies charged with protecting animal health, biosecurity, and disease control are responsible for establishing any additional technical requirements and procedures pertaining to their authorities.
2. The State environmental agency may survey all potentially qualified land disposal facilities to determine their interest in accepting HPAI wastes. Information on the technical requirements and procedures for land disposal of HPAI wastes is included in the communication so landfills can perform an initial evaluation of their facility's capability in regards acceptance of HPAI wastes.
3. The landfill notifies the State environmental agency of its willingness to accept HPAI wastes.
4. The State environmental agency meets with landfill representatives to evaluate the suitability of their facility to accept HPAI wastes. The evaluation includes the following topics:

   a. Area within the landfill for disposal of HPAI wastes; verification that the area is underlain by a leachate collection system.
   b. Number of acres available for disposal of HPAI wastes.
   c. Thickness of already-disposed waste layer between surface of landfill and leachate collection system.
   d. Leachate management activities and method for disposal of excess leachate.
   e. Logistics of HPAI waste acceptance and coordination of HPAI waste acceptance with acceptance of routine waste streams.
   f. Gas collection system – location and any necessary operational changes during HPAI waste disposal activities to reduce the risk of fires.
   g. Mobile incinerator – is landfill facility willing and able to host a mobile incinerator at their facility, and if so, determine if a fuel source is available.
   h. Public relations and community outreach – discuss how the public and local elected officials will be informed of and educated about potential HPAI waste landfilling activities at the facility.
5. The State environmental agency informs federal/State agencies charged with protecting animal health, biosecurity, and disease control of the landfill facilities deemed technically able and willing to accept HPAI wastes for disposal.

Typical Emergency Landfilling Procedures, Roles, and Responsibilities

1. The landfill agrees to receive infected birds.
2. State provides permits and permit conditions to landfill.
3. USDA contractor visits the landfill to evaluate access, and works with the landfill to:
   a. plan traffic routing for trucks carrying HPAI waste,
   b. stabilize the roadway if needed,
   c. select the location for vehicle C&D, and
   d. select C&D wash water disposal option(s).
4. The USDA contractor provides recommendations for road stabilization material in addition to possible government equipment needed.
5. USDA APHIS awards contract to the landfill.
6. The landfill consults with the USDA APHIS on cost—an agreement is then made to proceed with any required modifications to handle the HPAI waste.
7. The USDA contractor sets up and operates vehicle C&D station(s).
8. The USDA contractor provides, loads, and disinfects outbound trucks at origin (e.g., sealed roll-offs lined with plastic to allow bags to slip out; biozip (or similar) bag placed in roll-off over liner; 1 foot wood chips placed in bottom of bag; birds loaded to within 1 foot of top of roll-off; biozip (or similar) bag sealed; roll-off disinfected and tarped).
9. USDA provides a permit for the truck to leave the infected premises.
10. The USDA contractor or subcontractor drives the truck to the landfill and prepares to dump where directed by landfill staff or designee.
11. The USDA contractor uses heavy equipment to open roll-off gate.
12. The truck driver tips load where directed.
13. The USDA contractor covers the waste material.
14. The landfill manages leachate in accordance with permit conditions.
15. The USDA contractor or subcontractor drives the truck to the C&D station for washing prior to leaving landfill.
16. The USDA contractor or subcontractor disposes of C&D wash water in accordance with the landfill and State requirements (likely at the municipal waste water treatment plant).
17. USDA APHIS pays the contractor and landfill when their invoices are approved.

Aerial View of Landfill Staging

For Further Information

Please see the following websites for further information concerning HPAI:

- go.usdatraining.com/FADPReP
- go.usdatraining.com/HPAI

CDC Interim Guidance for Landfill Workers in the United States Disposing of Poultry Carcasses During Outbreaks of Highly Pathogenic Avian Influenza

A. Purpose and Background

The purpose of this document is to provide information and guidance for workers at landfill sites in the United States where poultry carcasses are disposed of during outbreaks of highly pathogenic avian influenza (HPAI) A(H5N2) virus. Landfill workers include mechanical equipment operators, individuals standing on the surface of the landfill when carcasses are deposited, and personnel having direct physical contact with AI virus-infected bird carcasses or potentially infected materials.

Avian Influenza (AI) Viruses

- Avian influenza (AI) viruses circulate naturally among wild birds, particularly the waterfowl reservoir, and readily enter domestic bird/poultry populations.
- Most AI viruses are low pathogenic and do not cause serious illness among infected birds or people.
- Highly pathogenic AI viruses often cause severe illness and death in infected poultry.
- AI viruses can spread quickly among birds.
- AI virus infections of people are rare, but can occur.

The HPAI H5N2 virus that caused poultry outbreaks during 2014-2015 in North America is an emerging virus. Preliminary laboratory studies indicate that this HPAI H5N2 virus is not well-adapted to humans. However, sporadic severe and fatal human respiratory illness from infections with other closely related HPAI A(H5) viruses (e.g. H5N1, H5N6) have occurred in other countries. Most human infections with avian influenza A viruses have occurred in persons not using appropriate personal protective equipment (PPE) who had exposures consisting of either 1) direct physical contact with infected birds or surfaces contaminated by the viruses; 2) being in close proximity (e.g. within 2 meters) to infected birds; or 3) visiting a live poultry market. Although no human infections with HPAI H5N2 virus have been reported to date, direct or close (e.g. within 2 meters) contact without PPE to infected birds or virus-contaminated environments may increase the risk of human infection. To reduce their risk of HPAI H5N2 virus infection, landfill workers should use appropriate PPE when disposing of poultry carcasses during outbreaks of HPAI. The following guidance, although developed for an outbreak of HPAI A(H5N2) virus, also applies to disposal of poultry carcasses during outbreaks of HPAI H5N8 and HPAI H5N1 viruses. Consultation and close coordination with public health departments are recommended.

<u>Key points: To reduce the risk of HPAI virus infection, landfill workers should do all of the following:</u>

Wear recommended personal protective equipment (PPE): gloves, boots, protective coveralls, goggles and a respirator) when in direct contact with infected birds, poultry carcasses, and/or poultry feces or litter;

- Avoid unprotected direct physical contact with ill birds or poultry carcasses;
- Avoid unprotected direct physical contact with bird droppings/feces from HPAI virus-infected birds;
- Wash hands with soap and water after removing gloves and other PPE. If soap and water are not readily available, alcohol-based hand rubs may be used, but must be followed by washing with soap and water once it becomes available because hand sanitizers do not reduce organic load (e.g., dirt);

- Report any illness that occurs within 10 days of the past exposure to poultry carcasses or potentially-infected materials (see section C. below for more details).

B. Guidance for landfill workers disposing of poultry carcasses

1. Bury the AI virus-infected bird carcasses and materials immediately (within 30 minutes) after unloading at the landfill.

2. Whenever possible, avoid physical handling of the carcasses by using mechanical equipment such as trucks and back hoes with enclosed cabs.

3. All landfill workers should:

   a) Use PPE including: properly-fitted safety goggles, disposable gloves, boots, a NIOSH-certified respirator (e.g., N95), and disposable fluid-resistant[1] coveralls.

      (1) NIOSH-certified N95 (or higher) respirators are recommended for landfill workers who have contact with AI virus-infected carcasses or potentially infected materials.

      Respirator use should be in the context of a complete respiratory protection program in accordance with the Occupational Safety and Health Administration (OSHA) Respiratory Protection standard (29 CFR 1910.134) and other requirements. Staff that will need to wear N95 (or higher) respirators should be medically-cleared, trained, and fit-tested for respirator use. Detailed information on respiratory protection programs, including fit testing procedures, can be accessed at OSHA's Respiratory Protection eTool: (www.osha.gov/SLTC/etools/respiratory).

      Training topics should include all of the following:

      (a) Proper fit-testing, wearing and use of respirators;

      (b) Safe removal of respirators;

      (c) Safe disposal of disposable respirators or cleaning and disinfection of reusable respirators;

      (d) Medical contraindications to respirator use.

      (2) Reusable PPE should be:

      (a) Cleaned until visible dirt is removed, and then

[1] Fluid-resistant coveralls should be made of fabric that passes:
- AATCC 42 ≤ 1 g and AATCC 127 ≥ 50 cm H_2O or EN 20811 ≥ 50 cm H2O; or
- ASTM F1670 (13.8 kPa); or
- ISO 16603 ≥ 3.5 kPA

(b) Disinfected with an EPA approved disinfectant that has label claims against influenza A viruses (http://www.epa.gov/oppad001/influenza-disinfectants.html) according to the manufacturer's instructions.

(3) Respirator use is not necessary inside enclosed cabs when the cab's filtration system has been independently evaluated against the NIOSH leak test method for enclosed cab filtration systems and it can be demonstrated that the cab provides the same, or higher level, of protection as an N95 respirator. The NIOSH leak test method for enclosed cab filtration systems are available on the web at http://www.cdc.gov/niosh/mining/UserFiles/works/pdfs/2012-145.pdf.

(4) All PPE should be used in accordance with OSHA regulations found at 29 CFR 1910 Subpart I (Personal Protective Equipment). Workers should receive training on and demonstrate an understanding of when to use PPE; what PPE is necessary; how to properly put on, use, take off, properly dispose of, and maintain PPE; and the limitations of PPE.

(5) Landfill workers who may have direct contact with carcasses or potentially infected materials (e.g. individuals responsible for opening the roll-off container for unloading) should wear a disposable impermeable[2] coverall in place of the fluid-resistant coverall referenced above or an apron over the fluid-resistant coverall to protect against exposure to liquids.

b) Safely remove PPE after burial in sequence:

(1) Remove and dispose of the apron, if worn;

(2) Clean and disinfect boots;

(3) Remove boots;

(4) Remove and dispose of the coverall;

(5) Remove and dispose of gloves;

(6) Wash hands with soap and water;

(7) Remove goggles and respirator;

(8) Clean and disinfect reusable goggles and respirator;

(9) Wash hands with soap and water again.

c) Put on and take off PPE in separate clean areas;

d) Perform good hand hygiene such as hand-washing with soap and water or using an alcohol-based hand rub after removing PPE;

e) Avoid touching eyes, mouth, nose after touching any contaminated material while wearing PPE;

f) Do not eat, drink, smoke, or use the bathroom while wearing PPE.

[2] Impermeable coveralls should be made of fabric and seams/closures that pass

- ASTM F1671 (13.8 kPA); or
- ISO 16604 ≥ 14 kPa

C. Reporting of illness

1. Workers at the landfill should monitor their health starting on the first day of exposure and for ten days after the last exposure to material and poultry carcasses from affected farms, and report any illness signs or symptoms (e.g. fever or feeling feverish, cough, runny nose, sore throat, headache, muscle aches, eye redness, difficulty breathing, shortness of breath, diarrhea, etc.) to the local and state public health department as soon as possible.

2. Additional information about avian influenza and worker protection can be found at:

   a) NIOSH Avian Influenza: http://www.cdc.gov/niosh/topics/avianflu/

   b) OSHA Guidance for Protecting Employees Against Avian Flu: https://www.osha.gov/dsg/guidance/avian-flu.html

   c) CDC Information on Avian Influenza: http://www.cdc.gov/flu/avianflu/

   d) CDC H5 Viruses in the United States: http://www.cdc.gov/flu/avianflu/h5/index.htm

   e) CDC Prevention and Treatment of Avian Influenza A Viruses in People http://www.cdc.gov/flu/avianflu/prevention.htm

   f) CDC Interim Guidance on Influenza Antiviral Chemoprophylaxis of Persons Exposed to Birds with Avian Influenza A Viruses Associated with Severe Human Disease or with the Potential to Cause Severe Human Disease http://www.cdc.gov/flu/avianflu/guidance-exposed-persons.htm

   g) OSHA Guidance Update on Protecting Employees from Avian Flu (Avian Influenza) Viruses: http://www.osha.gov/Publications/3323-10N-2006-English-07-17-2007.html

   h) OSHA Safety and Health Topics Page for Avian Flu: http://www.osha.gov/dsg/guidance/avian-flu.html

   i) OSHA Avian Flu Fact Sheet: http://www.osha.gov/OshDoc/data_AvianFlu/avian_flu_factsheet.pdf

   j) OSHA Avian Flu Quick Card: http://www.osha.gov/Publications/3306-10-06-english-06-27-2007.html

   k) OSHA Safety and Health Information Bulletin (SHIB) on Avian Flu: https://www.osha.gov/dts/shib/shib121304.html

D. References

1. Senne DA, Panigrahy B, Morgan RL. Effect of composting poultry carcasses on survival of exotic avian viruses: highly pathogenic avian influenza (HPAI) virus and adenovirus of egg drop syndrome-76. Avian Dis. 1994 Oct-Dec;38(4):733-7.

2. Guan J, Chan M, Grenier C, Wilkie DC, Brooks BW, Spencer JL. Survival of avian influenza and Newcastle disease viruses in compost and at ambient temperatures based on virus isolation and real-time reverse transcriptase PCR. Avian Dis. 2009 Mar;53(1):26-33.

STANDARD OPERATING PROCEDURES: 14. DISPOSAL

Attachment 14.C Landfilling

Planning

1. Contact state environmental agency for approval to landfill waste.
2. Identify permitted Subtitle D landfills in the vicinity of the affected premises (see EPA's I-WASTE Tool at http://www2.ergweb.com/bdrtool/login.asp for a database of disposal facilities).
3. Contact identified landfills and ensure operator will accept catastrophic FAD mortalities, and the conditions of acceptance.
4. Verify the availability of adequate carcass storage facilities such as refrigerated rooms, transport vehicles, freezers or other means of carcass preservation.
5. Identify haulers who:
   a. Are equipped to haul carcasses in accordance with State and Federal laws.
   b. Can provide secure, leak-resistant, covered, transport for the infected carcasses and contaminated materials.
   c. Employ appropriately licensed drivers.
   d. Possess vehicles in good mechanical condition and capable of carrying the load without difficulty.
   e. Have vehicles which can be covered with a tarpaulin if they do not have closed tops.
   f. Employ drivers adequately trained in biosecurity (see 49 CFR 172 and 173 DOT regulations for further guidance).
   g. Have an emergency plan and associated supplies which address spills/excess leakage; vehicle break-downs; traffic accidents; adverse weather conditions; and terrorist attacks.

Operations

1. Don all required PPE as detailed in the Site-Specific Health and Safety/PPE Plan.
2. Prior to loading each vehicle, confirm with landfill operator(s) that they will accept the load of disease-infected carcasses. Inform landfill contact person about space, personnel, safety, and biosecurity requirements.
3. If the vehicle is not leak-resistant with a sealed cover, line the vehicle with plastic sheeting or bags and place one foot of absorbent bedding material over the liner to cushion the load and minimize the risk of puncturing the liner.
4. Puncture/vent the carcass by stabbing the area posterior to the ribs and the thoracic and abdominal cavities.
5. Load punctured carcasses into lined/leak-resistant vehicle leaving at least one foot of space at the top.
6. Seal full load.
7. Disinfect exterior of vehicle.

8. Prepare all placards and manifests in accordance with applicable regulations.
9. Obtain controlled movement permit from state.
10. Maintain a log of all shipments including
    a. the amount and type of material hauled;
    b. address of originating premises;
    c. location of landfill, contact name and contact phone number;
    d. transport vehicle license and registration numbers;
    e. driver name and contact information;
    f. supervisor's name and signature;
    g. C&D checklist;
    h. time/date of departure from premises and arrival at disposal site;
    i. unique reference number for each load; and
    j. any unusual circumstances.
11. Transport load to the landfill. using transport routes that minimize exposure to susceptible premises.
12. Check in at weigh station.
13. Obtain receipt for weight of load and any tipping fees.
14. Proceed to working face of landfill as directed by landfill staff.
15. Have site operators open the tailgate; not the driver.
16. Tip the vehicle into the hollow under the working face or as directed by the landfill operator.
17. Landfill operators should cover carcasses immediately.
18. Proceed to designated biosecurity station to disinfect vehicle before leaving the landfill. See the Biosecurity and Health and Safety/PPE SOPs.
19. Properly clean and disinfect all site machinery used in the operation. See the NAHEMS Guidelines: C&D and the C&D SOP.
20. All individuals involved in the disposal process must wear appropriate PPE. See the NAHEMS Guidelines: Health and Safety, NAHEMS Guidelines: PPE, and the Health and Safety/PPE SOP.

Table 14.C-1 compares recommended actions for handling and disposing of carcasses for routine, noninfectious material and potentially infectious material.

Figure 14.C-1. Recommended Actions for Handling and Disposal of Carcasses During Burial and Landfill[15]

Routine, Noninfectious Material	Potentially Infectious Material (Actions in Addition to Those for Routine Material)
Prepare waste profile paperwork	Excavate site before carcass arrival and cover with soil immediately after burial
Cover transportation vehicles (with tarp or similar covering)	Avoid transportation of carcasses through neighborhoods
Avoid free liquids by using adsorbent materials	Dispose of infectious material in a separate area of the landfill
Minimize odors with quick, efficient handling	Monitor air for presence of bacteria
Avoid personnel coming into direct contact with materials	Use proper personal protection equipment for workers unloading infectious material
Bury as soon as possible	Dispose of material 40 feet above leachate collection system
Keep birds and vermin away from working landfill surface as much as possible	Implement formal bird-control program on landfill surface
Account for stability considerations if volume is large, because subsidence may be significant and the decaying carcasses may be slimy and have little geotechnical strength	Map and record vault disposal area and store information with asbestos data
	Decontaminate transportation vehicles
	Protect heavy-equipment operators by using pressurized cabs
	Hire specialized contractors to handle infectious material (biosecurity)

[15] CAST [Council for Agricultural Science and Technology]. "Ruminant Carcass Disposal Options for Routine and Catastrophic Mortality." Issue Paper, No. 41: January 2009. http://www.cast-science.org/

Carcass Management: Rendering Checklist

- [ ] **Will state environmental agency approve rendering?**

- [ ] **If so, see a complete list of renderers at** go.usdatraining.com/NRA **or the EPA database at** go.usdatraining.com/I-WASTE**.**
  - [ ] Log on to the I-WASTE Tool and obtain a password if you do not currently have one.
  - [ ] Enter userid and password.
  - [ ] Choose treatment and disposal facilities button on the lower left.
  - [ ] Enter filter criteria such as "facility type (e.g., rendering, incinerators, or landfill)"
  - [ ] Enter State or EPA region, and click "View List of Facilities" button or map facilities.

- [ ] **Contact facilities and determine if they will accept your livestock or poultry and meet some or all of your capacity needs.**
  - [ ] If the capacity is less than needed, can the carcasses be stored/refrigerated while awaiting disposal?

- [ ] **If so, arrange for storage and transport to rendering facility for disposal.**
  - [ ] Determine if any permits are required for transport of infected carcasses.
  - [ ] Determine type of transport vehicles required. If the waste must travel on public roads, it should be transported in closed, leak-proof trucks or dumpsters. Secondary containment may be needed, depending on the type of waste being transported. Contact National Veterinary Stockpile.
  - [ ] Work with Depopulation Group Supervisor within the Incident Command System to determine how many animals can be depopulated per day and how many trucks will be needed for transport per day, ensuring the rates are about equal. If not, arrange for leak-resistant, covered storage.
  - [ ] Pre-identify transport routes to minimize exposure of susceptible premises.

- [ ] **If rendering is an option, see Secure Transport and Off-Site Treatment/Burial training modules at** go.usdatraining.com/Disposal **and implement rendering. If not, continue to Eighth Option.**

STANDARD OPERATING PROCEDURES: 14. DISPOSAL

Attachment 14.B Rendering

In carcass rendering, whole carcasses are mechanically crushed into 2-in^3 cubes of tissues, broken down thermally, and sterilized in a sealed and controllable container using pressurized steam.[13] The process converts the carcasses into 60% water, 20% fat/tallow and 20% meat/bone meal, which is often used as animal feed. Because the rendering plant will likely be located off the affected premises, the carcasses will have to be securely transported to the rendering plant.

Planning

1. Identify carcass rendering plant(s) in the region of the affected premises; ideally one that participates in the Animal Protein Producers Industry (APPI) program to test for Salmonella in the meat and bone meal and has at least one person on site who has received training by the APPI or a certified trainer from an equivalent program. Ensure that the rendering plant has a deodorizing system. See National Renderers Association Directory
2. Develop a memorandum of understanding with nearby counties if county lines must be crossed to reach the identified rendering plant.
3. Coordinate with the managers of the rendering plants about rendering infected carcasses. Discuss with the managers at the rendering plant:
   a. The responsible party for C&D after rendering is complete.
   b. Potential compensation for use of the facility.
   c. The volume of carcasses accepted per day.
4. Make all necessary arrangements for the transportation and delivery of carcasses to the plant, making use of the renderer's hauling service if appropriate.
5. Ensure that all rendering plant personnel are trained on proper procedures for rendering infected carcasses, biosecurity procedures, work safety issues, and the use of PPE. If not,
6. Train the rendering plant personnel on biosecurity, work safety issues, and the use of PPE based on the Code of Practice approved October 18, 2004, by the North American Rendering Industry,[14] as well as the Site Specific Disposal Plan, the NAHEMS Guidelines: Biosecurity, Biosecurity SOP, NAHEMS Guidelines: Health and Safety, NAHEMS Guidelines: PPE, and the Health and Safety/PPE SOP or use engineering controls to contain the system so exposures are minimized.
7. Have a Disposal Team Member available to facilitate the rendering process of disease-infected carcasses.
8. Employ biosecurity zones in the plant to minimize the risk of contamination from carcass materials entering, and of finished products exiting, the processing plant.

[13] http://www.fda.gov/AnimalVeterinary/GuidanceComplianceEnforcement/ComplianceEnforcement/BovineSpongiformEncephalopathy/ucm167655.htm.
[14] http://www.nationalrenderers.org/biosecurity-appi/.

9. Ensure all rendering permit conditions are met and ensure pathogens that may be emitted as aerosols from the process, particularly near the grinders are contained.

Operations

1. Don all required PPE as detailed in the Site-Specific Health and Safety/PPE Plan.
2. If possible, use the rendering company's carcass pickup service. Regardless of the transportation provider, the transport of infected carcasses off premises must follow the transportation procedures outlined in Section 14.4.3.5.3 Transport
3. Perform the rendering process within 24 to 48 hours of an animal's death or as advised by rendering company.
4. Control and record the input rate relative to the size of the rendering vessel and verify that all locations in the vessel reach the minimum temperature and cooking time to inactivate the virus.
5. Properly maintain the carcass-receiving and finished-product sections as "dirty" and "clean" areas of the rendering plant and keep them separated.
6. Workers cannot move between the "dirty" and "clean" areas without personnel decontamination. See go.usdatraining.com/NAHEMS_Biosecurity and go.usdatraining.com/SOP_Biosecurity
7. Routinely sanitize the equipment and maintain the tools used on the processing lines and in the facilities.
8. Prevent the drainage of liquids from dirty to clean areas to avoid contaminating the finished products and their transportation system.
9. Implement procedures to monitor odors and investigate and resolve odor-related complaints.
10. Monitor the cooking process.
11. Plan to dispose of the rendered products unless specifically authorized to use for pet feed. Disposal options for rendered product include composting, landfilling, or recycling at a cement kiln.
12. Thoroughly clean and disinfect all of the rendering plant equipment. See the NAHEMS Guidelines: C&D and the C&D SOP and any additional standards for returning the plant to normal production. Heating the plant to 120 F for 7 days may also be acceptable.

STANDARD OPERATING PROCEDURES: 14. DISPOSAL

Attachment 14.4.3.5.3 Transport

Transport vehicles will be needed to transport items (carcasses, other materials) to the disposal site whether it is on or off the premises. If the waste must travel on public roads, it should be transported in closed, leak-resistant trucks or dumpsters. Secondary containment may be needed, depending on the type of waste being transported. Consult a qualified waste management professional when developing this section of the plan. Some other transport planning considerations are listed below:

- ☐ Do disposal facilities selected for this premises have any special requirements for incoming waste shipments?

- ☐ Have the disposal facilities agreed to accept the type and amount of waste you plan to send them and are they permitted appropriately?

- ☐ Have members of the disposal team visited the facility to ensure it is operated in accordance with all applicable laws and regulations?

- ☐ Is there an existing contract or agreement in place with the disposal facility to receive the material?

- ☐ Are all permit, agreement, and/or contract conditions delineated and will the shipments meet the conditions? If not, what corrective actions would be needed?

- ☐ Are haulers to be used for the response properly equipped to haul carcasses in accordance with all applicable laws?

- ☐ Are transport vehicles designed to handle the materials to be transported?

- ☐ Are the drivers adequately trained in biosecurity (see 49 Code of Federal Regulations [CFR] 172 and 173 Department of Transportation [DOT] regulations for further guidance)?

- ☐ Can two-way communications be maintained with the hauler during transport?

- ☐ Do shipments require law enforcement escorts?

- ☐ What travel routes will be used from the premises to the disposal site? Consider road construction, neighborhoods, and densely populated areas, as well as susceptible farms.

- ☐ Has an alternate travel route been identified?

- ☐ What procedures will be followed if the vehicle is damaged during transit?

- ☐ Does the receiving facility have sufficient space for incoming vehicles to avoid causing traffic disruptions on access roads? Does it have a secure location for transport vehicles, freezers, or other means of storage if there is a delay of more than 1 day?

- ☐ Coordinate with State and local transportation authorities to verify any transport restrictions and obtain any necessary permit requirements and document these conditions in the site-specific plan.

- ☐ How will vehicles be cleaned and disinfected before leaving the affected premises and after materials have been offloaded at the disposal site? See go.usdatraining.com/NAHEMS_Biosecurity and go.usdatraining.com/SOP_Biosecurity for more details.

- ☐ How is the waste classified for transport? What DOT packaging standards apply? Are all standards consistently met, including labeling, placarding, and manifesting?

- ☐ How will vehicle loading be performed in order to avoid releasing biological agent(s) to the environment?

- ☐ How will transport vehicle traffic be minimized into the Control Area?

Example Rendering Plant Biosecurity Protocol

Infected materials will have temporal separation from the general rendering materials. They will be the last materials run in the plant at the end of a week. This will minimize cross contamination.

Infected material trailers will be sealed, tarped, and loaded per rendering norms or University of Minnesota Risk Assessment.

Following offloading, the trailers will be washed per incident-specific protocols and will be cleaned at a commercial truck wash prior to returning to service.

Access points between raw material processing and finished product grinding and load out will be limited to one or two hand wash/ boot wash station(s). All other access points will be sealed and no longer used. Workers will be required to clean and sanitize their hands and boots prior to entering the finished product handling area.

Developed by Texas A&M University. Source: L. Miller, personal communication, 2014

Carcass Management: Off-Site Incineration Checklist

- [ ] **Will state environmental agency approve incineration?**

- [ ] **If so, see a complete list of incinerators at the EPA database at** go.usdatraining.com/I-WASTE**.**
  - [ ] Log on to the I-WASTE Tool and obtain a password if you do not currently have one.
  - [ ] Enter userid and password.
  - [ ] Choose treatment and disposal facilities button on the lower left.
  - [ ] Enter filter criteria such as "facility type (e.g. rendering, incinerators, or landfill)"
  - [ ] Enter State or EPA region, and click "View List of Facilities" button or map facilities.

- [ ] **Contact air authorities to verify operations are not in violation of their air permits.**

- [ ] **If the facilities are compliant, contact them and determine if they will accept your livestock or poultry and meet some or all of your capacity needs.**

- [ ] **If so, arrange for transport to off-site incineration facility for disposal.**
  - [ ] Determine if any permits are required for transport of infected carcasses.
  - [ ] Determine type of transport vehicles required. If the waste must travel on public roads, it should be transported in closed, leak-proof trucks or dumpsters. Secondary containment may be needed, depending on the type of waste being transported. See University of Minnesota Risk Assessment
  - [ ] Work with Depopulation Group Supervisor within the Incident Command System to determine how many animals can be depopulated per day and how many trucks will be needed for transport per day, ensuring the rates are about equal. If not, arrange for leak-resistant, covered storage.
  - [ ] Pre-identify transport routes to minimize exposure of susceptible premises.

- [ ] **If off-site incineration is an option see the Secure Transport and Off-Site Treatment/Burial training modules at** go.usdatraining.com/Disposal **and implement off-site incineration. If not, and you still need to dispose of animals, inform Operations Chief and discuss alternate strategies such as vaccination. Return to First Option and repeat cycle until all carcasses can be managed.**

Developed by USDA, DHS, and the 3D IPT

STANDARD OPERATING PROCEDURES: 14. DISPOSAL

Attachment 14.D Fixed Incineration

Planning

1. Identify permitted pathological waste incinerators in the vicinity of the affected premises (see EPA's I-WASTE Tool at http://www2.ergweb.com/bdrtool/login.asp for a database of disposal facilities).
2. Contact identified facilities and ensure operator will accept catastrophic FAD mortalities, and the conditions of acceptance.
2. Contact state environmental agency for approval.
3. Verify the availability of adequate carcass storage facilities such as refrigerated rooms, transport vehicles, freezers or other means of carcass preservation if storage will be needed.
4. Identify haulers who:
   a. Are equipped to haul carcasses in accordance with State and Federal laws.
   b. Can provide secure, leak resistant transport for the infected carcasses and contaminated materials.
   c. Employ appropriately licensed drivers.
   d. Possess vehicles in good mechanical condition and capable of carrying the load without difficulty.
   e. Have vehicles which can be covered with a tarpaulin if they do not have closed tops.
   f. Employ drivers adequately trained in biosecurity (see 49 CFR 172 and 173 DOT regulations for further guidance).
   g. Have an emergency plan and associated supplies which address spills/excess leakage; vehicle break-downs; traffic accidents; adverse weather conditions; terrorist attacks.

Operations

1. Don all required PPE as detailed in the Site-Specific Health and Safety/PPE Plan.
2. Prior to loading each vehicle, confirm with incinerator operator(s) that they will accept the load of infected carcasses.
3. Inform contact person about space, personnel, safety, and biosecurity requirements.
4. If the vehicle is not leak-resistant with a secure cover, line the vehicle with plastic sheeting or bags and place one foot of absorbent bedding material over the liner to cushion the load and minimize the risk of puncturing the liner.
5. Puncture/vent the carcass by stabbing the area posterior to the ribs and the thoracic and abdominal cavities.
6. Load punctured carcasses into leak-resistant or lined vehicle, leaving one foot free space at the top.
7. Securely cover load.
8. Disinfect exterior of vehicle.

9. Prepare all placards and manifests in accordance with applicable regulations.
10. Obtain permit for controlled movement from state.
11. Maintain a log of all shipments including
    a. the amount and type of material hauled;
    b. address of originating premises;
    c. location of incinerator, contact name, and contact phone number;
    d. transport vehicle license and registration numbers;
    e. driver name and contact information;
    f. supervisor's name and signature;
    g. C&D checklist;
    h. time/date of departure from premises and arrival at disposal site;
    i. unique reference number for each load; and
    j. any unusual circumstances.
12. Transport load to the incinerator
13. Check in at weigh station if applicable.
14. Obtain receipt for weight of load and any disposal fees.
15. Proceed to unloading area as directed by facility staff.
16. Have site operators open the tailgate; not the driver.
17. The carcasses should be covered immediately and kept covered until they are moved to temporary storage or to processing.
18. Incinerate the carcasses in accordance with facility protocols.
19. Ensure the facility follows all biosecurity requirements.
20. Proceed to designated biosecurity station to disinfect vehicle before leaving the facility. See the Biosecurity and Health and Safety/PPE SOPs.
21. Properly clean and disinfect all site machinery used in the operation. See the NAHEMS Guidelines: C&D and the C&D SOP.
22. All individuals involved in the disposal process must wear appropriate PPE. See the NAHEMS Guidelines: Health and Safety, NAHEMS Guidelines: PPE, and the Health and Safety/PPE SOP.

STANDARD OPERATING PROCEDURES: 14. DISPOSAL

Attachment 14.E Air-Curtain Incineration

Planning

1. Consult with appropriate State regulatory agencies for air quality and solid-waste permits before initiating operations.
2. Inform any other local authorities about the planned thermal destruction as required.
3. Ensure that equipment, and spare parts, are available for the chosen thermal method.
4. Ensure enough trained personnel are available to maintain continuous operations.
5. Provide appropriate sustenance and housing needs for disposal personnel if necessary.
6. Assuming a mobile air-curtain incinerator will be brought to the affected premises, verify the availability of air curtain incineration units and carcass storage facilities such as refrigerated rooms, transport vehicles, freezers or other means of carcass preservation.
7. Consult with USDA NRCS and evaluate the affected premises for the depth to the water table and proper soil conditions if trench burners will be used.
8. Use refractory boxes on sites with a high water table or on rocky soil and where trenches would be difficult or costly to build.
9. Locate the mobile air-curtain unit in an area that is easily accessible to heavy vehicles hauling carcasses and equipment.
10. Gather the appropriate materials such as solid fuels (straw, hay, coal, kindling wood, untreated lumber). Base the amount of solid fuels to use on the amount of moisture in the wood or other organic sources (hay, grain, stalks, and straw) and the fat and moisture content of the carcasses. Use a fuel-to-carcass weight ratio ranging from 1:1 to 2:1. Ensure availability of enough fuel to last 2-3 days or the length of time needed to maintain uninterrupted supply.

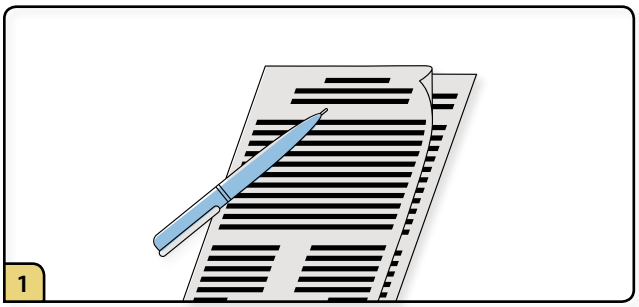
Operations

1. Don all required PPE as detailed in the Site-Specific Health and Safety/PPE Plan.
2. Build the appropriate sized trench based on equipment vendor recommendations, or use refractory boxes. See NAHEMS Guidelines: Disposal.
3. Monitor the wind direction before and during the burning operations.
4. Keep workers out of the path of the flame.
5. Handle the ash in the refractory boxes carefully and dispose of it at a burial or land application site that has been approved by the appropriate regulatory agency.
6. If a large number of animal carcasses (exceeding a cumulative weight of 1 million pounds) require destruction, conduct the thermal destruction at a distance of 2 miles from residential buildings, roads, and utilities.
7. Use proper precautions when dealing with certain FADs such as HPAI to prevent personnel inhalation of airborne pathogens. Personnel must use proper PPE. See the NAHEMS Guidelines: Health and Safety, NAHEMS Guidelines: PPE, and disease specific Health and Safety/PPE SOPs for more information.
8. Thoroughly clean and disinfect all of the disposal equipment. See the C&D and Biosecurity SOPs.

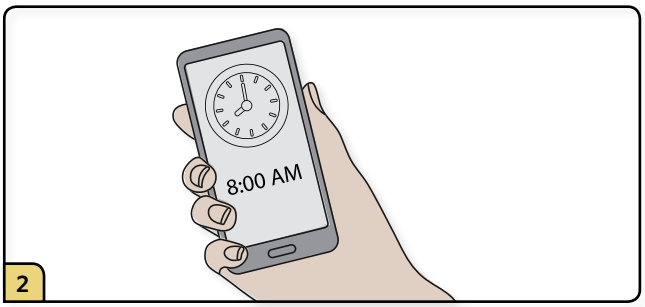
Loading Procedures

See Secure Transport training module at go.usdatraining.com/Disposal and implement transport phase.

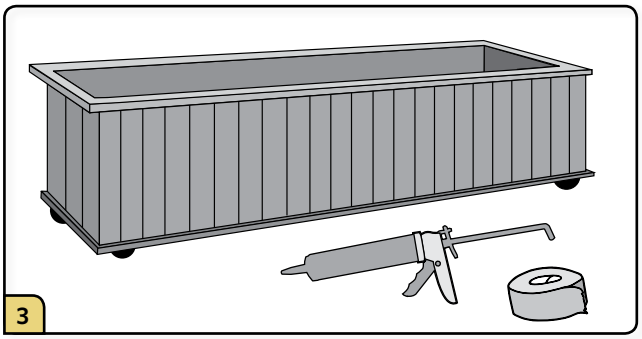
PRE-LOADING



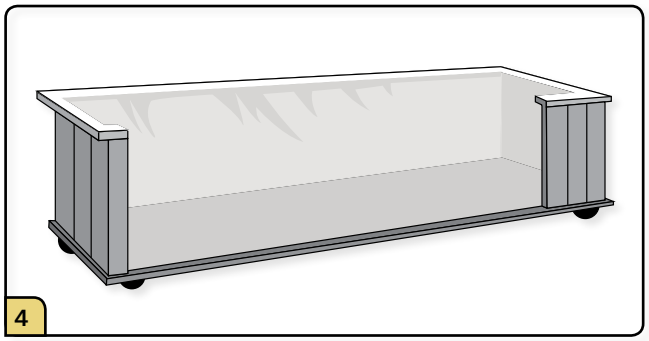
complete all paperwork including manifests and/or controlled movement permits.



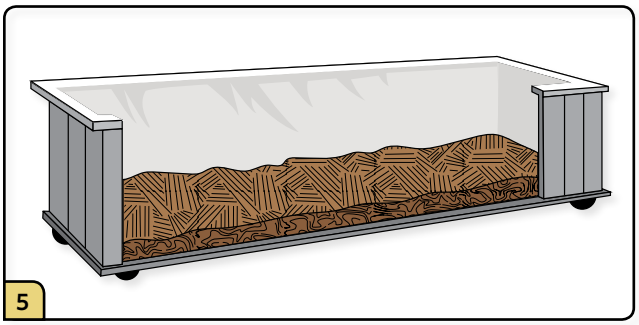
Order through ICS Logistics by 10:00 a.m. of the previous day. Specify type of delivery, type of container, size of waste, delivery time window, bin identification number, and contact name and phone number for job site.



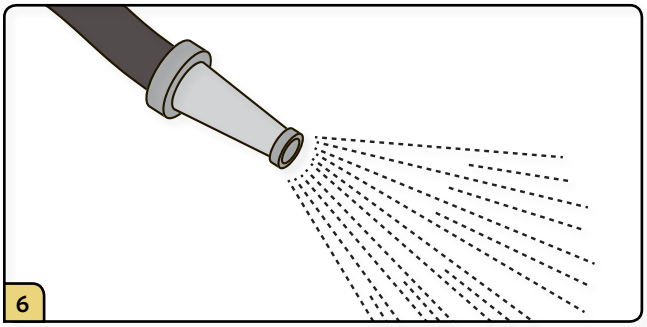
Inspect and line the containers. Seal any holes or spaces with duct tape, plastic liner, caulk, or silicone. Return containers that you cannot seal.



Insert Biozip or similar bag.



Rake one foot of absorbent material on the container floor with a heavier concentration near the rear door. Close container and adjust plastic and absorbent material as needed.



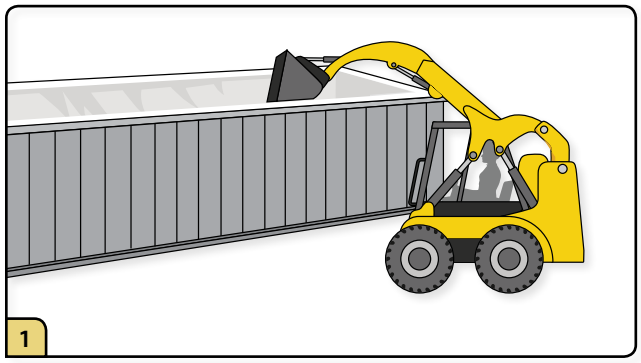
Disinfect carcasses and/or byproducts to minimize virus spread.

PRECAUTIONS

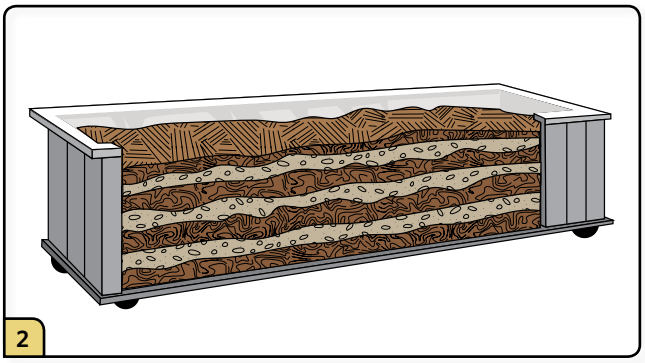
- Clean and degrease work area and equipment.
- Inform driver of all activities.
- Drivers should wear PPE at all times.
- Drivers should remain seated in vehicle with windows and doors closed while truck is loaded.

Source: USDA-APHIS Secure Transport Training Module (go.usdatraining.com/transport)

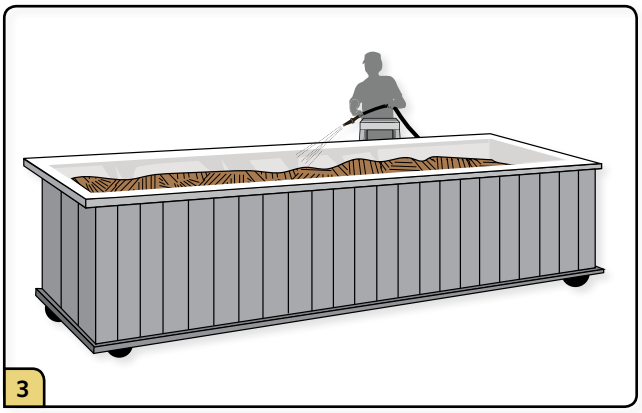
LOADING



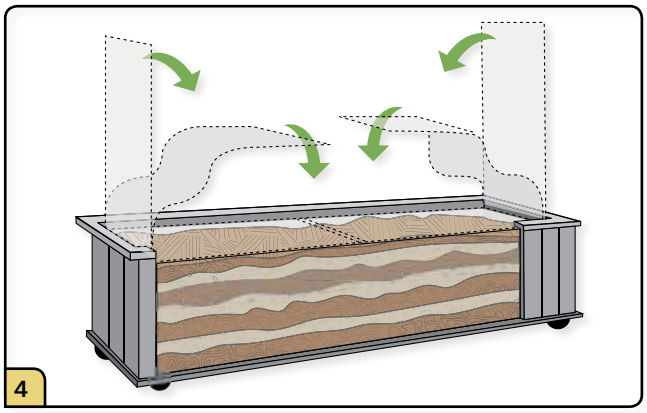
Load container with carcasses using a skid steer loader and/or front-end loader. Ensure carcasses are not placed on the ground while moving from the staging area to the container.



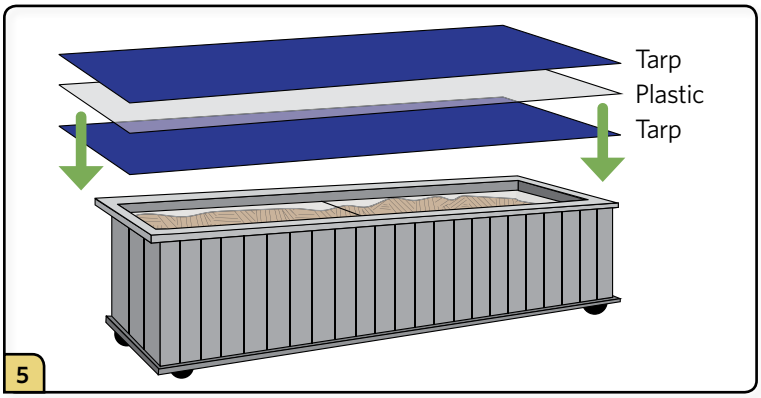
Load carcasses evenly. Alternate one foot of absorbent material with each layer ending with absorbent material.



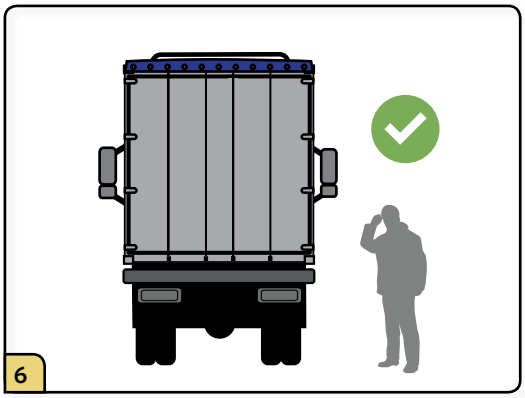
Load is full when contents reach maximum weight limit or fill container one foot from top of container.



Seal Biozip bag or similar.



if container does not have a lid, securely fasten a tarp to the top.



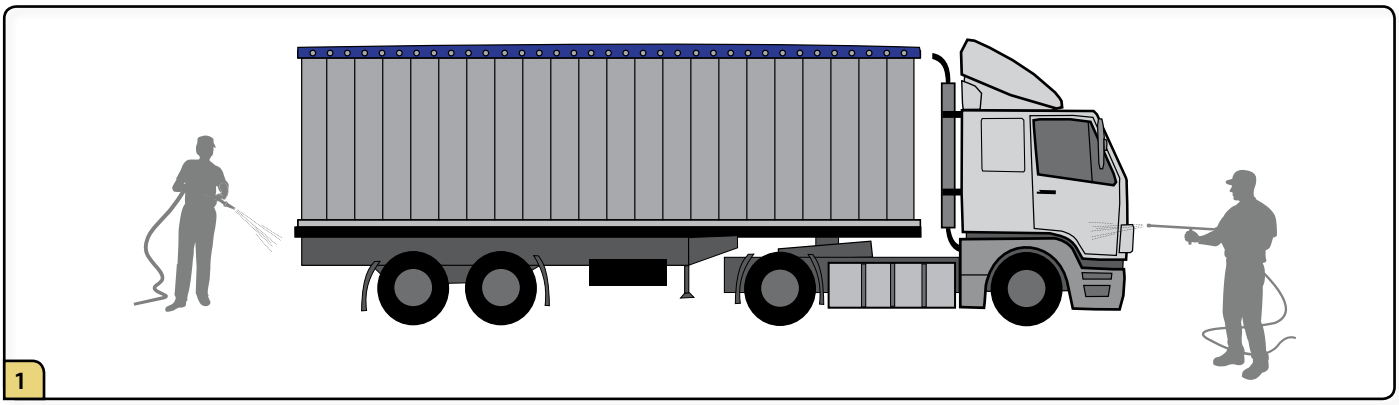
Disinfect and inspect vehicle before departure. Verify the load is not too large, and there are no leaks, cuts, or holes. If the load is dripping, the contents must be transferred to a correctly lined container.

PRECAUTIONS

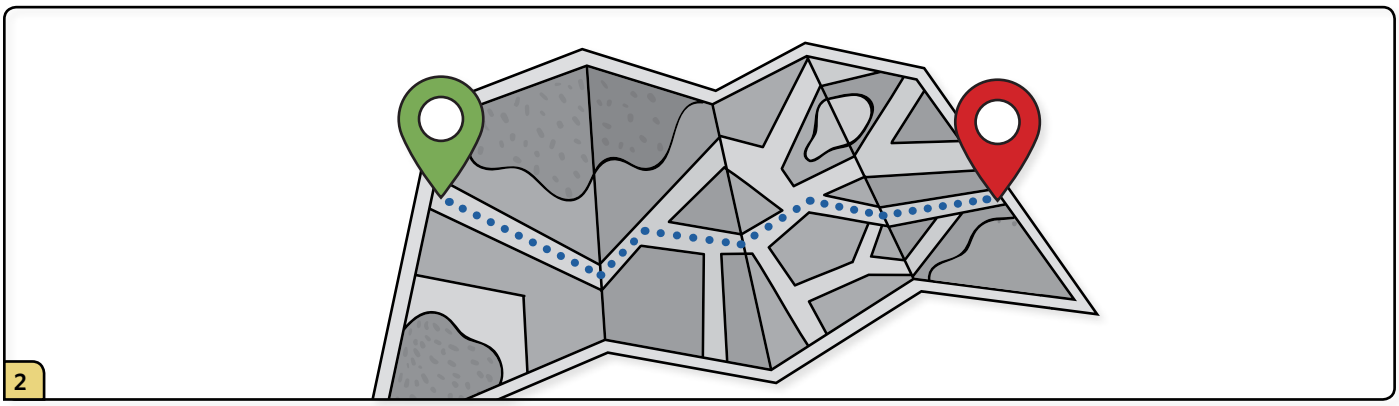
- Sheet roll-off bins on the ground.
- Use fixed ladders to enter bins.
- Use at least two people to line bins.
- Conduct heavy lifting mechanically.
- Avoid climbing the sides, backs, or onto roll-offs during inspection.
- Avoid standing or walking on top of carcasses.

Source: USDA-APHIS Secure Transport Training Module (go.usdatraining.com/transport)

POST-LOADING



Clean and disinfect the outside of the truck and the container. Decontamination area must be a one-way system. Animal health technicians, site managers or case managers will supervise process and issue a permit documenting proper disinfection.



Use pre-arranged route. No unplanned stops are permitted.

PRECAUTIONS

- Wear PPE at all times.
- Ensure drivers turn off engines prior to decontamination.
- Create a one-way system for decontamination area.
- Disinfect undercarriage, wheels, and wheel wells.
- Beware of vehicle movements, disinfectants and spread of disease.

Permit Requirements

(See Appendix IV)

Information Required for a Permit

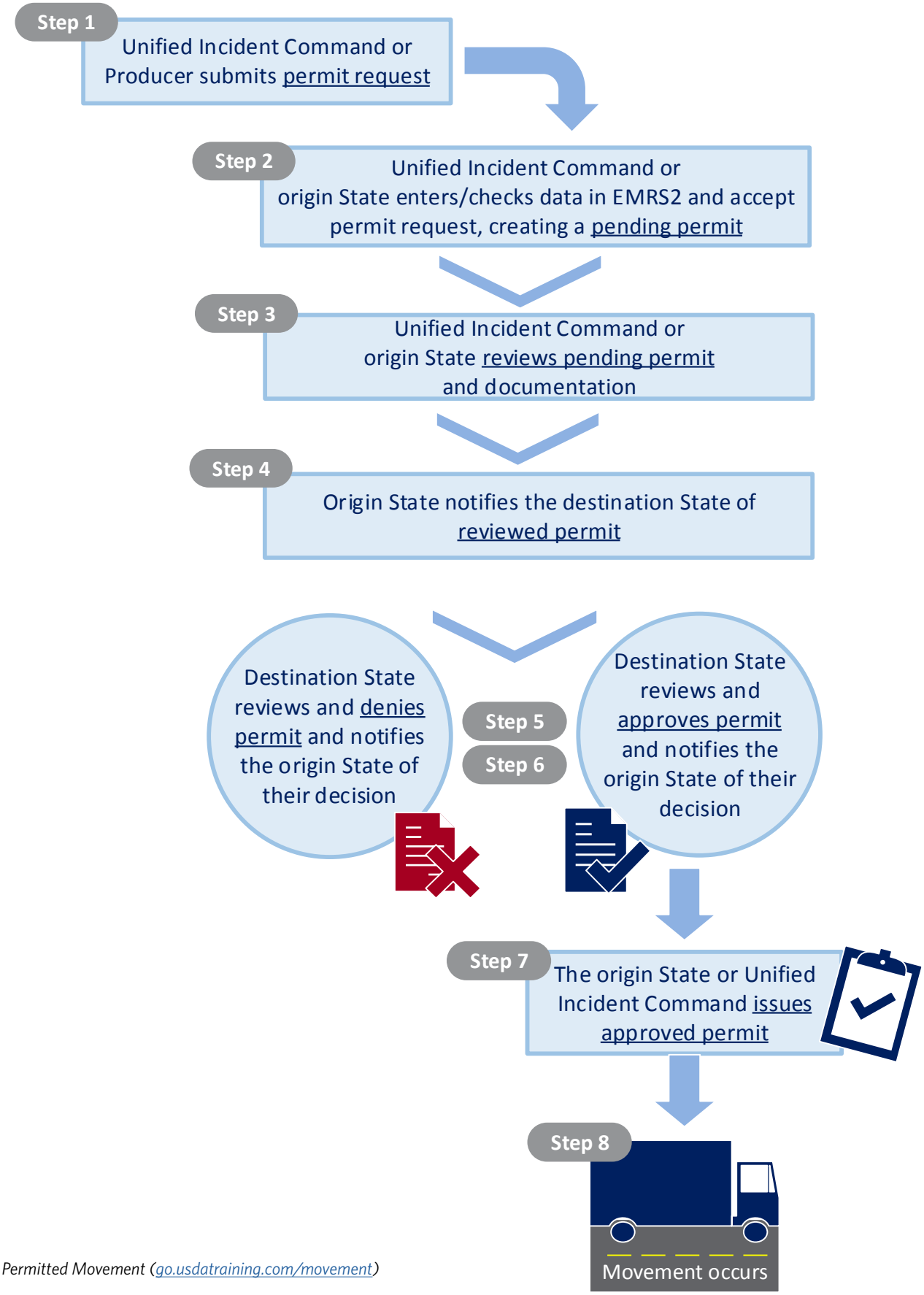
- ✓ **Permit Class** — location, e.g., into CA, out of CA, or within CA.
- ✓ **Permit Reason** — reason for permit, e.g., direct to farm, direct to landfill, or into commerce.
- ✓ **Origin Premises** — Must be in EMRS2.
- ✓ **Destination Premises** — Must be in EMRS2.
- ✓ **Items** — What is allowed to move, e.g., manure/litter, feed, eggs, groups of animals.
- ✓ **Item Class** — Further description of item, e.g., if the item permitted was "groups of animals," the item class offers further information.
- ✓ **Duration/Span of Permit** — First movement date, as well as how long the permit is valid for.

Additional Requirements Prior to Movement

- ✓ Permits and their associated permitted movement may have additional requirements that must be met before the movement is made.
- ✓ These records and documentation can be uploaded in EMRS2 for review by relevant parties.
- ✓ For example, diagnostic testing or mortality reports from the premises may be required.
- ✓ Diagnostic testing results can be entered into EMRS2 or automatically messaged, if the testing laboratory can message results (strongly preferred), and attached to the origin premises in EMRS2.

Source: Permitted Movement (go.usdatraining.com/movement)

Overview of the Eight Steps in Interstate Permitted Movement



Source: Permitted Movement (go.usdatraining.com/movement)

HPAI Outbreak 2014-2015
Safety, Health & Environmental Protection

May 20, 2015

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

QUICK RESPONSE CARD

Ensuring responder safety is the first priority at all times.

Always know the hazards of the job, and how to protect yourself – read the SOP

Buddy system – know where your buddy is during on-farm activities

Care – take care of yourself – ppe, rest breaks, water, food, cool off

Defensive Driving – seat belts, no use of any communications devices while driving. Carry a vehicle accident kit and a first aid kit.

EAP – Employee Assistance Program – (800) 222-0364 (24 hrs/day, 7 days/week)

Fatigue – get plenty of rest and sleep – don't drive when you're tired

Get the Standard Operating Procedures (SOP) and understand them

Program phone numbers for your Incident Supervisor and the Safety Officer into your phone.

Make sure Location Services is enabled on your phone. Know the location of the nearest hospital.

See your Safety Officer or Incident Supervisor for more information on:

http://sp.we.aphis.gov/vs/sites/SPRS/NPIC/SiteAssets/SitePages/HPAI/Responder%20Safety%20%20Health%20for%20ICS%20Deployment_20%20May%202015%20Final.pdf (requires a VPN connection)

Heat stress
Rest breaks – take them!
Accident/injury/illness reporting
Workers Compensation (OWCP)
Check-out/check-in procedures
Respirator use
Weather
Chemical safety

Medical clearance
Respirator training and fit testing
Personal protective equipment
Daily briefing
Incident action plan
Emergency procedures
Uncooperative individuals
Standard operating procedures

Other Important Stuff

- Tell your Incident Supervisor or Safety Officer immediately if you're injured or feel sick.
- Report hazards immediately.
- Don't work more than 12 hours without specific supervisor instructions.
- Take breaks at least every 2 hours to cool off and drink fluids.
- If your urine is yellow, drink more water.
- Watch for weather, ticks, mosquitos, dogs, deer on the highways, hostile owners.
- Practice biosecurity: prevent contamination, clean, disinfect.
- Watch your step – booties can be slippery.
- Campylobacteriosis and Salmonellosis are among the zoonotic diseases of concern when working with poultry. Wash hands with soap after contact with animal feces. All food and water are to be consumed on the clean side of the clean/dirty line.
- Don't enter barns during/after CO_2 operations until Incident Supervisor or safety officer declares it's safe. Stay out of foam during foaming operations.
- Shower and shampoo as soon as possible. Clean and disinfect the vehicle before leaving infected premises, and wash the vehicle after leaving the premises.
- Biosafety is very important, but don't forget about other hazards:

Quick Response (QR) codes require a Smartphone with an enabled app – recommend "RedLaser Barcode Scanner". Access to SharePoint also requires the Cisco AnyConnect app on your Smartphone to establish a VPN connection.

USDA HPAI website (go.usdatraining.com/HPAI)

    - Electrical, machinery/vehicles, enclosed spaces/tanks/silos/pits, chemicals including disinfectants/detergents, high pressure sprayers, ammonia, walking and working surfaces.
- Wear visible ID while conducting surveillance.
- Wash hands frequently. Don't share food or drink.
- Try to get a healthy diet. Minimize alcohol intake, especially in hot weather. Build up heat resistance over a period of several days.

Personal Protective Equipment (PPE)

Wear proper personal protective equipment (PPE) for the job you are doing. Don't remove your PPE until you're back at the clean/dirty line. Full PPE is required for work done on infected premises:

- Tyvek coveralls (Tychem coveralls for foam depopulation)
- Rubber boots or boot covers
- N95 respirators as a minimum
- Safety goggles or safety glasses with sideshields
- Gloves (double) (e.g., inner latex gloves; outer glove)
- Head bonnet and/or hardhat
- Hearing protection (disposable ear plugs) where noise is a hazard

What to do if your PPE is breached or compromised:

- If your PPE is breached (torn or obviously damaged), take your buddy with you and leave the work area, doff PPE, decontaminate yourself, and don new PPE. A minor tear might be "fixable" with duct tape after you've used alcohol gel on your skin. If your skin was cut or scraped, you should shower, then apply first aid. Let your Incident Supervisor know as soon as you can, but at least by the end of your shift.
- If you think your PPE is compromised (possibly damaged or not working properly) at any time the work being done, stop work immediately. Contact your Incident Supervisor and/or the Safety Officer for guidance. If this requires leaving the work area, take your buddy with you.

More on the Buddy System

While in the Hot or Exclusion Zone, use the buddy system. Work in pairs and stay in close visual contact and summon rapid assistance in case of an emergency. The responsibilities of workers using the buddy system include:

- remaining in close visual contact with their partner,
- providing their partner with assistance as needed or requested,
- observing their partner for signs of heat stress or other difficulties,
- periodically checking the integrity of partner's PPE, and
- notifying the site manager or other site personnel if emergency assistance is needed.

