ENVIRONMENTAL ASSESSMENT

REDUCING BIRD DAMAGE

IN THE STATE OF DELAWARE

Prepared by:

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WILDLIFE SERVICES

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ACRONYMS

APHIS	Animal and Plant Health Inspection Service
AQDO	Aquaculture Depredation Order
AVMA	American Veterinary Medical Association
BBS	Breeding Bird Survey
BDM	Bird Damage Management
CBC	Christmas Bird Count
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
EA	Environmental Assessment
ECOFRAM	Ecological Committee on FIFRA Risk Assessment
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FDA	Food and Drug Administration
FEIS	Final Environmental Impact Statement
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FONSI	Finding of No Significant Impact
FR	Federal Register
FY	Fiscal Year
MA	Methyl Anthranilate
MBTA	Migratory Bird Treaty Act
DDA	Delaware Department of Agriculture
DNREC	Delaware Natural Resources and Environmental Control
MOU	Memorandum of Understanding
NAS	National Audubon Society
NASS	National Agricultural Statistics Service
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NWRC	National Wildlife Research Center
PL	Public Law
PRDO	Public Resource Depredation Order
ROD	Record of Decision
SOP	Standard Operating Procedure
T&E	Threatened and Endangered
USC	United States Code
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
WS	Wildlife Services

CHAPTER 1: PURPOSE AND NEED FOR ACTION

1.1 INTRODUCTION

Across the United States, wildlife habitat has been substantially changed as human populations expand and land is used for human needs. These human uses and needs often compete with the needs of wildlife which increases the potential for conflicting human/wildlife interactions. This Environmental Assessment (EA) evaluates the potential environmental effects of alternatives for Wildlife Services (WS) involvement in bird damage management (BDM) in Delaware.

Wildlife damage management (WDM) is the science of reducing damage or other problems associated with wildlife, and is recognized as an integral part of wildlife management (The Wildlife Society 2010). The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), WS program is the federal agency authorized to protect American resources from damage associated with wildlife (the Act of March 2, 1931 (7 U.S.C. 8351-8352) as amended, and the Act of December 22, 1987 (7 U.S.C. 8353)). Human/wildlife conflict issues are complicated by the wide range of public responses to wildlife and wildlife damage. What may be unacceptable damage to one person may be a normal cost of living with nature to someone else. An individual person will have a unique definition of damage. However, the use of the term *"damage"* will consistently be used to describe situations where the individual person has determined the losses associated with wildlife is actual damage requiring assistance (i.e., has reached an individual threshold).

WS' activities are conducted to prevent or reduce wildlife damage to agricultural, industrial and natural resources, property, livestock, and threats to public health and safety on private and public lands in cooperation with federal, state and local agencies, tribes, private organizations, and individuals. The WS program uses an integrated wildlife damage management (IWDM) approach (WS Directive 2.105[1]) in which a combination of methods may be used or recommended to reduce wildlife damage. These methods may include nonlethal techniques like alteration of cultural practices, habitat management, repellents, frightening devices, and physical exclusion to prevent or reduce damage. The reduction of wildlife damage may also require removal of individual animals, reducing the local animal populations through lethal means. In some instances, the goal may be to eradicate an invasive species. Program activities are not based on punishing offending animals but are conducted to reduce damage and risks to human and livestock health and safety, and are used as part of the WS Decision Model (Slate et al. 1992).

WS is a cooperatively funded, service-oriented program that receives requests for assistance with wildlife damage management from private and public entities, including tribes and other governmental agencies. As requested, WS cooperates with land and wildlife management agencies to reduce wildlife damage effectively and efficiently in accordance with applicable federal, state, and local laws and Memoranda of Understanding (MOUs) between WS and other agencies.

WS chose to prepare this EA to facilitate planning, interagency coordination and the streamlining of program management, and to clearly communicate with the public the analysis of individual and cumulative impacts. In addition, this EA has been prepared to evaluate and determine if there are any potentially significant or cumulative impacts from the proposed damage management program.

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[1]The WS Policy Manual (http://www.aphis.usda.gov/wildlifedamage) provides guidance for WS personnel to conduct wildlife damage management activities through Program Directives. WS Directives referenced in this EA can be found in the manual but will not be referenced in the Literature Cited Appendix.

1.2 PURPOSE

The purpose of this EA is to evaluate cumulatively the individual projects conducted by WS in Delaware to manage damage and threats to agricultural resources, property, natural resources, and threats to humans associated with the bird species listed in Appendix C.

This EA will assist in determining if the proposed management of bird damage could have a significant impact on the human environment based on previous activities conducted and based on the anticipation of receiving additional requests for assistance. It is conceivable that additional damage management efforts could occur as the goal of WS is to conduct a coordinated program, when requested, in accordance with objectives developed to reduce damage within the constraints of available funding and workforce. Thus, this EA anticipates those additional efforts and the analyses are intended to apply to actions that may occur in any locale and at any time within Delaware as part of a coordinated program.

This EA will evaluate the need for action to manage damage associated with birds in the state, the potential issues associated with bird damage management, and the environmental consequences of conducting different alternatives to address the need for action and the identified issues. The USFWS and the Delaware Department of Natural Resource and Environmental Control (DNREC) were consulted on the development of this EA as applicable. To assist with the identification of additional issues and alternatives to managing damage associated with birds in Delaware, this EA will be made available to the public for review and comment prior to the issuance of a decision[2].

1.3 NEED FOR ACTION

Some species of wildlife have adapted to and have thrived in human altered habitats. Those species, in particular, are often responsible for the majority of conflicts between humans and wildlife that lead to requests for assistance to reduce damage to resources and to reduce threats to human safety.

Both sociological and biological carrying capacities must be applied when resolving wildlife damage problems. The wildlife acceptance capacity, or cultural carrying capacity, is the limit of human tolerance for wildlife or the maximum number of a given species that can coexist compatibly with local human populations. Biological carrying capacity is the land or habitat's ability to support healthy populations of wildlife without degradation to the species' health or their environment during an extended period of time (Decker and Purdy 1988). Those phenomena are especially important because they define the sensitivity of a person or community to a wildlife species. For any given damage situation, there are varying thresholds of tolerance exhibited by those people directly and indirectly affected by the species and any associated damage. This damage threshold determines the wildlife acceptance capacity. While the habitat might have a biological carrying capacity to support higher populations of wildlife, in many cases, the wildlife acceptance capacity is lower or has been met. Once the wildlife acceptance capacity is met or exceeded, people begin to implement population or damage management to alleviate damage or address threats to human health and safety.

The alleviation of damage or other problems caused by or related to the behavior of wildlife is termed wildlife damage management and is recognized as an integral component of wildlife management (The Wildlife Society 2010). The imminent threat of damage or loss of resources is often sufficient for individual actions to be initiated and the need for damage management is derived from the specific threats to resources. Wildlife utilize habitats (e.g., reproduce, walk, forage) where they can find a niche. If their

[2]After the development of the EA by WS and consulting agencies and after public involvement in identifying new issues and alternatives, WS will issue a decision. Based on the analyses in the EA after public involvement, a decision will be made to either publish a Notice of Intent to prepare an Environmental Impact Statement or a Finding of No Significant Impact will be noticed to the public in accordance to NEPA and the Council of Environmental Quality regulations.

activities result in lost economic value of resources or threaten human safety, people characterize this as damage. When damage exceeds or threatens to exceed an economic threshold and/or poses a threat to human safety, people often seek assistance. The threshold triggering a request for assistance is often unique to the individual person requesting assistance and can be based on many factors (e.g., economic, social, aesthetics). Therefore, how damage is defined is often unique to the individual person and damage occurring to one individual may not be considered damage by another individual. However, the use of the term "*damage*" is consistently used to describe situations where the individual person has determined the losses associated with wildlife is actual damage requiring assistance (i.e., has reached an individual threshold). The term "*damage*" is most often defined as economic losses to resources or threats to human safety, but the term "*damage*" could also include a loss in aesthetic value and other situations where the actions of wildlife are no longer tolerable to an individual person.

Wildlife management is often based on balancing wildlife populations and human perceptions, in a struggle to preserve rare species, regulate species populations, oversee consumptive uses of wildlife, and conserve the environment that provides habitat for wildlife resources. Increasingly, cities, towns, parks, airports, and private properties have become sites of some of the greatest challenges for wildlife management (Adams et al. 2006). When the presence of a prolific, adaptable species is combined with human expansion, land management conflicts often develop. Birds are generally regarded as providing ecological, educational, economic, recreational, and aesthetic benefits, and there is enjoyment in knowing wildlife exists and contributes to natural ecosystems (Decker and Goff 1987).

Birds add an aesthetic component to the environment, sometimes provide opportunities for recreational hunting, and like all wildlife, provide people with valued close contact with nature. Many people, even those people experiencing damage, consider those species of birds addressed in this EA to be a charismatic and valuable component of their environment; however, tolerance differs among individuals. Because of their prolific nature, site tenacity, longevity, size, and tolerance of human activity, many bird species are often associated with situations where damage or threats can occur. For example, free-ranging waterfowl are extremely adaptable and may use the resources provided by humans in urban landscapes for nesting, raising young, molting, feeding, and loafing.

Birds are difficult to manage because they are highly mobile, able to exploit a variety of habitat types within a given area, and cannot be permanently excluded from large areas. It is rarely desirable or possible to remove or disperse all problem birds from an area, but with a proper management scheme, the number of birds and associated problems may be reduced to a level that can be tolerated. Additionally, management of bird-related problems often exceeds the capabilities of individual people to reduce damage to tolerable levels. In Delaware, problem situations associated with birds typically involve, but are not limited to, unacceptable accumulations of feces in public-use areas, damage to agricultural and natural resources, and unacceptable safety hazards (e.g., aircraft striking birds). Those problems frequently occur on private properties, natural/habitat restoration sites, corporate and industrial sites, airports, in residential communities, apartment/condominium complexes, municipal parks, schools, hospitals, office complexes, roadways, and other areas.

The need for action to manage damage and threats associated with birds in Delaware arises from requests for assistance[3] received by WS and the USFWS to reduce and prevent damage associated with birds from occurring to four major categories. Those four major categories include agricultural resources, natural resources, property, and threats to human safety. WS have identified those bird species most likely to be responsible for causing damage to those four categories based on previous requests for assistance and

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[3]WS only conducts bird damage management after receiving a request for assistance. Before initiating bird damage activities, a Memorandum of Understanding, cooperative service agreement, or other comparable document must be signed between WS and the cooperating entity, which lists all the methods the property owner or manager will allow to be used on property they own and/or manage.

assessments of the threat of bird strike hazards at airports. Table 1.1 lists WS' technical assistance projects involving bird damage to those four major resource types in Delaware from the federal fiscal year[4] (FY) 2012 through FY 2016. Table 1.1 does not include projects where direct operational assistance was conducted by WS.

Technical assistance has been provided by WS to those persons requesting assistance with resolving damage or the threat of damage by providing information and recommendations on methods and techniques to reduce damage that can be conducted by the requestor without WS' direct involvement in managing or preventing the damage. WS' technical assistance activities will be discussed further in Chapter 3 of this EA. The technical assistance projects conducted by WS are representative of the damage and threats that are caused and could be caused by birds. Some of the projects involved multiple resources and multiple species.

Table 1.1 lists those bird species and the resource types that those bird species can cause damage to in Delaware. Many of the bird species addressed in this EA can cause damage to or pose threats to a variety of resources. Most requests for assistance received by WS are related to threats associated with those bird species being struck by aircraft at or near airports. Bird strikes can cause substantial damage to aircraft requiring costly repairs. In some cases, bird strikes can lead to the catastrophic failure of the aircraft, which can threaten passenger safety.

Many of the species addressed in this assessment are gregarious (i.e., form large flocks) species especially during the fall and spring migration periods. Although damage and threats can occur throughout the year, damage or the threat of damage is highest during those periods when birds are concentrated into large flocks such as migration periods and during winter months when food sources are limited. For some bird species, high concentrations of birds can be found during the breeding season where suitable nesting habitat exists. The flocking behavior of many bird species during migration periods can pose increased risks when those species occur near or on airport properties. An aircraft striking multiple birds not only can increase the damage to the aircraft but also increases the risk that a catastrophic failure of the aircraft might occur, especially if multiple birds are ingested into aircraft engines.

Table 1.1 – Primary bird species addressed by WS in Delaware and the resource types damaged

Species	Resource[a]				Species	Resource			
	A	N	P	H		A	N	P	H
Snow goose	X		X	X	Great horned owl	X	X	X	X
Mute swan		X	X	X	Barred owl	X	X	X	X
Mallard			X	X	Chimney swift			X	X
Feral waterfowl		X	X	X	Red-headed woodpecker			X	
Double-crested cormorant	X	X	X	X	Red-bellied woodpecker			X	
Great blue heron	X		X	X	Yellow-bellied sapsucker			X	
Great egret	X		X	X	Downy woodpecker			X	
Snowy egret	X		X	X	Hairy woodpecker			X	
Cattle egret	X		X	X	Northern flicker			X	
Black vulture	X		X	X	Pileated woodpecker			X	
Turkey vulture	X		X	X	American kestrel	X	X	X	X
Osprey		X	X	X	Blue jay			X	X
Northern harrier	X	X	X	X	Tree swallow			X	X
Sharp-shinned hawk		X	X	X	Northern rough-winged swallow			X	X
Cooper's hawk	X	X	X	X	Bank swallow			X	X

[4]The federal fiscal year begins on October 1 and ends on September 30 the following year.

Species	Resource[a]				Species	Resource			
	A	N	P	H		A	N	P	H
Red-shouldered hawk	X	X	X	X	**Cliff swallow**			X	X
Broad-winged hawk	X	X	X	X	**Barn swallow**	X		X	X
Red-tailed hawk	X		X	X	**Gray catbird**			X	X
American coot			X	X	**Northern mockingbird**			X	X
Killdeer			X	X	**European starling**	X	X	X	X
Bonaparte's gull			X	X	**Northern cardinal**			X	
Laughing gull	X	X	X	X	**Red-winged blackbird**	X		X	X
Ring-billed gull	X	X	X	X	**Eastern meadowlark**			X	X
Herring gull	X	X	X	X	**Common grackle**	X	X	X	X
Great black-backed gull		X	X	X	**Brown-headed cowbird**	X	X	X	X
Rock pigeon	X	X	X	X	**House finch**			X	X
Mourning dove			X	X	**House sparrow**	X	X	X	X
Barn owl	X	X	X	X					

*A=Agriculture, H=Human Health and Safety, N=Natural Resources, P=Property

Cooperators often report or WS verifies damage associated with various species of birds through site visits. Between FY 2014 and 2018, bird damage has been reported to WS or has been verified to average $242,286 per year (see Table 1.2). Damages have been reported or verified as occurring primarily to property and agricultural resources. The majority of damage that occurred was by Canada geese. However, vultures, blackbirds, great blue herons, and starlings also greatly contributed to the bird damage reported to or verified by WS.

Table 1.2 – Reported or WS verified monetary damage by resource caused by birds in Delaware

Resource Type	Year					Average
	2014	2015	2016	2017	2018	
Agriculture	$141,500	$2,270,778	$1,284	$3,749	$0	**$483,462**
Property	$1,700	$8,950	$500	$3,400	$1,000	**$3,110**
Average	**$71,600**	**$1,139,864**	**$892**	**$3,574**	**$500**	**$243,286**

Table 1.2 only reflects damage that has been reported to or verified by WS based on requests received for assistance. Assigning a monetary value to damage to natural resources can be difficult, especially when factoring in the lost aesthetic value when natural resources are damaged by birds. Similarly, placing a monetary value on threats to human safety can be a challenge. Therefore, these values may not represent the true value of damage caused by birds to these resources. Monetary damage reported in Table 1.2 reflects damage that has occurred and that has been reported to WS, but is not reflective of all bird damage occurring in the state since not all bird damage or threats are reported to WS. Information

regarding bird damage to agricultural resources, property, natural resources, and threats to human safety are discussed in the following subsections of the EA.

Need to Resolve Bird Damage to Agricultural Resources

Agriculture is an important industry in Delaware with over 500,000 acres devoted to agricultural production in 2016 (USDA 2016). The total market value of agricultural products sold in the state was over $1.2 billion in 2016 (USDA 2016). The value of grain crops, oilseeds, dry beans, and dry pea production was over $345 million (USDA 2016). The broilers and chickens total head was 252,500,000 with a total market value of over $43 billion, plus another $1 billion in egg sales (USDA 2016).

A variety of bird species can cause damage to agricultural resources. Damage and threats of damage to agricultural resources is often associated with bird species that exhibit flocking behaviors (*e.g*., red-winged blackbirds) or colonial nesting behavior (*e.g*., pigeons). Damage occurs through direct consumption of agricultural resources, the contamination of resources from fecal droppings, or the threat of disease transmission to livestock from contact with fecal matter. Poultry operations are particularly sensitive to disease transmission from wild birds occupying or roosting nearby.

Damage to Aquaculture Resources

Damage to aquaculture resources occurs primarily from the economic losses associated with birds consuming fish and other commercially raised aquatic organisms. Damage can also result from the death of fish and other aquatic wildlife from injuries associated with bird predation as well as the threat of disease transmission from one impoundment to another or from one aquaculture facility to other facilities as birds move between sites. Aquaculture consists of both commercial fish production for the consumer market by private industry, and sport fish production in hatcheries operated by DNREC and the USFWS. Delaware doesn't have a commercial aquaculture market but hosts small entities and private businesses, (USDA 2016). However, the need to resolve damage to aquaculture may arise, thus BDM for private entities is discussed in this EA.

Price and Nickum (1995) concluded that the aquaculture industry has small profit margins so that even a small percentage reduction in the farm gate value due to predation is an economic issue. The magnitude of economic impacts that birds have on the aquaculture industry can vary dependent upon many different variables including, the value of the fish stock, number of depredating birds present, and the time of year the predation is taking place. In 1984, a survey of fish producing facilities identified 43 species of birds as foraging on fish at those facilities, including grebes, pelicans, herons, egrets, waterfowl, osprey, hawks, harriers, owls, gulls, terns, crows, mergansers, common grackles, and brown-headed cowbirds (Parkhurst et al. 1987). Of those birds shown in Table 1.1 associated with damage, of primary concern to aquaculture facilities are various species of herons and egrets, double-crested cormorants, herring gulls, ring-billed gulls, and ospreys. Those birds prey on young fry and fingerlings, adult fish ready for stocking or sale, or brood fish at fish rearing facilities (Salmon and Conte 1981).

Double-crested cormorants can feed heavily on fish being raised for human consumption, and on fish commercially raised for bait and restocking. The frequency of cormorant occurrence at a given aquaculture facility can be a function of many interacting factors, including: (1) size of the regional and local cormorant population; (2) the number, size, and distribution of aquaculture facilities; (3) the size distribution, density, health, and species composition of fish populations at facilities; (4) the number, size, and distribution of wetlands in the immediate area; (5) the size distribution, density, health, and species composition of free-ranging fish populations in the surrounding landscape; (6) the number, size, and distribution of suitable roosting habitat; and (7) the variety, intensity and distribution of local damage abatement activities. Cormorants are adept at seeking out the most favorable foraging and roosting sites.

As a result, cormorants are rarely distributed evenly over a given region but are often highly clumped or localized. Damage abatement activities can shift bird activities from one area to another; thereby, not eliminating predation but only reducing damage at one site while increasing damage at another location (Aderman and Hill 1995, Mott et al. 1998, Reinhold and Sloan 1999, Tobin et al. 2002). Thus, some aquaculture producers in a region suffer little or no economic damage from cormorants, while others experience exceptionally high losses.

In addition to cormorants, great blue herons, great egrets, and other wading birds are also known to forage at aquaculture facilities. Those species have been associated with depredations on trout (Parkhurst et al. 1992, Pitt and Conover 1996, Glahn et al. 1999*a*), baitfish (Hoy et al. 1989), and ornamental fish (Avery et al. 1999). Even though great blue herons and great egrets are widespread at aquaculture facilities, little is known about their potential to spread parasitic diseases to fish. Great blue herons are thought to have a greater impact on baitfish, trout, brood fish, and minnow production. Loss of trout in ponds with herons present ranged from 9.1% to 39.4% in Pennsylvania with an estimated loss in production ranging from $8,000 to nearly $66,000 (Glahn et al. 1999*b*). The stomach contents of great blue herons collected at trout producing facilities in the northeastern United States contained almost exclusively trout (Glahn et al. 1999*b*).

Mallards have been identified by aquaculture facilities as posing a threat of economic loss from foraging behavior (Parkhurst et al. 1987, Parkhurst et al. 1992). During a survey conducted in 1984 of fisheries primarily in the eastern United States, managers at 49 of 175 facilities reported mallards as feeding on fish at those facilities, which represented an increase in the number of facilities reporting mallards as feeding on fish when compared to prior surveys (Parkhurst et al. 1987). Parkhurst et al. (1992) found mallards foraging on trout fingerlings at facilities in Pennsylvania. Mallards selected trout ranging in size from 8.9 centimeters to 12.2 centimeters in length. Of those predatory birds observed by Parkhurst et al. (1992), mallards consumed the most fish at the facilities with a mean of 148,599 fish captured and had the highest mean economic loss per year per site based on mallards being present at those facilities for a longer period of time per year compared to other species.

During a survey of fisheries in 1984, osprey were ranked third highest among 43 species of birds identified as foraging on fish at aquaculture facilities in the United States (Parkhurst et al. 1987). Fish comprise the primary food source of osprey (Poole et al. 2002). Parkhurst et al. (1992) found that when ospreys were present at aquaculture facilities, over 60% of their mean time was devoted to foraging. The mean length of trout captured by osprey was 30.5 centimeters leading to a higher economic loss per captured fish compared to other observed species (Parkhurst et al. 1992).

Also of concern to aquaculture facilities is the transmission of diseases by birds between impoundments and from facility to facility. Given the confinement of aquatic organisms inside impoundments at aquaculture facilities and the high densities of those organisms in those impoundments, the introduction of a disease could result in substantial economic losses. Although actual transmission of diseases through transport by birds is difficult to document, birds have been documented as having the capability of spreading diseases through fecal droppings and possibly through other mechanical means such as on feathers, feet, and regurgitation.

Although documentation that birds, primarily herons and cormorants, can pose as vectors of diseases known to infect fish, the rate of transmission is currently unknown and is likely very low. Fish-eating birds are known to target fish that are diseased and less likely to escape predation at aquaculture facilities (Price and Nickum 1995, Glahn et al. 2002). Given the mobility of birds to move from one impoundment or facility to another, the threat of disease transmission is a concern given the potential economic loss resulting from extensive mortality of fish or other cultivated aquatic wildlife if a disease outbreak occurs.

Damage and Threats to Livestock Operations

Damage to livestock operations can occur from several bird species. Economic damage can occur from birds feeding on livestock feed, from birds feeding on livestock, from birds feeding on newly-planted seed, and from the increased risks of disease transmission associated with large concentrations of birds. Birds also defecate while feeding, increasing the possibility of disease transmission through livestock directly contacting or consuming fecal droppings. Birds can also cause damage by defecating on fences, shade canopies, and other structures, which can accelerate corrosion of metal components and can be aesthetically displeasing. Large concentrations of birds at livestock feeding operations can also pose potential health hazards to feedlot/dairy operators and their personnel through directly contacting fecal droppings or by droppings creating unsafe working conditions.

Although damage and disease threats to livestock operations can occur throughout the year, damage can be highest during those periods when birds are concentrated into large flocks, such as migration periods and during winter months when food sources are limited. For some bird species, high concentrations of birds can be found during the breeding season where suitable nesting habitat exists, such as swallows, pigeons, and house sparrows. Of primary concern to livestock feedlots and dairies are starlings, red-winged blackbirds, common grackles, cowbirds, house sparrows, pigeons, and to a lesser extent gulls. The flocking behavior of those species either from roosting and/or nesting behavior can lead to economic losses to agricultural producers from the consumption of livestock feed and from the increased risks associated with the transmission of diseases from fecal matter being deposited in feeding areas and in water used by livestock.

The flocking behavior of European starlings, house/English sparrows, crows, and feral pigeons either from feeding, roosting and/or nesting behavior can lead to economic losses to agricultural producers from the consumption of livestock feed. Economic damages associated with starlings and blackbirds feeding on livestock rations has been documented in France and Great Britain (Feare 1984), and in the United States (Besser et al. 1968, Dolbeer et al. 1978, Glahn and Otis 1981, Glahn 1983, Glahn and Otis 1986). It has been estimated that starlings damage an estimated $800 million worth of agricultural resources per year (Pimentel et al. 2000). Diet rations for cattle contain all of the nutrients and fiber that cattle need, and are so thoroughly mixed that cattle are unable to select any single component over others. Livestock feed and rations are often formulated to ensure proper health of the animal. Higher fiber roughage in livestock feed is often supplemented with corn, barley, and other grains to ensure weight gain and in the case of dairies, for dairy cattle to produce milk. Livestock are unable to select for certain ingredients in livestock feed while birds often can selectively choose to feed on the corn, barley, and other grains formulated in livestock feed. Livestock feed provided in open troughs is most vulnerable to feeding by birds. Birds often select for those components of feed that are most beneficial to the desired outcome of livestock. When large flocks of birds selectively forage for components in livestock feeds, the composition and the energy value of the feed can be altered, which can negatively affect the health and production of livestock. The removal of this high-energy source by European starlings is believed to reduce milk yields and weight gains, which is economically critical (Feare 1984). Glahn and Otis (1986) reported that starling damage was also associated with proximity to roosts, snow, freezing temperatures, and the number of livestock on feed.

Forbes (1995) reported European starlings consumed up to 50% of their body weight in feed each day. Glahn and Otis (1981) reported losses of 4.8 kg of pelletized feed consumed per 1,000 bird minutes. Glahn (1983) reported that 25.8% of farms in Tennessee experienced starling depredation problems of which 6.3% experienced considerable economic loss. Williams (1983) estimated seasonal feed losses to five species of blackbirds (primarily brown-headed cowbirds) at one feedlot in south Texas at nearly 140 tons valued at $18,000. Depenbusch et al. (2011) estimated that feed consumption by European starlings increased the daily production cost by $0.92 per animal.

Agricultural areas provide ideal habitat for many bird species, which can be attracted in large numbers to those locations. Large concentrations of birds feeding, roosting, or loafing in those areas can increase the possibility of and the concern over the transmission of diseases from birds to livestock. This concern is important and can have far-reaching implications (Daniels et al. 2003, Fraser and Fraser 2010, Miller et al. 2012). Birds feeding alongside livestock in open livestock feeding areas or feeding on stored livestock feed can leave fecal deposits, which can be consumed by livestock. Fecal matter can also be deposited in sources of water for livestock, which increases the likelihood of disease transmission and can contaminate other surface areas where livestock can encounter fecal matter deposited by birds. Many bird species, especially those encountered at livestock operations, are known to carry infectious diseases which can be excreted in fecal matter and pose not only a risk to individual livestock operations, but can be a source of transmission to other livestock operations as birds move from one area to another. The rate of transmission is likely very low; however, the threat of transmission exists since birds are known vectors of many diseases transmittable to livestock.

