High Pathogenicity Avian Influenza Control in Commercial Poultry Operations – A National Approach

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I. Introduction

A. Background

The United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Veterinary Services (VS) is responsible for protecting and improving the health, quality, and marketability of U.S. animals, animal products, and veterinary biologics by (1) preventing, controlling, and/or eliminating animal diseases, and (2) monitoring and promoting animal health and productivity. The authority for the mission of VS is found in the Animal Health Protection Act (7 United States Code 8301 et seq.).

Avian Influenza (AI), also known as bird flu, is caused by infection with viruses of the family Orthomyxoviridae, genus *influenza virus A*, species *influenza A virus* (Center for Food Security and Public Health, 2014). Influenza A viruses are the only orthomyxoviruses known to affect birds (USDA-APHIS, 2012). Influenza A viruses are isolated from more than 100 different species of birds. Migratory waterfowl (such as gulls, ducks, and shorebirds) are a major reservoir for these viruses (CDC, 2015a; USDA, 2015). They serve as sources of infection for domestic flocks during yearly migrations.

Strains of AI viruses are classified as highly pathogenic1 (HPAI) or low pathogenic (LPAI) based on the genetic features of the virus and the severity of the illness they cause (CDC, 2015a). Influenza A viruses have antigenically-related nucleocapsid and matrix proteins, and are classified into subtypes on the basis of their haemagglutinin (H) and neuraminidase (N) antigens. Sixteen H subtypes (H1–H16) and 9 N subtypes (N1–N9) are known (USDA-APHIS, 2012). To date, the highly virulent influenza A viruses that produce acute clinical disease in chickens, turkeys, and other birds of economic importance are only associated with the H5 and H7 subtypes (OIE, 2010).

Worldwide, many strains of AI cause varying degrees of clinical illness in poultry. Low pathogenicity viruses generally cause mild disease (USDA-APHIS, 2012); birds infected with LPAI exhibit symptoms such as ruffled feathers and decreased egg production (CDC, 2015a). LPAI is one of the “other communicable diseases of livestock or poultry” regulated under 9 CFR part 53. Section 53.2 allows the APHIS Administrator to invite the proper State authorities to cooperate with the Department in the control and eradication of this disease including the use of indemnity payments. Other sections provide for appraisal (9 CFR § 53.2) and destruction (9 CFR § 53.3) of animals, and disinfection or destruction of materials (9 CFR § 53.5), premises, and conveyances (9 CFR § 53.7). Provisions for the control of H5/H7 LPAI in 9 CFR part 56, focus on the reduction of LPAI in flocks on a long-term or ongoing basis. The National Poultry

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1 Pathogenicity is the ability of the virus to produce disease.
Improvement Plan (NPIP) for Commercial Poultry (9 CFR part 146) and its Auxiliary Provisions (9 CFR part 147) do not specifically identify procedures, processes, and control for highly pathogenic strains of AI. That is, current regulations are not explicit on the likelihood of additional provisions being needed for highly pathogenic viral strains. Yet the intent is to be prepared for detection and control of HPAI outbreaks.

HPAI is an extremely infectious and fatal form of the disease that, once established, rapidly spreads within and between flocks (USDA-APHIS, 2012; USDA, 2015). Birds infected with the HPAI virus could exhibit symptoms ranging from coughing, sneezing, nasal discharges, lack of energy and/or appetite, and decreased egg production, to soft–shelled or misshapen eggs, swelling, purple discoloration, lack of coordination and diarrhea, or sudden death. To detect HPAI in wild migratory birds as quickly as possible, APHIS established a national early detection system that involves monitoring and surveillance of migratory birds in the United States (HHS et al., 2006).

HPAI is known to affect humans (CDC, 2015a). Rare, sporadic human infections with the related Asian H5N1 viruses are associated with prolonged and close contact with infected birds. The Centers for Disease Control and Prevention (CDC) conducts extensive preparedness efforts for the H5N1 strain. Although human-to-human spread of the H5N1 virus has previously occurred, spread of H5N2 virus within a human community is not known. Flu viruses are constantly changing in their genetic makeup (Sonnberg, 2013). Strains of AI are highly variable with respect to their reassortment and competition; host immunity, receptor availability, and temperature requirements; and with their tolerance to temperature, humidity, composition of sediment, and salinity level ranges (Sonnberg, 2013). The risk of human-to-human pathogenicity is not currently associated with the HPAI strains, such as H5N2, that APHIS seeks to control.

**B. Purpose and Need**

In 2014, APHIS identified two mixed-origin viruses in the Pacific Flyway: the H5N2 virus and a new H5N1 virus. Since December 19, 2014 (date of first detection), APHIS confirmed HPAI H5 in the Pacific, Central, and Mississippi flyways on migratory bird paths, and identified the disease in wild bird, backyard, and commercial poultry flocks. APHIS is coordinating closely with its partners, including state officials, the U.S. Department of the Interior, and the U.S. Department of Health and Human Services, on avian influenza surveillance, reporting, and control efforts.

APHIS believes wild birds were responsible for introducing HPAI into commercial poultry through airborne virus particles. APHIS found genetic material from HPAI viruses could be detected in air samples taken from inside and outside poultry houses, supporting the idea that the
virus can be transmitted through air (USDA-APHIS, 2015a). Preliminary analysis of wind data shows a relationship between sustained high winds (25 mph or greater for 2 days or longer) and an increase in the number of infected farms 5 to 7 days later (USDA-APHIS, 2015a). Insufficient application of recommended biosecurity measures likely perpetuated the spread of HPAI among premises (USDA-APHIS, 2015a).

In 2015, more than 48 million chickens and turkeys were affected by HPAI, based on 223 reported detections in 15 U.S. states. This accounts for approximately 3% of the U.S. annual turkey production, 10% of the U.S. average layer inventory, 5.5% of the U.S. average pullet inventory, and less than 0.01% of the U.S. broiler inventory. Figure 1 shows the counties with HPAI detections in poultry.

APHIS is responding to these detections by implementing quarantine and movement controls, depopulating affected flocks to prevent the spread of this disease to additional flocks, disposing of the carcasses, and cleaning and disinfecting facilities and equipment. Effective management of both poultry infected with the HPAI virus and resulting poultry carcasses needs to minimize the spread of disease while protecting human health and the environment. For example, APHIS uses carbon dioxide and Type A fire suppression foam for its depopulation methods because these methods are humane and limit exposure to the AI virus by workers, to the general public, and in the environment (USDA-APHIS, 2015b). In addition, these methods are readily adaptable to large-scale disease eradication efforts.

As carcasses begin to degrade, bodily fluids, chemical and biological leachate components, agricultural dust, and toxic gases are released into the environment, potentially impacting the health and safety of surrounding humans and wildlife. Poultry carcasses also may:

- disrupt the flow of commerce by removing poultry from the market,
- transmit viruses to other susceptible animals,
- attract undesirable vectors such as insects and wildlife,
- disseminate disease among wildlife populations that scavenge for food, and
- cause public concern.

APHIS and State officials work together to evaluate disposal options based on the size of the flock, local conditions, and applicable laws and regulations to ensure the safe disposal of

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2 For purposes of this document, the term “carcass” will refer to the bodies or body parts of dead poultry combined with manure, bedding, and other organic materials that are difficult to separate from the dead animal remains.

3 Biological leachate is the liquid that results from decomposition of biomass. It includes bodily fluids that leak from dead animals.
carcasses (see Appendix A—Pertinent State Laws on Carcass Management) (USDA-APHIS, 2015b). At each location, APHIS along with State and locally affected poultry producers identify available disposal options. Typically they include landfilling, rendering, incineration, composting, and on-site burial. Appendix B discusses the benefits and limitations of each method as related to disposal of poultry carcasses. When necessary, APHIS takes an integrated approach to disposal and uses a combination of methods to achieve its goals (USDA-APHIS, 2015b). Individual euthanasia and carcass management actions occur within poultry facility boundaries (onsite composting, burial, and incineration), or at offsite locations (after transport to offsite landfills, incinerators, or renderers).

APHIS follows standard operating procedures (SOPs) for cleaning and disinfection, as outlined in the Foreign Animal Disease Preparedness and Response Plan/ National Animal Health Emergency Management System Guidelines (USDA-APHIS, 2013). To meet APHIS’ cleaning and disinfection needs, APHIS uses antimicrobial products the U.S. Environmental Protection Agency (EPA) has approved for use against influenza A viruses. The list of disinfectants is available at http://www.epa.gov/opp00001/factsheets/avian_flu_products.htm. While there are not any disinfectants registered specifically for use against the H5N2 subtype of the influenza A virus, based on available scientific information, EPA believes these disinfectants will be effective against pertinent viral strains (EPA, 2015).

Outbreaks of AI in poultry tend to occur in cooler months (CDC, 2015b). Given the magnitude of the HPAI poultry incidents4 this spring, APHIS wants to ensure adequate preparation for subsequent incidents in poultry in the fall during the wild bird migration, or thereafter. Therefore, APHIS’ preferred alternative is to continue to provide assistance in establishing and enforcing HPAI quarantines and conducting bird flu control activities as outbreaks occur throughout the nation.

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4 Incidents refer to the number of new cases or outbreaks of disease that occur in a population at risk in a particular geographical area within a defined time interval (OIE, 2010).
Figure 1. HPAI detections in poultry in the United States during 2014-15.
II. Alternatives

The CEQ’s NEPA regulations (40 CFR §§ 1500-1508) require Federal agencies to consider in their environmental documents alternatives which include other reasonable courses of actions in addition to a “no action alternative” (40 CFR § 1508.25(b)). In this situation, the no action alternative considers a lack of Federal actions taken during HPAI outbreaks5 for the purpose of making comparisons to the other alternative.

This EA considers two possible alternatives: (1) The No Action—only States and local authorities take actions during bird flu epidemics, and (2) the Proposed Action—APHIS will continue to provide assistance to States and local authorities in establishing and enforcing HPAI quarantines and conducting bird flu control activities as outbreaks occur throughout the nation under existing authorities in 9 CFR parts 53, 56, 145, 146, and 147. These alternatives are discussed in this chapter, and are the basis for further analyzing potential environmental effects addressed in chapters 3 and 4 of this EA. These alternatives focus on an entire range of avian influenza control activities, from surveillance, establishing quarantines, and depopulation, to carcass management, sanitation, environmental sampling, quarantine release, and restocking.

A. No Action

Under the No Action alternative, APHIS would not be involved in HPAI activities such as depopulation, transport, and disposal of carcasses and disinfection of equipment and premises. State and local authorities would be responsible for managing and funding these types of HPAI activities. Under this alternative, APHIS could conduct nationwide surveillance of commercial and backyard flocks through the NPIP, implement quarantines where HPAI outbreaks occur, conduct environmental sampling, and release quarantines. This alternative represents the baseline against which to compare a proposed action.

B. Adaptive Management Program (Preferred Alternative)

The Adaptive Management Program includes the actions listed in Appendix C and represents a continuation of the baseline or current situation for future bird flu outbreaks. This alternative incorporates by reference all procedures and processes in 9 CFR parts 53, 56, 145, 146 and 147 as part of this alternative, and would apply them to strains of the HPAI virus nationwide as they

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5 An outbreak is the occurrence of one or more cases (an individual animal infected by a pathogenic agent, with or without clinical signs) in a group of animals that share the same likelihood of exposure to a pathogen due to a shared common environment or common management practices (World Organization for Animal Health [OIE], 2010 #35).
are detected. This EA also incorporates by reference all necessary and reasonable modifications as needed by the NPIP program as they appear on APHIS webpages (http://www.aphis.usda.gov/wps/portal/aphis/ourfocus/animalhealth?1dmy&urile=wcm%3Aaphis_content_library/sa_our_focus/sa_animal_health/sa_animal_disease_information/saavian_health/ct_poultry_disease_home_page) and are currently practiced (http://www.poultryimprovement.org/default.cfm). Although these sources state they are for “LPAI”, the current need is to also detect, prevent, and control HPAI nationwide as it occurs. These procedural sources use H5/H7 to identify the pertinent genetic contribution to bird flu, and this adaptive management program would focus on the intent to control all forms of bird flu as the need arises.

Under this alternative, APHIS would use its central repository of carcass disposal resources and national contacts to provide consistency to the nation’s response during HPAI outbreaks. This information helps States and local authorities determine which depopulation, disposal, and cleaning and disinfection methods are most appropriate for the situation. APHIS follows the recommendations outlined by the American Veterinary Medical Association and the World Organisation for Animal Health (OIE) whenever possible while depopulating diseased flocks and herds (USDA-APHIS, 2015c). For HPAI outbreaks, APHIS has selected depopulation methods that limit human exposure to the AI virus and accommodate large-scale eradication efforts. Carbon dioxide is one such technique. In addition, the use of water-based foam has the potential to reduce the number of workers involved in depopulation efforts, decreases their exposure to potentially zoonotic HPAI viruses, and is relatively easy to deploy under field conditions (USDA-APHIS, 2015b).

Disposal methods selected for HPAI outbreaks include landfilling, rendering, incineration, composting, and burial (Appendix B). Incineration is distinguished from open burning by higher combustion temperatures and control of the gases and particulates released into the environment. On-site incineration needs can be met by mobile technologies or on-site fixtures depending on their availability. State and local laws will restrict the siting of compost and burial locations; these remain as disposal options depending on the poultry producer’s acreage and capabilities. Rendering is only an option when a nearby facility agrees to accept the carcasses. The selection of a particular methodology would be coordinated with appropriate State authorities and landowners, and depend on the availability of local resources. For example, if there are no rendering facilities capable of handling the carcasses in a reasonable range of the locally affected area, then rendering is not a viable option. If there is an appropriate landfill nearby, then disposal at the landfill may be the preferred option. This alternative requires all State and local requirements for transport of dead animals to be met.

All properties infected with HPAI must be cleaned and disinfected as described in Figure 2. APHIS uses antimicrobial products the EPA has approved for use against influenza A viruses,
and also uses the EPA registered sterilant, chlorine dioxide, for disinfection of premises. Decisions about the most appropriate cleaning and disinfection methods for HPAI-infected premises are made on a site-specific basis. Additional information about cleaning and disinfection SOPs is located in APHIS’ Foreign Animal Disease Preparedness and Response Plan Cleaning and Disinfection SOP (http://www.aphis.usda.gov/animal_health/emergency_management/downloads/sop/sop_cd.pdf).

Figure 2. Options for cleaning and disinfecting HPAI-infected premises.
III. Affected Environment

This section presents the baseline conditions of the affected environment that could be impacted by HPAI control activities. APHIS uses this information as the basis to evaluate potential impacts of the program. The affected environment is the same for both the No Action and Preferred Alternatives.

In the field of animal health, an outbreak is considered to be the occurrence of one or more individual animals infected by a pathogenic agent (with or without clinical signs), within a group of animals sharing approximately the same likelihood of exposure to a pathogen (OIE, 2010). These animals may share a common environment or management practices (for example, a flock), and the epidemiological relationship may differ among strains of the pathogen. This is in contrast to the term “incidence”, which refers to the number of new cases or outbreaks of a disease that occur in a population at risk in a particular geographical area within a defined time interval (OIE, 2010). For this analysis, incidences occurred in the past year in the United States.

Under both alternatives, APHIS activities would remain focused on individual outbreaks as they occur on individual poultry-producing sites throughout the nation. APHIS would not address AI in wild bird populations. The proposed program would consider the potential for agency action during future outbreaks.

Poultry are raised in every state, which means they exploit a wide range of land, water, and air resources in the country. Brief descriptions of poultry production and facility emissions and waste management, the AI virus, environmental resources, and human health aspects associated with the proposed program are discussed below.

A. Poultry Production, Facilities, and Waste Management
The U.S. poultry industry is technologically advanced and uses its high level of concentrated production practices to produce meat and egg products. Taxonomically, domesticated birds typically include:

- Broilers and meat-type chicken (*Gallus gallus domesticus* L. Galliformes: Phasianidae)
- Chicken pullets for laying flock replacement (*G. gallus domesticus*)
- Turkey (*Meleagris gallopavo* L. Galliformes: Phasianidae)
- Duck (*Anas platyrhynchos* L. Anseriformes: Anatidae)
- Goose (primarily *Anser anser* L. and *A. cygnoides* L. Anseriformes: Anatidae)\(^6\)

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The average weight of poultry is less than 10 pounds. Most chicken for meat is processed at 4.5 pounds live weight; however, this varies with the type of meat product that will be produced (Lessler et al., 2007). During 2014, chicken for meat (broiler) production was 51.3 billion pounds; during that same time interval, turkey production was 7.2 billion pounds. The top five broiler-producing States were Georgia, Alabama, North Carolina, Arkansas, and Mississippi (Figure 3). The top five turkey production states were Minnesota, North Carolina, Indiana, Arkansas, and Missouri (USDA-APHIS, 2015a).