All responders must follow safety and health guidelines to protect themselves and everyone around them. You risk more than your own health and safety, as well as biosecurity, if you do not.

APHIS Emergency Mobilization Guide, APHIS 1050, March 3, 2014
http://www.aphis.usda.gov/emergency_response/downloads/APHIS%20Emergency%20Mobilization%20Guide.pdf

Highly Pathogenic Avian Influenza Standard Operating Procedures: 8. Health and Safety & Personal Protective Equipment, FADPReP, USDA APHIS, January 2014
http://www.aphis.usda.gov/animal_health/emergency_management/downloads/sop/sop_hpai_health_safety.pdf

Highly Pathogenic Avian Influenza Response Plan -- The Red Book, FADPReP, USDA APHIS, September 2012
http://www.aphis.usda.gov/animal_health/emergency_management/downloads/hpai_response_plan.pdf

Quick Response (QR) codes require a Smartphone with an enabled app – recommend "RedLaser Barcode Scanner". Access to SharePoint also requires the Cisco AnyConnect app on your Smartphone to establish a VPN connection.

Personal Protective Equipment

Disposal personnel (equipment operators, drivers, contractors) must be briefed on safety requirements, appropropriate PPE, site conditions, and tasks by their supervisor and/or designated safety officer. The PPE outlined in this section is an example; actual PPE may vary based on tasks.

IMPORTANT PPE FUNCTIONS

- Protects user from exposure to potentially life-threatening infectious agents.
- Prevents spread of biological hazards by the user.

All personnel are responsible for understanding how to use PPE appropriately to prevent the transmission of disease.

For donning PPE and other health and safety needs, see:

- FAD site-specific health and safety plan
- *NAHEMS Guidelines: Health and Safety*: go.usdatraining.com/NAHEMS_Safety
- *NAHEMS Guidelines: PPE*: go.usdatraining.com/NAHEMS_PPE
- *Standard Operating Procedures: Health and Safety & PPE*: go.usdatraining.com/SOP_PPE

PPE OPTIONS

To reduce the risk of exposure to disease, it is important that you wear the proper PPE.

Developed by Texas A&M University (go.usdatraining.com/investigation)

PPE Requirements

APPROPRIATE PPE

CLEAN UP

- Dispose of PPE (except non-disposable items like PAPR blower/filters)
- Disinfect boots
- Wash hands
- Shower

PPE PROCEDURE VIDEOS

The following videos depict proper procedures for the donning and doffing of PPE in both assisted and unassisted scenarios. To view the videos on a mobile device, scan the graphic code below with a QR code reader. The videos can also be accessed at www.usdatraining.com/ppe

Developed by Texas A&M University (go.usdatraining.com/investigation)

Go-Bag Checklist

Below is a list of personal protective equipment and other biosecurity items that individuals deploying to an animal disease outbreak response may want to have upon arrival at an incident. The quantities are sufficient for 1 to 2 days unsupported by a centralized supply point.

	ITEM	QUANTITY	COMMENTS
☐	Large duffel bag	1	12 in. x 12 in. x 36 in. minimum, wheels optional. High visibility, waterproof, durable with luggage tag.
	PPE		
☐	Tyvek coveralls	10	Hooded with elastic wrists and ankles. At least one per farm visit. Other coveralls made from non-woven spunbond Olefin fiber, plain or vinyl coated like Tychem, can be substituted.
☐	Duct tape	1 roll	Keep in mind some brands of duct tape have poor adhesive qualities in cold weather.
☐	Hard hat with ratchet	1	
☐	Head lamp flashlight with batteries	1	
☐	Respirator (N95 equivalent minimum)	10	Respirator model must correspond to fit test card.
☐	Goggles		
☐	Face protection (shield)	1	Provides secondary protection of face/mucous membranes from exposure to pathogens.
☐	Fog Fixer towlettes		
☐	Eyewear cleaning wipes		
☐	Nitrile gloves	20	2 pair per expected farm visit. Double gloves required.
☐	Hearing protection		As needed.
	CLEANING AND DISINFECTION		
☐	Surgical scrub brush and nail cleaner with Chlorhexidine Gluconate and water	20	
☐	Disinfecting wipes	Enough for 10 farm visits	Ensure wipes are labeled for pathogen of concern and follow instructions for use on label.
☐	Spray disinfectant		Aerosol sprays greater than 100ml cannot be transported on domestic airlines. Can only transport powdered or pelleted disinfectants by air in original packaging. Most common is Lysol or Techtrol brands. May be simpler to purchase after deployment arrival. See the USDA-APHIS Registered Antimicrobial Products with Label Claims for specific pathogen: go.usdatraining.com/Disinfectants
☐	Trash bags	1 box 13 gal. drawstring 1 box 30 gal. contractor	For collection of biosecure trash within the vehicle. Drawstring bags are easiest to use due to size. One to two large contractor bags for double bagging prior to disposal into biosecure trash on site.
☐	Pens, pencils, sharpie pens	2 of each	
☐	Hand sanitizer		

Developed by APHIS Composting Technical Team

	ITEM	QUANTITY	COMMENTS
	DOCUMENTATION		
☐	Proof of Fit Test	1 each	Hard and digital copy. Must be re-fit tested annually.
☐	Proof of Physical Fitness	1 each	Hard and digital copy of letter from Doctor. Must be renewed at interval specified in letter.
☐	ID card lanyard	1	Needed to hold the issued USDA ID while working on site.
☐	USDA SOPs and Job Aids	As desired	Hardcopy, laminated hardcopy and digital copies can be brought at the rate desired.
☐	Flash drive with all required docs and reporting forms	1	
	OPTIONAL ITEMS		
☐	Carbiner or "S-biner"	1	Secures rental car keys to belt loop inside Tyvek overalls.
☐	Light gloves (cotton or other light work type)	5 to 10 pair	Can be substituted as outer glove in the double glove scheme.
☐	Cooling vest if working in hot conditions		
☐	Bouffant (hair net)	5 to 10 as a minimum	Required head cover when using Tyvek coveralls without a hood. Bouffonts can be used as a lens or screen drying or cleaning tool.
☐	Hand-pumped spray bottle	1	For use in mixing with water and spraying dry disinfectant if needed.
☐	Shoe cover	10 to 20	Shoe covers may be worn between the removal of disinfectable inner boot at rear of vehicle and entry into driver's seat as a way to minimize "contamination" of the inside of the car.
☐	Hoof pick on a lanyard	1	Attached to belt loop inside Tyvek overalls. If using multiuse disinfectable inner boots, hoof pick can be used to clean out the lugs of the boot heel and sole at transfer from Hot Zone to Warm Zone.
☐	Ziplock storage bags	10 to 20	To keep phone "clean" while in the Hot Zone
☐	Small inverter	1	To provide AC power for computer use in vehicle on site.
☐	Accordion file	1	For organizing paperwork
☐	Yard spray bottle	1	For spraying GOV and other large items
☐	Disinfecting wipes		

Temporary Vehicle Wash Station
Draft Standard Operating Procedure

April 2015

MATERIALS CHECKLIST (Approximate total = $850)

	ITEM	QUANTITY	COST	COMMENTS
☐	Large heavy-duty tarp	1	$120	20'x30' heavy duty from Home Depot or similar.
☐	Swimming pool noodles	10	$80	Case of 9. 4in diameter from Home Depot or similar.
☐	Submersible sump pump	1	$190	With bottom intake and discharge hose. 1/2 HP submersible at Home Depot or similar
☐	Basket strainer	1		(see photo 2)
☐	Back-pack chemical sprayer	2	$270 ea.	Example: go.usdatraining.com/sprayer or similar
☐	10-pound pail Virkon S	1	$70	
☐	Pressure washer detergent	1	$15	
☐	Heavy-duty 32-gal plastic trash cans	2	$30 ea.	One for storing supplies and one for collecting wash water.
☐	Wide 24-inch push broom with telescoping handle	1	$35	
☐	Long-handled scrub brushes	2	$5 ea.	
☐	Personal protective equipment			Based on site safety plan and hazard analysis – see Safety Officer
☐	Water supply			
☐	Discharge container			Secure properly licensed contractor for removal or written permission from jurisdiction to discharge to sanitary or storm sewer

Temporary vehicle wash station set-up.

Sump pump in bucket strainer.

Developed by LPMiller, USDA, 2015

PROCEDURE

1. Select a location with flat or gently sloping topography for the vehicle wash station which is between the infected zone and the exit.
2. Spread tarp on the ground.
3. Place swimming pool noodles under tarp around entire perimeter. Roll edges of tarp around noodles to promote drainage (see photo 1).
4. Place sump pump in bucket strainer on tarp at low end where water is collecting (see photo 2). Connect pump electrical cord to power outlet. Direct discharge hose to collection container or approved sanitary sewer drain (not storm sewer).
5. If using 55-gallon drums or trash cans to collect wash water, place empty containers on/in haul vehicle before filling, then pump water to container on/in truck rather than filling the container on the ground then trying to lift full container later.
6. Fill sprayers with cleaning/disinfecting solution(s). NOTE: up to 40% propylene glycol antifreeze can be mixed with water before preparing solutions if temperatures are sub-freezing.
7. Drive vehicle onto tarp.
8. Wash vehicle with cleaning solution, taking extra care on tires and wheel wells, scrubbing with scrub brushes as necessary. NOTE: tarp will be extremely slippery – use rubber overboots with good traction.
9. Use long-handled broom to push accumulating liquid towards sump pump as needed.
10. Rinse vehicle with clean water.
11. Apply disinfectant if using separate disinfection step. Ensure full wetted contact time (foam formulations are easier in this regard).
12. Rinse vehicle with clean water.
13. Drive vehicle off tarp towards exit. Do not allow vehicle to drive back into infected area prior to exiting.
14. At end of operation, wash both sides of tarp, rinse with clean water, and allow tarp to dry before storing.
15. Dispose of collected wash water in accordance with jurisdiction WRITTEN instructions. Alternately, hire properly licensed local waste hauler to remove waste water.

Developed by LPMiller, USDA, 2015

Work Zones and Control Areas

Identifying and designating work zones in the area of operations, and control areas on premises, may help prevent the transmission of the disease.

EXEMPLARY BIOSECURITY FUNCTIONS

- Protects general public and people involved
- Prevents further disease spread
- Contains the infectious agent

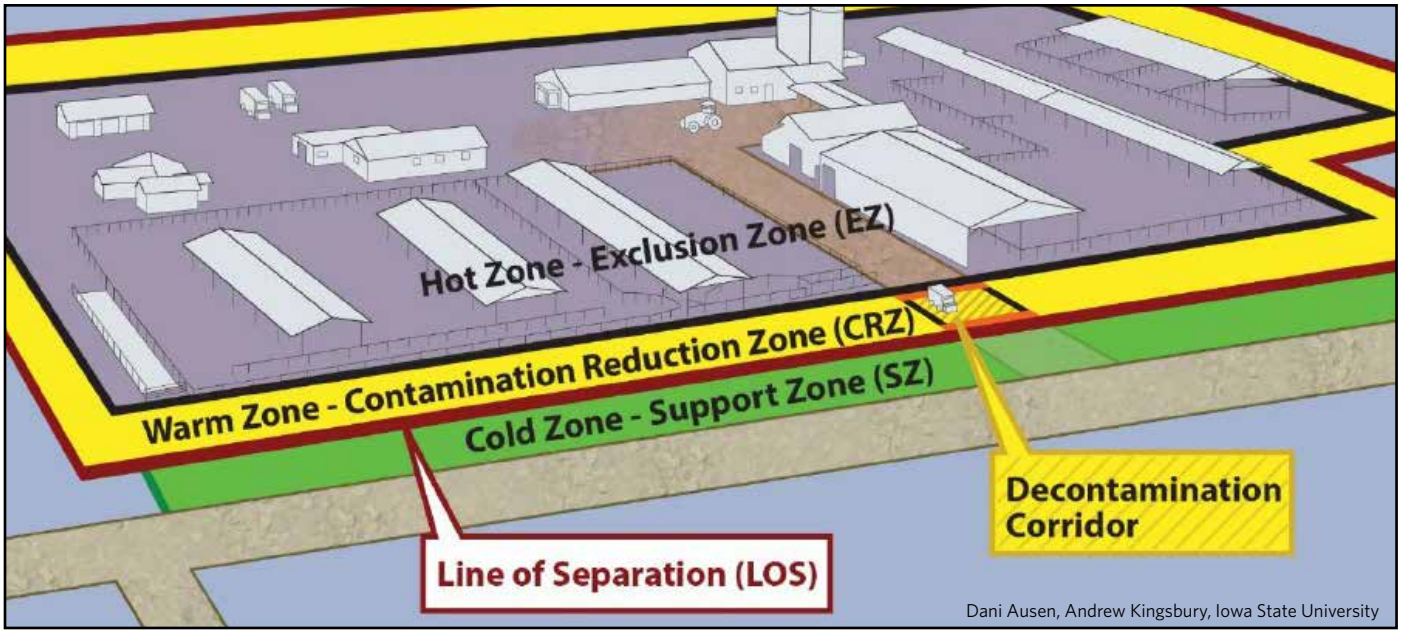
All personnel entering the site must:

- Meet security requirements as established by the Incident Command
- Present documentation of verified credentials showing they are qualified to perform their assigned tasks,
- Present documentation that they have received all required briefings as defined in the site-specific Incident Action Plan
- Wear the required PPE specified in the site-specific Incident Action Plan
  See *Standard Operating Procedures: Health and Safety & PPE*: go.usdatraining.com/SOP_PPE
- Follow all Biosecurity procedures specified in the site-specific Incident Action Plan
  See *NAHEMS Guidelines: Biosecurity:* go.usdatraining.com/NAHEMS_Biosecurity and *Standard Operating Procedures: Biosecurity:* go.usdatraining.com/SOP_Biosecurity

WORK ZONES

Work zones are small areas that only apply to specific premises and are identified as:

- **Exclusion Zone (EZ)/Red Zone/Hot Zone**
- **Contamination Reduction Zone (CRZ)/ Yellow Zone/Warm Zone**
- **Support Zone (SZ)/Green Zone/Cold Zone**

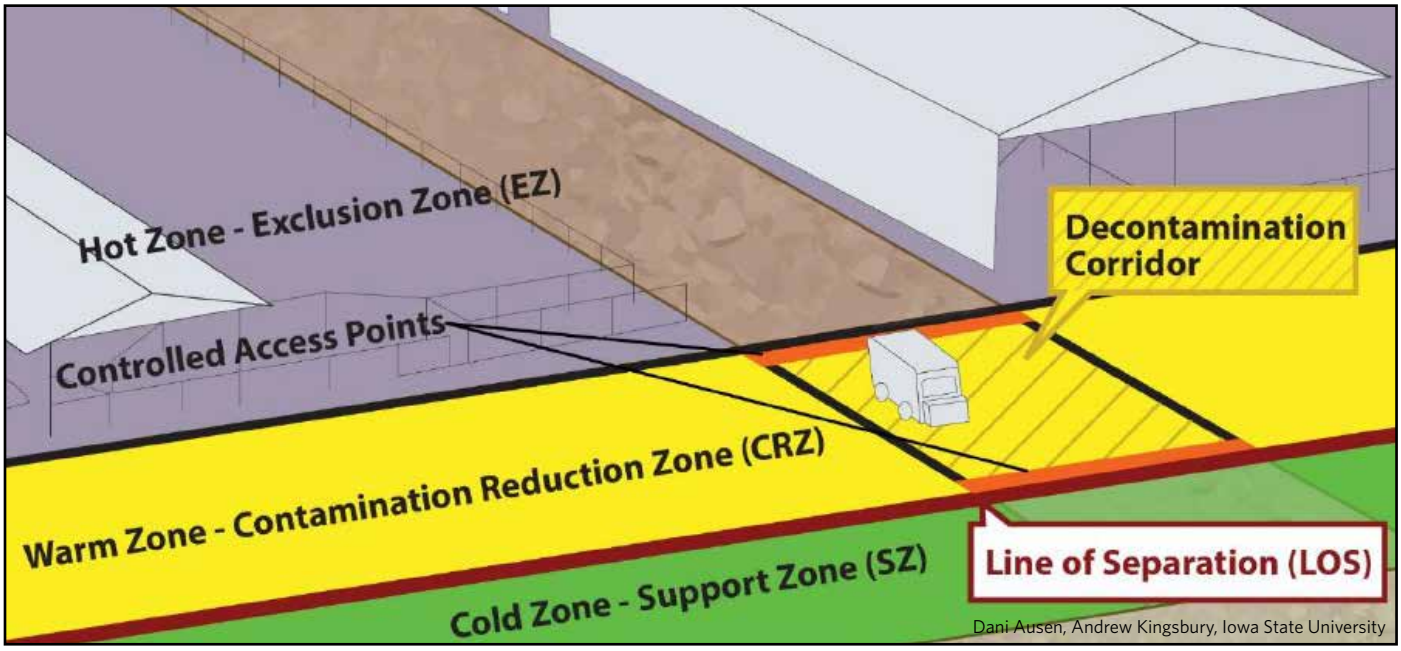


Adapted from FADPrep Disposal Guidelines

Best Practices for Managing Contamination Reduction Zone (CRZ)

1. **Set Up the CRZ**
   - Set up the CRZ to allow personnel to enter/exit the zone without risk of contamination.
   - Establish a decontamination corridor for personnel/PPE .
   - Allocate a place for emergency decontamination.
   - Create a slightly sloped impervious surface that facilitates disinfectant collection, such as a plastic ground cover at least 10 x 10 meters .
   - Provide a water supply and collection system.
   - Verify that run-off water is collected or flows back into the EZ.
2. **Coordinate Movement through the CRZ**
   - Monitor and enforce entry and exit into the CRZ via one or two sites for authorized personnel working in the secured EZ.
   - Create four enclosed areas to allow for doffing PPE.
   - Secure all other possible entrances.

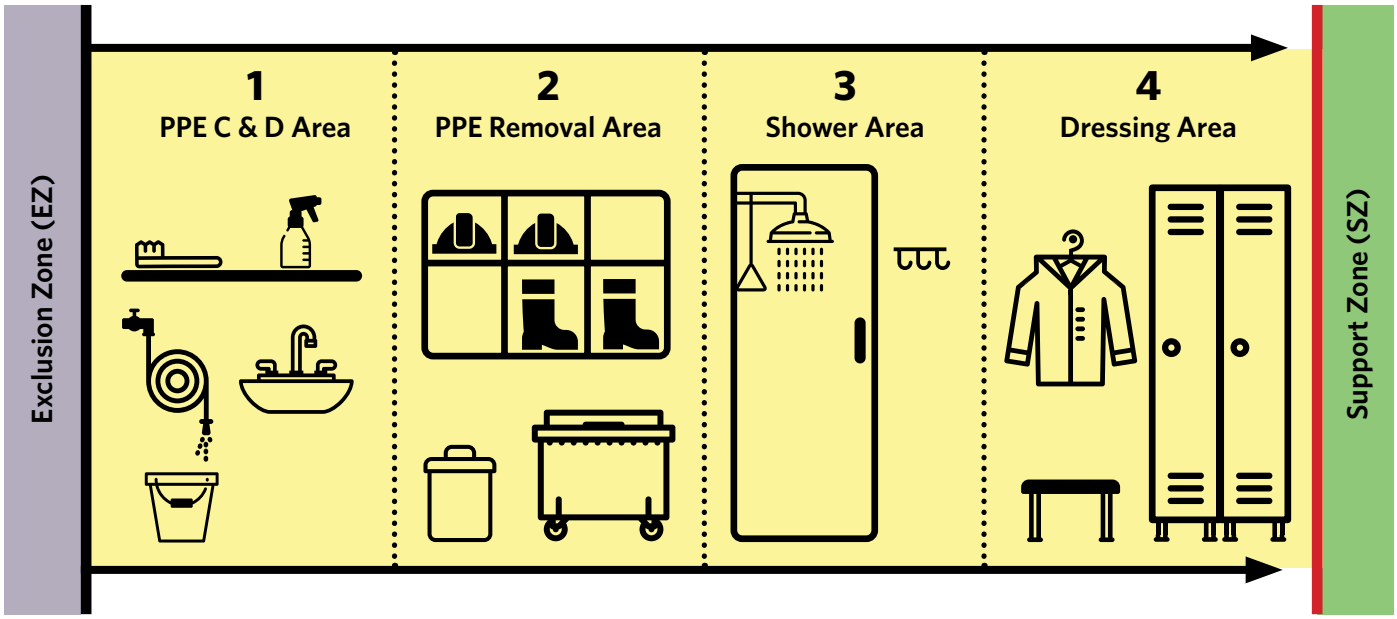
THE DECONTAMINATION CORRIDOR



Dani Ausen, Andrew Kingsbury, Iowa State University

Adapted from FADPrep Disposal Guidelines

BIOSECURITY IN THE DECONTAMINATION CORRIDOR



Area 1: PPE Cleaning & Disinfecting Area
- A washing station supplied with water and disinfectants
- Scrub or spray-off exterior protective clothing
- Thoroughly wash boots, coveralls, and gloved hands

Area 2: PPE Removal Area
- Always remove protective clothing first and discard or secure the clothing for disinfection
- Remove respirators and goggles
- Remove gloves last, by turning gloves inside out and using one gloved hand to remove the other glove
- Place clothing and equipment in prepared bins for disposal or cleaning
- Properly discard disposable items as infectious waste in accordance with all applicable regulations
- Clean/disinfect non-disposable items

Area 3: Shower Area
- Enter showering facilities if available
- Wash hair and all body surfaces
- If no showering facilities are available, proceed to dressing area

Area 4: Dressing Area
- Wash hands and face
- Change into clean clothing

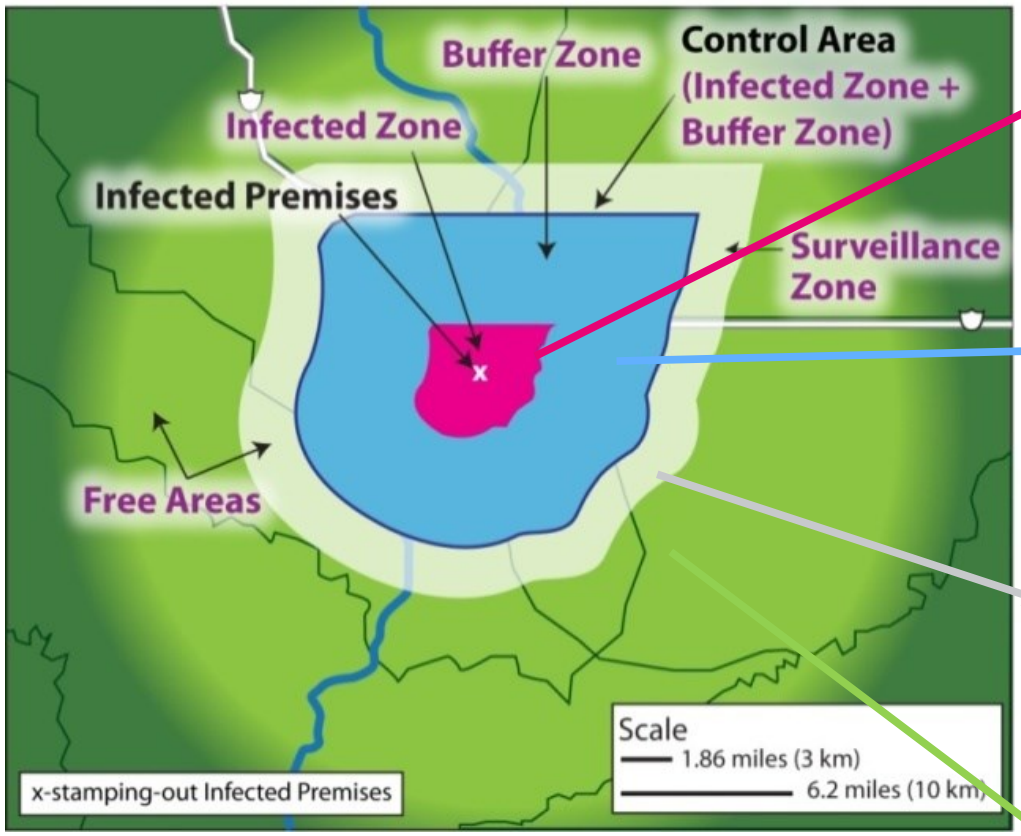
CONTROL AREAS

Control areas, in comparison to the smaller work zones areas, are another means of preventing disease transmission by monitoring movement around the quarantine zone. The quarantine zone may be miles in diameter and may include many premises. For more information on control areas see the Ready Reference Guide—Zones, Areas, and Premises in an FAD Outbreak

For more information see *Feed Delivery Biosecurity for Control of Disease*: go.usdatraining.com/Feed_delivery

Adapted from FADPrep Disposal Guidelines

Ready Reference Guide—Overview of Zones



In the **Infected Zone** (which is ***part* of the Control Area**), there are movement controls and surveillance activities. Infected Premises are quarantined.

In the **Buffer Zone** (which is ***part* of the Control Area**), there are movement controls and surveillance activities.

In the **Surveillance Zone** (which is ***part* of the Free Area)**, targeted poultry surveillance may be conducted (i.e. commercial premises).

In the **Free Area** (which ***includes* the Surveillance Zone**), routine or program surveillance may occur (i.e. NPIP and wild birds).

Infected Zone **Buffer Zone** **Surveillance Zone**

+ = Control Area **+ = Free Area**

Zone/Area	Definition
Infected Zone (IZ)	Zone that immediately surrounds an Infected Premises.
Buffer Zone (BZ)	Zone that immediately surrounds an Infected Zone or a Contact Premises.
Control Area (CA)	Consists of an Infected Zone and a Buffer Zone.
Surveillance Zone (SZ)	Zone outside and along the border of a Control Area. The Surveillance Zone is part of the Free Area.
Free Area (FA)	Area not included in any Control Area. Includes the Surveillance Zone.

Ready Reference Guide—Zones, Areas, and Premises in an FAD Outbreak (*go.usdatraining.com/zones*)

Infected, Contact, and Suspect Premises are subject to individual premises quarantines.

At-Risk and Monitored Premises are subject to movement control restrictions.

Summary of Premises Designations

Premises	Definition	Zone
Infected Premises (IP)	Premises where a presumptive positive case or confirmed positive case exists based on laboratory results, compatible clinical signs, case definition, and international standards.	Infected Zone
Contact Premises (CP)	Premises with susceptible animals that may have been exposed to the FAD, either directly or indirectly, including but not limited to exposure to animals, animal products, fomites, or people from Infected Premises.	Infected Zone, Buffer Zone
Suspect Premises (SP)	Premises under investigation due to the presence of susceptible animals reported to have clinical signs compatible with the FAD. This is intended to be a short-term premises designation.	Infected Zone, Buffer Zone, Surveillance Zone, Vaccination Zone
At-Risk Premises (ARP)	Premises that have susceptible animals, but none of those susceptible animals have clinical signs compatible with the FAD. Premises objectively demonstrates that it is not an Infected Premises, Contact Premises, or Suspect Premises. AtRisk Premises may seek to move susceptible animals or products within the Control Area by permit. Only AtRisk Premises are eligible to become Monitored Premises.	Infected Zone, Buffer Zone
Monitored Premises (MP)	Premises objectively demonstrates that it is not an Infected Premises, Contact Premises, or Suspect Premises. Only AtRisk Premises are eligible to become Monitored Premises. Monitored Premises meet a set of defined criteria in seeking to move susceptible animals or products out of the Control Area by permit.	Infected Zone, Buffer Zone
Free Premises (FP)	Premises outside of a Control Area and not a Contact or Suspect Premises.	Surveillance Zone, Free Area
Vaccinated Premises (VP)	Premises where emergency vaccination has been performed. This may be a secondary premises designation.	Containment Vaccination Zone, Protection Vaccination Zone

Summary of Zone and Area Designations

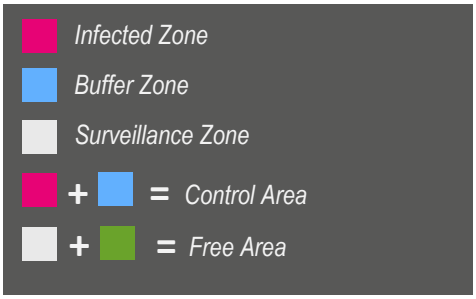
Zone/Area	Definition
Infected Zone (IZ)	Zone that immediately surrounds an Infected Premises.
Buffer Zone (BZ)	Zone that immediately surrounds an Infected Zone or a Contact Premises.
Control Area (CA)	Consists of an Infected Zone and a Buffer Zone.
Surveillance Zone (SZ)	Zone outside and along the border of a Control Area. The Surveillance Zone is part of the Free Area.
Free Area (FA)	Area not included in any Control Area. Includes the Surveillance Zone.
Vaccination Zone (VZ)	Emergency Vaccination Zone classified as either a Containment Vaccination Zone (typically inside a Control Area) or a Protection Vaccination Zone (typically outside a Control Area). This may be a secondary zone designation.

Example Zones, Areas, and Premises

Premises

Zones and Areas

Note: Figures are not to scale.



In an HPAI outbreak, the Incident Commander will work with the Operations Section and Planning Section to determine the appropriate designations.

Factors Used to Determine Control Area Size

Factors	Additional Details	
Jurisdictional areas	• Effectiveness and efficiency of administration • Multi-jurisdictional considerations: local, State, Tribal, and multistate	
Physical boundaries	• Areas defined by geography • Areas defined by distance between premises	
FAD epidemiology	• Reproductive rate • Incubation period • Ease of transmission • Infectious dose • Species susceptibility	• Modes of transmission (such as, fecal-oral, droplet, aerosol, vectors) • Survivability in the environment • Ease of diagnosis (for example, no pathognomonic signs; requires diagnostic laboratory testing) • Age of lesions
Infected Premises characteristics	• Number of contacts • Transmission pathways and transmission risk Extent of animal movement — Number of animals — Species of animals	— Age of animals — Movement of traffic and personnel to and from premises (fomite spread) — Biosecurity measures in place at time of outbreak
Contact Premises characteristics	• Number and types of premises • Susceptible animal populations and population density • Animal movements	• Movement of traffic (fomites) and personnel to and from premises (fomite spread) • Biosecurity measure in place prior to outbreak
Environment	• Types of premises in area or region • Land use in area or region	• Susceptible wildlife and population density • Wildlife as biological or mechanical vectors
Climate (for aerosol spread diseases)	• Prevailing winds • Humidity	
General area, region, or agricultural sector biosecurity	• Biosecurity practices in place prior to outbreak • Biosecurity practices implemented once outbreak detected	
Number of backyard or transitional premises	• Types of premises, animal movements, and network of animal and fomite movements	
Continuity of business	• Continuity of business plans and processes in place or activated at beginning of outbreak (such as surveillance, negative diagnostic tests, premises biosecurity, and risk-assessments) • Permit processes, memorandums of understanding, and information management systems in place or activated at beginning of outbreak	

Minimum Sizes of Zones and Areas

Zone or Area	Minimum Size and Details
Infected Zone (IZ)	Perimeter should be at least 3 km (~1.86 miles) beyond perimeters of presumptive or confirmed Infected Premises. Will depend on disease agent and epidemiological circumstances. This zone may be redefined as the outbreak continues.
Buffer Zone (BZ)	Perimeter should be at least 7 km (~4.35 miles) beyond the perimeter of the Infected Zone. Width is generally not less than the minimum radius of the associated Infected Zone, but may be much larger. This zone may be redefined as the outbreak continues.
Control Area (CA)	Perimeter should be at least 10 km (~6.21 miles) beyond the perimeter of the closest Infected Premises. Please see the table above for factors that influence the size of the Control Area. This area may be redefined as the outbreak continues.
Surveillance Zone (SZ)	Width should be at least 10 km (~6.21 miles), but may be much larger.

For more information, please go to: www.aphis.usda.gov/fadprep.

For more details on zones and premises designations, please see the *APHIS FAD Framework: Response Strategies (Manual 2-0)*: go.usdatraining.com/FADPReP_Manual_2

For the *HPAI Response Plan: The Red Book* see: go.usdatraining.com/HPAI_red_book

For the Secure Egg Supply Plan see www.secureeggsupply.com

Highly Pathogenic Avian Influenza

A Guide To Help You Understand the Response Process

1 Detect

You see unusual signs of illness or sudden deaths in your flock. You can report it to your private veterinarian or a State or USDA veterinarian. Samples are taken and tested. You find out your flock is positive for HPAI.

2 Quarantine

USDA and State personnel come to your farm. We assign you a case manager, who will be your main point of contact onsite, answer your questions, and guide you through the needed paperwork. We will also place your operation under quarantine, meaning only authorized workers are allowed in and out, and movement restrictions for poultry, poultry products, and equipment go into effect. We contact neighboring poultry farms and start testing their birds to see if they've been affected, too.

3 Appraise

We work with you to create a flock inventory. This lists how many birds you have, what species they are, their age, and other key details. USDA will compensate for birds that must be destroyed using species-specific calculators.

4 Depopulate

Infected flocks are depopulated as quickly as possible—ideally within 24 hours of the first HPAI detection—to get rid of the virus.

5 Compensate

Affected producers and growers must certify that a biosecurity plan was in place prior to an HPAI detection. Split payments can be provided between the owner and contract grower. You receive your first indemnity payment early on in the response process. We also pay you a standard amount for virus elimination activities (cleanup work).

6 Manage Disposal

USDA will help you dispose of the dead birds safely. Disposal methods include composting, burial, incineration, rendering, or landfilling. The options you'll have depend on several things: what type of farm you have, the specific conditions there, State and local laws, and what you prefer.

7 Eliminate Virus

The next step is to wipe out all traces of the virus at your property. To kill the virus, thoroughly clean and disinfect the barn, equipment, and all affected areas of your farm. You can do this work yourself or hire contractors to handle it.

8 Test

As soon as you're ready, let your case manager know you're finished with cleanup. Your site must then stay empty for at least 21 days. During this time, we'll return to collect and test environmental samples. We need to confirm that your property is completely virus-free.

9 Restock

Once USDA and the State both approve, you can restock your facilities and start production again. State officials will release your farm from quarantine after all required testing and waiting periods are done.

10 Maintain Biosecurity

After restocking, you'll need to continue maintaining the highest biosecurity standards to keep the virus from coming back. For biosecurity tips, go to www.aphis.usda.gov/-publications and download the factsheet "Prevent Avian Influenza at Your Farm."

How Long Does the Process Take?

Ideally, this entire process could be completed in as soon as 60–120 days. However, the timeframe varies depending on many things (for example, flock size, depopulation and disposal methods used, test results, farm's location). We're committed to restoring production as fast as we can while also protecting poultry health.

Questions?

Talk with your case manager or the State or Federal officials responding to the disease event in your area.

For general information and contacts, visit:

www.usda.gov/avian_influenza.html
www.aphis.usda.gov/fadprep
www.aphis.usda.gov/animalhealth/defendtheflock

Source: go.usdatraining.com/HPAI_guide

Highly Pathogenic Avian Influenza (HPAI)

Depopulation and Disposal
for Birds in Your HPAI-Infected Flock

Highly pathogenic avian influenza (HPAI) is a very contagious and deadly disease for poultry. All it takes is one infected bird, and the disease can spread from flock to flock within a matter of days. As with any highly contagious animal disease, a quick and early response is our best chance to limit the size and scope of the outbreak. Depopulating affected animals is a key part of the response: it's one of the most effective ways to stop disease spread and protect U.S. animal health as a whole.

Federal law gives the U.S. Department of Agriculture (USDA) authority to depopulate animals in these situations to stop disease spread. USDA's goal is to complete this work within 24 hours of first detecting HPAI at a property. The sooner we act, the faster we can contain the outbreak and help business return to normal.

Your case manager will walk you through the process as we prepare to depopulate your flock and find out—as best we can—how HPAI may have entered your facility and if it has spread to any neighboring farms. We will also handle the disposal process, working with you to make sure it's done safely, in compliance with all applicable laws, and without spreading HPAI further.

Depopulation Methods

There are two main methods we use to depopulate HPAI-affected flocks: water-based foam for floor-raised birds and carbon dioxide gas for caged birds. These are the most humane and effective options available in an emergency situation involving mass numbers of birds. Trained personnel will arrive onsite and handle these tasks under the supervision of Federal and State animal health officials.

If our preferred methods don't allow us to depopulate the flock as quickly as needed—within 24 hours—we must consider other options. These may include shutting off the facility's ventilation fans ("ventilation shutdown"). Federal and State officials will carefully evaluate your farm and work with you to figure out the best option for meeting the goal of 24-hour depopulation.

In every case, we take the decision very seriously and weigh many factors when choosing what depopulation method to use. These include, among other things, the size and type of the animals, their behavior, and their containment/housing facilities. We also look at the number of animals in the flock, the location of the farm and environmental conditions there, disease information, and available resources and personnel.

WHAT IS DEPOPULATION?

There is a difference between "depopulation" and "euthanasia."

Depopulation is when large numbers of animals must be destroyed in response to an animal health emergency. With depopulation, the welfare of the animals is given as much consideration as practical, but the situation is understood to be extenuating.

Euthanasia, however, involves transitioning an animal to death as painlessly and stress-free as possible. While euthanasia is preferable to depopulation, it is not always possible during an animal health emergency because of the need to move quickly to slow or stop disease spread.

During an HPAI outbreak, depopulating flocks within 24 hours is crucial. It's the best way to eliminate the disease and, overall, is a more humane approach. A lengthier depopulation process can lead to a greater number of birds suffering the terrible effects of HPAI.

Source: go.usdatraining.com/HPAI_depop

USDA follows the recommendations of the American Veterinary Medical Association and the World Organization for Animal Health whenever possible. We use trained veterinarians, animal health technicians, and specialized contractors to complete depopulation work. Throughout the process, our focus is on keeping personnel safe while minimizing stress to the animals.

Disposal Options

There are many safe methods for carcass disposal. These include composting, onsite burial, incineration, rendering, and landfilling. Each disposal option can take a different amount of time to complete. When deciding which method to use, we look at several factors, including the size of the flock, space requirements, associated costs, local conditions, and applicable laws.

We also consider the benefits and limits to using each method:

- **Composting.** Contains the virus to the farm and produces a soil amendment/fertilizer product. However, composting requires ample flat space and may not be possible for all farming operations, such as egg layer facilities or other places where space is limited.
- **Burial.** Must be approved by the State environmental regulatory agency and may not be permitted if the water table is close to the ground surface.
- **Incineration.** A safe method for disposing of carcasses, but the fuel requirements are substantial and can be costly.
- **Rendering.** This involves processing carcasses until they are reduced to water, fat or tallow, and meat or bone meal. It is very effective but requires added safety precautions to make sure the virus does not become aerosolized and dispersed throughout the rendering plant. It is also disruptive for the plant's normal operations.
- **Landfilling.** Landfilling allows safe and efficient disposal of large quantities of carcasses. However, individual landfill managers may put restrictions on the type or quantity of materials they accept.

Depending on the situation, we may end up taking a combined approach and use a few or all of these methods.

For More Information

If you have specific questions, talk with your case manager or call the nearest USDA office (**www.aphis.usda.gov/animal-health/state-offices**).

For general information on HPAI and emergency response, go to **www.usda.gov/avian_influenza.html** and **www.aphis.usda.gov/fadprep**. Here, you can also download USDA's "Ventilation Shutdown Evidence & Policy," which gives more technical details about this topic.

USDA's goal is to complete depopulation work within 24 hours of first detecting HPAI at a property. The sooner we act, the faster we can contain the outbreak and help business return to normal.

ACTIONS YOU NEED TO TAKE

- Talk with your case manager about how you'll be involved and if you'll work directly with emergency responders on these activities.
- Wear personal protective equipment if you are on the farm at the time depopulation or disposal work is happening or if you are directly involved in this work.
- Require that your employees also wear personal protective equipment if they are on the farm or helping with response activities. Your case manager can provide guidance on personal protective equipment if needed.
- Adhere to strict biosecurity procedures at your farm.
- Follow all other steps outlined by the response team to minimize risk of spreading the disease during the process.

Source: go.usdatraining.com/HPAI_depop

FEMA RECOVERY DIVISION

FACT SHEET 9580.202

DEBRIS REMOVAL
AUTHORITIES OF FEDERAL AGENCIES

Overview

This fact sheet identifies and describes the authorities of federal departments and agencies in support of debris operations following a presidential emergency or major disaster declaration. The following nine Federal agencies and departments are invested with authorities (described in detail below) addressing various aspects of debris management.

- Department of Homeland Security
  - *Federal Emergency Management Agency*
  - *United States Coast Guard*
- Department of Defense: *U.S. Army Corps of Engineers*
- Department of Agriculture
  - *Natural Resources and Conservation Service*
  - *Farm Service Agency*
  - *Animal Plant and Health Inspection Service*
- Department of Transportation: *Federal Highway Administration*
- Department of Commerce: *National Oceanic and Atmospheric Administration*
- Environmental Protection Agency

Department of Homeland Security

Federal Emergency Management Agency (FEMA)

- FEMA is authorized in Sections 403, 407 and 502 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act to provide assistance to eligible applicants to remove debris from public and private property following a Presidential disaster declaration, when in the public interest.

- Removal must be necessary to eliminate immediate threats to lives, public health and safety; eliminate immediate threats of significant damage to improved public or private property; or ensure

RECOVERY DIVISION FACT SHEET - RP9580.202

DEBRIS REMOVAL AUTHORITIES OF FEDERAL AGENCIES

the economic recovery of the affected community to the benefit of the community-at-large. The debris must be the direct result of the disaster and located in the disaster area, and the applicant must have the legal responsibility to remove the debris.

- FEMA will (1) reimburse applicants to remove eligible debris, or (2) through a mission assignment to another Federal agency (and upon request of the State) - provide *direct Federal assistance* when it has been demonstrated that the State and local government lack the capability to perform or contract for the requested work.

- Assistance will be cost-shared (at no less than 75% Federal and 25% non-Federal). In extreme circumstances, FEMA will provide up to 100% funding for a limited period of time.

United States Coast Guard (USCG)

- Under the National Contingency Plan (NCP), the USCG and Environmental Protection Agency (EPA) are responsible for providing pre-designated Federal On-Scene Coordinators (FOSCs) to conduct emergency removals of oil and hazardous materials.

- USCG is responsible for the coastal zone, and the EPA is responsible for the inland zone. The delineation between coastal and inland zones is by mutual agreement between the USCG and the EPA, and the geographic limits are indicated in Area Contingency Plans.

- Under the Comprehensive Environmental Response, Compensation, and Liability Act, or CERCLA (also known as Superfund), and the Clean Water Act, USCG has the authority to respond to actual or potential discharges of oil and actual or potential releases of hazardous substances, pollutants and contaminants that may endanger public health or the environment.

- Response actions may include containment, stabilization, decontamination, collection (e.g., orphan drums tanks and drums), and final disposal. Debris may be mixed with, or contain, oil or hazardous materials that are subject to USCG response authorities. Oil removal is funded from the Oil Spill Liability Trust Fund, while hazardous materials removal is conducted using CERCLA funds.

- USCG, under the Ports and Waterways Safety Act (33 U.S.C. §§1221), is responsible for keeping waterways safe and open. While there is no specific language stating that the USCG is responsible for debris removal from waterways, the USCG has been tasked - in the past - to assist in waterway and marine transportation system recovery.

RECOVERY DIVISION FACT SHEET - RP9580.202

DEBRIS REMOVAL AUTHORITIES OF FEDERAL AGENCIES

Department of Defense

United States Army Corps of Engineers (USACE)

- USACE is authorized by Section 202 of Water Resources Development Act (WRDA) of 1976 (PL 94-587) to develop projects for the collection and removal of drift and debris from publicly maintained commercial harbors, and from land and water areas immediately adjacent thereto.

- Specific and limited local programs for continuing debris collection and disposal have been authorized (on an individual basis, with the authorized work carried out at each locality as a separate, distinct project) by Congress for:

  - New York Harbor
  - Baltimore Harbor
  - Norfolk Harbor
  - Potomac and Anacostia Rivers, in the Washington, D.C. Metropolitan area
  - San Francisco Harbor/Bay, California.

- Sections 15, 19, and 20 of the River and Harbor Act of 1899, as amended, authorize USACE to remove sunken vessels or other obstructions from navigable waterways under emergency conditions. A navigable waterway is one that has been authorized by Congress, and which USACE operates and maintains for general (including commercial and recreational) navigation. Funding for operation and maintenance of these "Federal" waterways is through USACE's annual Operations and Maintenance General Appropriation. USACE's policy is to oversee removal of sunken vessels by an identifiable owner, operator or lessee if the sunken vessel is in or likely to be moved into a Federal navigation channel. USACE will remove a vessel using its emergency authorities only if the owner, operator, or lessee cannot be identified or they cannot effect removal in a timely and safe manner.

- USACE is also authorized, under Flood Control and Coastal Emergencies (PL 84-99), to provide assistance for debris removal from flood control works, i.e., structures designed and constructed to have appreciable and dependable effects in preventing damage by irregular and unusual rises in water level. Under this authority, USACE requires that an applicant, to be eligible for assistance, be an active participant in its PL 84-99 Rehabilitation and Inspection Program at the time of the disaster.

RECOVERY DIVISION FACT SHEET - RP9580.202

DEBRIS REMOVAL AUTHORITIES OF FEDERAL AGENCIES

United States Department of Agriculture

Natural Resources Conservation Service (NRCS)

- NRCS' Emergency Watershed Protection Program (EWP) is authorized by Section 216 of the Flood Control Act of 1950, PL 81–516, 33 U.S.C. 701b–1; and Section 403 of the Agricultural Credit Act of 1978, PL 95–334, as amended by Section 382, of the Federal Agriculture Improvement and Reform Act of 1996, PL 104–127, 16 U.S.C. 2203.

- Debris clean up must be for either runoff retardation or soil erosion prevention that is causing a sudden impairment in the watershed creating an imminent threat to life or property. Typically, this includes debris within channels but could also include debris in close proximity to a channel or situated where the next event could create an imminent threat to life or property. There is no size limit to the watershed except that EWP assistance is not eligible for coastal erosion restoration.

- The EWP is funded through specific Congressional appropriations.

- Public and private landowners are eligible for assistance but must be represented by a project sponsor (a state or political subdivision thereof, qualified Indian tribe or tribal organization, or unit of local government).

- Work can be done either through Federal or local contracts. Sponsors are responsible for the 75% local cost share.

- NRCS can provide assistance when the President declares an area to be a major disaster area or when an NRCS State Conservationist determines that a watershed impairment exists.

- NRCS will not provide funding for activities undertaken by a sponsor prior to the signing of an agreement between NRCS and the sponsor.

Farm Service Agency (FSA)

- Emergency Conservation Program (ECP) is authorized by Sections 401 - 406 of the Agricultural Credit Act of 1978, PL 95–334, and provides emergency assistance for debris removal from privately-owned land following a natural disaster. It is funded through Congressional supplemental appropriations.

RECOVERY DIVISION FACT SHEET - RP9580.202

DEBRIS REMOVAL AUTHORITIES OF FEDERAL AGENCIES

- The damage must be so costly that Federal assistance is or will be required to return the land to productive agricultural use or to provide emergency water for livestock.

- The ECP provides emergency cost share funding (up to 75% federal share) and technical assistance for farmers and ranchers to remove debris (other than animal carcasses).

Animal, Plant and Health Inspection Service (APHIS)

- APHIS has two programs under which it can provide debris removal assistance:

  - Veterinary Services (VS) program authorized by Animal Health Protection Act (7 U.S.C. 8301–8317) which provides for removal and burial of diseased animal carcasses.

  - Plant Protection and Quarantine (PPQ) program authorized by Plant Protection Act (Title IV, Pub. L. 106–224, 114 Stat. 438, 7 U.S.C. 7701–7772). This program manages issues related to the health of plant resources. Primary objective is to regulate and monitor in order to reduce the risk of introduction and spread of invasive species, including planning, surveillance, quick detection, containment, and eradication.

- Both public and private lands are eligible under these programs which provide assistance to Federal, State, tribes, local jurisdictions, and private landowners to manage animal and plant health by collecting and providing information, conducting or supporting treatments, providing technical assistance for planning and program implementation (removal).

Environmental Protection Agency (EPA)

- EPA's primary authorities related to debris removal fall into two categories: (1) authorities related to cleaning up debris that is mixed with or contains oil or hazardous materials; and (2) authorities related to establishing standards for proper management of debris (hazardous and non-hazardous). EPA generally does not remove non-hazardous debris after emergencies/disasters.

- Under the Comprehensive Environmental Response, Compensation, and Liability Act, or CERCLA (also known as Superfund), and the Clean Water Act, EPA and the United States Coast Guard (USCG) have the authority to respond to actual or potential discharges of oil and actual or potential discharges of hazardous substances, and to actual or potential discharges of pollutants and contaminants that may present an imminent and substantial danger to the public health or welfare.

RECOVERY DIVISION FACT SHEET - RP9580.202

DEBRIS REMOVAL AUTHORITIES OF FEDERAL AGENCIES

- EPA has responsibility for responses in the inland zone and USCG has responsibility for responses in the coastal zone. The delineation between the inland and coastal zone is determined by mutual agreement by the EPA and USCG, and the geographic boundaries are indicated in Area Contingency Plans.

- EPA and USCG carry out these responsibilities under implementing regulations known as the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). EPA and USCG pre-designate Federal On-Scene Coordinators (FOSCs) to direct and coordinate response actions.

- Response actions may include containment, stabilization, decontamination, collection (e.g., orphan tanks and drums), and disposal. Debris may be mixed with, or contain, oil or hazardous materials that are subject to these response authorities.

- CERCLA requires that the State in which the site is located fund 10% of remedial action costs, with the other 90% drawn from the Superfund. However, where the potentially responsible party is a political subdivision of a State, the State must agree to fund 50% of the remedial action costs, with the other 50% drawn from the Superfund.

- The Resource Conservation and Recovery Act established a framework for Federal, State, and local cooperation in controlling the management of hazardous and non-hazardous solid waste. The EPA role is to establish minimum regulatory standards that are, in most cases, implemented by the States and to provide technical assistance. EPA administers other laws as well that may impact the management of debris (e.g., Clean Air Act requirements that apply to asbestos-containing debris). Again, some of these programs may be delegated to the States.

- FEMA may mission assign the EPA through the United States Army Corps of Engineers to dispose of household hazardous waste following a major disaster declaration from the President.

Department of Transportation

Federal Highway Administration (FHWA)

- The Emergency Relief (or ER) program is authorized in Title 23, United States Code, Section 125, from the Highway Trust Fund, and supports repair or reconstruction of Federal-aid highways and roads on Federal lands which have suffered serious damage as a result of natural disasters or catastrophic failures from an external cause.

- Debris removal from Federal-aid roads is eligible for 100% reimbursement during the first 180 days following an emergency event that qualifies and is approved for the ER program.

RECOVERY DIVISION FACT SHEET - RP9580.202

DEBRIS REMOVAL AUTHORITIES OF FEDERAL AGENCIES

- The ER program is funded $100 million in annual authorizations. If the annual authorization is expended, FHWA will reimburse eligible costs when ER funds become available.
- The State must incur a cost of at least $700,000 statewide to qualify for ER assistance. The cost of individual projects (sites) must be $5,000.
- It is the responsibility of individual States to request ER funds for assistance in the cost of necessary repair of Federal-aid highways damaged by natural disasters or catastrophic failures.

Department of Commerce

National Oceanic and Atmospheric Administration (NOAA)

- The Coastal and Geodetic Survey Act of 1947 and the Hydrographic Services Improvement Acts of 1998, 2002, authorize NOAA to be directly involved in programs to assess and remove hazards and debris. NOAA does not fund debris removal.
- NOAA's Office of Coastal Survey is responsible for surveying and charting the nation's waters and coast, and has been heavily involved in hydro-surveying using side-scan and multi-beam sonar to identify hazards and debris and dangers to navigation along the Gulf Coast for the last three years.

David Garratt
Acting Director of Recovery
Federal Emergency Management Agency

1/27/07
Date

United States Department of Agriculture

Animal and Plant Health Inspection Service
Program Aid No. 2139

National Veterinary Stockpile:

Ready for Animal Disease Emergencies

As part of its safeguarding mission, the U.S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Service (APHIS) coordinates the National Veterinary Stockpile (NVS) program.

The NVS is our Nation's repository of veterinary "countermeasures"—animal vaccines, antivirals, supplies, equipment, and response support services. Simply put, it exists to provide States, tribes, and territories with the tools they need to combat an animal disease outbreak. In an animal health emergency, the response must be fast and well coordinated to keep disease from spreading. The NVS can dispatch—within 24 hours—critical resources animal health officials need onsite.

With NVS support, officials can set up immediate measures to contain and eradicate the disease, minimizing the animal losses and other economic damages that result from an outbreak. In addition to providing resources and materials when outbreaks occur, NVS personnel help States, tribes, and territories prepare for future outbreaks through careful advance planning, training, and exercises. Our goal is to make sure that, when faced with an emergency, our partners understand the process for rapidly requesting, receiving, processing, and distributing NVS resources so responders get help quickly.

What We Offer

Equipment and Supplies

The NVS offers many resources to address animal health threats during disease outbreaks. These resources (i.e., veterinary countermeasures) include:

1) personal protective equipment for on-the-ground responders to guard against infection and other onsite hazards;
2) decontamination supplies to inactivate pathogens;
3) vaccines to quickly protect livestock and poultry at risk of infection;
4) vaccination equipment and supplies (such as needles and syringes) to effectively immunize large numbers of livestock and poultry;
5) animal handling equipment, including corrals, to safely contain and restrain livestock;
6) equipment for emergency euthanasia and depopulation of animals;
7) assistance in securing outside companies, if needed, to provide trained personnel and additional equipment for large-scale depopulation, disposal, and decontamination work.

Training and Exercises

We help States, tribes, and territories plan for potential disease outbreaks to support a smooth response should they need NVS resources. For example, we offer a planning guide, a plan template, and other tools that explain in detail what logistical factors to consider when preparing for an agricultural emergency. Our staff can also share their first-hand experiences and expertise in handling various disease situations, which further aids the planning process.

Once a plan is in place, our staff conduct logistical training and exercises with NVS partners per the Homeland Security Exercise Evaluation Program. These exercises give participants an opportunity to:

- learn in detail about the NVS program and available resources;
- test their abilities to request, receive, process, and distribute NVS equipment, supplies, and vaccines;
- clarify roles and responsibilities to aid in a logistics operation; and
- identify resource gaps and improve response plans before outbreaks occur.

Contact Us

To learn more, visit our Web site at http://nvs.aphis.usda.gov or email us at nvs@aphis.usda.gov .

You can also reach our staff by phone at (301) 851-3595 or fax at (301) 734-7817 .

In an emergency, please call our 24/7 hotline: 1-800-940-6524 .

USDA is an equal opportunity provider and employer.

Issued June 2013

APHIS Factsheet

Veterinary Services

March 2013

Questions and Answers: The National Veterinary Stockpile and the 24 Hour Push Pack

The National Veterinary Stockpile (NVS) program, coordinated by the U.S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Service (APHIS), provides support to States, Tribes, and Territories responding to damaging animal disease outbreaks. Within 24 hours, the NVS can provide veterinary countermeasures—including certain types of animal vaccines, antivirals, supplies, equipment, and response services—to animal health officials in affected areas. To learn more about this program, see the NVS factsheet go.usdatraining.com/NVS_factsheet

One of the services NVS provides is shipping the "24 Hour Push Pack" when needed to combat a damaging animal disease outbreak.

Q. What is a "24 Hour Push Pack?"
A. A 24 Hour Push Pack is the initial shipment of supplies. The shipment will arrive within 24 hours of APHIS' approval to deploy resources. The requestor only needs to provide basic information about the situation, and we will coordinate the transport of supplies needed to respond to a damaging animal disease.

There are four details we need to determine which push pack is most appropriate for the situation:

1) **Type of disease—**this helps determine whether a standard or high-protection push pack is needed. High-protection push packs include high-level respiratory protection, such as Powered Air Purifying Respirators (PAPR).

2) **Number of responders expected—**this determines the number of push packs needed. Each push pack supports 10 responders for 10 days, changing 6 times per day. When making your request, round the number of responders up to the nearest multiple of 10.

3) **Incident command point-of-contact** to coordinate the NVS deployment

4) The **physical address of the facility** that will receive NVS supplies

Once we receive this information, the NVS Deployment Management Team will determine what to provide immediately.

Q. What does a push pack contain?
A. Depending on the level of protection needed, there are two types of push packs.

A standard protection push pack contains four modules:
- 2 Tyvek personal protective equipment (PPE) modules, which include 450 PPE kits, a first aid kit, bulk nitrile gloves, and boot covers;
- 1 Tychem module, which includes 150 PPE kits; and
- 1 decontamination module, which contains disposable aprons, isolation bags, Ziploc® bags, long-handled brushes, buckets with covers, pop-up ultra pols, shoe and boot scrapers, EMS shears, 2-gallon sprayers, chemical tape, caution tape, and Virkon® S test strips.

A high-protection push pack contains five modules:
- 2 Tyvek PPE modules, which include 450 PPE kits, a first aid kit, bulk nitrile gloves, and boot covers;
- 1 Tychem module, which includes 150 PPE kits;
- 1 decontamination module, which contains disposable aprons, isolation bags, Ziploc bags, long-handled brushes, buckets with covers, pop-up ultra pols, shoe and boot scrapers, EMS shears, 2-gallon sprayers, chemical tape, caution tape, and Virkon S test strips; and
- 1 PAPR module, which contains the 3M™ Breathe Easy™ PAPR System.

If emergency vaccination is approved, you may also request a module containing vaccine ancillary supplies (e.g., needles, syringes, and sharps containers). In the event of a foot-and-mouth disease (FMD) outbreak, you may request a second vaccine ancillary supplies module containing pink FMD tags. This request is subject to North American FMD Vaccine Bank (NAFMDVB) approval; NVS stores the pink FMD tags for the NAFMDVB.

Source: The National Veterinary Stockpile and the 24 Hour Push Pack (go.usdatraining.com/NVS_pushpack)

Q. What sizes of PPE are included in each 24 Hour Push Pack?
A. Each PPE module contains 2XL and 3XL suits. The NVS staff determined, after careful consideration, that these two sizes fit the vast majority of responders.

Q. Will all of the 24 Hour Push Packs arrive on one truck?
A. NVS can typically load 50 to 52 modules in one tractor trailer. This equates to 10 push packs, with the remaining 2 spaces available for possible vaccine ancillary supplies. If you require more than 10 push packs, expect more than one tractor trailer.

Q. Do the 24 Hour Push Packs arrive on pallets?
A. The push packs are fully contained in Tri-Walls™, which consist of triple-walled, fiberboard sleeves, a plastic top, and a plastic bottom pallet. The sleeve can be locked with the bottom pallet and top to form a rigid and secure system that eliminates the requirement for banding, stretch wrap, or strapping material. They are 40 inches by 48 inches and are either 45 inches or 52 inches tall. The plastic top and bottom pallet can be removed and the sleeve folded for storage. Forklifts or pallet jacks move them easily.