A number of diseases that affect livestock have been associated with rock pigeons, European starlings, and house sparrows (Weber 1979, Carlson et al. 2010). Rock pigeons, starlings, and house sparrows have been identified as carriers of several bacteria that are known to cause diseases in livestock and pets, including erysipeloid, salmonellosis, pasteurellosis, avian tuberculosis, streptococcosis, vibrosis, and listeriosis (Weber 1979, Gough and Beyer 1981). Weber (1979) also reported pigeons, starlings, and house sparrows as vectors of several viral, fungal, protozoal, and rickettsial diseases that are known to infect livestock and pets.

Contamination of livestock facilities through fecal accumulation by various bird species has been identified as an important concern. Numerous diseases are spread through feces, with salmonellosis and *Escherichia coli* being two diseases of concern. Salmonellosis is an infection with bacteria called *Salmonella* and numerous bird species have been documented as reservoirs for this bacterium (Friend and Franson 1999, Tizard 2004). *E. coli* is a fecal coliform bacteria associated with the fecal material of warm-blooded animals. Multiple studies have found that birds can be an important source of *E. coli* contamination of both land and water sources (Fallacara et al. 2001, Kullas et al. 2002, Hansen et al. 2009, Silva et al. 2009). Multiple species have been documented as carrying dangerous strains of *E. coli*, including gulls, geese, pigeons, and starlings (Pedersen and Clark 2007). LeJeune et al. (2008) found that starlings could play a role in the transmission of *E. coli* between dairy farms.

Carlson et al. (2010) found *Salmonella enterica* in the gastrointestinal tract of starlings at cattle feedlots in Texas and suggested starlings could contribute to the contamination of cattle feed and water. Salmonella contamination levels can be directly related to the number of European starlings present (Carlson et al. 2010, Carlson et al. 2011). Poultry operations can be highly susceptible to diseases spread by wild birds, including those from starlings and house sparrows. This includes salmonella, campylobacter, and clostridium (Craven et al. 2000).

Salmonella transmission by gulls to livestock can also be a concern (Williams et al. 1977, Johnston et al. 1979, Coulson et al. 1983). Williams et al. (1977) and Johnston et al. (1979) reported that gulls can transmit salmonella to livestock through droppings and contaminated drinking water. Pedersen and Clark (2007) did an extensive review of the literature and found geese, gulls, pigeons, house sparrows, cowbirds, grackles, blackbirds and starlings have the potential to play a role in the direct transmission of *E. coli* and *S. enterica* among cattle at feedlots and dairies and from livestock operation to livestock operation.

Waterfowl, including ducks, geese, and swans, can also be a concern to livestock producers. Waterfowl droppings in and around livestock ponds can affect water quality and can be a source of a number of different types of bacteria. The transmission of diseases through drinking water is one of the primary concerns for a safe water supply for livestock. Bacteria levels for livestock depend on the age of the animal since adults are more tolerant of bacteria than young animals (Mancl 1989). The bacteria guidelines for livestock water supplies are <1000 fecal coliform/100 ml for adult animals and < 1 fecal coliform/100 ml for young animals (Mancl 1989). Salmonella causes shedding of the intestinal lining and severe diarrhea in cattle. If undetected and untreated, salmonella can kill cattle and calves. Additionally, the contamination of feed by waterfowl through dropping in pastures, crops, or harvested grasses can also be a method of disease transmission to livestock (Fraser and Fraser 2010).

Wild and domestic waterfowl, as well as a variety of other bird species, are the acknowledged natural reservoirs for a variety of avian influenza viruses (Davidson and Nettles 1997, Alexander 2000, Stallknecht 2003, Pedersen et al. 2010). Avian influenza (AI) circulates among these birds without clinical signs and is not an important mortality factor in wild waterfowl (Davidson and Nettles 1997, Clark and Hall 2006). However, the potential for AI to produce devastating disease in domestic poultry makes its occurrence in waterfowl an important issue (Davidson and Nettles 1997, Clark and Hall 2006, Gauthier-Clerc et al. 2007). Although low pathogenic strains of AI are often found in wild birds (Stallknecht 2003, Pedersen et al. 2010), high pathogenic strains have also been found to exist in wild waterfowl species (Brown et al. 2006, Keawcharoen et al. 2008). The ability for wild birds to carry these highly pathogenic strains increases the potential for transmission to domestic poultry facilities, which are highly susceptible to high pathogenic strains of AI (Nettles et al. 1985, Gauthier-Clerc et al. 2007, Pedersen et al. 2010). The potential impacts from a severe outbreak of high pathogenic AI in domestic poultry could be devastating, and possibly cripple the multi-billion dollar industry through losses in trade, consumer confidence, and eradication efforts (Pedersen et al. 2010).

Some diseases that could affect the poultry industry and might originate in wild bird species include exotic Newcastle disease, chlamydiosis, high-pathogenic AI, low-pathogenic AI, salmonellosis, and pasteurellosis (Clark and McLean 2003). A single outbreak of high-pathogenic AI in 1984 cost the poultry industry $63 million in destroyed or sick birds and clean-up costs, and the price of poultry food products rose in the six months following the outbreak (Hahn and Clark 2002). When adjusted for inflation, those costs were equivalent to nearly $1 billion in 2003 (Clark 2003). Similarly, a low-pathogenic strain of AI virus was isolated in Virginia in March 2002. The control and containment efforts cost $13 million in destruction of flocks, $50 million in paid indemnities, and an overall cost of $129 million to the industry in an effort to minimize the trade impacts (Hahn and Clark 2002). Genetic evidence and documented temporal associations between AI prevalence in wild waterfowl and poultry flocks suggests that wild waterfowl can be a source of infection to poultry (Clark 2003, Clark and Hall 2006). In samples of over 260,000 wild birds, the prevalence of low-pathogenic AI across the United States in 2007 and 2008 was 9.7 and 11%, respectively and the prevalence of high-pathogenic AI in the same years was 0.5 and 0.06%, respectively (Deliberto et al. 2009). The majority of those wild birds were dabbling ducks, geese, swans, and shorebirds (Deliberto et al. 2009).

Certain bird species are also known to prey upon livestock, which can result in economic losses to livestock producers. Direct damage to livestock occurs primarily from vultures, but can also include raptors. Economic damages occur from vultures and raptors feeding on livestock. Vultures are known to prey upon newly born calves and harass adult cattle, especially during the birthing process. The NASS reported livestock owners in the United States lost 11,900 head of cattle and calves from vultures in 2010 valued at $4.6 million (NASS 2011). While both turkey vultures and black vultures have been documented harassing expectant cattle, damages are primarily attributed to black vultures. Vulture predation on livestock is distinctive. Black vultures killed pigs by pulling their eyes out followed by attacks to the rectal area (Lovell 1947, Lovell 1952, Lowney 1999). During a difficult delivery, vultures will peck at the half-expunged calf and kill it. A livestock producer in Kent County, Delaware requested WS' assistance after 70 to 100 vultures killed as many as 20 lambs and injured several calves on the farm.

A livestock facility in Queen Anne's County, Maryland has also addressed damage associated with approximately 40 black vultures threatening and causing damage to calves. Reports of calf depredation occur throughout Delaware but are not necessarily common.

Economic losses can also result from raptors, particularly red-tailed hawks, feeding on domestic fowl, such as chickens quail, guineas, racing/show pigeons, and waterfowl (Hygnstrom and Craven 1994). Free-ranging fowl or fowl allowed to range outside of confinement are particularly vulnerable to predation by raptors.

Damage to Agricultural Crops

Besser (1985) estimated damage to agricultural crops associated with birds exceeded $100 million annually in the United States. Bird damage to agricultural crops occurs primarily from the consumption of crops (*i.e*., loss of the crop and revenue), but also consists of trampling of emerging crops and compaction of soil by waterfowl, consumption of cover crops used to prevent erosion and condition soil, damage to fruits associated with feeding, and fecal contamination. Damage to agricultural crops by all bird species reported to WS by the public from FY 2014 through FY 2018 averaged $483,462 per year in Delaware.

The most common damage to agricultural resources associated with geese is crop consumption (loss of the crop and revenue), but also consists of trampling of emerging crops, and increased erosion and runoff from fields where the cover crop has been grazed (USFWS 2005). Waterfowl can graze and trample a variety of crops, including alfalfa, barley, corn, soybeans, wheat, rye, and oats (Cleary 1994). For example, a single intense grazing event by Canada geese in fall, winter, or spring can reduce the yield of winter wheat by 16 to 30% (Fledger et al. 1987), and reduce growth of rye plants by more than 40% (Conover 1988). However, some research has reported that grazing by geese during the winter may increase rye or wheat seed yields (Clark and Jarvis 1978, Allen et al. 1985). Since 1985, agricultural practices have changed resulting in intensive wheat growing methods with much higher yields of approximately 100 bushels per acre, but these crops are unable to sustain even light grazing pressure without losing yield. Associated costs with agricultural damage involving waterfowl include costs to replant grazed crops (e.g., soybeans, corn, peanuts), implement nonlethal wildlife management practices, purchase replacement hay, and decreased yields.

Several studies have shown that European starlings can pose a great economic threat to agricultural producers (Besser et al. 1968, Dolbeer et al. 1978, Feare 1984). Starlings and sparrows can also have a detrimental effect on agricultural food production by feeding at vineyards, orchards, gardens, crops, and feedlots (Weber 1979). For example, starlings feed on numerous types of fruits such as, cherries, figs, blueberries, apples, apricots, grapes, nectarines, peaches, plums, persimmons, strawberries, and olives (Weber 1979). Starlings were also found to damage ripening corn (Johnson and Glahn 1994) and are known to feed on the green, milk, and dough stage kernels of sorghum (Weber 1979). Additionally, starlings may pull sprouting grains, especially winter wheat, and feed on planted seed (Johnson and Glahn 1994). Sparrows damage crops by pecking seeds, seedlings, buds, flowers, vegetables, and maturing fruits (Fitzwater 1994), and localized damage can be great because sparrows often feed in large flocks on a small area (Fitzwater 1994).

Fruit and nut crops can be damaged by robins, starlings, red-winged blackbirds, grackles, cowbirds, and woodpeckers. Avery et al. (1991) estimated bird damage to blueberry production in the United States cost growers $8.5 million in 1989. Red-winged blackbirds, cowbirds, and woodpeckers are known to cause damage to blueberries (Besser 1985). Damage to blueberries typically occurs from birds plucking and consuming the berry or from knocking the berries from the bushes (Besser 1985). Damage to apples can occur from beak punctures, which makes the apples unmarketable (Besser 1985). Crows, robins, and starlings have been documented as causing damage to apples (Mitterling 1965). Bird damage to sweet corn can also result in economic losses to producers. Damage to sweet corn caused by birds makes the ear of corn unmarketable because the damage is unsightly to the consumer (Besser 1985). Large flocks of red-winged blackbirds are responsible for most of the damage reported to sweet corn with damage also occurring from grackles and starlings (Besser 1985). Damage occurs when birds rip or pull back the husk exposing the ear for consumption. Most bird damage occurs during the development stage known as the milk and dough stage when the kernels are soft and filled with a milky liquid. Birds will puncture the kernel to ingest the contents. Once punctured, the area of the ear damaged often discolors and is susceptible to disease introduction into the ear (Besser 1985). Damage usually begins at the tip of the ear as the husk is ripped and pulled back but can occur anywhere on the ear (Besser 1985).

Damage can also occur to sprouting corn as birds pull out the sprout or dig the sprout up to feed on the seed kernel (Besser 1985). Damage to sprouting corn occurs primarily from crows, but grackles and red-winged blackbirds are also known to cause damage to sprouting corn (Stone and Mott 1973). Additionally, starlings may pull sprouting grains and feed on planted seed (Johnson and Glahn 1994). Damage to sprouting corn is likely localized and highest in areas where breeding colonies of grackles exist in close proximity to agricultural fields planted with corn (Stone and Mott 1973, Rogers, Jr. and Linehan 1977). Rogers, Jr. and Linehan (1977) found grackles damaged two corn sprouts per minute on average when present at a field planted near a breeding colony of grackles.

Need to Resolve Threats that Birds Pose to Human Safety

Several bird species listed in Table 1.1 can be closely associated with human habitation and often exhibit gregarious roosting behavior, such as vultures, waterfowl, crows, starlings, and pigeons. The close association of those bird species with human activity can pose threats to human safety from disease transmission; threaten the safety of air passengers if birds are struck by aircraft; excessive droppings can be aesthetically displeasing; and aggressive behavior, primarily from waterfowl, can pose risks to human safety. Delaware has not reported any monetary cost to health and human safety since 2012 from birds; however, it is extremely difficult to place a monetary value on human lives and their safety. Monetary damages to human health and safety are derived from medical expenses caused as a result of injury from accidents involving wildlife or from lawsuits that payout a settlement to beneficiaries for loss of life in wildlife related accidents. In Maryland, this type of damage causes about $15,000 per year with similar damage possible in Delaware, especially around hospitals and airports.

Threat of Disease Transmission

Birds can play a role in the transmission of diseases where humans may encounter fecal droppings. Few studies are available on the occurrence of zoonotic diseases in wild birds and on the risks to humans from transmission of those diseases (Clark and McLean 2003). Study of this issue is complicated by the fact that some disease-causing agents associated with birds may also be contracted from other sources. The risk of disease transmission from birds to humans is likely very low. However, human exposure through direct contact or through the disturbance of fecal droppings where disease organisms are known to occur increases the likelihood of disease transmission. The gregarious behavior of bird species leads to accumulations of fecal droppings that can be considered a threat to human health and safety due to the close association of those species of birds with human activity. Accumulations of bird droppings in public areas are aesthetically displeasing and are often in areas where humans may come in direct contact with fecal droppings.

Fecal droppings in and around water resources can affect water quality and can be a source of a number of different types of pathogens and contaminants. Waterbird excrement can contain coliform bacteria, streptococcus bacteria, *Salmonella*, toxic chemicals, and nutrients, and it is known to compromise water quality, depending on the number of birds, the amount of excrement, and the size of the water body. Elevated contaminant levels associated with breeding and/or roosting concentrations of cormorants and their potential effects on water supplies can be concerns.

Birds can play a role in the transmission of diseases to humans such as encephalitis, West Nile virus, psittacosis, and histoplasmosis. Birds may also play a direct and indirect role in transmission of *Escherichia coli* and *S. enterica* to humans through contact with infected cattle feces, watering troughs, and agriculture fields fertilized with manure slurries (Pedersen and Clark 2007). For example, as many as 65 different diseases transmittable to humans or domestic animals have been associated with pigeons, European starlings, and house sparrows (Weber 1979). Public health officials and residents at such sites express concerns for human health related to the potential for disease transmission where fecal droppings accumulate. Fecal droppings that accumulate from large communal bird roosts can facilitate the growth of disease organisms, which grow in soils enriched by bird excrement, such as the fungus *Histoplasma capsulatum*, which causes the disease histoplasmosis in humans (Weeks and Stickley 1984).

The disturbance of soil or fecal droppings under bird roosts where fecal droppings have accumulated can cause *H. capsulatum* to become airborne. Once airborne, the fungus could be inhaled by people in the area. For example, workers at an ethanol plant in eastern Nebraska became ill with histoplasmosis after breathing in spores from construction in an area that had a starling roost (Mortality and Morbidity Weekly Report 2004). Viable *H. capsulatum* remains in the soil and can be contracted several years after a roost is abandoned (Clark and McLean 2003).

Ornithosis (*Chlamydia psittaci*) is another respiratory disease that can be contracted by people, livestock, and pets that can be associated with accumulations of bird droppings. Waterfowl, herons, and rock pigeons are the most commonly infected wild birds in North America (Locke 1987). Pigeons are most commonly associated with the spread of Ornithosis to people. Ornithosis is a virus that can be spread through infected bird droppings when viral particles become airborne after infected bird droppings are disturbed.

Waterfowl may affect human health through the distribution and incubation of various pathogens and through nutrient loading. Public swimming beaches, private ponds, and lakes can be affected by waterfowl droppings. In Delaware, Trap Pond State Park experienced heavy contamination from Canada geese resulting in the closure of the swimming beach. There are several pathogens involving waterfowl that may be contracted by people; however, the risk of infection is likely low (EPA 2001). Linking the transmission of diseases from waterfowl to people can be especially difficult since many pathogens occur naturally in the environment and pathogens can be attributed to contamination from other sources. However, the presence of disease causing organisms in waterfowl feces can increase the risk of exposure and transmission of zoonoses wherever people may encounter large accumulations of feces from waterfowl.

Cryptosporidiosis is a disease caused by the parasite *Cryptosporidium parvum*, which was not known to cause disease in people until 1976 (Department of Health Services 2004). A person can be infected by drinking contaminated water or by direct contact with the fecal material of infected animals (Department of Health Services 2004). Exposure can occur from swimming in lakes, ponds, streams, and pools, and from swallowing water while swimming (Colley 1996). *Cryptosporidium* can cause gastrointestinal disorders (Virginia Department of Health 1995) and can produce life-threatening infections, especially in people with compromised or suppressed immune systems (Roffe 1987, Graczyk et al. 1998). Cryptosporidiosis has been recognized as a disease with implications for human health (Smith et al. 1997).

E. coli are fecal coliform bacteria associated with fecal material of warm-blooded animals. There are over 200 specific serological types of *E. coli* with the majority of serological types being harmless (Sterritt and Lester 1988). The serological type of *E. coli* that is best known is *E. coli* O157:H7, which is usually associated with cattle (Gallien and Hartung 1994). Many communities monitor water quality at swimming beaches and lakes, but they lack the financial resources to pinpoint the source of elevated fecal coliform counts. When fecal coliform counts at swimming beaches exceed established standards, the beaches are often temporarily closed, which can adversely affect the enjoyment of those areas by the public, even though the serological type of the *E. coli* is unknown. Simmons et al. (1995) used genetic fingerprinting to link fecal contamination of small ponds on Fisherman Island, Virginia to waterfowl. Microbiologists were able to implicate waterfowl and gulls as the source of fecal coliform bacteria at the Kensico Watershed, a water supply for New York City (Klett et al. 1998, Alderisio and DeLuca 1999). In addition, fecal coliform bacteria counts coincided with the number of gulls roosting at the reservoir.

While transmission of diseases or parasites from birds to humans has not been well documented, the potential exists (Luechtefeld et al. 1980, Wobeser and Brand 1982, Hill and Grimes 1984, Pacha et al. 1988, Blankespoor and Reimink 1991, Graczyk et al. 1997, Saltoun et al. 2000). In worst-case scenarios, infections may even be life threatening for people with suppressed or compromised immune systems (Roffe 1987, Graczyk et al. 1998). Even though many people are concerned about disease transmission from feces, the probability of contracting a disease from feces is believed to be small. However, human exposure to fecal droppings through direct contact or through the disturbance of accumulations of fecal droppings where disease organisms are known to occur increases the likelihood of disease transmission. Several of the bird species addressed in this EA are closely associated with the activities of people and they often exhibit gregarious roosting and nesting behavior. This gregarious behavior can lead to accumulations of fecal droppings that could be considered a threat to human health and safety due to the close association of those species of birds with people. Accumulations of bird droppings in public areas are aesthetically displeasing and are often in areas where people may come in direct contact with fecal droppings.

Threat of Aircraft Striking Wildlife at Airports and Military Installations

In addition to threats of zoonotic diseases, birds also pose a threat to human safety from being struck by aircraft. Birds struck by aircraft, especially when ingested into engines, can lead to structural damage to the aircraft and can cause catastrophic engine failure. The civil and military aviation communities have acknowledged that the threat to human health and safety from aircraft collisions with wildlife is increasing (Dolbeer 2000, MacKinnon et al. 2004). Collisions between aircraft and wildlife are a concern throughout the world because wildlife strikes threaten passenger safety (Thorpe 1996), result in lost revenue, and repairs to aircraft can be costly (Linnell et al. 1996, Robinson 1996). Aircraft collisions with wildlife can also erode public confidence in the air transportation industry as a whole (Conover et al. 1995). Wildlife strikes pose increasing risks and economic losses to the aviation industry worldwide. Annual economic losses from wildlife strikes with civil average $677 million annually in the United States (Dolbeer et al. 2012).

In several instances, wildlife-aircraft collisions in the United States have resulted in human fatalities. The risk that birds pose to aircraft is well documented with the worst case reported in Boston during 1960 when 62 people were killed in the crash of an airliner that collided with a flock of European starlings (Terres 1980). Since 1988, more than 229 people worldwide have died in aircraft that have crashed after striking wildlife (Dolbeer et al. 2012). Between 1990 and 2010, 24 people have died after aircraft have stuck birds in the United States (Dolbeer et al. 2012). Of those 24 fatalities involving bird strikes, seven fatalities occurred after striking birds that were not identified while eight fatalities occurred after strikes involving red-tailed hawks (Dolbeer et al. 2012). Injuries can also occur to pilots and passengers from bird strikes. Between 1990 and 2010, 44 strikes involving waterfowl have resulted in injuries to 49 people, while 29 strikes involving vultures resulted in injuries to 32 people (Dolbeer et al. 2012). From 1990 through 2015, 168 birds have been reported as struck by aircraft in Delaware (Dolbeer et al. 2015).

Threats can occur when large flocks or flight lines of birds enter or exit a roost at or near airports or when present in large flocks foraging on or near an airport. Vultures and raptors can also present a risk to aircraft because of their large body mass and slow-flying or soaring behavior. Vultures are considered the most hazardous bird for an aircraft to strike based on the frequency of strikes, effect on flight, and amount of damage caused by vultures throughout the country (Dolbeer et al. 2000). Mourning doves also present risks when their late summer behaviors include creating large roosting and loafing flocks. Their feeding, watering, and gritting behavior on airport turf and runways further increases the risk of bird-aircraft collisions.

From 1990 through 2015, 166,276 wildlife strikes have been reported to the Federal Aviation Administration (FAA) in the United States (Dolbeer et al. 2015). Birds were involved with over 97% of those reported strikes to civil aircraft in the United States (Dolbeer et al. 2013). The number of bird strikes actually occurring is likely much greater since Dolbeer (2009) estimated that only 39% of civil wildlife strike are actually reported. In Delaware, over 93% of the reported aircraft strikes from 1990 to 2015 involved birds (Dolbeer et al. 2015). Generally, bird collisions occur when aircraft are near the ground during take-off and approach to the runway. From 1990 through 2013, approximately 74% of reported bird strikes to general aviation aircraft in the United States occurred when the aircraft was at an altitude of 500 feet above ground level or less. Additionally, approximately 97% occurred less than 3,500 feet above ground level (Dolbeer et al. 2013).

Gulls, pigeons/doves, raptors, and waterfowl have been the bird groups most frequently struck by aircraft in the United States. Of the total known birds struck in the United States from 1990 through 2012, gulls comprised 15% of the strikes, pigeons and doves comprised 15% of the total reported strikes where identification occurred, while raptors accounted for 13%, and waterfowl were identified in 7% of reported strikes (Dolbeer et al. 2013).

Birds being struck by aircraft can cause substantial damage to the aircraft. Bird strikes can cause catastrophic failure of aircraft systems (*e.g.*, ingesting birds into engines), which can cause the plane to become uncontrollable leading to crashes. DeVault et al. (2011) concluded that snow geese, duck species, turkey vultures, great-horned owls, and double-crested cormorants were among the most hazardous birds to aircraft. Those hazards were based upon the number of strikes involving those birds, the amount of damage strikes involving those birds have caused to aircraft, the effect on the flight after the strike, and the body mass the bird (DeVault et al. 2011). Species of birds that congregate into large flocks or bird species that form large flight lines entering or exiting a roost at or near airports are those most hazardous species.

Additional Human Safety Concerns Associated with Birds

As people are increasingly living with wildlife, the lack of harassing and threatening behavior by people toward many species of wildlife, especially around urban areas, has led to a decline in the fear that wildlife have toward people. When wildlife species begin to habituate to the presence of people and human activity, a loss of apprehension can occur, which can lead those species to exhibit threatening behavior or abnormal behavior toward people. This behavior continues to increase as human populations expand and the populations of those species that adapt to human activity increase. Threatening or abnormal behavior can occur in the form of aggressive posturing or a general lack of apprehension toward people. Although birds attacking people occurs rarely, aggressive behavior by birds does occur, especially during nest building and the rearing of eggs and chicks.

Raptors can aggressively defend their nests, nesting areas, and young, and may swoop and strike at pets, children, and adults. In addition to raptors, waterfowl can also aggressively defend their nests and nestlings, during the nesting season, and attack pets, children, and adults. In April 2012, a man drowned in Des Plains, Illinois when he was attacked by a mute swan that knocked him out of his kayak (Golab 2012).

Feral waterfowl and Canada geese often nest in high densities in areas used by people for recreational purposes, such as parks, beaches, and sports fields (VerCauteren and Marks 2004). If people unknowingly approach waterfowl or their nests at those locations, injuries could occur if those waterfowl reacted aggressively to the presence of those people or pets. Additionally, the buildup of feces from waterfowl on docks, walkways, and other areas of foot traffic can create slipping hazards. If fecal droppings occur in areas with foot traffic, slipping could occur resulting in injuries to people. To avoid those conditions, regular clean-up is often required to alleviate threats of slipping on fecal matter, which can be economically burdensome.

Need to Resolve Bird Damage Occurring to Property

As shown in Table 1.1, all the bird species addressed in this assessment are known to cause damage to property in Delaware. Property damage can occur in a variety of ways and can result in costly repairs and clean-up. Bird damage to property occurs through direct damage to structures, through roosting behavior, and through their nesting behavior. One example of direct damage to property occurs when vultures tear roofing shingles or pull out latex caulking around windows. Accumulations of fecal droppings can cause damage to buildings and statues. Woodpeckers also cause direct damage to property through excavating holes in buildings either for nesting purposes, attracting a mate, or to locate food which can remove insulation and allows water and other wildlife to enter the building.

Property Damage to Aircraft from Bird Strikes

Aircraft striking birds can also cause substantial damage requiring costly repairs and aircraft downtime. Direct damage can also result from birds that act aggressively toward their reflection in mirrors and windows, which can scratch paint and siding. Target bird species can present a safety threat to aviation when those species occur in areas on and around airports. Species of birds that occur in large flocks or flight lines entering or exiting a roost at or near airports or when present in large flocks foraging on airport property can result in aircraft strikes involving several individuals of a bird species, which can increase damage and increase the risks of catastrophic failure of the aircraft.