The most recent Census of Agriculture reported 233,770 poultry farms in the United States in 2012 (USDA-NASS, 2014). 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 (USDA-NASS, 2015c). An estimated 21,000 farms produced 5 million ducks primarily in California, Indiana, and Pennsylvania, while about 10,000 farms produced 106,000 geese primarily in Texas, South Dakota, and California according to the 2012 Census of Agriculture. Other National Agricultural Statistics Service maps and poultry production data from the 2012 Census of Agriculture are incorporated by reference (USDA-NASS, 2014). For a historical perspective of the structure of agriculture as related to farm size, income and landownership, please see Chapter 2 in the RCA Appraisal (USDA-NRCS, 2011a).
Poultry Facilities
Poultry production generally occurs in enclosed buildings that may be located side-by-side. This arrangement allows producers to increase production efficiency while reducing labor. Enclosed domestic poultry facilities reduce the likelihood of exposure to predators and diseases from wild birds, but can also accelerate the spread of an introduced disease inside the facilities. Vegetation is removed from within poultry houses and barns, and weeds generally are removed from farming acreage to facilitate the movement of equipment. Implementing biosecurity measures between production buildings on the same farm, and among separate farms, can reduce the incidence and spread of disease (EPA, 2012).

Poultry production recognizes chickens reared for laying eggs as “layers”, while hens before they lay their first egg are known as pullets. These birds usually are grown in cages until they are moved to the laying house. In contrast, chickens raised for meat production are known as “broilers”. Broilers are brooded in a portion of the facility before they are granted access to the entire barn. Breeder broilers are generally kept in a barn with a slotted floor or with a wire floor with litter in the middle. The facilities for broilers generally have litter floors (EPA, 2012).

Poults (or baby turkeys) generally are sorted by gender at the hatchery to allow the males and females to be reared separately. Turkeys are often raised in a series of several different barns, where the brooder barn is used for six to eight weeks, followed by movement to an intermediate barn, and finally to a grow-out facility. This allows farms to rear a large number of turkeys in a short timeframe. Most turkeys are reared on litter floors (EPA, 2012). Ducks and geese may be raised in similar types of production facilities during their early development, and subsequently grown to market weight on pasture. Chicken and turkey chicks often are inoculated against diseases, while the more disease resistant ducks and geese generally are not. For additional information on poultry production, see Nelson, 2005.

Wildlife are not found within poultry production barns and houses except as transient visitors (e.g., pigeons (*Columba livia*), house sparrows (*Passer domesticus*), European starlings (*Sturnus vulgaris*), etc.). Although their numbers will be low relative to the number of poultry being raised, they are likely to be present long enough to acquire AI viruses from infected birds through direct contact, food, and water. Nevertheless, any release (rather than removal) of wild birds could allow viral strains to reenter other wildlife populations.

Poultry Production Emissions and Waste Management
Ventilation systems in poultry facilities are necessary to reduce excess heat, moisture, dust, and odors while simultaneously diluting airborne disease organisms. Ventilation systems also remove harmful gases such as carbon dioxide, methane, ammonia, and hydrogen sulfide (Fairchild et al., 2012). Poultry production facilities use either natural air flow or mechanical air movement ventilation systems to achieve these needs (Fairchild et al., 2012).
During poultry production, greenhouse gas (GHG) emissions come from feed production, the use of fossil fuels to generate energy (mechanical emissions), and enteric fermentation and manure management (nonmechanical emissions). In general, poultry producers do not control the production of the feed they use, but other types of GHG emissions are likely to be under their control. Mechanical emissions typically include purchased electricity, propane used for heat and incineration of dead birds, and diesel used in farm equipment such as generators. The type of production system (broiler, pullet, or breeder) affects the amount of greenhouse gases emitted, and while emissions from older houses were greater in one study (probably because of how they were equipped), farms should be individually evaluated for GHG emissions to account for individual variability (Dunkley et al., 2015). Broiler and pullet houses are associated with higher mechanical emissions from propane use than breeder houses because they use more propane for heating and brooding purposes. Broiler and pullet houses have relatively lower nonmechanical emissions than breeder houses based on manure management practices (Dunkley et al., 2015).

Domestic poultry production involves large volumes of by-products such as manure and hatchery/processing wastes. Birds succumbing to congenital defects, accidents, equipment failures, and diseases create a relatively high level of routine mortality associated with poultry production in comparison to other livestock (Blake et al., 2008). Composting of poultry carcasses was a new idea in the late 1980s that is now accepted and implemented by poultry producers nationwide (Blake et al., 2008). A study composting HPAI H5N2 infected chicks completely inactivated the virus after the second stage of the composting process (Senne et al., 1994); composting is recognized as a reliable, environmentally safe way to dispose of H5N1-infected poultry waste (Ahmed et al., 2012). In general, on-farm methods normally used for routine mortalities and by-products are adapted to deal with catastrophic losses, such as an incidence of AI.

B. Avian Influenza

Avian Influenza or “bird flu” refers to illnesses caused by many different strains of influenza A virus that are adapted to specific bird hosts. The eight segments of the RNA genome of AI viruses exhibit high mutation rates7. The large and diverse genetic reservoir of LPAI viruses circulating in poultry leads to frequent gene reassortment during replication and recombination (Sonnberg et al., 2013). For example, two H5N2 AI viral strains in China were derived from reassortment events where H5N1 viruses acquired novel neuraminidase and nonstructural protein

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7 The influenza viral RNA polymerase lacks a proof-reading mechanism which leads to error-prone RNA replication and the observed high mutation rate. When two different AI viruses infect the same cell, the segmented RNA genome leads to genetic reassortment. Recombination in the viral RNA genome acts in concert with these two processes leading the viruses to cross species barriers and evade host immune responses (Peiris and Yen, 2014).
genes, while another two isolates acquired hemagglutinin genes from H5 viruses and other genes from H9N2 isolates (Zhao et al., 2012a). Additionally, in Tibet in 2010, a novel H5N2 AI isolated from chickens was a natural reassortment between H9N2 and H5N1 subtypes (Zhao et al., 2012b). Selection pressures encountered by novel strains, or in novel hosts, or in novel sites of replication combine to drive diversification of the virus population and its adaptation to new hosts. The relative abundance of AI subtypes changes cyclically between years, probably in response to herd immunity from adults in flocks. The H5 and H7 subtypes can naturally switch to a highly pathogenic phenotype by the spontaneous acquisition of basic amino acid residues into the multibasic cleavage site during circulation in poultry (Herfst et al., 2012; Sonnberg et al., 2013). In China, there are more than 47 genotypes of H5 AI viruses recognized, and many genotypes are reassortments between H5N1 and H9N2 (Su, 2015).

The three transmission routes for AI viruses are aerosols, droplets, and direct contact; among poultry, transmission is commonly through the fecal-oral route (Zhong et al., 2014). AI viruses replicate primarily in avian intestinal tracts. The magnitude and duration of viral shedding is highly species and virus strain-specific. Viral shedding from the avian respiratory tract tends to be more pronounced in HPAI infections and is associated with adaptation to terrestrial poultry. LPAI viruses exhibit greatest stability and environmental persistence in cooler conditions. The avian respiratory tract is critical for bird temperature regulation, and it is at a comparatively lower temperature than the intestinal tract. For many strains, ducks and geese may be asymptomatic while chicken and turkey infections lead to mortalities (Sonnberg et al., 2013).

The geographic spread of the related H5N1 from China to Siberia, India, Europe and Africa largely correlates in time and space with annual bird migration movements along the overlapping flyways spanning Eurasia. Since its introduction into Egypt in 2006, dissemination of that strain relied on poultry movement (live bird trade) and on low-level biosecurity in mid-size commercial farms and backyard flocks; there was sporadic transmission to humans when they were associated with close contact with sick poultry. Additionally, recent reports of related H9N2 viruses raise the possibility of further, rapid changes in the phenotypes through reassortment with these LPAI viruses (Sonnberg et al., 2013). For additional information on genetic changes, dissemination, and human interactions see Sonnberg et al., 2013; for information on the epidemiology of HPAI across the United States, please see the links available through (http://www.aphis.usda.gov/wps/portal/aphis/ourfocus/animalhealth?1dmy&urile=wcm%3apath%3a%2Faphis_content_library%2Fsa_our_focus%2Fsa_animal_health%2Fsa_animal_disease_information%2Fsa_avian_health%2Fct_avian_influenza_disease).

It is important to bear in mind that the H5N2 strain observed in the United States during 2015 does not carry human infectivity, and also may differ in dissemination characteristics from previously problematic AI strains. Nevertheless, the dissemination of the H5 and H9 viral strains
throughout the world can be used to show how land, water, and air resources become involved in
disease control efforts. Additionally, carcass management may impact these natural resources.

C. Environmental Resources

In this section, a brief review of potential AI viral interactions with the environmental resource is
followed by consideration of the resource as it relates to carcass management. This structure
attempts to synthesize considerations under the natural resources of land, water, and air. Carcass
management as it is practiced in affected areas is considered in depth in the 2004 Carcass

In an AI animal health emergency, the potentially affected natural resources are closely allied
with the actual farm’s environment. APHIS is not asserting all farms are alike, or that regional
and local variations in poultry production do not exist and will not be important. Instead, by
focusing on the segments of the environment that are most likely to be affected by a poultry
disease occurring within commercial poultry production settings, APHIS is trying to remove
sources of uncertainty from this analysis that may otherwise confuse or deflect discussion.
APHIS anticipates individualized discussions will occur with landowners and state and local
officials as the need arises to accommodate the specific land, water, and air resources impacted
by HPAI outbreaks.

Land Cover and Land Use

According to the Food and Agricultural Organization of the United Nations, land cover is the
observed physical cover on the surface of the Earth as seen from the ground or through remote
sensing. It includes vegetation (natural or planted) and human construction such as buildings
and roads (Pasquali et al., 2005). For the purpose of this analysis, land cover associated with
poultry operations includes farms, farm buildings, and roads that lead to offsite disposal
facilities.

Land use includes activities that produce goods or services (Pasquali et al., 2005). During HPAI
outbreaks, land use on a premise may shift from poultry production to disposal, particularly for
on-site burial or composting. This shift in land use could cause physical and chemical changes
to the soil quality. Physical impacts from digging trenches, removing topsoil, and physically
compacting soil from the use of heavy equipment may increase erosion and decrease soil quality.
Erodible soil types, or soils in sloped areas, may facilitate the movement of soil offsite, creating
potential water quality issues and impeding or preventing revegetation (Engel et al., 2004).

In any given year, the affected environment will form a discontinuous patchwork of farms within
poultry-producing regions. In 2015, HPAI was detected in farms in the counties on the map in
Figure 1 (http://www.aphis.usda.gov/animal_health/downloads/animal_diseases/ai/HPAI-incident-
The combination of strain prevalence, disease severity in wild bird populations, and domesticated flock resistance are sources of uncertainty that will influence the HPAI detection rate each year in poultry-producing facilities.

**Soil Resources**

A variety of soil types exist across the United States composing 12 different orders that are further divided into 64 suborders (USDA-NRCS, 1999). Criteria used to separate soil series determine the stability and erosion potential of various soil types, and predict the potential risks to human health and property (USDA-NRCS, 2004). Naturally occurring wind and water erosion can be exacerbated by human activities that affect the soil properties in a given area (USDA-NRCS, 2004). Soil information is used to site landfill facilities, and determine burial and composting locations (Brinton, 2000; Chang et al., 2008; FitzMaurice, 2013).

Physical and chemical changes to soil quality occur whenever soil is disturbed. Physical impacts from digging trenches, removal of topsoil, and physical compaction due to the use of heavy equipment may increase erosion and decrease soil quality. Erodible soil types, or soils in sloped areas, may facilitate the movement of soil offsite, creating potential water quality issues and impeding or preventing revegetation (Engel et al., 2004). Pathogens and organic compounds are released during carcass decomposition, but proper management of compost piles can minimize the potential for soil contamination (Guan et al., 2010; Blake, 2008; Kalbasi et al., 2005). Antibiotics may leach into soil and affect naturally occurring soil microorganisms (Joy et al., 2014). Decaying materials impact soil quality by releasing chemical contaminants or leachate. Nitrogen and phosphorus from carcass leachate may add minerals and nutrients to the soil that become available for plant and microbial growth (Kim and Kim, 2012; Robinson and Luo, 1991). Excessive amounts of these chemicals can negatively affect native soil microorganism populations, or alter normal carbon, nitrogen, and phosphorus cycling (Kim and Kim, 2012).

Other contaminants may become deposited onto soil from the incineration of carcasses, either on-site or at a fixed facility; these generally include ash, particulate matter, and to a lesser extent dioxins, polyaromatic hydrocarbons (PAH), and metals (Engel et al., 2004, Chen et al., 2004, Chen et al., 2003a, Chen et al., 2003b). Depending on the ability of a pathogen to remain infective after a carcass is burned (such as a prion), disposal at a landfill may be required for the ash. Application of ash to agricultural lands may occur for non-infected carcasses (Mukhtar et al., 2008), or those where the pathogen is no longer infective after the carcass is burned. While ash adds carbon and other nutrients to the soil, the phosphorus may not be available unless dissolved in an acid prior to application (Cohen, 2009).

Regardless of which alternative is chosen, State and local authorities would continue to use the disposal methods authorized in Federal and State regulations, and vehicle use to/ from poultry production facilities would remain consistent regardless of who does the action. Under the No
Action alternative,APHIS would not be involved in HPAI depopulation,transport and disposal of carcasses,and disinfection of equipment and premises activities.State and local authorities would be responsible for managing and funding these types of HPAI activities.Overall GHG emissions from the vehicles used during these operations will depend on the nature and age of the equipment combined with the severity of the incidences and the number of outbreaks.APHIS would still conduct nationwide surveillance of commercial and backyard flocks through the NPIP and implement and release quarantines where HPAI outbreaks occur but would not assist with restoring biosecurity.Wildlife may experience longer exposure times to carcasses piled up outdoors if the response time is increased due to the lack of personnel.

The buildup of dead animals awaiting carcass management is problematic for many reasons.Diseased carcasses can serve as a source of inoculum for wildlife either directly or indirectly (e.g., water and insects)(Root et al., 2014; Nazni et al., 2013). Decay is associated with unacceptable odors,and leachate forms and flows outward toward water resources. Water may become contaminated if leachate retains infective doses of viral particles. The next section addresses water-related aspects.

**Water Resources**

Based on information from 2005, the United States uses approximately 410,600 million gallons of water per day (Mgal/d). Approximately 20 percent is from ground water, and 80 percent is from surface water (Kenny et al., 2009). Ground water flows underground, and contributes water in substantial quantities to streams and rivers; it is stored in natural geologic formations called aquifers, and sustains ecosystems by releasing a constant supply of water (USDA-FSA, 2010).

Surface runoff from rain,snowmelt,or irrigation can affect water quality by depositing sediment, minerals,and contaminants into streams, rivers, lakes, wetlands, and coastal waters. The amount of surface runoff is influenced by meteorological factors (such as rainfall intensity and duration), and physical factors (such as vegetation, soil type, and topography). Natural features (i.e., the physical and chemical properties) of the land surrounding a water body have the greatest impact on quality. The topography, soil type, vegetative cover, minerals, and climate also influence water quality (USDA-FSA, 2010; USDA-NRCS, 2011). Currently, exceptional drought conditions continue in California and Nevada, but the rest of the nation is not under drought (Fuchs, 2015).

In the United States, the primary water bodies on affected farms are likely to be surface waters including farm ponds, ditches, and streams. Poultry producers use both farm ponds and groundwater sources to provide water to poultry flocks. These ponds also may be used by migratory waterfowl.
Studies demonstrate the risk of AI transmission appears greater when there is access to water; the presence of a river stream, or flooded land area, or pond or canal around the farmhouse; or proximity to mixosaline water wetlands (Gilbert and Pfeiffer, 2012). As runoff enters other waterways, viral particles surviving outside of a host may be moved. Aquatic habitats are believed to transmit and maintain LPAI viruses in wild waterfowl when viral particles remain infective for extended durations (months) in water (Zhang et al., 2014).

Viral persistence in water is strongly dependent on the viral strain, water temperature, salinity, and pH (Brown, 2014). Zhang et al. (2014, citing Ito et al., 1995) reported, “AIVs [Avian Influenza viruses] remain infectious for months in low temperature waters and for >1 week even at 22°C.” Infected duck fecal material diluted in nonchlorinated water remains infective for more than 32 days at 4°C and between 4 and 7 days at 22°C (Nielsen et al., 2013). In general, viral particles remained infective longer in colder water and with high organic matter; the organic matter content can mask effects of salinity (Nielsen et al., 2013).

Depending on the temperature and organic matter content, surface water in rivers, streams, creeks, lakes, and reservoirs that provides water for poultry production and irrigation could allow AI viruses to survive and be disseminated. The infective AI viral titer level of H5N2 surviving in U.S. farm ponds is unknown. Migratory bird use of water that is subsequently used for agricultural purposes could be a source of viral contamination. Meanwhile, every improperly disposed of poultry carcass could become a point source of water pollution.