Q. How are the 24 Hour Push Packs configured? How can I quickly identify items in the pack?
A. Each 24 Hour Push Pack consists of modules that are packed with like items. This allows warehouse personnel to quickly find specific items; for example, all decontamination supplies are packed in modules that have been labeled with a number "4." We also attach a detailed packing list to the outside of each module that identifies the contents. A packing diagram for each module is included on a drop flap.

To expedite filling requests, the NVS uses the following color-coded labeling system to distinguish the contents of each module so that items can be located quickly:

- Blue = PPE
- White = decontamination supplies
- Yellow = vaccines, antivirals, and vaccination supplies
- Green = PAPR systems

Q. Can empty modules be used to ship supplies from a storage location to a premises?
A. Empty Tri-Walls must be returned to an NVS logistics center so that they can be reused. The NVS Deployment Management Team will arrange for pickup and transport back to one of our centers.

Q. If I have questions about the NVS, who should I contact?
A. Email us at nvs@aphis.usda.gov with any questions. More information is also available on our Web site go.usdatraining.com/NVS

USDA is an equal opportunity provider and employer.

Mention of companies or commercial products does not imply recommendation or endorsement by the U.S. Department of Agriculture over others not mentioned. USDA neither guarantees nor warrants the standard of any product mentioned. Product names are mentioned solely to report factually on available data and to provide specific information.

Source: The National Veterinary Stockpile and the 24 Hour Push Pack (go.usdatraining.com/NVS_pushpack)

APHIS Factsheet

Veterinary Services

March 2013

Questions and Answers: The National Veterinary Stockpile and 3D Response Support Services

The National Veterinary Stockpile (NVS) program, coordinated by the U.S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Service (APHIS), provides support to States, Tribes, and Territories responding to damaging animal disease outbreaks. Within 24 hours, the NVS can provide veterinary countermeasures—including certain types of animal vaccines, antivirals, supplies, equipment, and response services—to animal health officials in affected areas. To learn more about this program, see the NVS factsheet go.usdatraining.com/NVS_factsheet

NVS provides depopulation, disposal, and decontamination (3D) response support through a variety of contractors.

Q. What are 3D response support services?
A. "3D" refers to depopulation, disposal, and decontamination activities. These activities commonly require the rapid deployment of large numbers of response personnel and equipment. The NVS maintains contracts with all-hazards emergency response companies to assist with 3D operations as needed and serves as the single point-of-contact within APHIS for 3D response support services.

Q. What types of services can 3D contractors provide?
A. 3D response support services include:

- **surge personnel** fully equipped with personal protective equipment;
- **decontamination equipment and mobile teams** to support field responders onsite;
- **waste management and disposal,** including carcass and debris recovery, handling, and disposal;
- **hazardous and infectious material transportation** and access to landfills;
- **staging area setup** and operations for distribution of equipment and materials;
- **certified operators for special equipment,** including forklifts, skid loaders, and heavy trucks/equipment; and
- **special equipment** such as mobile command centers, emergency power and lighting, pumps/pressure washers, and satellite terminal and radio communications.

Q. How experienced are the 3D contractors in responding to agricultural emergencies?
A. All of our 3D contractors receive annual training from NVS specific to agricultural emergency response. We design this training to ensure that our contractors are proficient—and efficient—in responding to these types of emergencies and in using NVS equipment and resources. Our contractors also participate in the NVS exercise program, which reinforces lessons learned and prepares them on an operational level for responding to agricultural emergencies.

The 3D contractors are also highly trained in all-hazards emergency response and are capable of deploying with their own equipment and supplies. They are experts in decontamination and disposal operations, including State requirements for transporting and disposing of hazardous materials. The contractors operate within the National Incident Management System.

Q. How quickly will 3D contractors arrive onsite? What is their surge capacity?
A. The 3D contractors will arrive within 24 hours of receiving the approval to deploy and report to Incident Command. Depending on services required, the contractors can deploy approximately 600 personnel within 72 hours and 1,000 personnel within a week.

Q. What happens if there are simultaneous events and multiple requests for 3D services?
A. We work with multiple 3D contractors to ensure redundancy in coverage.

It is a common business practice in the all-hazards emergency response industry for companies to work together to get the job done. For example, during

Source: The National Veterinary Stockpile and the 24 Hour Push Pack (go.usdatraining.com/3D)

the first days of the 2010 Deepwater Horizon oil spill, NVS conducted an unannounced notification exercise with our 3D contractors while conducting a full-scale deployment exercise with one of the 3D companies in attendance. All 3D contractors indicated they had the capability to respond to an agricultural emergency while responding to the oil spill at the same time.

Q. How do I request 3D services during an animal disease event?
A. Call our 24/7 emergency hotline at 1-800-940-6524.

Q. If I have questions about NVS or 3D services, who should I contact?
A. Email us at nvs@aphis.usda.gov with any questions. More information is also available on go.usdatraining.com/NVS

USDA is an equal opportunity provider and employer.

Source: The National Veterinary Stockpile and the 24 Hour Push Pack (go.usdatraining.com/3D)

Animal and Plant
Health Inspection
Service

Veterinary Services
May 2015

Producer Information Sheet

USDA Avian Influenza Response: Mass Depopulation and Carcass Disposal

As part of its safeguarding mission, the U.S. Department of Agriculture (USDA) protects the health of the Nation's livestock and poultry. USDA responds to major animal disease events, helping to keep dangerous diseases from spreading and threatening even more animals. USDA also works to reduce the economic impact of disease events.

Since December 2014, USDA has confirmed cases of highly pathogenic avian influenza (HPAI) H5 in the Pacific, Central, and Mississippi flyways (or migratory bird paths). The disease has been found in wild birds, as well as in a few backyard and commercial poultry flocks. The Centers for Disease Control and Prevention (CDC) considers the risk to people from these HPAI H5 infections to be low. No human cases of these HPAI H5 viruses have been detected in the United States, Canada, or internationally.

In responding to the detections, USDA must depopulate affected flocks to prevent the spread of this highly contagious disease to additional flocks and must safely dispose of all depopulated birds. USDA and State officials evaluate disposal options based on the size of the flock, local conditions, and applicable laws/regulations.

Mass Depopulation Method

- HPAI eradication activities typically involve quarantine and movement controls, a humane depopulation component, disposal, and cleaning and disinfection activities.
- When depopulation is deemed necessary, Federal authorities, in conjunction with State and Tribal agricultural officials and industry, will euthanize infected birds and affected flocks.
- USDA's Animal and Plant Health Inspection Service (APHIS) employs depopulation technologies that are humane, limit human exposure to the AI virus, and better accommodate large-scale eradication efforts.
- The use of water-based foam has the potential to reduce the number of workers involved in depopulation efforts, decreases their exposure to zoonotic HPAI viruses, is relatively easy to deploy under field conditions, and will mitigate the physical threat to responders who depopulate animals in a structurally unsound building.

Source: USDA Avian Influenza Response: Mass Depopulation and Carcass Disposal (go.usdatraining.com/depopulation)

Biosecurity During Carcass Disposal

If USDA determines that moving the carcasses to a landfill for disposal is the best available option, animal health officials will ensure this move is safe for both landfill operators and the general public, and that all necessary biosecurity steps are followed.

General Carcass Disposal

Q. What are the carcass disposal options?
A. There are a variety of safe methods for carcass disposal. These methods include composting, onsite burial, incineration, rendering, and landfilling.

Q. How do animal health officials decide which disposal method to use?
A. USDA and its State partners evaluate disposal methods based on a variety of factors, including the size of the flock, space requirements, associated costs, local conditions, and applicable laws/regulations. There are benefits and limitations to using each method:

- **Composting.** This method contains the virus to the farm and produces a soil amendment/fertilizer product. However, composting requires wide-open spaces and may not be feasible for all farming operations, such as egg layer facilities or other facilities where space is limited.
- **Burial.** On-farm carcass burial must be approved by the State environmental regulatory agency and may not be permitted if the water table is close to the ground surface.
- **Incineration.** Incineration is another method that can be safely used to dispose of carcasses. The limitation of this method is that the fuel requirements are substantial and can be costly.
- **Rendering.** This involves processing carcasses until they are reduced to water, fat or tallow, and meat or bone meal. It is very effective but requires additional safety precautions to ensure that the virus does not become aerosolized during the rendering process and transported throughout the plant. It also necessitates disruption of the plant's normal operations.
- **Landfilling.** Landfilling allows safe and efficient disposal of large quantities of carcasses.

When necessary, USDA takes an integrated approach and uses a combination of some or all of these methods.

Landfilling—Health and Safety Concerns

Q. Is landfilling an environmentally safe option for HPAI carcass disposal?
A. Yes. Landfills are highly regulated by the U.S. Environmental Protection Agency (EPA) and—in many cases—individual States to ensure that disposed materials do not present a risk to human health and the environment. Under EPA and State regulations, landfills are located, designed, operated, and monitored to ensure protection of the environment from contaminants that might be present.

Source: USDA Avian Influenza Response: Mass Depopulation and Carcass Disposal (go.usdatraining.com/depopulation)

Q. What measures are in place at the landfill to protect the environment?
A. There are numerous, overlapping safety controls in place to protect the environment. For example, per EPA and State requirements, municipal solid waste landfills must include an impermeable liner overlaying 2 feet of clay soil along the bottom and sides of the landfill. This protects groundwater and soil from water that trickles through the landfill and absorbs some of its materials, referred to as leachate. In addition, a collection and removal system sits on top of the liner system and removes leachate from the landfill for treatment and disposal.

Q. Will the carcasses in the landfill pose a threat to human health?
A. No. The CDC considers the risk to people from these HPAI H5 infections to be low. No human cases of these HPAI H5 viruses have been detected in the United States, Canada, or internationally. In addition, the virus does not survive more than 6 days in carcasses held at room temperature.

Carcass Transport

Q. How will the carcasses be safely moved to the landfill?
A. A clean trailer is brought onsite by State-licensed haulers and is fitted with a biosecure containment bag. The carcasses are then loaded into the biosecure containment bag, which is sealed, and the truck and trailer—including the exterior of the biosecure containment bag—are disinfected with EPA-registered products labeled for this use. Upon arrival at the landfill, the biosecure containment bag slides out and is immediately buried. The truck and trailer are then cleaned and disinfected again prior to leaving the landfill.

Q. Will moving the carcasses spread the virus to new locations or farms?
A. No. USDA has conducted a thorough assessment of the risks associated with transporting such carcasses; the risk assessment found that, when transporting the carcasses is necessary, the movement can be done safely and will not spread the disease if the protocols described are followed. In addition, we employ several layers of redundant safety measures and carefully monitor all cleanup and disposal activities to ensure that they are done in compliance with USDA protocols.

Q. Who is ultimately responsible for ensuring this transport is done safely?
A. USDA is responsible for ensuring that carcasses are transported safely. Each truck carrying infected carcasses is issued a permit by USDA which allows it to move outside of the quarantine zone. USDA also establishes the requirements that must be met to allow such movement.

Q. Has this been done successfully in previous disease outbreaks?
A. Yes. USDA has successfully used landfilling in several major disease situations over the years. In 2002, USDA used landfills to dispose of turkeys infected with low pathogenic avian influenza in Virginia and routinely uses landfilling in Wisconsin to dispose of cervid carcasses infected with chronic wasting disease.

Source: USDA Avian Influenza Response: Mass Depopulation and Carcass Disposal (go.usdatraining.com/depopulation)

Q. Is there anything the public or producers in the area need to do?
A. All bird owners, whether commercial producers or backyard enthusiasts, need to continue:

- practicing good biosecurity,
- preventing contact between their birds and wild birds, and
- reporting sick birds or unusual bird deaths to State/Federal officials, either through your State veterinarian or through USDA's toll-free number at 1-866-536-7593.

You can find more information online at http://healthybirds.aphis.usda.gov.

USDA is an equal opportunity provider and employer.

Source: USDA Avian Influenza Response: Mass Depopulation and Carcass Disposal (go.usdatraining.com/depopulation)

FY2016 HPAI Response
Timeline, Eligibility, and Approval for Restocking

March 30, 2016

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

Document History & Related Documents

This document updates and supersedes the following documents:

- *Timeline to Restocking & Environmental Sampling Procedures*
- *Restocking Criteria for Previously Infected Premises.*

Please also see the following, related policy documents (www.aphis.usda.gov/fadprep):

- *Protocol for Environmental Sample Collection and Testing for AI Virus*
- *Cleaning & Disinfection Basics (Virus Elimination).*

Intended Use

This document provides guidance to State Animal Health Officials (SAHOs), USDA Animal and Plant Health Inspection Service (APHIS) Officials, and Incident Management Teams (IMTs) for the restocking of highly pathogenic avian influenza (HPAI)-infected commercial poultry premises. This includes the timeline to restocking and criteria that must be met for premises to restock.

In order for premises to restock after HPAI infection, they must meet the minimum time requirements, all criteria laid out in this document, AND be approved to restock. Being approved to restock indicates that in addition to finishing all the steps in the restocking process, the premises has met any additional criteria that may have been laid out by the State or APHIS, and that State and APHIS officials have agreed in writing that the premises can be restocked.

Biosecurity Measures

All biosecurity practices currently in place on the premises (including use of personal protective equipment [PPE]) will be followed for activities discussed in this document, including sample collection for environmental testing and final inspection of the premises prior to quarantine release. The level of PPE needed for different activities (environmental sampling, for example) will be determined by the SAHOs and/or IMTs.

Timeline To Restocking of Previously Infected Premises

The timelines provided below offer guidance on just the *steps, time,* and *sampling* it takes to reach the point to be eligible to begin the restocking process and, ultimately, approved to restock.

Timelines for Restocking for Premises Using Composting

Please see Figures 1 through 3 for the timelines on premises using composting. Figure 1 covers in-house composting, Figure 2 covers outdoor composting, and Figure 3 covers the combination of in-house/outdoor composting.

For premises using composting, environmental sampling inside the houses/barns occurs after the compost pile is complete and removed from inside the barns. For outdoor composting, environmental sampling inside the houses/barns can occur after the houses/barns are cleaned and disinfected.

Please note: There is no requirement OR option to release compost based upon compost sample testing.

Figure 1. Timeline for Disposal & Premises Restocking: IN-HOUSE COMPOSTING

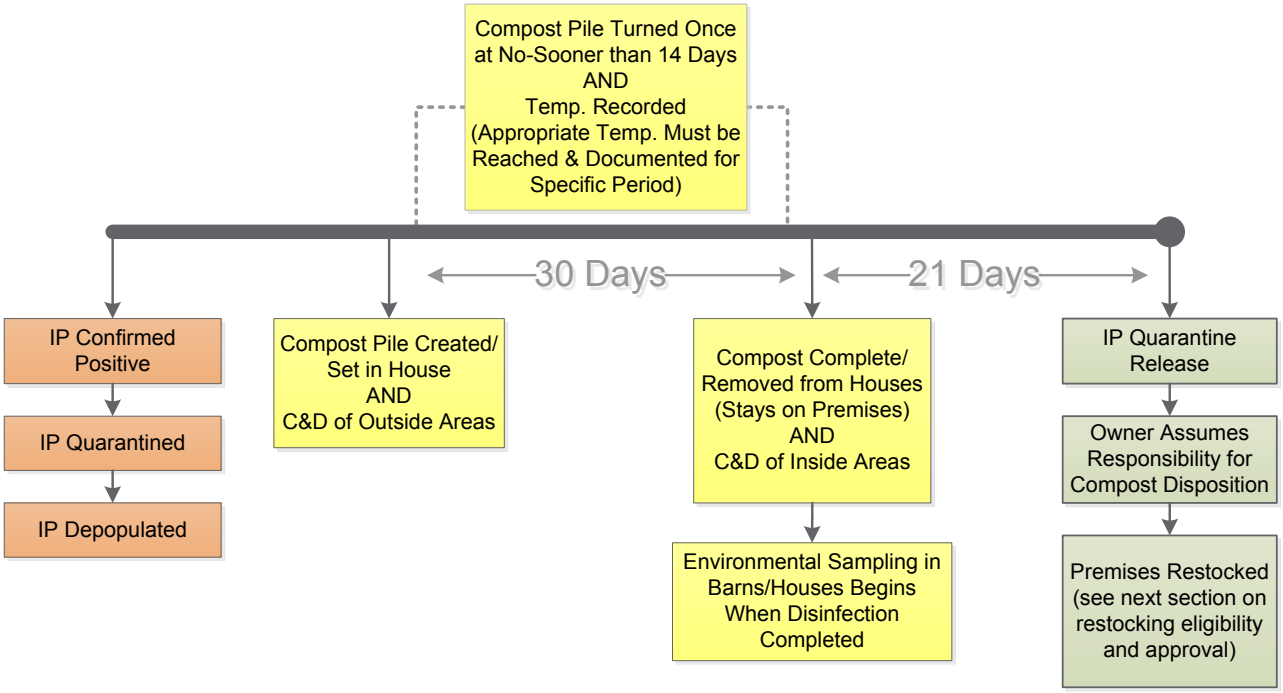
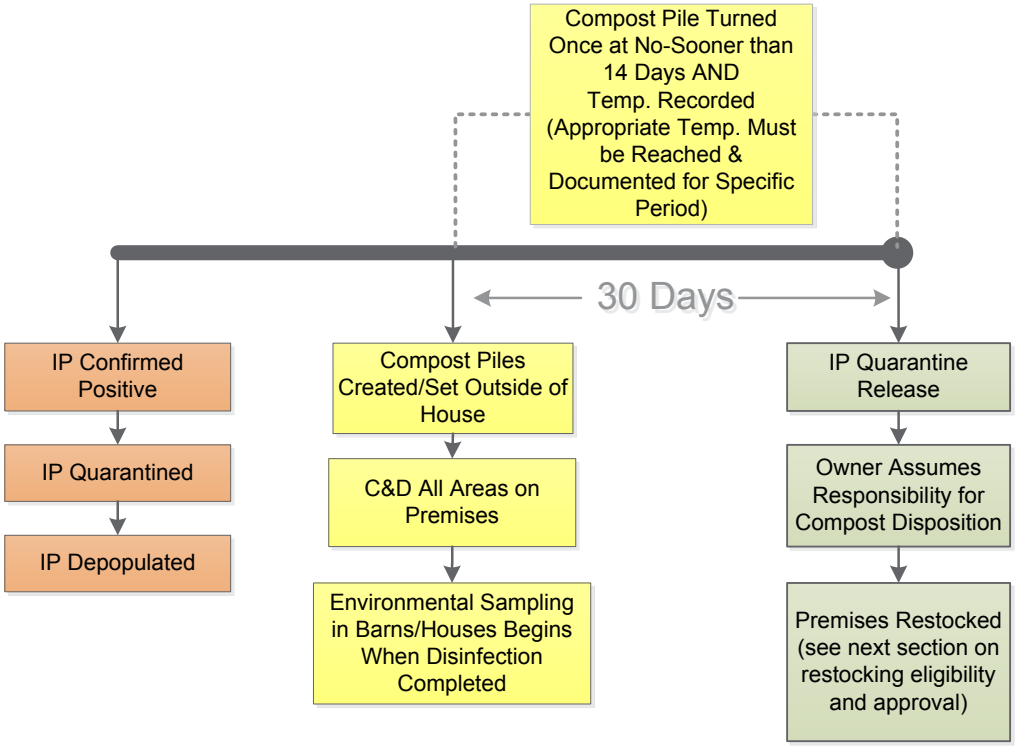
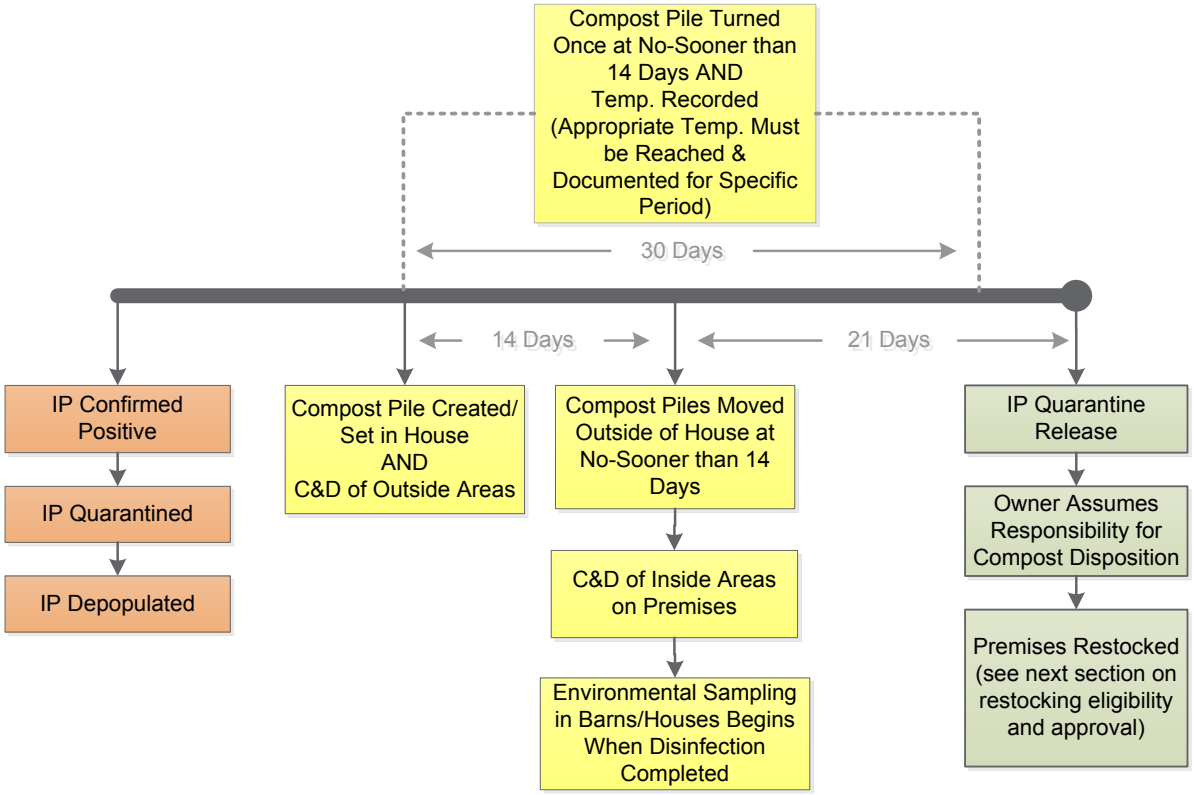


Figure 2. Timeline for Disposal & Premises Restocking: OUTDOOR COMPOSTING



Source: Timeline, Eligibility, and Approval for Restocking (go.usdatraining.com/criteriarestock)

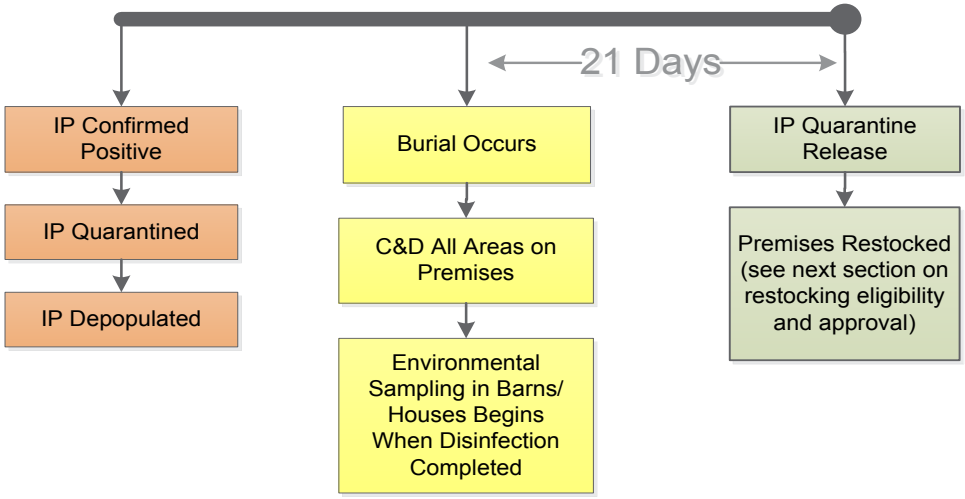
Figure 3. Timeline for Disposal & Premises Restocking: COMBO OF IN-HOUSE/OUTDOOR COMPOSTING



Timeline for Restocking for Premises Using Burial

For premises using burial, environmental sampling is performed inside the houses/barns *after* the premises is cleaned and disinfected following disposal. Figure 4 provides the restocking timeline for premises using burial.

Figure 4. Timeline for Disposal & Premises Restocking: BURIAL



Source: Timeline, Eligibility, and Approval for Restocking (go.usdatraining.com/criteriarestock)

RESTOCKING PREVIOUSLY INFECTED PREMISES

A primary goal of the HPAI response is to ensure that the response efforts and activities do not cause more damage and disruption than the disease outbreak itself. However, restocked premises that subsequently become infected with HPAI a second time place added stress on already strained resources and continue the risk of ongoing HPAI transmission in commercial poultry. As such, APHIS urges appropriate caution restocking premises in an HPAI outbreak.

Restocking Assessments

Two assessments must occur to restock previously infected premises:

1. An assessment of the previously Infected Premises being restocked. This includes the environmental sampling results and assessment of whether the premises has met the timeline requirements in Figures 1-4 (as applicable to the specific premises).

2. An assessment of the surrounding area or Control Area in which the Infected Premises is located. Assessment information includes the epidemiological curve (rate of new infected premises), geospatial risk factors, and other epidemiological risk factors for the previously infected premises.

Indemnity

APHIS will not indemnify previously Infected Premises that are restocked without written APHIS **and** State approval and subsequently become an Infected Premises a second time. For premises that meet the following criteria, including written approval by APHIS and State officials that restocking can occur, full indemnification will be provided by APHIS as funds are available.

Restocking Process

When a premises finishes virus elimination, and a final inspection of the premises has been completed, the premises enters the restocking phase of the response. At this point, the premises can begin the restocking process (in other words, the premises is "eligible to begin the restocking process/pending restock approval"), but is **not yet** approved to restock.

In order to restock a previously Infected Premises, all of the following criteria must be met:

1. The owner and/or grower meets, for the original Infected Premises, the requirements of the
    a. State Quarantine Notice or Hold Order(s); AND
    b. USDA Flock Plan.
2. An assessment that the premises meets the minimum conditions laid out in this document with regard to timeline to restocking, including the
    a. Minimum fallow time, for the method of disposal chosen; AND
    b. Environmental sampling, with no evidence of HPAI infection.
3. In consultation with State animal health officials, the owner evaluates risk factors at the start of the 21 day fallow period (that begins upon completion of virus elimination activities).

When these three steps have been completed, the premises can then seek approval to restock from APHIS and State officials. To restate: a premises may only seek approval to restock when the premises is 21-days post completion of final virus elimination, environmental sampling is complete and shows no evidence of HPAI, and the premises meets requirements of the State Quarantine Notice/Hold Order and the USDA Flock Plan.

Source: Timeline, Eligibility, and Approval for Restocking (go.usdatraining.com/criteriarestock)

Approval for Restocking

After all of the above criteria are met in the "Restocking Process" section, premises become ready for State and APHIS officials to approve the restocking. Additional criteria, particularly further biosecurity measures, may be required by State and/or APHIS officials in order for the premises to be restocked; State requirements may vary by State:

1. The owner and/or grower will complete any additional surveillance, biosecurity procedures, and requirements for movement as may be required by the State and APHIS upon and following restocking. These biosecurity requirements may include, but are not limited to, the following areas:
    a. Cleaning and disinfection procedures for all movement onto the farm and all movement into and between barns.
    b. Personnel-specific biosecurity measures, including barn specific clothing not to be worn outside.
    c. Exclusion of wild birds and rodents from the barn structure.
    d. Measures to ensure feed and water are not contaminated by wild birds or their feces.
    e. Immediate mitigation of standing water, feed spills, and other environmental factors that may attract wild birds.
    f. Elimination of visits by non-essential personnel.

After State/APHIS criteria have been met and State and APHIS officials have assessed the Control Area, they will approve, in writing, that the premises can be restocked. The premises is now "approved to restock." This means that the premises has met all the requirements set by State and APHIS officials to be approved to restock, and has a signed restock agreement. In some cases, the formal Restock Approval Letter may be issued a few days prior to the end of the fallow period; however, the premises cannot restock until the date on the Letter. Any USDA Flock Plan requirements pertaining to restocking remain in place.

Premises that are Eligible but Not Approved for Restocking

At times, a premises may have completed the 21-day fallow period and have negative environmental testing, but not be approved to restock because of ongoing disease cases in the Control Area. These premises are "eligible to begin the restocking process/pending restock approval" until State and APHIS officials assess the Control Area and determine that a Restock Approval Letter can be issued to the premises. At this point the premises is "approved to restock."

Premises that Do Not Plan to Restock

There may be the case in which a premises does not plan to restock immediately or in the near future and therefore does not seek a Restock Approval Letter (but may complete the rest of the steps outlined above). These premises will continue to be "Pending Restock Approval" until State and/or APHIS officials approve, in writing, that the premises can be restocked. The steps in the "Restocking Process" section must be documented in EMRS in the same manner regardless of the premises' intention to obtain a Restock Approval Letter from State/APHIS officials.

Testing for Restocked Birds

Birds used for restocking must be from flocks tested for HPAI. These flocks must be tested for HPAI prior to movement; the minimum standard is 2 negative rRT-PCR tests at least 24 hours apart, with one negative test within 24 hours of movement.

Source: Timeline, Eligibility, and Approval for Restocking (go.usdatraining.com/criteriarestock)

SECTION 14 Appendices

Mortality Composting Protocol for Avian Influenza Infected Flocks I

Landfills and Highly Pathogenic Avian Influenza (HPAI) Response..... II

National Renderers Association Directory III

Permitted Movement IV

University of Minnesota Risk Assessment V

United States Department of Agriculture

FY2016 HPAI Response

Mortality Composting Protocol for Avian Influenza Infected Flocks

February 5, 2016

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.

Prepared by members of the USDA Composting Technical Committee: Lori P. Miller, Gary A. Flory, Robert W. Peer, Eric S. Bendfeldt, Mark L. Hutchinson, Mark A. King, Bill Seekins, George W. Malone, Joshua B. Payne, Jerry Floren, Edward Malek, Mary Schwarz, and Jean Bonhotal

Completed windrow (photo by Gary Flory)

CONTENTS

Key Elements for Successful Composting 3
Labor, Equipment, and Supplies 3
Protocol 3
- Prior to Windrow Construction 3
- Typical Windrow Construction Protocol 4
- Layering Method 7
- Approval of Windrow Design 7
- Temperature Monitoring 7
- Turning the Windrows 8
- Release of the Compost 8
- Composting Layer Manure and Waste Feed 8

Troubleshooting 9
Appendix A Siting a Compost Location for Disposal of Poultry Carcasses 10
Appendix B Methods of Estimating Carbon (Bulking Agent) Needs 12
Appendix C Variations on Typical Windrow Construction Protocol 14
Appendix D Temperature Monitoring Procedure 17
Appendix E Temperature Monitoring Log Sheet 19
Appendix F In-House Composting Ammonia Safety 20
Appendix G Compost Approval Checklist 21
Appendix H Windrow Turning Equipment and Methods 26
Appendix I Characteristics of Raw Material 28

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 (typically 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

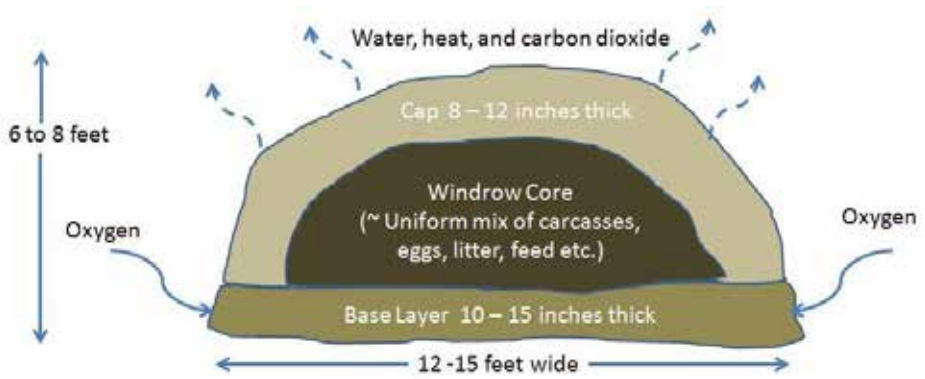
- Evaluate barn configuration to determine if space is adequate for windrow(s) construction within the poultry barns. If not, assess other on-site structures or outside compost sites.
  - To assess outside sites, see Appendix A.
- Evaluate type and quantity of infected materials to be composted:
  - 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

Clearing the base (photo by Gary Flory)

- 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. (Note: base will compress over time.)
  - 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

Constructing the core (photo by Bob Peer)

- 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.

- 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.

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

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.

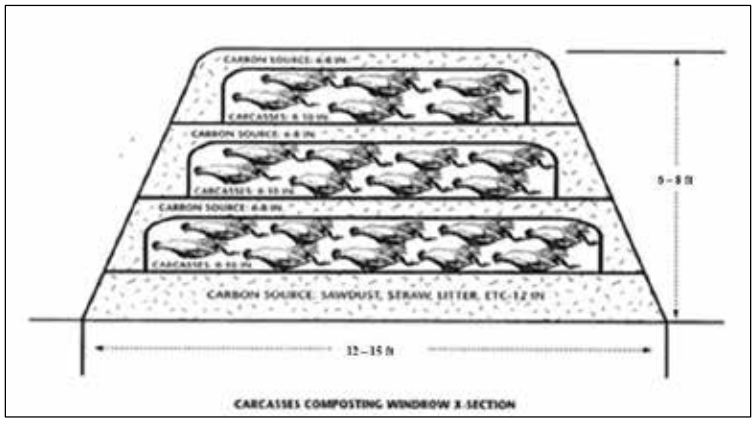
➤ Windrows should be numbered and flagged by the SME at a minimum of 10 temperature monitoring locations spaced equidistantly the length of each windrow.

Layering Method

Layering method (photo by Mary Schwarz)

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:

- 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 (Phase 1), 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 (Phase 2), 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.

Problem	Issue	Solution
Excessive flies or odor	Exposed carcasses	Add additional cap material
Leachate from windrow	Mixture too wet	Add additional carbon material, mix and cap
Temperature does not reach 131 ºF	Mixture too dry (< 40% moisture)	Add water to pile, mix if necessary
Temperature does not reach 131 ºF	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

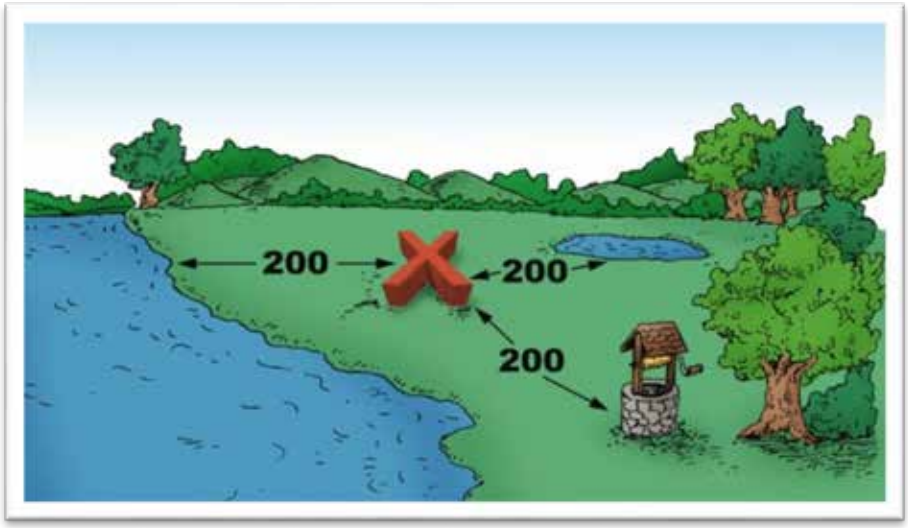
Selection and siting of environmentally suitable and appropriate locations for composting of poultry carcasses infected with avian influenza is an important consideration in the disease management process. Because of the virulent nature of this disease, it is important to locate such sites within or 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,

- 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.



Reprinted with permission from Cornell Waste Management Institute

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 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 to10 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.

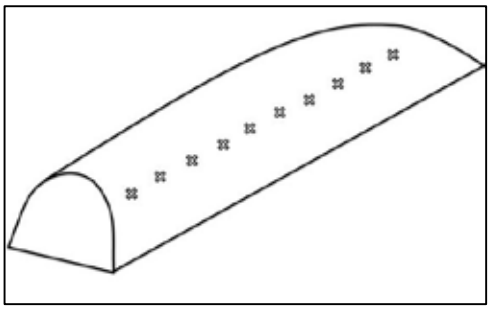
Pre-compost windrows (photo by Josh Payne)

- 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.

Final windrow (photo by Josh Payne)

APPENDIX D
TEMPERATURE MONITORING PROCEDURE

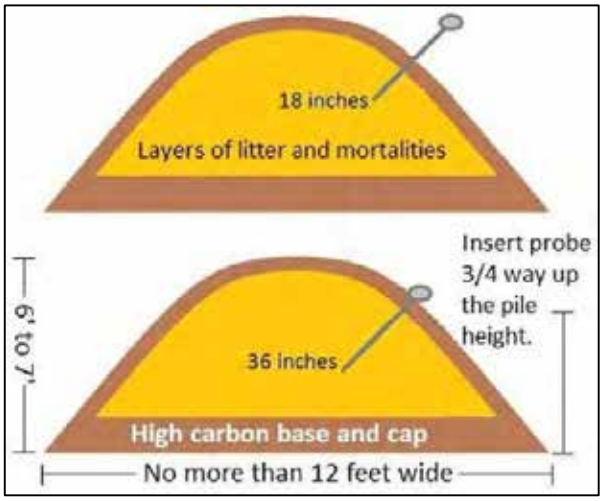
Monitor temperatures of the windrow daily at a minimum of 10 locations flagged by the SME. The temperature monitoring locations should be spaced equidistantly the length of each windrow. Take two temperature readings at each flagged location within a foot of the flag; one reading at a depth of 18 inches 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 inches. Place the temperature probe ¾ 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.



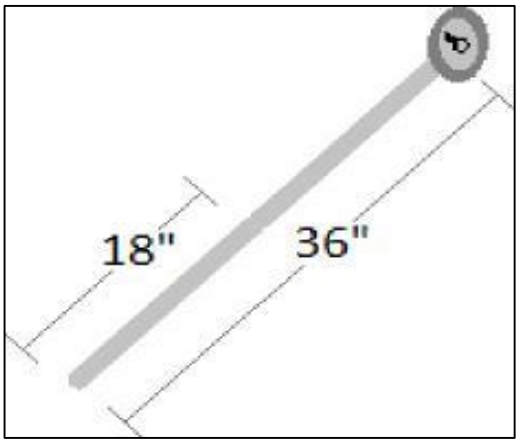
Example temperature monitoring locations

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 by averaging both depths and note it on the Composting Temperature Log.
- Windrows should reach an average temperature of 131 °F for a minimum of 72 hours at both the 18 inch and 36 inch depths or be assessed by a SME for possible corrective measures.
- Disinfect the thermometer and return it to its protective case.
- 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 Phase 2, 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

COMPOSTING TEMPERATURE LOG			
County:	Site Number:		
Street address, city, state:			
Farm Name:			
House/Windrow Number:	Date Started:	Date Finished:	Date Turned:

Use the cells below to record the temperatures each day at 18 inches and at 36 inches.

Date	Depth	Flag #1	Flag #2	Flag #3	Flag #4	Flag #5	Flag #6	Flag #7	Flag #8	Flag #9	Flag#10	Avg
	18”											
	36”											
	18”											
	36”											
	18”											
	36”											
	18”											
	36”											
	18”											
	36”											
	18”											
	36”											
	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.

Exposure Guidelines (NIOSH)	
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 CHECKLISTS

INITIAL COMPOST WINDROW CONSTRUCTION CHECKLIST

Farm Name:		**County:**	
Farm Address:			
Farm Contact:		**Contact Phone:**	
Date Windrows Started:		**Date Windrows Completed:**	
Windrow #:		**Premises County & #:**	
Who constructed windrow?		**Contact Info:**	

	WINDROW DESIGN	*Yes*	*No*	*N/A*	*Comments/Description*
1	Height between 6 and 8 feet.				
2	Width between 10 and 15 feet				
3	Base between 8 and 12 inches				
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				
7	Sketch of flag locations with dimensions attached				

Recommendations:

☐ I have observed 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 observed 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:

_____

_____

_____

Signature of Composting SME: _____ Date: _____

Print name of Composting SME: _____

– -

The corrective actions recommended above were completed on: _____

Signature of Composting SME: _____ Date: _____

PHASE 1 WINDROW APPROVAL CHECKLIST

Applicability: This checklist is to be used 14 days after windrow construction to verify that they have been constructed in accordance with the protocol and have reached temperatures necessary for virus inactivation.

Farm Name:		**County:**	
Farm Address:			
Farm Contact:		**Contact Phone:**	
Date Windrows Started:		**Date Windrows Completed:**	
Windrow #:		**Premises County & #:**	
Who constructed windrow?		**Contact Info:**	

		Yes	*No*	*N/A*	*Comments/Description*
	PHASE 1 WINDROW EVALUATION—Days 1–14				
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				

Phase 1 Recommendations of State Animal Health, APHIS or IMT Official:

☐ I have observed 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 observed 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: _____

– –

Phase 1 Recommendations of Subject Matter Expert:

☐ I have observed the windrows at this site and based on their construction and my review of the temperature logs, the windrows have performed in a manner demonstrated to inactive the avian influenza virus. The 14-day initial composting cycle is complete.

☐ I have observed the windrows at this site and based on their construction and my review of the temperature logs, the windrows have **NOT** performed in a manner demonstrated to inactive the avian influenza virus. The following corrective actions are recommended:

_____

_____

Date of windrow evaluation: _____

Signature of Composting SME: _____ Date: _____

Print name of Composting SME: _____

– –

The corrective actions recommended above were completed on: _____

Phase 1 was complete on: _____

Signature of Composting SME: _____ Date: _____

PHASE 2 WINDROW APPROVAL CHECKLIST

Applicability: This checklist is to be used 14 days after Phase 1 was completed to verify that the compost windrows may be moved without restriction on the premises or may leave the premises with appropriate permits.

Farm Name:		**County:**	
Farm Address:			
Farm Contact:		**Contact Phone:**	
Date Windrows Started:		**Date Windrows Completed:**	
Windrow #:		**Premises County & #:**	
Who constructed windrow?		**Contact Info:**	

		Yes	*No*	*N/A*	*Comments/Description*
	PHASE 2 WINDROW EVALUATION—Days 14–28				
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				

Phase 2 Recommendations of State Animal Health, APHIS or IMT Official:

☐ I have observed 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 observed 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: _____

- -

Phase 2 Recommendations of Subject Matter Expert:

☐ I have observed the windrows at this site and based on their construction and my review of the temperature logs, the windrows have performed in a manner demonstrated to inactive the avian influenza virus. The windrows may be moved without restriction on the premises or may leave the premises with appropriate permits.

☐ I have observed the windrows at this site and based on their construction and my review of the temperature logs, the windrows have **NOT** performed in a manner demonstrated to inactive the avian influenza virus. The following corrective actions are recommended:

_____

_____

Date of windrow evaluation: _____

Signature of Composting SME: _____ Date: _____

Print name of Composting SME: _____

- -

The corrective actions recommended above were completed on: _____

Phase 2 was complete on: _____

Signature of Composting SME: _____ Date: _____

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[1]

Material	Type of value	% N (dry weight)	C:N ratio (weight to weight)	Moisture content % (wet weight)	Bulk density (pounds per cubic yard)
Crop residues and fruit/vegetable-processing waste					
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[a]	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[a]	62	—
Vegetable produce	Typical	2.7	19	87	1,585
Vegetable wastes	Typical	2.5–4	11–13	—	—
Fish and meat processing					
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	—

[1] Reprinted with permission from the Cornell Waste Management Institute.

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

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

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	Range	0.06–0.11	451–819	—	—
(chips, shavings, and so on)	Average	0.09	560	—	—
Wood-softwoods	Range	0.04–0.23	212–1,313	—	—
(chips, shavings, and so on)	Average	0.09	641	—	—
Yard wastes and other vegetation					
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

[a] Estimated from ash or volatile solids data.
[b] Mostly organic nitrogen.

United States Department of Agriculture

Landfills and Highly Pathogenic Avian Influenza (HPAI) Response

May 2016

USDA APHIS Veterinary Services

"Worst agricultural disaster in decades"

Why does it matter?

- Financial impact of HPAI
  - US, Regional, State economies
  - $960+ million spent on response since December 2014
  - International trade: several countries banned poultry from the United States
    - Billions in lost exports
  - Direct/indirect impacts-jobs, affiliated industries, emotional impact
- Safe food supply (perception)
  - Safe to eat meat, eggs
- Potential public health issues
  - NOT currently infectious to humans, virus can change

DEFINITIONS

- USDA APHIS Veterinary Services
  - US Department of Agriculture, Animal and Plant Health Inspection Service
  - Veterinary Services oversees pre-harvest animal production
- FAD: foreign animal disease
- HPAI: highly pathogenic avian influenza
  - Also referred to as “high path AI”
  - Differentiated from low pathogenic AI based on morbidity and mortality, or how quickly birds get sick and/or die from the disease
  - Current high path strain in U.S. is mainly H5
- FMD: foot and mouth disease
- PPE: personal protective equipment
- Zoonotic Disease: a disease that can be spread from animals to humans
- Depopulation: also known as “culling” or “stamping out” a large number of animals to quickly eliminate the disease

HOW ARE DISEASE OUTBREAKS HANDLED?

- Is it a disease of high consequence?
  - e.g., High Path Avian Influenza, Foot and Mouth Disease, African Swine Fever, Rift Valley Fever, Glanders
- What is the scope of the outbreak?
  - County, State, Regional, National
  - Can that jurisdiction respond without national assistance (funding, equipment, people)?
- Is it a zoonotic disease?
  - Will humans become infected?
- Who would be the lead agency?
  - Animal Diseases: State Departments of Agriculture, USDA APHIS Veterinary Services
  - Human Diseases: Center for Disease Control and Prevention (U.S. Department of Heath and Human Services), State Public Health Departments

WHAT ARE THE GOALS IN A FAD OUTBREAK?

In the event of an FAD outbreak, the three key response goals are:

1) Detect, control, and contain the outbreak as quickly as possible.
2) Eradicate the FAD using strategies that stabilize animal agriculture, the food supply, the economy, and protect public health and the environment.
3) Provide science- and risk-based approaches and systems to facilitate continuity of business for non-infected animals and non-contaminated animal products.

Achieving these three goals will allow individual livestock facilities, States, Tribes, regions, and industries to resume normal production as quickly as possible. They will also allow the United States to regain FAD-free status

USDA Poultry Production Data
May 2015

The most recent Census of Agriculture reported ***233,770 poultry*** farms in the United States in 2012.

In 2014, the U.S. poultry industry produced:

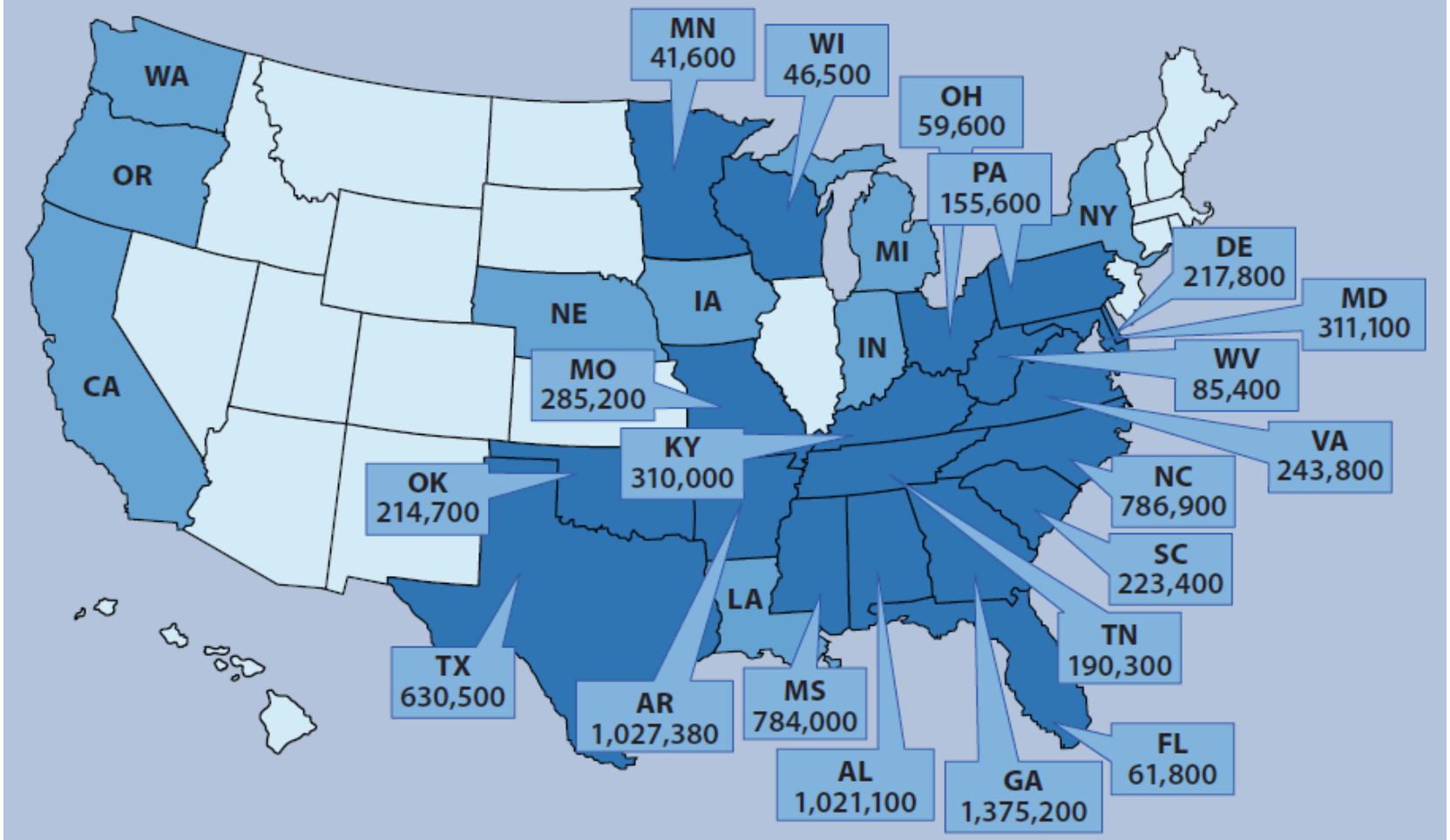
- 8.54 billion broilers,
- 99.8 billion eggs, and
- 238 million turkeys.

The combined value of production from broilers, eggs, turkeys, and the value of sales from chickens in 2014 was $48.3 billion, up 9 percent from $44.4 billion in 2013.