Gulls, raptors, waterfowl, and doves are the bird groups most frequently struck by aircraft in the United States. When struck, 27% of the reported gull strikes resulted in damage to the aircraft or had a negative effect on the flight while 66% of the reported waterfowl strikes resulted in damage or negative effects on the flight compared to 26% of strikes involving raptors and 12% of strikes involving pigeons and doves (Dolbeer et al. 2012). Since 1990, over $150 million in damages to civil aircraft have been reported from strikes involving waterfowl (Dolbeer et al. 2012). In total, aircraft strikes involving birds has resulted in over $394 million in reported damages to civil aircraft since 1990 in the United States (Dolbeer et al. 2012).

When in large flocks or flight lines entering or exiting a winter roost at or near airports, starlings and blackbirds present a safety threat to aviation. Starlings and blackbirds are particularly dangerous birds to aircraft during take-offs and landings because of their high body density and tendency to travel in large flocks of hundreds to thousands of birds (Seamans et al. 1995). Mourning doves also present similar risks when their late summer behaviors include creating large roosting and loafing flocks. Their feeding, watering, and gritting behavior on airport turf and runways further increase the risks of bird-aircraft collisions. Snow geese and vultures are considered to be the most hazardous birds for an aircraft to strike based on the percentage of strikes resulting in an adverse effect to the aircraft (*i.e*., a strike resulting in damage to the aircraft and/or having a negative effect on the flight) (Dolbeer et al. 2012).

Other Property Damage Associated with Birds

Damage to property associated with large concentrations of roosting birds occurs primarily from accumulations of droppings and feather debris. Many of the bird species addressed in this assessment are gregarious (*i.e*., found together in large numbers), especially during the fall and spring migration periods. Although damage and threats can occur throughout the year, damage can be highest during those periods when birds are concentrated into large flocks such as migration periods and during winter months when food sources are limited. Birds that routinely roost and loaf in the same areas often leave large accumulations of droppings and feather debris, which is aesthetically displeasing and can cause damage to property. The reoccurring presence of fecal droppings under bird roosts can lead to constant cleaning costs for property owners.

Birds frequently damage structures on private property, or public facilities, with fecal contamination. Accumulated bird droppings can reduce the functional life of some building roofs by 50% (Weber 1979). Corrosion damage to metal structures and painted finishes, including those on automobiles, can occur because of uric acid from bird droppings. Electrical utility companies frequently have problems with birds and bird droppings causing power outages by shorting out transformers and substations. This can result in hundreds of thousands of dollars of outage time for power companies. Birds are known to also nest on cell towers, which can cause damage and disrupt the function of the tower. Cell tower damage is noted in Delaware with ospreys using the towers for nesting. In addition to causing power outages noted above, property damage from black vultures can include tearing and consuming latex window caulking or rubber gaskets sealing windowpanes, asphalt and cedar roof shingles, vinyl seat covers from boats, patio furniture, and ATV seats. Black vultures and turkey vultures also cause damage to cell phone and radio towers by roosting on critical tower infrastructure.

Large numbers of gulls can be attracted to landfills and they often use landfills as feeding and loafing areas throughout North America (Mudge and Ferns 1982, Patton 1988, Belant et al. 1995, Belant et al. 1998*a*, Belant et al. 1998*b*, Gabrey 1997). In the United States, landfills often serve as foraging and loafing areas for gulls throughout the year, while attracting larger populations of gulls during migration periods (Bruleigh et al. 1998). Landfills have even been suggested as contributing to the increase in gull populations (Verbeek 1977, Patton 1988, Belant and Dolbeer 1993). Gulls that visit landfills may loaf and nest on nearby rooftops, causing health concerns and structural damage to buildings and equipment. Bird conflicts associated with landfills include accumulation of feces on equipment and buildings, distraction of heavy machinery operators, and the potential for birds to transmit disease to workers on the site. The tendency for gulls to carry waste off site results in accumulation of feces and deposition of garbage in surrounding industrial and residential areas which creates a nuisance, as well as generates the potential for birds to transmit disease to neighboring residents.

The nesting behavior of some bird species can also cause damage to property. Nesting material can be aesthetically displeasing and fecal droppings often accumulate near nests. Many bird species are colonial nesters meaning they nest together in large numbers. Gulls, cormorants, egrets, and herons nest in large colonies. Swallows can also nest in large colonies. Colonies of gulls nesting on building rooftops has been well documented. The presence of nesting gulls on rooftops can cause damage to urban and industrial structures. Nesting gulls peck at spray-on-foam roofing and rubber roofing material, including caulking. This creates holes that must be repaired or leaks in the roof can result. Gulls transport large amounts of nest material and food remains to the rooftops, which can obstruct roof drainage systems and lead to structural damage or roof failure if clogged drains result in rooftop flooding (Vermeer et al. 1988, Blokpoel and Scharf 1991, Belant 1993). Nesting material and feathers can also clog ventilation systems resulting in cleaning and repairs.

Osprey nests are often constructed of large sticks, twigs, and other building materials that can cause damage and prevent access to critical areas when those nests are built on man-made structures (*e.g.*, power lines, cell towers, boats). Disruptions in the electrical power supply can occur when nests are located on utility structures and can inhibit access to utility structures for maintenance by creating obstacles to workers. For example, the average nest size of osprey in Corvallis, Oregon weighed 264 pounds and was 41-inches in diameter (USGS 2005). In 2001, 74% of occupied osprey nests along the Willamette River in Oregon occurred on power pole sites (USGS 2005).

Waterfowl sometimes congregate at golf courses, parks, recreational areas, and business complexes that have ponds or watercourses and cause damage by grazing on turf and by deposition of droppings. In Delaware, WS responded to requests for assistance from FY 2012 through FY 2016 to address $5,000 in damage caused by Canada geese, at various facilities. Economic damage has been in the form of cleanup of parking lots, retention ponds, sidewalks, patios, and lawns at business, residential and recreational locations. At golf courses, costs have been associated with restoration of greens and other turf areas, cleanup of human use areas, and lost revenue from loss of memberships. Members and the club's management were also concerned about possible health hazards from exposure to the droppings.

Vultures congregate in business complexes and residential areas and inflict damage via their droppings. In Delaware, over $8,000 in damage has been reported to WS from FY 2012 though FY 2016. Similar to Canada geese, economic costs have been in the form of cleanup of parking lots, sidewalks, vehicles, and business complexes. The total value of property damage by birds reported to WS in Delaware from FY 2012 through FY 2016 was approximately $15,250 with the annual average being $3,050. This included property damage reported for residential and non-residential buildings, landscaping and turf, and structures.

Need to Resolve Bird Damage Occurring to Natural Resources

Birds can also negatively affect natural resources through habitat degradation, direct depredation on natural resources, and competition with other wildlife. Habitat degradation can occur when large concentrations of birds in a localized area negatively affect characteristics of the surrounding habitat, which can adversely affect other wildlife species and can be aesthetically displeasing. Direct depredation occurs when predatory bird species feed on other wildlife species, which can negatively influence those species' populations, especially when depredation occurs on threatened and endangered (T&E) species. Competition can occur when two species compete (usually to the detriment of one species) for available resources, such as food or nesting sites.

Gulls will consume a variety of food items, including the eggs and chicks of other birds (Pierotti and Good 1994, Burger 1996, Good 1998, Pollet et al. 2012). Some of the species listed as threatened or endangered under the Endangered Species Act of 1973 (ESA) are preyed upon or otherwise could be adversely affected by certain bird species. Impacts on the productivity and survivorship of rare or threatened colonial waterbirds can be severe when nesting colonies become targets of avian predators. Fish eating birds such as cormorants, egrets, herons, and osprey also have the potential to impact fish and amphibian populations, and especially those of T&E species.

Double-crested cormorants can have a negative effect on wetland habitats (Jarvie et al. 1999, Shieldcastle and Martin 1999) and wildlife, including T&E species (Korfanty et al. 1999). Concentrations of gulls often affect the productivity and survivorship of rare or endangered colonial species such as terns (USFWS 1996) and prey upon the chicks of colonial waterbirds. Common grackles, red-winged blackbirds, northern harriers, American crows, fish crows, and American kestrels can also feed on nesting colonial water birds and shorebirds, their chicks and/or eggs (Hunter and Morris 1976, Farraway et al. 1986, Rimmer and Deblinger 1990, Ivan and Murphy 2005, United States Army Corps of Engineers 2009).

Cuthbert et al. (2002) examined potential impacts of cormorants on great blue herons and black-crowned night-herons in the Great Lakes and found that cormorants have not negatively influenced breeding distribution or productivity of either species at a regional scale, but did contribute to declines in heron presence and increases in site abandonment in certain site-specific circumstances. Similarly, gulls can also displace other colonial nesting birds (USFWS 1996).

Degradation of habitat can occur from the continuous accumulation of fecal droppings under nesting colonies of birds or under areas where birds consistently roost. Over time, the accumulation of fecal droppings under those areas can lead to the loss of vegetation from the ammonium nitrogen found in the fecal droppings of birds. Hebert et al. (2005) noted that ammonium toxicity caused by an accumulation of fecal droppings from double-crested cormorants might be an important factor contributing to the declining presence of vegetation on some islands in the Great Lakes. Cuthbert et al. (2002) found that cormorants could have a negative effect on normal plant growth and survival on a localized level in the Great Lakes region. Wires and Cuthbert (2001) identified vegetation die off as an important threat to 66% of the colonial waterbird sites designated as conservation sites of priority in the Great Lakes. Of 29 conservation priority sites reporting vegetation die off as a threat in the Great Lakes, Wires and Cuthbert (2001) reported cormorants were present at 23 of those sites. Based on survey information provided by Wires et al. (2001), biologists in the Great Lakes region reported cormorants as having an effect to herbaceous layers and trees where nesting occurred. Damage to trees was mainly caused by fecal deposits, and resulted in tree die off at breeding colonies and roost sites. Effects to the herbaceous layer of vegetation were also reported due to fecal deposition, and often this layer was reduced or eliminated from the colony site. In addition, survey respondents reported that the effects to avian species from cormorants occurred primarily from habitat degradation and from competition for nest sites (Wires et al. 2001).

Severe grazing by waterfowl can result in the loss of turf that stabilizes soil on manmade levees. Heavy rains on the bare soil of levees can result in erosion, which would not have occurred if the levee had been vegetated. Large accumulations of fecal droppings under crow roosts could have a detrimental impact on desirable vegetation. A study conducted in Oklahoma found fewer annual and perennial plants in locations where crows roosted over several years (Hicks 1979).

It has been well documented that birds can carry a wide range of bacterial, viral, fungal, and protozoan diseases that can affect other bird species, as well as mammals. A variety of diseases that birds can carry can affect natural resources (*e.g.*, see Friend and Franson 1999, Forrester and Spalding 2003, Thomas et al. 2007). Potential impacts from diseases found in wild birds may include transmission to a single individual or a local population, transmission to a new habitat, and transmission to other species of wildlife including birds, mammals, reptiles, amphibians, and fish species. Birds may also act as a vector, reservoir, or intermediate host as it relates to diseases and parasites. Diseases like avian botulism, avian cholera, and Newcastle disease can account for the death of hundreds to thousands of bird species across the natural landscape (Friend et al. 2001). For example, an avian botulism outbreak in Lake Erie was responsible for a mass die-off of common loons (*Gavia immer*) (Campbell et al. 2001) as well as other species that may have fed on the carcasses or on fly larva associated with the carcasses (Duncan and Jensen 1976). Although diseases spread through populations of birds, it is often difficult to determine the potential impacts they will have on other wildlife species due to the range of variables that are involved in a disease outbreak (Friend et al. 2001).

Delaware Shorebird Project

The Delaware Shorebird Project (DSP) is an initiative started in 1997 under the Division of Soil and Water's Coastal Management Program to monitor the status of shorebird populations that stop in Delaware during their migratory routes and protect resources vital to the success of shorebirds migrations and to mitigate threats to those resources. The Division of Fish and Wildlife's Natural Heritage and Endangered Species Program took over management of the DSP in 2005, and partners with DNREC and USGS to band, survey, and protect shorebirds. The major resource for shorebirds, and impetus for their stopover in Delaware along their migration routes, is horseshoe crab eggs which provide fuel shorebirds for the next leg of their seasonal journey. Shorebirds coordinate their migration with the horseshoe breeding season, thus timing and resource protection is critical to the success of the DSP and shorebirds conservation. Among these shorebird species are the red knot, ruddy turnstone, sanderling, and semipalmated sandpiper, which have declining population numbers since 2009. The most notable has been the red knots, with observable populations declining from over 100,000 birds to under 25,000, in 2009, and waning in recent years. Direct threats to natural resources (i.e., horseshoe crabs and horseshoe crab eggs) can originate from human interference, predation from invasive or native bird species, competition with other bird species for space (i.e., gulls), and disturbances to roosting and feeding sites. WS may receive requests for BDM assistance in coordination with the DSP, and per cooperation with DNREC and USFWS. WS may be requested to manage gulls that directly compete with shorebirds or shorebird habitat, since gulls and other shorebirds (including the red knot, ruddy turnstone, sanderling, and semipalmated sandpiper) are known to segregate via aggressive behavior from gulls (Burger et al., 2007). All work concerning shorebirds and gulls is pursuant of the Migratory Bird Treaty Act (MBTA).

1.4 DECISIONS TO BE MADE

Based on agency relationships, MOUs, and legislative authorities, WS is the lead agency for this EA, and therefore, responsible for the scope, content, and decisions made. Management of migratory birds is the responsibility of the USFWS. As the authority for the overall management of bird populations, the USFWS was consulted the development of the EA to provide input throughout the EA preparation process to ensure an interdisciplinary approach according to the NEPA and agency mandates, policies, and regulations. The DNREC is responsible for managing wildlife in the State of Delaware, including birds. The DNREC establishes and enforces regulated hunting seasons, including the establishment of seasons that allow the removal of some of the bird species addressed in this assessment.

For migratory birds, the DNREC can establish hunting seasons for those species under frameworks determined by the USFWS. WS' activities to reduce and/or prevent bird damage would be coordinated with the USFWS and the DNREC, which would ensure WS' actions are incorporated into population objectives established by those agencies. The removal of many of the bird species addressed in this EA can only occur when authorized by a depredation permit issued by the USFWS and/or the DNREC; therefore, the removal of those bird species by WS to alleviate damage or reduce threats of damage would only occur at the discretion of those agencies. In addition, WS' annual removal of birds to alleviate damage or threats of damage would only occur at levels authorized by those agencies as specified in depredation permits.

Based on the scope of this EA, the decisions to be made are:

- How can WS best respond to the need to reduce bird damage in Delaware?

- Do the alternatives have significant cumulative impacts meriting an Environmental Impact Statement (EIS)?

1.5 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT

Actions Analyzed

This EA evaluates the need for bird damage management to reduce threats to human safety and to resolve damage to property, natural resources, and agricultural resources on federal, state, tribal, municipal, and private land within the State of Delaware, wherever such management is requested by a cooperator. This EA discusses the issues associated with conducting damage management activities to meet the need for action and evaluates different alternatives to meet that need while addressing those issues.

The methods available for use under the alternatives evaluated are provided in Appendix B. The alternatives and Appendix B also discuss how methods would be employed to manage damage and threats associated with birds. Therefore, the actions evaluated in this EA are the use of those methods available under the alternatives by WS to manage or prevent damage and threats associated with birds from occurring when permitted by the USFWS pursuant to the Migratory Bird Treaty Act MBTA and/or when permitted by the DNREC in compliance with Delaware statutes and codes.

The MBTA makes it unlawful to pursue, hunt, take, capture, kill, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or their parts, nests, or eggs (16 U.S.C 703-711). A list of bird species protected under the MBTA can be found in 50 CFR 10.13.

The MBTA does allow for the lethal removal of those bird species listed in 50 CFR 10.13 when depredation occurs through the issuance of depredation permits or the establishment of depredation orders. Under authorities in the MBTA, the USFWS is the federal agency responsible for the issuance of depredation permits or the establishment of depredation orders for the removal of those protected bird species when damage or threats of damage are occurring. Information regarding migratory bird permits can be found in 50 CFR 13 and 50 CFR 21.

Native American Lands and Tribes

The WS program in Delaware would only conduct damage management activities on tribal lands when requested by a Native American Tribe. Activities would only be conducted after a MOU or cooperative service agreement had been signed between WS and the Tribe requesting assistance. Therefore, the Tribe would determine when WS' assistance is required and what activities would be allowed. Because Tribal officials would be responsible for requesting assistance from WS and determining what methods would be available to alleviate damage, no conflict with traditional cultural properties or beliefs would be anticipated. Those methods available to alleviate damage associated with birds on federal, state, county, municipal, and private properties under the alternatives analyzed in this EA would be available for use to alleviate damage on Tribal properties when the use of those methods has been approved by the Tribe requesting WS' assistance. Therefore, the activities and methods addressed under the alternatives would include those methods that could be employed on Native American lands, when requested and agreed upon between the Tribe and WS.

Federal, State, County, City, and Private Lands

Under two of the alternatives, WS could continue to provide bird damage management activities on federal, state, county, municipal, and private land in Delaware when a request is received for such services by the appropriate resource owner or manager. In those cases where a federal agency requests WS' assistance with managing damage caused by birds, the requesting agency would be responsible for analyzing those activities in accordance with the NEPA. However, this EA would cover such actions if the requesting federal agency determined the analyses and scope of this EA were appropriate for those actions and the requesting federal agency adopted this EA through their own Decision based on the analyses in this EA. Therefore, actions taken on federal lands have been analyzed in the scope of this EA.

Period for which this EA is Valid

If the analyses in this EA indicate an Environmental Impact Statement (EIS) is not warranted, this EA would remain valid until WS determines that new needs for action, changed conditions, new issues, or new alternatives having different potential environmental impacts must be analyzed. At that time, this analysis and document would be reviewed and supplemented pursuant to the NEPA. The EA would be reviewed to ensure that activities conducted under the selected alternative occur within the parameters evaluated in the EA. If the alternative analyzing no involvement in bird damage activities by WS were selected, no additional analyses would occur based on the lack of involvement by WS. The monitoring of activities by WS would ensure the EA remained appropriate to the scope of damage management activities conducted by WS in Delaware under the selected alternative, when requested.

Site Specificity

This EA analyzes the potential impacts of bird damage management based on previous activities conducted on private and public lands in Delaware where WS and the appropriate entities have entered into a MOU, cooperative service agreement, or other comparable document. This EA also addresses the potential impacts of bird damage management on areas where additional agreements may be signed in the future. Because the need for action is to reduce damage and because the program's goals and directives are to provide services when requested, within the constraints of available funding and workforce, it is conceivable that additional damage management efforts could occur. Thus, this EA anticipates the potential expansion and analyzes the impacts of such efforts as part of the alternatives.

Many of the bird species addressed in this EA can be found statewide and throughout the year; therefore, damage or threats of damage can occur wherever those birds occur. Planning for the management of bird damage must be viewed as being conceptually similar to other entities whose missions are to stop or prevent adverse consequences from anticipated future events for which the actual sites and locations where they would occur are unknown, but could be anywhere in a defined geographic area. Examples of such agencies and programs include fire and police departments, emergency clean-up organizations, and insurance companies. Some of the sites where bird damage could occur can be predicted; however, specific locations or times where such damage would occur in any given year cannot be predicted. The threshold triggering an entity to request assistance from WS to manage damage associated with birds is often unique to the individual; therefore, predicting where and when such a request for assistance would be received by WS is difficult. This EA emphasizes major issues as those issues relate to specific areas whenever possible; however, many issues apply wherever bird damage occurs and those issues are treated as such in this EA.

Chapter 2 of this EA identifies and discusses issues relating to bird damage management in Delaware. The standard WS Decision Model (Slate et al. 1992) would be the site-specific procedure for individual actions conducted by WS (see Chapter 3 for a description of the WS Decision Model and its application). Decisions made using the model would be in accordance with WS' directives[5] and Standard Operating Procedures (SOPs) described in this EA as well as relevant laws and regulations.

The analyses in this EA are intended to apply to any action that may occur in any locale and at any time within Delaware. In this way, WS believes it meets the intent of the NEPA with regard to site-specific

[5]WS' Directives could be found at the following web address: http://www.aphis.usda.gov/wildlife_damage/ws_directives.shtml.

analysis and that this is the only practical way for WS to comply with the NEPA and still be able to accomplish the program's mission.

Summary of Public Involvement

Issues and alternatives related to bird damage management as conducted by WS in Delaware were initially developed by WS in consultation with the USFWS and the DNREC. Issues were defined and preliminary alternatives were identified through the scoping process. As part of this process, and as required by the Council on Environmental Quality (CEQ) and APHIS' NEPA implementing regulations, this document will be noticed to the public through legal notices published in local print media, through direct mailings to parties that have requested to be notified or have been identified to have an interest in the reduction of threats and damage associated with birds, and by posting the EA on the APHIS website at http://www.aphis.usda.gov/wildlife_damage/nepa.shtml.

WS will provide for a minimum of a 30-day comment period for the public and interested parties to provide new issues, concerns, and/or alternatives. Through the public involvement process, WS will clearly communicate to the public and interested parties the analyses of potential environmental impacts on the quality of the human environment. New issues or alternatives raised after publication of public notices will be fully considered to determine whether the EA should be revisited and, if appropriate, revised prior to issuance of a decision.

1.6 RELATIONSHIP OF THIS DOCUMENT TO OTHER ENVIRONMENTAL DOCUMENTS

Proposal to Permit Take as provided under the Final Programmatic Environmental Impact Statement for the Eagle Rule Revision

Developed by the USFWS, this EIS evaluated the issues and alternatives associated with the promulgation of new regulations to authorize the "*take*" of bald eagles and golden eagles as defined under the Bald and Golden Eagle Protection Act. The preferred alternative in the EIS evaluated the management on an eagle management unit level (similar to the migratory bird flyways) to establish limits on the amount of eagle take that the USFWS could authorize in order to maintain stable or increasing populations. This alternative further establishes a maximum duration for permits of 30 years with evaluations in five year increments (USFWS 2016). A Record of Decision was made for the preferred alternative in the EIS. The selected alternative revised the permit regulations for the "*take*" of eagles (see 50 CFR 22.26 as amended) and a provision to authorize the removal of eagle nests (see 50 CFR 22.27 as amended). The USFWS published a Final Rule on December 16, 2016 (81 FR 91551-91553).

USFWS Light Goose Management FEIS: The USFWS has issued a FEIS that analyzes the potential environmental impacts of management alternatives for addressing problems associated with overabundant light goose populations. The "*light*" geese referred to in the FEIS include the lesser snow goose (*Chen caerulescens caerulescens*), the greater snow goose (*C. c. atlantica*), and the Ross's goose (*C. rossii*) that nest in Arctic and sub-Arctic regions of Canada and migrate and winter throughout the United States. A ROD and Final Rule were published by the USFWS and the final rule went into effect on December 5, 2008.

Waterbird Conservation Plan: 2006-2010, Mid-Atlantic/New England/Maritimes Region: The Mid-Atlantic/New England/Maritime (MANEM) Working Group developed a regional waterbird conservation plan for the MANEM region of the United States and Canada (MANEM Waterbird Conservation Plan 2006). The MANEM region consists of Bird Conservation Region (BCR) 14 (Atlantic Northern Forest) and BCR 30 (New England/Mid-Atlantic Coast) along with the Pelagic Bird Conservation Region 78

(Northeast United States Continental Shelf) and Pelagic Bird Conservation Region 79 (Scotian Shelf). The plan consists of technical appendices that address: (1) waterbird populations including occurrence, status, and conservation needs, (2) waterbird habitats and locations within the region that are critical to waterbird sustainability, (3) MANEM partners and regional expertise for waterbird conservation, and (4) conservation project descriptions that present current and proposed research, management, habitat acquisition, and education activities (MANEM Waterbird Conservation Plan 2006). Information in the Plan on waterbirds and their habitats provide a regional perspective for local conservation action.

Atlantic Flyway Mute Swan Management Plan 2002-2013: In response to increasing populations of mute swans along the Atlantic Flyway, the Atlantic Flyway Council developed a mute swan plan to reduce swan populations in the Flyway to minimize negative ecological damages occurring to wetland habitats from the overgrazing of submerged aquatic vegetation by swans. Another goal of the plan is to reduce swan populations in the Flyway to reduce competition between swans and native wildlife and to prevent the further expansion of mute swans (Atlantic Flyway Council 2003).

Mute Swan Management Plan for the Chesapeake Bay: The Chesapeake Bay Mute Swan Working Group prepared a plan to manage mute swan populations in Chesapeake Bay (Chesapeake Bay Mute Swan Working Group 2004). The goal of the plan is to manage the mute swan population in the Bay "*…to a level that a) minimizes the impacts on native wildlife, important habitats, and local economies; b) minimizes conflict with humans; c) is in agreement with Chesapeake 2000 Agreement goals for* [submerged aquatic vegetation] *and invasive species; and d) is in agreement with the Atlantic Flyway Mute Swan Management Plan*."

WS' Environmental Assessments**:** WS has previously developed EAs that analyzed the need for action to manage damage associated with several bird species (USDA 2015). WS has also prepared separate EAs to evaluate the need to manage damage associated with crows and Canada geese (USDA 2009; USDA 2011). Those EAs identified the issues associated with managing damage associated with birds and analyzed alternative approaches to meet the specific need identified in those EAs while addressing the identified issues. Since activities conducted under the previous EAs will be re-evaluated under this EA to address the new need for action and the associated affected environment, the previous EAs that addressed birds will be superseded by this analysis and the outcome of the decision issued.

1.7 AUTHORITY OF FEDERAL AND STATE AGENCIES

The authorities of WS and other agencies as those authorities relate to conducting wildlife damage management activities are discussed by agency below:

WS' Legislative Authority

The primary statutory authorities for the WS program are the Act of March 2, 1931 (46 Stat. 1468; 7 USC 8351-8352) as amended, and the Act of December 22, 1987 (101 Stat. 1329-331, 7 USC 8353). The WS program is the lead federal authority in managing damage to agricultural resources, natural resources, property, and threats to human safety associated with wildlife. WS' directives define program objectives and guide WS' activities to manage wildlife damage management.

USFWS' Authority

The USFWS mission is to conserve, protect, and enhance fish and wildlife along with their habitats for the continuing benefit of the American people. Responsibilities are shared with other federal, state, tribal, and local entities; however, the USFWS has specific responsibilities for the protection of T&E species under the ESA, migratory birds, inter-jurisdictional fish, and certain marine mammals, as well as for lands and waters that the USFWS administers for the management and protection of those resources. The USFWS also manages lands under the National Wildlife Refuge System.

The USFWS is responsible for managing and regulating take of bird species that are listed as migratory under the MBTA and those that are listed as T&E under the ESA. The removal of migratory birds is prohibited by the MBTA. However, the USFWS can issue depredation permits for the removal of migratory birds when certain criteria are met pursuant to the MBTA. Depredation permits are issued to remove migratory birds to alleviate damage and threats of damage. Under the permitting application process, the USFWS requires applicants to describe prior nonlethal damage management techniques that have been used. In addition, the USFWS can establish orders that allow for the removal of those migratory birds addressed in those orders without the need for a depredation permit.