Efficient carcass management must consider carcass composition in addition to the potential to transmit disease. On average, a fresh broiler carcass contains approximately 34.2 percent dry matter, consisting of approximately 52 percent protein, 41 percent fat, and 6 percent ash (Blake et al., 2008). As a carcass degrades, leachate, biological and chemicals agents, and gases are naturally released. Decomposition byproducts can elevate the biochemical oxygen demand (the level of dissolved oxygen needed by aerobic biological organisms in a body of water to break down organic material at a specific temperature and over a specific time period). The total dissolved solids (a measure of inorganic and organic substances suspended in a liquid; the measurement is used as an indicator of the presence of chemical contaminants) may become elevated. Particularly near burial sites, the levels of other decomposition byproducts such as ammonia-nitrogen, phosphorus, and chloride may rise. The relative concentrations of these types of pollutants vary over time because release rates during degradation do not synchronously peak (Engel et al., 2004).

Environmental monitoring in water includes standard indicators for the presence of human pathogens and adverse environmental conditions (Engel et al., 2004). Agriculture is the primary cause of impairment to rivers and streams, the second leading cause of impairment for lakes, and the third leading cause of impairment for wetlands (EPA, 2014a). The most common types of agricultural pollutants include excess sediment, fertilizers, animal manure, pesticides and
herbicides (TAMU, 2014). Some of these pollutants eventually contaminate ground water by leaching. Proper management of manure limits groundwater pollution from poultry production facilities (Nelson, 2005).

**Air Resources**
Airborne transmission of AI (including aerosols and droplet particles) would allow efficient transmission among intensively farmed poultry and increase the likelihood of interspecies transmission. The mechanism underlying airborne transmission of AI is multifactorial. The related H9 viruses contribute to the genetic and geographic diversity of H5 viruses, and there is the potential for reassortment among key amino acids in hemagglutinin, basic polymerase 2, and sialic acid receptor sites that are deemed vital for transmissibility (Herfst et al., 2012; Zhong et al., 2014). Indirect transmission of AI, such as through windborne transfer, led to a model for between-farm spread of HPAI that explained transmission over short distance ranges by considering the deposition pattern of (contaminated) farm dust and pathogen decay, using a Plume Model and HPAI H7N7 specific parameter values. Using this model, a windborne route alone did not explain the 2003 epidemic of HPAI in the Netherlands, and unassisted movement of HPAI through the air generally will be less than 2 km (Ssematimba et al., 2012). Based on these findings, the extent that farm biosecurity measures can contribute to limiting transmission of viral particles as an air contaminant is unclear. This data also suggests uptake of viral particles from the soil and dispersion through ventilation systems contribute to, but are unlikely to be, the primary modes of viral transmission.

Air quality conditions vary across the United States; Federal and State agencies monitor air quality. The Clean Air Act (amended in 1990) requires States to comply with the National Ambient Air Quality Standards (NAAQSs) established by the EPA for six principal pollutants, called criteria pollutants. The intention of these standards is to protect public health and the environment from these pollutants. The six criteria pollutants are: ozone (O3), nitrogen dioxide (NO2), carbon monoxide (CO), sulfur dioxide (SO2), lead (Pb), and inhalable particulate matter (PM). Although European systems use occupational health size fractions to classify particulates, in the United States, there are three subgroups of particulates based on particle size (Cambra-Lopez et al., 2010). They are PM (coarse particulate matter greater than 10 μm [micrometers]), PM10 (particulates 2.5-10 μm), and PM2.5, (fine particles less than 2.5 μm) (EPA, 2013).

Clearly viral particles are not among the six principal pollutants, yet it is interesting to compare the particulate matter subgroups to viral particle size during transmission. Transmission of infectious particles with a diameter of 5 μm or less generally occurs via aerosols even though there is no exact particle size cut-off separating transmission from large droplets to aerosols (Herfst et al., 2012). The rather inefficient AI virus particle release process tends to form virus aggregates (Herfst et al., 2012). Large aerosol droplets typically travel <1m before settling (Sorrell et al., 2011). The modelling of windborne spread of HPAI between farms specifically
included consideration of chicken activities (such as pecking, wing flapping, and dust bathing) that can re-suspend viral particles into the air (Ssematimba et al., 2012).

Air quality monitoring data is collected and reviewed by EPA, state, and local regulatory agencies, and is available to the public. This data is often published with respect to a local air quality index (AQI). The AQI is a measurement (from zero to 500) of the level of criteria pollutants in the atmosphere. An AQI above 100 indicates that air quality conditions may be unhealthy for certain sensitive groups of people. An AQI over 300 represents air quality that is hazardous to everyone. AQI values below 100 indicate pollutant levels are at satisfactory levels (AirNow, 2013; EPA, 2014b).

Agricultural operations can affect air quality by releasing particulates, gases, and other chemicals into the air. Particulates may be released through a variety of cropping practices including the burning of crop residues or animal carcasses (Cambra-Lopez et al., 2010; Lemieux et al., 2004; Yang and Sheng, 2003). Burning releases smoke, exhaust from motorized equipment may release criteria pollutants, and cropping activities (such as planting, tillage, and harvesting) generate airborne soil particulates when growers use motorized equipment (Lemieux et al., 2004). Gases, such as CO₂, hydrocarbons, hydrogen sulfide, other volatile organic compounds, and methane, are released through equipment exhaust (Zhao, 2007). Gases and particulate matter are released at every disturbance of the soil and through the production of manure, both of which induce population changes among the microbial flora (Aneja et al., 2009; Cambra-Lopez et al., 2010; Zhao, 2007). Disturbance of the soil and wind-induced erosion may lead to suspended soil particles in the air and adsorbed aerosols becoming airborne (Felsot, 2005; Hernandez-Soriano et al., 2007).

Decomposition of carcasses releases gases such as methane (CH₄), carbon monoxide (CO), nitrogen oxides (NOₓ), sulfur dioxide (SO₂), hydrogen chloride (HCl), hydrogen fluoride (HF), and polycyclic aromatic hydrocarbons. Carbon dioxide may also be released and is considered to be a GHG that could contribute to climate change effects (Engel et al., 2004). In a larger context, production of any of these gases influences human health and considerations arise at global, epidemic, and individual farm levels. These are discussed in the next section with an emphasis on the involvement of federal workers in the poultry production facilities and biosecurity.

D. Human Health Aspects

The link between animal diseases and public health is recognized in the “One World, One Health” initiative supported by OIE, United Nation agencies, and the World Bank (http://web.oie.int/boutique/index.php?page=ficprod&id_produit=1308&fichrech=1&lang=en). The global perspective on collaborative efforts to obtain optimal health for people, animals, and
the environment, as envisioned by writers such as Cook (2005), Peiris and Yen (2014), and in other papers available at the preceding link, is beyond the scope of this analysis to review. See those references for additional discussion of the global human-animal health aspects.

In the past, outbreaks of some AI strains were associated with infected humans in Asia, Africa, Europe, the Pacific, and the Near East. While very rare, some H7 strains caused illness in humans in North America between 2002 and 2004. In south-central Texas in 2004 the first outbreak of HPAI in the United States in 20 years occurred when an outbreak of H5N2 was reported in a flock of 7,000 chickens. Since that time, HPAI H5N1 viruses have caused outbreaks in poultry, and human cases have occurred in Indonesia, Vietnam, Egypt, and Africa (http://www.cdc.gov/flu/avianflu/outbreaks.htm).

The CDC considers the risk to people from HPAI H5 infections to be low because current strains of HPAI H5N1, H7, and H9N2 viruses do not spread efficiently from person-to-person (see links from http://www.cdc.gov/flu/avianflu/index.htm; Herfst, 2012). A transmissible strain of AI viruses may emerge either by genetic mutation or by reassortment of human and avian influenza viruses (Herfst, 2012; Peiris and Yen, 2014; Sonnberg et al., 2013). To some extent, H5N1 field isolates circulating in Europe, the Middle East, and Africa have acquired the ability to recognize human-type receptors (http://www.cdc.gov/flu/avianflu/h5n1-human-infections.htm; Herfst, 2012). HPAI H9N2 viruses are now endemic in poultry populations in parts of Asia and the Middle East, and numerous H9N2 viruses acquired human-type receptor binding specificity (Imai and Kawaoka, 2012).

Poultry producers and APHIS workers in prolonged contact with infected poultry are at the greatest risk of contracting strains of bird flu that have the genes for virulence in humans. Viral mutations to increase or decrease pathogenicity naturally occur, and the rate they will occur over time presents an unknown risk. These types of viral mutations are not irreversible, that is, pathogenicity of viruses fluctuates as natural selection influences the balance of susceptible host populations, strain prevalence, and dissemination. Global movement of susceptible humans, in particular, has the potential to widely disseminate a contagious strain when it develops in the future. Under the proposed action, APHIS would continue to support the Department of Health and Human Services in whatever ways are necessary and practically possible in their efforts to control human infections as they arise.

IV. Potential Environmental Impacts

The NEPA implementing regulations provide criteria that Federal agencies should evaluate, if applicable, in environmental documents for proposed actions. This section of the Environmental Assessment addresses the applicable criteria related to potential impacts from the No Action Alternative and from the Preferred Alternative. NEPA criteria that are applicable for
consideration in this section of the document include the physical environment, human health and safety, and wildlife impacts.

A. No Action

Under the No Action Alternative,APHIS would not be involved in HPAI depopulation, disposal of carcasses, and disinfection of equipment and premises. State and local authorities would be responsible for managing and funding these types of HPAI activities. APHIS would still conduct nationwide surveillance of commercial and backyard flocks through the NPIP and implement quarantines where HPAI outbreaks occur but would not assist with restoring biosecurity. In addition, compensation would not be provided to affected producers to encourage the reporting of disease incidence.

Under the No Action Alternative, APHIS would not address the impacts perpetuated by the continued presence and genetic reassortment of AI viruses across the nation. While humans are unable to stop viral mutation, they can reduce the potential for exposure of susceptible hosts. Under the No Action Alternative, APHIS would reduce the potential for exposure by conducting surveillance to identify infected hosts. Implementing quarantines whenever an outbreak of HPAI occurs in poultry would minimize the spread of the HPAI virus. APHIS employees would not be at risk for infection or psychological impacts during an outbreak due to lack of participation in restoring biosecurity, but individual producers, their families, and contractors would remain at risk. The public’s concerns regarding human health and safety, and long-term impacts of an outbreak on food security, would be similar under both alternatives. Under the No Action Alternative, the length of time people experience these sources of anxiety is expected to be longer.

Impacts to air, soil quality, and local vegetation would be the same under both the No Action Alternative and the Preferred Alternative because State and local authorities would continue to use the disposal methods authorized in Federal and State regulations. Under the No Action Alternative, wildlife may experience longer exposure times to carcasses piled up outdoors if the response time is increased due to the lack of personnel.

B. Preferred Alternative

APHIS classifies Tier 1 diseases of national concern as those diseases posing the most significant threat to animal agriculture in the United States, and this includes AI. The OIE maintains a list of highly infectious diseases of concern (OIE, 2015; see http://www.oie.int/animal-health-in-the-world/oie-listed-diseases-2015/), of which HPAI is one. HPAI poses serious danger for animal health and welfare, an economic threat to animal livestock industries, and also a risk to human public health if the virus reassorts into strains capable of impacting humans. The Preferred
Alternative, therefore, would use an adaptive management approach to identify and control future AI outbreaks, and includes but is not limited to the following activities:

- Surveillance
- Quarantine
- Depopulation
- Carcass Management
- Cleaning and Disinfection
- Environmental Sampling
- Quarantine Release
- Restocking

The adaptive management approach provides flexibility when responding to each HPAI outbreak, including selecting the most appropriate disposal method for the situation. The Preferred Alternative will allow APHIS to use its central repository of carcass disposal resources and national contacts, provide consistency during the response to an outbreak, and facilitate international trade. Impacts associated with the adaptive management approach are discussed in detail below.

**Environmental Resources**

Poultry production is associated with numerous pollutants including ammonia, nitrogen, phosphorus, pathogens, pesticides, hormones, odor, and airborne emissions. Anthropogenic sources emit approximately 60 percent of total methane (CH₄) and include agriculture (ruminants, rice, etc.), fossil fuel extraction and use, biomass burning, landfills, and waste (Hall et al., 2013). Meat products account for 15 to 24 percent of the global anthropogenic emissions of greenhouse gases, which is larger than global emissions from waste disposal (3 percent), manufacturing (7 percent), residential (10 percent), and transportation (14 percent) (Stavi and Lal, 2013). Beef production is associated with the greatest amount of GHG with 14.8 kg CO₂ equivalent (CO₂-e) kg⁻¹. Pork has a lower impact, with 3.8 kg CO₂-e kg⁻¹, while chicken produces the least amount of GHG emissions, with 1.1 kg CO₂-e kg⁻¹ (Stavi and Lal, 2013). Therefore, intensive poultry production contributes an estimated 3 percent of the total human-caused GHG emissions and 2 percent of the total GHG emissions from the livestock sector (Gerber et al., n.d.). Pollutants and GHG emissions are expected to increase temporarily in response to, and as a result of, HPAI outbreaks. If handled properly, impacts to air, water, and soil quality from disposal of infected poultry and materials should be minimized.

**Air Resources**

Air emissions can impact human health and contribute to global warming. The release of criteria pollutants are associated with transportation to and from premises for surveillance, depopulation, carcass management, cleaning and disinfection, environmental sampling, and restocking. Depopulation, carcass management, and cleaning and disinfection may release additional
particulates, gases, and other chemicals into the air. Air emissions are not associated with setting up quarantines and releasing them.

Mass depopulation occurs via two methods: Class A foam and carbon dioxide. Foam is only approved for floor-reared poultry such as broiler chickens, turkeys, and ducks. Carbon dioxide is used for caged hens. Both depopulation chemicals have non-flammable and non-explosive properties, occur over a short period of time, and are not expected to significantly impact air quality around poultry production facilities.

Air emissions associated with disposal of poultry carcasses is variable. Unlined burial of carcasses may release gases associated with anaerobic decomposition, such as carbon dioxide, carbon monoxide, nitrogen oxides, sulfur dioxide, hydrogen chloride and fluoride, and methane (Engel et al., 2004; Yuan et al., 2012). Disturbance of soil also will cause soil particles to become airborne. With the burial of carcasses containing disease, there is a potential for pathogens to be discharged into the atmosphere if the burial site accumulates gases, resulting in the forceful rupture of cover soils. Proper burial techniques (e.g., venting burial sites) would reduce this likelihood.

Air emissions from outdoor composting are expected to be minimal; however, composting does release carbon dioxide, methane, nitrous oxide, and ammonia in small quantities. Indoor composting reduces air quality concerns because there is no uncontrolled wind across the piles re-suspending particulates into the air. Air emissions from rendering, fixed-facility, incineration, and landfilling are regulated through a Federal or State permitting process to minimize releases. The controlled environments associated with these disposal methods, as well as curtain incineration and thermal decomposition, are effective at containing pollutants associated with carcasses.

Disinfectants could impact air quality or terrestrial ecosystems during use, and cause health problems, such as dermal or respiratory impacts to workers using them. Chlorine dioxide, a frequently used gaseous sterilant for clean-up following an HPAI outbreak is a powerful oxidizer and unstable in light (HHS, 2004). Therefore, it is not expected to significantly impact air quality. When using chlorine dioxide and other disinfectants, label instructions should be followed to ensure proper use of the chemical and to minimize impacts to the environment.

Water Resources
Sources of water contamination include soil erosion, leaching, surface water runoff, and groundwater contamination. Impacts to water are not expected to occur from surveillance, quarantining and releasing premises, environmental sampling, and restocking. Therefore, this section will focus on the impacts of depopulation, carcass management, and cleaning and disinfection.
During the 2015 HPAI outbreak, APHIS increased its capability to five foaming depopulation teams and contracted for six additional teams. For depopulating the layer houses, incident command teams and the National Veterinary Stockpile acquired CO₂ carts through various sources. These additional assets allow APHIS to begin depopulation within 72 hours of a presumptive positive result. The Type A fire suppression water-based foam used to depopulate poultry houses dissipates and is an EPA-approved product. The CO₂ depopulation method is American Veterinary Association-approved and is vented to the atmosphere with no impact on water quality.

Improper disposal of poultry carcasses can contribute to water quality problems. Methods for disposal of poultry carcasses include landfilling, rendering, incineration, composting, and burial. The burial of carcasses may impact the quality of surface and ground water resources. Several contaminants of concern are present in carcasses that may leach into the surrounding soil and migrate to surface and ground water. These contaminants include ammonia-nitrogen, phosphorus, and chloride (Engel et al., 2004 and Pratt and Fonstad, 2009). In addition, poultry by-products and waste may contain numerous microorganisms, including pathogens (Arvanitoyannis and Ladas, 2007).