Today's Commercial Industry

- 8.5 billion meat chickens
- 150 million meat turkeys
- 250 million table egg layers
- 88 million meat type chicken breeders
- 4.5 million egg type chicken breeders
- 8 million breeder turkeys
- 253 meat type chicken hatcheries
- 35 turkey hatcheries

Figure 1. Broiler Production by State Number Produced, Thousand, 2012



U.S. Total: 8.61 Billion Head

8.07 Billion Head, 94% of U.S. Total

All Other Production States

USDA/NASS
04/20/12

Table 2. Leading Broiler Production States (2012)		
National Ranking	*State*	*Billions of Broilers*
1	Georgia	1.362
2	Alabama	1.004
3	Arkansas	0.977
4	North Carolina	0.800
5	Mississippi	0.751

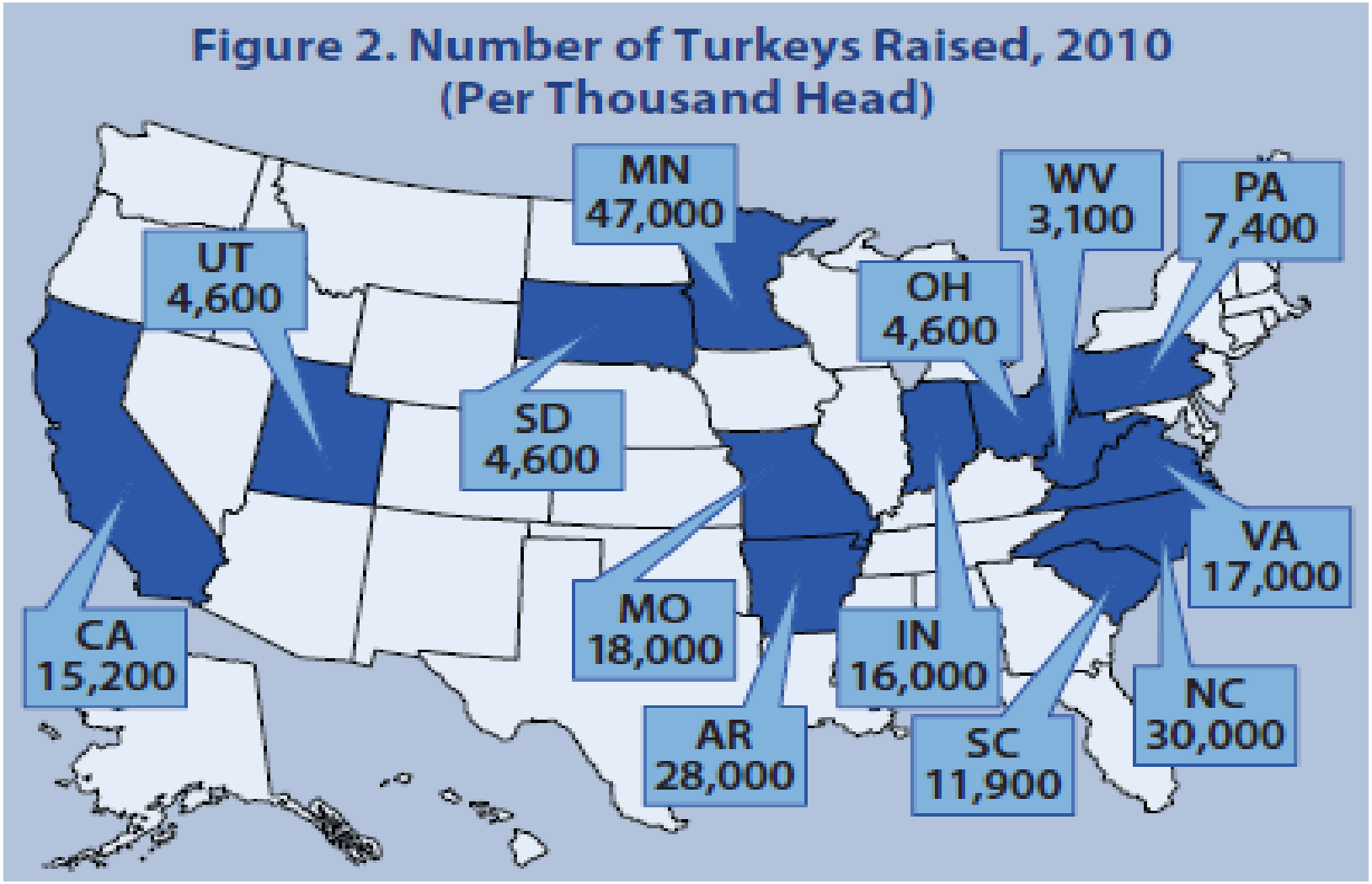


Figure 2. Number of Turkeys Raised, 2010
(Per Thousand Head)
MN
47,000
WV
3,100
PA
7,400
UT
4,600
OH
4,600
SD
4,600
VA
17,000
MO
18,000
IN
16,000
CA
15,200
NC
30,000
AR
28,000
SC
11,900

Table 2. Top Turkey Producing States in the US in 2011.				
Rank	State	Number of Birds (head, millions)	Pounds Produced (millions)	Value (millions)
1	Minnesota	46.5	1,171.8	799.2
2	North Carolina	32.0	1,132.8	772.6
3	Arkansas	30.5	603.9	411.9
4	Missouri	17.5	568.8	387.9
5	Virginia	17.5	460.3	313.9
6	Indiana	16.0	579.2	395.0
7	California	15.0	421.5	287.5
8	South Carolina	11.5	448.5	305.9
9	Pennsylvania	7.5	174.8	119.2
10	Ohio	5.0	210.0	143.2
11	South Dakota	4.4	180.4	123.0
12	Utah	4.3	97.6	66.6
13	West Virginia	3.3	92.4	6309
	Other	37.5	1,177.4	803.0
Source: USDA, National Agricultural Statistics Service, 2012 Summary				

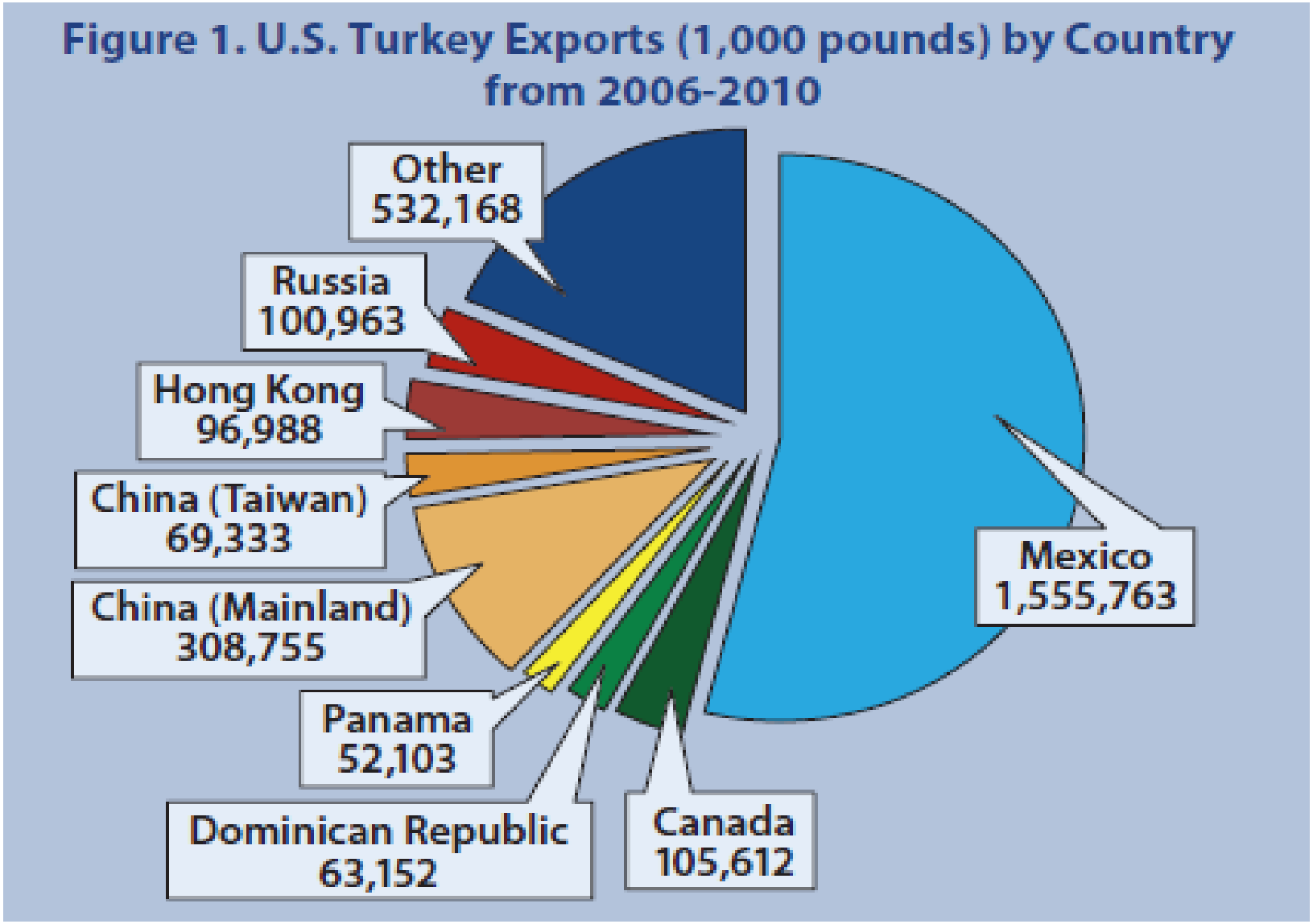


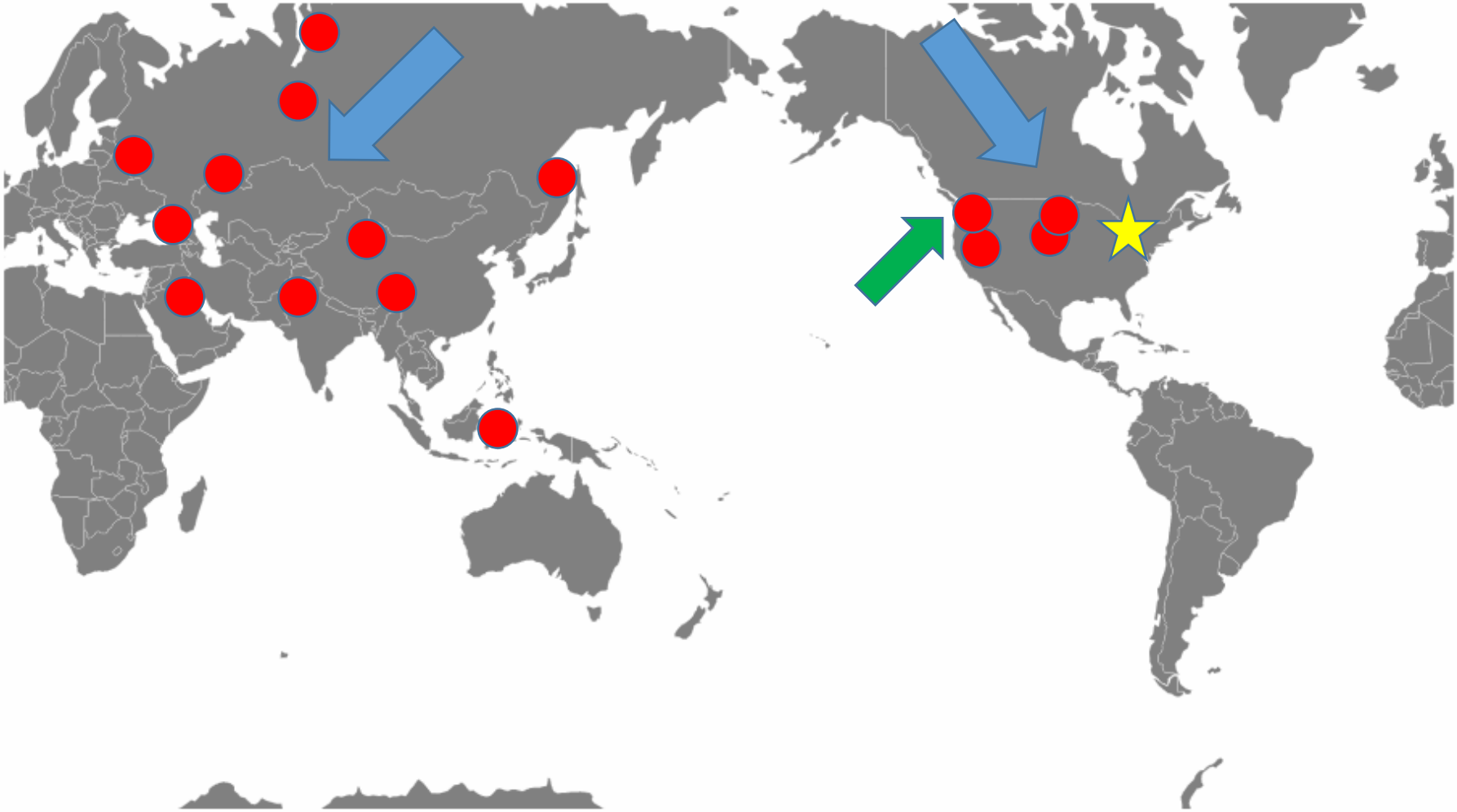
Figure 1. U.S. Turkey Exports (1,000 pounds) by Country from 2006-2010
Other 532,168
Russia 100,963
Hong Kong 96,988
China (Taiwan) 69,333
China (Mainland) 308,755
Panama 52,103
Dominican Republic 63,152
Canada 105,612
Mexico 1,555,763

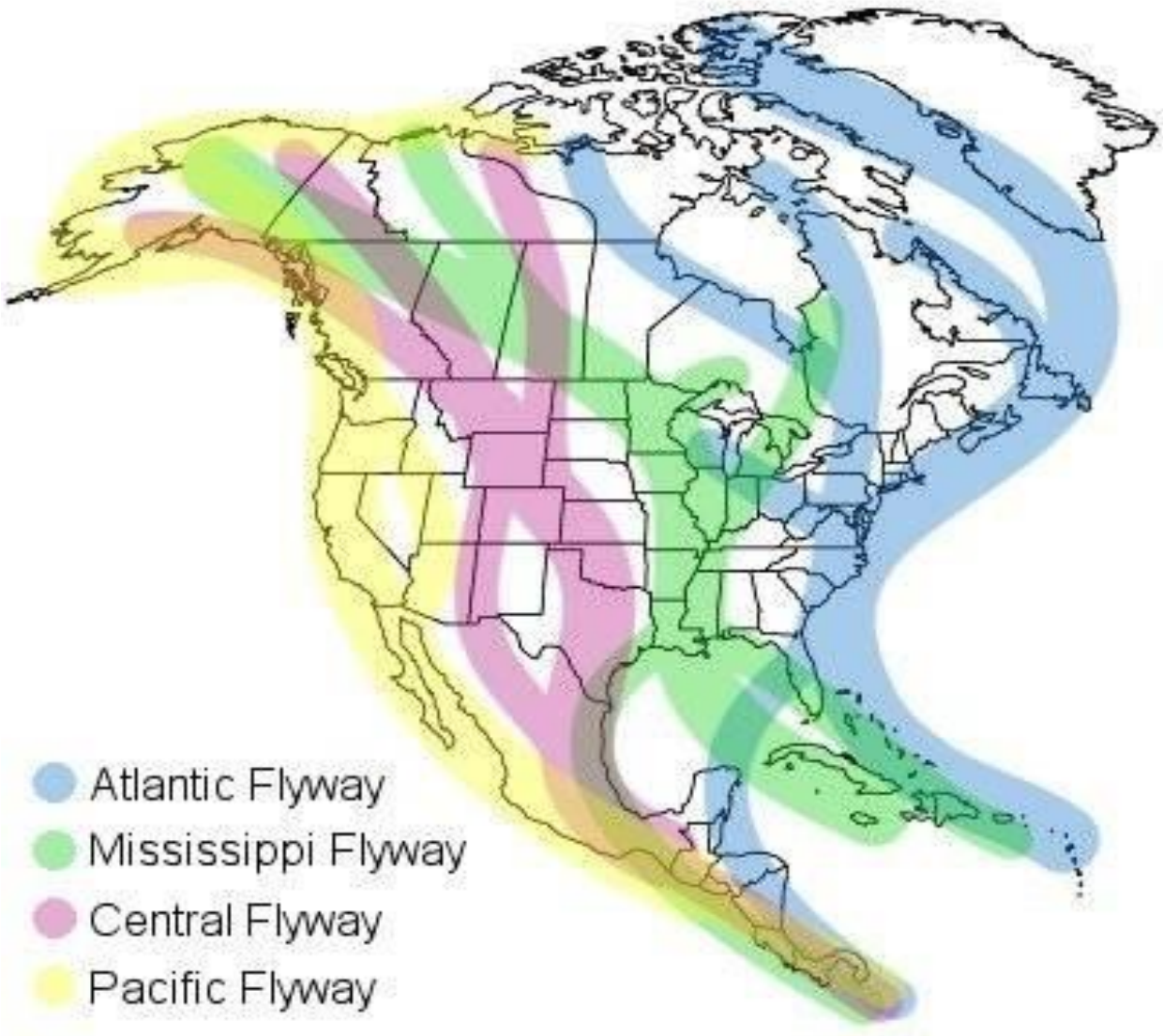
Table 1. Leading Egg Production States (2012)		
National Ranking	*State*	*Millions of Layers in Production*
1	Iowa	52.3
2	Ohio	26.9
3	Pennsylvania	24.4
4	Indiana	22.8
5	California	18.9

Table 2. Leading Egg Production Companies (2012)		
National Ranking	*Company*	*Millions of Layers in Production*
1	Cal-Maine Foods	33.5
2	Rose Acre Farms, Inc.	23.7
3	Moark, LLC	14.9
4	Daybreak Foods	13.5
5	Rembrandt Enterprises	13.4

Lesser known poultry industries: game birds, backyard birds, and hobby birds of any species

How did we get here?
2014-2015 and 2016 HPAI Outbreaks

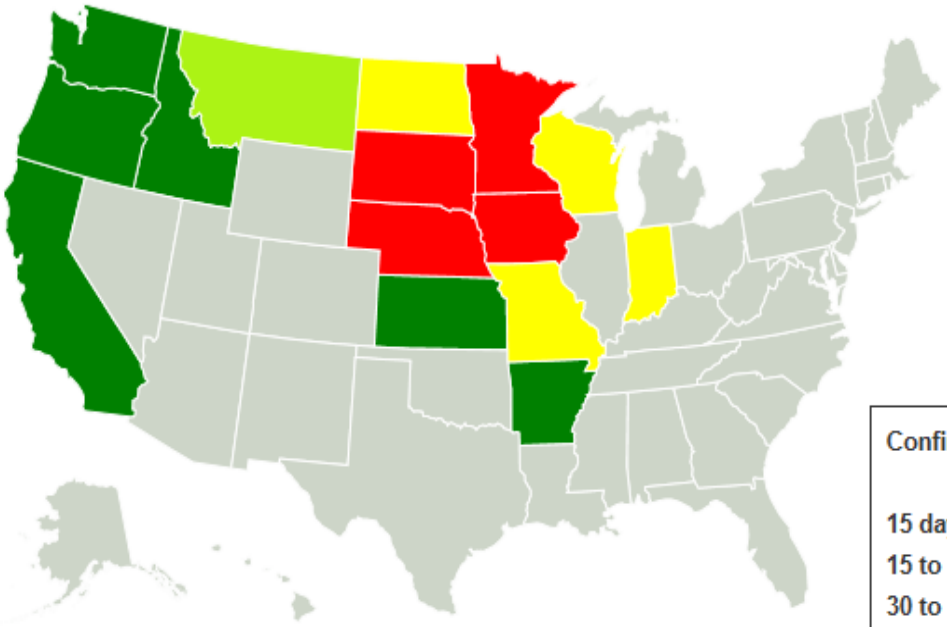



Atlantic Flyway
Mississippi Flyway
Central Flyway
Pacific Flyway

Waterfowl
Central Flyway
Mississippi Flyway
Pacific Flyway
Atlantic Flyway
Approximate locations of counties with affected wild birds, backyard poultry flocks, and/or commercial poultry flocks

United States Department of Agriculture

Update on Avian Influenza Findings
Poultry Findings Confirmed by USDA's National Veterinary Services Laboratories



Confirmed in the past

- 15 days:
- 15 to 30 days:
- 30 to 60 days:
- 60 to 90 days:
- 90 plus days:

232
Detections Reported

6/17/2015
Last Reported Detection (IA)

12/19/2014
First Detection Reported

49.6 Million
Number of all birds affected

2014-2015 HPAI Outbreak in the United States

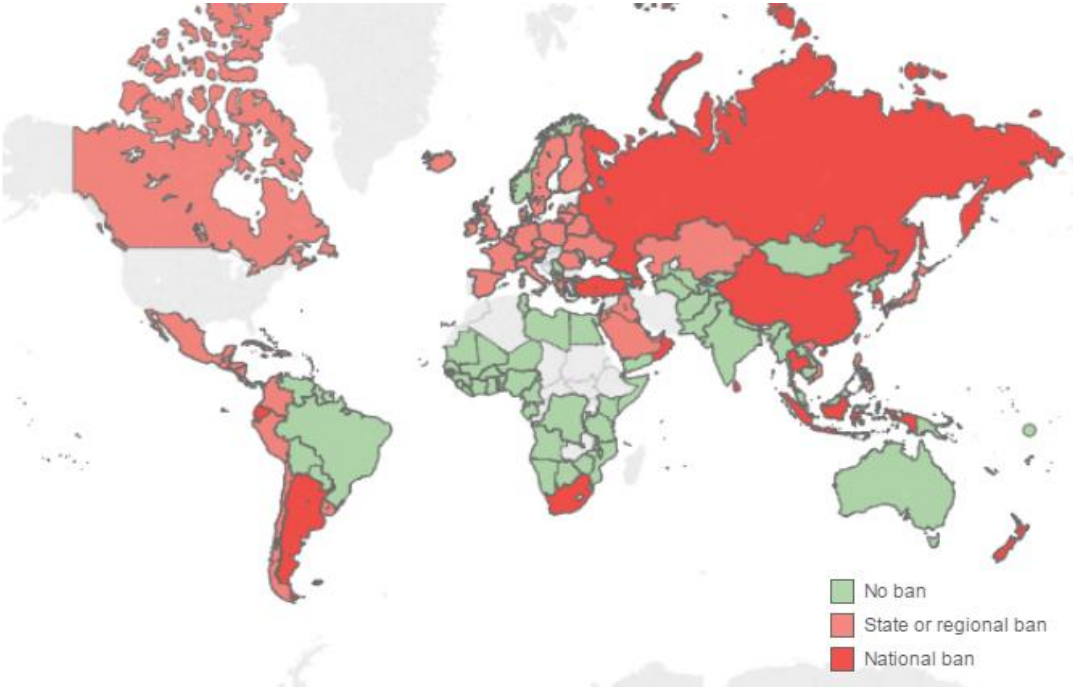
- First case detected in Oregon, December 2014
- Total number of HPAI positive premises: 232
  - 211 commercial (MN-109, IA-72, WI-9, SD-10, NE-5, CA-2, MO-2, ND-2, AR-1)
  - 21 backyard
- Commercial poultry depopulated
  - Turkeys: approx. 7.5 million
  - Chickens, laying hens and pullets: approx. 42.1 million

Impact

- Approximately 10% of the poultry meat and egg supply was destroyed in 6 months in 2015.
- Food prices increased.
- Virus prefers cold, damp weather, so it “slowed down” during the hot summer months (last confirmed positive in Iowa mid-June, 2015).
- Birds that commingle up north will fly south for the winter, potentially exposing wild, commercial, and backyard birds to the virus.

Trade Implications from the 2014-2015 HPAI Outbreak

- Trade impact
  - 18 countries imposed bans on ALL U.S. poultry and products
  - 38 countries imposed partial or regional bans



Trade bans on U.S. exports of broiler and turkey meat related to HPAI as of June 16, 2015 (data from USDA ERS)

2016 HPAI Outbreak

- First case detected January 16, 2016 in Dubois County, Indiana:
  - One case of HPAI in commercial turkeys
  - Nine cases of LPAI in commercial turkeys
    - Strain similar to that seen in wild birds in North America
  - 415,000 birds euthanized
  - Economic cost: over $20 million.

Does HPAI pose a health threat to humans?

- To date, there have been **no human cases** related to this H5 strain of HPAI (nearly 4300 responders nationwide).
- The Centers for Disease Control and Prevention (CDC) considers the risk to people from these H5/H7 infections to be low. No humans cases of these H5/H7 viruses have been detected in the United States, Canada, or internationally.
- Historically, human infections with other avian influenza viruses have occurred after close and prolonged contact with infected birds or the excretions/secretions of infected birds (e.g., droppings, oral fluids), as in SE Asia.

USDA

United States Department of Agriculture

What happens once a farm is infected?

USDA

United States Department of Agriculture

Highly Pathogenic Avian Influenza

A Guide To Help You Understand the Response Process

1 2 3 4 5 6 7 8 9 10

Detect

You see unusual signs of illness or sudden deaths in your flock. You report it to your private or State veterinarian. Samples are taken and tested. You find out your flock is positive for HPAI.

Quarantine

USDA and State personnel come to your farm. We assign you a caseworker, who will be your main point of contact onsite, answer your questions, and guide you through the needed paperwork. We will also place your operation under quarantine, meaning only authorized workers are allowed in and out, and movement restrictions for poultry, poultry products, and equipment go into effect. We contact neighboring poultry farms and start testing their birds to see if they've been affected, too.

Appraise

We work with you to create a flock inventory. This lists how many birds you have, what species they are, their age, and other key details that will help us give you 100 percent of fair market value for your birds.

Depopulate

Infected flocks are depopulated as quickly as possible—ideally within 24 hours of the first HPAI detection—to get rid of the virus.

Compensate

You receive your first indemnity payment early on in the response process. We also pay you a standard amount for virus elimination activities (cleanup work).

Manage Disposal

USDA will help you dispose of the dead birds safely. Disposal methods include composting, burial, incineration, rendering, or landfilling. The options you'll have depend on several things: what type of farm you have, the specific conditions there, State and local laws, and what you prefer.

Eliminate Virus

The next step is to wipe out all traces of the virus at your property. To kill the virus, thoroughly clean and disinfect the barn, equipment, and all affected areas of your farm. You can do this work yourself or hire contractors to handle it.

Test

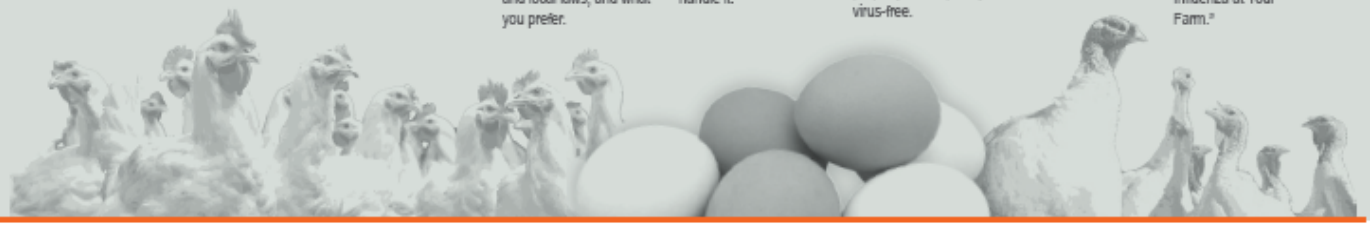
As soon as you're ready, let your caseworker know you're finished with cleanup. Your site must then stay empty for at least 21 days. During this time, we'll return to collect and test environmental samples. We need to confirm that your property is completely virus-free.

Restock

Once USDA and the State both approve, you can restock your facilities and start production again. State officials will release your farm from quarantine after all required testing and waiting periods are done.

Maintain Biosecurity

After restocking, you'll need to continue maintaining the highest biosecurity standards to keep the virus from coming back. For biosecurity tips, go to www.aphis.usda.gov/-publications and download the factsheet "Prevent Avian Influenza at Your Farm."



How Long Does the Process Take?

Ideally, this entire process could be completed in as soon as 60–120 days. However, the timeframe varies depending on many things (for example, flock size, depopulation and disposal methods used, test results, farm's location). We're committed to restoring production as fast as we can while also protecting poultry health.

Questions?

Talk with your caseworker or the State or Federal officials responding to the disease event in your area.

For general information and contacts, visit:

www.usda.gov/avian_influenza.html

www.aphis.usda.gov/fadprep

USDA is an equal opportunity provider and employer.

Animal and Plant Health Inspection Service • APHIS 91-85-005 • Issued September 2015

Roles of Landfills

With **billions of birds**, seeking landfills that could accept:

- Bird carcasses: adults and pullets/poults (young birds)
  - Adults range from 6-8 lbs (layers & broilers) up to 80 (for tom turkeys)
- Waste products, such as manure and litter (typically shavings or pellets), egg flats, pallets
- Hatchery waste
- Leftover feed
- Eggs and egg product that cannot enter the food supply
- PPE (personal protective equipment such as Tyvek coveralls, gloves, etc.)
- Cleaning and disinfection materials/supplies
- ***Or any combination of the above.***

Disposal needs beyond bird carcasses:

Egg Washing System

Candling of Eggs

Egg Packaging System

Eggs in Cartons and in Boxes

Management considerations at landfill:

Leachate Management

- Storage/recirculation/land application?
- County/state specific
- USDA white paper on risk of leachate expected summer 2016

Operations/Logistics

- Consider working hours, scale operations, tracking AI waste, tipping fees, billing, transportation to and from
- Scheduling delivery of waste
- Use of contractors at landfills
- Clean/disinfection/gray water management

Public Relations/Outreach

- MSW vs. private landfill
- Accepting waste can help protect animal and human health
- Work with State/Fed Depts of Agriculture PIO

Regulations/Permitting

- County/state regulations
- Modification of permits needed?
- Will permitting be handled differently in emergency/disease outbreak?

Use of contractors at landfills:

- USDA contractor responsible for logistics and biosecurity, but rely on landfill operators to assist with identifying local resources.
  - Heavy equipment rentals, power sprayer rentals, frac tanks, tents, gravel for roads and command area, wooden mats, odor control mister, portable toilets, food for workers, etc.
- Landfill needs a system for weighing and tracking AI wastes simultaneously with regular MSW receipts.
- Landfill bills USDA, contractor, or producer (depending on who hired the landfill).

Planning/Operations

- Use landfill staff or contractors for excavation and disposal activities (includes cleaning/disinfection of vehicles)?
- Amount of time necessary to excavate trenches?
- Separate areas for MSW and AI waste staging and disposal.
- Dedicated trucks and decontamination areas for the hot, warm, and cool zones (typically supplied by contractor).
- Ability of farms to stage wastes on-site to control timing of delivery to landfills.
  - Consider both space and container constraints.
- How many loads of wastes can the landfill expect to receive based on the size of farm and the amount of time it takes to depopulate and containerize wastes?
- How will landfill control odor, flies, scavenger birds/wildlife?

On Site Operations

Courtesy Rebecca Joniskan

Scale house

Courtesy Rebecca Joniskan

Roll-off Staging Area/Access Road

Courtesy Rebecca Joniskan

Command Area

Courtesy Rebecca Joniskan

Command Area: PPE Supplies

Courtesy Rebecca Joniskan

Command Area: USDA and Contractor Office

Courtesy Rebecca Joniskan

Full Roll-off Staging Area

Truck tire decontamination in foreground.

Courtesy Rebecca Joniskan

Excavated disposal trench

Courtesy Rebecca Joniskan

Excavated disposal trench

Courtesy Rebecca Joniskan

Full load approaching disposal trench.

Courtesy Rebecca Joniskan

Tailgate being unlatched; hot zone delineated by yellow caution tape.

Courtesy Rebecca Joniskan

Preparing to dispose of load. Excavator and delivery truck personnel communicate using a series of honks.

Courtesy Rebecca Joniskan

Disposal of waste in trench.

Courtesy Rebecca Joniskan

Breaching of waste bag: State- or locality-specific regulations.

Courtesy Rebecca Joniskan

Constructed road at landfill. Contractors cleaning and disinfecting roll-offs after tipping.

Truck tire decontamination adjacent to a hot zone.

Courtesy Rebecca Joniskan

Decontamination station

Courtesy Rebecca Joniskan

Decontamination station: roll-offs are steam cleaned after disposal using a power-sprayer with bleach and surfactant. Decontamination liquids are collected and pumped into a frac tank for off-site disposal.

Courtesy Rebecca Joniskan

Decontamination of tarp.

Courtesy Rebecca Joniskan

Removing liner at decontamination station. Disposed of in landfill with other contaminated PPE.

Courtesy Rebecca Joniskan

Wooden crane mats.

Courtesy Rebecca Joniskan

Wooden crane mats.

Courtesy Rebecca Joniskan

Odor control product and mister unit.

Courtesy Rebecca Joniskan

Final truck tire decontamination station at facility exit.

Courtesy Rebecca Joniskan

Landfill Challenges in 2015 IA Outbreak

- Concerns about risk of infected leachate, protection of operators, public opposition, and potential lawsuits.
- APHIS, state DNR and landfill companies developed waste acceptance criteria to address operational issues.
- APHIS, CDC and NIOSH developed safety guidelines for operators.
- APHIS developed Frequently Asked Questions for public.
- Landfill companies requested federal indemnification but it was prohibited by law.

Lessons learned in Iowa and Minnesota:

- Educate people before a disease outbreak.
- Because of the potential volume of birds and waste materials, large landfills are ideal for birds and smaller ones could take egg or hatchery waste, PPE, etc.
- States worked to modify transportation weight restrictions in case of an outbreak, allowing larger (but still safe) loads to be hauled. States rerouted trucks to avoid passing poultry farms.
- Keep documentation for HPAI operations separate.
- Consider the weather, road conditions, and any extra equipment needed.
- Odor and fly control.
- Work with USDA APHIS LPA or IMT's Public Information Officer to craft appropriate messaging for stakeholders and public.

Support for Landfills

- For any who may be interested in accepting HPAI waste, state, federal and industry partners would work closely to ensure:
  - Worker safety, including in person training and supplying with any PPE needs. Most important!
  - Work to establish SOPs for accepting waste that will be beneficial to your operation.
  - Supply contractors if needed to bring in roll-offs and trucks, assist in tipping, cleaning and disinfection, directing traffic, and managing a staging area.
  - *Landfill may be hired by a state or federal government, clean up contractor, or by a poultry grower/company.*
  - We will work with you to manage public perception, prepare for town hall meetings if needed- landfills could provide a valuable public service by assisting in disposal during an outbreak.

Interested?

- USDA can supply job aids that have already been developed and can work one on one with landfills to facilitate their involvement
- To start the process of becoming a federal contractor:
  - http://www.dnb.com/get-a-duns-number.html
  - www.sam.gov

This process can take several weeks, so please plan ahead.

Other Resources on HPAI and Landfills

Information about HPAI and landfills:

https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/emergency-management/ct_fadprep

https://www.aphis.usda.gov/animal_health/emergency_management/downloads/hpai/landfilldisposalpolicy.pdf

CDC guidelines for landfill workers:

https://www.aphis.usda.gov/animal_health/emergency_management/downloads/hpai/cdc_int_guid_landfill_op_disp_poulcarc_during_outbreaks.pdf

Reach out to your State departments of agriculture, USDA, or poultry producers to let them know of your interest.

2017 NRA Officers

Chairman:
Tim Guzek
Sanimax
Green Bay, WI
920-494-5233

First Vice Chairman:
Ridley Bestwick
West Coast Reduction
Vancouver, BC, Canada
604-255-9301

Second Vice Chairman:
Doyle Leefers
National Beef Packing Company
Kansas City, MO
800-449-2333

2017 NRA Regional Officers

EASTERN REGION

President:
Bill Schmieder
Baker Commodities Inc.
585-482-1880

CENTRAL REGION

President:
Ed Frakes
Darling International
920-361-2092

Vice President:
Mike Karman
Sanimax
920-884-3925

Secretary/Treasurer:
Jason Hartman
Mendota Agri-Products Inc.
815-539-5633

WESTERN REGION

President:
Doug Smith
Baker Commodities Inc.
323-268-2801

Vice President:
Ken Kage
Darling Ingredients Inc.
303-295-7551

2017 Active Members

Producers of animal fats and proteins

American Proteins Inc. - Headquarters
4705 Leland Drive
Cumming, GA 30041
www.americanproteins.com
Contact: Stan Gudenkauf
Phone: 770-886-2250
Fax: 770-886-2296
E-mail: stan.gudenkauf@amprot.com
Region: Eastern

American Proteins Inc. - *Cuthbert Division*
P.O. Box 528
Cuthbert, GA 31740
Contact: Brandon Kyzar
Phone: 229-732-2114
Fax: 229-732-3896
E-mail: brandon.kyzar@amprot.com
Products: CM,PB,PF,PM,SF
Region: Eastern

American Proteins Inc. - *Cumming Division*
4990 Leland Drive
Cumming, GA 30041
Contact: Jonathan Green
Phone: 770-887-6148
Fax: 770-889-2820
E-mail: jonathan.green@amprot.com
Products: SF,PB,FM
Region: Eastern

American Proteins Inc. - *Hanceville Division*
P.O. Box 429
Hanceville, AL 35077
Contact: Jason Spann
Phone: 256-352-9821
Fax: 256-352-4223
E-mail: jason.spann@amprot.com
Products: SF,PB,FM
Region: Eastern

American Proteins Inc. - *Ampro Division*
2305 O'Kelly Drive
Gainsville, GA 30501
Contact: Scott Duchette or Bryan Kattelmann
Phone: 770-535-6646
Fax: 770-535-7207
E-mail: e.scottduchette@amproproducts.com, bryan.kattelmann@amproproducts.com
Products: Animal protein blends
Region: Eastern

American Proteins Inc. - *APF&O Division*
Rt 1 Box 150, Hwy 82 East
Cuthbert, GA 39840
Contact: Brian White
Phone: 770-886-2250
Fax: 770-886-2292
E-mail: brian.white@amprot.com
Products: Fat blends
Region: Eastern

Product code key:

BFP	Blender - Fat and Proteins
BLF	Blender of Fat
BLP	Blender of Protein
BM	Blood Meal
BR	Broker
CH	Chemicals
CM	Chicken Meal
CN	Consultant
CWG	Choice White Grease
DL	Dealer
DT	Dry Rendered Tankage
EQ	Equipment
ET	Edible Tallow
EX	Exporter
FA	Fatty Acids
FGAF	Feed Grade Animal Fat
FM	Feather Meal
HI	Hide
IN	Insurance
LG	Lard/Grease
LT	Laboratory/Testing
MB	Meat and Bone Meal
MM	Meat Meal
PB	Poultry By-product Meal
PF	Poultry Fat
PM	Poultry Meal
RF	Refined Fats
SF	Stabilized Animal Fats
SS	Samplers and Surveyors
ST	Storage Terminals
TG	Tallow and Grease
YG	Yellow Grease
OT	Other

APC Inc.
The Lauridsen Group, Inc.
2425 SE Oak Tree Court
Ankeny, IA 50021
www.functionalproteins.com
Contact: Jerry Frankl
Phone: 515-289-7600
Fax: 515-289-4360
E-mail: jerry.frankl@functionalproteins.com
Products: Spray-dried blood and plasma products
Region: Central

APC Inc. - *Arion*
2248 Lincoln Way
Arion, IA 51520
Contact: Tom Kuchemann
Phone: 712-263-6690
Fax: 712-263-6772
E-mail: thomas.kuchemann@functionalproteins.com
Products: Spray-dried blood and plasma products
Region: Central

APC Inc. - *Boone*
2621 Mamie Eisenhower Ave.
Boone, IA 50036
Contact: Jeff Ostendorf
Phone: 515-432-8021
Fax: 515-432-8027
E-mail: jeff.ostendorf@functionalproteins.com
Products: Spray-dried blood and plasma products
Region: Central

APC Inc. - *Dubuque*
1300 Inland Lane
P.O. Box 1398
Dubuque, IA 52003
Contact: Jim Oberman
Phone: 563-588-3333
Fax: 563-588-2691
E-mail: james.oberman@functionalproteins.com
Products: Spray-dried blood and plasma products
Region: Central

APC Inc. - *Selma*
1451 West Noble Street
Selma, NC 27576
Contact: Tony Lester
Phone: 919-965-2051
Fax: 919-965-2130
E-mail: tony.lester@functionalproteins.com
Products: Spray-dried blood and plasma products
Region: Central

APC Inc. - *Sublette*
1197 US Highway 83
Sublette, KS 67877
Contact: Mark McGaughey
Phone: 620-675-8691
Fax: 620-675-2369
E-mail: mark.mcgaughey@functionalproteins.com
Products: Spray-dried blood and plasma products
Region: Central

Baker Commodities Inc. - Headquarters
4020 Bandini Boulevard
Vernon, CA 90058-4274
Contact: James M. Andreoli
Phone: 323-268-2801
Fax: 323-264-9862
E-mail: jandreoli@bakercommodities.com
Products: EX,RF,SF,TG,HI,MM, MB,FGAF,ST
Region: Western

Baker Commodities Inc. - *Billerica*
P.O. Box 132
No. Billerica, MA 01862
Contact: Walter Gurschick
Phone: 978-454-8811
Fax: 978-454-0448
E-mail: wgurschick@bakercommodities.com
Products: EX,SF,TG,FGAF,MM,MB, ST
Region: Eastern

Baker Commodities Inc.
Island Commodities
91-269 Olai Street
Kapolei, HI 96707
Contact: John Tsukada
Phone: 808-682-5844
Fax: 808-682-4389
E-mail: jtsukada@bakercommodities.com
Products: TG,MB
Region: Western

Baker Commodities Inc. - *Kerman*
P.O. Box 416
Kerman, CA 93630-0487
Contact: Manuel Ponte
Phone: 559-846-9393
Fax: 559-846-7671
E-mail: mponte@bakercommodities.com
Products: EX,FGAF,HI,MB,SF,TG
Region: Western

Baker Commodities Inc. - *Los Angeles*
4020 Bandini Boulevard
Vernon, CA 90058-4274
Contact: Shelton Wang
Phone: 323-268-2801
Fax: 323-268-5166
E-mail: swang@bakercommodities.com
Products: EX,RF,SF,TG,HI,MM, MB,FGAF,ST
Region: Western

Baker Commodities Inc. - *Phoenix*
P.O. Box 6518
Phoenix, AZ 85005
Contact: Beverly Norris
Phone: 602-254-5971 or 602-275-3402
Fax: 602-272-1846
E-mail: bnorris@bakercommodities.com
Products: TG,MM,MB,SF,FGAF
Region: Western

Baker Commodities Inc. - *Rochester*
2268 Browncroft Boulevard
Rochester, NY 14625-1050
Contact: Bill Schmieder
Phone: 585-482-1880
Fax: 585-654-7070
E-mail: bschmieder@bakercommodities.com
Products: SF,TG,HI,MB,FGAF, BLP
Region: Eastern

Baker Commodities Inc. - *Seattle*
P.O. Box 58368
Seattle, WA 98138-1368
Contact: Mike Bulleri
Phone: 206-243-7387
Fax: 206-243-3412
E-mail: mbulleri@bakercommodities.com
Products: EX,TG,MB,FGAF,HI, OT,Fish meal
Region: Western

Baker Commodities Inc. - *Spokane*
P.O. Box 11157
Spokane, WA 99211-1157
Contact: John McCartney
Phone: 509-535-5435
Fax: 509-536-3817
E-mail: jmccartney@bakercommodities.com
Products: SF,TG,HI,MB
Region: Western

BHT ReSources
P.O. Box 1596
700 Maple Street, Suite A
Birmingham, AL 35210
www.bhtonline.com
Contact: T. Owen Vickers
Phone: 205-252-1197
Fax: 205-251-1522
E-mail: tovickers@aol.com
Products: TG,SF,FGAF,HI,MB,BFP
Region: Eastern

Cargill Meat Solutions Inc. - Headquarters
Excel Corporation
P.O. Box 2519
Wichita, KS 67201
www.excelmeats.com
Contact: Dan Schaefer
Phone: 316-291-3409
E-mail: daniel_schaefer@cargill.com
Products: EX,BM,DT,FGAF,HI MB,MM,SF,TG
Region: Central

Cargill Meat Solutions - *Dodge City*
P.O. Box 1060
Dodge City, KS 67801
Contact: Daryl Kuker
Phone: 620-227-0550
Fax: 316-227-5839
Products: BM,DT,FGAF,HI,MB, MM,SF,TG
Region: Central

Cargill Meat Solutions - *Fort Morgan*
P.O. Box 4100
Fort Morgan, CO 80701
Contact: Mario Rivera
Phone: 303-867-1540
Fax: 303-867-1564
E-mail: mario_rivera@cargill.com
Products: BM,DT,FGAF,HI,MB, MM,SF,TG
Region: Central

Cargill Meat Solutions - *Friona*
P.O. Box 579
Friona, TX 79035
Contact: David Wathen
Phone: 806-295-8380
Fax: 806-295-8214
Products: BM,DT,FGAF,HI,MB, MM,SF,TG
Region: Central

Cargill Meat Solutions - *Schuyler*
P.O. Box 544
Schuyler, NE 68661
Contact: Dave Limbach
Phone: 402-352-5411
Fax: 402-352-8334
Products: BM,DT,FGAF,HI,MB, MM,SF,TG
Region: Central

Cargill Meat Solutions
P.O. Box 3850
High River, AB, T1V 1P4
Canada
Contact: Shane Mulrooney
Phone: 403-652-4688
Fax: 403-652-5245
Products: EX,BM,DT,FGAF,HI, MB,MM,SF,TG
Region: Western

Cargill Regional Beef
P.O. Box 188
Wyalusing, PA 18853
Contact: Lisa Kerr-House
Phone: 570-746-9224, x7347
Fax: 570-746-1235
E-mail: lisa_kerr-house@cargill.com
Products: SF,TG,MB,BFP,EX,BM
Region: Eastern

Central Bi-Products
Farmers Union Industries LLC
P.O. Box 319
Redwood Falls, MN 56283
www.fuillc.com
Phone: 507-637-2938
Fax: 507-637-5409
E-mail: danderson@centralbi.com
Products: FM,PB,SF,TG,HI,MM, MB,DT,BFP,FGAF,BM,OT(Pet food)
Region: Central

Central Bi-Products
Farmers Union Industries LLC
P.O. Box 359
Long Prairie, MN 56346
Phone: 507-637-2938
Fax: 507-637-5409
Products: FM,PB,SF,TG,HI,MM, MB,PM,BFP,FGAF,BM,OT(Pet food)
Region: Central

Darling Ingredients Inc. - Headquarters
251 O'Connor Ridge Blvd., Suite 300
Irving, TX 75038
www.darlingii.com
Phone: 972-717-0300
Fax: 972-717-1588
E-mail: info@darlingii.com
Region: Central, Western, Eastern

Darling Ingredients Inc. - Regional Office
P.O. Box 615
Des Moines, IA 50306
www.darlingii.com
Phone: 515-288-2166
Fax: 515-288-1007
Region: Central, Western, Eastern

Darling Ingredients Inc.
Griffin Industries LLC offices
4221 Alexandria Pike
Cold Spring, KY 41076
www.darlingii.com
Phone: 859-781-2010
Fax: 859-572-2575
Region: Central, Western, Eastern

Rothsay
A Division of Darling International Canada Inc.
150 Research Lane, Suite 307
Guelph, ON, N1G 4T2
Canada
www.rothsay.ca
Phone: 519-780-3342
Fax: 519-780-3360
Region: Central

Terra Renewal
Part of Darling Ingredients Inc.
4221 Alexandria Pike
Cold Spring, KY 41076
www.terrarenewal.com
Phone: 479-668-4503
Region: Central

For rendered fat sales

DAR PRO Ingredients, a Darling Brand
www.darpro-ingredients.com
Contact: Michael Rath
Phone: 800-669-1209
Fax: 972-717-1959
E-mail: fats-proteins@darpro.com
Products: BLF,BR,CN,DL,EQ,ET, EX,FGAF,HI,LT,RF,SF,ST,TG,YG, OT (bio-based diesel)

For rendered protein sales

DAR PRO Ingredients, a Darling Brand
www.darpro-ingredients.com
Contact: Doyle Nauman
Phone: 877-659-8438
Fax: 859-781-2569
E-mail: fats-proteins@darpro.com
Products: BLP,BM,CM,EQ,EX, PB,PM,FM,LT,MB,MM,OT (Organic fertilizer, specialty proteins, flavor enhancers)

For restaurant services

DAR PRO Solutions, a Darling/Griffin Brand
www.darpro-solutions.com
Contact: Todd Mathes
Phone: 972-717-0300
Fax: 972-717-1588
E-mail: recyclingservices@darpro.com

Rousselot
Part of Darling Ingredients Inc.
1231 S. Rochester Street, Suite 250
Mukwonago, WI 53149
www.rousselot.com
Contact: Lawrence Jeske
Phone: 262-363-6051
Fax: 262-363-2789
E-mail: larry.jeske@darlingii.com
Products: Gelatin, hydrolyzed collagen

Sonac USA LLC
Part of Darling Ingredients Inc.
1231 S. Rochester Street, Suite 250
Mukwonago, WI 53149
www.sonac.biz
Contact: Lawrence Jeske
Phone: 262-363-6051
Fax: 262-363-2789
E-mail: larry.jeske@darlingii.com
Products: Spray-dried blood and plasma products, gelatin, hydrolyzed collagen, protein isolates, other functional proteins
Region: Central

Foster Farms
P.O. Box 457
Livingston, CA 95334
www.fosterfarms.com
Contact: Dennis Richmond
Phone: 318-368-4344
Fax: 318-368-4310
E-mail: dennis.richmond@fosterfarms.com
Products: PM,FM,PF,CM,OT (organic fertilizers)
Region: Western

G.A. Wintzer & Son Co.
204 W. Auglaize Street
P.O. Box 406
Wapakoneta, OH 45895
www.gawintzer.com
Contact: Gus Wintzer
Phone: 419-739-4900
Fax: 419-738-9058
E-mail: gus@gawintzer.com
Products: EX,RF,SF,TG,FGAF,HI, MB,FM,PB
Region: Eastern

Gelita USA
Gelita AG
P.O. Box 927
Sioux City, IA 51102
www.gelita.com
Contact: Tonya Hanson
Phone: 712-943-5516
Fax: 712-943-3372
E-mail: tonya.hanson@gelita.com
Products: MB,SF,Gelatine
Region: Central

Gelita USA - *Chicago*
10 Wentworth Avenue
Calumet City, IL 60409
Contact: Jim Boguslawski
Phone: 708-730-5513
Fax: 708-891-8432
E-mail: jim.boguslawski@gelita.com
Products: SF,Gelatine
Region: Central

Holmes By-Products Inc.
3175 T.R. 411
Millersburg, OH 44654
Contact: Abe L. Miller or Dennis Koshmider
Phone: 330-893-2322
Fax: 330-893-2321
Products: SF,HI,MM,MB,PB,FM
Region: Eastern

Hormel Foods Corp.
1 Hormel Place
Austin, MN 55912
Contact: Tim Carlson
Phone: 507-437-5207
Fax: 507-437-5367
E-mail: ttcarlson@hormel.com
Products: MB,HI,SF,BM,Lard, Deodorized edible lard/tallow
Region: Central

Hormel Foods - *Austin*
500 14th Avenue NE
Austin, MN 55912
Contact: Dean Steines
Phone: 507-437-5373
Fax: 507-437-5524
E-mail: dwsteines@hormel.com
Products: MB,HI,SF,BM,Lard, Deodorized edible lard/tallow
Region: Central

Hormel Foods - *Fremont*
900 S. Platte Avenue
Fremont, NE 68025
Contact: Jim Farnsworth
Phone: 402-721-2300, x3210
Fax: 402-721-0445
E-mail: jlfarnsworth@hormel.com
Products: MB,HI,SF,BM,Lard
Region: Central

JBS Swift & Company - Headquarters
1770 Promontory Circle
Greeley, CO 80634-9039
Contact: Jim Fisher
Phone: 970-506-8354
Fax: 970-506-8320
E-mail: jim.fisher@jbssa.com
Products: TG,RF,HI,MBM,BM,EX
Region: Western

Plant locations

JBS Swift & Company
800 N. 8th Avenue
Greeley, CO 80634
Contact: Keith Neddermeyer
Phone: 970-304-7247
Fax: 970-304-7320
E-mail: keith.neddermeyer@jbssa.com
Products: TG,HI,MB,BM,EX
Region: Western

JBS Swift & Company
410 N. 200 W
Hyrum, UT 84319
Contact: Elton Varner
Phone: 435-245-6456
Fax: 435-245-5207
E-mail: elton.varner@jbssa.com
Products: TG,RF,HI,MBM,BM,EX
Region: Western

JBS Swift & Company
P.O. Box 2137
Grand Island, NE 68801
Contact: Steve Caravan
Phone: 308-384-5330
Fax: 308-389-4834
E-mail: steve.caravan@jbssa.com
Products: TG,HI,MB,BM,EX
Region: Central

JBS Swift & Company
P.O. Box 524
Dumas, TX 79029
Contact: Needham Carswell
Phone: 806-966-5103
Fax: 806-966-5481
E-mail: needham.carswell@jbssa.com
Products: TG,HI,MB,BM,EX
Region: Central

JBS Swift & Company
1200 Story Avenue
Louisville, KY 40206
Contact: Dave Dewitt
Phone: 502-582-0235
Fax: 502-582-6295
E-mail: dave.dewitt@jbssa.com
Products: TG,MBM,BM
Region: Eastern

JBS Swift & Company
North & 10th Avenue
Marshalltown, IA 50158
Contact: Jon Holden
Phone: 641-752-7131
Fax: 641-752-8509
E-mail: jon.holden@jbssa.com
Products: TG,MBM,BM
Region: Central

JBS Swift & Company
1700 N.E. Highway 60
Worthington, MN 56187
Contact: Kevin Schweigert
Phone: 507-372-2121
Fax: 507-372-4611
E-mail: kevin.schweigert@jbssa.com
Products: TG,MBM,BM
Region: Central

Mountain View Rendering Company
JBS Souderton Inc.
173 Rocco Road
Edinburg, VA 22824
Contact: Jason Janita
Phone: 540-984-4158 ext. 239
Fax: 540-984-4159
E-mail: jason.janita@jbssa.com
Products: SF,FM,PB,PF,BM, FGAF,OT
Region: Eastern

JBS - MOPAC
JBS Souderton Inc.
P.O. Box 64395
Souderton, PA 18964
Contact: Ken Gilmurray
Phone: 215-703-6085
E-mail: ken.gilmurray@jbssa.com
Products: BLF,BLP,FGAF,SF,TG, EX,LT,MB,PB,BM
Region: Eastern

JBS Packerland Tolleson
651 S. 91st Avenue
Tolleson, AZ 85353
Contact: Jeremy Eatherton
Phone: 970-506-8355
E-mail: jeremy.eatherton@jbssa.com
Products: DT,HI,MB,SF,TG
Region: Western

JBS Packerland Green Bay
P.O. Box 23000
Green Bay, WI 54305
Contact: Jim Holly
Phone: 970-506-8355
E-mail: jim.holly@jbssa.com
Products: DT,HI,MB,SF,TG
Region: Central

Pilgrim's Pride Corp. - Rendering Headquarters
P.O. Box 1268
Mt. Pleasant, TX 75456
www.pilgrims.com
Contact: Mark Glover
Phone: 903-434-1190
Fax: 972-290-8345
E-mail: mark.glover@pilgrims.com
Products: SF,FM,BM,PF,PM
Region: Central

Plant locations

Pilgrim's Pride Corp. - *Broadway*
330 Co-Op Drive
Timberville, VA 22853
Contact: Hal Davis
Phone: 540-901-6130
Fax: 540-901-6181
E-mail: hal.davis@pilgrims.com
Products: SF,PM,FM,PB,PF
Region: Eastern

Pilgrim's Pride Corp. - *Moorefield*
129 Potomac Avenue
Moorefield, WV 26836
Contact: Hal Davis
Phone: 304-538-7834
Fax: 304-538-3540
E-mail: hal.davis@pilgrims.com
Products: SF,PM,FM,PF,PB
Region: Eastern

Pilgrim's Pride Corp. - *Mt. Pleasant*
1220 Pilgrim Street
Mt. Pleasant, TX 75455
Contact: William Welborn
Phone: 903-575-3909
Fax: 903-575-3901
E-mail: william.welborn@pilgrims.com
Products: SF,PM,FM,BM,PB,PF
Region: Central

Pilgrim's Pride Corp. - *Sumter*
2050 Highway 15 South
Sumter, SC 29150-8799
Contact: Robert Canty
Phone: 803-481-8555, x5100
Fax: 803-481-4263
E-mail: robert.canty@pilgrims.com
Products: SF,PM,FM,PB,PF
Region: Eastern

John Kuhni Sons Inc.
P.O. Box 15
Nephi, UT 84648
Phone: 435-758-7600
Fax: 435-758-7610
Products: SF,TG,HI,MB,FGAF, OT(Transporter)
Region: Western

Kaluzny Bros. Inc.
1528 Mound Road
Joliet, IL 60436-9808
Contact: David Kaluzny II
Phone: 815-744-1453
Fax: 815-729-5069
E-mail: dkaluzny2@aol.com
Products: SF,TG,DT,BLF,FGAF, HI,CWG,YG
Region: Central

Kruger Commodities Inc. - Headquarters
14344 Y Street, Suite 202
Omaha, NE 68137
www.krugerinc.com
Contact: James H. Kruger
Phone: 402-896-1324
Fax: 402-896-1784
E-mail: jim@krugerinc.com
Region: Central

Kruger Commodities, Inc.
5900 Old Allegan Road
Hamilton, MI 49419
Contact: Terry Pfannenstiel
Phone: 269-751-0560
Fax: 269-751-8929
E-mail: terry@krugerinc.com
Products: FM,MB,TG,YG
Region: Eastern

KCI Restaurant Services
Kruger Commodities Inc.
4125 Dahlman Avenue
Omaha, NE 68107
Contact: Scott Ethridge
Phone: 402-898-4700
Fax: 402-898-4702
Products: YG
Region: Central

KCI Restaurant Services
Kruger Commodities Inc.
3370 L Avenue
Tama, IA 52339
Contact: Bill Farris
Phone: 641-484-3823
Fax: 641-484-3825
Products: DT,TG,YG
Region: Central

Maple Lodge Farms Ltd.
8301 Winston Churchill Blvd.
Brampton, ON, L6Y 0A2
Canada
Contact: David Willison
Phone: 905-455-8340 x 2359
Fax: 905-455-8370
E-mail: dwillison@maplelodgefarms.com
Products: SF,PB,FM
Region: Eastern

Mendota Agri-Products Inc. - Headquarters
712 Essington Road
Joliet, IL 60435
www.mendotaagriproducts.com
Contact: John Mahoney
Phone: 815-730-2080
Fax: 815-730-2087
E-mail: johnm@mahoneyes.com
Products: BLF,DT,FGAF,SF,TG,YG
Region: Central

Mendota Agri-Products Inc.
P.O. Box 439,
448 N. 3973 Road
Mendota, IL 61342
www.mendotaagriproducts.com
Contact: John Setchell
Phone: 815-539-5633
Fax: 815-539-7943
E-mail: johns@mendag.com
Products: BLF,DT,FGAF,SF,TG, MB,YG
Region: Central

Mahoney Environmental
712 Essington
Joliet, IL 60435
www.mahoneyenvironmental.com
Contact: Rick Sabol
Phone: 815-302-3912
Fax: 815-730-2087
E-mail: ricks@mahoneyes.com
Product codes: BLF,FGAF,LG, YG,TG

Mountaire Farms of Delaware
Mountaire Corporation
P.O. Box 1320
29093 John J. Williams Hwy
Millsboro, DE 19966
www.mountaire.com
Contact: Brian Schoeberl
Phone: 302-934-4178
Fax: 302-934-3445
E-mail: bschoeberl@mountaire.com
Products: SF,PB,FM
Region: Eastern

National Beef Packing Company LLC - Headquarters
P.O. Box 20046
Kansas City, MO 64195-0046
www.nationalbeef.com
Contact: Doyle Leefers
Phone: 800-449-2333
Fax: 816-713-8859
E-mail: doyle.leefers@nationalbeef.com
Products: SF,TG,HI,MM,MB, BM,EX
Region: Central

National Beef - *Dodge City*
2000 E. Trail Street
Dodge City, KS 67801
Contact: Randy Lyle or Mike Clayton
Phone: 620-227-7135
Fax: 620-338-4339
E-mail: randy.lyle@nationalbeef.com or mlclayton@nationalbeef.com
Products: SF,TG,HI,MM,MB, BM,EX
Region: Central

National Beef - *Liberal*
P.O. Box 978
Liberal, KS 67905
Contact: Arlie Wright
Phone: 620-624-1851
Fax: 620-626-0285
E-mail: alwright@nationalbeef.com
Products: SF,TG,HI,MM,MB, BM,EX
Region: Central

Nutri-Feeds Inc.
101 SE 11th Avenue
Amarillo, TX 79101
Contact: Garth Merrick
Phone: 806-350-5525
Fax: 806-357-2292
E-mail: garth@merrickpetcare.com
Products: TG,MB
Region: Central

Protein Products Inc. - Headquarters
P.O. Box 2974
Gainesville, GA 30503
www.proteinproductsinc.com
Contact: Jeff Gay
Phone: 770-536-3922
Fax: 770-536-8365
E-mail: jeffg@ppicorp.com
Region: Eastern

Protein Products Inc.
1042 Highway 3
Sunflower, MS 38778
www.proteinproductsinc.com
Contact: Eric Hilley
Phone: 770-536-3922
Fax: 770-536-8365
E-mail: erich@ppicorp.com
Region: Eastern

Sacramento Rendering Company
SRC Companies
11350 Kiefer Boulevard
Sacramento, CA 95830
Contact: Michael Koewler
Phone: 916-363-4821
Fax: 916-363-8641
E-mail: michaelkoewler@aol.com
Products: EX,SF,TG,HI,MM,MB, DT,FGAF,BFP
Region: Western

Reno Rendering
SRC Companies
1705 N. Wells Avenue
Reno, NV 89512
Phone: 800-733-6498
Products: Transfer station
Region: Western

Sanimax - Headquarters
9900 Maurice-Duplessis
Montreal, QB, H1C 1G1
Canada
www.sanimax.com
Contact: Martin Couture
Phone: 514-648-6001 or 888-495-9091
Fax: 514-648-3013
E-mail: info@sanimax.com
Region: Eastern

Sanimax
P.O. Box 45100
2001 Avenue de La Rotonde
Charny, QB, G6X 3R4
Canada
www.sanimax.com
Contact: Vincent Brossard
Phone: 418-832-4645, x3190
Fax: 418-832-6995
E-mail: info@sanimax.com
Products: EX,FM,PB,SF,TG,BM, RF,FGAF,BLF,HI,PM
Region: Eastern

Sanimax
9900 Maurice-Duplessis
Montreal, QB, H1C 1G1
Canada
www.sanimax.com
Contact: Eric Caputo
Phone: 514-648-6001, x3249
Fax: 514-648-0597
E-mail: info@sanimax.com
Products: EX,FM,PB,SF,TG,BM, RF,FGAF,BLF,HI,PM
Region: Eastern

Sanimax
P.O. Box 10067
2099 Badgerland Drive
Green Bay, WI 54303
www.sanimax.com
Contact: Donn Johnson
Phone: 920-494-5233
Fax: 920-494-9141
E-mail: info@sanimax.com
Products: EX,SF,TG,HI,DT,FGAF, MB,BFP
Region: Central

Sanimax
505 Hardman Avenue
South St. Paul, MN 55075
www.sanimax.com
Contact: Donn Johnson
Phone: 651-451-6858
Fax: 651-451-6542
E-mail: info@sanimax.com
Products: EX,SF,TG,MB,BM, MM,FGAF,FM,PB,HI,BFP,RF
Region: Central

Sanimax
605 Bassett Street
DeForest, WI 53532
www.sanimax.com
Contact: Tony Loritz
Phone: 608-846-5466
Fax: 608-846-5370
E-mail: info@sanimax.com
Products: SF,TG,FGAF
Region: Central

Simmons Feed Ingredients
10700 S. State Highway 43
Southwest City, MO 64863
www.simmonsfeedingredients.com
Contact: Ken Wilson
Phone: 417-762-3001
Fax: 417-762-3867
E-mail: ken.wilson@simfoods.com
Products: SF,PB,PM,FM
Region: Central

Smithfield - *Sales*
111 Commerce Street
Smithfield, VA 23430
Contact: Gregg Redd
Phone: 757-357-1636
Fax: 757-357-1624
E-mail: gredd@smithfield.com
Products: SF,RF,HI,LG,MM,MB, BM,EX,OT(Heparin, plasma, runners, hydrolized hog hair)
Region: Eastern

Smithfield - *Clinton*
424 E. Railroad Street
Clinton, NC 28328
Contact: Andrew Jordan
Phone: 910-385-7751
Fax: 910-299-3001
E-mail: ajordan@smithfield.com
Products: SF,RF,HI,LG,MM,MB, BM,EX,OT(Heparin, plasma, runners, hydrolized hog hair)
Region: Eastern

Smithfield - *Crete*
2223 County Road I
Crete, NE 68333
Contact: Roger Eiklenborg
Phone: 402-826-8885
E-mail: reiklenborg@smithfield.com
Products: SF,RF,HI,LG,MM,MB, BM,EX,OT(Heparin, plasma, runners, hydrolized hog hair)
Region: Central

Smithfield - *Dennison*
800 Industrial Drive
Dennison, IA 51442
Contact: Ron Pankau
Phone: 800-831-1812
E-mail: rpankau@smithfield.com
Products: SF,RF,HI,LG,MM,MB, BM,EX,OT(Heparin, plasma, runners, hydrolized hog hair)
Region: Central

Smithfield - *Kansas City*
11500 NW Ambassador Drive
Kansas City, MO 64195
Contact: Austin Angel
E-mail: aangel@smithfield.com
Products: SF,RF,HI,LG,MM,MB, BM,EX,OT(Heparin, plasma, runners, hydrolized hog hair)
Region: Central

Smithfield - *Milan*
22123 Highway 5
Milan, MO 63556
Contact: Gary Banner
Phone: 660-865-4061
E-mail: gbanner@smithfield.com
Products: SF,RF,HI,LG,MM,MB, BM,EX,OT(Heparin, plasma, runners, hydrolized hog hair)
Region: Central