The USFWS authority for migratory bird management is based on the MBTA of 1918 (as amended), which implements treaties with the United States, Great Britain (for Canada), the United Mexican States, Japan, and the Soviet Union. Section 3 of this Act authorized the Secretary of Agriculture:

> *"From time to time, having due regard to the zones of temperature and distribution, abundance, economic value, breeding habits, and times and lines of migratory flight of such birds, to determine when, to what extent, if at all, and by what means, it is compatible with the terms of the convention to allow hunting, taking, capture, killing, possession, sale, purchase, shipment, transportation, carriage, or export of any such bird, or any part, nest, or egg thereof, and to adopt suitable regulations permitting and governing the same, in accordance with such determinations, which regulations shall become effective when approved by the President."*

The authority of the Secretary of Agriculture, with respect to the MBTA, was transferred to the Secretary of the Interior in 1939 pursuant to Reorganization Plan No. II. Section 4(f), 4 FR 2731, 53 Stat. 1433.

United States Environmental Protection Agency (EPA)

The EPA is responsible for implementing and enforcing the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) which regulates the registration and use of pesticides, including repellents for dispersing birds and avicides available for use to lethally remove birds.

United States Food and Drug Administration (FDA)

The FDA is responsible for protecting the public health by assuring the safety, efficacy, and security of human and veterinary drugs, biological products, medical devices, our nation's food supply, cosmetics, and products that emit radiation. The FDA is also responsible for advancing the public health by helping to speed innovations that make medicines and foods more effective, safer, and more affordable; and helping the public get the accurate, science-based information they need to use medicines and foods to improve their health.

Delaware Department of Natural Resources and Environmental Control (DNREC)

The DNREC is specifically charged by the General Assembly of the State with the management of the State's wildlife resources (Code of Delaware, Title 7). The primary statutory authorities include the protection, reproduction, care, management, survival, and regulation of wild animal populations regardless of whether the wild animals are present on public or private property in Delaware (Code of Delaware, 7-100-115). Code of Delaware, 7-103 authorizes the Department to authorize hunting seasons for wetland game birds. Natural Resources Article, Section 10-206 authorizes the DNREC to reduce the wildlife population in any county, election district, or other identifiable area after a thorough investigation reveals that protected wildlife is seriously injurious to agricultural or other interests in the affected area. The method of reducing the population occurs at the discretion of the DNREC.

The DNREC currently has an MOU with WS that establishes a cooperative relationship between the two agencies. Responsibilities include planning, coordinating, and implementing policies to address wildlife damage management and facilitating exchange of information.

Delaware Department of Agriculture (DDA)

The Pesticide Regulation Section of the DDA enforces state laws pertaining to the use and application of pesticides. Under the Delaware Pesticide Management Law this Section monitors the use of pesticides in a variety of pest management situations. It also licenses private and commercial pesticide applicators and pesticide contractors. Under the Delaware Pesticide Management Law the Section licenses restricted use pesticide dealers and registers all pesticides for sale and distribution in the State of Delaware.

1.8 COMPLIANCE WITH LAWS AND STATUTES

Several laws or statutes authorize, regulate, or otherwise would affect WS' activities under the alternatives. WS would comply with all applicable federal, state, and local laws and regulations in accordance with WS Directive 2.210. Those laws and regulations relevant to managing bird damage in the state are addressed below:

National Environmental Policy Act (NEPA)

All federal actions are subject to the NEPA (Public Law 9-190, 42 USC 4321 et seq.). WS follows CEQ regulations implementing the NEPA (40 CFR 1500 et seq.), USDA (7 CFR 1b), and APHIS Implementing Guidelines (7 CFR 372) as part of the decision-making process. Those laws, regulations, and guidelines generally outline five broad types of activities to be accomplished as part of any project: public involvement, analysis, documentation, implementation, and monitoring. The NEPA also sets forth the requirement that all major federal actions be evaluated in terms of their potential to significantly affect the quality of the human environment for the purpose of avoiding or, where possible, mitigating and minimizing adverse impacts. Federal activities affecting the physical and biological environment are regulated in part by the CEQ through regulations in 40 CFR 1500-1508. In accordance with the CEQ and USDA regulations, APHIS guidelines concerning the implementation of NEPA procedures, as published in the Federal Register (44 CFR 50381-50384), provide guidance to the APHIS regarding the NEPA process.

Pursuant to the NEPA and CEQ regulations, this EA documents the analyses resulting from federal actions, informs decision-makers and the public of reasonable alternatives capable of avoiding or minimizing adverse impacts, and serves as a decision-aiding mechanism to ensure that the policies and goals of the NEPA are infused into federal agency actions. This EA was prepared by integrating as many of the natural and social sciences as warranted, based on the potential effects of the proposed action. The direct, indirect, and cumulative impacts of the proposed action are analyzed.

Migratory Bird Treaty Act of 1918 (16 USC 703-711; 40 Stat. 755), as amended

The MBTA makes it unlawful to pursue, hunt, take, capture, kill, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or their parts, nests, or eggs (16 USC 703-711). A list of bird species protected under the MBTA can be found in 50 CFR 10.13.

The MBTA also provides the USFWS regulatory authority to protect families of migratory birds. The law prohibits any "*take*" of migratory bird species by any entities, except as permitted by the USFWS. Under permitting guidelines in the Act, the USFWS may issue depredation permits to requesters experiencing damage caused by bird species protected under the Act. Information regarding migratory bird permits can be found in 50 CFR 13 and 50 CFR 21. All actions analyzed in this EA would be conducted in compliance with the regulations of the MBTA, as amended.

The law was further clarified to include only those birds afforded protection from take in the United States by the Migratory Bird Treaty Reform Act of 2004. Under the Reform Act, the USFWS published a list of bird species not protected under the MBTA (70 FR 12710-12716). Free-ranging or feral domestic waterfowl, mute swans, ring-necked pheasants, wild turkeys, monk parakeets, rock pigeons, European starlings, and house sparrows are not protected from take under the MBTA. A permit from the USFWS to take those species is not required. However, a permit or authorization from the DNREC may be required to take those species.

In addition to the issuance of depredation permits for the removal of migratory birds, the Act allows for the establishment of depredation orders that allow migratory birds to be removed without a depredation permit when certain criteria are met.

Depredation Order for Blackbirds, Cowbirds, Grackles, Crows, and Magpies (50 CFR 21.43)

Pursuant to the MBTA under 50 CFR 21.43, a depredation permit is not required to lethally remove blackbirds when those species are found committing or about to commit depredations upon ornamental or shade trees, agricultural crops, livestock, or wildlife, or when concentrated in such numbers and manner as to constitute a health hazard or other nuisance (Sobeck 2010). Those bird species that can be lethally removed under the blackbird depredation order that are addressed in the assessment include American crows, red-winged blackbirds, common grackles, and brown-headed cowbirds.

Control Order for Muscovy Ducks (50 CFR 21.54)

Muscovy ducks are native to South America, Central America, and Mexico with a small naturally occurring population in southern Texas. Muscovy ducks have also been domesticated and have been sold and kept for food and as pets in the United States. In many states, Muscovy ducks have been released or escaped captivity and have formed feral populations, especially in urban areas, that are non-migratory. The USFWS has issued a Final Rule on the status of the Muscovy duck in the United States (75 FR 9316-9322). Since naturally occurring populations of Muscovy ducks are known to inhabit parts of south Texas, the USFWS has included the Muscovy duck on the list of bird species afforded protection under the MBTA at 50 CFR 10.13 (75 FR 9316-9322). To address damage and threats of damage associated with Muscovy ducks, the USFWS has also established a control order for Muscovy ducks under 50 CFR 21.54 (75 FR 9316-9322). Under 50 CFR 21.54, Muscovy ducks, and their nests and eggs, may be removed or destroyed without a depredation permit from the USFWS at any time in the United States, except in Hidalgo, Starr, and Zapata Counties in Texas (75 FR 9316-9322).

Bald and Golden Eagle Protection Act (16 USC 668-668c), as amended. Populations of bald eagles showed periods of steep declines in the lower United States during the early 1900s attributed to the loss of nesting habitat, hunting, poisoning, and pesticide contamination. To curtail declining trends in bald eagles, Congress passed the Bald Eagle Protection Act (16 USC 668) in 1940 prohibiting the take or possession of bald eagles or their parts. The Bald Eagle Protection Act was amended in 1962 to include the golden eagle and is now referred to as the Bald and Golden Eagle Protection Act. Certain populations of bald eagles were listed as "endangered" under the Endangered Species Preservation Act of 1966, which was extended when the modern Endangered Species Act (ESA) was passed in 1973. The "endangered" status was extended to all populations of bald eagles in the lower 48 states, except populations of bald eagles in Minnesota, Wisconsin, Michigan, Washington, and Oregon, which were listed as "threatened" in 1978. As recovery goals for bald eagle populations began to be reached in 1995, all populations of eagles in the lower 48 States were reclassified as "threatened". In 1999, the recovery goals for populations of eagles had been reached or exceeded and the eagle was proposed for removal from the ESA. The bald eagle was officially de-listed from the ESA on June 28, 2007 with the exception of the Sonora Desert bald eagle population. Although officially removed from the protection of the ESA across most of its range, the bald eagle is still afforded protection under the Bald and Golden Eagle Protection Act.

Under the Bald and Golden Eagle Protection Act (16 USC 668-668c), the take of bald eagles is prohibited without a permit from the USFWS. Under the Act, the definition of "take" includes actions that "*pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, destroy, molest, or disturb*" eagles. The regulations authorize the USFWS to issue permits for the take of bald eagles and golden eagles on a limited basis (see 81 FR 91551-91553, 50 CFR 22.26, 50 CFR 22.27). As necessary, WS would apply for the appropriate permits as required by the Bald and Golden Eagle Protection Act.

Endangered Species Act (ESA)

Under the ESA, all federal agencies will seek to conserve T&E species and will utilize their authorities in furtherance of the purposes of the Act (Sec. 2(c)). WS conducts Section 7 consultations with the USFWS to use the expertise of the USFWS to ensure that "*any action authorized, funded or carried out by such an agency...is not likely to jeopardize the continued existence of any endangered or threatened species...Each agency will use the best scientific and commercial data available*" (Sec. 7 (a) (2)).

National Historic Preservation Act (NHPA) of 1966, as amended

The NHPA and its implementing regulations (36 CFR 800) require federal agencies to initiate the Section 106 process if an agency determines that the agency's actions are undertakings as defined in Sec. 800.16(y) and, if so, whether it is a type of activity that has the potential to cause effects on historic properties. If the undertaking is a type of activity that does not have the potential to cause effects on historic properties, assuming such historic properties were present, the agency official has no further obligations under Section 106. None of the bird damage management methods described in this EA that might be used under the alternatives causes major ground disturbance, any physical destruction or damage to property, any alterations of property, wildlife habitat, or landscapes, nor involves the sale, lease, or transfer of ownership of any property. In general, such methods also do not have the potential to introduce visual, atmospheric, or audible elements to areas in which they are used that could result in effects on the character or use of historic properties. Therefore, the methods that could be used by WS under the proposed action are not generally the types of activities that would have the potential to affect historic properties. If an individual activity with the potential to affect historic resources is planned under an alternative selected as a result of a decision on this EA, the site-specific consultation as required by Section 106 of the NHPA would be conducted as necessary.

Noise-making methods, such as firearms, that are used at or in close proximity to historic or cultural sites for the purposes of hazing or removing nuisance wildlife have the potential for audible effects on the use and enjoyment of historic property. However, such methods would only be used at a historic site at the request of the owner or manager of the site to resolve a damage problem, which means the use of those methods would be to the benefit of the historic property. A built-in minimization factor for this issue is that virtually all the methods involved would only have temporary effects on the audible nature of a site and can be ended at any time to restore the audible qualities of such sites to their original condition with no further adverse effects. Site-specific consultation as required by Section 106 of the NHPA would be conducted as necessary in those types of situations.

Coastal Zone Management Act of 1972, as amended (16 USC 1451-1464, Chapter 33; PL 92-583, October 27, 1972; 86 Stat. 1280).

This law established a voluntary national program within the Department of Commerce to encourage coastal states to develop and implement coastal zone management plans. Funds were authorized for cost-sharing grants to states to develop their programs. Subsequent to federal approval of their plans, grants would be awarded for implementation purposes. In order to be eligible for federal approval, each state's plan was required to define boundaries of the coastal zone, identify uses of the area to be regulated by the state, determine the mechanism (criteria, standards or regulations) for controlling such uses, and develop broad guidelines for priorities of uses within the coastal zone. In addition, this law established a system of criteria and standards for requiring that federal actions be conducted in a manner consistent with the federally approved plan. The standard for determining consistency varied depending on whether the federal action involved a permit, license, financial assistance, or a federally authorized activity. As appropriate, a consistency determination would be conducted by WS to assure management actions would be consistent with the State's Coastal Zone Management Program.

Environmental Justice - Executive Order 12898

Executive Order 12898 promotes the fair treatment of people of all races, income levels, and cultures with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Environmental justice is the pursuit of equal justice and protection under the law for all environmental statutes and regulations without discrimination based on race, ethnicity, or socioeconomic status. Environmental justice is a priority within APHIS and WS. Executive Order 12898 requires federal agencies to make environmental justice part of their mission, and to identify and address disproportionately high and adverse human health and environmental effects of federal programs, policies, and activities on minorities and persons or populations of low income. APHIS implements Executive Order 12898 principally through its compliance with the NEPA. All WS' activities are evaluated for their impact on the human environment and compliance with Executive Order 12898. WS' personnel use only legal, effective, and environmentally safe wildlife damage management methods, tools, and approaches. It is not anticipated that the use of methods would result in any adverse or disproportionate environmental impacts to minorities and persons or populations of low income.

Protection of Children - Executive Order 13045

Children may suffer disproportionately for many reasons from environmental health and safety risks, including the development of their physical and mental status. Because WS makes it a high priority to identify and assess environmental health and safety risks that may disproportionately affect children, WS has considered the impacts that this proposal might have on children. WS would only employ and/or recommend legally available and approved methods under the alternatives where it is highly unlikely that children would be adversely affected. For these reasons, WS concludes that it would not create an environmental health or safety risk to children from implementing this proposed action.

Invasive Species - Executive Order 13112

Executive Order 13112 establishes guidance to federal agencies to prevent the introduction of invasive species, provide for the control of invasive species, and to minimize the economic, ecological, and human health impacts that invasive species cause. The Order states that each federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law: 1) reduce invasion of exotic species and the associated damages, 2) monitor invasive species populations and provide for restoration of native species and habitats, 3) conduct research on invasive species and develop technologies to prevent introduction, and 4) provide for environmentally sound control and promote public education of invasive species.

The Native American Graves and Repatriation Act of 1990

The Native American Graves Protection and Repatriation Act requires federal agencies to notify the Secretary of the Department that manages the federal lands upon the discovery of Native American cultural items on federal or tribal lands. Federal projects would discontinue until a reasonable effort has been made to protect the items and the proper authority has been notified.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

The FIFRA requires the registration, classification, and regulation of all pesticides used in the United States. The EPA is responsible for implementing and enforcing the FIFRA. All chemical methods employed and/or recommended by the WS' program in Delaware pursuant to the alternatives would be registered with the EPA and DDA, when applicable. All chemical methods would be employed by WS pursuant to label requirements when providing direct operational assistance under the alternatives. In addition, WS would recommend that all label requirements be adhered to when recommending the using of chemical methods while conducting technical assistance projects under the alternatives.

Occupational Safety and Health Act of 1970

The Occupational Safety and Health Act of 1970 and its implementing regulations (29 CFR 1910) on sanitation standards states that, "*Every enclosed workplace shall be so constructed, equipped, and maintained, so far as reasonably practical, as to prevent the entrance or harborage of rodents, insects, and other vermin. A continuing and effective extermination program shall be instituted where their presence is detected*." This standard includes birds that may cause safety and health concerns at workplaces.

Controlled Substances Act of 1970 (21 USC 821 et seq.)

This law requires an individual or agency to have a special registration number from the federal DEA to possess controlled substances, including those that are used in wildlife capture and handling.

Federal Food, Drug, and Cosmetic Act (21 USC 360)

This law places administration of pharmaceutical drugs, including those used in wildlife capture and handling, under the FDA.

CHAPTER 2: AFFECTED ENVIRONMENT AND ISSUES

Chapter 2 contains a discussion of the issues, including issues that will receive detailed environmental impact analysis in Chapter 4 (Environmental Consequences), issues that have driven the development of SOPs, and issues that will not be considered in detail, with rationale. Pertinent portions of the affected environment will be included in this chapter in the discussion of issues used to develop SOPs. Additional descriptions of affected environments will be incorporated into the discussion of the environmental effects in Chapter 4.

2.1 AFFECTED ENVIRONMENT

Bird damage or threats of damage can occur statewide in Delaware wherever birds occur. However, bird damage management would only be conducted by WS when requested by a landowner or manager and only on properties where a cooperative service agreement or other comparable document has been signed between WS and a cooperating entity. Most species of birds addressed in this EA can be found throughout the year across the state where suitable habitat exists for foraging, loafing, roosting, and breeding. Since birds can be found throughout the state, requests for assistance to manage damage or threats of damage could occur in areas occupied by those bird species.

Upon receiving a request for assistance, the proposed action alternative or those actions described in the other alternatives could be conducted on private, federal, state, tribal, and municipal lands in Delaware to reduce damages and threats associated with birds to agricultural resources, natural resources, property, and threats to human safety. The analyses in this EA are intended to apply to actions taken under the selected alternative that could occur in any locale and at any time within the analysis area. This EA analyzes the potential impacts of bird damage management and addresses activities in Delaware that are currently being conducted under a MOU or cooperative service agreement with WS where activities have been and currently are being conducted. This EA also addresses the impacts of bird damage management where additional agreements may be signed in the future.

Assistance requests to resolve bird damage could occur, but are not necessarily limited to, areas in and around commercial, industrial, public, and private buildings, facilities and properties and at other sites where birds may roost, loaf, feed, nest, or otherwise occur. Examples of areas where bird damage management activities could be conducted are: residential buildings, golf courses, athletic fields, recreational areas, swimming beaches, parks, corporate complexes, subdivisions, businesses, industrial parks, schools, agricultural areas, wetlands, restoration sites, cemeteries, public parks, bridges, industrial sites, urban/suburban woodlots, hydro-electric dam structures, reservoirs and reservoir shore lands, nuclear, hydro and fossil power plant sites, substations, transmission line rights-of-way, landfills, on ship fleets, military bases, or at any other sites where birds may roost, loaf, or nest. Damage management activities could be conducted at agricultural fields, vineyards, orchards, farmyards, dairies, ranches, livestock operations, grain mills, and grain handling areas (e.g., railroad yards) where birds destroy crops, feed on spilled grains, or contaminate food products for human or livestock consumption. Additionally, activities could be conducted at airports and surrounding properties where birds represent a threat to aviation safety.

Environmental Status Quo

As defined by the NEPA implementing regulations, the "*human environment shall be interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment*" (40 CFR 1508.14). Therefore, when a federal action agency analyzes its potential impacts on the "*human environment*", it is reasonable for that agency to compare not only the effects of the federal action, but also the potential impacts that occur or would occur in the absence of the federal action. This concept is applicable to situations involving federal assistance in managing damage associated with resident wildlife species managed by the state natural resources agency, invasive species, or unprotected wildlife species.

Most native wildlife species are protected under state or federal law. For some bird species, harvest during the hunting season is regulated pursuant to the MBTA by the USFWS through the issuance of frameworks that include the allowable length of hunting seasons, methods of removal, and allowed harvest which are implemented by the DNREC. Under the blackbird depredation order (50 CFR 21.43), blackbirds can be removed by any entity without a depredation permit when those species identified in the order are found committing or about to commit damage or posing a human safety threat. In addition, Muscovy ducks can also be removed in Delaware pursuant to a control order without the need for a permit. Pursuant to the MBTA, the USFWS can issue depredation permits to those entities experiencing damage associated with birds, when deemed appropriate. Free-ranging or feral domestic waterfowl, European starlings, rock pigeons, mute swans, ring-necked pheasants, wild turkeys, monk parakeets, and house sparrows are not protected from removal under the MBTA and can be addressed without the need for a depredation permit from the USFWS.

When a non-federal entity (e.g., agricultural producers, health agencies, municipalities, counties, private companies, individuals, or any other non-federal entity) takes an action to alleviate bird damage, the action is not subject to compliance with the NEPA due to the lack of federal involvement[6] in the action. Under such circumstances, the environmental baseline or status quo must be viewed as an environment that includes those resources as they are managed or impacted by non-federal entities in the absence of the federal action being proposed. Therefore, in those situations in which a non-federal entity has decided that a management action directed towards birds should occur and even the particular methods that would be used, WS' involvement in the action would not affect the environmental status quo. WS' involvement would not change the environmental status quo if the requestor had conducted the action in the absence of WS' involvement in the action.

2.2 ISSUES ASSOCIATED WITH BIRD DAMAGE MANAGEMENT ACTIVITIES

Issues are concerns of the public and/or professional community raised regarding potential adverse effects that might occur from a proposed action. Such issues must be considered in the NEPA decision-making process. Issues related to managing damage associated with birds in Delaware were developed by WS in consultation with the USFWS and the DNREC. The EA will also be made available to the public for review and comment to identify additional issues.

The issues as those issues relate to the possible implementation of the alternatives, including the proposed action alternative, are discussed in Chapter 4. The issues analyzed in detail are the following:

Issue 1 - Effects of Damage Management Activities on Target Bird Populations

A common issue when addressing damage caused by wildlife is the potential impact of management actions on the populations of target species. Methods available to resolve damage or threats to human safety are categorized into nonlethal and lethal methods. Nonlethal methods available can disperse or otherwise make an area unattractive to target species causing damage, which reduces the presence of those species at the site and potentially the immediate area around the site where nonlethal methods were employed. Lethal methods would result in local population reductions in the area where damage or threats were occurring. The number of target species that could be removed from the population using lethal methods under the alternatives would be dependent on the number of requests for assistance received, the number of individual birds involved with the associated damage or threat, and the efficacy of methods employed. Under certain alternatives, both nonlethal and lethal methods could be recommended, as governed by federal, state, and local laws and regulations.

The analysis for magnitude of impact on the populations of those species addressed in the EA would be based on a measure of the number of individuals killed from each species in relation to that species' abundance. Magnitude may be determined either quantitatively or qualitatively. Quantitative determinations would be based on population estimates, allowable harvest levels, and actual harvest data.

[6]If a federal permit is required to conduct damage management activities, the issuing federal agency would be responsible for compliance with the NEPA for issuing the permit.

Qualitative determinations would be based on population trends and harvest trend data, when available. Removal would be monitored by comparing the number killed with overall populations or trends in the population. All lethal removal of birds by WS would occur at the requests of a cooperator seeking assistance and only after the removal of those birds species has been permitted by the USFWS and the DNREC pursuant to the MBTA, when required.

Issue 2 - Effects of Damage Management Activities on Non-target Wildlife Species Populations, Including T&E Species

A common issue when addressing damage caused by wildlife are the potential impacts of management actions on nontarget species, including threatened and endangered species. Methods available to resolve damage or threats of damage can be categorized as lethal and nonlethal. Nonlethal methods disperse or otherwise make an area where damage is occurring unattractive to the species (target species) causing the damage, thereby reducing the presence of those species in the area. However, nonlethal methods also have the potential to inadvertently disperse nontarget wildlife. Lethal methods remove individuals of the species (target species) causing the damage, thereby reducing the presence of those species in the area and the local population. However, lethal methods also have the potential to inadvertently capture or kill nontarget wildlife.

The Endangered Species Act (ESA) makes it illegal for any person to '*take*' any listed endangered or threatened species or their critical habitat. The ESA defines take as, "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (16 USC 1531-1544). Critical habitat is a specific geographic area or areas that are essential for the conservation of a threatened or endangered species. The Act requires that federal agencies conduct their activities in a way to conserve species. It also requires that federal agencies consult with the appropriate implementing agency (either the USFWS or the National Marine Fisheries Service) prior to undertaking any action that may take listed endangered or threatened species or their critical habitat pursuant to Section 7(a)(2) of the ESA.

There may also be concerns that WS' activities could result in the disturbance of eagles that may be near or within the vicinity of WS' activities. Under 50 CFR 22.3, the term "disturb," as it relates to take under the Bald and Golden Eagle Protection Act, has been defined as "to agitate or bother bald and golden eagles to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior." The environmental consequences evaluation conducted in Chapter 3 of this EA will discuss the potential for WS' activities to disturb eagles as defined by the Act.

Issue 3 - Effects of Damage Management Methods on Human Health and Safety

An additional issue often raised is the potential risks associated with employing methods to manage damage caused by target species. Both chemical and non-chemical methods have the potential to have adverse effects on human safety. Risks can occur to persons employing methods and to persons coming into contact with methods. Risks can be inherent to the method itself or related to the misuse of the method.

Safety of Chemical Methods Employed

The issue of using chemical methods as part of managing damage associated with wildlife relates to the potential for human exposure either through direct contact with the chemical or exposure to the chemical from wildlife that have been exposed. Under the alternatives identified, the use of chemical methods would include avicides, immobilizing drugs, reproductive inhibitors, and repellents. Avicides are those chemical methods used to lethally remove birds. DRC-1339 is the only avicide currently being considered for use to manage damage in this assessment. DRC-1339 is currently registered with the EPA for use by WS to manage damage associated with pigeons, starlings, red-winged blackbirds, brown-headed cowbirds, common grackles, and gulls. However, formulations registered with the EPA must also be registered with the DDA. During the development of this EA, formulations of DRC-1339 were registered with the DDA for use to manage damage associated with pigeons, starlings, and blackbirds.

Several avian repellents are commercially available to disperse birds from an area or discourage birds from feeding on desired resources. Avitrol is an avian repellent available for use to manage damage associated with several bird species. For those species addressed in this assessment, Avitrol is available to manage damage associated with European starlings, house sparrows, and feral pigeons. Other repellents are also available with the most common ingredients being polybutene, anthraquinone, and methyl anthranilate.

Chemical methods are further discussed in Appendix B of this EA. The use of chemical methods is regulated by the EPA through the FIFRA, the DDA, by the FDA, and by WS Directives.

Safety of Non-Chemical Methods Employed

Most methods available to alleviate damage and threats associated with birds are considered non-chemical methods. Non-chemical methods employed to reduce damage and threats to safety caused by birds, if misused, could potentially be hazardous to human safety. Non-chemical methods are also discussed in detail in Appendix B. Many of the non-chemical methods are only activated when triggered by attending personnel (e.g., cannon nets, firearms, pyrotechnics, lasers, remote control vehicles), are passive live-capture methods (e.g., walk-in style live-traps, mist nets), or are passive harassment methods (e.g., effigies, exclusion, anti-perching devices, electronic distress calls).