Leachate from carcass burial has been shown to impact water quality parameters, such as pH, conductivity, and biological oxygen demand (Yuan et al., 2013; Glanville et al., 2006). Many of these pollutants and water quality parameters are listed as reasons for water impairment under section 303(d) of the CWA. Excessive nutrient loading from phosphorus and nitrogen compounds, as well as total dissolved solids and pathogens, are common causes of impairment in U.S. waters. Phosphorus and nitrogen may cause eutrophication of water bodies (Carpenter et al., 1998). Unlined burial may contribute to the release of contaminants into impacted waters, or impairment of otherwise healthy water bodies. In general, the potential for impacts to water quality rises as the number of carcasses increases. Organic compounds from carcass management may reduce dissolved oxygen in surface waters, which could negatively impact aquatic life (USDA-NRCS, 2012).

In addition to leachate, heavy equipment used for burying carcasses can disturb soil and cause sediment runoff to surface water. In cases where vegetation is not able to regenerate in an area after disposal, further sediment transport to surface water from wind and rain erosion is possible.

Impacts to water quality from outdoor composting should be less than the impacts from burial, assuming all Federal and State agency regulations and guidance are followed for the siting of compost piles. Carcasses may be placed on an impermeable or semipermeable barrier, which further decreases the amount of leachate in the surrounding environment. Indoor composting does not pose a threat to surface or ground water.
Landfills are regulated by the EPA, and in many cases, they are also regulated by individual States to ensure that disposed materials do not pose 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 (USDA-APHIS, 2015b). 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 the 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 (USDA-APHIS, 2015b).

As part of an outbreak response program, measures aimed at preventing the spread of the HPAI virus, including disinfection of equipment, transport vehicles, and/or premises where infected poultry were maintained, would be required to prevent mechanical transfer of the virus. If not used properly, the compounds in disinfectants can impact the human environment as residues on surfaces or in wastewater. Improperly used disinfectant compounds could end up in sewage systems and potentially impact aquatic systems. In contrast, the disinfectants used in the HPAI adaptive management program are registered for specific use with EPA and used according to label requirements. Label instructions for a disinfectant are provided for its proper application to prevent potential environmental impacts associated with the use of the registered product (EPA, 2008; Pollard et al., 2008).

Soil Resources
Soil resources are unlikely to be impacted during surveillance, depopulation, cleaning and disinfection, environmental sampling, and restocking. Therefore, this section will focus on the impacts to soil from carcass management activities.

Onsite unlined burial will impact the physical properties of soil by using heavy machinery to dig trenches and remove topsoil. Compaction may result in increased soil-bulk density values (the dry weight of the soil divided by the total volume the soil occupies) that may decrease re-vegetation rates of burial sites. These physical impacts to soil may result in increased erosion during and after burial activities have occurred.

Disposal of poultry carcasses in unlined burial trenches allows any biological and chemical agents that may be present to leach into the surrounding soil. The impact of these agents on soil quality is dependent on the type of agent, its concentration, ability to degrade, and binding potential to soil particles. Elevated levels of phosphorus, nitrogen, chloride, antibiotics, hormones, and veterinary pharmaceuticals have been observed in soils surrounding unlined burial pits.
In the case of phosphorus- and nitrogen-containing compounds, impacts to surface soil quality may be beneficial; however, excess levels may limit plant growth. The contribution of these pollutants to soils may also alter naturally occurring soil microorganisms responsible for cycling phosphorus and nitrogen in soils (Pratt and Fonstad, 2009). In addition, nitrogen is very mobile in soil and can easily leach from the soil into groundwater (Erisman et al., 2001; de Vries et al., 2003).

Offsite rendering, incineration, and landfilling are conducted at permitted facilities with controls meant to protect the environment, and would be expected to result in less of an impact to soil than unlined burial. The release of chemicals from these facilities is typically regulated through a Federal or State permitting process. In addition, the controlled environments of offsite facilities are more effective in processing pollutants, compared to unlined burial. If an offsite facility already exists, that reduces the need for soil disturbance, and resulting potential for erosion, compared to onsite management options.

Outdoor composting of carcasses would result in physical and chemical changes to soil quality, in particular to those areas where the composted material would be applied. The changes to soil quality may be beneficial by providing nutrients and minerals that would increase crop yield and plant growth; however, excess nutrients in the soil may be harmful to plants. In addition, nutrients may be susceptible to moving offsite as runoff. Federal and State guidelines provide recommendations regarding the application of compost to fields designed to minimize the potential for nutrients to move offsite (USDA-NRCS, 2003). If composting and land application of composted material is done according to site-specific soil characteristics and guidance from Federal and State agencies, the disposal option should have fewer impacts to soil quality than unlined burial (Glanville, 2009). Material may be placed on an impermeable or semipermeable barrier during composting and is monitored; therefore, leachate is less likely than unlined burial to contaminate the surrounding soil. Indoor composting would not impact soil quality during the composting process but would impact soil quality in areas where the compost was applied.

**Human Health Aspects**

The impact of avian influenza on the public is based on reassortment of H5 and H9 strains leading to human-to-human spread (Sonnberg et al., 2013; Sorrell et al., 2011; Su et al., 2015). The minimal requirements for efficient transmission are believed to include efficient viral attachment to upper respiratory tissues, replication to high titers in these tissues, and release and aerosolization of single viral particles (Sorrell et al., 2011). H5N1 continues to circulate, and continued biosecurity efforts are designed to assure reduced likelihood of dissemination into the human population. While there is nothing humans can do to stop viral mutation, reducing the potential for exposure to susceptible hosts is a necessary precaution.
Migratory birds are expected to disseminate new viral strains on a global scale over time. The related global human-animal health impact is part of ongoing studies on the transmissibility of virulence genes. These types of studies use ferrets as animal models (Imai and Watanabi, 2012), and are not reviewed here based on the limited scope of this analysis. Pandemic influenza strains will arise at unpredictable intervals, and these novel strains can outpace current vaccine development technologies (Peiris and Yen, 2014). The ability of H5N2 to reassort into a strain leading to human-to-human spread is assessed as low at the present time (CDC, 2015c), but over time, the risk cannot be completely discounted.

Public Health
Under the Preferred Alternative, APHIS surveillance, carcass management, and cleaning and disinfection actions would attempt to ameliorate the impacts created by the presence and reassortment of AI viruses as they occur across the nation. As of the end of February, there were no human cases of H5N2, H5N8 or H5N1 viruses detected in the United States or Canada (CDC, 2015b; Murti et al., 2015). Although confirmed cases of human infection from several subtypes of AI infection were periodically reported since 1997, the human-to-human transmission was reported very rarely, and has been limited, inefficient, and unsustainable (CDC, 2015d; USDA-APHIS, 2011). Most of these cases resulted from close contact with infected poultry (e.g., domesticated chicken, ducks, and turkeys) or surfaces contaminated with secretions or excretions from infected birds. To date, all viruses identified in the United States lack key amino acid substitutions associated with human-like receptor binding or substitutions in the polymerase or other internal genes associated with increased virulence and transmission in mammals (USDA-APHIS, 2015a).

The spectrum of illness seen in birds, not humans, gives rise to the term “highly pathogenic” (Murti et al., 2015). There have been no reported cases of H5N2 virus in humans. In the countries where other viruses have crossed the species barrier to humans, there was close, prolonged contact with infected poultry (Sonnberg et al., 2013). This type of exposure by the general public is not likely to occur during the current response if poultry carcasses are properly disposed.

Producers and Worker Safety
Individual producers or growers are the so-called “first in line” to potentially contract HPAI because of their close association with their flocks. Direct or indirect exposure to infected live or dead poultry, or a viral contaminated environment, is the primary risk factor for human infection (WHO, 2015). During an outbreak of AI among poultry, people who contact infected birds, or surfaces that are contaminated with secretions or excretions from infected birds, are at higher risk of infection than the general population, although no human cases of H5N2 have been reported (CDC, 2015e). These individuals and their contractors also may build compost piles, load birds into incinerators, transport carcasses to the landfill, clean and disinfect vehicles,
equipment, and materials, and clean and disinfect premises. With every action, there is a potential risk of contracting influenza; however, their risks are reduced by incorporating personal protective equipment into their daily routines.

While some chickens and turkeys die from AI before emergency responders can get to the birds, some sick or exposed birds must be euthanized. The CO₂ gas used during depopulation events is vented to the atmosphere, and is not of a sufficient concentration or volume to pose a human health risk. The use of water-based foam has the potential to decrease human exposure to AI viruses that may be present in a barn or house where H5N2 predominates. The foam technique is relatively easy to deploy under production conditions, and requires fewer workers than other depopulation techniques. By reducing the number of workers involved in depopulation efforts, it can mitigate physical threats associated with the depopulation efforts (USDA-APHIS, 2015e).

APHIS employees are filling many roles in the response operations including but not limited to: surveillance; overseeing 3-D (depopulation, disposal, and disinfection) activities; and administration. APHIS contracted with several entities to participate in the decontamination and disposal of poultry during the 2015 HPAI outbreak. Prior to any carcass management work, the contracted companies are responsible to brief their workers are on the nature of the disease and train them in specific hygiene requirements. Individuals who have the knowledge, labor, and equipment also are building compost piles with the guidance of an APHIS composting expert. APHIS provides personal protective equipment to its employees. Wearing proper protective equipment, such as respirators, can minimize the potential for worker exposure to aerosolized pathogens.

Pathogens can inadvertently be carried offsite by workers, visitors, or intruders. Site security systems prevent unauthorized personnel from accessing the area and spreading disease. Decontamination of personnel prevents cross-contamination, and minimizes the risk of transporting disease agents (Baird and Savell, 2004). For offsite disposal methods, a decontamination station located near the exit of the carcass management site allows thorough cleaning and disinfection of all personnel, vehicles, equipment and material prior to leaving the site. These practices minimize potential health effects to offsite workers and the general public. Although there are no antimicrobial products registered specifically against H5N2 strains, the EPA believes currently registered anti-viral products will be effective against this and related strains (EPA, 2015). Users should carefully follow the disinfection directions on the label to handle and safely use the pesticide product and avoid harm to human health and the environment.

Psychological impacts
The sights and odors from a large number of carcasses can be emotionally upsetting to humans because human sympathies and compassion are invoked. Farmers and their families could suffer psychologically from the loss of animals, disruptions in community life, and from stress
over concern for their financial future. Farmers have a vested interest in livestock blood lines maintained over many generations that may face extinction. Poultry producers would experience a loss of control over their business due to animal movement restrictions. Mental health counseling can help to mitigate psychological health impacts. Federal financial aid may also help to ease the mental and emotional stresses created by farmer financial burdens.

Decontamination and disposal workers could suffer psychologically from seeing and smelling the carcasses while they work. The use of personal protective equipment such as respirators minimizes the effects. Acute distress is likely to be felt by workers when initially confronted with odors until their olfactory system becomes desensitized during continuous exposure.

The general public is likely to be impacted if pictures of dead poultry permeate the public media. To the extent they recognize the impacts of bird flu when confronted by increases in egg and meat prices, the psychological “sticker shock” is not likely to be of lasting duration.

Psychological impacts from landfilling large numbers of carcasses can be minimized through public outreach and education because public concerns sometimes focus around the potential for landfills to experience technical failure (Giusti, 2009). There may be public concerns about increased traffic or the transportation of carcasses through neighborhoods en route to a landfill. For these reasons, outreach and education could minimize concerns and minimize psychological impacts before landfill disposal is used during a specific mass animal health emergency, especially when infectious disease control is an issue.

Carcass Management Methodologies
A certain amount of carcass transport is necessary as a precursor to disposal, and it may occur only on the farm or need to encompass movement off-site. Animal health officials work to ensure the movement is safe for decontamination personnel, transport operators, landfill, incinerator, and rendering workers, and the general public. To reduce the potential for impacts, all necessary biosecurity steps must be followed (USDA-APHIS, 2015e). Euthanized poultry is transported off-premises in sealed containers lined with heavy-duty plastic zip bags that are sealed, covered with a tarp, and disinfected prior to transport (Slingluff, 2014). Further information on carcass transport is in Appendix A.

In general, the use of best management practices during carcass management minimizes risk to the general public, farm workers, and poultry producers. Public health impacts associated with unlined burial arise from exposure to pathogens and decomposition chemicals released into the environment. Proper site selection and burial procedures can slow the spread of pathogens and reduce human exposure, although pathogens persist in an anaerobic environment (Nutsch and Spire, 2004). Unlined burial releases high concentrations of ammonia, organic acids, and gases (e.g., carbon dioxide or methane) (Nutsch and Spire, 2004) which may be toxic to humans.
In contrast, carcass rendering generally uses pressurized steam at 239 to 309 °F for 40 to 90 minutes in continuous- or batch-flow units to inactivate bacteria, viruses, protozoa, and parasites (Meeker, 2006). This would be sufficient to inactivate AI viruses. Further, rendering plants may not be available during an incident, and cleaning and disinfection procedures after handling diseased poultry may be challenging.

The human health risks for incineration are associated with air emission and ash disposal. Incineration of carcasses at a fixed-facility incinerator is a highly controlled process designed to minimize human health risks from air emissions. Ash is disposed at landfills or other controlled facilities designed to minimize human health risks.

Disposal of carcasses in Subtitle D municipal solid waste landfills is considered as an advantageous option due to their large capacities and facility distribution throughout the country, however, AI strains can remain infectious for up to 30 days in landfill conditions (Graiver et al., 2009). Proper design and long-term management minimizes the human health risks from landfill disposal of animal carcasses. Design features include liners at the bottom of the landfill, cover materials (such as soil and vegetation) at the top of the landfill, and gas control systems (which collects and removes gases). These measures reduce the likelihood of uncontrolled leachate and/or gases moving into the environment and potentially affecting the human water supply.

The human health risks for composting include the potential for (1) disease transmission from pathogens remaining in the composted material, (2) leachate contamination of ground water and soil, (3) the vectoring of diseases from vermin attracted to the compost piles, and (4) odors. Proper carcass composting piles exceed 131°F for several days, which inactivates the HPAI virus. Leachate contamination of areas outside the poultry barns and houses does not occur when compost piles are properly constructed inside these facilities. Outdoors, a properly selected composting site seeks to minimize potential human health impacts, in part, by reducing surface water runoff, movement of leachate, and migration of composted nutrients into ground water (Berge et al., 2009; Mukhtar et al., 2004). Properly constructed piles include at least a 1-foot thick base layer of carbonaceous material like wood chips that absorbs liquids and prevents leachate migration. Properly constructed piles also include at least a 1-foot thick cover of carbon material which minimizes release of gasses and odors and prevents access by insects and scavengers. Proper composting techniques (e.g., adequate cover material) (Rahman et al., 2009; Hao et al., 2009; Xu et al., 2007) reduce the release of these gases.

**Wild Birds**

Avian influenza A viruses have been isolated around the world from more than 100 different species of wild birds (CDC, 2015f). Influenza A viruses also include viruses that cause influenza in horses, pigs, domestic cats, tigers, leopards, and dogs (Center for Food Security and Public Health, 2014; USDA-APHIS, 2012). These influenza viruses can change through mutation, shift, or drift, causing the emergence of new types of viruses with differing pathogenicity (Center
for Food Security and Public Health, 2014). While it is typical for an influenza virus to infect only a host-specific species (i.e., equine influenza in horses or canine influenza in dogs), these viruses occasionally infect other species.

Wild birds are a reservoir\(^8\) for AI, and movement of wild birds carrying HPAI spreads the virus to new areas. Surveillance activities targeting wild birds revealed that by January 2015, every State sampled in the Pacific Flyway had at least one positive HPAI case (USDA-APHIS et al., 2015). Additional detections have since occurred in the Mississippi and Central Flyways, andAPHIS anticipates that HPAI-infected birds will be detected in the Atlantic Flyway during the fall migration (see Figure X for migratory flyway delineation).

![Figure 4. Migratory bird flyways in the United States. From left to right: Pacific, Mississippi, Central, and Atlantic. (Source: FWS, 2012)](image)

Between December 8, 2014 and July 10, 2015, State and Federal agencies identified 85 wild birds with HPAI in the United States (USDA-APHIS et al., 2015). The majority of these cases involve waterfowl; however, the first detection of HPAI in a songbird (black-capped chickadee) occurred in June (USDA-APHIS et al., 2015; USAgNet, 2015). Other wild birds that have tested positive for HPAI include Cooper’s hawks, red-tailed hawks, a snowy owl, and a bald eagle (USDA-APHIS et al., 2015). HPAI is usually fatal in raptors and songbirds (USAgNet, 2015).

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\(^8\) Any population of free-ranging or free-living species in which an infectious agent/vector has become established, lives and multiplies and is therefore a potential source of infection/infestation to other domestic and free-ranging species.
According to survey results collected from turkey producers impacted by the HPAI strain H5N2, 35 percent of respondents have wild birds in their poultry houses and 28 percent have raccoons, opossums, or foxes (USDA-APHIS, 2015a). In addition, 60 percent of respondents reported having waterfowl around their farm, while 25 percent reported observing birds in their barns (Table 1).