Smithfield - *Monmouth*
1220 N. 6th Street
Monmouth, IL 61462
Contact: Scott Peel
Phone: 309-299-4753
E-mail: speel@smithfield.com
Products: SF,RF,HI,LG,MM,MB, BM,EX,OT(Heparin, plasma, runners, hydrolized hog hair)
Region: Central

Smithfield - *Sioux Falls*
1400 N. Weber Avenue
Sioux Falls, SD 57103
Contact: Don Johnson
Phone: 605-330-3295
E-mail: djohnson@smithfield.com
Products: BFP,TG,FGAF,MM, EX,OT(Pet food meat products)
Region: Central

Smithfield Foods - *Smithfield*
501 N. Church Street
Smithfield, VA 23430
Contact: John Acevedo
Phone: 757-357-3131 ext. 2750
E-mail: jacevedo@smithfield.com
Products: SF,RF,HI,LG,MM,MB, BM,EX,OT(Heparin, plasma, runners, hydrolized hog hair)
Region: Eastern

Smithfield - *Tar Heel*
15855 Highway 87 West
Tar Heel, NC 28392
Contact: Ted Stafford
Phone: 910-879-5758 ext. 758
E-mail: tstafford@smithfield.com
Products: SF,RF,HI,LG,MM,MB,BM,EX,OT(Heparin, plasma, runners, hydrolized hog hair)
Region: Eastern

Coastal Protein
1600 Martin Road
Godwin, NC 28344
Contact: Blake Bullard
Phone: 910-567-5604
E-mail: bbullard@coastalproteins.com
Products: MM,LG
Region: Eastern

Farmer John
3049 E. Vernon Avenue
Los Angeles, CA 90058
Contact: Vince Claugherty
Phone: 626-710-7337
E-mail: vclougherty@farmerjohn.com
Products: SF,MB,BM,Lard
Region: Western

Pine Ridge Farms
1800 Maury Street
Des Moines, IA 50317
Contact: Brady Stewart
Phone: 515-266-4100
E-mail: bstewart@pineridgefarmspork.com
Products: MM,LG
Region: Central

South Chicago Packing Company
16250 S. Vincennes Avenue
South Holland, IL 60473
www.miniat.com
Contact: Mike Botelho
Phone: 708-589-2432
Fax: 708-589-2532
E-mail: mbotelho@miniat.com
Products: ET,RF,SF,TG,EX
Region: Central

Tyson Foods Inc. - Headquarters
2200 Don Tyson Parkway, CP721
Springdale, AR 72762
www.tyson.com
Contact: Bo Watson
Phone: 479-290-2897
E-mail: bo.watson@tyson.com
Products: FM,PB,PM,PF,OT
Region: Central

Plant locations

Cullman Blending
P.O. Box 1144
Cullman, AL 35055
Contact: Mike Lankford
Phone: 256-734-7100
Fax: 256-734-4521

Pine Bluff Blending
4211 Emmett Sanders Road
Pine Bluff, AR 71601
Contact: Mike Lankford
Phone: 870-534-7276
Fax: 870-534-7273

RVAF - *Clarksville*
1238 Market Street
Clarksville, AR 72830
Contact: Frank Fox
Phone: 479-754-3441
Fax: 479-754-8018

RVAF - *Forest*
11634 Hwy 80 W
Forest, MS 39074
Contact: Reed Kilpatrick
Phone: 601-469-8301
Fax: 479-717-0198

RVAF - *Harmony*
501 Sheffield Road
Harmony, NC 28634
Contact: Gregg Wikstrom
Phone: 704-546-2602
Fax: 704-546-5944

RVAF - *Robards (Henderson)*
14660 U.S. Hwy 41 S
Robards, KY 42452
Contact: Mark Badertscher
Phone: 270-521-3160
Fax: 270-521-3181

RVAF - *Scranton*
7755 N. Hwy 393 S
Scranton, AR 72863
Contact: Jim Rofkahr
Phone: 479-938-2025
Fax: 479-757-7731

RVAF - *Sedalia*
20003 Menefee Road
Sedalia, MO 65301
Contact: Jim Robejsek
Phone: 660-826-7071
Fax: 660-826-7119
E-mail: james.robejsek@tyson.com

RVAF - *Seguin*
1200 W. Kingsbury Street
Seguin, TX 78155
Contact: Keith Yovonavich
Phone: 830-401-8842
Fax: 479-203-4221

RVAF - *Temperanceville*
11224 Lankford Hwy
Temperanceville, VA 23442
Contact: Tim Johnson
Phone: 757-824-3471
Fax: 757-854-1415

RVAF - *Texarkana*
5465 Miller County 64
Texarkana, AR 71854
Contact: Dan Crowe
Phone: 870-645-2693
Fax: 870-645-2619

Tyson Fresh Meats
800 Stephens Port Drive, DD828D
Dakota Dunes, SD 57049
Contact: Bob Bestgen or Kim Broekemeier
Phone: 605-235-2523 or 605-235-2836
Fax: 479-757-7595 or 479-757-7547
E-mail: bob.bestgen@tyson.com or kim.broekemeier@tyson.com

Plant locations

Beef sites:
Amarillo, TX
Dakota City, NE
Holcomb, KS
Joslin, IL
Lexington, NE
Pasco, WA

Pork sites:
Columbus Junction, IA
Denison, IA
Madison, NE
Perry, IA
Storm Lake, IA
Logansport, IN
Waterloo, IA

Valley Proteins Inc. - Headquarters
P.O. Box 3588
Winchester, VA 22604-2586
www.valleyproteins.com
Contact: Gerald F. Smith Jr.
Phone: 540-877-2590
Fax: 540-877-3210
E-mail: jjsmith@valleyproteins.com
Products: BFP,BM,CM,EX,FGAF,FM,HI,MM,PF,PM,SF,TG,YG,OT(Pet food meat products)
Region: Eastern

Valley Proteins Inc. - *Amarillo Division*
8415 S.E. 1st Avenue
Amarillo, TX 79118-7302
Contact: Steve Heredia
Phone: 540-877-2590
Fax: 806-374-1207
E-mail: sheredia@valleyproteins.com
Region: Central

Valley Proteins Inc. - *Baltimore Division*
1515 Open Street
Baltimore, MD 21226
Contact: Robert Hutson
Phone: 540-877-2590
Fax: 410-355-3095
E-mail: rhutson@valleyproteins.com
Region: Eastern

Valley Proteins Inc. - *Fayetteville Division*
1309 Industrial Drive
Fayetteville, NC 28301
Contact: Paul White
Phone: 540-877-2590
Fax: 910-213-1140
E-mail: pwhite@valleyproteins.com
Region: Eastern

Valley Proteins Inc. - *Gastonia Division*
5533 S. York Road
Gastonia, NC 28052
Contact: Shannon Owen
Phone: 540-877-2590
Fax: 704-861-9252
E-mail: sowen@valleyproteins.com
Region: Eastern

Valley Proteins Inc. - *Knoxville Division*
9300 Johnson Road
Strawberry Plains, TN 37871
Contact: Bobby Watson
Phone: 540-877-2590
Fax: 865-932-5713
E-mail: rwatson@valleyproteins.com
Region: Eastern

Valley Proteins Inc. - *Lewiston Division*
P.O. Box 10
Lewiston, NC 27849
Contact: Mike Anderson
Phone: 540-877-2590
Fax: 252-348-2389
E-mail: manderson@valleyproteins.com
Region: Eastern

Valley Proteins Inc. - *Linkwood Division*
5420 Linkwood Road
Linkwood, MD 21835
Contact: Reed Parks
Phone: 540-877-2590
Fax: 410-228-9389
E-mail: rparks@valleyproteins.com
Region: Eastern

Valley Proteins Inc. - *Linville Division*
6230 Kratzer Road
Linville, VA 22834
Contact: Hobie Halterman
Phone: 540-877-2590
Fax: 540-833-6504
E-mail: hhalterman@valleyproteins.com
Region: Eastern

Valley Proteins Inc. - *Oklahoma Division*
2228 S. Santa Fe Avenue
Okalahoma City, OK 73109
Contact: Randy McKiddie
Phone: 540-877-2590
Fax: 405-235-9960
E-mail: rmckiddie@valleyproteins.com
Region: Central

Valley Proteins Inc. -
Rose Hill Division
P.O. Box 1026
469 Yellow Cut Road
Rose Hill, NC 28458
Contact: Steve Lester
Phone: 540-877-2590
Fax: 910-289-3312
E-mail: slester@
valleyproteins.com
Region: Eastern

Valley Proteins Inc. -
Terre Hill Division
693 Wide Hollow Road
East Earl, PA 17519
Contact: John Hamzik
Phone: 540-877-2590
Fax: 717-445-6379
E-mail: jhamzik@
valleyproteins.com
Region: Eastern

Valley Proteins Inc. -
Veribest Division
8394 FM 380
San Angelo, TX 76905
Contact: Ronnie Meine
Phone: 540-877-2590
Fax: 325-659-3823
E-mail: rmeine@
valleyproteins.com
Region: Central

Valley Proteins Inc. -
Wadesboro Division
P.O. Box 718
Wadesboro, NC 28170
Contact: Chris Bivans
Phone: 540-877-2590
Fax: 704-694-6145
E-mail: cbivans@
valleyproteins.com
Region: Eastern

Valley Proteins Inc. -
Ward Division
271 Val-Pro Road
Ward, SC 29166-9801
Contact: Bill Brochin
Phone: 540-877-2590
Fax: 803-685-2591
E-mail: bbrochin@
valleyproteins.com
Region: Eastern

Valley Proteins Inc. -
Winchester Division
P.O. Box 3588
Winchester, VA 22604
Contact: Robert Golightly
Phone: 540-877-2590
Fax: 540-877-3136
E-mail: rgolightly@
valleyproteins.com
Region: Eastern

West Coast Reduction Ltd. - Headquarters
1292 Venables Street
Vancouver, BC, V6A 4B4
Canada
www.wcrl.com
Contact: Gordon Diamond or
Barry Glotman
Phone: 604-255-9301
Fax: 604-255-3434
E-mail: info@wcrl.com

West Coast Reduction Ltd.
Vancouver Plant Operations
105 Commercial Drive North
Vancouver, BC, V5L 4V7
Canada
Contact: Doug Davidson
Phone: 604-255-9301
Fax: 604-255-1803
E-mail: info@wcrl.com
Products: EX,FM,PB,SF,TG,BM,
ST,FGAF,BLF,HI,RF,YG,PF,BFP,
CWG,PM,Fish meal,Porcine
meal
Region: Western

West Coast Reduction Ltd. - *Calgary*
7030 Ogden Dale Place SE
Calgary, AB, T2C 2A3
Canada
www.wcrl.com
Contact: Geoff Smolkin
Phone: 403-279-4441
Fax: 403-279-6928
E-mail: info@wcrl.com
Products: EX,FM,SF,TG,MB,HI,
DT,BM,ST,FGAF,BLF,RF,YG,Fish
meal
Region: Western

West Coast Reduction Ltd. - *Edmonton*
1930 121 Avenue NE
Edmonton, AB, T6S 1B1
Canada
www.wcrl.com
Contact: James Taylor
Phone: 780-472-6750
Fax: 780-472-6944
E-mail: info@wcrl.com
Products: EX,FM,PB,SF,TG,DT,
BM,ST,FGAF,BLF,RF,YG,Fish
meal,Porcine meal
Region: Western

West Coast Reduction Ltd. - *Saskatoon*
3018 Miners Avenue
Saskatoon, SK, S7K 4Z8
Canada
www.wcrl.com
Contact: Bruce Sestak
Phone: 306-934-4887
Fax: 306-934-3364
E-mail: info@wcrl.com
Products: EX,FM,PB,SF,TG,MB,
DT,BM,ST,FGAF,BLF,HI,RF,YG,
Fish meal
Region: Western

Western Mass. Rendering Co. Inc.
94 Foster Road
Southwick, MA 01077
www.westernmassrendering.com
Contact: David T. Plakias
Phone: 413-569-6265
Fax: 413-569-6512
E-mail: david@wmrco.com
Products: EX,SF,FGAF,DT,TG
Region: Eastern

REGIONAL AREAS OF THE NATIONAL RENDERERS ASSOCIATION

1. Eastern Region
2. Central Region
3. Western Region

Active Members by State/Canada

Full listing is available on indicated page number.

Alabama
American Proteins Inc. 23
BHT ReSources 24
Cullman Blending..... 28

Arizona
Baker Commodities Inc. 24
JBS Packerland Tolleson 26

Arkansas
Pine Bluff Blending..... 28
Tyson Foods Inc. 28
Tyson Foods Inc. - RVAF 28

California
Baker Commodities Inc. 24
Farmer John 28
Foster Farms 25
Sacramento Rendering Co. 27

Canada
Cargill Meat Solutions 24
Maple Lodge Farms Ltd. 26
Rothsay..... 25
Sanimax 27
West Coast Reduction Ltd. 29

Colorado
Cargill Meat Solutions 24
JBS Swift & Company..... 25

Delaware
Mountaire Farms 26

Georgia
American Proteins Inc. 23
Protein Products Inc. 27

Hawaii
Baker Commodities Inc. 24

Illinois
Gelita USA 25
Kaluzny Bros. Inc. 26
Mahoney Environmental 26
Mendota Agri-Products 26
Smithfield 27
South Chicago Packing Co..... 28
Tyson Fresh Meats..... 28

Indiana
Tyson Fresh Meats..... 28

Iowa
APC Inc. 24
Darling Ingredients 25
Gelita USA 25
JBS Swift & Company..... 26
KCI Restaurant Services..... 26
Pine Ridge Farms 28
Smithfield 27
Tyson Fresh Meats..... 28

Kansas
APC Inc. 24
Cargill Meat Solutions 24
National Beef Packing 27
Tyson Fresh Meats..... 28

Kentucky
Darling Ingredients 25
JBS Swift & Company..... 26
Terra Renewal 25
Tyson Foods Inc. - RVAF 28

Maryland
Valley Proteins Inc. 28

Massachusetts
Baker Commodities Inc. 24
Western Mass. Rendering 29

Michigan
Kruger Commodities Inc. 26

Minnesota
Central Bi-Products Co. 24/25
Hormel Foods Corp. 25
JBS Swift & Company..... 26
Sanimax 27

Mississippi
Protein Products Inc. 27
Tyson Foods Inc. - RVAF 28

Missouri
National Beef Packing Co. 27
Simmons Feed Ingredients 27
Smithfield 27
Tyson Foods Inc. - RVAF 28

Nebraska
Cargill Meat Solutions 24
Hormel Foods Corp. 25
JBS Swift & Company..... 26
KCI Restaurant Services..... 26
Kruger Commodities Inc. 26
Smithfield 27
Tyson Fresh Meats..... 28

Nevada
Reno Rendering 27

New York
Baker Commodities Inc. 24

North Carolina
APC Inc. 24
Coastal Proteins 28
Smithfield 27/28
Tyson Foods Inc. - RVAF 28
Valley Proteins Inc. 28/29

Ohio
G.A. Wintzer & Son Co. 25
Holmes By-Products Inc. 25

Oklahoma
Valley Proteins 28

Pennsylvania
Cargill Regional Beef..... 24
JBS-MOPAC 26
Valley Proteins Inc. 29

South Carolina
Pilgrim's Pride Corp. 26
Valley Proteins Inc. 29

South Dakota
Smithfield 27
Tyson Fresh Meats..... 28

Tennessee
Valley Proteins Inc. 28

Texas
Cargill Meat Solutions 24
Darling Ingredients 25
JBS Swift & Company..... 25
Nutri-Feeds Inc. 27
Pilgrim's Pride Corp. 26
Tyson Foods Inc. - RVAF 28
Tyson Fresh Meats..... 28
Valley Proteins Inc. 28/29

Utah
JBS Swift & Company..... 25
John Kuhni Sons Inc. 26

Virginia
Mountain View Rendering..... 26
Pilgrim's Pride Corp. 26
Smithfield 27
Tyson Foods Inc. - RVAF 28
Valley Proteins Inc. 28/29

Washington
Baker Commodities Inc. 24
Tyson Fresh Meats..... 28

West Virginia
Pilgrim's Pride Corp. 26

Wisconsin
JBS Packerland Green Bay 26
Rousselot 25
Sanimax 27
Sonac USA LLC 25

2017 Associate Members

Brokers of fats and proteins, equipment manufacturers, and firms serving the rendering industry

Air/Water Treatment

Aulick Chemical Solutions
P.O. Box 127
Nicholasville, KY 40340
www.aulickchemical.com
Contact: Jesse Chula
Phone: 859-881-5422
Fax: 859-881-8194
E-mail: jchula@aulickchemical.com
Products: H2S elimination, odor control, wastewater treatment
Region: Eastern

Chem-Aqua Inc.
NCH Corporation
2727 Chemsearch Boulevard
Irving, TX 75062
www.chemaqua.com
Contact: Brandon Bischoff
Phone: 936-870-5420
E-mail: brandon.bischoff@chemaqua.com
Contact: Terry Waldo
Phone: 972-438-0120
E-mail: twaldo@nch.com
Products: Water treatment
Region: Central, Western

Chemtron Corporation
3500 Harry S. Truman Boulevard
St. Charles, MO 63301
www.chemtroncorporation.com
Contact: Leah Woods
Phone: 636-940-5445
Fax: 636-940-0773
E-mail: leahw@chemtronh2o.com
Region: Central

Clean Water Technology Inc.
151 W. 135th Street
Los Angeles, CA 90061
www.cleanwatertech.com
Contact: Colette Tassin
Phone: 310-380-4648 x114
E-mail: ctassin@cleanwatertech.com
Region: Western

FRC Systems International
P.O. Box 3147
Cumming, GA 30028
www.frcsystems.com
Contact: Leah Surber
Phone: 770-534-3681
Fax: 770-783-8632
E-mail: leah@frcsystems.com
Products: Dissolved air flotation equipment
Region: Eastern

Garratt-Callahan Company
50 Ingold Road
Burlingame, CA 94010
www.garrattcallahan.com
Contact: Manny Chargualaf
Phone: 650-697-5811
Fax: 650-692-6098
E-mail: marketing@g-c.com
Products: Water treatment
Region: Western

Kusters Water
Kusters Zima Corporation
P.O. Box 6128
Spartanburg, SC 29304
www.kusterszima.com
Contact: Bill Guarini
Phone: 864-576-0660
Fax: 864-587-5761
E-mail: bill.guarini@kusterszima.com
Region: Eastern

NCM Odor Control
425 Whitehead Avenue
South River, NJ 08882
www.ncmodorcontrol.com
Contact: Steve Fleisher
Phone: 732-238-6700
Fax: 570-801-7879
E-mail: ncmodorcontrol.steve@gmal.com
Region: Eastern

Parkson Corp.
1401 W. Cypress Creek Road, Suite 100
Ft. Lauderdale, FL 33309
www.parkson.com
Contact: Lydia Villamar
Phone: 888-PARKSON
Fax: 954-974-6182
E-mail: technology@parkson.com
Region: Eastern

SCP Control Inc.
7791 Elm Street NE
P.O. Box 32022
Minneapolis, MN 55432
Contact: Eric Peterson
Phone: 763-572-8042
Fax: 763-572-8066
E-mail: info@scpcontrol.com
Region: Central

Steen Research LLC
19363 Willamette Drive, Suite 235
West Linn, OR 97068
Contact: Steve Temple
Phone: 408-828-8177 or 503-722-9088
Fax: 503-722-1336
E-mail: stemple@steenresearch.com
Region: Western

VanAire Inc.
840 Clark Drive
Gladstone, MI 49837
www.vanaireinc.com
Contact: Nicole LaPalme
Phone: 906-428-2731
Fax: 906-428-9061
E-mail: nlapalme@vanaireinc.com
Region: Eastern

Antioxidants

Ameri-Pac Inc.
P.O. Box 1088
751 S. 4th Street
St. Joseph, MO 64502
www.ameri-pac.com
Contact: Robert Colescott
Phone: 816-233-4530
Fax: 816-233-1702
E-mail: bobc@ameri-pac.com
Region: Central

Caldic USA
2425 Alft Lane
Elgin, IL 60124
www.caldic.com
Contact: Sandy Boston
Phone: 913-302-0132
E-mail: sboston@caldic.us
Region: Central

C.F. Zeiler & Company Inc.
8601 LaSalle Road, Suite 203
Towson, MD 21286
www.cfzeiler.com
Contact: Charlie Zeiler
Phone: 410-828-7182
Fax: 410-828-7183
E-mail: cf_zeiler@cfzeiler.com
Region: Eastern

CFS North America LLC
Camlin Fine Sciences
3179 99th Street
Urbandale, IA 50322
www.camlinfs.com
Contact: Sandra Grossmann
Phone: 515-423-9854
E-mail: sandra.grossmann@camlinfs.com
Region: Central

FoodSafe Technologies
94 East Jefryn Boulevard, Unit H
Deer Park, NY 11729
www.foodsafetech.com
Phone: 631-392-1526
Fax: 631-392-1529
E-mail: render@foodsafetech.com
Region: Eastern, Central

Kemin Nutrisurance Inc.
1900 Scott Avenue
Des Moines, IA 50317
www.kemin.com
Contact: Chris Gloger or Kevin Custer
Phone: 281-615-7924 (Chris) or 515-289-6842 (Kevin)
E-mail: chris.gloger@kemin.com or kevin.custer@kemin.com
Region: Central

Novus International Inc.
20 Research Park Drive
St. Charles, MO 63304
Contact: Vanessa Stewart
Phone: 314-550-1592
Fax: 314-576-6041
E-mail: vanessa.stewart@novusint.com
Region: Central

Peak Tech Inc.
P.O. Box 7
Jeffersonville, IN 47130
Contact: Jim Sparrow
Phone: 812-283-6697
Fax: 812-283-0765
E-mail: jsparrow@pfauoil.com
Region: Central

Rensin International Corporation
17901 Von Karman Avenue
Irvine, CA 92614
www.rensin-intl.com
Contact: Yan Feng Cai
Phone: 949-556-8874
Fax: 949-242-4766
E-mail: contact@rensin-intl.com
Region: Eastern

Videka
A Diana Pet Food & Kalsec Alliance
3713 West Main Street
Kalamazoo, MI 49006
www.diana-group.com
Contact: Kevin Meyle
Phone: 800-323-9320
Fax: 269-382-3060
E-mail: kmeyle@kalsec.com
Region: Eastern

Bulk Liquid Storage / Transportation

CST Storage
A Division of CST Industries Inc.
345 Harvestore Drive
DeKalb, IL 60115
Contact: Tim O'Connell
Phone: 815-220-5730 or 405-380-5410
E-mail: toconnell@cst-storage.com
Region: Central

Dupre Logistics LLC
201 Energy Parkway, Suite 500
Lafayette, LA 70508
www.duprelogistics.com
Contact: Alfred Parker
Phone: 504-812-8622
E-mail: aparker@duprelogistics.com
Region: Central

Dura Cast Products Inc.
16160 Hwy 27
Lake Wales, FL 33859
www.duracast.com
Contact: Gabe Madlang
Phone: 863-638-3200
Fax: 863-638-2443
E-mail: gmadlang@duracast.com
Region: Eastern

Greentree Logistics Inc.
2703 Geryville Pike
Pennsburg, PA 18073
www.greentreelogistics.com
Contact: Anthony Pellegrino
Phone: 855-263-3725 x310
Fax: 866-261-8446
E-mail: apellegrino@greentreelogistics.com
Region: Central

LNL Trucking Inc.
P.O. Box 192
Bedford, IN 47421
www.lnltrucking.com
Contact: Larry Limp
Phone: 812-278-9410
Fax: 812-278-9810
E-mail: larry.lnl@comcast.net
Region: Eastern

Paul Marcotte Farms Inc.
1725N, 12000 E Road
Momence, IL 60954-9467
Contact: Sherrie Smart
Phone: 815-472-4400
Fax: 815-472-4453
E-mail: smartdispatcher@hotmail.com
Products: Transporters
Region: Central

Stoller Trucking Inc.
P.O. Box 309
Gridley, IL 61744
www.stollertrucking.com
Contact: Brian S. Stoller
Phone: 309-747-4521
Fax: 309-747-4457
E-mail: bstoller@stollertrucking.com
Region: Central

T-Haul Tank Lines
2561 N. Patterson Avenue
Springfield, MO 65803
www.thaultanklines.com
Contact: Dave Samford
Phone: 417-893-3690
Fax: 417-761-6630
E-mail: dave.samford@t-haul.com
Region: Central

Chemicals

Anderson Chemical Co.
325 S. Davis
Litchfield, MN 55355
www.accomn.com
Contact: Brett Anderson
Phone: 320-693-2477
Fax: 320-693-7740
E-mail: bca@accomn.com
Region: Central

Bluestar Silicones USA
Bluestar Chemical Co. Ltd.
2 Town Center Boulevard
New Brunswick, NJ 08816
www.bluestarsilicones.com
Contact: Tom Stremlau
Phone: 678-477-3366
E-mail: tom.stremlau@bluestarsilicones.com
Region: Central

CCI
3540 East 26th
Vernon, CA 90058
Contact: Joe Graffies
Phone: 800-767-9112
E-mail: jgraffies@ccichemical.com
Region: Western

Chem-Tech Solutions Inc.
427 Brook Street
Belmont, NC 28012
www.chemtechsolutions.com
Contact: Tony Phillips
Phone: 704-829-9202
Fax: 704-829-9203
E-mail: info@chemtechsolutions.com
Products: Degreasers, cleaners, anti-foam for cookers
Region: Eastern

Cleaning Systems Inc.
Formerly DBA DynaEdge
1997 American Boulevard
De Pere, WI 54115
www.cleaningsystemsinc.com
Contact: Michael Lamminen
Phone: 920-337-4400
Fax: 920-337-9410
E-mail: mlamminen@cleaningsystemsinc.com
Products: Degreasers/cleaners
Region: Central

Croda Inc. - *Atlas Point*
315 Cherry Lane
New Castle, DE 19720
Contact: Vernon Clark or Stephen McKnight
Phone: 770-331-8588 or 732-425-1050
E-mail: c.vernon.clark@croda.com or stephen.mcknight@croda.com
Products: Surfactants
Region: Eastern

Impact Cleaning/DuBois Distribution
N8898 River Road
Berlin, WI 54923
www.duboischemicals.com
Contact: Dale Jezwinski
Phone: 513-504-6036
Fax: 800-543-1720
E-mail: dale.jezwinski@gmal.com
Products: Degreasers/Cleaners for trucks, equipment, walls and floors, truck wash systems
Region: Eastern, Central

Hydro Solutions Inc.
P.O. Box 221016
Louisville, KY 40252-1016
www.hydrosolutions.com
Contact: David Davis
Phone: 502-899-7107
Fax: 502-897-8738
E-mail: hydro@hydrosolutions.com
Region: Eastern

Vantage OleoChemical
4650 South Racine Avenue
Chicago, IL 60609-3321
Contact: Jason Bettenhausen
Phone: 773-376-9000
Fax: 773-376-1936
E-mail: jason.bettenhausen@vantagegrp.com
Products: Oleochemicals
Region: Central

Commodity Brokers/ Traders

Agri Trading
P.O. Box 609
340 Michigan Street SE
Hutchinson, MN 55350
www.agritradingcorp.com
Contact: Steve Borstad
Phone: 320-587-2133 or 320-583-3209
Fax: 320-587-5816
E-mail: steve.borstad@agritradingcorp.com
Region: Central

D.A. Lorentzen Inc.
1523 Guthrie Drive
Inverness, IL 60010
Contact: Duane Lorentzen
Phone: 847-991-5220
Fax: 847-991-5220
E-mail: dalorentzen@gmail.com
Products: TG,FGAF,SF,ET,BR
Region: Central

Decom Inc.
11325 South Hudson Avenue
Tulsa, OK 74137
Contact: J.C. Deyoe
Phone: 918-298-5205
E-mail: jcdeyoe@aol.com
Products: FM,BP,SF,TG,FGAF, MM,MB,DT,BR
Region: Central

E.B. Wakeman Company
846 Higuera Street, Suite 5
San Luis Obispo, CA 93401
Contact: Gary Gibson
Phone: 805-781-8475
Fax: 805-781-0516
Products: FM,PB,MB,TG,BR
Region: Western

Gavilon Ingredients LLC
1331 Capitol Avenue
Omaha, NE 68102-1106
www.gavilon.com
Contact: Aaron Perkinson
Phone: 402-889-4304
Fax: 402-221-0343
E-mail: aaron.perkinson@gavilon.com
Products: Animal proteins and fats, grain, feed ingredients, energy, and biofuels
Region: Central

Gersony Strauss Company Inc.
171 Church Street, Suite 270
Charleston, SC 29401
Contact: Lonnie James
Phone: 843-853-7777
Fax: 843-853-6777
E-mail: gersony@gersony.com
Region: Eastern

Hurley Brokerage Inc.
11524 West 183rd Street, Unit 103
Orland Park, IL 60467
Contact: Bill Hurley
Phone: 708-361-8823
Fax: 708-361-9649
E-mail: bill.hurley@hurleybrokerage.com
Products: BR,FM,PB,RF,SF,TF,ET, FGAF,MM,MB,DT
Region: Central

Mini Bruno North America Inc.
Mini Bruno Sucesores C.A.
41 West Putnam Avenue, 2nd Floor
Greenwich, CT 06830
www.minibruno.us
Contact: Alves Neri
Phone: 203-422-2923
Fax: 203-422-0441
E-mail: aneri@minibruno.com
Region: Eastern

Mirasco Inc.
900 Circle 75 Parkway, Suite 1660
Atlanta, GA 30339
www.mirasco.com
Contact: Diaa Ghaly
Phone: 770-956-1945
Fax: 770-956-0308
E-mail: diaa.ghaly@mirasco.com
Region: Eastern

Noble America's Energy Solutions LLC
130 Voyage Mall
Marina del Rey, CA 90292
www.noblesolutions.com
Contact: Gene Owens
Phone: 310-686-5702
E-mail: gowens@noblesolutions.com
Products: Natural gas and power
Region: Western

Pasternak, Baum & Co. Inc.
500 Mamaroneck Avenue
Harrison, NY 10528
www.pasternakbaum.com
Contact: Michael Sanchez or Mike Moran
Phone: 914-630-8080
Fax: 914-630-8120
E-mail: fatsandoils@pbaum.net
Products: Fats, oils, grains
Region: Eastern

Perdue Agribusiness LLC
6906 Zion Church Road
Salisbury, MD 21804
www.perdueagribusiness.com/animal-nutrition
Contact: Darryl Betts
Phone: 410-341-2598
Fax: 410-341-2603
E-mail: darryl.betts@perdue.com
Products: Poultry and dairy
Region: Eastern

POET Nutrition
POET LLC
4506 N. Lewis Avenue
Sioux Falls, SD 57104
www.poet.com
Contact: Ashley Hummel
Phone: 605-965-6232
E-mail: ashley.hummel@poet.com
Products: Fats and oils
Region: Central

Scoular
250 S Marquette Avenue, Suite 1050
Minneapolis, MN 55401
www.scoular.com
Contact: Rendered Desk
Phone: 612-335-8205
Fax: 612-335-8770
E-mail: mmccartan@scoular.com
Region: Central

Sunbelt Commodities Inc.
P.O. Box 70006
Marietta, GA 30007-0006
Contact: Dave Haselschwerdt
Phone: 770-578-8883
Fax: 844-269-8316
E-mail: dave@sunbeltcommodities.com
Products: BR,TG,ET,FM,PB
Region: Central

Third Coast Commodities LLC
1218 W. Glendora
Buchanan, MI 49107
Contact: Paul Dickerson
Phone: 269-422-1944
Fax: 847-589-0820
E-mail: paul@thirdcoastcommodities.com
Region: Central

Universal Green Consultants
201 Montauk Highway
West Hampton Beach, NY 11978
www.ugccorp.org
Contact: Jamie O'Brien
Phone: 631-998-3700
Fax: 631-288-9012
E-mail: jobrien@ugccorp.org
Region: Eastern

Wilbur-Ellis Feed Division
Wilbur-Ellis Company
2001 SE Columbia River Drive
Vancouver, WA 98661
www.wilburellis.com
Contact: Diane Kimmel
Phone: 360-816-0748
Fax: 360-892-4097
E-mail: dkimmel@wilburellis.com
Region: Western

Wilks & Topper Inc.
567 5th Street
Oakland, CA 94607-3500
Contact: Alex Elsner
Phone: 510-251-6300
Fax: 510-251-6295
E-mail: wilkstoppr@aol.com
Products: FM,PB,TG,ET,FGAF, MM,MB,BM,FA,OT
Region: Western

W.W.S. Inc.
4032 Shoreline Drive, Suite 2
Spring Park, MN 55384
www.wwstrading.com
Contact: Wendy Weihe Storlie
Phone: 952-541-9001 or 888-645-6328
Fax: 952-541-9206
E-mail: wendy@wwstrading.com
Products: Commodity merchandiser of fats, oils, and proteins
Region: Central, Eastern, Western

Consultants

Bolton & Menk Inc.
P.O. Box 668
Ames, IA 50010-0668
www.bolton-menk.com
Contact: Greg Sindt
Phone: 515-233-6100
Fax: 515-233-4430
E-mail: gregsi@bolton-menk.com
Products: Environmental engineering and permit services, wastewater treatment facility design and studies
Region: Central

Energy Management Resources Inc.
7501 Tiffany Springs Parkway
Kansas City, MO 64153
www.emr-energy.com
Contact: Ginger Needham
Phone: 816-883-1000
Fax: 816-883-1001
E-mail: slawrence@emr-energy.com
Region: Central

GHD Services Inc.
7086 N. Maple Avenue, Suite 101
Fresno, CA 93720
www.ghd.com
Contact: Michael Beerends or Jason Haelzle
Phone: 559-326-5900
Fax: 559-326-5905
E-mail: michael.beerends@ghd.com or jason.haelzle@ghd.com
Region: Western

National Grease Recycling Inc.
2708 Charlie Taylor Road
Plant City, FL 33565
E-mail: nationalgrease@aol.com
Region: Eastern

Praedium Ventures
10538 Justin Drive
Urbandale, IA 50322
www.praediumventures.com
Contact: David Meisinger
E-mail: meisingerd@praediumventures.com
Products: Animal welfare, food safety, and quality, FSMA prep
Region: Central

Reid Engineering Company Inc.
1210 Princess Anne Street
Fredericksburg, VA 22401
www.reidengineering.com
Contact: Shane H. Reid
Phone: 540-371-8500
Fax: 540-371-8576
E-mail: sreid@reidengineering.com
Products: Wastewater, water, utility, and site development
Region: Eastern

Equipment

AC Corporation
P.O. Box 16367
Greensboro, NC 27416-0367
Contact: Trip Walker
www.accorporation.com
Phone: 336-273-4472
Fax: 336-274-6035
E-mail: twalker@accorporation.com
Region: Eastern

Alfa Laval Inc.
111 Parker Street
Newburyport, MA 01970
www.alfalaval.com
Contact: Jeff Logan
Phone: 978-853-8218
E-mail: jeff.logan@alfalaval.com
Region: Eastern

Alloy Hardfacing & Eng. Co. Inc.
20425 Johnson Memorial Dr. (Hwy 169)
Jordan, MN 55352
www.alloyhardfacing.com
Contact: Paul Rothenberger
Phone: 800-328-8408 or 952-492-5569
Fax: 952-492-3100
E-mail: paulr@alloyhardfacing.net
Region: Central, Western

Anco-Eaglin Inc.
1420 Lorraine Avenue
High Point, NC 27263-2040
www.ancoeaglin.com
Contact: Rick Eaglin
Phone: 336-855-7800
Fax: 336-855-7831
E-mail: ancoeaglin@aol.com
Region: Western

Artex Manufacturing
P.O. Box 88
Redwood Falls, MN 56283
www.artexmfg.com
Contact: Mark Schwiderski
Phone: 507-644-2893
Fax: 507-644-7000
E-mail: mschwiderski@artexmfg.com
Products: Aluminum rendering trailers, air/water treatment
Region: Central

Brown Industrial Inc.
311 W. South Street
P.O. Box 74
Botkins, OH 45306-0074
www.brownindustrial.com
Contact: Craig D. Brown
Phone: 937-693-3838
Fax: 937-693-4121
E-mail: craig@brownindustrial.com
Products: Truck bodies/trailers
Region: Central, Eastern, Western

Cablevey Conveyors
Intraco Inc.
P.O. Box 148
Oskaloosa, IA 52577
www.cablevey.com
Contact: Karl Seidel
Phone: 641-673-8451
Fax: 641-673-7419
E-mail: Karl.Seidel@cablevey.com
Region: Central

Consolidated Fabricators
14620 Arminta Street
Van Nuys, CA 91402
www.con-fab.com
Contact: Kerry Holmes
Phone: 818-933-0885
E-mail: kholmes@con-fab.com
Products: Waste containers
Region: Western

DGA & Associates
P.O. Box 145
Clitherall, MN 56524
Contact: Duane G. Anderson
Phone: 952-881-4088
Fax: 952-881-2703
E-mail: dgaassociates@qwestoffice.net
Region: Central

Dupps Company
P.O. Box 189
Germantown, OH 45327
www.dupps.com
Contact: Frank Dupps Jr. or Richard Weeks
Phone: 937-855-6555
Fax: 937-855-6554
E-mail: info@dupps.com
Region: Central, Eastern, Western

Dupps Company - *Ankeny*
P.O. Box 257
Ankeny, IA 50021
www.dupps.com
Contact: Theodore Clapper
Phone: 515-964-1110
Fax: 515-964-0863
E-mail: tclapper@ dupps.com
Products: Repair and sales
Region: Central, Western

Dupps Separation Technology / Dupps Gratt Centrifuges
P.O. Box 189
Germantown, OH 45327
www.dupps.com
Contact: Ray Jobe
Phone: 937-855-6555
Fax: 937-855-6554
E-mail: rjobe@dupps.com
Region: Central, Eastern, Western

Frontline International Inc.
95 16th Street, SW
Barberton, OH 44203
www.frontlineii.com
Contact: John Palazzo
Phone: 330-861-1100
Fax: 330-861-1105
E-mail: jpalazzo@frontlineii.com
Products: Used cooking oil automated system (equipment only)
Region: Eastern

Gainesville Welding & Rendering Equipment
37 Henry Grady Highway
Dawsonville, GA 30534-9802
www.gwrendering.com
Contact: Terry Stephens
Phone: 706-216-2666
Fax: 706-216-4282
E-mail: gwrenderingequipment@windstream.net
Region: Eastern

Genesis III Inc.
P.O. Box 186
5575 Lyndon Road
Prophetstown, IL 61277
www.g3hammers.com
Contact: Jonathan Paul
Phone: 815-537-7900 or 866-376-7900
Fax: 815-537-7905
E-mail: jonathan.paul@g3hammers.com
Products: Hammermills and parts
Region: Central

Haarslev Inc.
9700 NW Conant Avenue
Kansas City, MO 64153
www.haarslev.com
Contact: Hans H. Nissen
Phone: 816-799-0808
Fax: 816-799-0812
E-mail: info-usa@haarslev.com
Region: Central, Western

Industrial Hardfacing Inc.
218 E. Main Street
Lamoni, IA 50140
www.industrialhardfacing.com
Contact: Chip Millslagle
Phone: 800-247-7778
Fax: 641-784-6923
E-mail: sales@industhard.com
Region: Central

Industrial Steam
1403 SW 7th Street
Atlantic, IA 50022
www.industrialsteam.com
Contact: Jeremy Zellmer
Phone: 712-243-5300
E-mail: jzellmer@industrialsteam.com
Products: Deaerators, firetube boilers, and high pressure condensate systems
Region: Central

Leem Filtration
25 Arrow Road
Ramsey, NJ 07446
www.leemfiltration.com
Contact: Bill Boyd
Phone: 813-653-9006
Fax: 813-685-3382
Products: Filtration equipment
Region: Eastern

MAC Trailer Mfg.
14599 Commerce Street
Alliance, OH 44601
www.mactrailer.com
Contact: Joe Dennis
Phone: 330-823-9900
Fax: 330-823-0232
Region: Eastern

Martin Sprocket & Gear
3600 McCart Street
Ft. Worth, TX 76110
www.martinsprocket.com
Contact: Juan Fletes
Phone: 817-258-3000
Fax: 817-258-3173
E-mail: jfletes@martinsprocket.com
Products: Bulk material handling and mechanical power transmission equipment
Region: Central

MMI Tank and Industrial Services
3240 S. 37th Avenue
Phoenix, AZ 85009-9700
www.mmitank.com
Contact: Steve Denny
Phone: 602-272-6000
Fax: 602-272-6700
E-mail: steve@mmitank.com
Products: Manufacture/Install carbon steel/stainless steel tanks, repair/replace cooker shafts, screw conveyors/presses, dryers, grinders, boilers, etc.
Region: Western

Olson Manufacturing/ V-Ram
620 S. Broadway
Albert Lea, MN 56007-4526
www.vram.com
Contact: Jeff Hall
Phone: 507-373-3996
Fax: 507-373-5937
E-mail: jeff@vram.com
Region: Central

Olymspan US Branch
Changzhou Olymspan Thermal Energy Equipment Co. Ltd.
659 E. 1250 S
Providence, UT 84332
www.olymspan.com
Contact: Tina Feng
Phone: 970-430-1289
E-mail: tina.feng@olymspan.com
Products: Boilers, pressure vessels, horizontal production center, rolling machines
Region: Western

Onkens Inc.
P.O. Box 72
320 E. Main
Easton, IL 62633
www.onkens.net
Contact: David Hull
Phone: 309-562-7271
Fax: 309-562-7272
E-mail: dhull@onkens.net
Products: Truck bodies, trailers, and bulk grease containers
Region: Central, Eastern, Western

Orthman Conveying Systems
P.O. Box B
Lexington, NE 68850
www.orthman.com
Contact: Jimmy Rios
Phone: 817-542-8859
E-mail: jrios@orthman.com
Region: Central

Par-Kan Company
2915 W 900 S
Silver Lake, IN 46982
www.par-kan.com
Contact: Kyle Bruner
Phone: 260-352-2141
Fax: 260-352-0701
E-mail: kbruner@par-kan.com
Products: Grease containers/lids
Region: Central

Phelps Fan LLC
P.O. Box 190718
Little Rock, AR 72219-0718
www.phelpsfan.com
Contact: Harold Specht
Phone: 501-568-5550
Fax: 501-568-3363
E-mail: hspecht@phelpsfan.com
Region: Central

Rendeq Inc.
1813 Frank S. Holt Drive
Burlington, NC 27215
www.rendeq.com
Contact: Mark DeWeese
Phone: 336-226-1100
Fax: 336-270-5357
E-mail: info@rendeq.com
Region: Eastern

Roll Rite LLC
650 Industrial Drive
Gladwin, MI 48624
www.rollrite.com
Contact: James Kenyon
Phone: 989-896-1111
Fax: 989-345-7805
E-mail: jamesk@rollrite.com
Products: Automated tarp system for trucking industry
Region: Central

RW Manufacturing
P.O. Box 599
Stuttgart, AR 72026
www.rwmfginc.com
Contact: Shane Sweetin or Randy Sweetin
Phone: 870-673-7226
Fax: 870-673-6131
E-mail: ssweetin@rwmfginc.com or rsweetin@rwmfginc.com
Products: Replacement parts for hammer mills and shakers
Region: Central

Saeplast Americas Inc.
100 Industrial Drive
Saint John, NB, E2R 1A5
Canada
www.saeplast.com
Contact: Mike Kilpatrick
Phone: 506-633-0101
Fax: 506-658-0227
E-mail: mike.kilpatrick@promens.com
Products: Plastic containers
Region: Eastern

Scan American Corp.
9505 N. Congress Avenue
Kansas City, MO 64153
www.scanamcorp.com
Contact: Jeff Drake
Phone: 816-880-9321
Fax: 816-880-9343
E-mail: jdrake@scanamcorp.com
Products: Pumps, cookers, presses, driers, grinders, coagulators, crushers, mixers
Region: Central

Seepex Inc.
Seeberger Gmbh
511 Speedway Drive
Enon, OH 45323
www.seepex.com
Contact: Aaron Renick
Phone: 937-864-7150
Fax: 937-864-7157
E-mail: arenick@seepex.net
Products: Aseptic designs for food processing
Region: Eastern

Sturtevant Inc.
348 Circuit Street
Hanover, MA 02339
www.sturtevantinc.com
Contact: Steve Marshall
Phone: 781-829-6501
Products: Air classifier separator for poultry meal
Region: Eastern

Summit Trailer Sales Inc.
One Summit Plaza
Summit Station, PA 17979
www.summittrailer.com
Contact: Chuck Pishock
Phone: 570-754-3511
Fax: 570-754-7025
E-mail: chuck@summittrailer.com
Region: Eastern

Superior Process Technologies
1915 Broadway Street NE
Minneapolis, MN 55413
www.superiorprocesstech.com
Contact: Doug Smith
Phone: 612-378-0800
Fax: 702-975-5758
Products: Biodiesel production
Region: Central

Titus Inc.
9887 6 B Road
Plymouth, IN 46563
www.titusinc.com
Contact: Tom Read
Phone: 574-936-3345
Fax: 574-936-3905
E-mail: tread@titusinc.com
Products: Titus II grinder
Region: Central, Eastern

Travis Body and Trailer Inc.
13955 FM 529
Houston, TX 77041
www.travistrailers.com
Contact: C.K. (Bud) Hughes
Phone: 713-466-5888 or 800-535-4372
Fax: 713-466-3238
E-mail: info@travistrailers.com
Products: Trailer manufacturer
Region: Central

Uzelac Industries Inc.
6901 Industrial Loop
Greendale, WI 53129
www.uzelacind.com
Contact: Michael Uzelac
Phone: 414-529-0240
Fax: 414-529-0362
E-mail: mike@uzelacind.com
Products: Duske drying systems
Region: Central

Virginia Truck Center
P.O. Box 96
Weyers Cave, VA 24486
www.virginiatruckcenter.com
Contact: Greg Witt
Phone: 540-453-1003
Fax: 540-234-0997
E-mail: gwitt@virginiatruckcenter.com
Region: Eastern

Walinga USA Inc.
1190 Electric Avenue
Wayland, MI 49348
www.walinga.com
Contact: Terry Medemblik
Phone: 800-466-1197
Fax: 616-877-3474
E-mail: tjm@walinga.com
Products: Collection vehicles
Region: Eastern

Equipment - Centrifuges

Centrifuge Chicago Corporation
1721 Summer Street
Hammond, IN 46320
www.centrifugechicago.com
Contact: Doug Rivich
Phone: 219-852-5200
Fax: 219-852-5204
E-mail: doug@centrifugechicago.com
Products: Repair, parts, service
Region: Central

Centrisys Corporation
9586 58th Place
Kenosha, WI 53144
www.centrisys.us
Contact: Michele Whitfield
Phone: 262-654-6006
Fax: 262-764-8705
E-mail: info@centrisys.com
Region: Western

CentriTEK - Industrial Centrifuge Specialists
Chris Gatewood Industries Inc.
77 Solano Square, #303
Benicia, CA 94510
www.centritek.us
Contact: Chris Gatewood
Phone: 209-304-2200
E-mail: chris@centritek.com
Region: Western

Elgin Separation Solutions
Elgin Equipment Group
10050 Cash Road
Stafford, TX 77477
www.elginseparationsolutions.com
Contact: Raymond Pietramale
Phone: 281-261-5778
Fax: 281-499-4080
E-mail: ray.pietramale@elginindustries.com
Region: Central

GEA Westfalia Separator
100 Fairway Court
Northvale, NJ 07647
www.wsus.com
Contact: Rawn Walley
Phone: 201-767-3900
Fax: 201-767-3416
E-mail: info.wsus@geagroup.com
Region: Eastern

GreySun Equipment Company
3102 Avenue M Ex
Conroe, TX 77301
www.greysuncentrifugerental.com
Contact: Kye Keliehor
Phone: 936-524-5162
Fax: 936-494-3897
E-mail: cbrock@greysunrentals.com
Region: Central

GTech
2511 N. Frazier Street
Conroe, TX 77305
www.gtechus.com
Contact: Dennis Edwards
Phone: 281-290-9229
Fax: 936-494-0012
E-mail: dennis.edwards@gtechus.com
Region: Central

Industrial Process Equipment
Centrifugal Services LLC
312 C Street
St. Albans, WV 25177
Contact: Chad Dillon
Phone: 304-727-6652
Fax: 304-201-4395
E-mail: chad.dillon@elginindustries.com
Region: Eastern

Jenkins Centrifuge Company LLC
1123 Swift Street
North Kansas City, MO 64116
www.jenkinscentrifuge.com
Contact: Kevin Jenkins or Cam Kirkpatrick
Phone: 800-635-1431
Fax: 816-471-6692
E-mail: kjenkins@jenkinscentrifuge.com or ckirkpatrick@jenkinscentrifuge.com
Products: Rebuild centrifuges, buy and sell equipment, manufacture horizontal centrifuges
Region: Central, Eastern, Western

Kayden Industries LP
3348 58th Avenue SE
Calgary, AB, T2C 0B3
Canada
www.kaydenindustries.com
Contact: Mark Oscienny
Phone: 403-571-6688
Fax: 403-264-5901
E-mail: moscienny@kaydenindustries.com
Region: Eastern

Separators Inc.
5707 W. Minnesota Street
Indianapolis, IN 46241
www.separatorsinc.com
Contact: Bill Otter
Phone: 317-484-3745
Fax: 317-484-3755
E-mail: separate@sepinc.com
Region: Central, Eastern

Equipment - Repair

Brown's Milling Supply Inc.
P.O. Box 500
Alma, NE 68920
www.brownssupply.com
Contact: Mike Stemper
Phone: 402-721-7899
Fax: 866-313-2256
E-mail: billing@brownssupply.com
Region: Central

Cen-Tex Centrifuge LLC
16505 I-45 South
Willis, TX 77318
www.cen-tex.net
Contact: Jeremy Files
Phone: 281-914-2516
Fax: 936-344-2152
E-mail: jfiles@cen-tex.net
Region: Central

MDH Boiler Service & Repair Inc.
12106 S. Center Street
South Gate, CA 90280
Contact: Mauro Donate
Phone: 562-630-2875
Fax: 562-630-2595
E-mail: mdonate@mdhboiler.com
Region: Western

Exporters

Fornazor International Inc.
455 Hillsdale Avenue
Hillsdale, NJ 07642
www.fornazor.com
Contact: John Fornazor
Phone: 201-664-4000
Fax: 201-664-3222
E-mail: john@fornazor.com
Region: Eastern

International Feed
P.O. Box 280
2075 Daniels Street
Long Lake, MN 55356
www.internationalfeed.com
Contact: Derek Michalski or Bernie Kaiser
Phone: 952-249-9818
E-mail: dmichalski@internationalfeed.com or berniek@internationalfeed.com
Products: Supplier/Exporter of animal protein meals
Region: Central

Feed Manufacturers/ Ingredients

Boyer Valley Company
LGI Company
2425 S.E. Oak Tree Court
Ankeny, IA 50021
www.boyervalley.com
Contact: Steve Lankford
Phone: 515-289-7666
Fax: 515-289-4369
E-mail: steve.lankford@boyervalley.com
Products: PBM,BM,FM,YG
Region: Central

Feed Energy Company
4400 E. University Ave
Pleasant Hill, IA 50327
www.feedenergy.com
Contact: Joe Green
Phone: 800-451-9413
Fax: 515-265-4163
E-mail: sales@feedenergy.com
Products: BLF,FA,FGAF,RF,SF
Region: Central

International Ingredient Corporation
150 Larkin Williams Industrial Court
Fenton, MO 63026
www.iicag.com
Contact: Kevin M. Halpin
Phone: 636-343-4111
Fax: 636-349-4845
E-mail: khalpin@iicag.com
Products: Specialty ingredients
Region: Central

International Nutrition
P.O. Box 27540
Omaha, NE 68127
www.ini-agworld.com
Contact: Steve Silver
Phone: 402-331-0123
Fax: 402-331-0169
E-mail: info@ini-agworld.com
Region: Central

Mid-South Milling Company
710 Oakleaf Office Lane
Memphis, TN 38117
www.msmilling.com
Contact: Nathan Pappas
Phone: 901-681-4301
Fax: 901-681-4337
E-mail: npappas@msmilling.com
Region: Eastern, Central

Nutra-Flo Protein Products
202 North Derby Lane
North Sioux City, IA 57049
www.nfprotein.com
Contact: Eric J. Lohry
Phone: 712-279-1938
Fax: 712-279-1973
Products: Animal protein producer
Region: Central

Nutrient Concepts Inc.
500 Cathedral, Suite 2325
Aptos, CA 95001
Contact: Jerry Ball
Phone: 209-481-3943
Fax: 888-761-8927
E-mail: ball.jerry@sbcglobal.net
Region: Western

P&G Pet Care
Procter and Gamble
8700 Mason-Montgomery Road
Mason, OH 45040
www.iams.com
Contact: Greg Daniel
Phone: 513-622-0774
Fax: 513-945-2798
E-mail: daniel.gd.2@pg.com
Products: Dog/Cat food
Region: Eastern

Papillon Agriculture Company
30 N. Harrison Street, Suite 204
Easton, MD 21601
www.papillon-ag.com
Contact: Brenda Roop
Phone: 401-820-7400
E-mail: brenda@papillon-ag.com
Products: Bypass protein products for dairy industry.
Region: Eastern

Premier Ag Resources Ltd.
747 Hyde Park Road, Suite 205
London, ON, Canada N6H 3S3
www.parltd.ca
Contact: Paul Primeau
Phone: 519-657-1177
E-mail: pprimeau@parltd.ca
Region: Eastern

The Peterson Company
6312 W. Main
Kalamazoo, MI 49009
www.thepetersoncompany.com
Contact: Leigh Ann Sayen
Phone: 269-350-2900
E-mail: leighanns@thepetersoncompany.com
Region: Eastern

Financial/ Professional Services

Marsh
Marsh McLennan Companies
777 South Figueroa Street
Los Angeles, CA 90017
www.marsh.com
Contact: Richard B. Cook
Phone: 213-346-5323
Fax: 213-346-5928
E-mail: dick.cook@marsh.com
Region: Western

Williams Mullen
1441 Main Street, Suite 1250
Columbia, SC 29201
www.williamsmullen.com
Contact: Ethan Ware
Phone: 803-567-4610
E-mail: eware@williams-mullen.com
Products: Law firm
Region: Eastern

Laboratory/Testing

Crystal Laboratory
242 Hwy 60 E, Suite 2
P.O. Box 829
Lake Crystal, MN 56055
Contact: Steve Marsh
Phone: 507-726-2387
Fax: 507-726-2388
E-mail: smarsh507@gmail.com
Region: Central

Diversified Laboratories Inc.
4150 Lafayette Center Drive, Suite 600
Chantilly, VA 20151
www.diversifiedlaboratories.com
Contact: Peter Kendrick
Phone: 703-222-8700
Fax: 703-222-0786
E-mail: pkendrick@diversifiedlaboratories.com
Region: Eastern

Eurofins Scientific Inc.
2200 Rittenhouse Street, Suite 150
Des Moines, IA 50321
www.eurofinsus.com
Contact: Lars Reimann
Phone: 901-301-8425
E-mail: larsreimann@eurofinsus.com
2219 Lakeshore Drive, Suite 500
New Orleans, LA 70122
Contact: Christine McIntosh
Phone: 504-297-3400
E-mail: christinemcintosh@eurofinsus.com
Region: Central

FOSS North America
8091 Wallace Road
Eden Prairie, MN 55344
www.foss.us
Contact: Tim Welby
Phone: 800-547-6275
Fax: 952-974-9823
E-mail: twelby@fossna.com
Region: Central

NP Analytical Laboratories
Checkerboard Square
St. Louis, MO 63164
www.npal.com
Contact: Judy O'Brien
Phone: 314-982-2193
Fax: 314-982-1078
E-mail: jobrien@purina.com
Region: Central

Thionville Laboratories Inc.
Thionville Surveying Co. Inc.
5440 Pepsi Street
New Orleans, LA 70123
Contact: Paul Thionville
Phone: 504-733-9603
Fax: 504-733-6457
E-mail: operations@thionvillenola.com
Region: Central

Whitbeck Laboratories Inc.
1000 Backus Avenue
Springdale, AR 72764
www.whitbecklabs.com
Phone: 800-874-8195
E-mail: info@whitbecklabs.com
Region: Central

Samplers and Surveyors

Cullen Maritime Services Inc.
465 46th Street
Richmond, CA 94805-2301
Contact: John Spenik
Phone: 510-232-6700
Fax: 510-232-6766
E-mail: cmssfo@pacbell.net
2126 E. 7th Street
Long Beach, CA 90804
Contact: John Spenik
Phone: 562-433-4355
Fax: 562-433-3457
E-mail: john.spenik@cullenmaritime.com
9317 232nd Street SW
Edmonds, WA 98020-5026
Contact: Craig Burgess
Phone: 206-783-6979
Fax: 206-783-6913
Region: Western

Trade Groups/Journals

American Feed Industry Association
2101 Wilson Boulevard, Suite 916
Arlington, VA 22201
www.afia.org
Contact: Joel G. Newman
Phone: 703-524-0810
Fax: 703-524-1921
E-mail: jnewman@afia.org
Region: Eastern

Pet Food Institute
2025 M Street NW, Suite 800
Washington, DC 20036
www.petfoodinstitute.org
Phone: 202-367-1120
Fax: 202-367-2120
Region: Eastern

Poultry Protein and Fat Council
1530 Cooledge Road
Tucker, GA 30084
www.uspoultry.org/ppfc_index.cfm
Contact: Rafael Rivera
Phone: 678-514-1978
Fax: 770-493-9257
E-mail: rrivera@uspoultry.org
Region: Eastern

Western United Dairymen
1017 L Street, Suite 582
Sacramento, CA 95814
www.westernuniteddairymen.com
Contact: Gary Conover
Phone: 916-492-0892
Fax: 916-492-1645
E-mail: gary@garyconover.com
Products: California dairy milk producer/trade organization
Region: Western

Other

Anitox
1055 Progress Circle
Lawrenceville, GA 30043
www.anitox.com
Contact: John Putnam
Phone: 678-376-1055
Fax: 678-376-1413
E-mail: jputnam@anitox.com
Products: Pathogen control, milling efficiency
Region: Eastern

ALG Labels & Graphics
3005 4th Avenue South
Birmingham, AL 35233
www.alggraphics.com
Contact: Wilson Pirtle
Phone: 205-313-5135
Fax: 205-328-0123
E-mail: wpirtle@alggraphics.com
Region: Eastern

Arreff Terminals Inc.
Fornazor International Inc.
3600 Elm Avenue
Portsmith, VA 23704
Contact: Noel Smith
Phone: 757-393-2730
Fax: 757-393-2899
Products: Bulk transloading/bagging
Region: Eastern

BIS Computer Solutions Inc.
2428 Foothill Boulevard
La Crescenta, CA 91214
Contact: Veronika Pitross
Phone: 818-248-5023
Fax: 818-249-1169
E-mail: veronikap@biscomputer.com
Products: Software design
Region: Western

Bruker Optics
19 Fortune Drive
Billerica, MA 01821
www.brukeroptics.com
Contact: Nancy Wright-Ross
Phone: 978-439-9899
Region: Eastern

Caito Fisheries Inc.
P.O. Box 2415
San Francisco, CA 94126
Contact: Jeanette Caito
Phone: 415-441-2121
Fax: 415-441-2221
E-mail: caitosf@mcn.org
Products: Seafood processor
Region: Western

Chemol Company Inc.
P.O. Box 16286
Greensboro, NC 27416
www.chemol.com
Contact: Fred Wellons
Phone: 336-333-3050
E-mail: fred@chemol.com
Products: Bio-based and bio-renewable chemicals from animal fats and vegetable oils
Region: Eastern

Countryside Hides Inc.
Boston Hides and Furs
10261 Twin Angela Lane
Alma Center, WI 54611
Contact: Sidney Erickson
Phone: 715-964-5021
Fax: 715-964-5023
E-mail: cowboycountryside@gmail.com
Products: Dead stock removal, pet food, hides
Region: Central

FaegreBD Consulting
1050 K Street NW, Suite 400
Washington, DC 20001
www.faegrebdc.com
Contact: Andy Ehrlich
Phone: 202-312-7400
Fax: 202-312-7461
E-mail: andy.ehrlich@faegrebd.com
Products: Legal Counsel
Region: Eastern

Farmland Foods
P.O. Box 20121, Dept. 122
Kansas City, MO 64195
www.farmlandfoods.com
Contact: Robert Eastep
Phone: 816-713-7878
Fax: 816-713-7700
E-mail: rleastep@farmland.com
Products: Beef/pork packers
Region: Central

High Performance Systems Corp.
107-3 Cramer Ave
Dunellen, NJ 08812
www.highperfsystems.com
Contact: Jeffrey Smedley
Phone: 908-377-4111
Fax: 908-279-7021
E-mail: highperfsystems@yahoo.com
Region: Eastern

Jacob Stern & Sons Inc.
2104 75th Street
Houston, TX 77011
Contact: Jay Van Valen or Jeffrey Peeler
Phone: 713-926-8386
Fax: 713-926-8128
E-mail: jvanvalen@tx.jacobstern.com or jeffp@tx.jacobstern.com
Products: Tallow
Region: Central

Jacobsen Publishing
1123 W. Washington Boulevard, Floor 3
Chicago, IL 60607
www.thejacobsen.com
Contact: Ryan Standard
Phone: 312-726-6600
Fax: 312-726-6654
E-mail: ryan@thejacobsen.com
Region: Central

Kappa Products Corp.
1301 E. 99th Street
Chicago, IL 60628-1697
Contact: Paul Stern
Phone: 773-374-0600
Fax: 773-374-5625
Products: Animal and vegetable oils producers
Region: Central

Olymel S.E.C.
2200 Avenue Pratte
Bureau 400
St-Hyacinthe, QB, J2S 4B6
Canada
www.olymel.ca
Phone: 450-771-0400
Fax: 450-771-4872
E-mail: ClaudeBourgault@olymel.com
Products: Meat processor
Region: Eastern

Renewable Energy Group
416 S. Bell Avenue
P.O. Box 888
Ames, IA 50010
www.regfuel.com
Contact: Dave Elsenbast
Phone: 515-239-8117
E-mail: dave.elsenbast@regi.com
Products: Biodiesel production, feedstock procurement, marketing
Region: Central

Southwest Hide Co.
9207 W. Blackeagle Drive
Boise, ID 83709
www.southwesthide.com
Contact: John Rueb
Phone: 208-378-8000
Fax: 208-377-9069
E-mail: jr@southwesthide.com
Products: DL,EX,HI
Region: Central, Western

Stolt-Nielsen USA Inc.
Stolt Tankers B.V.
800 Connecticut Avenue, 4th Floor East
Norwalk, CT 06856
www.stolt-nielsen.com
Contact: Gary Kolachovsky
Phone: 203-838-7100
Fax: 203-299-0067
Region: Eastern

Sustainable Sourcing LLC
19633 LaGrange Road
Mokena, IL 60448
www.sustainablesourcingllc.com
Contact: David Ciarlette
Phone: 815-714-8055
Fax: 812-645-1830
E-mail: rosanne.crockett@sustainablesourcingllc.com
Products: Sustenance (food) for probiotic (animal) processes
Region: Central

Universal Maintenance Inc.
P.O. Box 104
Murrayville, GA 30564
www.universalmaintenance.com
Contact: Jessica Colbert
Phone: 706-297-0087
Fax: 706-297-0088
E-mail: jessica@bellsouth.net
Products: General contractor
Region: Eastern

Val-U-Meat Pkg
2107 So. Milliken
Ontario, CA 91761
Contact: Steve Stiles
Phone: 909-390-9828
Fax: 909-390-9833
E-mail: stevestiles@dslextreme.com
Products: Dead stock removal - dairy
Region: Western

Validus
A division of Where Food Comes From Inc.
10538 Justin Drive
Urbandale, IA 50322
www.validusservices.com
Contact: Brian Bennett
Phone: 571-830-6603
Fax: 703-563-6027
E-mail: bennettb@validusservices.com
Products: Professional services
Region: Central

Wells Fargo Food and Agribusiness
7000 Central Parkway, Suite 580
Atlanta, GA 30328
www.wellsfargo.com
Contact: Jim Nutt
Phone: 770-551-4678
Fax: 770-551-5139
E-mail: james.h.nutt@wellsfargo.com
Region: Eastern

Worcester Industrial Products
7 Brookfield Street
Worcester, MA 01605
www.shortening-shuttle.com
Contact: Martha Hawley
Phone: 800-533-5711
Fax: 508-831-9990
E-mail: mhawley@shortening-shuttle.com
Products: Grease transport
Region: Eastern

Associate Members by Alphabetical

Full listing is available on indicated page number.