The primary safety risk of most non-chemical methods occurs directly to the applicator or those persons assisting the applicator. However, risks to others do exist when employing non-chemical methods, such as when using firearms, cannon nets, or pyrotechnics. Most of the non-chemical methods available to address bird damage in Delaware would be available for use under any of the alternatives and could be employed by any entity, when permitted. Risks to human safety from the use of non-chemical methods will be further evaluated as this issue relates to the alternatives in Chapter 4.

Issue 4 - Effects of Damage Management Activities on the Aesthetic Value of Birds

One issue is the concern that the proposed action or the other alternatives would result in the loss of aesthetic benefits of target birds to the public, resource owners, or residents in the area where damage management activities occur. Wildlife generally is regarded as providing economic, recreational, and aesthetic benefits (Decker and Goff 1987), and the mere knowledge that wildlife exists is a positive benefit to many people. Aesthetics is the philosophy dealing with the nature of beauty, or the appreciation of beauty. Therefore, aesthetics is truly subjective in nature, dependent on what an observer regards as beautiful.

The human attraction to animals has been well documented throughout history and started when humans began domesticating animals. The American public shares a similar bond with animals and/or wildlife in general and in modern societies, large percentages of households have indoor or outdoor pets. However, some people may consider individual wild animals as "*pets*" or exhibit affection toward those animals, especially people who enjoy viewing wildlife. Therefore, the public reaction is variable and mixed to wildlife damage management because there are numerous philosophical, aesthetic, and personal attitudes, values, and opinions about the best ways to manage conflicts/problems between humans and wildlife. Wildlife populations provide a wide range of social and economic benefits (Decker and Goff 1987). Those benefits include direct benefits related to consumptive and non-consumptive uses, indirect benefits derived from vicarious wildlife related experiences, and the personal enjoyment of knowing wildlife exists and contributes to the stability of natural ecosystems (Bishop 1987). Direct benefits are derived from a personal relationship with animals. Direct benefits may be derived from direct consumptive use (e.g., using parts of or the entire animal) or non-consumptive use (e.g., viewing or photographing the animal in nature) (Decker and Goff 1987).

Indirect benefits or indirect exercised values arise without the user being in direct contact with the animal and come from experiences such as looking at photographs and films of wildlife, reading about wildlife, or benefiting from activities or contributions of animals such as their use in research (Decker and Goff 1987). Indirect benefits come in two forms: bequest and pure existence (Decker and Goff 1987). Bequest is providing for future generations and pure existence is merely knowledge that the animals exist (Decker and Goff 1987).

Public attitudes toward wildlife vary considerably. Some people believe that all wildlife should be captured and translocated to another area to alleviate damage or threats to protected resources. Some people directly affected by the problems caused by wildlife strongly support removal. Individuals not directly affected by the harm or damage may be supportive, neutral, or totally opposed to any removal of wildlife from specific locations. Some people totally opposed to wildlife damage management want agencies to teach tolerance for damage and threats caused by wildlife, and that wildlife should never be killed. Some of the people who oppose removal of wildlife do so because of human-affectionate bonds with individual wildlife. Those human-affectionate bonds are similar to attitudes of a pet owner and result in aesthetic enjoyment. The effects on the aesthetic value of birds from implementation of the identified alternatives, including the proposed action, are analyzed in Chapter 4.

2.3 ISSUES CONSIDERED BUT NOT IN DETAIL WITH RATIONALE

Additional issues were identified by WS during the scoping process of this EA. Those issues were considered by WS; however, those issues will not be analyzed in detail for the reasons provided.

Appropriateness of Preparing an EA (instead of an EIS) for Such a Large Area

There may be a concern that an EA for an area as large as the State of Delaware would not meet the NEPA requirements for site specificity. Wildlife damage management falls within the category of federal or other regulatory agency actions in which the exact timing or location of individual activities cannot usually be predicted well enough ahead of time to accurately describe such locations or times in an EA or EIS. Although WS can predict some of the possible locations or types of situations and sites where some kinds of wildlife damage would occur, WS cannot predict the specific locations or times at which affected resource owners would determine a damage problem has become intolerable to the point that they request assistance from WS. WS has the discretion to determine the geographic scope of their analyses under the NEPA. The intent in developing this EA is to determine if the proposed action would potentially have significant individual and/or cumulative impacts on the quality of the human environment that would warrant the preparation of an EIS or a finding of no significant impact (FONSI). In terms of considering cumulative effects, one EA analyzing impacts for the entire state will provide a more comprehensive and less redundant analysis than multiple EAs covering smaller areas.

WS' Impact on Biodiversity

The WS program does not attempt to eradicate any species of native wildlife. WS operates in accordance with applicable federal and state laws and regulations enacted to ensure species viability. Methods available are employed to target individual birds or groups of birds identified as causing damage or posing a threat of damage. Any reduction of a local population or group would frequently be temporary because immigration from adjacent areas or reproduction would replace the animals removed. WS operates on a small percentage of the land area of Delaware and would only target those birds identified as causing damage or posing a threat. Therefore, damage management activities conducted pursuant to any of the alternatives would not adversely affect biodiversity.

Humaneness of Methods to be Employed

Humaneness, in part, is a person's perception of harm or pain inflicted on an animal, and people may perceive the humaneness of an action differently. The issue of humaneness and animal welfare, as it relates to the killing or capturing of wildlife, is an important and very complex concept that can be interpreted in a variety of ways. Schmidt (1989) indicated that vertebrate pest damage management for societal benefits could be compatible with animal welfare concerns, if " ... the reduction of pain, suffering, and unnecessary death is incorporated in the decision making process." Suffering is described as a " . . . highly unpleasant emotional response usually associated with pain and distress." However, suffering " . . . can occur without pain . . . ," and "... pain can occur without suffering . . ." (American Veterinary Medical Association (AVMA) 2013). Because suffering carries with it the implication of a time frame, a case could be made for " . . . little or no suffering where death comes immediately . . ." (CDFG 1991), such as shooting.

Pain obviously occurs in animals, but assessing pain experienced by animals can be challenging (AVMA 2007, CDFG 1991). The AVMA defines pain as being, "that sensation (perception) that results from nerve impulses reaching the cerebral cortex via ascending neural pathways" (AVMA 2013). The key component of this definition is the perception of pain. The AVMA (2013) notes that "pain" should not be used for stimuli, receptors, reflexes, or pathways because these factors may be active without pain perception. For pain to be experienced, the cerebral cortex and subcortical structures must be functional. If the cerebral cortex is nonfunctional because of hypoxia, depression by drugs, electric shock, or concussion, pain is not experienced.

The AVMA states "... euthanasia is the act of inducing humane death in an animal" and that "...that if an animal's life is to be taken, it is done with the highest degree of respect, and with an emphasis on making the death as painless and distress free as possible" (AVMA 2013). Additionally, euthanasia methods should minimize any stress and anxiety experienced by the animal prior to unconsciousness." Although use of euthanasia methods to end an animal's life is desirable, as noted by the AVMA, "For wild and feral animals, many of the recommended means of euthanasia for captive animals are not feasible. In field circumstances, wildlife biologists generally do not use the term euthanasia, but terms such as killing, collecting, or harvesting, recognizing that a distress- free death may not be possible" (Beaver et al. 2001).

AVMA (2013) notes, "While recommendations are made, it is important for those utilizing these recommendations to understand that, in some instances, agents and methods of euthanasia identified as appropriate for a particular species may not be available or may become less than an ideal choice due to differences in circumstances. Conversely, when settings are atypical, methods normally not considered appropriate may become the method of choice. Under such conditions, the humaneness (or perceived lack thereof) of the method used to bring about the death of an animal may be distinguished from the intent or outcome associated with an act of killing.

Following this reasoning, it may still be an act of euthanasia to kill an animal in a manner that is not perfectly humane or that would not be considered appropriate in other contexts. For example, due to lack of control over free-ranging wildlife and the stress associated with close human contact, use of a firearm may be the most appropriate means of euthanasia. Also, shooting a suffering animal that is in extremis, instead of catching and transporting it to a clinic to euthanize it using a method normally considered to be appropriate (e.g., barbiturates), is consistent with one interpretation of a good death. The former method promotes the animal's overall interests by ending its misery quickly, even though the latter technique may be considered to be more acceptable under normal conditions (Yeates 2010). Neither of these examples, however, absolves the individual from her or his responsibility to ensure that recommended methods and agents of euthanasia are preferentially used."

WS personnel are experienced and professional in their use of management methods so that they are as humane as possible under the constraints of current technology and funding. SOPs (Section 3.3) used to maximize humaneness are listed in this EA. As appropriate, WS euthanizes live animals by methods recommended by the AVMA (2013) or the recommendations of a veterinarian, even though the AVMA euthanasia methods were developed principally for companion animals and slaughter of food animals, and not for free-ranging wildlife. Due to the status quo definition, animals will be removed from the environment even with the absence of WS operations. Therefore, WS' professional involvement would ensure that most humane methods are utilized.

WS and the National Wildlife Research Center (NWRC) are striving to bring additional nonlethal damage management alternatives into practical use and to improve the selectivity and humaneness of management devices. Until new findings and products are found practical, a certain amount of animal suffering could occur when some methods are used in situations when nonlethal damage management methods are not practical or effective. WS supports the most humane, selective, and effective damage management techniques, and would continue to incorporate advances into program activities.

Bird Damage Management should not occur at Taxpayer Expense

An issue previously identified is the concern that wildlife damage management should not be provided at the expense of the taxpayer or that activities should be fee-based. Funding for damage management activities would be derived from federal appropriations and through cooperative funding. Activities conducted for the management of damage and threats to human safety from birds would be funded through cooperative service agreements with individual property owners or managers. A minimal federal appropriation is allotted for the maintenance of a WS program in Delaware. The remainder of the WS program is entirely fee-based. Technical assistance is provided to requesters as part of the federally funded activities, but all direct assistance in which WS' employees perform damage management activities is funded through cooperative service agreements between the requester and WS.

Cost Effectiveness of Management Methods

The CEQ does not require a formal, monetized cost benefit analysis to comply with the NEPA. Consideration of this issue is not essential to making a reasoned choice among the alternatives being considered. However, the methods determined to be most effective to reduce damage and threats to human safety caused by birds and that prove to be the most cost effective would receive the greatest application. As part of an integrated approach, evaluation of methods would continually occur to allow for those methods that are most effective at resolving damage or threats to be employed under similar circumstances where birds are causing damage or pose a threat. Additionally, management operations may be constrained by cooperator funding and/or objectives and needs. The cost effectiveness of methods and the effectiveness of methods are linked. The issue of cost effectiveness as it relates to the effectiveness of methods is discussed further in Section 2.2 of this EA.

Bird Damage should be Managed by Private Nuisance Wildlife Control Agents

Private nuisance wildlife control agents could be contacted to reduce bird damage for property owners when deemed appropriate by the resource owner. Some property owners would prefer to use a private nuisance wildlife control agent because the nuisance wildlife agent is located in closer proximity and thus could provide the service at less expense, or because they prefer to use a private business rather than a government agency. However, some property owners would prefer to enter into an agreement with a government agency. In particular, large industrial businesses, and cities and towns may prefer to use WS because of security and safety issues.

Effects from the Use of Lead Ammunition in Firearms

Questions have arisen about the deposition of lead into the environment from ammunition used in firearms to lethally remove birds. As described in Appendix B, the lethal removal of birds with firearms by WS to alleviate damage or threats would occur using a rifle or shotgun. In an ecological risk assessment of lead shot exposure in non-waterfowl birds, ingestion of lead shot was identified as the concern rather than just contact with lead shot or lead leaching from shot in the environment (Kendall et al. 1996). To address lead exposure from the use of shotguns, the standard conditions of depredation permits issued by the USFWS pursuant to the MBTA for the lethal removal of birds requires the use of non-toxic shot. To alleviate concerns associated with lead exposure in wildlife, WS would only use non-toxic shot as defined in 50 CFR 20.21(j) when using shotguns to remove all birds.

The removal of birds by WS would occur primarily from the use of shotguns. However, the use of rifles could be employed to lethally remove some species. Birds that were removed using rifles would occur within areas where retrieval of all bird carcasses for proper disposal would be highly likely (e.g*.,* at roost sites). With risks of lead exposure occurring primarily from ingestion of lead shot and bullet fragments, the retrieval and proper disposal of bird carcasses would greatly reduce the risk of scavengers ingesting or being exposed to lead that may be contained within the carcass.

However, deposition of lead into soil could occur if, during the use of a rifle, the projectile passes through a bird, if misses occur, or if the bird carcass is not retrieved. Laidlaw et al. (2005) reported that, because of the low mobility of lead in soil, all of the lead that accumulates on the surface layer of the soil is generally retained within the top 20 cm (about 8 inches). In addition, concerns occur that lead from bullets deposited in soil from shooting activities could lead to contamination of either ground water or surface water from runoff. The amount of lead that becomes soluble in soil is usually very small (0.1-2.0%) (USEPA 2013). Stansley et al. (1992) studied lead levels in water that was subjected directly to high concentrations of lead shot accumulation because of intensive target shooting at several shooting ranges. Although Stansley et al. (1992) detected elevated lead levels in water in a stream and a marsh that were in the shot "*fall zones*" at a shooting range, the study did not find higher lead levels in a lake into which the stream drained, except for one sample collected near a parking lot. Stansley et al. (1992) believed the lead contamination near the parking lot was due to runoff from the lot, and not from the shooting range areas. The study also indicated that even when lead shot is highly accumulated in areas with permanent water bodies present, the lead does not necessarily cause elevated lead contamination of water further downstream (Stansley et al. 1992). Ingestion of lead shot, bullets or associated fragments is not considered a significant risk to fish and amphibians (The Wildlife Society 2008).

Craig et al. (1999) reported that lead levels in water draining away from a shooting range with high accumulations of lead bullets in the soil around the impact areas were far below the "*action level*" of 15

parts per billion as defined by the EPA (i.e., requiring action to treat the water to remove lead). These studies suggest that the very low amounts of lead that could be deposited from damage management activities would have minimal effects on lead levels in soil and water.
Lead ammunition is only one of many sources of lead in the environment, including use of firearms for hunting and target shooting, lost fishing sinkers (an approximated 3,977 metric tons of lead fishing sinkers are sold in the United States annually; The Wildlife Society 2008), and airborne emissions from metals industries (such as lead smelters and iron and steel production), manufacturing industries, and waste incineration that can settle into soil and water (USEPA 2013). Since the harvest of birds can occur during regulated hunting seasons, through the issuance of depredation permits, under depredation orders without the need to obtain a depredation permit, or are considered non-native with no depredation permit required for removal, WS' assistance with removing birds would not be additive to the environmental status quo.

WS' assistance would not be additive to the environmental status quo since those birds removed by WS using firearms could be lethally removed by the entities experiencing damage using the same method in the absence of WS' involvement. The amount of lead deposited into the environment may be lowered by WS' involvement in damage management activities due to efforts by WS to ensure projectiles do no pass through, but are contained within, the bird carcass, which limits the amount of lead potentially deposited into soil from projectiles passing through the carcass. The proficiency training received by WS' employees in firearm use and accuracy increases the likelihood that birds are lethally removed humanely in situations that ensure accuracy and that misses occur infrequently, which further reduces the potential for lead to be deposited in the soil from misses or from projectiles passing through carcasses. In addition, WS' involvement ensures bird carcasses lethally removed using firearms would be retrieved and disposed of properly to limit the availability of lead in the environment and ensures bird carcass would be removed from the environment to prevent the ingestion of lead in carcasses by scavengers. Based on current information, the risks associated with lead bullets that could be deposited into the environment from WS' activities due to misses, the bullet passing through the carcass, or from bird carcasses that may be irretrievable would be below any level that would pose any risk from exposure or significant contamination of water. Additionally, WS' actions are not restricted to one small geographic area, but are spread out over the state, further reducing any impacts from lead in any one place.

CHAPTER 3: ALTERNATIVES

Chapter 3 contains a discussion of the alternatives that were developed to address the identified issues discussed in Chapter 2. Alternatives were developed for consideration based on the issues using the WS Decision model (Slate et al. 1992). The alternatives will receive detailed environmental impacts analysis in Chapter 4 (Environmental Consequences). Chapter 3 also discusses alternatives considered but not analyzed in detail, with rationale. SOPs for bird damage management in Delaware are also discussed in Chapter 3.

3.1 DESCRIPTION OF THE ALTERNATIVES

The following alternatives were developed to address the identified issues associated with managing damage caused by birds:

Alternative 1 - Continuing the Current Integrated Approach to Managing Bird Damage (Proposed Action/No Action)

The proposed action/no action alternative would continue the current implementation of an adaptive integrated approach utilizing nonlethal and lethal techniques, as deemed appropriate using the WS Decision Model, to reduce damage and threats caused by birds in Delaware. This approach would integrate the most practical and effective methods available to resolve bird damage. To meet this goal, WS, in consultation with the USFWS and the DNREC, would continue to respond to requests for assistance with, at a minimum, technical assistance, or when funding is available, operational damage management. Funding could occur through federal appropriations or from cooperative funding.

The adaptive approach to managing damage associated with birds would integrate the use of the most practical and effective methods to resolve a request for damage management as determined by site-specific evaluation to reduce damage or threats to human safety for each request after applying the WS Decision Model. City/town managers, agricultural producers, property owners, and others requesting assistance would be provided information regarding the use of appropriate nonlethal and lethal techniques. WS would work with those persons experiencing bird damage in addressing those birds responsible for causing damage as expeditiously as possible. To be most effective, damage management activities should begin as soon as birds begin to cause damage. Bird damage that has been ongoing can be difficult to resolve using available methods since birds are conditioned to feed, roost, loaf, and are familiar with a particular location. Subsequently, making that area unattractive using available methods can be difficult to achieve once damage has been ongoing. The USFWS could continue to issue depredation permits to WS and to those entities experiencing bird damage when requested by the entity and when deemed appropriate by the USFWS for those species that require a permit.

Under this alternative, WS could respond to requests for assistance by: 1) taking no action, if warranted, 2) providing only technical assistance to property owners or managers on actions they could take to reduce damages caused by birds, or 3) providing technical assistance and direct operational assistance to a property owner or manager experiencing damage. The removal of birds can only legally occur as authorized by the DNREC, and through the issuance of a depredation permit by the USFWS and only at levels specified in the permit, unless those bird species are afforded no protection under the MBTA or a depredation/control order has been established by the USFWS in which case no permit for removal is required. When applying for a depredation permit, the requesting entity submits with the application the number of birds requested to be removed to alleviate the damage. Therefore, under this alternative, the USFWS could: 1) deny an application for a depredation permit when requested to alleviate bird damage, 2) could issue a depredation permit at the removal levels requested, or 3) could issue permits at levels below those removal levels requested.

Property owners or managers may choose to implement WS' recommendations on their own (i.e., technical assistance), use contractual services of private businesses, use volunteer services of private organizations, use the services of WS (i.e., direct operational assistance), or take no action.

The property owner or manager may choose to apply for their own depredation permit from the USFWS to lethally remove birds, as required by the implementing regulations of the MBTA for depredation control (see 50 CFR 21.41). The USFWS requires nonlethal methods be used and shown ineffective or impractical before the USFWS will issue a depredation permit. In this situation, WS could evaluate the damage and complete a Migratory Bird Damage Report, which would include information on the extent of the damages, the number of birds present, and a recommendation for the number of birds that should be taken to best alleviate the damages.

Following USFWS review of a complete application for a depredation permit from a property owner or manager and the Migratory Bird Damage Report, a depredation permit could be issued to authorize the lethal removal of a specified number of birds as part of an integrated approach. Upon receipt of a depredation permit, the property owner, manager, or appropriate subpermittee may commence the authorized activities and must submit a written report of their activities upon expiration of their permit. Permits may be renewed annually as needed to resolve damage or reduce threats to human safety. Property owners or managers could conduct management using those methods legally available. Most methods discussed in Appendix B that are available for use to manage bird damage would be available to all entities. The only methods currently available that would not be available for use by those persons experiencing bird damage is the avicide DRC-1339 which can only be used by WS.

In anticipation of damage management activities, WS would annually submit an application for a depredation permit to the USFWS estimating the maximum number of birds that could be lethally removed to alleviate damage in Delaware through direct operational assistance projects. The number of birds anticipated to be lethally removed by WS would be based on previous requests for assistance received to manage damage associated with those species of birds. Therefore, the USFWS could: 1) deny WS' application for a depredation permit, 2) issue a depredation permit for the removal of birds at a level below the number requested by WS, or 3) issue a depredation permit for the number of birds requested by WS. In addition, WS could be listed as subpermittees under depredation permits issued to other entities.

Nonlethal methods include, but are not limited to, habitat/behavior modification, nest/egg destruction, lure crops, visual deterrents, live traps, translocation, exclusionary devices, frightening devices, reproductive inhibitors, and chemical taste repellents (see Appendix B for a complete list and description of potential methods). Lethal methods considered by WS include live-capture followed by euthanasia, DRC-1339, the recommendation of harvest during hunting seasons, and firearms. WS would employ cervical dislocation or carbon dioxide to euthanize target birds once those birds were live-captured using other methods. Carbon dioxide is an acceptable form of euthanasia for birds while cervical dislocation is a conditionally acceptable[7] method of euthanasia (AVMA 2013). The use of firearms could also be used to euthanize birds live-captured; however, the use of firearms for euthanasia is considered a conditionally acceptable method for wildlife (AVMA 2013).

Lethal and nonlethal methods are intended to be short-term attempts at reducing damage occurring at the time those methods are employed. Long-term solutions to managing bird damage would include limited habitat manipulations and changes in cultural practices that are addressed further below and in Appendix B.

Integrated Wildlife Damage Management (IWDM)

The most effective approach to resolving wildlife damage is to integrate the use of several methods simultaneously or sequentially. The philosophy behind IWDM is to implement the best combination of effective management methods in the most cost-effective manner while minimizing the potentially harmful effects on humans, target and nontarget species, and the environment. IWDM may incorporate cultural practices (e.g., animal husbandry), habitat modification (e.g., exclusion), animal behavior modification (e.g., scaring), removal of individual offending animals, local population reduction, elimination of invasive species (e.g., European starlings) or any combination of these, depending on the circumstances of the specific damage problem.

Technical Assistance Recommendations

The WS program in Delaware regularly provides technical assistance to individuals, organizations, and other federal, state, and local government agencies for managing bird damage. Technical assistance includes collecting information about the species involved, the nature and extent of the damage, and previous methods that the cooperator has attempted to resolve the problem. WS then provides information on appropriate methods that the cooperator may consider to resolve the damage themselves.

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[7]The AVMA (2013) defines conditional acceptable as "...[methods] *that by the nature of the technique or because of greater potential for operator error or safety hazards might not consistently produce humane death or are methods not well documented in the scientific literature".*

Types of technical assistance projects may include a visit to the affected property, written communication, telephone conversations, or presentations to groups such as homeowner associations or civic leagues.

Operational Damage Management Assistance

Operational damage management assistance includes damage management activities that are directly conducted by or supervised by personnel of WS. Operational damage management assistance may be initiated when the problem cannot effectively be resolved through technical assistance alone and there is a written MOU, cooperative service agreement, or other comparable document between WS and the entity requesting assistance. The initial investigation defines the nature, history, and extent of the problem; species responsible for the damage; and methods available to resolve the problem. The professional skills of WS' personnel are often required to resolve problems, especially if restricted-use chemicals are necessary or if the problems are complex.

To address the anticipated needs of property owners/managers with bird damages that may request WS' assistance with lethal methods to alleviate their damages, WS would submit an application for a one-year depredation permit to the USFWS estimating the maximum number of birds of each species to be lethally removed as part of an integrated approach. The USFWS would conduct an independent review of the application, and if acceptable, issue a permit as allowed under the depredation permit regulations. WS could request an amendment of their permit to increase the number of birds that could be removed to address unpredicted and emerging bird damages/conflicts. Each year, WS would submit an application for renewal of their permit, and using adaptive management principles, would adjust numbers of birds to meet anticipated needs, based upon management actions in the previous year and anticipated damages and conflicts in the next year. The USFWS would review these applications annually, and issue permits as allowed by regulations. All alterations in the number of birds to be removed would be checked against the impacts analyzed in this EA. All management actions by WS would comply with appropriate federal, state, and local laws.

Educational Efforts

Education is an important element of activities because wildlife damage management is about finding compromise and coexistence between the needs of people and needs of wildlife. This is extremely challenging as nature has no balance, but rather is in continual flux. In addition to the routine dissemination of recommendations and information to individuals or organizations sustaining damage, WS provides lectures, courses, and demonstrations to producers, homeowners, state and county agents, colleges and universities, and other interested groups. Cooperating agencies frequently collaborate with other entities in education and public information efforts. Additionally, technical papers are presented at professional meetings and conferences so that other wildlife professionals and the public are periodically updated on recent developments in damage management technology, programs, laws and regulations, and agency policies.

Research and Development

The National Wildlife Research Center (NWRC) functions as the research arm of WS by providing scientific information and development of methods for wildlife damage management that are effective and environmentally responsible. Research biologists with the NWRC work closely with wildlife managers, researchers, and others to develop and evaluate damage management techniques. For example, research biologists from the NWRC were involved with developing and evaluating mesurol for reducing crow predation on eggs. NWRC biologists have authored hundreds of scientific publications and reports, and are respected worldwide for their expertise in wildlife damage management.

WS' Decision Making Procedures

WS' personnel use a thought process for evaluating and responding to damage complaints that is depicted by the WS Decision Model (WS Directive 2.201) and described by Slate et al. (1992). WS' personnel are frequently contacted after requesters have tried or considered nonlethal methods and found them to be impractical, too costly, or inadequate for effectively reducing damage. WS' personnel assess the problem and then evaluate the appropriateness and availability (legal and administrative) of strategies and methods based on biological, economic, and social considerations. Following this evaluation, methods deemed practical for the situation would be incorporated into a damage management strategy. After this strategy had been implemented, monitoring would be conducted and evaluation would continue to assess the effectiveness of the strategy. If the strategy were effective, no further management would be needed. In terms of the WS Decision Model, most efforts to manage damage consist of continuous feedback between receiving the request and monitoring the results of the damage management strategy. The WS Decision Model is not a written documented process, but a mental problem-solving process common to most, if not all, professions, including WS.