<table>
<thead>
<tr>
<th>Wild Bird Characteristics</th>
<th>Number of Respondents</th>
<th>Level or Response</th>
<th>Percent farms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wild birds around farm</td>
<td>81</td>
<td>Waterfowl</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>81</td>
<td>Gulls</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>81</td>
<td>Small perching</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td>81</td>
<td>Other water birds</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>81</td>
<td>Other birds</td>
<td>27</td>
</tr>
<tr>
<td>Birds year round</td>
<td>77</td>
<td></td>
<td>90</td>
</tr>
<tr>
<td>Seasonality</td>
<td>79</td>
<td></td>
<td>84</td>
</tr>
<tr>
<td>Bird location</td>
<td>81</td>
<td>Away from facilities</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>81</td>
<td>On farm, not in barns</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>81</td>
<td>On farm, in barns</td>
<td>25</td>
</tr>
</tbody>
</table>

While APHIS believes wild birds were responsible for introducing HPAI into commercial poultry, given the close proximity of wild birds and other animals to poultry, it is possible that HPAI-infected poultry could introduce the virus to healthy wild birds. Vultures and other raptors, in particular, could be exposed to HPAI while scavenging on piles of carcasses awaiting burial, composting, or incineration. Raptors also could be exposed to individual carcasses if mammals such as raccoons drag a carcass outside. Smaller birds could be exposed to HPAI if they are able to gain access to infected poultry houses, and insectivorous (insect-eating) birds may be drawn to carcass piles due to the attractiveness of carcass piles to insects. Under the Preferred Alternative, Federal and State personnel, farm managers, and contractors would monitor farms daily and conduct wildlife management activities to minimize the exposure of wild populations to infected carcasses. In addition, the threat to raptors from depopulation efforts is likely minor.

Surveillance, quarantines, environmental sampling, quarantine release, and restocking poultry houses will have no effect on wildlife populations. Transportation of poultry carcasses would not further expose wildlife to HPAI because carcasses that are transported to offsite facilities such as a landfill are moved on trucks in a controlled manner that mitigates the risk of spreading the virus. In addition, APHIS employs several layers of redundant safety measures and carefully monitors all cleanup and disposal activities to ensure that they are done in compliance with USDA protocols. Each truck carrying infected carcasses follows APHIS requirements and is issued a permit that allows for movement outside of the quarantine zone (USDA-APHIS, 2015b).
Additional discussion about the impacts of depopulation, carcass management, and cleaning and disinfection on migratory birds and associated mitigation measures is located in the Migratory Bird Treaty Act section.

C. Other Environmental Issues

Environmental Justice
Federal agencies identify and address disproportionately high and adverse human health or environmental effects of proposed activities, as described in Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. Affected poultry production operations are likely to be in rural areas, but there is no way to determine in advance how many will be among the rural poor. Agency indemnity programs do not discriminate, so all qualifying producers would be eligible for compensation. To the extent that APHIS can provide assistance with the necessary paperwork, the Agency is committed to providing this aid in a timely fashion.

Poultry producers who conduct contract farming may not be eligible under current indemnity programs because they do not suffer the loss of fowl, but instead, suffer losses when their property and equipment cannot be used for the intended purpose due to viral contamination. To the extent the USDA can rapidly aid these farmers with disinfestation, as well as efforts to stabilize effects of commercial bonus systems that penalize operations solely because disease has removed facilities from production, the Agency shall seek to ensure the goals of environmental justice extend to these low-income, rural, poor farmers. To the extent the USDA can reduce the distribution of inferior chicks by inspection and making vaccination technologies available, the Agency shall seek to ensure the goals of environmental justice extend to these low-income, rural, poor farmers.

While backyard poultry producers whose flocks become affected are more likely to be part of a low-income population, their flock size often is restricted (generally to fewer than 10 birds at a time). Reaching out to these small-scale producers poses difficult choices for the agency with regard to disease detection, biosecurity, and helping them qualify for indemnities because disease control at larger facilities reduces overall disease risk to a greater extent than providing individualized services to backyard producers. With agency resources spread thinly, special outreach to backyard poultry producers in the form of education about biosecurity may be the only support APHIS can provide at the present time. For these reasons, APHIS intends to address minority and low-income population concerns expressed by individuals as they arise, while continuing multi-language poultry biosecurity information campaigns.

Protection of Children and the Preferred Alternative
Federal agencies comply with Executive Order 13045, *Protection of Children from Environmental Health Risks and Safety Risks*. The alternatives do not pose any disproportionate adverse effects to children because APHIS activities would not occur when children are present in the immediate area. Children residing on a quarantined farm are more likely to be exposed to the sights, smells, and emotional impacts associated with control actions; their exposure to applied chemical products is negligible based on the program’s application methods and product formulations. Poultry production facilities tend to not be adjacent to farm houses or in backyard play areas. Regardless of the alternative chosen, if facilities appear to be near play areas, APHIS would restrict access to discourage non-biosecure activities. While it is likely that schools may be within 10 miles of a poultry production facility, APHIS actions would not occur on, in, or near school properties. Any exposure of school children to control actions is likely to occur as they walk or travel by a quarantined farm, and this exposure is negligible based on the program’s application methods and the product formulations.

**Tribal Consultation**

Executive Order 13175, *Consultation and Coordination with Indian Tribal Governments*, calls for agency communication and collaboration with tribal officials when proposed Federal actions have the potential for Tribal implications. APHIS does not anticipate conducting any actions on Federal or Tribal lands. APHIS expects Tribal members with infected flocks to be directly affected by program activities. APHIS would rely on the owner or operator of the farm to self-identify as a member of a Tribe, and/or identify Tribal interests pertinent to the land. APHIS actions on Tribal lands would occur only if the affected poultry production operation is located on Tribal land and the pertinent Tribal authorities (such as the Tribal Historic Preservation Officer) participate in the process. Individual Tribal members would be equally impacted in comparison to other individuals in the area because APHIS program activities affect all quarantined poultry. Some of the carcass management options would disturb the ground but APHIS would work in consultation with Tribal Historic Preservation Officers during the decision-making process to determine the best options for the site. If APHIS disturbs any Native American sites or artifacts are unearthed during composting or burial activities, the appropriate individuals will be notified.

**Threatened and Endangered Species and the Preferred Alternative**

Section 7 of the Endangered Species Act and its implementing regulations require Federal agencies to ensure that their actions are not likely to jeopardize the continued existence of threatened or endangered (listed) species or result in the destruction or adverse modification of critical habitat. APHIS considered the potential effects of the proposed action on threatened and endangered species and designated critical habitat.

All bird species federally listed as threatened or endangered in the United States (Table 2) may be susceptible to infection by HPAI, although susceptibility of different types of birds to clinical
disease may be variable. HPAI viruses have been shown to cause morbidity and mortality in a wide variety of wild birds (USDA-APHIS et al., 2015). Uncontrolled spread of HPAI in the contiguous United States may have adverse impacts to listed birds, depending on their susceptibility to HPAI. However, it is most likely that listed birds would be exposed to HPAI from wild, migratory birds as the viruses circulate in the flyways (USDA-APHIS et al., 2015) and the proposed program targets only domestic poultry. Thus, the proposed action may be of limited benefit to federally listed birds.

The proposed action includes surveillance, quarantines, depopulation, transport, disposal, cleaning and disinfection, environmental sampling, quarantine release, and restocking. Surveillance, establishing quarantines, sampling the environment, releasing quarantines, and restocking will have no effect on listed species or critical habitat. There are no activities associated with surveillance, establishing quarantines, sampling the environment, quarantine release, and restocking that would co-occur with listed species or result in any impacts to them. Therefore, the following sections discuss the impacts of depopulation, transport, disposal, and cleaning and disinfection on listed species and critical habitat. The main potential effects discussed below include consumption of carcasses; run off and contamination from disinfectants and depopulation materials; disturbance; and, impacts to critical habitat.

**Impacts to Federally Listed Species**

**Depopulation**

There are many potential adverse effects to species from consuming carcasses if they are contaminated with veterinary euthanasia medications or lead ammunition. However, depopulated HPAI chickens and turkeys are not contaminated with veterinary euthanasia medications or lead ammunition; CO₂ or Class A fire-suppression foam (Phos-Chek® WD881 Class A Foam Concentrate) is used to depopulate birds inside of commercial poultry houses. If listed species were to ingest euthanized chickens or turkeys depopulated using these methods, there would be no toxic effect. In addition, there is no run-off of the foam as it dissipates, and the remaining moisture/residue is absorbed by the litter or substrate in the poultry house; thus, aquatic organisms would not be affected.

**Transport**

When carcasses are to be incinerated offsite or are to be landfilled, the carcasses must be transported to those sites. Carcasses to be transported are removed from the poultry houses, placed in lined roll-off containers, and covered with secure tarps prior to transport. No listed species would have access to carcasses during transport. Vehicles used to transport carcasses would only travel on established roadways and driveways and would not enter into listed species habitat. Therefore, transport of carcasses would have no effect on listed species.

**Disposal**
Indoor composting and incineration of carcasses will reduce the potential for any contact between listed species and carcasses because the carcasses are contained within barns or containers. Although it is possible that listed scavenging species or bird species could enter barns where carcasses are held prior to composting, there is a great deal of human activity around commercial poultry facilities, and these species would avoid such areas. In addition, wildlife management procedures are in place at the poultry facilities to reduce the potential for this occurrence.

Onsite burial, outdoor composting, and landfiling could potentially expose listed species to carcasses if they are left uncovered. However, landfilled and buried carcasses are covered with several feet of soil or other material, preferably within 30 minutes of placement, and composted carcasses are covered with 8 to 12 inches of clean material such as wood chips. Covering the carcasses will prevent listed species from accessing them. In addition, for onsite burial and composting, sites selected will likely be previously disturbed cropland areas, not undisturbed areas that could serve as habitat for listed species.

**Cleaning and disinfection**

There are many antimicrobial products available that may be used to disinfect vehicles, personnel, equipment, supplies, and buildings. See [http://www.epa.gov/opp00001/factsheets/avian_flu_products.htm](http://www.epa.gov/opp00001/factsheets/avian_flu_products.htm) for a list of antimicrobial products. It is the applicator’s responsibility to ensure that the product is labeled for HPAI and for the intended use site, and that the product is applied in accordance with the product label. If the Foreign Animal and Disease Preparedness and Response Plan SOPs for collection and disposal of disinfectant runoff are followed, listed species will not be exposed to these antimicrobial products. Therefore, there would be no effect on listed species from exposure to HPAI disinfectants.

**Impacts to Critical Habitat**

Critical habitat for federally “listed species consists of (1) the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the provisions of section 4 of the [Endangered Species] Act, on which are found those physical or biological features (constituent elements) (a) essential to the conservation of the species and (b) which may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 4 of the [Endangered Species] Act, upon determination by the Secretary [of the Interior] are essential for the conservation of the species” (FWS, 1998).

Placement of outdoor burial or compost sites could adversely modify the critical habitat of a listed species if it unfavorably affects the critical habitat’s basic elements that benefit the species. These elements are the physical and biological features of the habitat that are essential to the conservation of the species including space for individual and population growth and normal
behavior; food, water, air, light, minerals or other nutritional or physiological requirements; cover or shelter; sites for breeding; and habitats free from disturbance (FWS, 1998). The disturbance and habitat alteration from carcass onsite burial or outdoor composting could cause adverse effects to critical habitat of listed species. However, APHIS will not compost or bury carcasses within the proposed or designated critical habitat of listed species without consultation with the U.S. Fish and Wildlife Service and/or the National Marine Fisheries Service.

Table 2. Threatened and Endangered Birds Federally Listed in the Contiguous United States (FWS, 2015a).

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Listing status</th>
<th>Critical Habitat (Y or N)</th>
<th>States of Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albatross, short-tailed</td>
<td>Phoebastria (=Diomedea) albatrus</td>
<td>E</td>
<td>N</td>
<td>CA, OR, WA</td>
</tr>
<tr>
<td>Bobwhite, masked (quail)</td>
<td>Colinus virginianus ridgwayi</td>
<td>E</td>
<td>N</td>
<td>AZ</td>
</tr>
<tr>
<td>Caracara, Audubon's crested</td>
<td>Polyborus plancus audubonii</td>
<td>T</td>
<td>N</td>
<td>FL</td>
</tr>
<tr>
<td>Condor, California</td>
<td>Gymnogyps californianus</td>
<td>E, EXPN</td>
<td>Y</td>
<td>AZ, CA, UT</td>
</tr>
<tr>
<td>Crane, Mississippi sandhill</td>
<td>Grus canadensis pulla</td>
<td>E</td>
<td>Y</td>
<td>MS</td>
</tr>
<tr>
<td>Crane, whooping</td>
<td>Grus americana</td>
<td>E, EXPN</td>
<td>Y</td>
<td>CO, KS, MT, NE, ND, OK, SD, TX, AL, AR, GA, IL, IN, IA, KY, LA, MI, MN, MS, MO, NC, OH, SC, TN, VA, WI, WV, CO, ID, FL, NM, UT</td>
</tr>
<tr>
<td>Cuckoo, yellow-billed (Western US DPS)</td>
<td>Coccyzus americanus</td>
<td>T</td>
<td>N (PCH)</td>
<td>AZ, CA, CO, MT, NV, NM, OR, TX, UT, WA, WY</td>
</tr>
<tr>
<td>Curlew, Eskimo</td>
<td>Numenius borealis</td>
<td>E</td>
<td>N</td>
<td>NE, OK, TX</td>
</tr>
<tr>
<td>Falcon, northern aplomado</td>
<td>Falco femoralis septentrionalis</td>
<td>E, EXPN</td>
<td>N</td>
<td>TX, AZ, NM</td>
</tr>
<tr>
<td>Flycatcher, southwestern willow</td>
<td>Empidonax traillii extimus</td>
<td>E</td>
<td>Y</td>
<td>AZ, CA, CO, NV, NM, TX, UT</td>
</tr>
<tr>
<td>Gnatcatcher, coastal California</td>
<td>Polioptila californica californica</td>
<td>T</td>
<td>Y</td>
<td>CA</td>
</tr>
<tr>
<td>Horned lark, streaked</td>
<td>Eremophila alpestris strigata</td>
<td>T</td>
<td>Y</td>
<td>OR, WA</td>
</tr>
<tr>
<td>Kite, Everglade snail</td>
<td>Rostrhamus sociabilis plumbeus</td>
<td>E</td>
<td>Y</td>
<td>FL</td>
</tr>
<tr>
<td>Knot, red</td>
<td>Calidris canutus rufa</td>
<td>T</td>
<td>N</td>
<td>AL, AR, CO, DE, FL, GA, IL, IN, IA, KS, KY, LA, ME, MD, MI, MN, MS, MO, MT, NE, NJ, NY, NC, ND, OH, OK, PA, SC, SD, TN, TX, VA, WA, WY</td>
</tr>
<tr>
<td>Murrelet, marbled</td>
<td>Brachyramphus marmoratus</td>
<td>T</td>
<td>Y</td>
<td>CA, OR, WA</td>
</tr>
<tr>
<td>Owl, Mexican spotted</td>
<td>Strix occidentalis lucida</td>
<td>T</td>
<td>Y</td>
<td>AZ, CO, NM, TX, UT</td>
</tr>
<tr>
<td>Owl, northern spotted</td>
<td>Strix occidentalis caurina</td>
<td>T</td>
<td>Y</td>
<td>CA, OR, WA</td>
</tr>
<tr>
<td>Common Name</td>
<td>Scientific Name</td>
<td>Listing status</td>
<td>Critical Habitat (Y or N)</td>
<td>States of Occurrence</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>----------------------------------</td>
<td>----------------</td>
<td>---------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>Parrot, thick-billed</td>
<td><em>Rhynchopsitta pachyrhyncha</em></td>
<td>E</td>
<td>N</td>
<td>AZ, NM</td>
</tr>
<tr>
<td>Plover, piping</td>
<td><em>Charadrius melodus</em></td>
<td>T</td>
<td>Y</td>
<td>AL, AR, CO, CT, FL, GA, IA, KS, LA, ME, MA, MN, MO, MT, NE, NH, NJ, NM, NY, NC, ND, OK, RI, SC, SD, TX, VA</td>
</tr>
<tr>
<td>Plover, piping (Great Lakes watershed)</td>
<td><em>Charadrius melodus</em></td>
<td>E</td>
<td>N</td>
<td>IL, IN, MI, MN, OH, PA, WI</td>
</tr>
<tr>
<td>Plover, western snowy</td>
<td><em>Charadrius alexandrinus nivosus</em></td>
<td>T</td>
<td>Y</td>
<td>CA, OR, WA</td>
</tr>
<tr>
<td>Prairie-chicken, Attwater's greater</td>
<td><em>Tympanuchus cupido attwateri</em></td>
<td>E</td>
<td>N</td>
<td>TX</td>
</tr>
<tr>
<td>Prairie-chicken, lesser</td>
<td><em>Tympanuchus pallidicinctus</em></td>
<td>T</td>
<td>N</td>
<td>CO, KS, NM, OK, TX</td>
</tr>
<tr>
<td>Rail, California clapper</td>
<td><em>Rallus longirostris obsoletus</em></td>
<td>E</td>
<td>N</td>
<td>CA</td>
</tr>
<tr>
<td>Rail, light-footed clapper</td>
<td><em>Rallus longirostris levipes</em></td>
<td>E</td>
<td>N</td>
<td>CA</td>
</tr>
<tr>
<td>Rail, Yuma clapper</td>
<td><em>Rallus longirostris yumanensis</em></td>
<td>E</td>
<td>N</td>
<td>AZ, CA, NV</td>
</tr>
<tr>
<td>Sage-grouse, Gunnison</td>
<td><em>Centrocercus minimus</em></td>
<td>T</td>
<td>Y</td>
<td>CO, UT</td>
</tr>
<tr>
<td>Scrub-jay, Florida</td>
<td><em>Aphelocoma coerulescens</em></td>
<td>T</td>
<td>N</td>
<td>FL</td>
</tr>
<tr>
<td>Shrike, San Clemente loggerhead</td>
<td><em>Lanius ludovicianus mearnsi</em></td>
<td>E</td>
<td>N</td>
<td>CA</td>
</tr>
<tr>
<td>Sparrow, Cape Sable seaside</td>
<td><em>Ammodramus maritimus mirabilis</em></td>
<td>E</td>
<td>Y</td>
<td>FL</td>
</tr>
<tr>
<td>Sparrow, Florida grasshopper</td>
<td><em>Ammodramus savannarum floridanus</em></td>
<td>E</td>
<td>N</td>
<td>FL</td>
</tr>
<tr>
<td>Sparrow, San Clemente sage</td>
<td><em>Amphispiza belli clementeae</em></td>
<td>T</td>
<td>N</td>
<td>CA</td>
</tr>
<tr>
<td>Stork, wood</td>
<td><em>Mysteria americana</em></td>
<td>T</td>
<td>N</td>
<td>AL, FL, GA, MS, NC, SC</td>
</tr>
<tr>
<td>Tern, California least</td>
<td><em>Sterna antillarum browni</em></td>
<td>E</td>
<td>N</td>
<td>AZ, CA</td>
</tr>
<tr>
<td>Tern, least</td>
<td><em>Sterna antillarum</em></td>
<td>E</td>
<td>N</td>
<td>AR, CO, IA, IL, IN, KS, KY, LA, MS, MO, MT, ND, NE, NM, OK, SD, TN, TX</td>
</tr>
<tr>
<td>Tern, roseate (northeastern U.S.</td>
<td><em>Sterna dougallii dougallii</em></td>
<td>E</td>
<td>N</td>
<td>CT, ME, MA, NH, NJ, NY, NC, RI, VA</td>
</tr>
<tr>
<td>Tern, roseate (Western Hemisphere)</td>
<td><em>Sterna dougallii dougallii</em></td>
<td>T</td>
<td>N</td>
<td>FL</td>
</tr>
<tr>
<td>Towhee, Inyo California</td>
<td><em>Pipilo crissalis eremophilus</em></td>
<td>T</td>
<td>Y</td>
<td>CA</td>
</tr>
<tr>
<td>Vireo, black-capped</td>
<td><em>Vireo atricapilla</em></td>
<td>E</td>
<td>N</td>
<td>OK, TX</td>
</tr>
<tr>
<td>Vireo, least Bell's</td>
<td><em>Vireo bellii pusillus</em></td>
<td>E</td>
<td>Y</td>
<td>CA</td>
</tr>
<tr>
<td>Warbler, Kirtland's</td>
<td><em>Setophaga kirtlandii</em> (= <em>Dendroica kirtlandii</em>)</td>
<td>E</td>
<td>N</td>
<td>FL, MI, SC, WI</td>
</tr>
<tr>
<td>Common Name</td>
<td>Scientific Name</td>
<td>Listing status</td>
<td>Critical Habitat (Y or N)</td>
<td>States of Occurrence</td>
</tr>
<tr>
<td>-------------------------------------------------</td>
<td>---------------------------</td>
<td>----------------</td>
<td>---------------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Warbler (=wood), Bachman’s</td>
<td><em>Vermivora bachmanii</em></td>
<td>E</td>
<td>N</td>
<td>FL, SC</td>
</tr>
<tr>
<td>Warbler (=wood), golden-cheeked</td>
<td><em>Dendroica chrysoparia</em></td>
<td>E</td>
<td>N</td>
<td>TX</td>
</tr>
<tr>
<td>Woodpecker, ivory-billed</td>
<td><em>Campephilus principalis</em></td>
<td>E</td>
<td>N</td>
<td>AR</td>
</tr>
<tr>
<td>Woodpecker, red-cockaded</td>
<td><em>Picoides borealis</em></td>
<td>E</td>
<td>N</td>
<td>AL, AR, FL, GA, LA, MS, MO, NC, OK, SC, TX, VA</td>
</tr>
</tbody>
</table>