AC Corporation 33
Agri Trading 32
Alfa Laval Inc. 33
ALG Lables & Graphics 37
Alloy Hardfacing & Eng. 33
Ameri-Pac Inc. 31
American Feed Industry 37
Anco-Eaglin Inc. 33
Anderson Chemical Co. 32
Anitox 37
Arreff Terminals Inc. 37
Artex Manufacturing 33
Aulick Chemical Solutions 31
BIS Computer Solutions 37
Bluestar Silicones 32
Bolton & Menk Inc. 33
Boyer Valley Company 36
Brown Industrial Inc. 33
Brown's Milling Supply Inc. 35
Bruker Optics 37
Cablevey Conveyors 33
Caito Fisheries Inc. 37
Caldic USA 31
CCI 32
Cen-Tex Centrifuge 36
Centrifuge Chicago Corp. 35
Centrisys Corporation 35
CentriTEK 35
C.F. Zeiler & Company Inc. 31
CFS North America LLC 31
Chem-Aqua Inc. 31
Chem-Tech Solutions Inc. 32
Chemol Company Inc. 37
Chemtron Corporation 31
Clean Water Technology 31
Cleaning Systems Inc. 32
Consolidated Fabricators 34
Countryside Hides Inc. 37
Croda Inc. 32
Crystal Laboratory 36
CST Storage 31
Cullen Maritime Services 37
D.A. Lorentzen Inc. 32
Decom Inc. 32
DGA & Associates 34
Diversified Laboratories 36
Dupps Company 34
Dupps Separation 34
Dupre Logistics LLC 32
Dura Cast Products Inc. 32
E.B. Wakeman Company 32
Elgin Separation Solutions 35
Energy Management 33
Eurofins Scientific Inc. 36
FaegreBD Consulting 37
Farmland Foods 37
Feed Energy Company 36
FoodSafe Technologies 31
Fornazor International Inc. 36
FOSS North America 36
FRC Systems 31
Frontline International Inc. 34
Gainesville Welding 34
Garratt-Callahan Company 31
Gavilon Ingredients LLC 32
GEA Westfalia Separator 35
Genesis III Inc. 34
Gersony Strauss Company 32
GHD Services Inc. 33
Greentree Logistics Inc. 32
GreySun Equipment 35
GTech 35
Haarslev Inc. 34
High Performance Systems 37
Hurley Brokerage Inc. 32
Hydro Solutions Inc. 32
Impact Cleaning/DuBois 32
Industrial Hardfacing Inc. 34
Industrial Process Equipment 35
Industrial Steam 34
International Feed 36
International Ingredient Corp. 36
International Nutrition 36
Jacob Stern & Sons Inc. 37
Jacobsen Publishing 37
Jenkins Centrifuge Co. 35
Kappa Products Corp 37
Kayden Industries LP 35
Kemin Nutrisurance Inc. 31
Kusters Water 31
Leem Filtration 34
LNL Trucking Inc. 32
Lock America International 34
MAC Trailer Mfg. 34
Marsh 36
Martin Sprocket & Gear 34
MDH Boiler Service 36
Mid-South Milling Company 36
Mini Bruno North America 32
Mirasco Inc. 32
MMI Tank and Industrial 34
National Grease Recycling 33
NCM Odor Control 31
Noble America's Energy 33
Novus International Inc. 31
NP Analytical Laboratories 36
Nutra-Flo Protein Products 36
Nutrient Concepts Inc. 36
Olson Manufacturing/V-Ram 34
Olymel S.E.C. 37
Olymspan US Branch 34
Onkens Inc. 34
Orthman Conveying 34
P&G Pet Care 36
Papillon Agricultural 36
Par-Kan Company 34
Parkson Corp. 31
Pasternak, Baum & Co. 33
Paul Marcotte Farms Inc. 32
Peak Tech Inc. 31
Perdue Agribusiness 33
Pet Food Institute 37
Phelps Fan LLC 34
POET Nutrition 33
Poultry Protein & Fat Council 37
Praedium Ventures 33
Premier Ag Resources 36
Reid Engineering Company 33
Rendeq Inc 34
Renewable Energy Group 37
Rensin International 31
Roll Rite LLC 34
RW Manufacturing 35
Saeplast Americas Inc. 35
Scan American Corp. 35
Scoular 33
SCP Control Inc. 31
Seepex Inc. 35
Separators Inc. 35
Southwest Hide Co. 37
Steen Research LLC 31
Stoller Trucking Inc. 32
Stolt-Nielsen USA Inc. 37
Sturtevant Inc. 35
Summit Trailer Sales Inc. 35
Sunbelt Commodities Inc. 33
Superior Process Technologies 35
Sustainable Sourcing LLC 37
T-Haul Tank Lines 32
The Peterson Company 36
Thionville Laboratories 37
Third Coast Commodities 33
Titus Inc. 35
Travis Body and Trailer Inc. 35
Universal Maintenance 38
Universal Green Consultants 33
Uzelac Industries LLC 35
Val-U-Meat Pkg 38
Vantage OleoChemical 32
Videka 31
Virginia Truck Center 35
Validus 38
VanAire Inc. 31
Walinga USA Inc. 35
Wells Fargo Food 38
Western United Dairymen 37
Whitbeck Laboratories Inc. 36
Wilbur-Ellis Feed Division 33
Wilks & Topper Inc. 33
Williams Mullen 36
Worcester Industrial Products 38
W.W.S. Inc. 33

2017 International Active Members

Akiolis Group
72 Avenue Olivier Messiaen
Le Mans, 72000 France
www.akiolis.com
Contact: Stephan Grawitz
Phone: 32-244-81-5010
Fax: 32-244-81-5012
E-mail: stephan.grawitz@akiolis.com
Products: BM,CM,FM,PM,MB, MM,PF,SF,TG,YK

Bachoco S.A. de C.V.
AV. Tecnologico #401 CD. Industrial
Celaya, Guanajuato, 38010 Mexico
www.bachoco.com
Contact: Juan Alejandro Hernandez Ripalda
Phone: 46-1618-3593
E-mail: juan.hernandez@bachoco.net
Products: BM,FM,PM,PB,PF

Daka Denmark A/S
Dakavej 10
Loesning, 8723 Denmark
www.daka.dk
Contact: N.C. Leth Nielsen
Phone: 45-5156-4600
Fax: 45-7928-4008
E-mail: ln@daka.dk
Products: SF,TG,HI,EX,MM,MB, BM,FGAF

Harinas de Minatitlan S.A. de C.V.
San Jose S/N - A. Col. Nueva Mina
Minatitlan, Veracruz, 96760 Mexico
www.harinasdeminatitlan.com
Contact: Andres Arbesu Lago
Phone: 922-221-0909
Fax: 922-221-0908
E-mail: arbesu1@prodigy.net.mx
Products: MB,Tallow

Jabon y Grasas S.A. de C.V.
Cerrada Rafael Angel de la Peña #247
INT 1 Colonia Transito
Mexico City, Distrito Federal, 06820 Mexico
www.jabonygrasas.com.mx
Contact: Rodrigo Gonzalez Lopez or Andres Gonzalez Lopez
Phone: 52-55-5788-8614
Fax: 52-55-5788-8614
E-mail: rgonzalez@jygsa.com.mx, agonzalez@jygsa.com.mx
Products: Horn/hoof meal, TG

Peerless Holdings Pty. Ltd.
21 Evans Street
Braybrook, Victoria, 3019 Australia
Contact: Julius Rath
Phone: 613-9214-7777
Fax: 613-9318-2396
Products: TG,MB,BM,FM

Productos para Aves y Animales S.A. de C.V.
Porvenir 67, Los Olivos, Del Tlahuac
Mexico City, D.F., 13210 Mexico
Contact: Eduardo Lopez
Phone: 52-555-845-0126
Fax: 52-555-845-0127
Products: MB,Animal fat

Render Grases S.L.
Ctra. SE-3410 KM 3
Salteras, Sevilla, 41909 Spain
www.rendergrasas.es
Contact: Maria Pabon
Phone: 34-902-26-00-10
E-mail: mariapabon@rendersur.net
Products: PM,Animal fat

Rengra - Rendimientos Grasos
Rengra SA de CV
Km 7.5 Carretera Monterrey Monclova int "B"
El Carmen, Nuevo Leon 66550 Mexico
www.rengra.com.mx
Contact: Fernando Mendizabal Fernandez
Phone: 52-818-1543220
Fax: 52-818-1543216
E-mail: fmf@rengra.com.mx
Products: MBM,YG,Technical grade tallow

Ryco Jamaica Ltd.
P.O. Box 239
Mandeville, Manchester
Jamaica W.I.
www.rycoja.com
Contact: Kevin Mullane
Phone: 876-987-1891
Fax: 876-987-1629
E-mail: rycoja@aol.com
Products: PB,YG,PF

SARIA Bio-Industries AG & Co. KG
Werner Str. 95
Selm, 59379 Germany
www.saria.com
Contact: Dr. Kurt Stoffel
Phone: 49-2592-210-258
Fax: 49-2592-210-124
E-mail: kurt.stoffel@saria.com
Products: EX,FM,PB,RF,SF,TG, HI,MM,MB,BM,BFP,ET,FGAF, CM,PF,PM,YG

ZheJiang Biomass Solutions Co. Ltd
25th Floor Global Center
19 West Lake Culture Plaza
Hangzhou, 310014 PR China
www.cnbioms.com
Contact: Jim Zhao
E-mail: msn572@hotmail.com
Phone: 86-571-85268601
Fax: 86-571-88333322
Products: OT

2017 International Associate Members

Agro Commercial Terramar Chile
Carretera Goal.
San Martin 13240 Paradero Colina, Santiago, 74340000 Chile
www.terramar-chile.com
Contact: Sacha Ilic
Phone: 56-2-860-8212
E-mail: sacha.ilic@terramar-chile.com

ChinaFeedOnline.com
15th Floor, Radio City
505 Hennessy Road
Causeway Bay, Hong Kong
www.chinafeedonline.com
Contact: Christine Wang
Phone: 852-2871-0708
Fax: 852-2871-0950
E-mail: hk@21cfo.com
Products: China market information service

Compania Scoular de Mexico S de R.L. de C.V.
Ave. Acueducto No. 4851
Piso 3 Oficina 2
Col. Puerta de Hierro
Zapopan, Jalisco, 45116 Mexico
www.scoular.com
Contact: Rodolfo Sanchez
Phone: 52-33-3679-3000
Fax: 52-33-3630-4807
E-mail: rsanchez@scoular.com
Products: Commodities broker

De Smet Rosedowns Ltd.
Cannon St.
Hull East Yorkshire, HU2 0AD England
www.rosedowns.co.uk
Phone: 44-1482-329864
Fax: 44-1482-325887
E-mail: rosedowns@desmetgroup.com

FMC International Corp.
11th Floor, No. 866-1, Chung Cheng Road
Chung-Ho City, Taipei Hsien
Taiwan, 235 China
Contact: Slim Chou
Phone: 886-2-8221-2666 x10
E-mail: fmc@fmcintco.com

Guandong Guonon Economic & Trade Co. Ltd.
Rm. F, 18/F, Mingyue Ge
Mingyeu One Road
Wuyang New City
Guangzhou, Guangdong 510600 China
www.guo-nong.com
Contact: Helen Zhou
Phone: 86-20-87358081
Fax: 86-20-87358082
Products: Purchaser of US/Canadian proteins, YG, and T

Haarslev Industries A/S
Bogensevej 85
P.O. Box 65
Bogense, DK 5400 Denmark
www.haarslev.com
Contact: Tony Johnson
Phone: 45-63-83-1100
Fax: 45-63-83-1120
E-mail: info@haarslev.dk

Keith Engineering (Australia) Pty. Ltd.
P.O. Box 354
St. Clair, NSW, 2759 Australia
www.keitheng.com.au
Contact: Derek Henderson
Phone: 612-9852-1000
Fax: 612-9852-1001
E-mail: admin@keitheng.com.au

Marpar SA
Pampa 1007
Valentin Alsina, BA, Argentina
1822
www.mapar.com.ar
Contact: Jaime Sasson
Phone: 54-114-208-7888
E-mail: jaime.sasson@
mapar.com.ar
Products: MB,Tallow

Materia Hnos SA CIF
Int. Camusso 1364
Mar Del Plata, Buenos Aires
Argentina 7600
www.materiaoleochemicals.com
Contact: Vicente Materia
Phone: 54-223-499-3000
Products: Oleochemicals

MJI Universal Pte Ltd.
133 Cecil Street, #11-01A
01B Keck Seng Tower
Singapore 069535
Contact: Johnny Hooi
Phone: 65-622-06676
Fax: 65-622-06678
E-mail: johnhooi@
mjiuniversal.com
Products: MB,FM,PM,BM

Natural Agricultural Co. (WA) Ltd.
P.O. Box 3117
21 Edinburgh Road
Enugu, 400001 Nigeria
Contact: Dr. Emmanuel
Okpara
Phone: 234-8033-338210
E-mail: graobynn@yahoo.com
Products: Poultry processing,
egg supplier

Oleon nv
Assenedestraat 2
Ertvelde, 9940 Belgium
Contact: Hubert Denoose
Phone: 32-9-341-17-52
Fax: 32-9-341-17-49
E-mail: hubert.denoose@
oleon.com
Products: EQ

Proteinas Marinas y Agropecuarias S.A. de C.V.
Calle Dos Cañas 2775
La Nogalera
Guadalajara, Jalisco, 44470
Mexico
www.protmagro.com
Contact: Raul Iniguez
Phone: 52-33-38-10-21-85
Fax: 52-38-38-10-30-49
E-mail: rauliniguez@
protmagro.com
Products: DL

Shanghai Gentech Industries Group Co. Ltd.
15F, Bldg 3, Lane 90, Jiuxin
Road
Songjiang District, Shanghai
China 201615
www.gentechchina.com
Contact: Mark Rottmann
Phone: 86-021-57633535
Fax: 86-021-57632800
E-mail: mrottmann@
gentechcnina.com
Products: Importer

Stord Process AS
Liamyrane 6, 5132 Nyborg
Bergen, Norway
www.stord-as.com
Contact: Harald Nesse
Phone: 47-551-97230
Fax: 47-551-97239
E-mail: harald@stord-as.com
Products: EQ

Teampower Feed & Grains Trading Ltd.
Rm 1803-1805,
Great Eagle Centre
No 26, Harbour Road
Wanchai, Hong Kong
Contact: Pang Kong Lik
Phone: 852-2845-3000
Fax: 852-2845-7000

World Renderers Organization
Tim Juzefowicz, President
E-mail: tim.juzefowicz@
csfproteins.com.au
www.worldrenderers.org
500 Montgomery Street,
Suite 310
Alexandria, VA 22314
Contact: Nancy Foster
Phone: 703-683-0155
Fax: 571-970-2279
E-mail: nfoster@
nationalrenderers.com

NRA Headquarters and Support Offices

National Renderers Association Inc.
500 Montgomery Street,
Suite 310
Alexandria, VA 22314
www.nationalrenderers.org
Phone: 703-683-0155
Fax: 571-970-2279
E-mail: renderers@
nationalrenderers.com

Headquarters Staff
Administrative
Nancy Foster, President
Phone: 571-858-5412
E-mail: nfoster@
nationalrenderers.com

Barbara Alexander,
Administrative/Office Manager
Phone: 703-683-0155
E-mail: balexander@
nationalrenderers.com

Scientific Services
David L. Meeker, PhD, MBA,
Senior Vice President
Phone: 703-683-2633
E-mail: dmeeker@
nationalrenderers.com

International Programs
Kent Swisher, Vice President
Phone: 703-683-3561
E-mail: kswisher@
nationalrenderers.com

Communications, Science and Education
Jessica Meisinger, PhD, MBA,
Director
Phone: 703-683-2914
E-mail: jmeisinger@
nationalrenderers.com

Convention Coordinator
Covert Operations
15460 Turnberry Drive
Haymarket, VA 20169-1908
Contact: Marty Covert
Phone: 703-754-8740
Fax: 703-754-7426
E-mail: co@martycovert.com

NRA Regional Offices
Asia
21/FL., Causeway Bay
Commercial Building
1-5 Sugar Street
Causeway Bay
Hong Kong
Contact: Peng Li, PhD,
Regional Director
Teresa Hon, Admin. Assistant
Phone: 852-2890-2529
Fax: 852-2576-8045
E-mail: nrahkg@
nrahongkong.com.hk

Latin America
E-mail: nramex@
nralatinamerica.org

Animal Protein Producers Industry (APPI) Committee
P.O. Box 132
1143 C.R. 1123
Huntsville, MO 65259
Contact: Dara John, Programs
Coordinator
Ansen Pond, Darling
Ingredients, Chairman
Phone: 660-277-3469
Fax: 660-277-3466
E-mail: appi@cvalley.net

Fats & Proteins Research Foundation (FPRF)
500 Montgomery Street,
Suite 310
Alexandria, VA 22314
www.fprf.org
Contact: David L. Meeker, PhD,
MBA, Director of Research
Duane Anderson, Farmers
Union Industry, Chairman
Phone: 703-683-2633
Fax: 571-970-2279
E-mail: dmeeker@
nationalrenderers.com

Render Magazine
1621 Glen Drive
Placerville, CA 95667
www.rendermagazine.com
Contact: Tina Caparella, Editor
Phone: 530-306-6792
Fax: 530-644-8429
E-mail: editors@
rendermagazine.com

Risk Assessment for the Transmission of Foot and Mouth Disease via Movement of Swine and Cattle Carcasses from FMD-infected Premises to a Disposal Site

February 2014

UNIVERSITY OF MINNESOTA

CENTER FOR ANIMAL HEALTH AND FOOD SAFETY

Prepared by the University of Minnesota Center for Animal Health and Food Safety for West Texas A&M University under a Cooperative Agreement from USDA APHIS funded by DHS S&T

Available at: go.usdatraining.com/UMRA

Table of Contents

List of Figures 4
Abbreviations 7
Definitions 8
Executive Summary 13
1. Background 14
2. Scope 15
3. Assumptions 16
4. Overview of data analysis approaches 17
5. FMD Depopulation Procedures and Carcass Movement 19
5.1. Standard Operating Procedures for FMD Depopulation 19
5.2. Types of Transportation 23
5.3. Transportation Regulations 26
5.4. Pathway analysis for Carcass Movement 27
6. Hazard identification 28
6.1. Background 28
6.2. Virus Characteristics 29
6.3. Host range of FMD 29
6.4. Transmission 30
6.5. Incubation Period 30
6.6. Clinical Signs 31
6.7. Concentration of virus in tissues, secretions, excretions 31
6.8. Environmental Persistence 32
7. Entry Assessment 32
7.1. Likelihood that swine and cattle carcasses moved from a FMD positive premise will contain an infective dose 33
7.1.1. Time for FMD detection 34
7.1.2. Time from detection to depopulation 36
7.1.3. Number of viremic livestock after depopulation 39
7.1.4. FMDv concentration in swine and cattle viremic carcasses 41

7.2. Likelihood that transportation of carcasses will produce leakage and spillage of fluids contaminated with FMDv 47
7.2.1. Carcass fluids 47
7.2.1.1. Leachate, Leakage and Spillage 47
7.2.1.2. Amount of Carcass Fluids 48
7.2.2. Potential for Leakage and Spillage of Carcass Fluids during Movement 48
7.3. Likelihood transportation of carcasses will aerosolizae FMDv particles.....49
7.3.1. Bioaerosol Science 50
7.3.2. Bioaerosols and FMDv..... 50
7.3.3. Expert Opinion on Bioaerosolization 51
7.3.4 Potential for Aerosolization of Carcass Fluids during Movement..... 52
8. Exposure Assessment 54
9. Risk Estimation..... 54
10. Conclusions..... 54
11. Recommendations for further research 55
Acknowledgments..... 56
References:..... 57
Appendix A: Model Disease Spread..... 62
Appendix B: Bio-Zip™ Bag product information..... 65
Appendix C: Federal and State Regulations for Carcass Movement..... 70
Appendix D: Expert Opinion – Rendering 74
Appendix E: Expert Opinion – Depopulation..... 75
Appendix F: Aerosol Science 76
Appendix G: Expert Opinion – Aerosols.....78

List of Figures

Figure 1: Standard Rendering Truck with Grapple System 20

Figure 2: Grapple truck with dump trailer. 20

Figure 3: Standard Rendering Truck and Trailer 23

Figure 4: Example of a tarp drawn tight over a trailer. 24

Figure 5: Example of a roll-off truck trailer. 25

Figure 6: Example of a dump truck trailer. 25

Figure 7: Series of events to expose susceptible species to FMDv through the movement of infected carcasses. 27

Figure 8: Aerosol (A) and cross-contamination (B) pathways for the exposure of susceptible species to FMDv through the transportation of infected carcasses. 28

Figure 9: FMD curve in a 3,000 head swine farm during the first index case 40

Figure 10: FMD curve in a 2,000 head dairy cattle farm during the first index case 40

Figure 11: FMD curve in a 5,000 head feedlot beef cattle farm during the first index case 41

List of Tables

Table 1: Descriptive scale to estimate the likelihood for an event to occur 18

Table 2: Expert opinion on time to euthanasia and euthanasia time 21

Table 3: Expert opinion on depopulation technology time efficiency 22

Table 4: Federal Regulations Addressing Transportation of Carcass 26

Table 5: Input parameters used in the FMD spread model in a swine farm. 34

Table 6: Input parameters used in the FMD spread model in a dairy and beef cattle herd. 35

Table 7: Total time from infection to starting the depopulation procedure 36

Table 8: Time to depopulate a farm for each of the species 37

Table 9: Input values to estimate timings for depopulation procedure in case of FMD outbreak in a dairy cattle farm. 38

Table 10: Input values to estimate timings for depopulation procedure in case of FMD outbreak in a swine farm 38

Table 11: Input values to estimate timings for depopulation procedure in case of FMD outbreak in a feedlot beef cattle farm 38

Table 12: Results from the simulation for the first FMD case 39

Table 13: Results from the simulation for the subsequent FMD cases 39

Table 14: Titers of FMDv present in select tissues, excretions and secretions of pigs after slaughter 41

Table 15: Titers of FMDv present in select tissues, excretions and secretions of cattle after slaughter. 43

Table 16: Weight ranges of different species, depending on the production phase. 45

Table 17: Number of carcasses in a disposal truck, depending on the capacity. 45

Table 18: Total amount of FMDv per disposal truck and growth phase 46

Table 19: Selected estimated Minimum Infectious Doses (TCID50) for cattle, sheep and pigs by route of exposure 46

Table 20: Volume of Body Fluids found in Cattle and Swine 48

Table 21: Leakage and Spillage of carcass fluids during conveyance 49

Table 22: Summary of bioaerosol responses from experts. 52

Table 23: Aerosolization of virus particles during conveyance 53

Abbreviations

APHIS	Animal and Plant Health Inspection Service
CFR	Code of Federal Regulations
DOT	Department of Transportation
EMRS	Emergency Management Response System
FAD	Foreign Animal Disease
FADD	Foreign Animal Disease Diagnostician
FADDL	Foreign Animal Disease Diagnostic Laboratory
FMD	Foot and Mouth Disease
FMDv	Foot and Mouth Disease virus
FMCSA	Federal Motor Carriers Safety Administration
FSIS	Food Safety Inspection Service
NASS	National Agricultural Statistics Service
NAHEMS	National Animal Health Emergency Management System
OIE	World Organization for Animal Health, Office International des Epizooties
US	United States of America
USDA	United States Department of Agriculture
USDA FAD PReP	United States Department of Agriculture Foreign Animal Disease Preparedness and Response Plan
VS	Veterinary Services

Definitions

Bio-Zip™ Liner

Bio-containment bags which are constructed of a thermally-bonded layering of polypropylene and featuring an industrial zippering system, The Bio-Zip™ Sealable Liners fit securely inside industrial roll-off containers, trailers or truck racks from 10 to 40 cubic yards in total volume. They are used to manage large volume biological and organic waste streams and the associated odor, leakage, disease and environmental contamination issues. **Disclaimer: The document is not endorsing the product of a specific vendor, but merely used the data on this product as an example**.

Carcass The body of an animal that has died or been killed, and is not being slaughtered for human or animal consumption.

Collecting station

An establishment where carcasses may be placed for temporary holding until loaded on trucks.

Confirmed positive case (of FMD)

An animal with clinical signs consistent with FMD and from which FMDv is isolated and identified in a USDA laboratory or other laboratory designated by the Secretary of Agriculture.

Control Area Consists of an infected zone and a buffer zone. Initially, the entire State, Commonwealth, Tribal Nation, or territory may be declared a control area and subject to movement restrictions until appropriate surveillance and epidemiological evidence has been evaluated and the extent of the outbreak is known.

Decomposition

The process by which organic substances are broken down into simpler forms of matter

Dump Truck A standard dump truck is equipped with an open-box bed, which is hinged at the rear and equipped with hydraulic pistons to lift the front, allowing the material in

the bed to be deposited on the ground behind the truck at the site of delivery. The truck does not have a sealed tailgate.

Fomites — Inanimate objects that, when contaminated with a viable disease agent, can serve as a source of infection for a susceptible host.

Grapple — A hydro-mechanical device able to rotate on an axis with a clamshell or bucket attached at the end of the boom, which is intended for the collection of large items, in this case carcasses

Hazardous Material

A substance or material that the Secretary of Transportation has determined is capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and has designated as hazardous under section 5103 of Federal hazardous materials transportation law (49 U.S.C. 5103). The term includes hazardous substances, hazardous wastes, marine pollutants, elevated temperature materials, materials designated as hazardous in the Hazardous Materials Table of 49 CFR 172.101), and materials that meet the defining criteria for hazard classes and divisions in part 173 of subchapter C of this chapter.

Herd — The population of animals at defined premises.

Incubation period

The known or assumed period between the introduction of a pathogen into a susceptible animal and the occurrence of the first clinical signs of the disease; the OIE standard for FMD is 14 days.

ID_{50} — Infectious Dose 50; amount of pathogen measured as number of colony forming units (CFU) for bacteria or number of virus particles required to infect 50% of exposed individuals.

Index premises

The first premises known to have a case of FMD during the outbreak under investigation. The true index premises are the premises with the first actual case in an outbreak; it is often not definitively determined.

Infected premises

Premises where a presumptive positive case or confirmed positive case exists based on laboratory results, compatible clinical signs, case definition, and international standards

Leakage — The body fluids that have the potential to leak from the intact carcass post-mortem. These include feces, urine, stomach/rumen contents, blood, saliva, and milk spillage

Leachate — Liquid that is produced by the decomposition of livestock carcasses and seeps from the carcasses.

Leak-Proof Liner

A temporary durable sheet lining (made of plastic, vinyl, etc.) placed in the container of the truck and used to protect the bed and sidewalls of the cargo space of truck trailers

PFU — Plaque-forming unit; used in virology studies to estimate the quantity of viral particles present in a sample based on the number of plaques formed per unit volume.

Premises — A location where livestock are raised, housed, or pass through during commerce.

Rendering truck

Tractor-trailer truck with detachable trailer box and a leak-proof tailgate specifically designed for rendering. Trailer specifications can vary in length from 26 to 40 feet (most common are 28, 32 and 40 feet) with standard width of 8 feet and height of 12 feet.

Roll-Off Truck

Tractor-trailer truck with detachable box trailer which is able to be removed from the trailer component. They are characterized by a rectangular footprint, utilizing wheels to facilitate rolling the trailer in place. The open top container is designed to be transported by special roll-off trucks. As the roll-off truck raises its hydraulically operated bed, the roll-off container rolls off of the bed. A cable is used to slowly lower the container. These can operate on a winch system or a hook-lift system.

Saprophytic decomposition/putrefaction

One of the stages of decomposition, produced mainly by the action of bacterial enzymes, mostly anaerobic organisms derived from the gastrointestinal tract, causing hemolysis, disintegration of tissue, and gas formation in blood vessels and tissue spaces.

Stamping out

Depopulation of clinically affected and all presumed exposed susceptible animals.

Spillage Seeping of carcass fluids from the carcass to the truck and then to the environment.

Tarp A sheet of material, such as waterproofed canvas, vinyl coated polyester mesh, etc. which is used to cover the open trailer to protect contents from visibility or ejection of material.

$TCID_{50}$ Tissue Culture Infective Dose 50; amount of a pathogen measured as number of virus particles required to produce pathological change in 50% of cell cultures inoculated, expressed as $TCID_{50}$/mL.

Truck A vehicle or conveyance used for the transportation of carcasses.

<u>Stages of disease:</u>

Infected Includes all stages of disease (L+I+C): latent (L), pre-clinically infected (I) and clinically infected (C).

Viremic Active virus circulating in the bloodstream. Susceptible species can be viremic and shedding virus before they develop clinical signs. Includes the pre-clinical (I) and clinical (C) stages of disease in this risk assessment.

Incubation period

Time from exposure to the development of clinical signs.

Pre-clinically infected stage (I)

Animal is viremic, is shedding virus, but does not have clinical signs. These animals represent the highest risk for spread of virus.

Clinically infected stage (C)

Animal is viremic, shedding virus and is exhibiting clinical signs of disease.

Latent (L) Susceptible animal that has been exposed and is incubating the virus, but is not viremic.

Recovered (R)

No longer infected with the virus.

Susceptible (S)

Healthy animal likely to be exposed to the virus.

Executive Summary

The present risk assessment proactively evaluated the risk of infecting susceptible livestock by the movement of Foot and Mouth Disease (FMD) infected carcasses (swine and cattle) from FMD infected premises. The risk assessment evaluated the most up to date available science and solicited opinion from experts when data was lacking. This risk assessment is proactive in nature and the scenarios, pathways and depopulation practices assessed were based on the current practices and regulations applicable during an animal disease outbreak in the US. The characteristics, types of conveyance methods, and equipment used to transport the infected carcasses were provided from expert opinion and verified through site visits. Different modeling techniques were used to estimate the number of infected animals during a FMD outbreak at various time intervals, the total time estimated from infection to depopulation and the total amount of FMD virus (FMDv) contained in a disposal truck. The main outcomes of the risk assessment should be reviewed if needed as new data becomes available in the future.

Risk estimation: The risk of FMD infection of susceptible livestock associated with the movement of swine and cattle carcasses from FMD infected premises to a disposal site during a FMD outbreak in the United States is **negligible** when using a standard rendering truck (tailgate sealed and tarp cover) and a Bio-Zip™ bag, and between **negligible and low** when using a standard rendering truck or a roll-off /dump truck with a Bio-Zip™ bag. The risk level in other scenarios (uncovered standard rendering trucks, uncovered roll-off/dump trucks, covered roll-off/dump trucks and a liner) is between **moderate and high**.

Main results: Time for FMD detection was estimated by a disease spread model to be between 4-10 days for swine and beef cattle and 3-9 days for dairy cattle premises of different sizes. Total time from infection to depopulation (including detection and confirmation) for the first FMD infected case was estimated to be between 10-15 days for swine, 8-12 days for dairy and 10-14 days for beef cattle premises. Total time estimated for subsequent FMD cases was between 7-12 days for swine, 6-9 for dairy and 8-11 days for beef cattle premises. Most of the animals (>65% for the first case and >81% for subsequent cases) were viremic at the time of depopulation. The average concentration of FMDv in a carcass in experimental inoculation studies was 10^3 Plaque-Forming Unit per gram (PFU/g) for a pig carcass and 10^6 PFU/g for a cattle carcass. The total amount of infected carcasses moved to the disposal site (relative to the size of the animal carcass and the capacity of the truck trailer) was between 23-390 cattle carcasses and 117-780 pig carcasses per truck. Any small amount of body fluids (1 mL) would contain virus that is equal and greatly exceeds the infective dose by oral and inhalation route for pigs and cattle. The likelihood that swine and cattle carcasses moved from FMD positive premises will contain an infective dose was high. The use of a Bio-Zip™ bag in a standard rendering truck (tailgate sealed and tarp cover) reduces the likelihood of leakage, spillage and aerosolization to negligible.

1. Background

This risk assessment was performed by the University of Minnesota's Center for Animal Health and Food Safety to proactively evaluate the risk of moving swine and cattle carcasses to an offsite disposal location, from a Foot and Mouth Disease (FMD) confirmed positive premises during a FMD outbreak in the United States (US), as it relates to potential spread to susceptible livestock.

In the event of a FMD outbreak in the US, Local, State and Federal authorities will implement a foreign animal disease emergency response as described in the USDA Animal and Plant Health Inspection Service (APHIS) Framework for Foreign Animal Disease Preparedness and Response Plan (USDA FAD PReP). This response includes a control and eradication strategy that will utilize depopulation, quarantine, vaccination, and movement control measures applied throughout the swine and cattle industry. If depopulation is utilized, due to the large amount of biomass from carcasses and potential limitations on the premises of origin for disposal, there may be a need to transport carcasses offsite for disposal. This movement has the potential to result in virus spread to other uninfected premises and susceptible livestock.

Risk assessment in the animal health context comprises a framework that uses a tool set and available scientific information to assess the situational level of risk to the health of an animal population and the potential consequences. Completing this type of risk assessment in a timely manner during an outbreak is typically impractical. Risk assessment conducted proactively, before an outbreak occurs, provides the framework necessary for decision makers to identify the risk pathways for disease transmission. They are thus equipped to quickly assess the effectiveness of the current practices, preventive measures and additional mitigation measures, if needed, as they pertain to the risk associated with the movement of an agricultural commodity.

2. Scope

The purpose of this risk assessment is to determine the risk of FMDv infection of susceptible livestock associated with the movement of swine and cattle carcasses from a FMD-infected premise to an off-site disposal facility during a FMD outbreak in the United States. The risk evaluation is based on the likelihood of FMDv being present in the carcasses at the time of transportation and the likelihood their movement could serve as a source of infection for susceptible livestock. The risk assessment evaluates the likelihood that: 1) the swine and cattle carcasses from a FMD-infected premises will contain an infective FMDv dose after completion of euthanasia; 2) FMDv could be released into the environment from the carcasses through post-mortem leakage of infected body fluids and/or aerosolization of infectious particles from the body fluids; and 3) susceptible livestock will be infected by FMDv during the transportation of carcasses from the infected premises to the disposal site.

The primary mode of transportation evaluated for carcass movement from the FMD-infected premises of origin directly to a disposal site is a rendering truck. This is defined as a tractor-trailer truck equipped with a box trailer (lengths of 28 ft, 32 ft, or 40 ft) that has a sealed, leak-proof tailgate and is open on the top. The second type of truck that will be considered in this risk assessment is the roll-off truck. This truck has a removable open-top, box trailer that is fitted onto a rectangular footprint and utilizes wheels to facilitate rolling the trailer into place. The third type of truck that will be considered is the dump truck. A standard dump truck is equipped with an open-box bed, which is hinged at the rear and equipped with hydraulic pistons to lift the front, allowing the material in the bed to be deposited on the ground behind the truck at the site of delivery. The standard rendering truck, roll-off and dump truck will be considered with and without the following mitigations (one or in combination) that can be used in conjunction with the standard trailer:

1) Tarp covering
2) Bio-Zip™, leak-proof carcass bags
3) Leak-proof liner (only for roll-off and dump trucks)

For each of the transportation modes, the following release and exposure pathways were addressed:

- Cross-contamination of trucks, personnel and equipment from carcass fluids contaminated with FMDv escaping from the conveyance.
- Aerosol transmission of FMDv particles escaping from the conveyance.

3. Assumptions

A conservative approach using the "worst-case" scenario was used in this risk assessment. Literature data on FMDv concentration in swine and cattle carcass tissues consider animals artificially inoculated with FMDv at high concentrations, which may not represent the reality of a naturally occurring outbreak.

This risk assessment takes into consideration all applicable regulations, including preventive measures already in place, as well as additional preventive measures that could be implemented during an outbreak. This assessment is proactive in nature and cannot address the specific circumstances surrounding an outbreak in detail. Therefore, we are making some assumptions to establish context and applicability. These assumptions are:

- A FMD outbreak in the United States in the commercial pig and/or cattle (beef or dairy) population has occurred.
- A swine or cattle farm has been confirmed as a FMD-infected premises and a specific euthanasia protocol has been established as the depopulation method.
- All animals in the infected premises will be euthanized and moved to disposal offsite as intact carcasses.
- All disposal options have been predetermined so that the time to locate is not part of the delay of the disposal.
- Time to complete indemnity was not included in the estimation of total time from infection to depopulation due to the assumption that this is not a time limiting step.
- The movement considered will be from one infected premises directly to the disposal site, without any subsequent stops along the route.
- The same trucks, personnel and/or equipment will not be shared among multiple infected premises without complete cleaning and disinfection.
- Carcasses will be moved immediately after euthanasia, so environmental factors (temperature, pH) will not have an effect on FMDv concentration in the carcass.
- Post-mortem autolysis will occur, and there will be some leakage of fluids from the intact carcasses. As fresh carcasses will be moved immediately after euthanasia, there will be little saprophytic decomposition/putrefaction. We assume minimal rigor mortis at the onset of loading due to the short time between euthanasia and carcass loading.
- The tarp (roll-off or drawn down) will be appropriately cleaned and disinfected prior to each load and following each unloading or there will be a new tarp utilized for each trip.
- Options and mitigations evaluated were provided to the risk assessment team and were evaluated for their impact on the risk pathways. They were not evaluated for their functionality. We assume all mitigations considered (e.g. Bio-Zip™ bag, liner, tarp,

equipment, cleaning and disinfection procedures) will function appropriately and/or be performed according to their specifications.

- The exterior surfaces of trucks and tires will be cleaned and disinfected prior to leaving the infected premises, as well as at disposal area following drop off, and will follow accepted procedures outlined in the USDA APHIS FAD Prep Guidance (USDA FAD PReP)
- Wildlife population pathways will not be considered in this risk assessment.
- Roads taken by the disposal trucks will be shared with the open traffic.
- All vehicles will be in compliance with federal and applicable state Department of Transportation (DOT) regulations and APHIS carcass transportation regulations, including that all vehicles used in transportation of carcasses will be leak-proof.
- The driver of the carcass truck will not come into contact with any carcasses or infected equipment while on the infected premises, the carcass loading area or the carcass unloading areas at the disposal site.

4. Overview of data analysis approaches

Risk Assessment Overview

This risk assessment is based on the OIE guidelines and methodology for import risk analysis with some modifications (OIE, 2004). The OIE model is comprised of hazard identification and three steps within a risk assessment: 1) entry assessment (release of virus to the environment through the carcasses); 2) exposure assessment (exposure of susceptible animals); and 3) risk evaluation (considers the entry and exposure assessments to provide the overall risk estimation). The emphasis of this risk assessment is the release of FMDv associated with the movement of swine and cattle carcasses from a FMD positive premises and exposure of susceptible livestock. If the entry assessment demonstrates a negligible likelihood of the carcass being contaminated with FMDv, the risk assessment may be concluded. However, if the risk is estimated to be greater than negligible, the next step in the risk assessment is the exposure assessment, which would assess the likelihood that susceptible animals will be infected by FMDv through the movement of carcasses from FMD positive premises.

As recommended by the OIE, the risk analysis process is described as follows:

- Hazard identification is the process of identifying and understanding the biology and epidemiology of FMD and FMDv to determine whether the agent is a hazard under specified situations.
- Entry assessment determines the likelihood of an agricultural commodity (e.g. carcass) being infected or contaminated with a hazard (e.g. FMDv) and describes the biological pathways

necessary for that hazard to be introduced into a particular environment with susceptible livestock. It includes an estimation of the likelihood (i.e. qualitative or quantitative) of each of the pathways.

- Exposure assessment describes the biological pathway(s) necessary for exposure of animals to the identified hazard (e.g. FMDv) and estimates the likelihood of those exposures occurring.
- Risk estimation consists of integrating the results from the entry and exposure assessments to produce summary measures of the risk associated with the identified hazard.

Likelihood and risk evaluation

The likelihood for each pathway was assessed and categorized using the descriptive scale in Table 1 below:

Table 1: Descriptive scale to estimate the likelihood for an event to occur

Likelihood	Descriptive Definition
High	The event is very likely to occur
Moderate	The event is unlikely but does occur with a certain probability
Low	The event is unlikely to occur
Negligible	The likelihood that the event will occur is insignificant, not worth considering

The risk estimation was based on the summarization of the likelihoods for each pathway in the entry and exposure assessments.

Uncertainty estimation

The uncertainty of the likelihood/risk estimation was assessed by using a range within the descriptive definitions in Table 1. When uncertainty about the estimation was low (the estimation was somewhat certain), only one descriptive definition was used to estimate the likelihood/risk (e.g., low, high). When the uncertainty on the estimation was moderate or high the descriptive definition used to estimate the likelihood/risk was within a range (e.g., between moderate and high), the range being broader as the uncertainty about the estimation was higher.

Modeling Overview

A within herd stochastic disease spread model was applied to simulate the transmission of FMDv within a group and estimate the number of pigs, dairy cattle and beef cattle in various disease states at each time period. The disease states include: susceptible (S), latent (L), pre-clinically infectious (PI), clinically infectious (CI) and recovered (R) (Carpenter TE, 2004).

Estimates of animal level disease stage durations (latent, preclinical, clinical, and recovered) were obtained from recently developed parameters used in the NAADSM (North American Animal Disease Spread Model) (USDA, 2012).The main outputs of the model were time for detection at different farm size scenarios and to simulate the number of viremic (pre-clinically and clinically infectious) and recovered animals that would be moved to the disposal site.

The model updates the number of animals in each disease state every 6 hours, which increases the accuracy of detection. The uncertainties in input variables, as well as the inherent variability associated with the course of infection in individual populations and the spread within the group, are considered in the model. Appendix A: Model Disease Spread presents the assumptions, definitions and background information used in the disease transmission model.

The detection module of the disease spread model estimates the time to detect FMD infection in the group based on heightened active observational surveillance for clinical signs, one of the mitigation measures that may be applied in an outbreak at the herd level. The model "checks" or applies specific detection mechanisms at user specified time steps (e.g., every day or twice per day). FMDv infection may be detected in a time period based on the specific detection mechanism and the number of clinically infectious animals.

Inputs for the disease spread model in the form of probability distributions for each disease state (latent, pre-clinical and clinical) for the transmission of FMDv within swine, dairy and beef cattle populations were obtained from an APHIS study where data from different FMD studies were analyzed by meta-analysis to estimate the probability distributions ((USDA 2012); (USDA, APHIS, NAHMS, 2012)).

5. FMD Depopulation Procedures and Carcass Movement

5.1. Standard Operating Procedures for FMD Depopulation

In infected premises that are being depopulated, the goals are to prevent contact between FMDv and susceptible animals, as well as to stop the production of FMDv in exposed or infected animals. The response strategy of stamping out infected premises is being considered in this risk assessment. This would be the case for an outbreak that is contained in jurisdictional areas in which FMD can be readily contained and further spread is unlikely. Stamping out is the preferred depopulation method for clinically infected and in-contact susceptible animals as a means to reduce the potential of disease spread. For purposes of this risk assessment, we assume the depopulation procedures will follow the USDA FAD PreP Guidance (USDA FAD PReP).

The standard operating procedures during depopulation are that the driver arrives at the site with the vehicle and makes contact with the officials/on-site command at the infected site. Many rendering industries utilize rendering trucks that are equipped with their own carcass lift arms and clam buckets (grapple systems) (Figure 1). These can be operated by the driver and although may need to leave the truck cabin to operate the lift, the driver will not step foot on the ground, nor have any contact with the carcasses.

Figure 1: Standard Rendering Truck with Grapple System

Image courtesy of Redwood Metal Works (http://redwoodmetalworks.com/)

Figure 2: Grapple truck with dump trailer.

Image courtesy of Mid-Atlantic Waste Systems (http://www.mawaste.com/mobile.html)

In cases where a forklift or front-end loader is used to lift an entire dump container and empty its contents into the trailer, an on-site operator (not the truck driver) would operate that machinery. If applicable, the driver would then cover the trailer using the roller tarp, operated from the front of the trailer (Figure 2).

During an outbreak, it is assumed that the driver never leaves the vehicle while on the infected premises (loading area). If duties cannot be performed by the driver from the cabin or platforms of the vehicle and would require the driver to be on the ground, personnel on the ground will load the vehicle and pull the tarp over the container. This tarp would be drawn tight in order to reduce air flow (although it still would not be 100% air-tight). In the US, it is required for trucks to be leak-proof while hauling animal carcasses (see 9 CFR 325.21 - Means of conveyance in which dead, dying, disabled, or diseased livestock and parts of carcasses thereof shall be transported (Code of Federal Regulations and Federal Register).

For purposes of this risk assessment, the assumption is that euthanasia would take place only when there is a dedicated destination for the carcass disposal. This means that euthanasia will take place within a matter of minutes to hours prior to the carcasses being transported to the destination. The time limiting factor in a depopulation scheme is disposal rate, especially for large operations where burial on site is not an option. Storage of carcasses creates another set of problems for landfills, rendering, and hauling (more liquids) unless chilled. Therefore, simultaneous euthanasia and disposal will be the operational plan considered for this risk assessment.

Estimates for depopulation rates and timing for depopulation procedures are not available in the literature. Expert opinion was thus solicited for euthanasia and depopulation times. Experts in the field were contacted to provide their input on starting times for euthanasia for: 1) FMD Index premises, 2) subsequent FMD-infected premises, and 3) most likely depopulations rates for both swine and cattle (head/hour). A range (minimum, most likely, and maximum) was requested for each of the times and rates. See Appendix E: Expert Opinion – Depopulation for more information. These data are summarized in the table below.

Table 2: Expert opinion on time to euthanasia and euthanasia time*

Expert	Time to start depopulation (h)**	Depopulation time (head/hour)***
1	Min: 24 Most likely: 48-96 Max: 72-168	Min: 30 Most likely: 50 Max: 75
2	Min: 12 Most likely: 48 Max: 72	Min: 4*3 crews=12 (cattle) 20*3 crews=60 (swine) Most likely: 8*3 crews=24 (cattle) 160*3 crews=480 (swine)

		Max: 300*3 crews=900 (swine)
3	Min: 12 Most likely: 24 Max: 48	Min: 6*3 crews=18 Most likely: 12*3 crews=36 Max: 20*3 crews=60
4	Min: 24 Most likely: Max: 48	-
5	Min: 36 Max: 60	Cash pistol-grip captive bolt: 30 CO_2 gassing roll-off trailers: 140 Mobile electrocution trailer: 600 Maximum rendering capacity: 167

**: Assuming the outbreak is localized, and all the resources are available.*
***: Using the longest time when a range was provided.*
****: Using 3 eight men crews (20 h +4 h cleaning), 2 ten cow side discharge alleys and 2 loaders*

Time to transport the depopulation equipment and to set-up for the depopulation is a likely range of 24 to 48 hours. The time required to move animals into position for depopulation should also be taken into consideration. Once equipment and animals are in position and the depopulation procedures are ready to begin, the next time-limiting factor is the speed of the depopulation technology chosen. Table 3 below shows several of these technologies and their estimated speed.

Table 3: Expert opinion on depopulation technology time efficiency

Depopulation Technology	Time Efficiency
On farm mobile electrocution trailer (construction in progress)	Limit is estimated to be 600 feeder pigs/h (more time for sows and boars; not practical for iso-weans)
On farm cash pistol-grip captive bolt	Estimate is 30 head/h depending on the experience of the operator and their tolerance
On farm CO_2 gassing of swine in roll-off trailers or constructed chambers	Dependent upon the size of the chamber or trailer, and size of animal, to determine batch size. It usually will take about 15 minutes for the euthanasia process for each batch.
Transport to slaughter plant but divert line to disposal rather than processing	Estimate is the line speed of the plant whether using CO_2/bolt or electric paddles*

** This option is not likely applicable to the situation being evaluated in this assessment, unless the premise is a slaughter facility.*

Assuming the outbreak is localized and all resources for depopulation are available, in larger premises and feeder premises the process to completely depopulate the premises may be slowed due to disposal and indemnity issues. Depopulation efforts must be directly linked to the rate of

disposal. The speed of euthanasia should not exceed the disposal rate. The disposal rate may be increased either through contracting multiple disposal options.

5.2. Types of Transportation

This risk assessment addresses mass depopulation at the infected premises site, with subsequent removal of carcasses from the infected premises using a standard rendering truck as conveyance. As defined for this risk assessment, the standard rendering truck is a tractor-trailer that is used to haul carcasses. This is a tractor-trailer truck (semi-truck) with an attached box trailer. The box trailers are constructed of aluminum, smooth wall panels or stakes and sheets of aluminum or steel. The trailers have a one-piece lift-off hinged doors or side swing tailgates, both of which are sealed and leak-proof, as required by federal law (9 CFR 325.21, Code of Federal Regulations and Federal Register). Standard trailers are 96 inches wide, with side heights of 5 ft or 6 ft smooth wall, double panel. The trailer lengths vary from 26 ft to 40 ft. and may be double- or triple axel. The most commonly used lengths in rendering industry practices are the 28, 32 and 40 ft trailers, which can haul 40000, 45000, and 50000 lbs., respectively.

Figure 3: Standard Rendering Truck and Trailer

Image courtesy of Walinga (http://www.walinga.com/index.php?id=223)

Figure 4: Example of a tarp drawn tight over a trailer.

Image courtesy of SolHuTech (http://www.solhutec.com/trucktarps.html)

Another option to the open-top trailer of the standard rendering truck is a trailer that is equipped with tarps systems. Tarps can be built in sizes that can accommodate dump trucks, roll off containers, dumpsters, and open top containers. Tarp cover systems can be constructed from range of materials including mesh, PVC or vinyl. In addition, tarp systems can come in a variety of formats including a sliding cable system, flip tarp system, rolling system, and solid waste tarps (tie-down system). Utilization of a tarp system is standard practice in states where law mandates that the top of the trailer be covered during carcass transportation to prevent leakage. Although the tarp reduces airflow, it is not airtight, and air will still flow over the carcasses. The tarp also helps to control scavengers. Other options are to have the trailer built with manual, air or hydraulic cylinder control lids, which tend to be less common.

For the purpose of lifting the carcasses into the trailer, trucks can be equipped with heavy duty hydraulic lift arms and buckets. Many farms will have a 'dump container' that is used to hold routine mortalities until the render haul truck arrives. The dump container could be used in the case of small premises depopulation. A forklift or front-end loader can also be used to lift the entire container in order to dump the carcasses into the truck's container.

There are other secondary types of trucks that can be used to transport carcasses, such as a roll-off truck. A roll-off truck is a tractor-trailer truck with detachable open-top box container, which is characterized by a rectangular footprint and wheels that facilitate rolling the container into position. As the roll-off truck raises its hydraulically operated bed, the container rolls off, and a cable is used to slowly lower it. These operate on a winch or hook-lift system.

Figure 5: Example of a roll-off truck trailer.

Image courtesy of Redwood Metal Works (http://redwoodmetalworks.com/)

The third type of truck trailer that will be considered in this risk assessment is the dump truck. A standard dump truck is equipped with an open-box bed, which is hinged at the rear and equipped with hydraulic pistons to lift the front, allowing the material in the bed to be deposited on the ground behind the truck at the site of delivery. By definition, this truck does not necessarily come equipped with a sealed tailgate. The roll-off and dump trucks will also be considered with and without a leak-proof liner, as some may not contain a sealed leak-proof tailgate.

Figure 6: Example of a dump truck trailer.

Image courtesy of Walinga (http://walinga.com/index.php?id=1741)

Each of these types of trucks has certain advantages and disadvantages. The decision to utilize the standard rendering truck as the primary form of conveyance is based on industry standard practices and the availability of equipment in the event of a FMD outbreak with mass animal depopulation. The standard rendering truck, roll-off and dump truck will be considered both

with and without the following mitigations that can be used in conjunction with the trailer: 1) Tarp covering, and 2) Bio-Zip™, leak-proof carcass bags (Appendix B: Bio-Zip™ Bags product information). Bio-Zip™ liners can be used to manage large volume biological waste streams, leakage and environmental contamination issues. The bags are constructed of coated layers of polypropylene-based material fitted with an industrial grade zippered sealing system. The Bio-Zip™ material is 100% solids and contains no hazardous air pollutants. It has a zero rating for health, fire and reactivity and is zero class flammability. The Bio-Zip™ sealable liners fit securely inside industrial roll-off containers, trailers or truck racks from 10 to 40 cubic yards in total volume. Bags are placed in the trailer and filled on premises with infected carcasses. The entire bag is then removed from the trailer at the disposal site and disposed of. Bio-Zip™ bags meet US regulations for land fillable materials.

By determining the likelihood of leakage with the standard rendering truck and various mitigations, the assessment can be extrapolated to the other types of trucks with and without mitigations as well.

5.3. Transportation Regulations

Transportation of carcasses is well-regulated in federal, state and local jurisdictions. Although it can be inferred from rules and known standards for carcass transport, there are no specific governing regulations for movement of high numbers of carcasses, such as in a disease outbreak situation. For purposes of this risk assessment, the assumption is that all conveyance of carcasses during the depopulation procedure of a FMD infected premises will follow federal regulations for carcass movement (9 CFR 325.21, Code of Federal Regulations and Federal Register). This section states that "All vehicles and other means of conveyance used by persons subject to 9 CFR 325.20 for transporting in commerce or importing, any dead, dying, disabled, and diseased livestock or parts of carcasses of livestock that died otherwise than by slaughter shall be leak-proof and so constructed and equipped as to permit thorough cleaning and sanitizing."