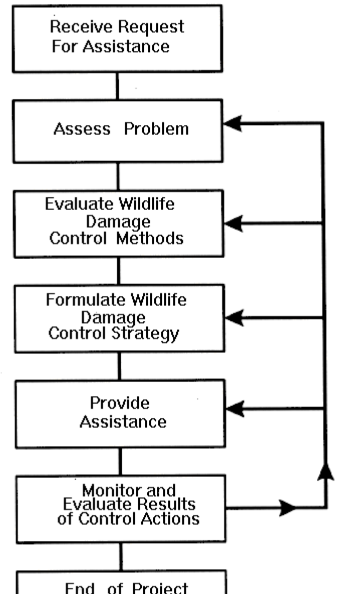

Figure 3.1 WS Decision Model as presented by Slate et al. (1992) for developing a strategy to respond to a request for assistance with human-wildlife conflicts.

Community-based Decision Making

The WS program in Delaware follows the "*co-managerial approach*" to solve wildlife damage or conflicts as described by Decker and Chase (1997). Within this management model, WS could provide technical assistance regarding the biology and ecology of birds and effective, practical, and reasonable methods available to the local decision-maker(s) to reduce damage or threats. This could include nonlethal and lethal methods. WS and other state and federal wildlife management agencies may facilitate discussions at local community meetings when resources are available. Resource owners and others directly affected by bird damage or conflicts have direct input into the resolution of such problems. They may implement management recommendations provided by WS or others, or may request management assistance from WS, other wildlife management agencies, local animal control agencies, or private businesses or organizations.

By involving decision-makers in the process, damage management actions can be presented to allow decisions to involve those individuals that the decision-maker(s) represents. Requests for assistance to manage birds often originate from the decision-maker(s) based on community feedback or from concerns about damage or threats to human safety. As representatives, the decision-maker(s) are able to provide the information to local interests either through technical assistance provided by WS or through demonstrations and presentations by WS on activities to manage damage. This process allows decisions on activities to be made based on local input.

Alternative 2 - Bird Damage Management by WS using only Nonlethal Methods

Under this alternative, WS would be restricted to only using or recommending nonlethal methods to resolve damage caused by birds in Delaware (Appendix B). Lethal methods could continue to be used under this alternative by those persons experiencing damage without involvement by WS. In situations where nonlethal methods were impractical or ineffective to alleviate damage, WS could refer requests for information regarding lethal methods to the state, local animal control agencies, or private businesses or organizations. Property owners or managers may choose to implement WS' nonlethal recommendations on their own or with the assistance of WS, implement lethal methods on their own, or request assistance (nonlethal or lethal) from a private or public entity other than WS.

Alternative 3 – No Bird Damage Management Conducted by WS

This alternative precludes any activities by WS to reduce threats to human health and safety, and alleviate damage to agricultural resources, property, and natural resources. WS would not be involved with any aspect of bird damage management. All requests for assistance received by WS to resolve damage caused by birds would be referred to the USFWS, the DNREC, and/or private entities. This alternative would not deny other federal, state, and/or local agencies, including private entities from conducting damage management activities directed at alleviating damage and threats associated with birds. Many of the methods listed in Appendix B would be available for use by other agencies and private entities, unless otherwise noted in the Appendix, to manage damage and threats associated with birds.

Despite no involvement by WS in resolving damage and threats associated with birds, those persons experiencing damage caused by birds could continue to resolve damage by employing those methods legally available since the removal of birds could occur either through the issuance of depredation permits by the USFWS; harvest during the hunting seasons, and blackbirds could be removed at any time when found committing or about to commit damage or posing a human safety threat under a depredation order; Muscovy ducks could be removed under the control order, and non-native bird species could be removed without the need for a depredation permit issued by the USFWS. All methods described in Appendix B would be available for use by those persons experiencing damage or threats except for the use of DRC-1339 for blackbirds and gulls, which can only be used by WS.

3.2 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL WITH RATIONALE

In addition to those alternatives analyzed in detail, several alternatives were identified by WS; however, those alternatives will not receive detailed analyses in this EA for the reasons provided. Those alternatives considered, but not analyzed in detail include:

Use of Nonlethal Methods before Lethal Methods

This alternative would require that all nonlethal methods or techniques described in Appendix B be applied to all requests for assistance to reduce damage and threats to safety from birds. If the use of all nonlethal methods fails to resolve the damage situation or reduce threats to human safety at each damage situation, lethal methods would be employed to resolve the request. Nonlethal methods would be applied to every request for assistance regardless of severity or intensity of the damage or threat until deemed inadequate to resolve the request. This alternative would not prevent the use of lethal methods by those persons experiencing bird damage.

Those persons experiencing damage often employ nonlethal methods to reduce damage or threats prior to contacting WS. Verification of the methods used would be the responsibility of WS. No standard exists to determine requester diligence in applying those methods, nor are there any standards to determine how many nonlethal applications are necessary before the initiation of lethal methods. Thus, only the presence or absence of nonlethal methods can be evaluated. The proposed action (Alternative 1) is similar to a nonlethal before lethal alternative because the use of nonlethal methods is considered before lethal methods by WS (WS Directive 2.101). Adding a nonlethal before lethal alternative and the associated analysis would not add additional information to the analyses in this EA.

Use of Lethal Methods Only by WS

This alternative would require the use of lethal methods only to reduce threats and damage associated with birds. However, nonlethal methods can be effective in preventing damage in certain instances. Under WS Directive 2.101, WS must consider the use of nonlethal methods before lethal methods. Therefore, this alternative was not considered in detail.

Trap and Translocate Birds Only

Under this alternative, all requests for assistance would be addressed using live-capture methods or the recommendation of live-capture methods. Birds would be live-captured using live-traps, cannon nets, rocket nets, bow nets, or mist nets. All birds live-captured through direct operational assistance by WS would be translocated. Translocation sites would be identified and have to be approved by the USFWS, the DNREC, and/or the property owner where the translocated birds would be placed prior to live-capture and translocation. Live-capture and translocation could be conducted as part of the alternatives analyzed in detail. However, the translocation of birds could only occur under the authority of the USFWS and/or DNREC. Therefore, the translocation of birds by WS would only occur as directed by those agencies. When requested by the USFWS and/or the DNREC, WS could translocate birds under any of the alternatives analyzed in detail, except under the no involvement by WS alternative (Alternative 3). Since WS does not have the authority to translocate birds in the state unless permitted by the USFWS and/or the DNREC, this alternative was not considered in detail.

The translocation of birds, that have caused damage to other areas following live-capture, generally would not be effective or cost-effective. Translocation is generally ineffective because problem bird species are highly mobile and can easily return to damage sites from long distances, habitats in other areas are generally already occupied, and translocation would most likely result in bird damage problems at the new location. In addition, hundreds or thousands of birds would need to be captured and translocated to solve some damage problems (e.g., urban blackbird roosts); therefore, translocation would be unrealistic. Translocation of wildlife is also discouraged by WS policy (WS Directive 2.501) because of the stress to the translocated animal, poor survival rates, and the difficulties that translocated wildlife have with adapting to new locations or habitats (Nielsen 1988).

Compensation for Bird Damage

The compensation alternative would require WS to establish a system to reimburse persons impacted by bird damage. Under such an alternative, WS would continue to provide technical assistance to those persons seeking assistance with managing damage. In addition, WS would conduct site visits to verify damage. Analysis of this alternative indicated that a compensation only alternative had many drawbacks. Compensation would: 1) require large expenditures of money and labor to investigate and validate all damage claims, and to determine and administer appropriate compensation, 2) most likely be below full market value, 3) give little incentive to resource owners to limit damage through improved cultural or other practices and management strategies, and 4) not be practical for reducing threats to human health and safety.

Technical Assistance Only

This alternative would restrict WS to only providing technical assistance (advice) on BDM. Producers, property owners, agency personnel, or others could obtain permits from the USFWS and/or the DNREC as needed and could conduct bird damage management using any of the legally available nonlethal and lethal techniques. Technical assistance information is also readily available from entities other than WS such as the USFWS, universities, extension agents, FAA, and private individual and organizations. Environmental impacts of this alternative are likely to be similar to Alternative 3. Consequently, the agencies have determined that detailed analysis of this alternative would not contribute substantive new information to the understanding of environmental impacts of damage management alternatives and have chosen to not analyze this alternative in detail.

3.3 STANDARD OPERATING PROCEDURES FOR BIRD DAMAGE MANAGEMENT

SOPs improve the safety, selectivity, and efficacy of those methods available to resolve or prevent damage. The current WS program uses many such SOPs. Those SOPs would be incorporated into activities conducted by WS when addressing bird damage and threats.

Some key SOPs pertinent to the proposed action and alternatives include the following:

- The WS Decision Model, which is designed to identify effective wildlife damage management strategies and their impacts, would be consistently used and applied when addressing bird damage.
- EPA-approved label directions would be followed for all pesticide use. The registration process for chemical pesticides is intended to assure minimal adverse effects occur to the environment when chemicals are used in accordance with label directions.
- Material Safety Data Sheets for pesticides would be provided to all WS' personnel involved with specific damage management activities.
- Reasonable and prudent measures would be established through consultation when necessary with the USFWS and the DNREC and implemented to avoid adverse impacts to T&E species.
- All personnel who would use chemicals are trained and certified to use such substances or would be supervised by trained or certified personnel.
- All personnel who use firearms would be trained according to WS' Directives.
- The use of nonlethal methods would be considered prior to the use of lethal methods when providing technical assistance and/or direct operational assistance.
- Management actions would be directed toward specific birds posing a threat to human safety, causing agricultural damage, causing damage to natural resources, or causing damage to property.
- Personnel would be trained in the latest and most humane devices/methods for removing problem birds.
- WS' use of euthanasia methods would comply with WS Directive 2.505.
- Carcasses of birds retrieved after damage management activities have been conducted would be disposed of in accordance with WS Directive 2.515, including any permits required by the USFWS and DNREC.

Several additional SOPs are applicable to the alternatives and the issues identified in Chapter 2 including the following:

Issue 1 - Effects of Damage Management Activities on Target Bird Populations

- Lethal removal of birds by WS would be reported and monitored by WS, by the USFWS, and by the DNREC to evaluate population trends and the magnitude of cumulative removal of birds.

- WS would only target those individuals or groups of target species identified as causing damage or posing a threat to human safety.

- The removal of birds would only occur when authorized by the USFWS and/or DNREC, when applicable, and only at levels authorized.

- Preference would be given to nonlethal methods, when practical and effective. If practical and effective nonlethal control methods are not available and if lethal control methods are available and appropriate for WS to implement, WS may implement lethal methods.

Issue 2 - Effects of Damage Management Activities on Nontarget Wildlife Species Populations, Including T&E Species

- When conducting removal operations via shooting, identification of the target animal would occur prior to application.

- Nontarget animals captured in traps would be released unless it was determined that the animal would not survive and/or that the animal could not be released safely.

- The presence of nontarget species would be monitored before using DRC-1339 to reduce the risk of mortality of nontarget species' populations.

- Only non-toxic shot would be used when employing shotguns to lethally remove bird species.

- WS' personnel would use bait, trap placements, and capture devices that are strategically placed at locations likely to capture a target animal and minimize the potential of nontarget animal captures.

- Any nontarget animals captured in cage traps, nets, or any other restraining device would be released whenever it is possible and safe to do so.

- Personnel would be present during the use of live-capture methods or live-traps would be checked frequently to ensure nontarget species are released immediately or are prevented from being captured.

WS would consult the USFWS iPaC website as necessary to check for indication or presence of threatened and endangered species.

Issue 3 - Effects of Damage Management Methods on Human Health and Safety

- Damage management via shooting would be conducted during times when public activity and access to the control areas are restricted. Personnel involved in shooting operations would be fully trained in the proper and safe application of this method.
- All personnel employing chemical methods would be properly trained and certified in the use of those chemicals. All chemicals used by WS would be securely stored and properly monitored to ensure the safety of the public. WS' use of chemicals and training requirements for those chemicals are outlined in WS Directive 2.401 and WS Directive 2.430.
- All chemical methods used by WS or recommended by WS would be registered with the EPA, FDA, and/or the DDA, when applicable.
- WS would adhere to all established withdrawal times when using immobilizing drugs for the capture of waterfowl that are agreed upon by WS, the USFWS, the DNREC, and veterinarian authorities. Although unlikely, in the event that WS is requested to immobilize waterfowl either during a period of time when harvest of waterfowl is occurring or during a time where the withdrawal period could overlap with the start of a harvest season, WS would euthanize the animal.

Issue 4 - Effects of Damage Management Activities on the Aesthetic Value of Birds

- Management actions to reduce or prevent damage caused by birds would be directed toward specific individuals identified as responsible for the damage, identified as posing a threat to human safety, or identified as posing a threat of damage.
- All methods or techniques applied to resolve damage or threats to human safety would be agreed upon by entering into a cooperative service agreement, MOU, or comparable document prior to the implementation of those methods.
- Preference would be given to nonlethal methods, when practical and effective under WS Directive 2.101.

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

Chapter 4 provides information needed for making informed decisions in selecting the appropriate alternative to address the need for action described in Chapter 1 and the issues described in Chapter 2. This chapter analyzes the environmental consequences of each alternative as those alternatives relate to the issues identified. The following resource values are not expected to be significantly impacted by any of the alternatives analyzed: soils, geology, minerals, water quality/quantity, flood plains, wetlands, visual resources, air quality, prime and unique farmlands, aquatic resources, timber, historical, and range. Those resources will not be analyzed further.

The activities proposed in the alternatives would have a negligible effect on atmospheric conditions including the global climate. Meaningful direct or indirect emissions of greenhouse gases would not occur as a result of any of the proposed alternatives. Those alternatives would meet the requirements of applicable laws, regulations, and Executive Orders including the Clean Air Act and Executive Order 13514.

Direct Effects: These are caused by the action and occur at the same time and place.

Indirect Effects: These are impacts caused by an action that are later in time or farther removed in distance, but are still reasonably foreseeable.

Cumulative Effects: As defined by CEQ (40 CFR 1508.7), these are impacts to the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts may result from individually minor, but collectively significant, actions taking place over time.

Irreversible and Irretrievable Commitments of Resources: Other than minor uses of fuels for motor vehicles and other materials, there are no irreversible or irretrievable commitments of resources.

4.1 ENVIRONMENTAL CONSEQUENCES FOR ISSUES ANALYZED IN DETAIL

The proposed action/no action alternative serves as the baseline for the analysis and the comparison of expected impacts among the alternatives. The analysis also takes into consideration mandates, directives, and the procedures of WS, the USFWS, and the DNREC.

Issue 1 - Effects of Damage Management Activities on Target Bird Populations

Population Impact Analyses of the Alternatives

The alternatives discussed in Chapter 3 were developed in response to the issues identified in Chapter 2. The issue of the potential impacts of conducting the alternatives on the populations of target bird species is analyzed for each alternative below. Information on bird populations and trends are often derived from several sources including the Breeding Bird Survey (BBS), the Christmas Bird Count (CBC), the Partners in Flight Landbird Population database, published literature, and harvest data. Further information on those sources of information is provided below.

Breeding Bird Survey (BBS)

Bird populations can be monitored by using trend data derived from data collected during the BBS. Under established guidelines, observers count birds at established survey points for a set duration along a pre-determined route, usually along a road. Routes are 24.5 miles long and are surveyed once per year with the observer stopping every 0.5 miles along the designated route. The numbers of birds observed and heard within 0.25 miles of each survey point during a 3-minute sampling period are recorded. Surveys were started in 1966 and are conducted in June, which is generally considered as the period of time when those birds present at a location are likely breeding in the immediate area. The BBS is conducted annually in the United States, across a large geographical area, under standardized survey guidelines. The BBS is a large-scale inventory of North American birds coordinated by the United States Geological Survey, Patuxent Wildlife Research Center (Sauer et al. 2017). The BBS is a combined set of over 3,700 roadside survey routes primarily covering the continental United States and southern Canada. The primary objective of the BBS has been to generate an estimate of population change for all breeding birds. Populations of birds tend to fluctuate, especially locally, because of variable local habitat and climatic conditions. Trends can be determined using different population equations and tested to identify whether it is statistically significant.

Current estimates of population trends from BBS data are derived from hierarchical model analysis (Link and Sauer 2002, Sauer and Link 2011) and are dependent upon a variety of assumptions (Link and Sauer 1998). The statistical significance of a trend for a given species is also determined using BBS data (Sauer et al. 2017).

Christmas Bird Count (CBC)

The CBC is conducted in December and early January annually by numerous volunteers under the guidance of the National Audubon Society (NAS). The CBC reflects the number of birds frequenting a location during the winter months. Participants count the number of birds observed within a 15-mile diameter circle around a central point (177 mi^2). The CBC data does not provide a population estimate, but the count data can be used as an indicator of trends in the population of a particular bird species over time. Researchers have found that population trends reflected in CBC data tend to correlate well with those from surveys performed by more stringent means (NAS 2010).

Partners in Flight Landbird Population Estimate

The BBS data are intended for use in monitoring bird population trends, but it is also possible to use BBS data to develop a general estimate of the size of bird populations. Using relative abundances derived from the BBS, Rich et al. (2004) extrapolated population estimates for many bird species in North America as part of the Partners in Flight Landbird Population Estimate database. The Partners in Flight system involves extrapolating the number of birds in the 50 quarter-mile circles (total area/route = 10 mi^2) survey conducted during the BBS to an area of interest. The model used by Rich et al. (2004) makes assumptions on the detectability of birds, which can vary for each species. Some species of birds that are more conspicuous (visual and auditory) are more likely to be detected during bird surveys when compared to bird species that are more secretive and do not vocalize often. Information on the detectability of a species is combined to create a detectability factor, which may be combined with relative abundance data from the BBS to yield a population estimate (Rich et al. 2004). The Partners in Flight Science Committee (2013) updated the database in the past year to reflect current population estimates.

Bird Conservation Regions

BCRs are areas in North America that are characterized by distinct ecological habitats that have similar bird communities and resource management issues. The State of Delaware lies within the Appalachian Mountains (BCR 28), the Piedmont (BCR 29), and the New England/Mid-Atlantic Coast (BCR 30) regions. The majority of the state lies within the New England/Mid-Atlantic Coast region. The Appalachian Mountains region is characterized by rugged terrain that includes the Blue Ridge, the Ridge and Valley Region, the Cumberland Plateau, the Ohio Hills, and the Allegheny Plateau. The Appalachian Mountains region covers the extreme western portion of the state. Areas within the state along the Appalachian Mountains lie within the Piedmont region (BCR 29). The region is characterized as a transitional area between the Appalachian Mountains and the flat coastal plain of the Atlantic Ocean consisting of a patchwork of various hardwood, grassland, and urban settings (USFWS 2000). The New England/Mid-Atlantic Coast region overlaps the eastern portion of the state. The New England/Mid-Atlantic Coast region encompasses the coastal areas of states ranging from southern Maine to Virginia.

The other Bird Conservation Region that dominates the northeastern United States is the Atlantic Northern Forest region (BCR 14), which encompasses most of Maine, Vermont, New Hampshire, and parts of New York, Massachusetts, and Connecticut. Although the Atlantic Northern Forest region does not include any of the land area of Delaware, several of the bird species addressed in this EA have breeding colonies that occur within the region. Those bird species with nesting colonies in the Atlantic

Northern Forest region also cause damage or pose a threat of damage in Delaware, especially during the migration periods. For example, several of the gull species addressed in this EA do not have breeding colonies in the state; however, those species often cause damage or pose threats of damage, primarily during the migration periods. Several of the analyses in Chapter 4 of this EA will address birds with breeding populations that occur primarily in the Atlantic Northern Forest region.

Atlantic Flyway Breeding Waterfowl Plot Survey

The Atlantic Flyway Technical Section initiated the Atlantic Flyway Breeding Waterfowl Plot Survey during 1989 across 11 northeast states ranging from New Hampshire to Virginia. The survey collects breeding population abundance data used to support effective management of eastern waterfowl breeding populations. Prior to the initiation of the survey, populations of waterfowl in the eastern part of the continent were managed based on data collected for mid-continent populations. The Atlantic Flyway Breeding Waterfowl Plot Survey has been described in detail by Heusmann and Sauer (1997, 2000), and involves monitoring 1-km plots apportioned randomly across physiographic strata. Plots are monitored once each year during the April/May nesting period by ground and/or aerial surveys. Observers record numbers and species of all waterfowl seen on the plot.

Annual Harvest Estimates

The populations of several migratory bird species are sufficient to allow for annual harvest seasons that typically occur during the fall migration periods of those species. Migratory bird hunting seasons are established under frameworks developed by the USFWS and implemented by the DNREC. Those species addressed in this EA that have established hunting seasons include Canada geese, snow geese, mourning doves, mallards, coots, and American crows.

For crows, removal can also occur under the blackbird depredation order established by the USFWS pursuant to the MBTA. Therefore, the removal of crows can occur during annual hunting seasons and under the blackbird depredation order that allows crows to be removed to alleviate damage and to alleviate threats of damage. For many migratory bird species considered harvestable during a hunting season, the number of birds harvested during the season is reported by the USFWS and/or the DNREC in published reports.

Alternative 1 - Continuing the Current Integrated Approach to Managing Bird Damage (Proposed Action/No Action)

Under the proposed action, WS would continue to provide both technical assistance and direct operational assistance using methods described in Appendix B to those persons requesting assistance with managing damage and threats associated with birds. WS' lethal removal is monitored by comparing numbers of animals killed with overall populations or trends in populations to assure the magnitude of removal is maintained below the level that would cause significant adverse impacts to the viability of native species' populations. The potential impacts on the populations of target bird species from the implementation of the proposed action are analyzed for each species below. Unless noted otherwise, the state population estimate listed for each species analyzed below was obtained from PFSC (2013). Breeding Bird Survey (BBS) population trends from 1966 to 2014 for Delaware and the region that the state falls mostly within (New England/Mid-Atlantic Coast) are listed for each species when available (Sauer et al. 2017). The statistical significance of a trend for a given species that is determined by the BBS data is color coded: a black percentage indicates a statistically non-significant positive or negative trend, a red percentage indicates a statistically significant negative trend, and a blue percentage indicates a statistically significant positive trend (Sauer et al. 2017). At the time this EA was written, survey results from 2017 for the Atlantic Flyway Waterfowl Breeding Plot Survey for waterfowl species were not available. The annual hunter harvest data for game species were not available at the time this EA was written. The lethal removal by non-WS entities for 2016 under depredation permits issued by the USFWS for all migratory bird species were not available at the time this EA was written.

Nonlethal methods can disperse or otherwise make an area unattractive to birds causing damage; thereby, reducing the presence of birds at the site and potentially the immediate area around the site where nonlethal methods are employed. Nonlethal methods would be given priority when addressing requests for assistance (WS Directive 2.101). However, nonlethal methods would not necessarily be employed or recommended to resolve every request for assistance if deemed inappropriate by WS' personnel using the WS Decision Model. For example, if a cooperator requesting assistance has already used nonlethal methods, WS would not likely recommend or continue to employ those particular methods since their use has already been proven ineffective in adequately resolving the damage or threat.

Many nonlethal methods are used to excluded, harass, and disperse target wildlife from areas where damage or threats are occurring. When effective, nonlethal methods would disperse birds from the area resulting in a reduction in the presence of those birds at the site where those methods were employed. However, birds responsible for causing damage or threats are moved to other areas with minimal impact on those species' populations. Nonlethal methods are not employed over large geographical areas or applied at such intensity that essential resources (*e.g*., food sources, habitat) would be unavailable for extended durations or over a wide geographical scope that long-term adverse effects would occur to a species' population. Nonlethal methods are generally regarded as having minimal impacts on overall populations of wildlife since individuals of those species are unharmed. The use of nonlethal methods would not have adverse impacts on bird populations in the state under any of the alternatives.

The use of lethal methods could result in local population reductions in the area where damage or threats were occurring since birds would be removed from the population. Lethal methods are often employed to reinforce nonlethal methods and to remove mammals that have been identified as causing damage or posing a threat to human safety. The use of lethal methods would result in local reductions of birds in the area where damage or threats were occurring. The number of birds removed from the population using lethal methods would be dependent on the number of requests for assistance received, the number of birds involved with the associated damage or threat, and the efficacy of methods employed.

WS may recommend birds be harvested during the regulated hunting and/or trapping season for those species in an attempt to reduce the number of birds causing damage. Managing bird populations over broad areas could lead to a decrease in the number of birds causing damage. Establishing hunting and trapping seasons and the allowed take during those seasons is the responsibility of the DNREC. WS does not have the authority to establish hunting or trapping seasons or to set allowed harvest numbers during those seasons. However, the harvest of those birds with hunting and/or trapping seasons would be occurring in addition to any take that could occur by WS under the alternatives or recommended by WS.

Generally, WS only conducts damage management on species whose population densities are high or concentrated and usually only after they have caused damage. No indirect effects were identified for this issue. The issue of the potential impacts of conducting the alternatives on the populations of those target bird species addressed in this EA is analyzed for each alternative below.

American Crow Biology and Population Impacts

DE population estimate: 20,000 WS proposed removal: 100
BBS DE, 1966-2015: 0.05% BBS New England/Mid-Atlantic Coast, 1966-2015: 0.48%
BBS DE, 2005-2015: 0.49% BBS New England/Mid-Atlantic Coast, 2005-2015: 1.39%
WS removal as % of state population: 0.5%

American crows are highly adaptable and will live in any open place that offers a few trees to perch in and a reliable food source. Crows regularly use both natural and human-created habitats, including farmlands, pastures, landfills, city parks, golf courses, cemeteries, yards, vacant lots, highway turnarounds, feedlots, and the shores of rivers, streams, and marshes. Crows tend to avoid unbroken expanses of forest, but do show up at forest campgrounds and travel into forests along roads and rivers (Verbeek and Caffrey 2002). American crows are found statewide, in Delaware, and large flocks of crows tend to concentrate in areas where abundant food and roosting sites are available (NAS 2010). In the fall and winter, crows often form large roosting flocks in urban areas. These large flocks disperse to different feeding areas during the day. Crows will fly up to 6-12 miles from the roost to a feeding site each day (Johnson 1994). The number of crows observed during the CBC has shown a relatively stable trend since 1966 (NAS 2016).

Crows can be harvested from June through March, with no bag or possession limits. From 2012 through 2016, the average estimated annual crow harvest has been 867, but this number does not account for the all harvest. WS proposed annual removal of 100 American crows would account for 11.5% of the average annual crow harvest from 2012 to 2016. The removal by all non-WS entities is unknown due to the Federal Depredation Order (50 CFR 21.43) for blackbirds that was established by the USFWS (Sobeck 2010). Under the depredation order, no federal permit is required to remove blackbirds, cowbirds, grackles, crows, and magpies if they are committing depredations upon ornamental or shade trees, agricultural crops, livestock, or wildlife, or when concentrated in such numbers and manner as to constitute a health hazard or other nuisance.