*E = Endangered; T = Threatened; PE = Proposed for listing as Endangered; PT = Proposed for listing as Threatened; PCH=Proposed critical habitat; EXPN = Experimental population; Y=Yes; N=No.

**Historic and Cultural Resources**

The National Historic Preservation Act of 1966, as amended (16 U.S. Code § 470 et seq.), requires Federal agencies to consider the impact on properties included in, or eligible for inclusion in, the National Register of Historic Places (36 Code of Federal Regulations §§ 63 and 800). The proposed action does not have the potential to cause long-term visual, atmospheric, or audible elements that would result in effects on the character or use of historic properties based on the nature and types of activities occurring on private poultry-producing land. Registered historic properties may be near poultry production locations, but they are likely to be historically important battlefields, farmsteads, homesteads, and other sites where carcass burial or composting would not occur. While methane released from carcass burials may migrate to nearby structures, accumulate at explosive levels, and explode if an ignition source occurs, APHIS is aware of this risk and consequently is highly unlikely to select any sites for onsite burial that are near structures, including historic properties. Similarly, APHIS is highly unlikely to select sites for burial pits that are within the viewshed of a historic site such that carcasses emerging from the burial pits due to expansion from methane generation are visible.

Under both alternatives, the proposed action involves inspections, surveillance, and cooperative work with State representatives and poultry producers. APHIS will not conduct aerial chemical applications; disease control measures will be ground-based and depopulation activities will remain contained within production facilities. Carcass management is likely to include transportation and final disposal offsite depending on the available resources over time. Aside from the quarantined facilities, APHIS program activities do not affect human-made structures and APHIS restricts program treatments and activities to an as-needed basis. If APHIS discovers any archaeological resources during composting or burial activities, the appropriate individuals will be notified.

**Migratory Bird Treaty Act**

The Migratory Bird Treaty Act of 1918 (16 U.S.C. 703–712) established a Federal prohibition, unless permitted by regulations, to pursue, hunt, take, capture, kill, attempt to take, capture or
kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird or any part, nest, or egg of any such bird. FWS released a final rule on November 1, 2013, identifying 1,026 birds on the List of Migratory Birds (FWS, 2013). Species not protected by the Migratory Bird Treaty Act include nonnative species introduced to the United States or its territories by humans and native species that are not mentioned by the Canadian, Mexican, or Russian Conventions that were implemented to protect migratory birds (FWS, 2013).

Federal law prohibits an individual to pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird or any part, nest, or egg of any such bird (16 U.S.C. §§ 703-712; 50 CFR § 21).

There are many potential adverse effects to birds from consuming carcasses if they are contaminated with chemical euthanasia solutions, lead ammunition, or are infected with HPAI. However, depopulated HPAI-infected chickens and turkeys are not contaminated with toxic veterinary medications or lead ammunition; CO2 or Class A fire-suppression foam (Phos-Chek® WD881 Class A Foam Concentrate) is used to depopulate birds inside of commercial poultry houses. If migratory birds were to ingest poultry depopulated using these methods, there would be no toxic effect. Exposure to HPAI-infected carcasses could adversely affect migratory birds; however, APHIS and its cooperators will take steps to prevent this from occurring. Carcasses transported from poultry houses to offsite disposal locations are placed in lined roll-off containers and covered with secure tarps prior to transport. Birds would not have access to carcasses during transport. Indoor composting and incineration of carcasses will reduce the likelihood of any contact between migratory birds and carcasses because the carcasses are contained within barns or in containers. Although it is possible that birds could enter barns where carcasses are held prior to composting, wildlife management procedures are in place to remove them to prevent them from further spreading HPAI.

Onsite burial, outdoor composting, and landfilling could potentially expose scavenging birds to carcasses if they are left uncovered. However, landfilled and buried carcasses are covered with several feet of soil or other material, preferably within 30 minutes of placement, and composted carcasses are covered with 8 to 12 inches of clean material such as wood chips. Covering the carcasses with soil or other material will prevent birds from accessing them. In addition, scavenging birds regularly feed on wildlife carcasses; wildlife is the endemic reservoir of avian influenza viruses. Therefore, the threat to scavenging birds from exposure to infected poultry carcasses is minor compared to the natural threat from infected wildlife carcasses.
Birds also may be adversely impacted by stressors such as vegetation removal, human disturbance, noise, and chemical contamination (FWS, 2015b). Conservation measures can be applied to both alternatives to minimize the impacts of these stressors on migratory birds. APHIS does not anticipate altering vegetation during HPAI activities. Carcass management activities will take place on previously cleared private property. While the presence of humans may increase during HPAI management activities, any birds frequenting these properties are already likely acclimated to the presence of humans. Likewise, the temporary increase in noise associated with carcass management activities will likely have a negligible impact on migratory birds at these facilities. When using disinfectants to clean poultry facilities, APHIS will comply with all applicable Federal and State laws. In addition, APHIS has selected non-chemical depopulation alternatives that will minimize the impacts to migratory birds.

**Bald and Golden Eagle Protection Act**

The Bald and Golden Eagle Protection Act (16 U.S.C. § 668) prohibits the take of bald or golden eagles unless permitted by FWS. The term “take” is defined as “pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, destroy, molest, or disturb” (50 CFR § 22.3). Disturb means to agitate or bother to a degree that causes . . . injury . . . a decrease in its productivity . . . or nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior (§ 22.3).

The bald eagle (*Haliaeetus leucocephalus*) has a widespread distribution in North America and is flourishing in the United States. The largest North American breeding populations are in Alaska and Canada, however, there are also significant bald eagle populations in the Great Lakes States, Florida, the Pacific Northwest, the Greater Yellowstone area, and the Chesapeake Bay region (FWS, 2013). Bald eagles are opportunistic feeders. Although fish comprise much of their diet, they also eat birds, small mammals, turtles, and carrion. They will also feed on carcasses along roads, in landfills, and at feedlots (FWS, 2007).

“Golden eagles (*Aquila chrysaetos canadensis*) can be found from the tundra, through grasslands, forested habitat and woodland-brushlands, south to arid deserts, including Death Valley, California. They are aerial predators and eat small to mid-sized reptiles, birds, and mammals up to the size of mule deer fawns and coyote pups” (FWS, 2011). They also are known to scavenge and eat carrion. Golden eagles move quickly to fresh carcasses and fend off other scavengers (Krueger and Krueger, n.d.).

Bald and golden eagles locate fresh carcasses quickly, which makes them susceptible to secondary poisoning when animals are euthanized with toxins or lead ammunition and left uncovered. However, bald and golden eagles will not be exposed to toxic euthanasia chemicals or lead ammunition because HPAI chickens and turkeys are depopulated using carbon dioxide or Class A fire-suppression foam (Phos-Chek® WD881 Class A Foam Concentrate). Although
efforts will be made to prevent eagles from accessing carcasses, if they were to ingest chickens or turkeys depopulated using these methods, there would be no toxic effect.

Activities in nesting areas of eagles during the breeding season can affect the nesting success and could cause the eagles to abandon the nest altogether. Disturbance of eagle roosting and foraging areas can also negatively affect bald eagles. Disturbance of eagle nesting, roosting, and foraging sites is unlikely because the areas around commercial poultry facilities are busy areas, and composting and burial sites will be only placed on farmed croplands. According to the Bald Eagle Management Guidelines (FWS, 2007), “[e]agles are unlikely to be disturbed by routine use of roads, homes, and other facilities where such use pre-dates the eagles’ successful nesting activity in a given area. Therefore, in most cases ongoing existing uses may proceed with the same intensity with little risk of disturbing bald eagles.” However, the guidelines recommend that activities should be kept as far away from nest trees as possible (FWS, 2007). The guidelines also recommend minimizing potentially disruptive activities and development in the eagles’ direct flight path between their nest and roost sites and important foraging areas (FWS, 2007).

Onsite burial, outdoor composting, and landfilling could potentially expose eagles to carcasses infected with HPAI if they are left uncovered. However, landfilled and buried carcasses are covered with several feet of soil or other material, and composted carcasses are covered with 8 to 12 inches of clean material such as wood chips. Covering the carcasses with soil or other material will prevent eagles from accessing them and becoming infected with HPAI. In addition, as with other migratory birds, scavenging birds such as eagles regularly feed on wildlife carcasses; wildlife is the endemic reservoir of avian influenza viruses. Therefore, the threat to eagles from exposure to infected poultry carcasses is minor compared to the natural threat from infected wildlife carcasses.

**Cumulative Effects**

The potential impacts from a national approach to HPAI control in commercial poultry production in combination with similar actions are referred to as cumulative impacts. The level of these cumulative impacts to soil, water, and air will depend upon the magnitude of the outbreak at each poultry production facility, the routine activities occurring at the facilities, and the disposal methods selected.

Historically, small independent farms raised poultry in the United States. Many of these farms have since been replaced by concentrated animal feeding operations. This change in farming results in large volumes of non-emergency mortalities requiring regular and prompt management. In poultry production operations, a relatively constant percentage of the flock will die daily from congenital defects, accidents, and equipment failures (Blake et al., 2008). A flock of 50,000 broilers grown to 49 days prior to slaughter will produce 2.4 tons of carcasses that must be managed if they average 0.1 percent daily mortality.
Similarly, a 30,000 bird turkey flock averaging 0.5% weekly mortality during an 18-week period is associated with approximately 13.9 tons of carcasses (Blake et al., 2008).

Soil, air, and water quality may be impacted by the leachate or air particulates from managing these routine carcasses onsite. Poultry carcasses may routinely be buried or composted on a farm, and poultry producers may use small-capacity onsite incinerators for their routine mortalities (Blake et al., 2008). Other routine activities that may impact soil, air, and water quality include year-round application of excess manure containing nutrients and chemicals on farmland (Halden and Schwab, 2008; Hribar, 2007).

In addition to routine activities on a farm, USDA, other Federal agencies, or State and local government agencies may have conducted, or may conduct in the future, programs or actions at poultry production facilities that could, combined with HPAI adaptive management activities, significantly impact the environment. To minimize impacts to the environment, selection of disposal methods must take into consideration other actions that have taken place or will take place on the site.

Since composting and burial occurs onsite, proper mitigations must be used to ensure minimal cumulative impacts to human and wildlife health. Potential cumulative impacts by regulated carcass management activities (e.g., rendering, fixed-facility incineration, and landfill) are expected to be negligible. Routine cleaning and disinfection already occurs inside poultry houses; however, the specific disinfectants used and the amount of each disinfectant used may change in response to an outbreak of HPAI. Disinfectants should be carefully selected and applied following label instructions to minimize environmental impacts.

While changes in disease prevalence among the migratory flyways over time is unknown, the impacted area is likely to remain nationwide wherever there is poultry production, with poultry houses along the migratory bird flyways impacted more frequently. HPAI adaptive management measures employed on a premise are likely to be individually insignificant but could be associated with cumulatively significant impacts if a farm has multiple outbreaks of HPAI. To preserve environmental quality for the human population and ecological resources, potentially negative cumulative impacts would be minimized by following best management practices, including enhanced implementation of biosecurity measures. As a result, the proposed action is not likely to result in long-term or adverse cumulative impacts to the quality of the environment.
V. References


CDC—See Centers for Disease Control and Prevention


EPA—See U.S. Environmental Protection Agency


FWS—See U.S. Fish and Wildlife Service


HHS—See U.S. Department of Health and Human Services


NABCC—See National Agricultural Biosecurity Center Consortium


OIE—See World Organisation for Animal Health


TAMU—See Texas Agricultural and Mechanical University


USDA-APHIS—See U.S. Department of Agriculture-Animal and Plant Health Inspection Service

USDA-NASS—See U.S. Department of Agriculture-National Agricultural Statistics Service

USDA-NRCS—See U.S. Department of Agriculture-Natural Resources Conservation Service

Agency. [Online]. Available: 


http://www.agcensus.usda.gov/Publications/2012/Online_Resources/Ag_Atlas_Maps/Livestock_and_Animals/Livestock,_Poultry_and Other_Animals/12-M158-RGBDot1-largetext.pdf [2015, July 10].