Table 4: Federal Regulations Addressing Transportation of Carcass

Federal Regulation	Addresses
9 CFR 325.21	Means of conveyance in which dead, dying, disabled, or diseased livestock and parts of carcasses thereof shall be transported.
9 CFR 325.20	Transportation and other transactions concerning dead, dying, disabled, or diseased livestock, and parts of carcasses of livestock that died otherwise than by slaughter.

For the case of a mass depopulation, we assume that the federal transportation regulations are followed as the minimum standard for all states. It is assumed that all rendering vehicles used in depopulation transportation efforts will be leak-proof. Rendering vehicles are required to be leak-proof but not airtight. States have additional regulations for carcass transportation that vary somewhat from state to state. Most states require that the carcass transportation trucks be licensed and permitted, and pass annual vehicle inspections. Some states also have specific requirements as to the timing of cleaning and disinfection of vehicles. This risk assessment assumes the state of origin of carcasses and state of disposal site carcass transportation and disposal statutes will be followed (Appendix C: Federal and State Regulations for Carcass Movement).

5.4. Pathway analysis for Carcass Movement

Figures 7 and 8 show the series of events and pathways by which susceptible species may be infected via the movement of FMD infected carcasses from an infected farm. Two main release and exposure pathways are assessed in the current risk assessment: 1) leakage of contaminated body fluids from the rendering truck and cross-contamination with other trucks, personnel or equipment that will be in contact with susceptible livestock in other uninfected farms (Figure 7 and Figure 8 A); 2) aerosolization of FMDv particles from the carcasses during movement and subsequent air transportation of those particles to uninfected farms with susceptible species (Figure 7 and Figure 8 B).

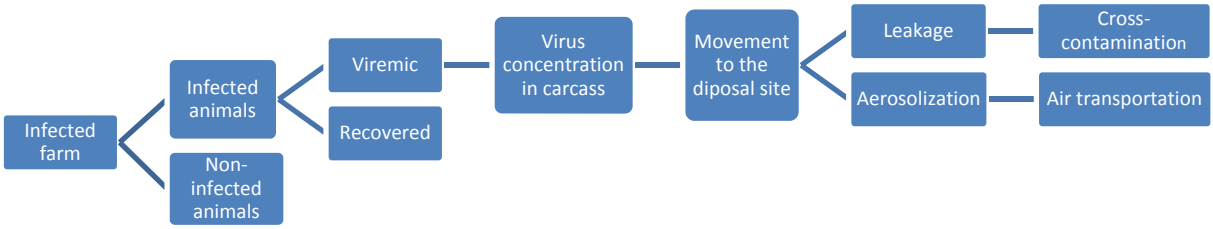
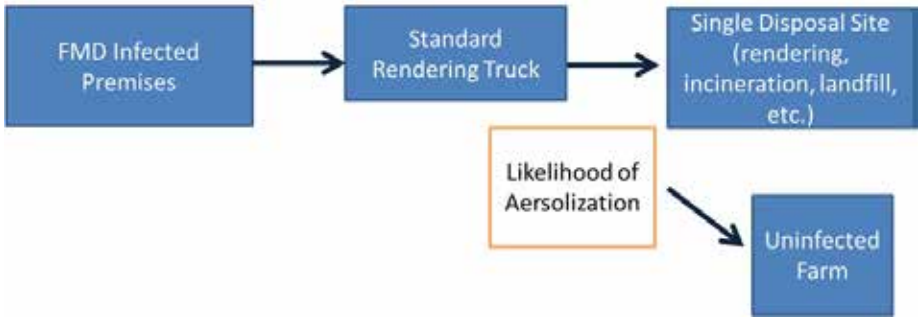


Figure 7: Series of events to expose susceptible species to FMDv through the movement of infected carcasses.

8A



8B

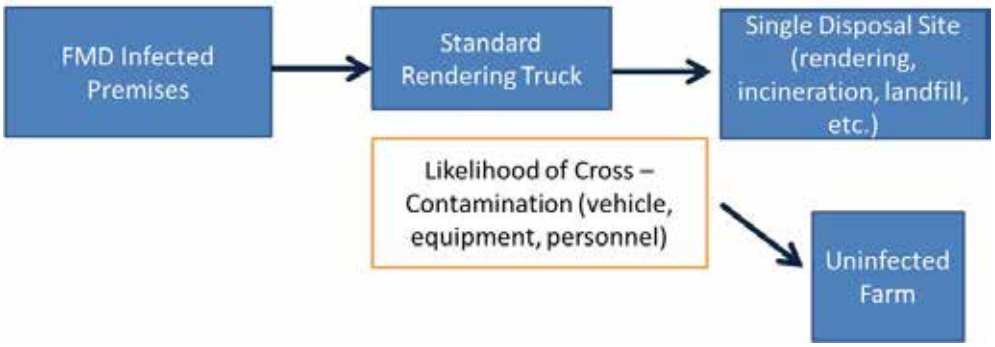


Figure 8: Aerosol (A) and cross-contamination (B) pathways for the exposure of susceptible species to FMDv through the transportation of infected carcasses.

6. Hazard identification

6.1. Background

Foot and mouth disease (FMD) is a highly contagious viral disease affecting primarily cloven-hoofed animals. The disease is characterized by the development of vesicles in and around the mouth and on the feet. Although natural FMD infection rarely causes the death of mature animals, the disease results in decreases in livestock productivity and causes serious economic impact on international trade of animals and animal products (OIE Technical Disease Cards)

FMD was last reported in the U.S. in 1929 and in North America in 1952 (Canada) and 1954 (Mexico). As of May 2012, of the OIE's 178 Member Countries, 102 do not have FMD-free status, 66 are recognized as officially free (65 without vaccination and one with vaccination), and ten have officially free zones (6 without vaccination and 4 having zones with or without

vaccination). Out of the 102 countries without FMD-free status, 6 had an official status that is currently suspended (current FMD status can be found at www.oie.int.gov). There is substantial concern about incursions of this disease into the U.S., because of the unexpected occurrence of FMD outbreaks in previously FMD-free countries, including Taiwan (1997, 2000); Japan (2010, 2000); South Korea (2010, 2000, 2002); North Korea (2007); South Africa (2000, 2006, 2007); Argentina (2001, 2006); Russia (2006, 2007) and Europe (2001). The potential risks and impacts that FMD may pose were demonstrated by the severe economic and livestock losses experienced in the United Kingdom in 2001. The historical consequences of these FMD outbreaks has reinforced the need for FMD awareness and evaluation of the possible pathways by which FMDv can spread and infect livestock and contaminate food sources, and how these can serve as a further route for spread of the virus (USDA FAD PReP, 2013).

6.2. Virus Characteristics

There are seven FMDv serotypes: A, O, C, SAT 1, SAT 2, SAT 3 and Asia 1. Each serotype can be divided further into subtypes. Serotypes A, O, C, SAT1, SAT2, SAT3, and Asia1 contain 32, 11, 5, 3, 6, 3, and 4 subtypes, respectively. All serotypes produce disease that is clinically indistinguishable, but immunologically distinct. No cross-immunity is conferred between serotypes. Serotype O is the most prevalent and occurs in many parts of the world. Within each serotype is a spectrum of antigenic variation, resulting in strains having close or distant relationships to each other. Serotype A has the greatest antigenic variation ((Kitching RP, 1989); (Kitching RP, 1998); (Alexandersen S, 2005)).

6.3. Host range of FMD

Cloven-hoofed animals (ungulates) are the natural domestic and wild hosts of FMDv. They are susceptible to all 7 serotypes and many of the subtypes of FMDv. The severity of illness may differ depending on the specific serotype and the species that is affected. Susceptible species include cattle, pigs, sheep, goats, water buffalo, impala, bison, African buffalo, American Bison antelope, reindeer, moose, elk (although low), hedgehogs, porcupines, giraffes, elephants and Bactrian camels. Horses are resistant to FMD infection. New World camelids (llamas, alpacas, vicunas and guanacos) have low susceptibility to FMD infection. FMDv may also be transmitted to mice, rats, guinea-pigs, rabbits, hamsters, embryonating chicken eggs, chickens and various wild species, including European hedgehogs, chinchillas, muskrats, armadillos and peccaries. However, these latter species are not generally capable of spreading FMD (Alexandersen S, 2005).

Humans can become infected with FMD through (1) handling of diseased livestock with virus entry through skin wounds and mucous membranes, (2) exposure through laboratory situations, or (3) by drinking infected milk. The virus is not readily transmissible to humans and thus should not be considered a zoonotic disease. (OIE, 2008) Cases of human disease are rare and have resulted in temporary and mild signs of disease (fever, vesicles on the hands, feet or in the mouth) (Alexandersen S, 2005). In contrast, Hand, Foot, and Mouth disease (HFMD) in humans is an unrelated viral disease that primarily affects infants and children. The human disease is often confused with FMD of livestock.

6.4. Transmission

FMDv is highly contagious, and can be transmitted by a variety of mechanisms. When infected and susceptible animals are in close proximity, the airborne transfer of droplets is the most common mode of transmission. Other common mechanisms by which FMDv is spread are summarized below ((Alexandersen S, 2003b); (Alexandersen S, 2005)).

- Direct contact with infected animals and movement of animals between premises.
- Contact with secretions from shedding animals─ exposure to secretions or mechanical transfer between groups by fomites (hands, footwear, clothing, vehicles, and equipment) and subsequent virus entry through cuts or abrasions in the skin or mucosa.
- Ingestion of FMDv contaminated animal products (meat) by pigs through swill feeding.
- Spread by wind, an uncommon event that requires the simultaneous occurrence of particular epidemiological and climatic conditions.

6.5. Incubation Period

The incubation period of an infectious disease is the time interval between exposure to an infective dose and development of clinical signs. The incubation period for FMD is known to be variable and dependent on the strain and dose of the virus, the route of transmission, the husbandry situation, and the species (Alexandersen S, 2003a). It is well known that FMD infected animals can shed virus during the incubation period, before the first detectable clinical signs are noted ((Orsel K, 2009); (Alexandersen S, 2001)). The peak of viremia can occur just before the animal breaks with clinical signs.

For control purposes, the OIE uses 14 days as the incubation period of FMD ((OIE, 2008); (Alexandersen S, 2003b)) summarized the variability observed in the incubation period of the disease, which is presented below:

- There is a strong inverse relationship between the dose of virus and the length of the incubation period, i.e., the higher the dose, the shorter the incubation period.
- The incubation period is usually 2-14 days, but can be as short as 24 hours.
- The latent period (animal exposed, infected and shedding the virus) is 1-2 days (Eble P, 2006).

6.6. Clinical Signs

Primary replication of FMDv takes place in the nasal and pharyngeal mucosa. Spread from these primary sites occurs to lymph nodes and the bloodstream, and resultant viremia distributes the virus to all organs and tissues. Viremia can commence a few hours after infection, and usually within 36 hours post-infection. Further replication of virus occurs in permissive cells and particularly at sites where characteristic lesions of FMD develop (Alexandersen S, 2001). The appearance of vesicles usually coincides with the peak of viremia and the highest concentration of virus is in tissues where the vesicles develop.

FMD in pigs is clinically indistinguishable from other viral vesicular diseases of swine (swine vesicular disease, vesicular stomatitis, vesicular exanthema) (Alexandersen S, 2001). It is usually severe and is characterized by lameness, reduced feed intake, lowered production, and the development of vesicles in and around the mouth and feet. Affected pigs become lethargic, remain huddled together and develop vesicles on the coronary band and heel of the feet, snout, lower jaw and tongue (Kitching RP, 2002). Body temperatures in pigs usually range from 39°C to 40°C, but can reach 42°C. The morbidity rate varies by the species affected, virus serotype and/or strain, and other factors. In regions where FMD is not endemic, the morbidity rate can be as high as 100 percent. The mortality rate is generally very low in adult animals, but may be high in young animals due to acute myocarditis (Alexandersen S, 2003b).

6.7. Concentration of virus in tissues, secretions, excretions

FMDv is present in multiple tissues, secretions and excretions of infected animals during pre-clinical, clinical, and post-clinical stages. Urine and feces contain virus but in low concentrations. Fresh feces collected from the floor have been found to contain small concentrations of the virus up to 10 days post infection in pigs (Parker J, 1971). The amount of aerosolized virus from infected animals can vary considerably. In contrast to other animals affected by FMD, infected pigs are recognized as the largest producers of aerosolized virus, excreting virus concentrations in the range of $10^{5.6}$ to $10^{8.6}$ $TCID_{50}$ per pig/day (Alexandersen S, 2005). Although pigs are large aerosol producers, they are very resistant to infection by this route. If a large group of pigs becomes infected with an appropriate viral serotype, the group can

excrete large volumes of aerosolized virus, which can be transported to farms downwind and constitute a risk to sheep and cattle. Ruminants excrete less virus in their breath (10^4 to 10^5 $TCID_{50}$/day) compared to pigs, but are highly susceptible to infection via the inhalation route (Alexandersen S, 2005)

In comparison with other livestock species, cattle are the largest overall producers of FMDv from all secretions/body fluids combined and are probably the main source for environmental contamination. They produce large volumes of FMDv in the epithelium of the tongue, which often sloughs off during clinical disease, as well as in saliva, urine, feces and milk, in comparison to other species. Cattle are extremely susceptible to infection by aerosol exposure to virus due to their large respiratory volume and may become infected at concentrations of FMDv as low as 0.06 $TCID_{50}$ per cubic meter of air (Donaldson AI, 2001). Survival time of FMDv post-mortem depends on the stage of disease at the time of slaughter, the organs affected, and the strain of virus.

6.8. Environmental Persistence

FMDv retains infectivity for considerable periods of time in the environment, provided it is protected from desiccation, heat and adverse pH conditions. For example, the virus may survive for 14 days in dry fecal material; six months in slurry in winter; 39 days in urine; 28 days on the surface of soil in autumn; and three days on the surface of soil in summer. Such observations have generally been made in countries with a temperate climate, and these survival times can be expected to be much the same in hotter climates (Geering WA, 2002). FMDv is sensitive to desiccation. Relative humidity and temperature are the primary factors that affect survival of the virus in the environment. The virus survives best when the relative humidity exceeds 70%, and has poor survival when the relative humidity is below 50-60 (Sellers R, 1971). Sunlight and ultraviolet radiation have little effect on virus persistence (Donaldson AI, 1975).

7. Entry Assessment

The entry assessment comprises the risk associated with the release of FMDv during the movement of swine and cattle carcasses from FMD positive premises to the disposal site. The release could occur by cross-contamination via contaminated body fluids escaping from the disposal vehicle or by transmission of FMDv by aerosolization. Each of these events was characterized by a pathway and, for each of the pathways, the likelihood of occurrence was evaluated based on available scientific information, logical assumptions and input from experts.

The pathways considered in the entry assessment that would result in the release of FMDv through swine and cattle carcasses movement were the following:

- Likelihood that carcasses moved from FMD positive premises will contain an infective dose. In this pathway, a disease spread model for FMD in swine, dairy and beef cattle and expert opinion were used to estimate the total time from infection to depopulation, the number of viremic and recovered animals, and the FMDv concentration in carcasses to be moved after depopulation.
- Likelihood that transportation of carcasses will produce leakage and spillage of fluids contaminated with FMDv. In this pathway, body fluid capacity of swine, dairy and beef cattle was estimated. Characteristics of the disposal trucks were analyzed for the potential for leakage of body fluids.
- Likelihood that transportation of carcasses will produce aerosolization of FMDv. In this pathway, the potential for aerosolization of FMDv particles during movement of carcasses was evaluated by using expert opinion.

7.1. Likelihood that swine and cattle carcasses moved from a FMD positive premise will contain an infective dose

Summary: Time for FMD detection was estimated by a disease spread model to be between 4-10 days for swine and beef cattle and 3-9 days for dairy cattle premises at different sizes. Total time from infection to depopulation (including detection and confirmation) for the first FMD infected case was estimated to be between 10-15 days for swine, 8-12 days for dairy and 10-14 days for beef cattle premises. Total time estimated for subsequent FMD cases was between 7-12 days for swine, 6-9 for dairy and 8-11 days for beef cattle premises. Most of the animals (>65% for the first case and >81% for subsequent cases) will be viremic at the time of depopulation. The average concentration of FMDv in a carcass in experimental inoculation studies was 10^3 PFU/g for a pig carcass and 10^6 PFU/g for a cattle carcass. The total amount of infected carcasses moved to the disposal site was between 23-390 cattle carcasses and 117-780 pig carcasses per truck. This range was based on the weight of the animal carcass as well as the capacity of the truck trailer, taking into account the number of carcasses that could fit in the trailer. Any small amount of body fluids from the carcasses would contain virus that greatly exceeds the infective dose. 1 mL of body fluids could contain same amount and 10-100,000 times higher virus quantity (10^3-10^6 PFU) than the minimum infectious dose by oral ($1.4x10^4$-$1.4x10^6$ PFU) and inhalation route (7-357 PFU) for pigs and cattle. **Likelihood estimation: The likelihood that the disposal truck with swine and cattle carcasses moved from FMD positive premises will contain an infective dose is high.**

7.1.1. Time for FMD detection

The time for FMD detection was estimated by a stochastic disease spread model. The parameters used in the model for the simulation of disease spread within a group are presented in Table 5: Input parameters used in the FMD spread model in a swine farm.. Estimates of animal level disease stage duration (latent, pre-clinical, clinical and recovery) were obtained from a recent study completed by USDA-APHIS-CEAH (USDA, 2012) by evaluating animal level data from published studies involving experimental infection with FMDv. The farm sizes selection was based on a compilation of statistics published by the National Agricultural Statistics Service (NASS) of the USDA for 2007-2012.

The surveillance component used in the model was based on observation of clinical signs and, using a conservative approach, was set at one time per day. The threshold for considering detection of the disease was set at 5% of the herd showing clinical signs. These values were based on expert opinion of subject matter experts regarding the average percentage of naturally occurring lameness on swine and cattle farms in the period of 2007 and 2009 ((USDA 2007); (USDA 2009)). The following components of the NAHMS survey were considered: the percentage of pig deaths from lameness (i.e. 5.4% for all group sizes); unusually high number of pigs unwilling to eat or stand up (i.e. 7.3% for all group sizes); and lame pigs with reddened areas above the hooves (i.e. 2.4% for all group sizes). Naturally occurring lameness is hard to predict, since it will be different from one producer to another, depending on the farm characteristics. Endemic lameness could mask the clinical signs of a FMD outbreak and has been reported to be less than 5% for cases of mild lameness and less than 0.5% for severe lameness (Dr. Peter Davies, personal communication).

Table 5: Input parameters used in the FMD spread model in a swine farm.

Variable [a]	Input Distribution/Value
Latent Period	Gamma (α=1.896, θ=0.869)
Pre-clinical Period	Gamma (α=1.770, θ=0.690)
Clinical Period	Gaussian (μ=4.330, σ=1.944)
Group Size	500, 1000, 5,000 and 10,000 head
Adequate Contact Rate	6.14 (3.75, 10.06)[b]
Detection Threshold	5% of group

[a]: *Distributions refer to swine groups of more than 200 head*
[b]: *Contact rate value from Eble et al.,* (Eble P 2006)

Table 6: Input parameters used in the FMD spread model in a dairy and beef cattle herd.

Variable	Input Distribution/Value
Latent Period	Exponential 0.709 (mean of 33.72 h, SD of 34.17 h)
Pre-clinical Period	Lognormal (μ=0.862, σ=0.774)
Clinical Period	Gamma (α=4.752, θ= 0.736)
Farm Size	100, 500, 1,000 and 2,000 head (dairy) 5,000, 15,000, 30,000 and 50,000 head (beef)
Adequate Contact Rate	52 to 216 contacts/day
Detection Method	5% of herd

The assumptions applied to the model included the following:

- The spread model does not include the aerosol route of infection or cross-contamination within groups (personnel and equipment), only direct contact between animals.
- The disease spread model assumes direct contact between all the animals in a herd, which may overestimate the number of infectious animals in large feedlots.
- The on-farm surveillance is based on daily visual observation for clinically suspicious animals. Clinically suspicious animals include animals with signs from any disease that is similar to FMD.
- Inputs for the analysis are based on published literature and the best current knowledge of the disease biology.

Appendix A: Model Disease Spread, contains the detailed information on the inputs and analysis of the model.

Percentages of farm sizes (100-50,000 head) for swine, dairy and beef cattle premises based on USDA NASS data for 2007-2012 was used to predict the most likely farm size where the occurrence of an FMD outbreak could happen. For example, for the swine industry the percentages of different farm sizes were as follows: 1-99 head (71.3%), 100-499 head (7.3%), 500-999 head (3.4%), 1,000-1,999 head (4.8%), 2,000-4,999 head (8.3%), and ≥5,000 head (4.8%). These data were included in a discrete distribution function to characterize the distribution of the swine farm sizes in the US by using @Risk software (Palisade Corp., Ithaca, NY, US) by the following distribution:

RiskDiscrete({100,500,1000,2000,5000,10000},{0.713,0.073,0.034,0.048,0.083,0.048}) Eq. 1

In any given outbreak situation, there is a 95% chance that the outbreak occurs in a pig farm with 5,000 head or less, in a dairy farm with 500 head or less, and in a feedlot beef farm with 1,000 head or less. Time for disease detection will depend on the farm size and clinical observation and was estimated to be between 4-10 days for swine and 3-9 days for dairy and beef cattle premises.

7.1.2. Time from detection to depopulation

Time from detection to depopulation was estimated by adding the time for detection and the time for starting the depopulation with the following equation:

$$\text{Total time} = t_{det} + t_{conf} + t_{sdep} \qquad \text{Eq. 2}$$

where t_{det} is the time for FMD detection depending on the farm size, t_{conf} is the time to the official laboratory confirmation of the disease and t_{sdep} is the time to start the depopulation procedure.

Time values for disease confirmation, starting the depopulation and depopulation rates were obtained from experts from Texas A&M Transportation Institute, West Texas A&M, Department of Homeland Security and APHIS. Time values were characterized by a Pert distribution, and @Risk software was used to estimate the total time by using Monte Carlo simulation with 10,000 iterations. Input values for swine, dairy cattle and beef cattle premises are shown in Tables 9, 10 and 11, respectively. Total time from infection to depopulation for the first FMD infected case was estimated to be between 10-15 days for swine, 8-12 days for dairy and 10-14 days for beef cattle premises. Total time estimated for subsequent FMD cases was between 7-12 days for swine, 6-9 for dairy and 8-11 days for beef cattle premises (Table 7).

Table 7: Total time from infection to starting the depopulation procedure

Type of farm	Total time (days)*	
	First index case	Subsequent cases
Swine	11.7 (9.6-15.2)	8.7 (6.9-12.0)
Dairy cattle	9.4 (7.5-11.6)	7.4 (5.7-9.4)
Feedlot cattle	12.6 (10.5-14.4)	9.6 (7.8-11.1)

**: After 10,000 iterations (mean, 5th, and 95th percentile values)*

Depopulation times were estimated by the following equation:

$$\text{Time for depopulation} = D_R \times \text{farm size} \qquad \text{Eq. 3}$$

where D_R is the depopulation rate in heads/h and farm size is the amount of heads in a farm.

Table 8: Time to depopulate a farm for each of the species

Type of farm	Depopulation time (h)*
Swine	7.59 (0.27-43.12)
Dairy cattle	4.33 (0.66-19.67)
Feedlot cattle	35.85 (19.90-43.93)

**: After 10,000 iterations (mean, 5th, and 95th percentile values)*

Table 9: Input values to estimate timings for depopulation procedure in case of FMD outbreak in a dairy cattle fa

Herd size	Time to detect disease post infection (5th, mean, 95th) (h)*	Time from disease detection to lab confirmation (min., most likely, max. values) (h)	Time from confirmation to starting depopulation (min., most likely, max. values) (h)	Depopulation rate (r likely, max. values)
0-100	Pert (72, 115, 192)	Pert (24, 48, 72)	Pert (24, 48, 72)	Pert (18, 36, 60)
100-500	Pert (96, 125, 192)			
500-1,000	Pert (96, 130, 192)			
1,000-2,000	Pert (96, 137, 216)			

*: 5% detection level. **: Using three crews (8 men each) during 3 working shifts (20 h + 4 h cleaning) and two cow side discharge loaders.

Table 10: Input values to estimate timings for depopulation procedure in case of FMD outbreak in a swine farm

Herd size	Time to detect disease post infection (5th, mean, 95th) (h)*	Time from disease detection to lab confirmation (min., most likely, max. values) (h)	Time from confirmation to starting depopulation (min., most likely, max. values) (h)	Depopulation rate likely, max. values
0-500	Pert (96, 144, 192)	Pert (24, 48, 72)	Pert (24, 48, 72)	Pert (30, 140, 600)
500-2,000	Pert (120, 168, 216)			
2,000-5,000	Pert (144, 168, 240)			
5,000-10,000	Pert (144, 190, 240)			

*: 5% detection level. **: Using three crews (8 men each) during 3 working shifts (20 h + 4 h cleaning) and two side discharge alle

Table 11: Input values to estimate timings for depopulation procedure in case of FMD outbreak in a feedlot beef

Herd size	Time to detect disease post infection (5th, mean, 95th) (h)*	Time from disease detection to lab confirmation (min., most likely, max. values) (h)	Time from confirmation to starting depopulation (min., most likely, max. values) (h)	Depopulation likely, max. va (heads/h)**
0-5,000	Pert (96, 142, 216)	Pert (24, 48, 72)	Pert (24, 48, 72)	Pert (18, 36, 6
5,000-15,000	Pert (120, 151, 216)			
15,000-30,000	Pert (120, 154, 216)			
30,000-50,000	Pert (120, 159, 240)			

*: 5% detection level. **: Using three crews (8 men each) during 3 working shifts (20 h + 4 h cleaning) and two cow side discharge loaders.

7.1.3. Number of viremic livestock after depopulation

The stochastic disease spread model was used to estimate the number of viremic (pre-clinical and clinical) and recovered animals at the time of depopulation for specific farm sizes (3,000 head for swine, 2,000 head for dairy and 5,000 head for feedlot cattle). Two different scenarios were evaluated: 1) First FMD case (Table 12); 2) Subsequent FMD cases (Table 13). The subsequent cases scenario was set at the minimum values obtained from experts for laboratory confirmation of the disease (24 h) and starting the depopulation procedure (24 h), due to the higher awareness of the disease. As shown in the table, most of the animals will be viremic (containing active FMDv) at the time of depopulation.

Table 12: Results from the simulation for the first FMD case

Type of farm	Time elapsed before depopulation (days)*	Percentage of viremic animals (pre-clinical + clinical) (%)	Percentage of recovered animals (%)
Swine (3,000 head)	11.2 (9.3-14)	82 (72-88)	16 (7-27)
Dairy cattle (2,000 head)	9.7 (7.7-12.8)	78 (65-88)	21 (9-34)
Feedlot cattle (5,000 head)	9.9 (8-12.9)	78 (65-88)	21 (9-34)

**: After 10,000 iterations (5th and 95th percentile values). Times are adjusted for each of the farm sizes.*

Table 13: Results from the simulation for the subsequent FMD cases

Type of farm	Time elapsed before depopulation (days)*	Percentage of viremic animals (pre-clinical + clinical) (%)	Percentage of recovered animals (%)
Swine (3,000 head)	9.2 (8-12)	85 (81-89)	3 (2-5)
Dairy cattle (2,000 head)	7.7 (6-11)	91 (90-92)	3 (1-5)
Feedlot cattle (5,000 head)	7.9 (6-11)	91 (90-92)	3 (1-5)

**: After 10,000 iterations (5th and 95th percentile values). Times are adjusted for each of the farm sizes. The time from detection to laboratory confirmation and from confirmation to starting the depopulation procedure was set at a total time of 48 h.*

Figures 9, 10 and 11 show the disease spread curve within a swine, dairy and beef cattle population for the first index case. As shown in the figures below at the time of depopulation there will be 2,300 viremic pigs, 1,400 viremic dairy cows and 3,500 viremic beef cattle.

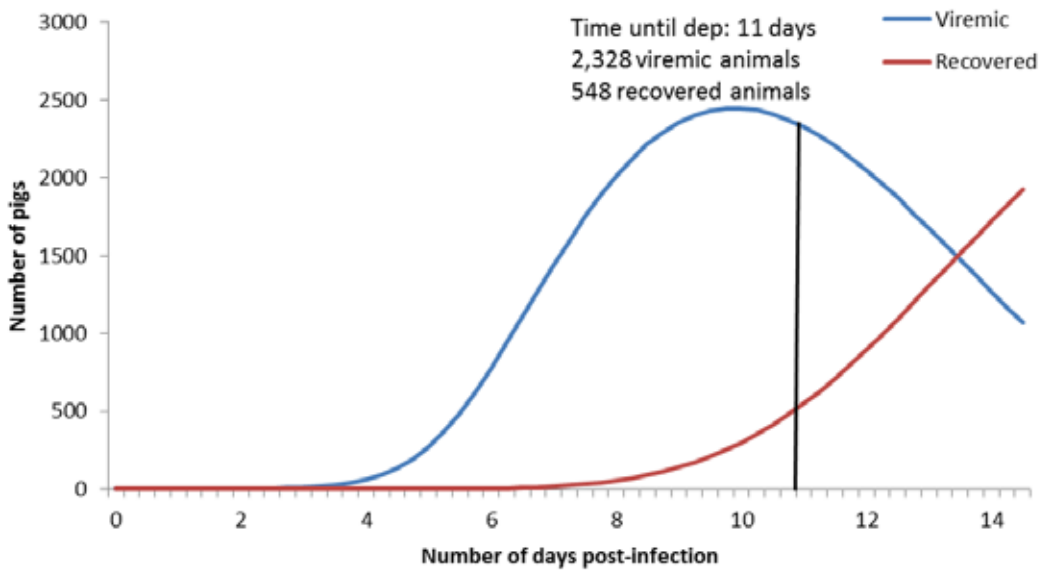


Figure 9: FMD curve in a 3,000 head swine farm during the first index case

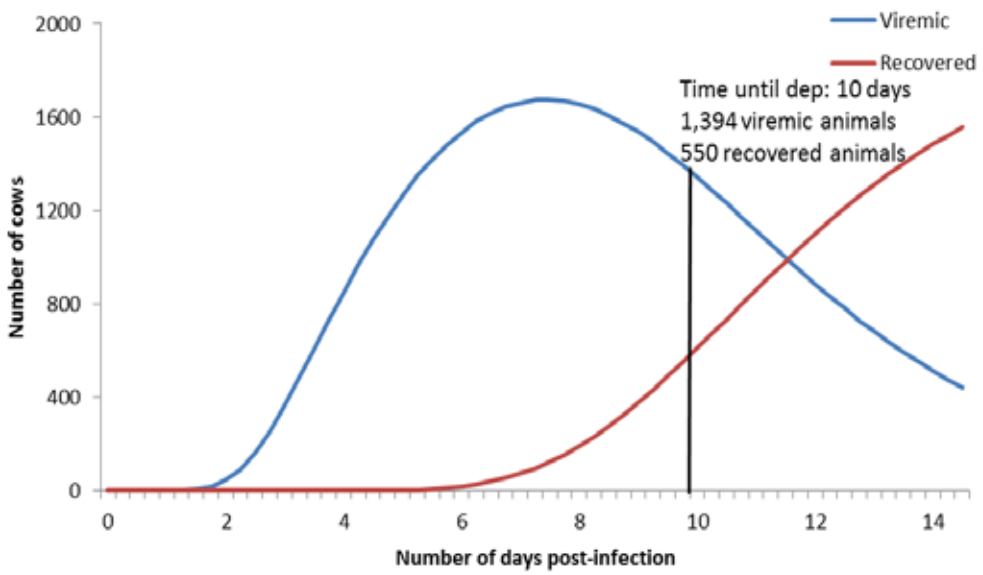


Figure 10: FMD curve in a 2,000 head dairy cattle farm during the first index case

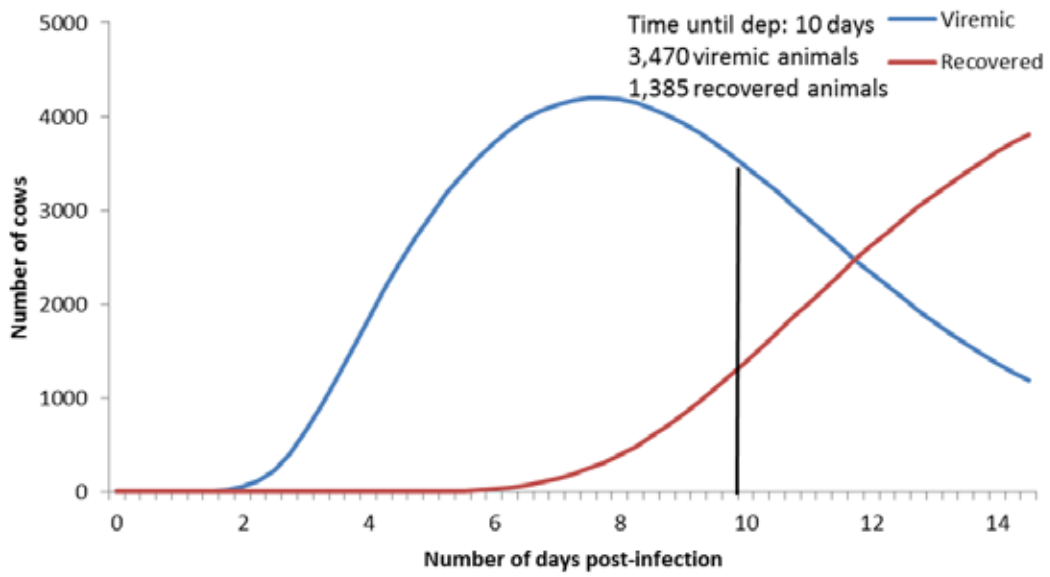


Figure 11: FMD curve in a 5,000 head feedlot beef cattle farm during the first index case

7.1.4. FMDv concentration in swine and cattle viremic carcasses

The concentration of FMDv observed in fresh tissues of pig skeletal muscle, fat, blood, lymph nodes and bone marrow in literature studies was from 6.31 PFU/g to $10^{9.6}$ ID_{50}/g for pigs (Table 14). It is worth noting the majority of reports were based on the 'worst-case scenario', where pigs were inoculated with high virus titers (Mebus C, 1997). The studies suggest that the greater quantities of virus were detected in pig blood, bone marrow or lymph nodes ((Alexandersen S, 2001); (Sellers R, 1971); (Chou CC, 2004); (Mebus CA ,1993); (Savi P, 1962)). The lowest quantities of virus were found in fat and muscle ((Mebus CA 1993); (Chou CC, 2004)). Given the high viral titers found in the various tissues, it is highly likely that FMDv would be present in the pig carcass tissues.

Table 14: Titers of FMDv present in select tissues, excretions and secretions of pigs after slaughter

Source of tissue, secretion, or excretion	Initial virus inoculation	Virus concentration at slaughter	Reference
Skin	10^7 $TCID_{50}$ (0.5 mL inoculum)	10^9 $TCID_{50}$/g	(Alexandersen S, 2001)
Pharynx		10^5-10^6 $TCID_{50}$/g	
Blood	$10^{7.5}$ $TCID_{50}$/mL	$10^{2.5}$-$10^{3.75}$ DCP_{50}/mL	(Savi P, 1962)

Source of tissue, secretion, or excretion	Initial virus inoculation	Virus concentration at slaughter	Reference
Blood clot	10^6 $TCID_{50}$ (0.5 mL inoculum)	$10^{4.8}$ $TCID_{50}$/g	(Chou CC, 2004)
Lymph node		$10^{3.8}$ $TCID_{50}$/g	
Muscle		ND	
Foot epithelium	NP	$10^{9.6}$ ID_{50}/g	(Sellers R, 1971)
Blood		$10^{7.2}$ ID_{50}/mL	
Bone marrow		$10^{6.1}$ ID_{50}/g	
Liver		$10^{5.6}$ ID_{50}/g	
Feces		$10^{2.9}$ ID_{50}/g	
Lymph node	$10^{8.9}$ $TCID_{50}$/mL	$10^{4.1}$ PFU/g (black pigs) $10^{2.7}$ PFU/g (white pigs)	(Mebus CA, 1993)
Blood		$10^{4.3}$ PFU/mL (black pigs) $10^{2.8}$ PFU/mL (white pigs)	
Bone marrow		$10^{2.7}$ PFU/g (black pigs) 10 PFU/g (white pigs)	
Fat		~6.31 PFU/g (black pigs) 1.58 PFU/g (white pigs)	
Muscle		ND*	
Blood	$10^{8.9}$ $TCID_{50}$/mL	$10^{3.6}$ PFU/mL	(Mebus C, 1997)
Lymph node		$10^{3.4}$ PFU/mL	
Bone marrow		$10^{1.9}$ PFU/mL	
Fat		~3.16 PFU/mL	
Muscle		~1.1 PFU/mL	
Muscle	$10^{7.5}$ PFU/mL	$>10^5$PFU/mL	(Panina, GF 1989)
Fat		$>10^5$PFU/mL	
Muscle psoas	NP	$10^{1.4}$-$10^{2.6}$**	(Dhenin L, 1980)

Source of tissue, secretion, or excretion	Initial virus inoculation	Virus concentration at slaughter	Reference
Shoulder muscle		$10^{0.3}$-$10^{4.0}$	
Tenderloin muscle		$10^{1.0}$-$10^{1.4}$	
Lymph node		$10^{2.5}$-$10^{4.0}$	
Fat		$10^{1.0}$-$10^{2.6}$	
Tonsils		$10^{2.0}$-$10^{4.0}$	

NP: None reported

ND*: None detected - The average titer of the sampled pigs was slightly greater than 0 PFU/g, with two samples with titers 10 PFU/g

**: Units not reported

$TCID_{50}$ (Median Tissue culture infectious dose) = The amount or quantity of a pathogenic agent (e.g. FMDv) required to produce a damaging effect to 50% of cells in the tissue inoculated.

PFU (Plaque forming units) = Provides an estimation of the number of infectious viral particles present by measuring the number of clear areas (areas of cell lysis) that are formed for a given culture plate area. One PFU equals about 1.4 $TCID_{50}$ for FMDv based on the equation by Horzinek (Horzinek MC, 1985).

Detectable viral titers in different cattle tissues ranged from $10^{2.5}$ PFU/g to $10^{10.6}$ PFU/g (Table 15). As was the case with swine, the majority of reports in cattle were based on the 'worst-case scenario', where cattle were inoculated with high virus titers. The studies suggest that the greater quantities of virus were detected in heart muscle, adrenal glands, pharynx and lymph nodes (Burrows R, 1966). The lowest quantities of virus were found in nervous tissue and spleen ((Scott FW, 1965); (Cottral GE, 1969)). Given the high viral titers found in these tissues, it is highly likely that FMDv would be present in cattle carcass tissues.

Table 15: Titers of FMDv present in select tissues, excretions and secretions of cattle after slaughter.

Source of tissue, secretion, or excretion	Initial virus inoculation	Virus concentration at slaughter	Reference
Pharynx	-	10^{7}	(Burrows R. 1966)

Source of tissue, secretion, or excretion	Initial virus inoculation	Virus concentration at slaughter	Reference
Blood	$10^{5.0}$ bovine ID_{50} U virus	$10^{5.6}$ PFU/g	(Cottral GE, 1969)
Semen	-	$10^{6.2}$ $TCID_{50}$/mL	(Sellers RF, 1968)
Milk	-	$10^{6.6}$ $TCID_{50}$/mL	(Donaldson AI, 1987)
Bone marrow	$10^{5.0}$ bovine ID_{50} U virus	$10^{5.9}$ PFU/g	(Cottral GE, 1969)
Lymph nodes	-	$10^{8.2}$ PFU/g	(Burrows R, 1981)
Heart muscle		10^{10} PFU/g	
Adrenal gland		$10^{10.6}$ PFU/g	
Thyroid gland	$10^{5.0}$ bovine ID_{50} U virus	$10^{6.0}$ PFU/g	(Cottral GE, 1969)
Pancreas		$10^{6.4}$ PFU/g	
Liver		$10^{3.6}$ PFU/g	
Rumen		$10^{6.4}$ PFU/g	
Spleen		$10^{3.1}$ PFU/g	
Kidney		$10^{4.0}$ PFU/g	
Cerebrum	-	$10^{2.5}$ PFU/g	(Scott FW, 1965)
Spinal cord		$10^{3.2}$ PFU/g	
Pineal body		$10^{4.3}$ PFU/g	
Pituitary		$10^{6.8}$ PFU/g	
Skin/Hides	-	$10^{6.0}$ PFU/g	(Gailiunas P, 1966)

7.1.5 FMDv concentration in the disposal truck

Tables 16 and 17 show the weight ranges of different production phases and animal capacity at different size options for the standard rendering truck trailer. The concentration of the FMDv in

the disposal truck will depend on the number of viremic carcasses and the virus concentration per carcass. Table 17 shows that the total amount of FMDv contained in a 50000 lbs disposal truck is between $2x10^{11}$ and $2x10^{14}$ Plaque Forming Units. This FMDv concentration is 6-12 times higher than the minimum infectious dose for cattle, pig and sheep for the inhalation route. Any small amount of body fluids escaping the truck would contain enough quantity of virus to potentially infect susceptible population.

Table 16: Weight ranges of different species, depending on the production phase.

Dairy	**Weight Ranges (lbs.)**
Calf (birth)	55-100
Yearling (12 months)	520-1100
Adult Cows/Bulls	800-1700
Beef	
Calf (birth)	60-100
Weaning (6-10 mo.)	450-700
Market wt. (18-22 mo.)	1200-1400
Swine	
Nursery pig	up to 55
Grower pig	55-154
Finisher pig	154-330

Table 17: Number of carcasses in a disposal truck, depending on the capacity

Animal weight (lbs)	**Disposal Vehicle Weight Capacity**		
	Trailer Weight Capacity (40,000 lbs) Trailer Length (ft) 28'	**Trailer Weight Capacity (45,000 lbs) Trailer Length (ft) 32'**	**Trailer Weight Capacity (50,000 lbs) Trailer Length (ft) 40'**
	Number of carcasses per X lbs		
10	4000	4500	5000
25	1600	1800	2000
50	800	900	1000
100	400	450	500
200	200	225	250
300	133	150	167
400	100	113	125
500	80	90	100
600	67	75	83
700	57	64	71

800	50	56	63
900	44	50	56
1000	40	45	50
1100	36	41	45
1200	33	38	42
1300	31	35	38
1400	29	32	36
1500	27	30	33

Table 18: Total amount of FMDv per disposal truck and growth phase

Type of farm	Number of carcasses per truck (40')	% of viremic carcasses	Number of viremic carcasses	Total amount of FMDv per truck (40') (PFU)*
Calf Dairy cows	500	78%	390	$2x10^{14}$
Yearling Dairy cows	45		35	
Adult Dairy cows	29		23	
Calf beef cow	500		390	
Weaning beef cow	71		55	
Market beef cow	36		28	
Nursery pig	1000	82%	780	$2x10^{11}$
Grower pig	350		273	
Finisher pig	150		117	

*: Average FMDv concentration per carcass is 10^6 PFU/g for cattle carcasses and 10^3 PFU/g for swine carcasses.

Table 19: Selected estimated Minimum Infectious Doses (TCID50) for cattle, sheep and pigs by route of exposure [1, 2, 3]

Species	Inhalation	Nasal inoculation	Oral
Cattle	10	10^4-10^5	10^5-10^6
Sheep	10	10^4-10^5	10^5-10^6
Pigs	>800	Unknown	10^4-10^5

[1]: Doses are given as $TCID_{50}$ (50% bovine thyroid tissue culture dose endpoint estimates).
[2]: One PFU equals about 1.4 TCID50 for FMDv.
[3]: Source: Alexandersen S. Q., 2003; Donaldson AI, 1987.

7.2. Likelihood that transportation of carcasses will produce leakage and spillage of fluids contaminated with FMDv

Summary: The volume of body fluids of carcasses will vary depending on the growth phase, body weight and species. The time from depopulation to movement of carcasses to the disposal site will be very short (as a matter of hours), so the potential for body fluids to escape from carcasses (leachate) will be minimized. Mitigation measures such as sealed tailgate, tarp cover and the use of Bio-Zip™ bags will minimize the likelihood of leakage and spillage of carcass fluids from the disposal truck. Likelihood estimation: **The likelihood of leakage and spillage of carcass fluids from a standard rendering truck (sealed tailgate and tarp cover) will be low. Adding a Bio-Zip™ bag will reduce the likelihood to between low and negligible for any type of truck. The rest of the scenarios (roll-off/dump trucks with/without tarp covering and liner) will have risk levels higher than low.**

7.2.1. Carcass fluids

7.2.1.1. Leachate, Leakage and Spillage

Leachate is the liquid that is produced by the decomposition of livestock carcasses when water travels through a burial site and picks up products from decomposing carcasses and carries them through the soil. This is a process that follows euthanasia as the carcass starts to decompose. Through literature search and expert opinion, ranges of leachate production for livestock were quantified. Mammals are approximately 70% water and, as they decompose, they turn into a compost-like material capable of holding onto about 50% of that water (e.g., in a 50 lb. carcass, 17.5 lb. of body weight will be lost during the leachate process). Due to the short time elapsed between euthanasia and disposal, post-mortem autolysis will be minimal. Leachate as a potential contributor to spillage will, thus, not be considered further in this risk assessment. If time to disposal following euthanasia is extended, leachate may become more significant and warrant further consideration.

Leakage is the volume of liquid matter (including feces, urine, blood, ingesta, serum, saliva, etc.) that could be released from the carcass upon euthanasia, but is not part of the decomposition process. This can happen post-mortem through various means, such as loss of sphincter tone, through maneuvering of carcasses, and through the site of euthanasia (e.g. captive bolt entry point). Leakage is a factor that could facilitate the release of FMDv from the truck during movement. Spillage is when carcass fluid from leachate or leakage spills out from the conveyance source into the environment and could potentially contribute to the spread of FMDv.

7.2.1.2. Amount of Carcass Fluids

The table below summarizes the estimated body fluid volumes for cattle (both dairy and beef), as well as swine at different life stages. This is based on fluid volume comprising about 70% of total weight for most mammals. About two-thirds of these fluids are intracellular. So for example, based on total body fluids on a per weight basis, the volume range for potential leakage under worst case scenario for a calf (beef or dairy) would range from 6 to 20 liters. The volume of potential leakage from a nursery pig would range from 2 to 6 liters. These fluid quantities provide a reference for the total potential volume of leakage by weight and species. They are not considered an estimate of expected leakage.

Table 20: Volume of Body Fluids found in Cattle and Swine

Cattle	**Calf (birth)** - Min	Max	**Weaning (6-10 mo.)** - Min	max	**Market wt. (18-22 mo.)** - Min	max
Weight, kg (lbs)	27 (59)	45 (99)	204 (449)	318 (700)	544 (1197)	810 (1782)
Total Body Fluid Volume (L)	19	32	143	223	381	567
Total Free Fluid Volume (that which is not intracellular) (L)	**6**	**10**	**48**	**74**	**127**	**189**
Swine	**Nursery pig** - Min	Max	**Grower pig** - Min	max	**Finisher pig** - Min	max
Weight, kg (lbs)	10 (22)	25 (55)	26 (57)	70 (154)	70 (154)	150 (330)
Total Body Fluid Volume (L)	7	18	18	49	49	105
Total Free Fluid Volume (that which is not intracellular) (L)	**2**	**6**	**6**	**16**	**16**	**35**

7.2.2. Potential for Leakage and Spillage of Carcass Fluids during Movement

In consulting with rendering industry experts on the typical amounts of leakage from fresh, intact carcasses under normal conditions, the body fluids normally remain in the carcass. In a full load of a standard rendering truck (29–1000 carcasses), the amount of leakage that was estimated by expert opinion was around 20 liters per load. The table below summarizes the likelihood of leakage and spillage of carcass fluids from intact carcasses during transport, with or without

further mitigation measures. The tarp covering will provide protection against aerosolization and spillage of carcass fluids, and the Bio-Zip™ bag will provide full protection for any of the possible pathways. The liner would provide a leak-proof barrier for fluids with a full-containment of carcasses and may aid in preventing spillage. It is not, however, sealed containment, such as with the sealed leak-proof tailgate or the Bio-Zip™ bag.

Table 21: Leakage and Spillage of carcass fluids during conveyance

Comparison of Conveyance Methods and Mitigations	Likelihood
Standard Rendering Truck (sealed tailgate)*	
With tarp covering, and Bio-Zip™ bag	Negligible
With tarp covering	Low
With Bio-Zip™ bag (uncovered)	Negligible
Uncovered	Moderate
Roll-off Truck/Dump Truck (no seal properties)*	
With tarp covering, liner and Bio-Zip™ bag	Negligible
With tarp covering and liner	Low to Moderate
With tarp covering and Bio-Zip™ bag	Negligible
With liner only (uncovered)	Moderate to High
With Bio-Zip™ only (uncovered)	Low

*: Capacity: 28', 32', 40'

From the table, it can be concluded that the use of a Bio-Zip™ bag, with any of the vehicle types, will produce a negligible to low risk of leakage and spillage of fluids during conveyance. The scenario of the standard rendering truck or roll-off and dump truck without tarp covering would have a moderate to high likelihood of spillage, due to the proximity of carcasses to the top of the trailer in a full load. Without mitigations to prevent spillage from the truck (i.e. tarp), carcass fluids may have the potential to escape

7.3. Likelihood that transportation of carcasses will produce aerosolization of FMDv particles

Summary: Bioaerosol is a complex field of science where multiple parameters (e.g.., environmental, climatic) can affect the survival and air transmission of FMDv. Likelihood estimation: **The overall likelihood of bioaerosols emanating from a trailer and spreading infectious virus through carcass transportation activities is estimated as negligible to low if conveyance is in a standard rendering truck with tarp covering. If aerosols could be**

produced from the carcass leakage, there is a moderate likelihood they could then move into the airstream.

7.3.1. Bioaerosol Science

Aerosols refer to an assortment of liquid or solid particles suspended in a gaseous medium (Gilbert Y 2009). Bioaerosols are aerosols that contain microorganisms, such as bacteria, fungi, and viruses—or organic compounds (endotoxins, metabolites, toxins, proteins from animals and plants, and other microbial fragments) (Macher J, 1999). The science of bioaerosols is extremely complex and requires an understanding of microbiology, biology, chemistry, meteorology, and aerosol physics (Mohr A, 2005). The sections below focus on the key points for general bioaerosol behavior that may pertain to FMDv associated bioaerosols. The ability to generate bioaerosols depends on the source, aerosolization mechanisms, environmental conditions, and composition (Pillai SD, 2002). Bioaerosols vary in size from 20 nm to >100 µm in diameter. Almost any environmental reservoir for microorganisms, such as fresh and marine surface waters, soil, plants, wastes and animals, is susceptible to being a source of bioaerosols.

Bioaerosols generated from water sources are generally surrounded by a thin layer of liquid that rapidly evaporates to give droplet nuclei. Droplet nuclei are the dried residue of larger aerosols that can remain airborne indefinitely on air currents. Transport of bioaerosols, and survival of airborne microorganisms, are influenced by many physical and environmental factors. The size, shape, and density of bioaerosols are of particular significance to transport because they are related to the aerodynamic diameter, which controls the settling velocity ((Cox C, 1995) (Mohr A, 2007)). Bioaerosols between 1 and 5 µm normally follow the pathlines of surrounding air, making them less susceptible than larger particles to impact surfaces and deposition (Mohr A, 2007).

7.3.2. Bioaerosols and FMDv

The airborne transmission of FMDv aerosols is complex. Windborne transport of virus can occur under specific epidemiological, climatic, and meteorological conditions, but is very uncommon. Prevailing climatic conditions, particularly wind speed and the vertical temperature structure, are major determinants of physical decay of aerosols. This is also influenced by the roughness of the surface over which the air plume travels. The survival of FMDv in plumes is likely across seaways, as the surface turbulence is low and concentrations of airborne particles can be maintained for greater distances than over land (Gloster J, 2005). The stability of FMDv is affected by radiation, RH, temperature, and weather factors. RH is the major meteorological

determinant affecting virus survival. It has been established that the virus is stable in aerosols at a RH above 60 percent and at temperatures below 33°C (91°F). Sunlight and a pollution complex termed "the outside air factor" have minimal direct effect on virus survival (Donaldson AI, 1975). The aerosols, once airborne, are subject to both physical and biological loss. Biologically, the virus may become inactivated if the RH of the air falls below 60 percent or the water vapor pH of the aerosol particle becomes acidic or alkaline (Gloster J, 2004). In the absence of turbulence, particles greater than 10 µm are likely to be removed from the atmosphere within minutes. Smaller particles may remain airborne for several hours and be carried many kilometers in the wind (Gloster J, 2007). Particles of 5 µm or less act as vapors and can move in and follow an airstream without impacting obstacles; this is the size of particle that represents the worst risk. It is unknown if bioaerosols from leakage of carcass fluids would require the same type of environmental conditions to remain viable and potentially lead to infection of susceptible livestock.

7.3.3. Expert Opinion on Bioaerosolization

There are no studies on carcass bioaerosols production in the literature. Bioaerosol science is a very complex field, and aerosol characteristics and behavior are measured quantitatively using sophisticated sampling methods and equipment. Questions on aerosol behavior cannot be accurately modeled mathematically, as it requires knowledge of the concentration of aerosols, the size distribution of aerosols, the media composition, and the environmental/atmospheric conditions under which they are generated. Due to the lack of information on carcass aerosols, the experts' opinions and rationale were based on extrapolation of their knowledge in aerosol science. All of the experts agreed that experimentation is required to accurately answer these questions and to validate their opinions.

We queried three bioaerosol experts on the potential for generation of bioaerosols during transport and the expected behavior of the aerosols. The experts have different professional backgrounds and expertise within the field of aerosol science. The list of experts interviewed, the questions asked and a summary table of their answers are presented in Appendix G: Expert Opinion – Aerosols. Responses were compiled and compared for consensus between experts. The explanation of aerosol behavior varied slightly among experts, but the overall conclusions of the probability of occurrence of bioaerosols did not vary significantly. Expert opinion consensus was that the likelihood of aerosolization in an uncovered rendering vehicle during transportation was negligible to moderate. When the rendering vehicle was covered during transportation, expert opinion consensus was that the likelihood of aerosolization was negligible to low.

Table 22: Summary of bioaerosol responses from experts.

Questions posed to the experts	Expert 1	Expert 2	Expert 3
Aerosolization in uncovered rendering vehicle during transportation			
What is the likelihood (see chart) of significant aerosolization of carcasses fluids during transportation?	**Moderate**	**Low**	**Negligible**
What is the likelihood that a significant portion of the aerosolized particles be less than 10 µm in size	**Moderate**	**Low**	**-**
If aerosols could be produced from the carcass leakage, what is the likelihood they could then move into the airstream at a farm?	**High**	**Moderate**	**-**
Aerosolization in covered rendering vehicle during transportation			
What is the likelihood (see chart) of significant aerosolization of carcasses fluids during transportation?	**Low**	**Negligible**	**Negligible**
What is the likelihood that a significant portion of the aerosolized particles be less than 10 µm in size	**Low**	**-**	**-**
If aerosols could be produced from the carcass leakage, what is the likelihood they could then move into the airstream at a farm?	**Moderate**	**-**	**-**

7.3.4. Potential for Aerosolization of Carcass Fluids during Movement

The likelihood estimate was based on the review of expert opinion, observation of truck design and operations, and current knowledge of FMDv epidemiology. The overall likelihood of bioaerosols emanating from a trailer with potential for spreading infectious virus through carcass transportation activities is estimated as low to moderate, if conveyance is in an uncovered standard rendering truck. When using a tarp covering, the likelihood was reduced to negligible-low, and with a Bio-Zip™ bag to negligible. In this case, if aerosols could be produced from the carcass leakage, there is a moderate to high likelihood they could then move into the airstream. Experts rated the likelihood of FMDv moving from the airstream into farms along the truck route as between moderate and high when trailer is uncovered, and between negligible to moderate when covered.

Table 23: Aerosolization of virus particles during conveyance

Comparison of Conveyance Methods and Mitigations	Likelihood
Standard Rendering Truck (sealed tailgate)*	
With tarp covering, and Bio-Zip™ bag	Negligible
With tarp covering	Negligible-Low
With Bio-Zip™ bag (uncovered)	Negligible
Uncovered	Low-Moderate
Roll-off Truck/Dump Truck (no seal properties)*	
With tarp covering, liner and Bio-Zip™ bag	Negligible
With tarp covering and liner	Negligible-Low
With tarp covering and Bio-Zip™ bag	Negligible
With liner only (uncovered)	Low to Moderate
With Bio-Zip™ only (uncovered)	Negligible

*: Capacity: 28', 32', 40'.

8. Exposure Assessment

The exposure assessment is an evaluation of the potential exposure pathways by which susceptible animals could be exposed to infectious amounts of FMDv. There are four major aspects of the exposure assessment: the exposed population, the pathway of exposure, the magnitude of exposure, and the likelihood of exposure. For the purpose of this assessment, the population of interest is primarily susceptible agriculture livestock species. The potential pathways for exposure are through the cross-contamination of trucks, personnel or equipment by FMDv contaminated carcass fluids, and exposure to aerosolized particles. These events and the factors associated with virus survival and infectiveness are uncertain.

For the exposure assessment of this risk assessment, the use of a standard rendering truck was assumed. In the entry assessment, the likelihood of the FMDv to be released during transportation was estimated to be between negligible to low (both for aerosolization and spillage). Based on the proposed mitigations in this assessment and the apparent effectiveness on the likelihood of virus to be released by the movement of carcasses, we conclude that the likelihood of exposure to FMDv by susceptible populations during the movement of infected carcasses will be **negligible**.

9. Risk Estimation

The risk of FMD infection of susceptible livestock associated with the movement of swine and cattle carcasses by leakage, spillage and aerosolization of carcass fluids will be **negligible** when using a standard rendering truck (tailgate sealed and tarp cover) and a Bio-Zip™ bag, between **negligible and low** when using a standard rendering truck or a roll-off /dump truck with a Bio-Zip™ bag. Other scenarios (uncovered standard rendering trucks, uncovered roll-off/dump trucks, covered roll-off/dump trucks and a liner) will have risk levels higher than low (**moderate to high**).

10. Conclusions

The following conclusions were drawn from this report:

- Conveyances evaluated will contain carcasses with a total FMDv amount that will exceed in several degrees of magnitude the minimum FMD infective dose for pigs and cattle.

- The use of Bio-Zip™ bags is an effective mitigation to reduce the risk of leakage and aerosolization to negligible in standard rendering trucks and to low in the other conveyance types.

11. Recommendations for further research

An important goal of the risk assessment process is to inform the risk managers about the data gaps encountered during the production of the document and research strategies to fulfill the data gaps, in order to decrease the uncertainty in the risk estimation.