Direct, Indirect, and Cumulative Effects:
WS proposed removal is not expected to create adverse direct or indirect effects on the American crow population in Delaware. Although non-WS removal is unknown, crows have maintained a historically increasing population that has remained viable enough to support an annual hunting season and a Federal Blackbird Depredation Order. Therefore, WS does not expect there to be significant adverse cumulative impacts to crow populations. Additionally, the USFWS could impose restrictions on depredation harvest as needed to assure cumulative removal does not adversely affect the continued viability of crow populations, which should also assure that cumulative impacts on crow populations would have no significant impact on the quality of the human environment. WS also does not expect crow populations to be impacted enough to limit the ability of those persons interested in harvesting crows during the regulated hunting season.

Black Vulture Biology and Population Impacts

DE population estimate: 1,400 WS proposed removal: 300 + 5 nests (and eggs)
BBS DE, 1966-2012: 8.70% BBS New England/Mid-Atlantic Coast, 1966-2012: 8.86%
BBS DE, 2002-2012: 9.05% BBS New England/Mid-Atlantic Coast, 2002-2012: 12.25%
WS removal as % of state population: 21.4%

Historically, black vultures occurred in the southeastern United States, Texas, Mexico, and parts of Arizona (Buckley 1999). However, black vultures have been expanding their range northward in the eastern United States and now occur as far north as New Jersey, Ohio, Pennsylvania, West Virginia and rarely into Connecticut and New York (Buckley 1999). In winter, black vultures migrate south from the most northern part of their range (Buckley 1999). Black vultures can be found in virtually all habitats but are most abundant where forest is interrupted by open land (Buckley 1999). Due to recent range expansion, black vultures are now commonly found throughout the state and considered a permanent resident. Nesting generally occurs between March and May (Ladin and Shriver 2017).

Since 1966, black vultures have shown a generally increasing trend in the survey data collected for the CBC (NAS 2010). During the CBC surveys conducted from 2010 through 2013, an average of 2,811 black vultures was observed in Delaware (NAS 2010). Estimates of bird populations calculated by Rich et al. (2004) are derived from BBS data for individual species; however the Partners in Flight vulture estimates for Delaware are minimal due to high variance on the BBS counts, low sample size, and due to other species-specific limitations of BBS methods for black vultures. BBS data is derived from surveyors identifying bird species based on visual and auditory cues at stationary points along roadways. Vultures produce very few auditory cues that would allow for identification (Buckley 1999) and thus, surveying for vultures is reliant upon visual identification. For visual identification to occur during surveys, vultures must be either flying or visible while roosting. Coleman and Fraser (1989) estimated that black and turkey vultures spend 12 to 33% of the day in summer and 9 to 27% of the day in winter flying. Avery et al. (2011) found that both turkey vultures and black vultures were most active in the winter (January to March) and least active during the summer (July to September). Avery et al. (2011) found that across all months of the year, black vultures were in flight only 8.4% of the daylight hours while turkey vultures were in flight 18.9% of the daylight hours.

Most vultures are counted while flying during surveys since counting at roosts can be difficult due to obstructions limiting sight and constraints of boundaries used during the surveys. This is especially true with the BBS since observers are limited to counting only those bird species within a quarter mile of a survey point along a roadway. Bunn et al. (1995) reported vulture activity increased from morning to afternoon as temperatures increased. Avery et al. (2011) found turkey vulture flight activity peaked during the middle of the day. Three hours after sunrise, Avery et al. (2011) found only 10% of turkey vultures in flight and black vultures lagged about an hour behind turkey vultures in their flight activities. Therefore, surveys for vultures should occur later in the day to increase the likelihood of vultures being observed by surveyors. Observations conducted for the BBS are initiated in the morning since mornings tend to be periods of high bird activity. Since vulture activity tends to increase from morning to afternoon when the air warms and vultures can find thermals for soaring, vultures are probably under-represented in BBS data. The limitations associated with surveying for vultures under current BBS guidelines is likely hindering the ability to calculate accurate population estimates for black vultures in Delaware and the black vulture population are likely higher than what would be derived from the surveys due to these limitations.

Direct, Indirect, and Cumulative Effects:
Based on the best scientific data, WS proposed removal level of 300 individuals and 5 nests will have no adverse direct effects on black vulture populations. Based on available survey data, the number of black vultures observed continues to increase significantly within the state as well as within the region, which indicates that previous levels of removal by other states has not resulted in population declines.

Runge et al. (2009) adapted a potential biological removal model to define a prescribed take level (PTL) and demonstrated this approach for the lethal removal of black vultures in Virginia. Data from the BBS and other sources were used to estimate the black vulture population in Virginia in 2006 at 91,190 birds (95% credible interval = 44,520 – 212,100) (Runge et al. 2009). Using a population estimate of 66,660 black vultures (the lower 60% credible interval) to account for uncertainty, Runge et al. (2009) found that conservatively the PTL, or allowable take of black vultures, in Virginia would be up to 3,533 birds annually and that a sustainable harvest strategy would be maintained with a take as high as 7,066 black vultures annually. Delaware and Virginia are located within the same region and harbor similar habitat for black vultures. Therefore, if 3,533 vultures can be removed without adverse effects, than WS proposed take should not adversely affect the population.

The majority of the direct operational assistance conducted by WS on black vultures would occur in the winter when they are in their winter roost and therefore would have no indirect effects on vultures. However, if assistance occurs in the spring, there could be an impact on the nesting and/or breeding success of individuals that are in close proximity to that area; this localized impact would be minimal and therefore would not cause adverse indirect effects on the state black vulture populations.

The potential authorized removal from all non-WS entities combined with WS proposed removal is not expected to create adverse cumulative impacts. The removal of black vultures can only occur when authorized through the issuance of depredation permits by the USFWS and the DNREC. The permitting of any lethal removal would ensure the cumulative removal of black vultures annually would occur within allowable removal levels to achieve desired population objectives for black vultures in Delaware.

Brown-headed Cowbird Biology and Population Impacts

DE population estimate: 60,000	WS proposed removal: 500
BBS DE, 1966-2012: 2.25	BBS New England/Mid-Atlantic Coast, 1966-2012: 0.3%
BBS DE, 2002-2012: -2.36%	BBS New England/Mid-Atlantic Coast, 2002-2012: 0.3%
WS removal as % of state population: 0.83%	

Brown-headed cowbirds are a species of the blackbird family commonly found in mixed species flocks during migration periods. Cowbirds are a common summer resident across the United States and southern Canada (Lowther 1993). Breeding populations in the northern range of the cowbird are migratory with cowbirds present year-round in much of the eastern United States and along the west Coast (Lowther 1993). Likely restricted to the range of the bison (*Bison bison*) before the presence of European settlers, cowbirds were likely a common occurrence on the short-grass plains where they fed on insects disturbed by foraging bison (Lowther 1993). Cowbirds expanded their breeding range as people began clearing forests for agricultural practices (Lowther 1993). Cowbirds are still commonly found in open grassland habitats but also inhabit urban and residential areas. Unique in their breeding habits, cowbirds are known as brood parasites meaning they lay their eggs in the nests of other bird species (Lowther 1993). Female cowbirds can lay up to 40 eggs per season with eggs reportedly being laid in the nests of over 220 species of birds, of which, 144 species have actually raised cowbird young (Lowther 1993). No parental care is provided by cowbirds with the raising of cowbird young occurring by the host species. Cowbirds can be found throughout the year in Delaware (Lowther 1993). Similar to the other blackbird species, the number of cowbirds observed during the CBC conducted annually in the state has shown a variable pattern, with a general declining trend occurring since 1966 (NAS 2010).

Since the removal of blackbird species, including brown-headed cowbirds can occur without the need for a depredation permit when committing or about to commit damage, the number of cowbirds lethally removed by non-WS entities in the state is currently unknown. Brown-headed cowbirds often form mixed species flocks with other blackbird species; hence, determining the number of birds of each species present in the mixed species flocks can be difficult. Therefore, when dispersing mixed species flocks, the number of brown-headed cowbirds present in the flocks was unknown.

Direct, Indirect, and Cumulative Effects:
Based on the best scientific data, WS' proposed annual removal level will have no adverse direct or indirect effects on brown-headed cowbird populations. While non-WS removal is unknown, cowbird populations have remained abundant enough that the USFWS has maintained the Federal Blackbird

Depredation Order. Therefore, WS does not anticipate any significant cumulative impacts to brown-headed cowbird populations.

Canada Geese Biology and Population Impacts

DE resident population estimate: 6,000 WS proposed removal: 1,000 + 100 nests
BBS DE, 1966-2012: 18.57% BBS New England/Mid-Atlantic Coast, 1966-2012: 7.56%
BBS DE, 2002-2012: 17.16% BBS New England/Mid-Atlantic Coast, 2002-2012: 4.92%
WS removal as % of state population: 12.6%

Canada geese are one of the most readily recognized and observable birds in Delaware. In some instances they can live up to 20-25 years in the wild. There are two behaviorally-distinct types of Canada goose populations in Delaware: resident and migratory. Although they may appear similar, they exhibit different behaviors that affect the management of these birds. Resident geese, in the Atlantic Flyway, are those that nest south of the 48° north latitude and east of the 80° west longitude and are largely non migratory. Migratory geese nest north of the 48° north latitude, migrating south beginning in October and returning back to their breeding grounds by March to begin nesting.

Delaware's resident Canada goose population originated from the release of decoy flocks during the 1930s and government and private stocking programs (Atlantic Flyway Council 2011). The earliest recording of Canada geese being stocked in Delaware was in 1935 when 41 geese were moved to Backwater National Wildlife Refuge (Atlantic Flyway Council 2011). Breeding pairs of Canada geese can be found in every county of the state, but most resident geese are found west of the Chesapeake Bay, mainly in the Piedmont region; Canada geese are also found in the vicinity of District of Columbia, the upper Chesapeake Bay near Aberdeen Proving Grounds, and in the marshes of the lower Eastern Shore (Atlantic Flyway Council 2011).

Population estimates for breeding resident geese in Delaware are obtained from the Atlantic Flyway Breeding Waterfowl Plot Survey that is conducted annually each April (Atlantic Flyway Council 2011). Delaware specific population counts are annually estimated by the DNREC using aerial surveys and listed on DNREC's open data portal (J. Foth personal comm. 2017). Estimates are derived from abundance by doubling the counted geese to include hidden or unseen individuals. Delaware CBC data from 1966 shows a declining population trend for Canada geese until the mid-1980s where it changes to an increasing population trend (NAS 2016).

Canada geese are migratory game birds that are afforded federal and state protection. Goose populations are managed by the USFWS and the DNREC pursuant to the MBTA, Federal Regulations (50 CFR 10, 13, 20 & 21), and other federal and state laws, regulations, policies, and court rulings. Procedures, such as handling nests and eggs, capturing and relocating birds, capturing and euthanizing birds, shooting birds to reduce damage, and any other activity that includes handling birds, their parts, and/or their nests and eggs requires compliance with these laws. A depredation permit is generally required to conduct any of these activities. Hunter harvest numbers were not used to assess the cumulative removal of resident Canada geese because they included primarily migratory Canada geese and did not include the resident population. In Delaware, harvest of Canada geese primarily targets migrants (Atlantic Flyway Council 2011).

Direct, Indirect, and Cumulative Effects:
WS' proposed removal level will have no adverse direct or indirect effects on the resident Canada geese populations. WS proposed removal level would still not bring the estimated resident goose population down to the population objective stated in the Atlantic Flyway Resident Population Canada Geese Management Plan for Delaware. WS does not typically remove geese during the migratory period;

however, occasionally minimal numbers of geese are removed during this period at airports for the protection of human safety. This minimal removal is not expected to have adverse direct or indirect effects on migratory Canada goose populations.

Canada goose nests are authorized to be destroyed by the USFWS through depredation permits issued to WS. Nest destruction methods are considered nonlethal when conducted before the development of an embryo. As with the lethal removal of geese, the destruction of nests must be authorized by the USFWS. Therefore, the number of geese lethally removed and the number of nests destroyed by WS annually would occur at levels permitted by the USFWS pursuant to the MBTA.

Additionally, the potential authorized removal from all non-WS entities combined with WS proposed removal is not expected to create significant impacts to Canada goose populations. The removal of Canada geese by WS would only occur at levels authorized by the USFWS, which ensures WS' removal and removal by all entities, including hunter harvest, would be considered to achieve the desired population management levels of Canada geese in Delaware. Provided that the goose population allows for an annual harvest, WS' removal could be considered of low magnitude when compared to the number of geese observed in Delaware annually and therefore will not hinder the ability of those interested persons to harvest geese during the hunting season.

Common Grackle Biology and Population Impacts

DE population estimate: 310,000	WS proposed removal: 300
BBS DE, 1966-2012: -1.92%	BBS New England/Mid-Atlantic Coast, 1966-2012: -2.45%
BBS DE, 2002-2012: -2.11%	BBS New England/Mid-Atlantic Coast, 2002-2012: -2.85%
WS removal as % of state population: 0.01%	

The common grackle is one of Delaware's most abundant breeding birds, and Delaware and the surrounding areas of and Virginia have been identified as a region in which the common grackle occurs in greatest abundance (DNREC 2012). Grackles can be found throughout the year in the United States except for the far northern and western portions of the species range in the United States (Peer and Bollinger 1997). Common grackles are a semi-colonial nesting species often associated with human activities. During the migration periods, common grackles can be found in mixed species flocks of blackbirds. The number of common grackles observed in areas surveyed during the CBC has shown a variable trend but an overall general declining trend since 1966 (NAS 2010). The variability may be correlated with the severity of winters in the state, which may limit the availability of food sources.

Since the removal of blackbird species, including common grackles can occur without the need for a depredation permit when committing or about to commit damage, the number of common grackles lethally removed by non-WS entities in the state is currently unknown. Since common grackles often form mixed species flocks with other blackbird species, determining the number of birds of each species present in the mixed species flocks can be difficult.

<u>Direct, Indirect, and Cumulative Effects</u>:
WS' proposed annual removal is only a fraction of a percentage of the state population estimate. Based on the best scientific data, WS' proposed removal level will have no adverse direct or indirect effects on common grackle populations. While non-WS removal is unknown, common grackle populations have remained abundant enough that the USFWS has maintained the Federal Blackbird Depredation Order. Therefore, WS does not anticipate any significant cumulative impacts to common grackle populations

Double-crested Cormorant Biology and Population Impacts

DE population estimate: 25,525
BBS MD, 1966-2012: 4.65%
BBS MD, 2002-2012: 3.44%
WS removal as % of state population: 0.39%

WS proposed removal: 100 + 25 nests (and eggs)
BBS New England/Mid-Atlantic Coast, 1966-2012: 9.91%
BBS New England/Mid-Atlantic Coast, 2002-2012: 17.14%

Double-crested cormorants are large fish-eating colonial waterbirds widely distributed across North America (Dorr et al. 2014). Wires et al. (2001) and Jackson and Jackson (1995) have suggested that the current cormorant resurgence may be, at least in part, a population recovery following years of DDT-induced reproductive suppression and unregulated removal prior to protection under the MBTA. There appears to be a correlation between increasing cormorant populations and growing concern about associated negative impacts; thus, creating a management need to address those concerns.

The double-crested cormorant is one of six species of cormorants breeding in North America and has the widest range (Hatch 1995). During the last 20 years, the cormorant population has expanded to an estimated 372,000 nesting pairs with the population (breeding and non-breeding birds) in the United States estimated to be greater than one million birds (Tyson et al. 1997). Tyson et al. (1997) found that the cormorant population increased about 2.6% annually during the early 1990s. The greatest increase was in the Interior region, which was the result of a 22% annual increase in the number of cormorants in Ontario and those states in the United States bordering the Great Lakes (Tyson et al. 1997). From the early 1970s to the early 1990s, the Atlantic population of cormorants increased from about 25,000 pairs to 96,000 pairs (Hatch 1995). While the number of cormorants in this region declined by 6.5% in the early to mid-1990s, some populations were still increasing during this period (Tyson et al. 1997). The number of breeding pairs of cormorants in the Atlantic and Interior population was estimated at over 85,510 and 256,212 nesting pairs, respectively (Tyson et al. 1997).

The Mid-Atlantic/New England/Maritimes population was estimated at over 173,000 breeding pairs, with 16,860 pairs occurring in the Southern New England area, which includes Delaware. The New England/Mid-Atlantic Coast (BCR 30) region has approximately 29,700 nesting pairs, while neighboring BCR 14 has approximately 143,400 nesting pairs (MANEM Waterbird Conservation Plan 2006). From the early 1970s to the early 1990s, the Atlantic population of cormorants increased from about 25,000 pairs to 96,000 pairs (Hatch 1995).

Cormorants are most commonly found in Delaware during the spring, summer, and fall months when the breeding and migrating populations are present (Wires et al. 2001). Those cormorants found in Delaware during those periods are composed of birds from the Atlantic populations of cormorants (Tyson et al. 1997). Breeding populations of cormorants in Delaware occur primarily along the coast. During 2006, approximately 300 pairs attempted to nest on the understructure of the Chesapeake Bay Bridge, but their nests were removed to discourage continued expansion of nesting on artificial structures (Ellison 2010). Since 2000, the number of cormorants observed during the CBC has shown a general stable trend in the state (Sauer et al., 2017).

Direct, Indirect, and Cumulative Effects:
All removal of cormorants in Delaware to alleviate damage or the threat of damage requires a depredation permit issued by the USFWS. . This includes cormorants that may be killed in the state under USFWS issued depredation permits. Therefore, WS' proposed annual removal level will have no adverse direct or indirect effects on double-crested cormorant populations in Delaware. Reducing cormorant populations within the state has the potential to decrease threats to natural resources if cormorants were competing with other colonial waterbirds for nest sites. Additionally, cormorants are a long-lived bird and egg

destruction programs are anticipated to have minimal effects on regional or continental cormorant populations.

The potential combined removal of double-crested cormorants by all entities in Delaware is not expected to create significant cumulative impacts to their populations. The removal of double-crested cormorants by WS would only occur at levels authorized by the USFWS, which ensures WS' removal and removal by all entities would be considered to achieve the desired population management levels of cormorants in Delaware.

European Starling Biology and Population Impacts

DE population estimate: 130,000	WS proposed removal: 5,000
BBS DE, 1966-2012: -1.06%	BBS New England/Mid-Atlantic Coast, 1966-2012: -2.79%
BBS DE, 2002-2012: -1.09%	BBS New England/Mid-Atlantic Coast, 2002-2012: -2.21%
WS removal as % of state population: 3.85%	

The European starling is an Old World passerine species introduced in the eastern U.S. in the late 1800's. The first record of European starlings in Maryland occurred in the fall of 1906 in Baltimore City (Robbins and Blom 1996). Today, starlings can be found throughout the state and are considered common permanent residents (DNREC 2012). However, some migration movements do occur within the state with large flocks often forming during the winter (DNREC 2012). The number of starlings observed in those areas surveyed during the CBC in the state has shown a cyclical pattern from 1966 through 2011 with a general overall declining trend (NAS 2010).

European starlings are considered a non-native species in Delaware and are afforded no protection under the MBTA. Therefore, no depredation permits, from either the USFWS or the DNREC, are needed for the removal of starlings. The number of starlings lethally removed by non-WS entities to alleviate damage or threats is unknown since the reporting of starling removal is not required. Executive Order 13112 states that each federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law; 1) reduce invasion of exotic species and associated damages, 2) monitor invasive species populations, provide for restoration of native species and habitats, 3) conduct research on invasive species and develop technologies to prevent introduction, and 4) provide for environmentally sound control and promote public education on invasive species.

Direct, Indirect, and Cumulative Effects:
Based on the best scientific data, WS' proposed annual removal level will have no adverse direct or indirect effects on European starling populations. While non-WS removal is unknown, starling populations have remained relatively stable and have historically expanded their range throughout North America. Additionally, starling populations have remained abundant enough that the USFWS has maintained the Federal Blackbird Depredation Order. Therefore, WS does not anticipate any significant cumulative impacts to starling populations.

Feral Waterfowl Biology and Population Impacts

Domestic waterfowl refers to captive-reared, domestic, of some domestic genetic stock, or domesticated breeds of ducks, geese, and swans. Examples of domestic waterfowl include, but are not limited to, Muscovy ducks, Pekin ducks, Rouen ducks, Cayuga ducks, Swedish ducks, Chinese geese, Toulouse geese, Khaki Campbell ducks, Embden geese, and pilgrim geese. Feral ducks may include a combination of mallards, Muscovy ducks, and mallard-Muscovy hybrids. All domestic ducks, except for Muscovy ducks, were derived from the mallard (Drilling et al. 2002).

Many waterfowl of domestic or semi-wild genetic backgrounds have been released by humans into rural and urban environments, including numerous species of ducks, geese, and swans. Selective breeding has resulted in the development of numerous domestic varieties of the mallard duck that no longer exhibit the external characteristics or coloration of their wild mallard ancestors.

Domestic waterfowl have been purchased and released by property owners for their aesthetic value, but those released waterfowl may not always remain at the release sites; thereby, becoming feral. Feral waterfowl are defined as a domestic species of waterfowl that cannot be linked to a specific ownership. Examples of areas where domestic waterfowl have been released are business parks, universities, wildlife management areas, parks, military bases, residential communities, and housing developments. Many times, those birds are released with no regard or understanding of the consequences or problems they can cause to the environment or the local community.

Federal law does not protect domestic varieties of waterfowl (see 50 CFR 21), nor are domestic waterfowl specifically protected by state law in Delaware. Domestic waterfowl may at times cross breed with migratory waterfowl species, creating a hybrid cross breed (e.g., mallard X domestic duck, Canada goose X domestic goose). Those types of hybrid waterfowl species would be removed in accordance with definitions and regulations provided in 50 CFR 10 and 50 CFR 21.

Domestic ducks, geese, and swans are non-indigenous species considered by many wildlife biologists and ornithologists to be an undesirable component of native ecosystems in North America. Any reduction in the number of these domestic waterfowl species could be considered as benefiting other native bird species since they compete with native wildlife for resources. Domestic and feral waterfowl are almost always found near water, such as ponds, lakes, retaining pools, and waterways. Domestic and feral waterfowl generally reside in the same area year-round with little to no migration occurring. Currently, population estimates do not exist for domestic and feral waterfowl in Delaware. Domestic and feral waterfowl are not protected by federal or state laws, and are not considered for population goal requirements, including the MBTA except for certain portions of the Muscovy duck population.

Direct, Indirect, and Cumulative Effects:
Based on anticipated future requests for assistance, WS could lethally remove up to 100 feral ducks and up to 100 feral geese annually under the proposed action. In addition, up to 50 feral waterfowl nests (and eggs) could be destroyed annually by WS under the proposed action. Although the number of feral waterfowl inhabiting Delaware is currently unknown, based on the limited removal proposed and the likely benefit to the natural environment that could occur, WS proposed removal level will have no adverse direct or indirect effects on feral waterfowl populations. Additionally, WS proposed removal combined with potential removal by non-WS entities, including hunter harvest, is not expected to create adverse cumulative impacts on feral waterfowl populations.

House Sparrow Biology and Population Impacts

DE population estimate: 100,000	WS proposed removal: 250
BBS DE, 1966-2012: -1.96%	BBS New England/Mid-Atlantic Coast, 1966-2012: -2.27%
BBS DE, 2002-2012: -2.02%	BBS New England/Mid-Atlantic Coast, 2002-2012: -1.85%
WS removal as % of state population: 0.25%	

House sparrows were introduced to North America from England in 1850 and have spread throughout the continent (Fitzwater 1994). House sparrows can be found throughout Delaware. Nesting locations often occur in areas of human activities and are considered "*...fairly gregarious at all times of year*" with nesting occurring in small colonies or clumped distribution (Lowther and Cink 2006). Large flocks of sparrows can also be found in the winter as birds forage and roost together. Since 1966, the number of house sparrows observed in areas surveyed in the state during the CBC has shown an overall declining trend (NAS 2010).

Like European starlings, because of their negative effects on and competition with native bird species, house sparrows are considered by many wildlife biologists, ornithologists, and naturalists to be an undesirable component of North American ecosystems. Since house sparrows are an introduced, rather than native species, they are not protected by the MBTA, and removal of house sparrows does not require depredation permits issued by either the USFWS or the DNREC. Executive Order 13112 states that each federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law; 1) reduce invasion of exotic species and associated damages, 2) monitor invasive species populations, provide for restoration of native species and habitats, 3) conduct research on invasive species and develop technologies to prevent introduction, and 4) provide for environmentally sound control and promote public education on invasive species. The number of house sparrows lethally removed by non-WS entities to alleviate damage or threats in Delaware is unknown since the reporting of sparrow removal is not required. The number of house sparrows dispersed and lethally removed by WS from FY 2010 through FY 2014 can be seen in Table 4.9.

***Direct, Indirect, and Cumulative Effects*:**
WS' removal of house sparrows to reduce damage and threats would be in compliance with Executive Order 13112. WS' proposed annual removal is only a fraction of a percent of the statewide population and therefore will have no adverse direct or indirect effects on sparrow populations. Although non-WS removal is unknown, house sparrow populations have remained relatively stable and have historically expanded their range throughout North America. Therefore, WS does not anticipate any significant cumulative impacts to sparrow populations in Delaware.

Laughing, Ring-billed, Herring, and Greater Blacked-backed Gull Population Impact Analysis

Biological assessments for identifying the potential impact of harvest and/or removal programs on bird populations have a long history of application in the United States, primarily with waterfowl species to determine allowable harvest during annual hunting seasons. Population modeling and extensive monitoring programs form the basis of an adaptive decision-making process used each year for setting migratory game bird harvest regulations, while ensuring that levels of removal are sustainable. Increasing human-wildlife conflicts caused by migratory bird species (both game and nongame), and their potential impacts on sensitive species and their habitats, has resulted in greater use of analytical tools to evaluate the effects of authorized removal to achieve population objectives (Runge et al. 2009). One such tool is referred to as the Potential Biological Removal (PBR) model (Wade 1998, Runge et al. 2004).

Although no hunting season exists for gulls, the lethal removal of gulls does occur under depredation permits issued by the USFWS to alleviate damage and threats of damage. To estimate the allowable take level for gulls, the USFWS has constructed PBR models for laughing gulls, ring-billed gulls, herring gulls, and great black-backed gulls that nest in Atlantic Northern Forest (BCR 14) region and New England/Mid-Atlantic Coast (BCR 30) region (Seamans et al. 2007). The gulls present in Delaware are those gulls likely to migrate from, or have breeding colonies in, BCR 14 and BCR 30, which covers most of the coastal and inland areas of the upper northeastern United States. Since population estimates and trends for gulls are limited, the PBR models developed by the USFWS for BCR 14 and BCR 30 were used to analyze potential population impacts to gull species under the proposed action alternative.