WHO—See World Health Organization


VI. Appendices

Appendix A: Selected state law regarding animal carcass disposal, focusing on poultry

Pertinent authorities during an animal health emergency in selected states

During an animal health emergency, the lead Federal agency and State officials cooperatively develop carcass management options from the measures identified by statute and rule, and may rely on these authorities to implement necessary disposal measures. Additional city and county ordinances and local health laws also are considered at that time. Table A–1 focuses on poultry information from selected State law sources to demonstrate a range of State agencies and entities with authority to act during mass animal health emergencies. The listed legal references define the entities and identify who can create rules and establish quarantines.

Table A–1. Summary of laws focusing on poultry, that identify State entities with the authority to act during an animal health emergency by setting quarantines, coordinating emergency eradication efforts, and/or creating rules in selected States

<table>
<thead>
<tr>
<th>State/Territory</th>
<th>Authority</th>
<th>Pertinent References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>AL State Board of Agriculture and Industries; Commissioner and State Veterinarian</td>
<td>Alabama Code §§ 2-15-170, 2-15-172, 2-16-21; Ala. Admin. Code r. 80-3-6-.04</td>
</tr>
<tr>
<td>California</td>
<td>CA Department Food and Agriculture; State Veterinarian</td>
<td>Cal. Food and Agricultural Code §§ 9141, 9175, 9561, 9562, 9569; 3 CCR 797, 905, 1301, 1302</td>
</tr>
<tr>
<td>Florida</td>
<td>FL Department of Agriculture and Consumer Services Division of Animal Industry, Division of Animal Industry; Governor or Commissioner of Agriculture declares emergency</td>
<td>Fla. Stat. Ann. §§ 585.08, 585.16, 585.22, 585.145</td>
</tr>
<tr>
<td>Georgia</td>
<td>GA Department of Agriculture, Animal Industry Division; Commissioner of Agriculture, State Veterinarian</td>
<td>Ga. Code Ann. §§ 4-1-1, 4-1-3, 4-4-2, 4-4-64, 4-4-67, 4-4-70, 4-4-71, 4-4-83, 4-4-120; Ga. Comp. R. &amp; Regs. r. 40-13-4-.02, 40-13-4-.17</td>
</tr>
<tr>
<td>Indiana</td>
<td>IN State Board of Animal Health; State Veterinarian</td>
<td>Ind. Code §§ 4-21.5-4, 4-22-2-37.1, 15-17-3-1 to 15-17-3-23, 15-17-10-1, 15-17-10-3, 15-17-10-10</td>
</tr>
<tr>
<td>Iowa</td>
<td>Department of Agriculture and Land Stewardship; an officer, regular assistant, or duly authorized agent; State Veterinarian</td>
<td>Iowa Code §§ 159.1, 163.1, 165B.2, 167.2; 21 IAC §§ 61.1, 64.1, 64.17, 64.186</td>
</tr>
<tr>
<td>Minnesota</td>
<td>MN Board of Animal Health; Board certifies the case to the Governor, who declares an emergency; this allows</td>
<td>Minn. Stat. §§ 29.051, 34A.11, 35.05, 35.0661, 35.815; Minn. R. 1520.0200,</td>
</tr>
</tbody>
</table>
Table A–1. Summary of laws focusing on poultry, that identify State entities with the authority to act during an animal health emergency by setting quarantines, coordinating emergency eradication efforts, and/or creating rules in selected States

<table>
<thead>
<tr>
<th>State/Territory</th>
<th>Authority</th>
<th>Pertinent References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Missouri</td>
<td>MO Department of Agriculture; Director or designated representative; but State Veterinarian creates emergency plan with Department of Natural Resources assistance</td>
<td>Mo. Rev. Stat. §§ 261.020, 267.240, 267.400, 269.010, 269.021, 269.200</td>
</tr>
<tr>
<td>North Carolina</td>
<td>Board of Agriculture; State Veterinarian or authorized representative for an animal, but for areas, the State Veterinarian consults with the Commissioner of Agriculture and needs Governor approval</td>
<td>N.C. Gen. Stat. §§ 106-121, 106-304, 106-306, 106-307.2, 106-401, 106-401.1, 106-403</td>
</tr>
<tr>
<td>Ohio</td>
<td>OH Department of Agriculture; Director of Agriculture or authorized representative</td>
<td>Ohio Rev. Code Ann. §§ 901.19, 941.03, 941.07, 941.15; Ohio Admin. Code § 901:1-21-02</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>Department of Agriculture of the Commonwealth of PA; the Department</td>
<td>7 Pa. Code §§ 5.1, 5.46, 5.83, 17.1, 17.11</td>
</tr>
<tr>
<td>South Dakota</td>
<td>Animal Industry Board; the Board, after consultation with and approval by the Governor</td>
<td>S.D. Codified Laws § 40-5-7, 40-5-8; S.D. Admin. R. 12:68:03:10</td>
</tr>
<tr>
<td>Virginia</td>
<td>VA Board of Agriculture and Consumer Services; State Veterinarian or representative, and counties, USDA inspectors empowered</td>
<td>Va. Code Ann. § 3.2-100, 3.2-5900, 3.2-5901, 3.2-6002 to 3.2-6009, 15.2-1200, 3.2-6015, 2 VAC 5-190-10 to 5-190-30, 5-200-20 to 5-200-60</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>WI Department of Agriculture, Trade and Consumer Protection; authorized agents; state constitutional officer</td>
<td>Wis. Stat. §§ 93.01, 93.07, 95.17, 95.19, 95.23, 95.31, 95.34, 95.50; Wis. Admin. Code ATCP 10.01, 10.89</td>
</tr>
</tbody>
</table>

1 All statements from statutes, rules, regulations, and bulletins are derived from free, Web-based materials available as of July, 2015, and use of the information is at the sole risk of the user. The USDA makes no warranty or representation of any kind, express or implied. The USDA provides this information on an “as is” basis for comparison purposes only, and it shall not be liable or held responsible for any omissions, additions, or errors. (Each State may have more current or accurate information. We make no warranties or guarantees about the accuracy, completeness, or adequacy of the information.)

Abbreviations include use of two letter Postal codes for states, but the abbreviations for legal sources are per the Bluebook: A
Table A–1. Summary of laws focusing on poultry, that identify State entities with the authority to act during an animal health emergency by setting quarantines, coordinating emergency eradication efforts, and/or creating rules in selected States¹

<table>
<thead>
<tr>
<th>State/Territory</th>
<th>Authority</th>
<th>Pertinent References</th>
</tr>
</thead>
</table>

¹Uniform System of Citation (16th Ed.); Admin. = Administrative; Ann. = Annotated; r. = rule; Regs. = Regulations; Rev. = Revised; Stat. = Statutes.

State Disposal Options in Selected States

In any given State, the carcass management options that are available include many of the measures considered in this EA. Table A–2 summarizes a variety of information from selected States regarding dead animal disposal options, including but not limited to poultry carcasses. Applicable laws vary, and this section briefly considers State law aspects associated with the most commonly authorized methods: burial, open burning / incineration, rendering, landfill, and composting. Although this EA does not contemplate APHIS using open burning as a disposal method, pertinent information is included in Table A-2 to facilitate comparisons. The listed statute, regulation, or rule identifies conditions, limitations, and special situations based on available information. Readers should consult current State brochures and factsheets for additional information, as well as note the table’s disclaimers.

Table A–2. Information on disposal methods available in selected States, based on State statutes, rules, regulations, and/or bulletins and focusing on law applicable to the poultry industry.¹

<table>
<thead>
<tr>
<th>State and References</th>
<th>Time Limit</th>
<th>Burial Depth/Setback</th>
<th>Burning Open-Air</th>
<th>Rendering</th>
<th>Landfill</th>
<th>Compost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama (Ala. Code §§ 2-16-40, 2-16-41; Ala. Admin. Code r. 80-3-6-.08, r. 80-3-6-.26, r. 80-3-6-.34, r. 80-3-20; ADEM 335-6-7, 335-13-1)</td>
<td>24 h</td>
<td>4ft / none but if catastrophic losses 2ft/Yes (poultry in pit)</td>
<td>if State Veterinarian approves</td>
<td>Type 4 approved facility</td>
<td>&gt;220°F &amp; &gt;4 hours; sanitary hauling</td>
<td>Sanitary landfills and freezers (USDA-NRCS, 2005)</td>
</tr>
</tbody>
</table>

Poultry operations are required to be equipped with facilities for handling, destruction and disposal of all dead poultry (Ala. Code § 2-16-41).


Extrusion, on-farm freezing, and cooking for swine feed are also allowed (Ark. Code § 2-40-403); acceptable methods in the event of a major die-off are set by regulation from the Arkansas Livestock and Poultry Commission (§ 2-40-404).
Table A–2. Information on disposal methods available in selected States, based on State statutes, rules, regulations, and/or bulletins and focusing on law applicable to the poultry industry.\(^1\)

<table>
<thead>
<tr>
<th>State and References</th>
<th>Time Limit</th>
<th>Burial Depth/Setback</th>
<th>Burning Open-Air Incinerator</th>
<th>Rendering</th>
<th>Landfill</th>
<th>Compost</th>
</tr>
</thead>
<tbody>
<tr>
<td>821.4, 1243, 1245.2, 1249</td>
<td></td>
<td>Y &gt;2 ft; and poultry in sanitary disposal pits</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Sanitary landfill</td>
</tr>
<tr>
<td>Florida (Fla. Stat. Ann. §§ 583.181, 823.041)</td>
<td>24 h</td>
<td>Y, 3 ft depth; poultry pit sites must be approved prior to construction</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y by arrangement</td>
</tr>
<tr>
<td>Georgia (Ga. Code Ann. §§ 4-4-43, 4-5-2, 4-5-3, 4-5-5; Ga. Comp. R. &amp; Regs. r. 40-13-5-.04; Ritz, 2014)</td>
<td>24 h</td>
<td>Y, 3 ft depth; poultry pit sites must be approved prior to construction</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y by arrangement</td>
</tr>
<tr>
<td>Indiana (Ind. Code §§ 15-17-11-19, 15-17-11-20; 15-17-11-22; IN BOAH Technical Bull. LG-1.97)</td>
<td>24 h</td>
<td>4 ft deep, also exotic animal feeding, anaerobic and chemical digestion; urban areas may prohibit</td>
<td>“burn piles” deemed insufficient</td>
<td>approved disposal plant</td>
<td>Y with landfill manager permission</td>
<td>Y</td>
</tr>
<tr>
<td>Iowa (Iowa Code §§ 167.12, 167.18; Iowa Admin. Code r. 21—61; but Iowa Admin. Code r. 8—100.4 special private agency disposal rules)</td>
<td>24 h (burial); or “within a reasonable time after death”</td>
<td>&gt;4 ft deep; quicklime required</td>
<td>within 24 h if anthrax or hog cholera</td>
<td>Y</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Kentucky (Ky. Rev. Stat. Ann. §§ 257.160)</td>
<td>48 h unless the carcass is in cold storage</td>
<td>&gt;4 ft deep, 2” quick-lime; 3 ft cover/100 ft setback</td>
<td>Y</td>
<td>Y (boil &gt; 2 h)</td>
<td>Y (refers to Ky. Rev. Stat. Chapter 224)</td>
<td>Y</td>
</tr>
<tr>
<td>Michigan (Mich. Comp. Laws §§ 287.652, 287.656, 287.671, 750.57; Mich. Admin. Code R. 287.652)</td>
<td>24 h and covered with 1 ft soil; weight limits that can be waived</td>
<td>&gt;2.5 ft (or &gt; 4 ft if &lt; 1 mile from a residence); &gt;200 ft from potable drinking water well</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td></td>
</tr>
</tbody>
</table>

Poultry producers must provide for the sanitary disposal of dead birds; disposal also may be by feeding to swine in permitted garbage feeding establishments after adequate heat treatment and other methods approved by the department. If not disposed of on the premises where produced, the materials must be transported to the disposal site in sealed containers to prevent spillage (Fla. Stat. Ann. §§ 583.181).
Table A–2. Information on disposal methods available in selected States, based on State statutes, rules, regulations, and/or bulletins and focusing on law applicable to the poultry industry.1

<table>
<thead>
<tr>
<th>State and References</th>
<th>Time Limit</th>
<th>Burial Depth/Setback</th>
<th>Burning Open-Air</th>
<th>Rendering</th>
<th>Landfill</th>
<th>Compost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minnesota (Minn. Stat. § 35.82; Minn. R. 1721.0700, 1721.0740)</td>
<td>“...as soon as reasonably possible...”&lt;72 h</td>
<td>Y “...at a depth adequate to prevent scavenging...”</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Missouri (Mo. Rev. Stat. §§ 269.020, 269.021)</td>
<td>24 h</td>
<td>Y; &gt; 6 ft, distance, load, and acreage restrictions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nebraska (Neb. Rev. Stat. §§ 54-701, 54-701.03, 54-703; 54-744, 54-744.01, 54-745, 54-776, 54-795; 23 Neb. Admin. R. &amp; Regs. § 002.50; 17 Neb. Admin. R. &amp; Regs. §§ 001 to 007)</td>
<td>36 h</td>
<td>4 ft / &gt; 500 ft to houses; &gt; 6 ft anthrax</td>
<td>Y</td>
<td>Y; liquefaction barred unless used in research</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>North Carolina (NC Gen. Stat. §§ 106-403, 106-549.51, 106-549.70; NC Admin. Code tit. 15A, r.02T.0113, r.18C.1212, r.18C.1104)</td>
<td>24 h</td>
<td>3 ft deep / &gt;300 to water; never in a water system</td>
<td>Y</td>
<td>Y for poultry</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Ohio (Ohio Rev. Code Ann. §§ 941.14, 953.26, 1511.022)</td>
<td>24 h</td>
<td>&gt; 4 ft deep</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Pennsylvania (Pa. Cons. Stat. §§ 2352, 2353, 2388; 25 Pa. Code § 243.11; 58 Pa. Code § 147.726)</td>
<td>48 h</td>
<td>2 ft deep / &gt;100 ft from waters; must meet water quality regulations</td>
<td>Must meet air quality regulations</td>
<td>Y (wildlife)</td>
<td>Y</td>
<td>Y (wildlife); Y; also fermenting</td>
</tr>
<tr>
<td>South Dakota (S.D. Codified Laws §§ 40-5-40-5-1 to 40-5-40-5-4)</td>
<td>36 h</td>
<td>4 ft deep</td>
<td>Y</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

"... another manner approved by the board as being equally effective for the control of animal diseases" (Minn. R. 1721.0700).

Or "... in a manner approved by the state veterinarian..."
Table A–2. Information on disposal methods available in selected States, based on State statutes, rules, regulations, and/or bulletins and focusing on law applicable to the poultry industry.1

<table>
<thead>
<tr>
<th>State and References</th>
<th>Time Limit</th>
<th>Burial Depth/Setback</th>
<th>Burning</th>
<th>Rendering</th>
<th>Landfill</th>
<th>Compost</th>
</tr>
</thead>
<tbody>
<tr>
<td>15, 40-5-16; S.D. Admin. R. 12:68:03:05)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Y &gt; 3 ft / setbacks as applicable for public health</td>
<td></td>
<td>Licensed and approved facilities</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Y approved facility or mobile air-curtain incinerator</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Y approved facility or mobile air-curtain incinerator</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Y by arrangement with officials</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Natural decomposition is allowed if death is not from disease and the location meets all legal requirements; composting and digestion are as approved by the Executive Director; variances from requirements granted on a case-by-case basis (4 Tex. Admin. Code § 59.12).</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Virginia (Va. Code Ann. §§ 3.2-6002, 3.2-6025 to 6029 poultry, 2.1-796.121 companion animals; 2 Va. Admin. Code 5-110-90, 5-200-30)</td>
<td>24 h if unrefrigerated</td>
<td>Y; disposal pit for poultry</td>
<td>Y; Poultry</td>
<td>Poultry</td>
<td>Poultry</td>
<td>Poultry</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Covered with lime</td>
<td></td>
<td>Licensed facility</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Licensed facility</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Licensed facility</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>“a method other than as provided . . . if . . . the alternative method meets standards for disposal of dead poultry” (Va. Code Ann. § 3.2-6028); “. . . or other methods acceptable to the Department of Health” (2 VAC 5-110-90)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>West Virginia (W. Va. Code § 19-9-34)</td>
<td>24 h</td>
<td>2 ft /100 ft cover with 3 inches lime</td>
<td>Licensed facility</td>
<td>Licensed facility</td>
<td>Licensed facility</td>
<td>Y</td>
</tr>
<tr>
<td>Wisconsin (Wis. Stat. §§ 95.34, 95.50, 95.72)</td>
<td>24 h Apr to Nov; 48 h Dec to Mar</td>
<td>Covered with lime</td>
<td></td>
<td></td>
<td></td>
<td>Y</td>
</tr>
</tbody>
</table>

1 All statements from statutes, rules, regulations, and bulletins are derived from free, Web-based materials available as of July 2015, and use of the information is at the sole risk of the user. The USDA makes no warranty or representation of any kind, express or implied. Each state may have more current or accurate information. The USDA provides this information on an “as is” basis for comparison purposes only, and it shall not be liable or held responsible for any omissions, additions, or errors.