A review of the literature on FMDv in cattle and swine indicated the following data gaps, research needs and uncertainties:

1. The amount of virus that would be present in naturally infected animals and their tissues. It may be significantly lower than the doses that have been used in scientific research. Some variables that could be studied include: strains of FMDv, post-exposure intervals, age/size of pig/cattle.
2. Data on infectivity of waste materials (i.e. aerosols, liquids, and solids) generated during 3D operations (i.e. Depopulation, Disposal, and Decontamination).
3. Confirmation on how FMD infected carcasses will be classified for transportation purposes, especially under the circumstances of mass depopulation, with the possibility that infected carcasses could be designated with a different classification. In the case of a FMD outbreak, it is possible that the Federal HazMat Transport Regulations could be used to cover transportation. However, the Code of Federal Regulations 49 CFR Part 175 addresses the movement of test samples and vials, but not intact infected carcasses.
4. New modeling approaches that contain the aerosol route of infection or cross-contamination within groups (personnel and equipment) need to be explored.
5. Research on the aerosolization of FMD is limited or lacking. Expert opinion was used in this assessment, but targeted research would add additional data and confidence to the issue.

Acknowledgments

This project was developed in funded through a sub-award with West Texas A&M University through USDA-APHIS and DHS. We sincerely thank all those who contributed to the planning, writing, reviewing and expert opinion and contributed to the development of this risk assessment including: Kristen Johnson (University of Minnesota), Sasi Malladi (University of Minnesota), Dyan L. Pratt (University of Saskatchewan), Kristen Tom Beseman (Central Bi-Products) Thomas Kuehn and Peter Raynor (University of Minnesota), Shawn M. Guetter (Redwood Metal Works), Lori P. Miller (Department of Homeland Security), Robert E. De Otte Jr. and Donald Topliff, (West Texas A&M University), David Finch (Texas Animal Health Commission), Curtis Morgan (Texas A&M Transportation Institute), Michael Mays and Jimmy Tickel (North Carolina Department of Agriculture and Consumer Services), Darrel Styles (USDA APHIS), Peter Davies (University of Minnesota).

Contributors:

Jamie Slingluff, DVM, MS
Veterinary Public Health and Preventive Medicine Resident
Center for Animal Health and Food Safety
University of Minnesota College of Veterinary Medicine

Fernando Sampedro, PhD
Risk Analyst/Assistant Professor
Center for Animal Health and Food Safety
University of Minnesota College of Veterinary Medicine

Timothy J. Goldsmith DVM, MPH, DACVPM
Assistant Clinical Professor
Center for Animal Health and Food Safety
University of Minnesota College of Veterinary Medicine

Reviewed by:

Robert E. De Otte Jr., Ph.D., P.E., P.G.
Professor of Civil & Environmental Engineering
School of Engineering & Computer Science
West Texas A&M University

Vanessa Spradlin
Research Assistant
School of Engineering & Computer Science
West Texas A&M University

Carie Alexander DVM
Graduate Research Assistant
Center for Animal Health and Food Safety
University of Minnesota

Curtis A. Morgan
Program Manager, Multimodal Freight Programs,
Texas A&M Transportation Institute (TTI)

Lori P. Miller, PE
3D/WARRP Program Manager,
Agricultural Defense Branch
Department of Homeland Security
Science and Technology Directorate

Michael Mays
North Carolina Department of Agriculture and Consumer Services

References:

Alexandersen S, Oleksiewicz MB, Donaldson AI. "The early pathogenesis of foot-and-mouth disease in pigs infected by contact: a quantitative time-course study using TaqMan RT-PCR." *J Gen Virol*, 2001: 82:747-55.

Alexandersen S, Quan M, Murphy C, Knight J, Zhang Z. "Studies of quantitative parameters of virus excretion and transmission in pigs and cattle experimentally infected with foot-and-mouth disease viru." *J Comp Pathol*, 2003a: 129(4):268.

Alexandersen S, Mowat N. "Foot-and-mouth disease: host range and pathogenesis." *Curr Top Microbiol Immunol*, 2005: 288; 9-42.

Alexandersen S, Zhang Z, Donaldson AI, Garland AJ. "The pathogenesis and diagnosis of foot-and-mouth disease." *J Comp Pathol*, 2003b: 129(1):1-36.

Biosecurity Australia. *Guidelines for Import Risk Analysis, Draft.* Australia: Biosecurity Australia, Agriculture Fisheries and Forestry-Australia, 2001.

Burrows R, Mann JA, Garland AJM, Greig A, Goodridge D. "The pathogenesis of natural and simulated natural foot-and-mouth disease infection in cattle." *Journal of Comparative Pathology*, 1981: Volume 91, Issue 4, October 599-609.

Burrows R. "Studies on the carrier state of cattle exposed to foot-and-mouth disease virus." *Journal of Hygiene*, 1966: 64: 81-90.

Carpenter TE, Thurmond MC, Bates TW. "A Simulation Model of Intraherd Transmission of Foot and Mouth Disease with Reference to Disease Spread before and after Clinical Diagnosis." *Journal of Veterinary Diagnostic Investigation*, 2004: 16(1): 11-16.

Chou CC, Yang SE. "Inactivation and degradation of O Taiwan97 foot-and-mouth disease virus in pork sausage processing. 21(6)." *Food Microbiology*, 2004: 737-742.

Code of Federal Regulations and Federal Register. "Title 9, Chapter III, Subchapter A, Part 325, Section 325.21." *Accessed By :http://federal.eregulations.us/cfr/section/title9/chapterIII/part325/sect325.21?selectdate=11/1/2011.* Code of Federal Regulations and Federal Register, n.d.

Cottral GE. "Persistence of foot-and-mouth disease virus in animals, their products and the environment." *Bull Off Int Epizoot* , 1969: 70(3):549-68.

Cox C, Wathes C. *Bioaerosols Handbook.* In Lewis Publication, 1995.

Dhenin L, Frouin A, Gicquel B, Bidard JP, Labie J. "Risques de dissemination de la fièvre aphteuse par des produits de charcuterie. Survie du virus aphteux dans le saucisson sec." *Bull. Acad. Vet. Fr.*, 1980: 53: 349-355.

Dietz K, Schenzle D. "Proportionate mixing models for age-dependent infection transmission." *Journal of Mathematical Biology*, June 1985: Volume 22, Issue 1, pp 117-120.

Dimmock NJ. "Differences between the thermal inactivation of picornaviruses at "high" and "low" temperatures." *Virology 31*, 1967: 338-353.

Donaldson AI, Alexandersen S. "Relative resistance of pigs to infection by natural aerosols of FMD virus." *Vet Rec*, 2001: 148, 600-60.

Donaldson AI, Ferris NP. "The survival of foot-and-mouth disease virus in open air conditions." *J Hyg (Lond)*, 1975: 74, 409-416.

Donaldson AI, Gibson CF, Oliver R, Hamblin C, Kitching RP. "Infection of cattle by airborne foot-and-mouth disease virus: minimal doses with O1 and SAT 2 strains." *Res Vet Sci.*, 1987: Nov;43(3), 339-46.

Dungan RS. "Fate and transport of bioaerosols associated with livestock operations and manures." *J Anim Sci*, 2010: 88, 3693-3706.

Eble P, de Koeijer A, Bouma A, Stegeman A, Dekker A. "Quantification of within- and between-pen transmission of Foot-and-Mouth disease virus in pigs." *Vet Res*, 2006: 37(5): 647-54.

Gailiunas P, Cottral GE. "Presence and Persistence of Foot-and-Mouth Disease Virus in Bovine Skin." *J. Bacteriol.*, 1966: June vol. 91 no. 6 2333-2338.

Geering WA, Lubroth J. *Preparation of Foot-and-Mouth disease contingency plans; FAO Animal Health Manual (FAO), no. 16.* Rome, Italy: Food and Agriculture Organization of the United Nations, 2002.

Gilbert Y, Duchaine C. "Bioaerosols in Industrial Environments: a review." *Canadian Journal of Civil Engineering*, 2009: 36, 873-188.

Gloster J, Alexandersen S. "New Directions: Airborne transmission of foot and mouth disease virus." *Atmospheric Environment 38*, 2004: 503-505.

Gloster J, Freshwater A, Sellers RF, Alexandersen S. "Re-assessing the likelihood of airborne spread of foot-and-mouth diseaseat the start of the 1967-1968 UK foot-and-mouth disease epidemic." *Epidemiol. Infect. 133*, 2005: 767-783.

Gloster J, Williams P, Doel C, Esteves I, Coe H, Valarcher JF. "Foot-and-mouth disease - quantification and size distribution of airborne particles emitted by healthy and infected pigs." *Vet J*, 2007: 174, 42-53.

Horzinek MC. "Algemene virologie." *Uitgeverij Bunge*, 1985: Utrecht, The Netherland. As cited by J.J. Winjker et al 2007.

Jones AM, Harrison RM. "The effects of meteorological factors on atmospheric bioaerosol concentrations--a review." *Sci Total Environ*, 2004: 326, 151-180.

Kitching RP. "A recent history of foot-and-mouth disease." *J Comp Pathol 118(2)*, 1998: 89-108.

Kitching RP. "Clinical variation in foot and mouth disease: cattle." *Rev Sci Tech*, 2002: 21(3): 499-504.

Kitching RP., Knowles NJ, Samuel AR, Donaldson AI. "Development of foot-and-mouth disease virus strain characterisation--a review." *Trop Anim Health Prod*, 1989: 21(3):153-66.

Lighthart B. "Mini-review of the concentration variations found in the alfresco atmospheric bacterial populations." *Aerobiologia 16*, 2000: 7-16.

Lighthart B. *Physics of microbial bioaerosols.* New York, NY: Atmospheric Microbial Aerosols: Theory and Applications, 1994.

Macher J., Ammann H., Milton D., Burge H., Morey P. "Bioaerosols: Assessment and Control." *American Conference of Governmental Industrial Hygienists, Cincinnati, OH.*, 1999.

Mebus C, Arias M, Pineda JM, Tapiador J, House C, Sanchez-Vizcaino JM. "Survival of several porcine viruses in different Spanish dry-cured meat products: Mediterranean Aspects of Meat Quality as Related to Muscle Biochemistry." *Food Chemistry*, 1997: 59: 555-559.

Mebus CA, House C, Gonzalvo FR, Pineda JM, Tapiador J, Pire JJ, Bergada J, Yedloutschnig RJ, Sahu S, Becerra V, Sanchez-Vizcaino JM. "Survival of foot-and-mouth disease, African swine fever, and hog cholera viruses in Spanish serrano cured hams and Iberian cured hams, shoulder and loins. 10:2." *Food Microbiology*, 1993: 133-143.

Mohr A. "Aerosol (Aerobiology, Aerosols, Bioaerosols, Microbial Aerosols)." *In: Pilch, R., Zilinskas, R. (Eds.), Aerosol Vol. Encyclopedia of Bioterrorism Defense*, 2005.

Mohr A. *Fate and transport of microorganisms in air. In, Manual for Environmental Microbiology.* Washington, DC.: ASM Press, 2007.

Muilenberg M. *The outdoor aerosol. In Bioaerosols.* Boca Raton, FL: Lewis Publishers, 1995.

National Center for Animal Health Emergency Management. *Foot and Mouth Disease Response Plan: The Red Book.* In: USDA APHIS VS (Ed.), 2011.

OIE. *OIE Terresterial Manual, Foot and Mouth Disease.* OIE, 2008.

OIE Technical Disease Cards. *Foot and Mouth Disease.* n.d.

OIE, *Handbook on Import Risk Analysis for Animals and Animal Products. Vol. 1,2.* Paris, France: OIE publications, 2004.

Orsel K, Bouma A, Dekker A, Stegeman JA, de Jong MC. "Foot and mouth disease virus transmission during the incubation period of the disease in piglets, lambs, calves, and dairy cows." *Prev Vet Med*, 2009: 88(2):158-63.

Panina GF, Civardi A, Massirio I, Scatozza F, Baldini P, Palmia F. "Survival of foot-and-mouth disease virus in sausage meat products (Italian salami)." *Int J Food Microbiol*, 1989: 8(2): 141-8.

Parker J. "Presence and inactivation of foot-and-mouth disease virus in animal faeces." *Vet Rec*, 1971: 88(25): p. 659-62.

Pillai SD, Ricke SC. "Bioaerosols from municipal and animal wastes: background and contemporary issues." *Can J Microbiol*, 2002: 48: 681-696.

Savi P. "Presence and Persistence of Foot-and-Mouth Disease Virus in Meat and Meat Products from Cattle and Pigs." *Bull. Off. Inter. Epizoot.*, 1962: 57: 853-890.

Scott FW, Cottral GE, Gailiunas P. "Presence of foot-and-mouth disease virus in the pituitary and central nervous system of experimentally infected cattle." *Proceedings of the 69th Annual Mtg US Livestock Sanitary Assoc, USA.*, 1965.

Sellers R. "Quantitative aspects of the spread of foot and mouth disease." *Vet. Bull*, 1971: 41: 431-439.

Sellers RF, Burrows R, Mann JA, Dawe P. "Recovery of virus from bulls affected with foot-and-mouth disease." *Vet Rec.*, 1968: Sep 21;83(12): p 303.

USDA FAD PReP. *USDA FAD Prep Foreign Animal Disease Preparedness and Response Plan. APHIS Framework for Foreign Animal Disease Preparedness and Response Plan. March* . USDA FAD Prep, 2013.

USDA. *Farms, Land in Farms, and Livestock operations 2011 Summary, February 2012. (Annual report No. ISSN: 1930-7128).* United States Department of Agriculture, 2012.

USDA. *Geographically Independent Parameters Used to Simulate the Spread of Foot-and-Mouth Disease Using the North American Animal Disease Spread Model (NAADSM).* Animal and Plant Health Inspection Service, Veterinary Services, Centers for Epidemiology and Animal Health, 2012.

USDA. *Overview of the U. S. Hog Industry, National Agricultural Statistics Service, Agricultural Statistics Board, Oct 2009. (No. Hg 9 (10-09)).* United States Department of Agriculture, 2009.

USDA. *Overview of U.S. Livestock, Poultry, and Aquaculture Production in 2012.* USDA APHIS NAHMS, 2012

USDA. *Quarterly Hogs and Pigs, National Agricultural Statistics Service, Agricultural Statistics Board. (Quarterly report No. ISSN: 1949-1921) December 1,.* United States Department of Agriculture, 2012.

USDA. *Swine 2006, Part I: Reference of Swine Health and Management Practices in the United States. #N475.1007.* Fort Collins, CO: USDA:APHIS:VS, CEAH, 2007.

Appendix A: Model Disease Spread

This appendix provide additional information on the disease spread model used to simulate the spread of FMDv within a swine and cattle group and estimate the number of pig and cows in various disease states at different time periods. The disease states included in the module are susceptible (S), latent (L), pre-clinically infected stage (I), clinically infected (C) and (R) (Carpenter, 2004). The module updates the number of pig/cows in the disease states at specific time steps (e.g., every 6 hours). The uncertainties in input variables as well as the inherent variability associated with FMD infection course in a pig/cow and spread within the group were considered in the model.

Assumptions and Notation

We have the following notation for this section:

N- The number of pig/cows in the group.
$\boldsymbol{i}$ - index of pig/cows in the farm i $\in 1, \dots, N$
$\boldsymbol{t}$ - index of time periods. i $\in 1, \dots, t$
$\widehat{\boldsymbol{S}}\boldsymbol{(t)}$- Set of indices of pig/cows that are in a susceptible state in time period t
$\widehat{\boldsymbol{L}}(\boldsymbol{t})$- Set of indices of pig/cows that are in a latent state in time period t
$\widehat{\boldsymbol{SI}}(\boldsymbol{t})$- Set of indices of pig/cows that are in a pre-clinically infectious state in time period t
$\widehat{\boldsymbol{CI}}(\boldsymbol{t})$- Set of indices of pig/cows that are in a clinically infectious state in time period t
$\widehat{\boldsymbol{R}}(\boldsymbol{t})$- Set of indices of pig/cows that are in an immune state in time period t.
$\boldsymbol{P_t}$- The probability that a pig/cow that is susceptible in period *t* becomes infected with FMD by period t+1.
$N_i(t)$-The number of infectious pig/cows/cows/cows in time period *t.*

K-The adequate contact rate is defined as the expected number of contacts that a pig/cow has with other pigs/cows in a time period that are adequate to transmit FMD infection.

$I_{t,t+1}^{new}$-The number of newly infected pig/cows between period t and t+1.

$N_s(t)$- The number of susceptible pig/cows in period t.
$\tau^L(i)$- A model variable denoting the length of the latently infected period for a pig/cow in a specific simulation iteration. This parameter was simulated using an exponential distribution as detailed in section 9.3
$\tau^{SI}(i)$- A model variable denoting the length of the pre-clinically infectious period for a pig/cow/cow in a specific simulation iteration. This parameter was simulated using a lognormal distribution as detailed in section 9.3

$\tau^{CI}(i)$- A model variable denoting the length of the clinically infectious period for a pig/cow/cow in a specific simulation iteration. This parameter was simulated using a gamma distribution as detailed in section 9.3
$T^{L}(i)$- A model variable denoting the simulation time at which a pig/cow/cow *i* entered into latently infected state.
$T^{SI}(i)$- A model variable denoting the simulation time at which a pig/cow/cow *i* entered into pre clinically infectious state.
$T^{CI}(i)$- A model variable denoting the simulation time at which a pig/cow *i* entered into clinically infectious state.
λ- The number of hours represented by each time period *t* of the simulation model. λ was set at 6 hours in our simulations.
The main assumptions associated with this model are listed below

- The pig/cows that are in susceptible state in a time period, all have an identical probability of becoming infected by the next period, (i.e., differences in transmission due to grouping of pig/cows in pens are not considered).
- Pre-clinically infectious or clinically infectious pig/cows are both equally infective with respect to transmitting FMD, if they have an adequate contact with a susceptible pig/cow.
- The number of adequate contacts per pig/cow in a period follows the Poisson distribution.
- The variability in adequate contact rate due to differences in density of pig/cows (number of pig or cows per unit area) among different swine or cattle operations is not considered (i.e., the transmission is modeled as being frequency dependent).
- The clinically immune state is not considered in the model

The Transmission Equation

The transmission equation estimates the number of susceptible pig/cows that become newly infected with FMD in each time period. The transmission equation is based on calculation of the probability that a susceptible pig/cow has an adequate contact with at least one infected pig/cow in a time period. The variables considered in the equation include the adequate contact rate, the number of infectious pig/cows, the number of susceptible pig/cows and the total number of pig/cows in the farm. In general, a higher adequate contact rate or higher proportion of infectious pig/cows will lead to increased transmission. We use the transmission equation derived in Dietz and Schenzle (Dietz K, 1985) as shown in Equation 1. This transmission equation assumes that the number of adequate contacts each pig/cow has in a period is Poisson distributed with a mean (k). A Poisson process indicates a continuous and constant opportunity for an event to occur.

$$P_t = 1 - e^{-\frac{k(N_i(t))}{N-1}}$$

$$I_{t,t+1}^{new} \sim Binomial(S, P_t)$$

Transition between Different Disease States

The transmission equation provides the basis for calculating the number of pigs/cows transitioning from susceptible to the latently infected state in one time period. In this section, we briefly describe the implementation details for transitions between other disease states. As stated earlier, the model updates the disease states of the pig/cows in unit time steps (e.g., 6 hours). The transitions from latently infected to pre-clinically infectious, pre-clinically infectious to clinically infectious and from clinically infectious to recovered are based on keeping track of each individual pig/cow's length of each disease state and timing of when a pig/cow transitioned into a disease state. For instance, in the case of transitioning between the latent to preclinical infected state for a pig/cow, the model first calculates the length of the latent period for the pig/cow (τ^L) based on the latent time distribution. The model also keeps tracks of the time period when a pig/cow transitioned into the latently infected state (T^L). The model transitions the pig/cow from the latently infected to sub-clinically infected state in the first time period t where $t*\lambda \geq \tau^L + T^L$. Other disease state transitions are performed in a similar manner. The main input parameters for this section of the model are the probability distributions of latent, sub clinically infectious and clinically infectious time periods. The model can be run for a specified number of time periods and provides the estimates of number of pig/cows in various disease states

WM®

Bio-Zip™ Rev. 2.0

Sealable Liner

Technical Data **June 2007**

Product Description

The **BIO-ZIP™** *SEALABLE LINER* is a cleaner way of managing large volume biological waste streams and potential odor, leakage, disease, and environmental contamination issues. Constructed using proprietary coated layers of polypropylene-based material also featuring an industrial grade zippered sealing system, the **BIO-ZIP™** *Sealable Liner* fits securely inside industrial roll-off containers, trailers or truck racks from 10 to 40 cubic yards in total volume. It's easy to install, capable of containing large, heavy loads and will slips right out when it's time. ONE SIZE FITS ALL.

Typical Physical Properties and Performance Characteristics

A. Dimensions:

Approximate Nominal Thickness	**96 mil-105 mil**
Physical Dimension	**See attached Engineering Drawing**
Standard Folded Size	**44”W X 48”L X16”H**
Weight per unit	**98 lbs**

B. Typical Physical Properties and Performance Characteristics

Nylon Coil Zipper

PROPERTY	TEST METHOD	UNITS US
Crosswise Strength of Chain	ASTM D-2061-93	254 lbs
Holding Strength of Separable Units	ASTM D-2061-93	70.1 lbs
Resistance to Pull Off of Slider Pull	ASTM D-2061-93	141.8 lbs
Salt Spray Exposure		Operational and Functional

Typical Physical Properties and Performance Characteristics *(Continued)*

6000 DENIER Thread

PROPERTY	TEST METHOD	UNITS US
Construction		1000 denier 6ply continuous filament
Elongation	ASTM D-882	17%
Tensile	ASTM D-882	105 lbs
Finish		Silicone 4%-6%

7.5 oz Inner Coated Water Proof Layer (proprietary coating)

PROPERTY	TEST METHOD	UNITS US
Weight		7.4oz
Thickness	ASTM D-5199	86.0 mils
Coating	ASTM D-5199	3mils
Grab Tensile	ASTM D-4632	290 lbs
Elongation	ASTM D-822	45%
Mullen Burst	ASTM D-3786	350 psi
Trapezoidal Tear Strength	ASTM D-4533	50 lbs
Puncture Strength	ASTM D-4833	120 lbs

3.0 oz Coated Polypropylene Outer Layer (proprietary coating)

PROPERTY	TEST METHOD	UNITS US
Weight	ASTM D-1910	3.7 oz/yd2
Thickness	ASTM D-5199	11mill min
Tensile Strength Warp	ASTM D-4623	140 lbs
Tensile Strength Weft	ASTM D-4632	132 lbs
Puncture	ASTM D-4355	69 lbs

C. Environmental Resistance

PROPERTY	TEST METHOD	UNITS US
7.5 oz Inner Water Proof Coated Layer UV Resistance (after 500 hrs)	ASTM D-4355	70% Strength
3.0 oz Water Proof Coated Outer Protective Layer UV Resistance (after 1200 hrs)	ASTM D-4355	>70% Strength

Safety and Regulatory

- **Material is 100% solids and contains no hazardous air pollutants**
- **Hazard rating: Zero rating for health, fire and reactivity and is zero class flammability**
- **Disposal: Meets US regulations for landfillable materials.**

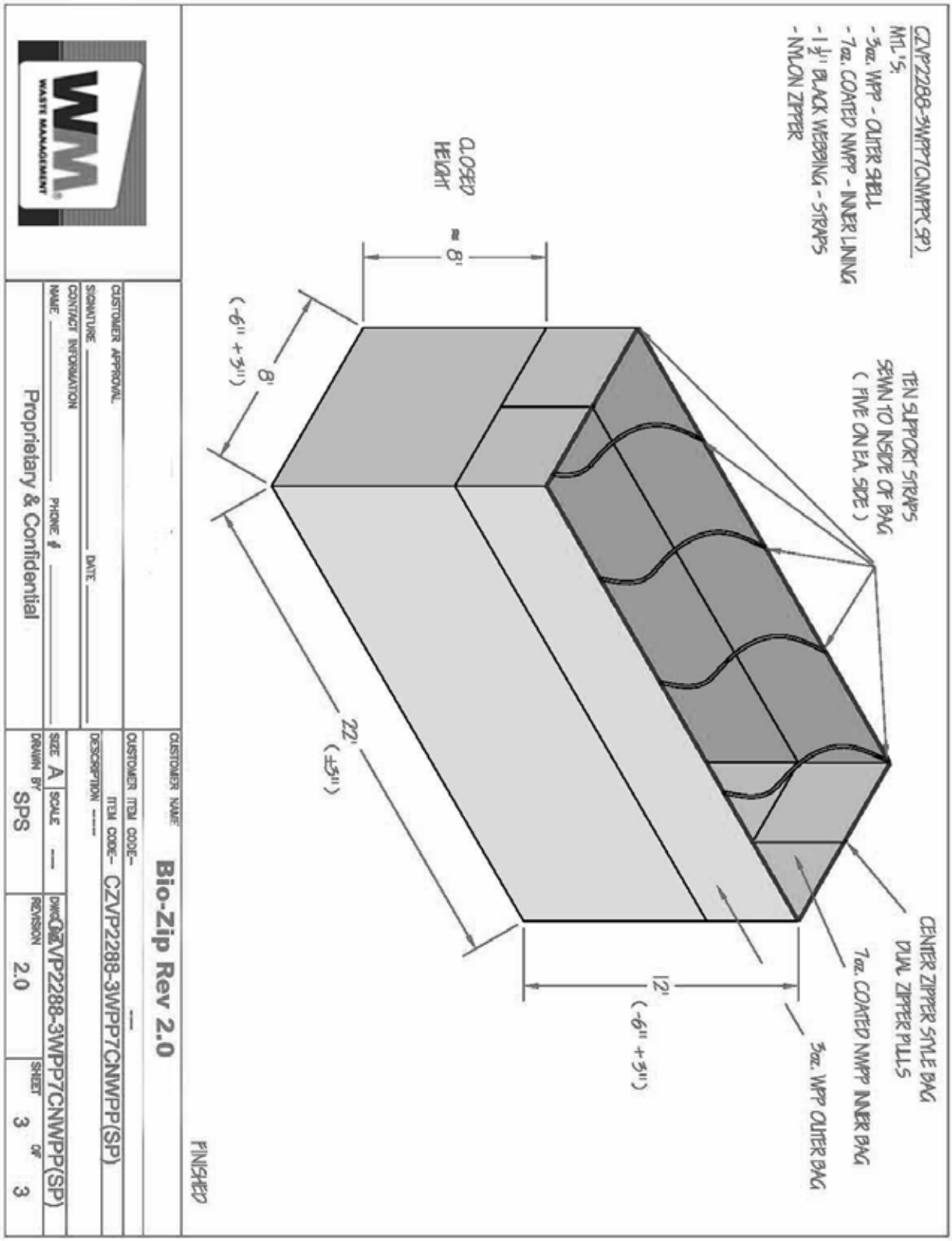
Manufacturing

- **Lead Time**
  - **Emergency Request: 24 hour lead-time, 25% expedite fee will apply with a 20-50 bag daily capacity.**
  - **Non-Emergency- Two week lead-time is required and a 20-50 bag daily capacity**
- **Capacity**
  - **Daily Maximum Capacity- 75-100 units per day**

Shipping and Storage

- **Shipping**
  - **Pallet Dimensions- 49”Wx52”L**
  - **Bio-Zip Dimension Folded- 44”WX48”LX16”H**
  - **Units Per Pallet-5**
  - **Weight Per unit-98 lbs**
  - **Weight Per Pallet-540 lbs (98 lbs x 5 +Pallet (50 lbs)**
- **Units per Semi-Trailer**
  - **48’ Semi-trailer-22 pallets (110 Bio-Zip bags)**
  - **52’ Semi-trailer-24 pallets (120 Bio-Zip bags)**
- **Storage**
  - **Optimal Storage: Climate control- shelf life 20 years**
  - **Covered, out of direct sunlight and out of elements: 5-10 years**

Drawing 1.0 **Bio-Zip Engineering Drawing**

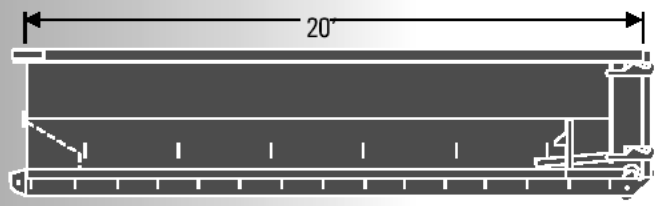


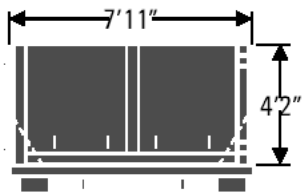
Bio-Zip Sealable Liner Compatible Containers

(10 yard container not shown)

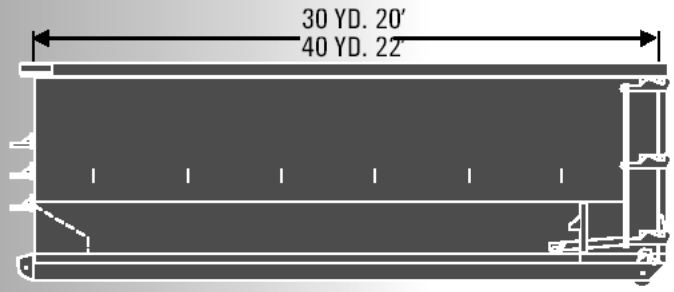
WASTE MANAGEMENT
NATIONAL ACCOUNTS SALES & SERVICE

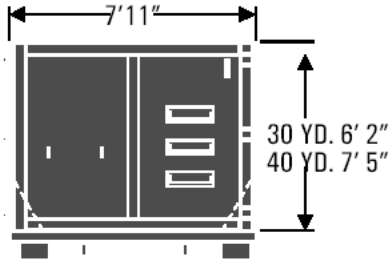
OPEN TOP CONTAINERS



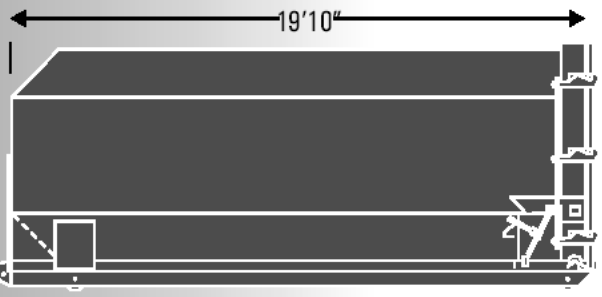


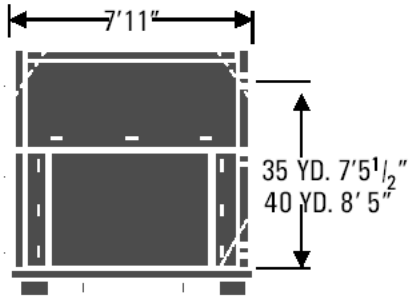
20 YARD OPEN TOP





30 AND 40 YARD OPEN TOP





WM®
1001 Fannin, Suite 4000
Houston, TX 77002
www.wmupstream.com/biozip

Appendix C: Federal and State Regulations for Carcass Movement

Federal Regulations

Summary 1: Code of Federal Regulations, pertaining to carcass transportation

CFR	
APHIS	
Title 9 - Animals and Animal Products » CHAPTER III--FOOD SAFETY AND INSPECTION SERVICE, DEPARTMENT OF AGRICULTURE » SUBCHAPTER A--AGENCY ORGANIZATION AND TERMINOLOGY; MANDATORY MEAT AND POULTRY PRODUCTS INSPECTION AND VOLUNTARY INSPECTION AND CERTIFICATION» Part 325--TRANSPORTATION » § 325.20 Transportation and other transactions concerning dead, dying, disabled, or diseased livestock, and parts of carcasses of livestock that died otherwise than by slaughter.	No person engaged in the business of buying, selling, or transporting in commerce, or importing any dead, dying, disabled or diseased animals or parts of the carcasses of any animals that died otherwise than by slaughter shall: (a) Buy, sell, transport, or offer for sale or transportation, in commerce, or import any dead livestock if its hide or skin has been removed; (b) Sell, transport, offer for sale or transportation, or receive for transportation, in commerce, any dead, dying, disabled, or diseased livestock, or parts of the carcasses of any livestock that died otherwise than by slaughter, unless such livestock and parts are consigned and delivered, without avoidable delay, to establishments of animal food manufacturers, renderers, or collection stations that are registered as required by part 320 of this subchapter, or to official establishments that operate under Federal inspection, or to establishments that operate under a State or Territorial inspection system approved by the Secretary as one that imposes requirements at least equal to the Federal requirements for purposes of paragraph 301(c) of the Act;4 4 A list of such registrants, States, and amendments thereof, will be published in the Federal Register, and information concerning the registration status of particular animal food manufacturers, renderers, or collection stations, or the status of particular States or Territories may also be obtained from the Director, Administrative Management Staff, Food Safety and Inspection Service, U.S. Department of Agriculture, Washington, DC 20250. (c) Buy in commerce or import any dead, dying, disabled, or diseased livestock or parts of the carcasses of any livestock that died otherwise than by slaughter, unless he is an animal food manufacturer or renderer and is registered as required by part 320 of this subchapter, or is the operator of an establishment inspected as required by paragraph (b) of this section and such livestock or parts of carcasses are to be delivered to establishments eligible to receive them under paragraph (b) of this section; (d) Unload en route to any establishment eligible to receive them under paragraph (b) of this section, any dead, dying, disabled, or diseased livestock or parts of the carcasses of any livestock that died otherwise than by slaughter, which are transported in commerce or imported by any such person: Provided, That any such dead, dying, disabled, or diseased livestock, or parts of carcasses may be unloaded from a means of conveyance en route where necessary in case of a wreck or otherwise extraordinary emergency, and may be reloaded into another means of conveyance; but in all such cases, the carrier shall immediately report the facts by telegraph or telephone to the Compliance Staff, Meat and Poultry Inspection Field Operations, Food Safety and Inspection Service, U.S. Department of Agriculture, Washington, DC 20250. (e) Load into any means of conveyance containing any dead, dying, disabled, or diseased livestock, or parts of the carcasses of any livestock that died otherwise than by slaughter, while in the course of importation or other transportation in commerce any livestock or parts of carcasses not within the foregoing description or any other products or other commodities.
Title 9 - Animals and Animal Products » CHAPTER III--FOOD SAFETY AND INSPECTION SERVICE, DEPARTMENT OF AGRICULTURE » SUBCHAPTER A--AGENCY ORGANIZATION AND TERMINOLOGY; MANDATORY MEAT AND POULTRY PRODUCTS INSPECTION AND	All vehicles and other means of conveyance used by persons subject to § 325.20 for transporting in commerce or importing, any dead, dying, disabled, and diseased livestock or parts of carcasses of livestock that died otherwise than by slaughter shall be leak-proof and so constructed and equipped as to permit thorough cleaning and sanitizing. The means of conveyance so used in conveying such livestock, or parts thereof, shall be cleaned and disinfected prior to use in the transportation of any product intended for use as human food. The cleaning procedure shall include the complete removal from the means of conveyance of any fluid, parts, or product of such dead, dying, disabled, or diseased livestock and the thorough application of a disinfectant to the interior surfaces of the cargo space. Substances permitted for such use are: (a) "Liquified phenol" (U.S.P. strength 87 percent phenol) in the proportion of at least 6 fluid ounces to 1 gallon of water.

VOLUNTARY INSPECTION AND CERTIFICATION» Part 325--TRANSPORTATION » § 325.21 Means of conveyance in which dead, dying, disabled, or diseased livestock and parts of carcasses thereof shall be transported.	(b) "Cresylic disinfectant" in the proportion of not less than 4 fluid ounces to 1 gallon of water; and such other disinfectants as are approved by the Administrator in specific cases. The use of "cresylic disinfectant" is permitted subject to the conditions prescribed in § 71.10(b) of this title.
DOT	
Title 49 › Subtitle B › Chapter I › Subchapter A › Part 105 - Hazardous Materials Program Definitions And General Procedures	Infectious Substances, CFR 49, 173.134 Class 6, Division 6.2 (1) Division 6.2 (Infectious substance) means a material known or reasonably expected to contain a pathogen. A pathogen is a microorganism (including bacteria, viruses, rickettsiae, parasites, fungi) or other agent, such as a proteinaceous infectious particle (prion), that can cause disease in humans or animals. An infectious substance must be assigned the identification number UN 2814, UN 2900, UN 3373, or UN 3291 as appropriate, and must be assigned to one of the following Category A An infectious substance in a form capable of causing permanent disability or life-threatening or fatal disease in otherwise healthy humans or animals when exposure to it occurs. An exposure occurs when an infectious substance is released outside of its protective packaging resulting in physical contact with humans or animals. Category B An infectious substance that is not in a form generally capable of causing generally capable of causing permanent disability or life threatening or fatal disease in healthy humans or animals when exposure occurs; incl. Cat B trans. for diagnostic or investigational purposes

Summary 2 - Examples of State Carcass Transportation Regulations

State	Regulations
Kansas	http://kansasstatutes.lesterama.org/Chapter_47/Article_12/ 47-1209: Transportation of carcasses of domestic animals and packing house refuse; conditions and limitations. All vehicles used in the transportation upon public highways of the carcasses of any domestic animals or packinghouse refuse, shall conform with the following conditions and limitations: (1) The carcasses of dead animals or packinghouse refuse, shall be placed in containers or vehicles which are constructed of, or lined with, impervious material, and which do not permit the escape of any liquid (2) after original loading, the carcasses of domestic animals shall not be moved from the transporting container or vehicle upon a public highway or in any other place except at the disposal plant, at an authorized substation, or at an authorized place for transfer of carcasses or refuse into line vehicles; (3) containers and vehicles shall be disinfected each time before leaving a disposal plant, or substation, and the exterior thereof shall be disinfected each time after loading and before entering the public highway, all in conformance with requirements and regulations prescribed by the commissioner; (4) containers and vehicles used for transporting of carcasses of animals or packinghouse refuse shall not be used for the transportation of live animals except to a licensed disposal plant or the transportation of food or feed for human or livestock consumption until properly cleaned and sterilized.
Wisconsin	http://docs.legis.wisconsin.gov/statutes/statutes/95/50 5.50 Transportation and disposal of animal carcasses. (2) Carcass transportation and disposal prohibitions. No person may do any of the following, either directly or through an employee or agent: (a) Transport or dispose of a carcass that the person knows or reasonably should know to be a diseased carcass in a manner that creates a significant and foreseeable risk of transmitting disease to humans or animals. (b) Dispose of a carcass in the waters of the state. This paragraph does not prohibit the use of farm-raised fish as bait. (4) Regulation of carcass transportation and disposal. The department may, by rule or order, regulate the transportation and disposal of carcasses to prevent and control contagious and infectious diseases.
Florida	https://www.flrules.org/gateway/ChapterHome.asp?Chapter=5C-23 5C-23.003 Transporting or Hauling Animal Carcasses or Refuse; Procedures; Records; Equipment; Quarantine.

(1) A copy of the official permit shall be kept in each vehicle used for transporting or hauling animal carcasses or refuse.

(2) Any person transporting or hauling animal carcasses or refuse shall keep records regarding the collection, transportation and distribution of animal carcasses or refuse. Such records must include the names and addresses of persons, firms and partnerships or corporations for which animal carcasses or refuse is being transported and cover the previous twelve months of operation.

(3) All vehicles and/or containers used to transport or haul animal carcasses or refuse shall be thoroughly cleaned and disinfected weekly or more often if deemed necessary by a representative of the Division. Each operator shall be responsible for the proper cleaning of his vehicles and/or containers.

(4) Vehicle and/or containers used to transport or haul animal carcasses or refuse which do not meet the requirement of this rule shall be placed under quarantine by the department until they are in compliance with this Chapter and proper cleaning and disinfection of the same has occurred

Texas

http://info.sos.state.tx.us/pls/pub/readtac$ext.TacPage?sl=R&app=9&p_dir=&p_rloc=&p_tloc=&p_ploc=&pg=1&p_tac=&ti=4&pt=2&ch=59&rl=12

(a) Purpose: Livestock in Texas are subject to a variety of highly contagious, foreign animal diseases (FAD). The infection or exposure of Texas livestock to a FAD would create an animal health emergency requiring the commission to respond as expediently as possible. A FAD may be very contagious; it may affect both farm/ranch animals and wildlife in Texas, and it may be extremely difficult to identify, isolate, control, and eradicate. It may spread to other areas in the state or other states and countries if the outbreak is not controlled in an expedient or effective manner. Any time delay in responding to such an emergency could cause a severe impact to, or even destroy, the agricultural economic stability and viability of the State and possibly the Nation. The purpose of this section is to authorize the executive director to be able to respond quickly and restrict the movement of livestock from specific areas or facilities in order to reduce any potential exposure of Texas livestock to a disease as provided in §58.2 of this title (relating to Disease Control).

(b) Emergency Response Movement Restrictions: As a control measure, the commission by rule may regulate the movement of livestock in this state. Movement restrictions contained in this section are to become effective upon a determination that there is exposure to a disease or an agent of transmission of one of the diseases as identified in §58.2 of this title (relating to Disease Control) and that these restrictions are necessary to protect livestock in this state.

(c) Executive Director Authority: The executive director may restrict movement of livestock in any part or all of the state, through this section, if the executive director determines that livestock are exposed or infected with a disease as identified in §58.2 of this title (relating to Disease Control) and believes that the disease presents a danger to the public health or livestock industry and that the executive director considers it necessary to protect livestock in this state, by restricting movement under this subchapter. The executive director may require testing, vaccination, or another epidemiologically sound procedure in order to authorize movement from restricted locations.

(d) Effect of Movement Restrictions: These movement restrictions will remain in effect until the executive director has determined that the exposure to the disease or infection from the disease has been eradicated or controlled.

(e) Inspection of Shipment of Animals or Animal Products: An agent of the commission is entitled to stop and inspect a shipment of animals or animal products being transported in this state in order to determine if the shipment originated from a quarantined area or herd; or determine if the shipment presents a danger to the public health or livestock industry through insect infestation or through a communicable or noncommunicable disease. An authorized agent of the commission may issue a hold under this chapter to detain a shipment of animals or animal products in order to determine if the shipment had been exposed to a disease as identified in §58.2 of this title (relating to Disease Control) or to determine if the shipment is being transported in violation of this chapter. The authorized agent of the commission may require that the shipment be unloaded at the nearest place designated as appropriate unloading/loading and boarding facility in order to assess health status or to protect against possible exposure from a disease provided by §58.2 of this title.

(f) Restricted Movement Locations: If the executive director has determined that there is an animal health emergency and that there is a need to restrict movement of livestock, then movement of livestock is restricted, until authorized by the commission through an agent of the commission, at the following locations:

(1) Livestock Market;

(2) Feedlots;

(3) Shows, Fairs and Exhibitions;

(4) Any premise where a caretaker for livestock has received written notice that movement restrictions are in place based on possible exposure to a disease as identified in §58.2 of this title (relating to Disease Control).

(g) Notice of Restrictions: Restricted movement from locations provided for in subsection (f) of this section are effective upon receipt of notice in accordance with §58.22 of this title (relating to Notice of Livestock Movement

	Restrictions). (h) Statewide application or part of state: The movement restrictions contained in this section can be made effective for all or part of the state in order to protect against exposure from a disease as identified in §58.2 of this title (relating to Disease Control).
Georgia	http://agr.georgia.gov/Data/Sites/1/media/ag_animalindustry/equine/files/laws/ocga4-5-1disposalofdeadanimals527031.pdf Dead animals or parts thereof, raw or unrendered, except green salted hides, shall not be allowed to enter the State of Georgia except by written permit issued by the Georgia Department of Agriculture; provided, however, that licensed research institutes, accredited colleges or state colleges and universities, and departments of municipal governments may transport and receive dead animals for research or investigational purposes only. (Ga. L. 1969, p. 1018, § 7.)3 4-5-9 Prohibition or restriction on transport of dead animals; permit issuance. The Commissioner of Agriculture may prohibit or restrict, at his or her discretion, and issue permits for the hauling or transportation of dead animals or types of dead animals and order the destruction thereof in accordance with this chapter.
Maine	www.maine.gov/sos/cec/rules/01/001/001c211.doc SECTION 15. TRANSPORTATION OF POULTRY AND LIVESTOCK CARCASSES 1. Secure Containers - Poultry or livestock carcasses transported over any public road shall be transported in secure containers. 2. Diseased Carcasses - Carcasses from animals that died or were slaughtered due to a disease outbreak may only be transported from the farm or other regulated facility where they originated with the permission of the Commissioner. A written biosecurity plan shall be required prior to transportation of diseased carcasses.
Minnesota	http://www.vetmed.state.mn.us/portals/22/BAH%20Rule%20Book.pdf Disposal of Dead Animals and Rendering Plants 1719.0200 Permits. Subpart 1. Generally. Permits from the board are required for all trucks used to transport carcasses or discarded animal parts over public roads. The permit authorizes the permittee to transport the carcasses or discarded animal parts over public roads to an establishment but does not authorize crossing state lines. Permits are valid for one year unless revoked in accordance with Minnesota Statutes, section 35.93. The permittee shall comply with rules of other state and federal agencies. No permit is required for a person to haul the carcass of an animal which was owned by that person before the animal died. 1719.0310 Trucks crossing state lines. Trucks crossing state lines must meet applicable conditions in any reciprocal agreement between the states involved. 1719.0400 Truck owned by person other than owner or operator of rendering plant. If a truck is owned by a person other than the owner or operator of the establishment, the owner or operator of the truck and the owner or operator of the establishment are responsible for compliance with all laws and rules pertaining to the transportation of carcasses. The application must indicate the name and address of the owner of the truck. 1719.0500 Inspection of plant facilities and trucks. Subpart 1. Generally. Before permits are issued, an inspection of the plant, collecting station, and trucks must be made by an agent of the board to determine if the facilities of the plant and the trucks comply with this chapter. A report of the inspection must be filed with the board. Subp. 2. Repealed by amendment, 20 SR 2033
Wyoming	http://legisweb.state.wy.us/statutes/titles/Title11/T11CH23AR3.htm ARTICLE 3 - TRANSPORTATION OF CARCASSES TO RENDERING PLANTS 11-23-301. Generally; exceptions. With the consent of the owner, unless removal is contrary to state, county or local sanitary regulations or in the opinion of the state veterinarian might result in spreading contagious or infectious disease or threaten the health of human beings, animals or poultry, carcasses of animals may be transported to any rendering plant legally operating without prior inspection for brands and ownership. The operator of a rendering plant within this state receiving the carcasses is a hide buyer and shall comply with W.S. 11-23-201 through 11-23-207.

Appendix D: Expert Opinion – Rendering

Expert opinion was sought on standard carcass transportation practices. Rendering companies have expertise in mass carcass removal and conveyance on a daily basis. Central Bi-Products, a full service rendering company that operates two complexes in Redwood Falls, MN and in Long Prairie, MN was contacted to provide expert opinion on carcass transportation in the rendering industry.

Expert opinion was sought on the means of conveyance (specifications, types of vehicles commonly utilized), standard procedures in carcass pick-up and transportation, and regulations regarding carcass conveyance.

The most commonly used trailers in the industry with the standard rendering truck (semi-truck with an open box container) are 28, 32 and 40 feet. Open containers are sealed with a tarp covering prior to transportations. These come in a variety of mechanisms. The majority of the industry in the Upper Midwest utilizes a roll-top system. Transportation regulations mandate that the rendering vehicles are leak-proof. In Minnesota, rendering vehicles are permitted and inspected. The driver can retrieve carcasses from locations without ever stepping foot on the premises using an automated grapple system on the standard rendering truck. Estimates on truck capacity for the maximum carcass weights of what each trailer can hold are below:

Trailer Length (ft)	Trailer Weight Capacity lbs (kg)
28'	40,000 lbs (18,182 kg)
32'	45,000 lbs (20,455 kg)
40'	50,000 lbs (22,727 kg)

According to the industry experts, in a full carcass load (cattle), the carcass fluid (manure, urine, blood, basically any liquid that can spill out of the carcasses and into the truck during transport process) depth that one typically would see in the bed of the rendering truck is very little if the animals are loaded fresh (within 24 hours). It was estimated that if one were to clean the bottom of the trailer with a broom and shovel you might get a 5 gallon pail full of carcass fluids, as there is very little leakage from fresh animals.

Appendix E: Expert Opinion – Depopulation

Sources and Generation

Expert opinion was sought for likely times for depopulation. Although official regulations state euthanasia and disposal will occur within 24hrs or as soon as possible after premises classification (Red Book, National Center for Animal Health Emergency Management, 2011), we know that these will be dependent on resources and scale of outbreak as well as interpretation. Experts in depopulation were contacted and requested to provide opinion on euthanasia time and depopulation rates.

Experts who agreed to provide opinions for euthanasia and depopulations times were:

- David Finch, Texas Animal Health Commission
- Lori Miller, Department of Homeland Security
- Donald Topliff, West Texas A&M University
- Jimmy Tickel, North Carolina Department of Agriculture and Consumer Services
- Darrel Styles, USDA APHIS

Euthanasia Time

The following questions were provided to experts. For each of these questions, experts were requested to provide their opinion on 1) minimum, 2) most likely, and 3) maximum timing.

1. What is the most likely time to start of euthanasia for FMD Index premises?
2. What is the most likely time to start of euthanasia for Subsequent FMD premises?
3. What are the most likely depopulation rates (Expert Opinion) for cattle and hogs. (animals /day or animals /hr)?

Appendix F: Aerosol Science

Sources and Generation

Generation of bioaerosols can occur under natural conditions as well as from human activities such as spreading of slurries, pressurized spray irrigation, and aeration basins at wastewater treatment plants. In general, airborne microorganisms (bacteria, fungi, and viruses), and their components, are generated as a mixture of droplets or particles, having different aerodynamic diameters ranging from 0.5 to 100 µm ((Cox C, 1995); (Lighthart B, 1994)).

Microorganisms associated with droplets evaporate to dryness or near-dryness before impacting the ground or vegetation and are transported by air currents (Dungan RS, 2010). The optimum aerodynamic particle range which represents a hazard to the human respiratory tract is between 1.0 and 10 µm ((Mohr A, 2005); (Mohr A, 2007)).

The dissemination and transport of bioaerosols depends on the method of bioaerosol generation and energy input into the system. Pressurized air, electricity, centrifugal forces, impaction, or heat can provide the energy needed to produce small particles. Many of these forces are so violent that inactivation of the microorganisms will occur. Fluids associated with newly aerosolized particles will instantaneously start to evaporate. The distribution and concentration of particle sizes are two important variables that directly affect the potential for dissemination and transport.

Transport

The transport, behavior, and deposition of bioaerosols are affected by their physical properties (i.e., size, shape, and density) and meteorological factors they encounter while airborne. Naturally occurring bioaerosols are ejected into the atmosphere by wind, rain and bursting bubbles, and other processes. The environmental conditions of wind velocity, RH, temperature, and precipitation significantly affect transport of bioaerosols with atmospheric stability being a major factor ((Jones AM, 2004); (Lighthart B, 2000)).

Bioaerosols are subject to inactivation and transport the moment they become airborne. Particle sizes of droplets are usually small (2 to 10 µm) and they tend to follow the streamlines of the local wind. Particles with sizes smaller than 5.0 µm act as vapors and follow the streamlines of the airstream. The aerodynamic diameter of particles determines whether it is small enough to follow the streamlines of the surrounding flows, or if it is large enough to cross streamline flow and impact upon a surface. Deposition of larger aerosols occurs through gravitational settling, impaction, diffusion, convection (due to temperature variations), and wash-out by raindrops (Muilenberg M, 1995).

Viability, Stability, and Infectivity

The viability of bioaerosols is dependent upon their chemical makeup and the environmental and meteorological factors they are exposed to, such as wind speed, temperature, and RH. These atmospheric conditions are strongly influenced by features such as large-scale flow fields, geographical locations, and local topography. The most significant environmental factors influencing viability are RH, solar irradiance, temperature, and oxygen concentration. Additional influences include air ions and open-air factors (OAF). Atmospheric turbulence is responsible for diffusion of particles during transport by the wind (mean wind speed) and is strongly influenced by local atmospheric conditions and the diurnal variation of solar irradiance reaching the ground.

Of all of the measurable meteorological parameters, RH is the most important with respect to aerosol stability, which is an important determinant of bioaerosol viability and infectiousness ((Mohr A, 2005); (Mohr A, 2007)). The majority of airborne microorganisms are immediately inactivated upon release because of environmental stresses (desiccation, temperature, and oxygen) which act upon and alter the surface of the microorganism. The fundamental factors that affect the viability of microorganisms are the state of the water and water content of the bioaerosol. As RH decreases, the water available to the exterior environment of the microorganism also decreases. Loss of water can cause dehydration, resulting in inactivation of many microorganisms. The RH of the system also directly affects the density of the bioaerosol unit. The size, shape, and density of the aerosolized particles are directly related to the aerodynamic diameter, which determines settling velocity and location of deposition in the respiratory tract ((Mohr A, 2005); (Mohr A, 2007)).

Studies to determine the effect of temperature on the fate of bioaerosols have generally shown that increasing temperatures tend to decrease the viability of airborne microorganisms (Dimmock NJ, 1967). It is difficult to separate the effects of temperature and RH, as the vapor pressure and RH of a system are dependent on temperature. The lipid content of the outer coat, or capsid of a virus, determines the stability at high or low RH values.

Appendix G: Expert Opinion – Aerosols

Bioaerosol Experts Interviewed and Questions

The three experts who responded to a request for expert opinion were interviewed about the probability of generating bioaerosols during pumping and transport of FMD-infected carcasses. Background information was provided to the experts on truck design, mitigations, and regulations. The following experts that agreed to an interview have varying backgrounds in aerosol /bioaerosols research including engineering and aerosol physics..

- Robert DeOtte, PhD, PE, PG, Professor of Civil & Environmental Engineering, West Texas A&M University
- Thomas Kuehn, MS, PhD , Professor, University of Minnesota, Department of Mechanical Engineering
- Peter Raynor, MS, PhD, Associate Professor, University of Minnesota, Division of Environmental Health Sciences

The questions below were posed to the experts in bioaerosol science. The table below summarizes their responses.

Expert opinion was sought as to whether or not infected fluids that may leak from the carcasses post-mortem (infectious fluids like feces, urine, stomach/rumen contents, blood, milk etc.) would generate aerosols while being transported from site of euthanasia to disposal. The conveyance assessed were a box trailer that is 1) open on the top and 2) one that is covered with a tarp.

Based on the likelihood definitions below, please provide expert opinion on aerosolization in 1) **uncovered** and 2) **covered** standard rendering vehicle during transportation

Likelihood	Descriptive Definition
High	The event would be very likely to occur
Moderate	The event is unlikely but does occur with a certain probability
Low	The event would be unlikely to occur
Negligible	The likelihood that the event will occur is insignificant, not worth considering

1. What is the likelihood (see chart) of significant aerosolization of carcasses fluids during transportation?
2. What is the likelihood that a significant portion of the aerosolized particles to be less than 10 µm in size?
3. If aerosols could be produced from the carcass leakage, what is the likelihood they could then move into the airstream at a subsequent farm?
4. Can you briefly describe your rationale for the selected likelihood levels?

Summary 3 - Expert Opinion on Bioaerosols

	Expert 1	Expert 2	Expert 3
UNCOVERED			
What is the likelihood of significant aerosolization of carcasses fluids during transportation?	**Moderate** There could be two potential mechanisms for particle formation: (1) the sloshing of fluids back and forth against walls and surfaces which could form particles as the fluids impact, and (2) wind eddies forming drops along the surface of the fluids. Although the carcasses will limit the sloshing of the fluids and the access of strong eddies against the surface of the fluids, thus reducing the risk of generation, I still think the likelihood is Moderate.	**Low** The only aerosolization process considered is direct generation by the air stream when the trailer is in motion. Generating aerosol particles from wet liquids or material that is moist is nearly impossible without extremely large shear forces caused by high air velocities. The liquid viscosity also plays a role, the more viscous the liquid the more shear force is required and the less likely that particles will be generated. Dried material that was liquid at one time is also quite resistant to particle production. Dry loose dust could be aerosolized in an open trailer but I think the materials you are working with should be very resistant to this. Another scenario is dripping from the trailer onto the roadway. This potentially could generate aerosols directly at elevated speeds and perhaps the material deposited on a roadway could be aerosolized by passing vehicles. I think the potential for this scenario to generate particles is higher than simply looking at the air forces generated in an open trailer because the fluid is being dripped in the form of small droplets into a fast moving air stream. Nonetheless, I think the likelihood of this causing any secondary infection is quite remote	**Negligible** Generating aerosols from the liquid collecting at the bottom of a trailer is unlikely. The carcasses above that pool will hinder air flow and limit the shear necessary to generate droplets. A more likely possibility for the uncovered trailer is matter on the hide of the upper layer or two of animals breaking loose by mechanical means and being carried by air currents away from the vehicle. These solid particles could be fairly large but if so, will settle quickly. The particles could impact solid surfaces and break into smaller particles. The particles of concern would be dust from dried, crushed manure on the hide. These can easily be smaller than 10 µm.
What is the likelihood that a significant portion of the aerosolized particles to be less than 10 µm in size	**Moderate** If some aerosol droplets are generated, a significant number could be smaller than 10 micrometers because the water portion of droplets will evaporate, potentially causing larger droplets to rapidly become smaller.	**Low**	**-**
If aerosols could be produced from the carcass leakage, what is the likelihood they could then move into the airstream at a subsequent farm?	**High** With the open top, I think there is a strong possibility for any aerosol droplets created to get into the air at a subsequent farm. Thus, I rate 1. c. High, although the overall likelihood of this outcome is only moderate because I think the risk of aerosols being produced in the first place is moderate.	**Moderate**	**-**
COVERED			

What is the likelihood of significant aerosolization of carcasses fluids during transportation?	**Low** Formation of droplets by wind eddies is negligible here, although droplet formation by sloshing fluid impacting on surfaces is still possible. Thus, I give 2. a. the Low rating.	**Negligible** Dripping could be an issue but direct aerosol production from under a covered load should be negligible	**Negligible** If the trailer is covered, that further reduces air flow at the bottom of the trailer, the likelihood for any aerosol generation and release is negligible for the covered trailer**.**
What is the likelihood that a significant portion of the aerosolized particles to be less than 10 µm in size	**Low** Because the trailer is covered, humidity inside the trailer is likely to be higher than if the trailer is uncovered, meaning that aerosol droplets are less able to evaporate than in 1. b. Thus, I have rated 2. b. as Low.	**-**	**-**
If aerosols could be produced from the carcass leakage, what is the likelihood they could then move into the airstream at a subsequent farm?	**Moderate** The trailer is not air tight, so there is still a significant possibility that any droplets formed will be able to escape the trailer at a subsequent farm. However, it is certainly less likely than if the trailer was uncovered, so I rate 2. c. as Moderate as opposed to the rating of High for 1. c.	**-**	**-**