Abbreviations and special uses: Admin. = Administrative; Ann. = Annotated; banned = specifically barred by law; blank = no explicit information found; ft = feet; h = hour; N = No; r. = rule; Regs. = Regulations; Rev. = Revised; Stat. = Statutes; Y = Yes. Note: If the type of burning is not specified, then Open burning was assumed and Incinerator is blank.

As Table A-2 shows, many States require livestock carcass management within a short interval of death or discovery of the carcass, generally within 24 hours. Rendering and incineration regulations generally dovetail with requirements for the carcass hauling and meat inspection industries to ensure food safety.

In general, comparisons among the States regarding burial depth appear to reflect prevailing soil porosity and weather. Setback requirements vary, and some States provide limitations on the total weight of carcasses that can be buried at a site in a given time interval. States generally allow burial of livestock on the land or property of the owner with appropriate setbacks, but in a mass animal health emergency, this may not be practical or possible because the volume of material to be disposed of may exceed the capacity of the site. State law can define carcasses as agricultural solid waste, food waste (garbage), infectious waste, or any type of hazardous waste which then allows burial within appropriately regulated landfills.
The finite capacity of existing landfills coupled with increasing transportation costs associated with disposed materials is a politically sensitive issue (Palmer, 2011; Thornley, 2009). In the context of emergency carcass management, a large volume of carcasses would displace the volume used for routinely disposed material and would require cover materials of sufficient depth and character to properly bury these carcasses (Haskell and Ormond, 2003; Nutsch and Spire, 2004), for the time needed to degrade them (Kim and Kim, 2012; Yuan et al., 2013). States recognize this dynamic situation, and consequently State laws may keep landfill disposal as one option for carcass management. States may explicitly authorize landfill disposal or allow landfill disposal during emergencies. For example, California’s rules allow licensed haulers to transport carcasses to appropriately permitted landfills during an emergency (CA Food & Agric. Code § 19348).

**Flexibility during Carcass Management with Respect to Methodologies**

Some State laws reflect the desire to incorporate flexibility when faced with carcass management situations. When it appears, this type of adaptive language can authorize the use of “any method” and this does not necessarily refer to use of novel or new disposal technologies. Flexibility may be incorporated by allowing State authorities (such as the Commissioner, State Veterinarian, or head of a department) to select appropriate methods under the circumstance, or in other words, allow a wider range of methodologies to become viable options. There may be provisions for immediate adoption of new methods in emergency situations or a requirement for codification within a departmental rule prior to use. To the extent that these options are available in a given location and their use can be approved in a timely manner,APHIS is likely to defer to the State for disposal during an HPAI outbreak. Table A-3 provides examples from selected States where adaptive management language may become applicable during an HPAI outbreak.

**Table A–3. Examples from Selected States with Flexible Language for Carcass Disposal in Their Statutes, Regulations, or Rules.¹**

<table>
<thead>
<tr>
<th>State</th>
<th>Circumstance and applicable text</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>For poultry, “Any other recommended methods and equipment for the disposal of dead poultry carcasses as may be approved by the State Veterinarian may be used . . . provided such grower obtains written approval for such use from the State Veterinarian.”</td>
<td>Code of Ala. § 80-3-20.01</td>
</tr>
<tr>
<td>Arkansas</td>
<td>“All other methods and procedures found acceptable . . .” by the Arkansas Livestock and Poultry Commission</td>
<td>Ark. Code Ann. § 2-40-1304</td>
</tr>
<tr>
<td>California</td>
<td>For carcasses on state highways, “If disposal technologies including, but not limited to, natural decomposition, burial, incineration, donation, rendering, or composting are not available or practicable, the department may use any nontraditional or novel technology that may be appropriate under the circumstances.”</td>
<td>Cal. Sts. &amp; High. Code § 91.8</td>
</tr>
<tr>
<td>Georgia</td>
<td>“. . . or any method using appropriate disposal technology which has been approved by the Commissioner of Agriculture”</td>
<td>Ga. Code Ann. § 4-5-5</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>“. . . only in accordance with one of the following methods or a method hereafter approved by the department . . . rendering, fermenting, composting or other method according to procedures and product safety standards established by the department.”</td>
<td>3 Pa. Cons. Stat. Ann. § 2352</td>
</tr>
<tr>
<td>Virginia</td>
<td>“. . . burial, incineration, or other methods acceptable to the Department of Health.”</td>
<td>2 Va. Admin. Code 5-110-90</td>
</tr>
</tbody>
</table>
Selected State Law Concerning Transportation of Carcasses

During the management of a large number of carcasses, APHIS must consider the impacts associated with program-specific activities such as transportation. Individuals involved in transporting the carcasses, “must be made aware of the regulations regarding public health, transportation, agriculture, and the environment of those jurisdictions along the selected trade route” (Pullen, 2004).

Routine intrastate transportation of carcasses is a well-regulated industry. Most States and many localities have their own standards and regulations governing the transportation of livestock carcasses, which carcass management activities during a mass animal health emergency must take into account. Many States require haulers to have a state license or permit (e.g. California [Cal. Food & Agric. § 19348], Florida [Fla. Stat. Ann. § 585.147], Georgia [Ga. Code Ann. §§ 4-5-9, 4-4-82], Minnesota [Minn. Stat. § 35.82], Nebraska [Neb. Rev. Stat. Ann. § 54-746], and Wisconsin [Wis. Adm. Code ATCP § 10.08]). In Mississippi, haulers need to be registered (Miss. Code Ann. § 75-33-3). In West Virginia, haulers require written permission from the state commissioner of agriculture (W. Va. Code Ann. § 19-9-38). States may limit haulers with restrictions on whether they can haul diseased carcasses and their destination. For example, haulers must travel directly to their destination in Idaho (IDAPA 02.04.17.040.03), Illinois (Ill. Admin. Code tit. 8 § 90.105), and Indiana (Ind. Code §§ 15-17-11-19).

Containment is one of the most important factors in transporting carcasses because the physical condition of the carcasses determines how the animals must be transported and influences what type of vehicle is needed. The potential for pathogenic organisms to become dispersed during movement of carcasses may require vehicles to be equipped with specific types of collection or filtration systems.

Even without the presence of a disease directly communicable to humans, many States set requirements for these transportation vehicles. For example, vehicles must be constructed and maintained so liquid and fluids cannot drip or seep during transport, in essence using a sealed vehicle that prevents seepage or residue from escaping (Florida [Fla. Stat. Ann. § 585.147], Indiana [Ind. Code § 15-17-11-17], and Minnesota [Minn. Stat. § 35.82]). In Arkansas, the statutory language says, “Large animal carcasses may be submitted to a rendering facility in a sealed vehicle that does not allow drainage while being moved” (Ark. Code Ann. §§ 2-33-101, 19-6-448). There may be a requirement to cover or conceal carcasses from public view during transportation (e.g. Idaho [IDAPA 02.04.17.040.01, 02.04.17.040.02], Indiana [Ind. Code § 15-17-11-17]), particularly by use of tarps or other materials (e.g. Arkansas [Ark. Code Ann. §§ 2-33-101, 19-6-448], Iowa [Iowa Code §§ 167.15], Kentucky [Ky. Rev. Stat. Ann. § 263.120]). Wisconsin also provides specifications on the vehicle that is allowed to transport dead animals. Their statutes provide that “... [n]o person may transport a dead animal on a public highway unless it is transported in a closed vehicle or container or unless it is completely covered with a tarpaulin or other suitable material. Vehicles or containers used for the transportation of dead...
animals shall be leakproof to prevent spilling or dripping of liquid waste.” Wis. Stat. § 95.72(7)(a).

After transporting the carcasses, many States require vehicles to be disinfected, cleaned, and/or sterilized prior to reuse (e.g. Kentucky, Ky. Rev. Stat. Ann. § 263.130). Missouri requires vehicles to, “be thoroughly cleansed and disinfected in such manner and with such a solution, as the state veterinarian shall prescribe by regulation, and in addition thereto all such vehicles shall be washed out thoroughly with steam or hot water after each use thereof in transporting such dead bodies.” Mo. Rev. Stat. § 269.150. Michigan requires any vehicle or container used to transport dead animals shall be kep, “clean and properly disinfected”. The regulation continues by stating, “. . . [i]f a licensed vehicle has been used to haul or handle dead animals which have died or which have been killed as a result of a contagious or infectious disease, the vehicle shall be cleaned and disinfected, in a manner approved by the director, at the point of destination before proceeding further.” Mich. Comp. Laws Serv. § 287.653. In Georgia (Ga. Code Ann. § 4-4-45), the vehicles must be “maintained in a sanitary condition”. Alabama requires rendering facilities to provide facilities for thoroughly washing and disinfecting all trucks and vehicles, which are, “thoroughly cleaned and disinfected after each trip to haul dead animals before being permitted to make trips to farms or other premises” (Ala. Admin. Code 80-3-6-.26).

While the handling of routine mortalities is well regulated, there has been relatively little planning regarding the transport of animal carcasses in an animal health emergency. Many State plans do not appear to adequately prepare and respond to transporting mass carcasses in an emergency situation. “There may be significant health risks, stress variables, manpower issues, and emotional trauma associated with the handling and transportation of diseased animals in an emergency situation” (Pullen, 2004).

There are many antimicrobial products available that may be used to disinfect vehicles, personnel, equipment, supplies, and buildings. See http://www.epa.gov/opp00001/factsheets/avian_flu_products.htm for a list of antimicrobial products. It is the applicator’s responsibility to ensure that the product is labeled for HPAI and for the intended use site. It is expected that Federally listed species will not be exposed to these antimicrobial products because used disinfectant runoff is collected and disposed of properly, ensuring no environmental effects from exposure to HPAI disinfectants.

Transportation equipment operators, supervisors, and drivers must have the necessary guidance and training when using necessary personal protective gear, handling diseased animals/carcasses, obtaining necessary permits and other transportation documents, and responding appropriately to the media or other public sources (Pullen, 2004). Workers must be aware that various public health, transportation, agriculture, and environmental regulations create a myriad of requirements as they travel through multiple cities, counties, and States.

Federal regulation affecting carcass management transportation may come from USDA agencies as well as U.S. Department of Transportation (DOT), U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Federal Emergency Management Agency, and the Occupational Health and Safety Administration, among others. For example, carcass management activities will be required to isolate and track biomass shipments along a
transportation corridor. The DOT oversees the transportation of hazardous materials under the requirements of the Hazardous Materials Transportation Act of 1975 (HMTA). Biohazard material or biological agents, substances or materials that can cause injury to animals, humans or the environment is covered under the HMTA, with specific requirements for their transportation (codified at 49 CFR 172 – 177). Under these requirements, carcass management activities must isolate and track biomass shipments along a transportation corridor. For instance, infectious substances must carry 6.2 as the label code, the technical name must not be on the outer package, and the quantity cannot exceed 4 kg (49 CFR §§ 172.101, 172.301, 173.27, 175.75). The HMTA requires DOT-approved methods be used to train employees (49 U.S.C. §§ 5107), to contain and label materials before and during transport (49 U.S.C. §§ 5104, 5110), and requirements for routing hazardous material (49 U.S.C. §§ 5112).

The DOT provides some online guidance for transporting diseased animals and infectious and non-infectious materials. For example, “Live animals may not be used to transport infectious substances unless such substances cannot be sent by any other means. An animal containing or contaminated with an infectious substance must be transported under terms and conditions approved by the Associate Administrator for Hazardous Materials Safety” (Healthcare Environmental Resource Center, n.d.). See the following Web site for more information: http://www.hercenter.org/regsandstandards/dot.cfm. The Web site also directs readers to a tool for checking State guidelines and regulations, which can differ from the Federal; it is located at http://www.hercenter.org/rmw/rmwlocator.cfm.

Non-statutory References Used in this Appendix


### Appendix B. Poultry Disposal Methods (USDA-APHIS, 2015b)

<table>
<thead>
<tr>
<th>Method</th>
<th>Benefits and Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landfilling</td>
<td>Landfilling allows safe and efficient disposal of large quantities of carcasses. Landfill managers may restrict the type or quantity of materials accepted.</td>
</tr>
<tr>
<td>Rendering</td>
<td>Rendering occurs off-site and rapidly disposes of carcasses. It requires additional safety precautions to ensure the virus does not become aerosolized, and necessitates the disruption of the rendering plant’s normal operations.</td>
</tr>
<tr>
<td>Incineration</td>
<td>On-site incineration can occur with the use of mobile units, or it can take place off-site at stationary facilities. There are a limited number of mobile units, and fuel requirements for incinerators are substantial and costly.</td>
</tr>
<tr>
<td>Composting</td>
<td>Composting occurs either inside or outside of a poultry production facility (barn or house). Although deactivation of the virus occurs early in the composting process, only a final decomposition product can be used as a soil amendment or fertilizer. Composting requires large areas and is not feasible where space is limited.</td>
</tr>
<tr>
<td>Burial</td>
<td>Burial occurs on the premises and must be approved by the State environmental regulatory agency. Burial may not be permitted if the water table is close to the ground surface.</td>
</tr>
</tbody>
</table>
### Appendix C. Adaptive Management Methods for Controlling HPAI

<table>
<thead>
<tr>
<th>Method</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surveillance</td>
<td>Surveillance after HPAI detection occurs in the control area within a 3 km radius of an HPAI-affected premises (e.g., infected zone) and the area between 3 km and 10 km (e.g., buffer zone) of an HPAI affected premises. Active surveillance in the control area is complete when the poultry census in the infected zone is complete, results are negative for all samples collected for AI testing in the control area, and at least 21 days have elapsed since depopulation of the last infected premises {U.S. Department of Agriculture, 2015 #37}. Targeted poultry surveillance also may occur in the surveillance zone, which is outside and along the border of the control area {U.S. Department of Agriculture, 2015 #39}.</td>
</tr>
<tr>
<td>Quarantine</td>
<td>Infected premises are quarantined and movement of poultry and poultry-moving equipment into and out of the control area is restricted {U.S. Department of Agriculture-Animal and Plant Health Inspection Service, 2015 #40}. Movements from infected premises are traced back and forward to control the spread of the HPAI virus {U.S. Department of Agriculture, 2015 #38}.</td>
</tr>
<tr>
<td>Depopulation</td>
<td>APHIS pays contractors to euthanize infected birds and affected flocks. The use of water-based foam and carbon dioxide are preferred methods during HPAI outbreaks.</td>
</tr>
<tr>
<td>Carcass Management</td>
<td>There are a variety of methods for disposal of poultry carcasses. These methods include landfilling, rendering, incineration, composting and burial. APHIS and its State partners select disposal methods based on the size of the flock, space requirements, associated costs, local conditions, and applicable laws and regulations {U.S. Department of Agriculture-Animal and Plant Health Inspection Service, 2015 #9}.</td>
</tr>
<tr>
<td>Cleaning and Disinfection</td>
<td>APHIS uses antimicrobial products registered by EPA for use against influenza A viruses, and also uses the sterilant, chlorine dioxide, for disinfection of premises. Decisions about the most appropriate cleaning and disinfection methods for HPAI-infected premises are made</td>
</tr>
<tr>
<td>Method</td>
<td>Explanation</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Environmental Sampling</td>
<td>After cleaning and disinfection, environmental samples are collected and tested to confirm that the active virus is no longer present (U.S. Department of Agriculture-Animal and Plant Health Inspection Service, 2015 #40).</td>
</tr>
<tr>
<td>Quarantine Release</td>
<td>After premises have been empty for a minimum of 21 days (this is the incubation period for AI) following completion of cleaning and disinfection and surveillance testing, then premises can be released from quarantine (U.S. Department of Agriculture-Animal and Plant Health Inspection Service, 2015 #40).</td>
</tr>
<tr>
<td>Restocking</td>
<td>Restocking requires that 21 days have passed since cleaning and disinfection, environmental samples test negative, all conditions of the flock plan and compliance cooperative agreement have been met, State and Federal officials agree that restocking is approved, and the State quarantine is released.</td>
</tr>
</tbody>
</table>
VII. Listing of Agencies Consulted

Council on Environmental Quality
Horst Greczmiel
Associate Director for NEPA Oversight
Council on Environmental Quality
722 Jackson Place, N.W.
Washington, DC 20503

U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Policy and Program Development
Environmental and Risk Analysis Services
4700 River Road, Unit 149
Riverdale, MD 20737–1237

U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Veterinary Services
Science, Technology and Analysis Services
4700 River Road, Unit 41
Riverdale, MD 20737-1237