To determine levels of allowable take, or cumulative impacts over a large geographic area, the information required for the PBR model must include a minimum estimate of the population size using science-based monitoring programs (*e.g.*, BBS, CBC, coordinated colony surveys) and the intrinsic rate of population growth. The formula for the PBR model is:

$$\text{PBR} = \tfrac{1}{2}\, R_{max} N_{min} F_R$$

Where R_{max} is the maximum population growth rate at low densities and in the absence of removal, N_{min} is the minimum population size, and F_R is a recovery factor ranging from 0.1 to 2.0 (Runge et al. 2004). The recovery factor is a qualitative assessment that is typically set at low levels for endangered (F_R = 0.1) or threatened species (F_R = 0.5; Taylor et al. 2000), or if the status of the population is poorly known (Runge et al. 2004). However, using a recovery factor above 1.0 has been discussed for species in which the management objective is to hold the population at a smaller fraction of its carrying capacity (Runge et al. 2009).

To estimate R_{max} for gulls in BCR 14 and BCR 30, the Slade formula (Slade et al. 1998) was used:

$$1 = p\lambda^{-1} + 1_{\alpha}\, b\lambda^{-\alpha} - l_{\alpha} b p^{(\omega-\alpha+1)}\, \lambda^{-(\omega+1)}$$

where p is adult annual survival rate, $l\alpha$ is the survival rate from birth to age at first reproduction, b is the number of female offspring per female of reproductive age per year, α is the age at first reproduction, ω is the age at last reproduction, and λ is the intrinsic rate of population change. After solving the above equation for λ, R_{max} was estimated as ln(λ). Population parameter estimates were taken from available literature for each gull species (see Table 4.11), or in cases where estimates were not available, surrogate estimates from closely related species were used (Seamans et al. 2007).

Table 4.1 - Demographic parameter estimates (θ) used for estimating R_{max} and the PBR of gulls in BCR 14 and BCR 30 (Seamans et al. 2007).

		Great black-backed gull[1]		Herring gull[2]		Laughing gull[3]		Ring-billed gull[4]	
Parameter	**Age class**	**(θ)**	**SE (θ)**	**(θ)**	**SE (θ)**	**(θ)**	**SE (θ)**	**(θ)**	**SE (θ)**
p	Adult	0.87	0.03	0.87	0.03	0.87	0.03	0.87	0.03
$l\alpha$	Adult	0.42		0.42		0.56		0.56	
	Hatch Year	0.729	0.035	0.729	0.035	0.729	0.035	0.729	0.035
	Second Year	0.886	0.024	0.886	0.024	0.886	0.024	0.886	0.024
b		0.784	0.018	0.752	0.022	0.752	0.022	0.752	0.022
α		5		5		3		3	
ω		19		20		19		19	
N_{min}		250,000		390,000		270,000		54,000	
R_{max}		0.09	0.027	0.086	0.027	0.113	0.036	0.113	0.036

[1]Good 1998
[2]Pierotti and Good 1994
[3]Burger 1996, Dinsmore and Schreiber 1974
[4]Seamans et al. 2007, Pollet et al. 2012

Because there was uncertainty associated with demographic parameter estimates, allowable take levels were calculated using a simulation approach to estimate a range of R_{max} values with parameter estimates randomly drawn from normal distributions based on reported standard errors (see Table 4.11; Seamans et al. 2007). Population estimates (N_{min}) for each species were based on the number of gulls at known breeding colonies in BCR 14 and BCR 30 during the mid-1990s (MANEM Waterbird Regional Plan 2006), and adjusted using a conservative estimate of 0.75 non-breeding gulls for every breeding adult to estimate the total population (Seamans et al. 2007). Allowable take levels (± 95% CI) for each of the four gull species addressed in this assessment under three recovery factors (0.5, 1.0, 1.5) in BCR 14 and BCR 30 are presented in Table 4.12.

Table 4.2 - Potential Biological Removal (± 95% CI) of gulls in BCR 14 and BCR 30 under three recovery factors (Seamans et al. 2007).			
Species	**F_R = 0.5**	**F_R = 1.0**	**F_R = 1.5**
Laughing Gull	7,685 (3,927–12,685)	15,274 (7,188–23,042)	26,044 (10,798–34,818)
Ring-billed Gull	1,532 (713–2,318)	3,065 (1,455–4,634)	4,588 (2,161–6,951)
Herring Gull	8,360 (3,892–12,656)	16,725 (7,788–25,397)	25,048 (11,716–37,875)
Great Black-backed Gull	5,614 (2,764 – 8,358)	11,234 (5,561–16,670)	16,853 (8,364–25,086)

Most states in the northeastern United States periodically conduct colonial waterbird surveys to determine breeding population trends for many colonial waterbirds, including gulls. Most state-level population estimates are provided as the number of breeding pairs of gulls surveyed. Therefore, one breeding pair equals two gulls. Gulls are migratory bird species and the breeding population of gulls estimated at the state-level are only representative of the number of gulls present in a state during a short period (*i.e.*, during the breeding season). The breeding colony surveys do not account for migratory gulls present during the winter, nor do they account for the population of non-breeding gulls (*i.e.*, sub-adults and non-breeding adults) present during the breeding season. Therefore, to better account for the mobility of gulls and the fact that gulls present in the northeastern United States are likely gulls that nest and migrate throughout BCR 14 and BCR 30, the USFWS developed models based on the geographical scope of the nesting populations of gulls. In addition, PBR models developed by the USFWS are based on breeding and non-breeding gulls, as opposed to colonial waterbird surveys. PBR models estimate allowable removal by calculating a total population for each gull species using 0.75 non-breeding gulls for every breeding adult. Since the removal of gulls to alleviate damage can occur throughout the year and not just during the breeding season, a comprehensive model like the PBR model, that includes non-breeding populations of gulls, allows for a systemic analysis of allowable removal on gull populations.

Laughing Gull Biology and Population Impact Analysis

DE population estimate: N/A
BBS DE, 1966-2012: -0.18%
BBS DE, 2002-2012: 0.46%
Eastern BBS Region, 1966-2012: 3.21%

WS proposed removal: 100 + 25 nests (and eggs)
BBS New England/Mid-Atlantic Coast, 1966-2012: 4.45%
BBS New England/Mid-Atlantic Coast, 2002-2012: 1.18%
Eastern BBS Region, 2002-2012: 4.77%

In the United States, laughing gulls can be found from Maine south along the Atlantic and Gulf coasts (including the coastal areas of BCR 14 and BCR 30) during the breeding season and from North Carolina south along the Atlantic and Gulf coast during the rest of the year (Burger 1996). Laughing gulls can be found nesting along the coastal areas of BCR 14 and BCR 30 with most breeding colonies occurring in BCR 14 (MANEM Regional Waterbird Plan 2006). In the 1970s, the breeding population of laughing gulls in BCR 14 and BCR 30 was estimated at 129,768 gulls distributed among 63 nesting sites (MANEM Regional Waterbird Plan 2006). By the 1990s, the breeding population of laughing gulls had increased to an estimated 205,348 gulls distributed among 275 nesting sites (MANEM Regional Waterbird Plan 2006). Seamans et al. (2007) estimated the minimum population of breeding and non-breeding laughing gulls in BCR 14 and BCR 30 at 270,000 gulls (see Table 4.11).

Laughing gulls are commonly seen in Delaware and have been known to nest in the state since the early 1900s, when the first colony was reported in the Delaware Bay (Hess et al. 2000). Between 1993 and

2003, the number of laughing gulls in breeding colonies on the Delmarva Peninsula has remained relatively stable at approximately 45,000 breeding pairs (Ladin and Shriver 2017); however, population counts specific to Delaware are not available. Current abundance reports indicate laughing gulls can be found in greater densities at the C&D Canal Wildlife Area, Seashore State Park, Delaware Bay, and Thompsons Island Nature Area (Ladin and Shriver 2017). CBC data for laughing gulls in the state has shown a fluctuating trend since 1966, with relatively few birds observed in areas surveyed (NAS 2016).

Direct, Indirect, and Cumulative Effects:
From 2010 through 2013, the lethal annual removal of laughing gulls by all entities in the northeastern United States (USFWS Region 5) has ranged from 4,792 to 6,211 gulls with an average annual removal of 5,556 laughing gulls. The PBR model for laughing gulls in BCR 14 and BCR 30 estimated that nearly 15,000 laughing gulls could be removed annually with no adverse direct effect on the current population. Current removal levels from all known entities in the breeding range of laughing gulls has not exceeded the level of annual removal that the PBR model predicts would cause a decline in the breeding laughing gull population. The best available data estimates the population of laughing gulls in BCR 14 and BCR 30 at 270,000 birds (Seamans et al. 2007). However, because population trends indicate an increasing laughing gull population, the population is likely greater than 270,000 birds. Based on this estimate, the annual removal of up to 300 laughing gulls by WS under the proposed action alternative would represent 0.1% of the population. Based on the best scientific data as well as the increasing population trend, WS proposed removal level will have no adverse direct or indirect effects on laughing gull populations.

The average annual cumulative removal by all entities in USFWS Region 5 (5,556 birds) in addition to WS proposed removal would be 5,656 gulls or 2.09% of the estimated population. The PBR model for laughing gulls in BCR 14 and BCR 30 estimates 15,274 laughing gulls could be lethally removed annually with no adverse effect on the current population (see Table 4.12). Current removal from all known entities has not exceeded this level of removal. Therefore, WS does not anticipate any adverse cumulative impacts on laughing gull populations. The removal of laughing gulls can only occur when permitted by the USFWS through the issuance of depredation permits. Therefore, all removal, including removal by WS, would be authorized by the USFWS and the DNREC and would occur at the discretion of the USFWS and the DNREC.

Additionally, impacts due to nest removal and destruction should have little adverse direct or indirect impacts on the laughing gull population. Laughing gulls are a long-lived species that have the ability to identify areas with regular human disturbance and low reproductive success, which can cause those birds to relocate and nesting elsewhere when confronted with repeated nest failure. Although there may be reduced fecundity for the individual laughing gulls affected by nest destruction, this activity has no long term effect on breeding adult laughing gulls. The removal of nests must be authorized by the USFWS and the DNREC. Therefore, the number of nests destroyed by WS annually would occur at the discretion of the USFWS and the DNREC.

Ring-billed Gull Biology and Population Impact Analysis

DE population estimate: N/A	WS proposed removal: 100
BBS DE, 1966-2012: -0.36%	BBS New England/Mid-Atlantic Coast, 1966-2012: 0.88%
BBS DE, 2002-2012: -0.01%	BBS New England/Mid-Atlantic Coast, 2002-2012: 0.33%
Eastern BBS Region, 1966-2012: 3.34%	BBS Atlantic Northern Forest, 1966-2012: 4.62%
Eastern BBS Region, 2002-2012: 5.75%	BBS Atlantic Northern Forest, 2002-2012: 6.55%

Ring-billed gulls are inland nesting gulls that are colonial ground nesters on sparsely vegetated islands in large lakes with occasional colonies on mainland peninsulas and near-shore oceanic islands (Pollet et al. 2012). The breeding population of ring-billed gulls is divided into the western population and the eastern population. The eastern breeding population of the United States includes New York, Vermont, Ohio, Illinois, Michigan, Wisconsin, and Minnesota (Blokpoel and Tessier 1986). The ring-billed gulls in BCR 14 and BCR 30 have been assigned a conservation rank of lowest concern (MANEM Regional Waterbird Plan 2006). The population of ring-billed gulls in BCR 14 and BCR 30 has increased at a rate of 8% to 11% per year since 1976 (MANEM Regional Waterbird Plan 2006). An estimated 40,800 ring-billed gulls are believed to breed in BCR 14, while no breeding colonies are known to occur in BCR 30 (MANEM Regional Waterbird Plan 2006). Seamans et al. (2007) estimates the minimum population of breeding and non-breeding laughing gulls in BCR 14 and BCR 30 at 54,000 birds (see Table 4.11).

Ring-billed gulls are not known to have nesting colonies in Delaware and ring-billed gulls present in the state during the breeding season are considered non-breeding gulls (Pollet et al. 2012). The numbers of ring-billed gulls observed in areas surveyed during the CBC are showing a general increasing trend in the state since 1966; however, since the mid-1990s, the number of gulls observed has shown a general declining to stable trend (NAS 2010).

Direct, Indirect, and Cumulative Effects:
Based on the best scientific data, WS proposed removal level will not have significant adverse direct or indirect effects on ring-billed gull populations. The best available data estimates the population of ring-billed gulls in BCR 14 and BCR 30 at 54,000 birds (Seamans et al. 2007). Based on this estimate, the annual removal of up to 1,000 ring-billed gulls by WS under the proposed action alternative would represent 1.9% of the population. From 2010 through 2013, the lethal annual removal of ring-billed gulls by all entities in the northeastern United States (USFWS Region 5) has ranged from 3,326 to 4,641 gulls with an average annual removal of 4,060 ring-billed gulls. The PBR model for ring-billed gulls in BCR 14 and BCR 30 estimated that up to 3,065 ring-billed gulls could be removed annually with no adverse direct effect on the current population. The model also predicted that the removal of 4,588 ring-billed gulls would be required to hold the population at a smaller fraction of its carrying capacity. Based on the known removal of ring-billed gulls occurring annually in BCR 14 and BCR 30, the average annual removal level from all known sources has been below the estimated level required to cause a population decline. The USFWS has and would continue to use the PBR model to determine allowable removal for ring-billed gulls when issuing permits; therefore, the number of gulls removed annually pursuant to depredation permits issued by the USFWS would remain within those levels analyzed in the models.

The average annual cumulative removal by all entities in USFWS Region 5 (4,060 birds) in addition to WS proposed removal would be 4,160 gulls or 7.7% of the estimated population. The PBR model for ring-billed gulls in BCR 14 and BCR 30 estimates 4,588 ring-billed gulls could be lethally removed annually to hold the population at a smaller fraction of its carrying capacity (see Table 4.12). Although the annual cumulative removal by all entities has and could exceed 4,588 gulls, the potential cumulative removal has only slightly exceeded the level where the PBR model predicts the population would be maintained slightly lower than the carrying capacity. The removal of ring-billed gulls can only occur when permitted by the USFWS through the issuance of depredation permits. Therefore, all removal, including removal by WS, would be authorized by the USFWS and the DNREC and would occur at the discretion of the USFWS and the DNREC. The USFWS, as the agency with migratory bird management responsibility, could impose restrictions on depredation harvest as needed to assure cumulative removal does not adversely affect the continued viability of populations.

Herring Gull Biology and Population Impact Analysis

DE population estimate: N/A
BBS DE, 1966-2012: -7.76%
BBS DE, 2002-2012: -8.89%
Eastern BBS Region, 1966-2012: -3.51%
Eastern BBS Region, 2002-2012: -2.71%

WS proposed removal: 1,000 + 500 nests (and eggs)
BBS New England/Mid-Atlantic Coast, 1966-2012: -4.35%
BBS New England/Mid-Atlantic Coast, 2002-2012: -1.39%
BBS Atlantic Northern Forest, 1966-2012: -4.95%
BBS Atlantic Northern Forest, 2002-2012: -4.41%

Herring gulls are the most common gulls in the northeastern United States (Pierotti and Good 1994). In the northeastern United States, herring gulls nest along the Great Lakes and along the Atlantic Coast from Maine to northern South Carolina. In the 1970s, the breeding population of herring gulls in BCR 14 and BCR 30 was estimated at 184,278 birds distributed among 414 nesting sites (MANEM Regional Waterbird Plan 2006). By the 1990s, the breeding population of herring gulls in BCR 14 and BCR 30 had declined 19% to 148,416 birds, while the number of nesting sites increased to 468 (MANEM Regional Waterbird Plan 2006). Almost 91,000 herring gulls are believed to breed in BCR 30. Of those herring gulls, over 36,000 occur in Southern New England, which includes those herring gull nesting colonies in and nearest to Delaware. In addition, over 196,000 herring gulls are believed to breed in neighboring BCR 14 (MANEM Regional Waterbird Plan 2006). Seamans et al. (2007) estimated the minimum population of breeding and non-breeding herring gulls in BCR 14 and BCR 30 to be 390,000 birds. According to the MANEM Regional Waterbird Conservation Plan (2006), herring gulls are considered a species of low concern in North America. In BCR 30, the herring gull is also considered a species of low concern and herring gulls are a species of moderate concern in BCR 14 (MANEM Regional Waterbird Plan 2006).

In Delaware, herring gulls can be found throughout the year (Pierotti and Good 1994). Herring gulls are now the most abundant breeding gull in Delaware, likely due to their adaptability and tolerance of human development (Ellison 2010). In 1990, the statewide population of herring gulls was estimated at 4,000 breeding pairs (Pierotti and Good 1994). In 2002, the population of herring gulls in the Delaware was estimated at approximately 3,000 pairs (Ellison 2010). The number herring gulls observed in areas surveyed in the state during the CBC showed a general increasing trend between 1966 and the mid-1990s; however, since the mid-1990s, the number observed has shown a declining trend (NAS 2010).

Direct, Indirect, and Cumulative Effects:
From 2010 through 2013, the lethal annual removal of herring gulls by all entities in the northeastern United States (USFWS Region 5) has ranged from 4,025 to 7,885 gulls with an average annual removal of 6,331 herring gulls. The PBR model for herring gulls in BCR 14 and BCR 30 estimated that 16,725 herring gulls could be removed annually with no adverse direct effect on the current population. Current removal levels from all known entities in the breeding range of herring gulls has not exceeded the level of annual removal that the PBR model predicts would cause a decline in the breeding herring gull population. The best available data estimates the population of herring gulls in BCR 14 and BCR 30 at 390,000 birds (Seamans et al. 2007). Based on this estimate, the annual removal of up to 100 herring gulls by WS under the proposed action alternative would represent 0.03% of the population. Based on the best scientific data, WS proposed removal level will have no adverse direct or indirect effects on herring gull populations.

The average annual cumulative removal by all entities in USFWS Region 5 (6,331birds) in addition to WS proposed removal would be 7,331 gulls or 1.9% of the estimated population. The PBR model for herring gulls in BCR 14 and BCR 30 estimates 16,725 herring gulls could be lethally removed annually with no adverse effect on the current population (see Table 4.12). Current removal from all known entities has not exceeded this level of removal. Therefore, WS does not anticipate any adverse cumulative impacts on herring gull populations. The removal of herring gulls can only occur when permitted by the USFWS through the issuance of depredation permits. Therefore, all removal, including removal by WS, would be authorized by the USFWS and the DNREC and would occur at the discretion of the USFWS and the DNREC.

Mallard Biology and Population Impacts

DE population estimate: 34,164	WS Proposed Removal: 200
BBS DE, 1966-2012: 6.18%	BBS New England/Mid-Atlantic Coast, 1966-2012: 1.82%
BBS DE, 2002-2012: 5.80%	BBS New England/Mid-Atlantic Coast, 2002-2012: 1.89%
WS removal as % of state population: 0.5%	

Mallards are one of the most recognizable waterfowl species and are considered the most abundant waterfowl species with the widest breeding range (Drilling et al. 2002). Mallards can be found wintering as far north as weather conditions allow. In Delaware, mallards can be found throughout the year (Drilling et al. 2002) and are considered common to locally abundant resident. Releases of captive-reared birds for hunting into the eastern and northeastern states have hastened the spread of mallards across the region. Through programs like the Delaware Waterfowl Stamp Program, which has raised more than $2.6 million for waterfowl conservation, mallard populations have proliferated throughout the state (DNREC 2017). The fall migration period begins in early August and continues through early-December with the peak occurring from early September through the end of November. The spring migration begins in early February and continues through early April with the peak occurring from mid-February through the end of May (Drilling et al. 2002). The number of mallards observed in areas surveyed during the CBC shows a general increasing trend since 1966, with a more stable trend observed since the mid-1980s (NAS 2010).

The harvest season for mallards begins in October and runs through January and allows for a bag limit of four (no more than two hens). From 2012 to 2016, USFWS reported 51,379 mallards having been harvested with an average annual harvest of 10,276 mallards. The cumulative removal of mallards has not decreased the population, but rather the mallard population has shown a steady increase over the last five years (USFWS 2017). The recent national population estimate for mallards is 10.5 million and increasing.

Direct, Indirect, and Cumulative Effects:
Based on the best scientific data, WS' proposed annual removal level is expected to have no adverse direct or indirect effects on mallard populations within the state. The cumulative impact is significantly over-estimated as the figure does not account for sportsman harvest of migrant mallards that are not part of the breeding population in Delaware. The removal of mallards by WS to alleviate damage will only occur when permitted by the USFWS and the DNREC pursuant to the MBTA through issuance of depredation permits. The potential authorized removal from all non-WS entities (including the annual harvest) and WS proposed removal is not expected to create adverse cumulative impacts. The removal of mallards by WS would only occur at levels authorized by USFWS and DNREC to ensure that WS' removal and the removal by all other entities, including annual hunter harvest, would be considered to maintain the desired population management levels of mallards within Delaware. Additionally, WS proposed removal is of low magnitude when compared to the annual harvest numbers and therefore is not expected to hinder the ability of those interested persons in harvesting mallards during the hunting season.

Mourning Dove Biology and Population Impacts

DE population estimate: 60,000 WS proposed removal: 200
BBS DE, 1966-2012: 0.99% BBS New England/Mid-Atlantic Coast, 1966-2012: 0.11%
BBS DE, 2002-2012: 0.71% BBS New England/Mid-Atlantic Coast, 2002-2012: -0.09%
WS removal as % of state population: 0.33%

Mourning doves are migratory birds with substantial populations throughout much of North America, and can be found throughout the year over most of the United States, including Delaware (Otis et al. 2008). Mourning doves thrive in agricultural, suburban, and urban landscapes (Ellison 2010). The mourning dove remains one of the five most widespread nesting birds in North America, and can be found anywhere but deep forests (CLO 2015). Mourning doves are considered migratory game birds and many states have regulated hunting seasons for doves, including Delaware. Doves can be harvested within Delaware during a three-way split season that occurs between September and January. Between 2002 through 2011, the number of doves heard and seen during the annual Mourning Dove Call-count Survey had declined -0.1% annually in Delaware and Maryland (Seamans et al. 2012). The number of mourning doves observed during the CBC had shown a general increasing trend in the state from 1966 until the mid-1990s. After the mid-1990s, the number of doves observed in areas surveyed during the CBC has shown a general declining trend (NAS 2010).

The annual harvest of mourning doves in Delaware ranged from 14,700 to 36,300 since 2012 with an average of 25,880 across the last five years; WS' proposed removal of 200 would only account for 0.77% of the annual harvest. The national mourning dove population shows an increasing trend, and overall estimate of 130 million, despite decreased hunting activity (USFWS 2017).

Direct, Indirect, and Cumulative Effects:
Based on the best scientific data, WS' proposed annual removal level will have no adverse direct or indirect effects on mourning dove populations. Local populations of mourning doves in Delaware are likely augmented by migrating birds during the winter months. Like other native bird species, the removal of mourning doves by WS to alleviate damage will only occur when permitted by the USFWS and the DNREC pursuant to the MBTA through the issuance of depredation permits. Additionally, the potential authorized removal from all non-WS entities combined with WS proposed removal and the annual harvest is not expected to create adverse cumulative impacts. The removal of mourning doves by WS would only occur at levels authorized by the USFWS and the DNREC, which ensures WS' removal and removal by all entities, including hunter harvest, would be considered to achieve the desired population management levels of doves in Delaware. WS' proposed removal is only a fraction of a percentage of the annual harvest, and therefore is not expected to hinder the ability of those interested persons in harvesting mourning doves during the hunting season.

Osprey Biology and Population Impact Analysis

DE population estimate: 400 WS proposed removal: 25 + 25 nests (and eggs)
BBS DE, 1966-2012: 3.61% BBS New England/Mid-Atlantic Coast, 1966-2012: 7.46%
BBS DE, 2002-2012: 3.7% BBS New England/Mid-Atlantic Coast, 2002-2012: 8.46%
WS removal as % of state population: 6.25%

Ospreys are large raptors most often associated with shallow aquatic habitats where they feed primarily on fish (Poole et al. 2002). Historically, nests of osprey were constructed on tall trees and rocky cliffs. Today, ospreys are most commonly found nesting on man-made structures. Ospreys began accepting man-made sites almost as soon as they became available, nesting on duck blinds, channel markers, high-voltage transmission towers, communication towers, silos, and man-made nesting platforms (Poole et al.

2002, Ellison 2010). A survey of nesting osprey in New Jersey found that 75% of nesting osprey use single-post platforms erected for nesting while 8% of osprey nests occurred on cell towers, 4% occurred on channel markers, 3% nested on duck blinds, 2% occurred on dead trees, and 7% nested on other structures (Clark and Wurst 2010). Ospreys can be found nearly statewide during the breeding season in areas near aquatic habitats, such as along the coast and major river systems (Poole et al. 2002). Over 290 osprey nests have been observed during an aerial survey in 2014, with 197 of those nests active (K. Flemming person. comm. 2017). Ospreys are infrequently observed in areas surveyed during the CBC (NAS 2016). The number of osprey found wintering in the state is likely related to the availability of open water for foraging on fish.

Requests for assistance is more commonly associated for the removal of osprey nests. In Delaware, a total of 87 nests were removed between 2014 and 2016. While WS personnel removed only one individual and dispersed 198 osprey from the Dover airport, requests for assistance pertaining to ospreys continue on a yearly basis (Kate Flemming person. Comm. 2017).

***Direct, Indirect, and Cumulative Effects*:**
Based on the best scientific data, WS proposed annual removal level will have no adverse direct or indirect effects on osprey populations. WS would continue to employ nonlethal methods to address requests for assistance, including destroying eggs and nests. Eggs located in nests to be removed could be destroyed, eggs could be transported to a state-approved wildlife rehabilitator to be reared until they could be released into the wild, or eggs could be relocated to other osprey nests. The removal of the nest and eggs would occur in an attempt to cause osprey to abandon the nest site and to disperse the osprey from the area. The removal of an osprey nest, including the removal of osprey eggs, is prohibited by the MBTA unless authorized through the issuance of a depredation permit by the USFWS pursuant to the Act. WS' proposed activities, including the removal of the nest and eggs, would only occur pursuant to the MBTA through the issuance of a permit for those activities. Additionally, the potential authorized removal from all non-WS entities combined with WS proposed removal is not expected to create adverse cumulative impacts. The permitting of the removal by the USFWS and the DNREC pursuant to the MBTA ensures removal of osprey, including nests and eggs, by WS and by other entities occurs within allowable removal levels to achieve the desired population objectives for ospreys.

Red-winged blackbird Biology and Population Impacts

DE population estimate: 70,000	WS proposed removal: 250
BBS DE, 1966-2012: -0.32%	BBS New England/Mid-Atlantic Coast, 1966-2012: -2.00%
BBS DE, 2002-2012: -1.83%	BBS New England/Mid-Atlantic Coast, 2002-2012: -2.38%
WS removal as % of state population: 0.36%	

The red-winged blackbird is one of the most abundant bird species in North America and is a commonly recognized bird that can be found in a variety of habitats (Yasukawa and Searcy 1995). The breeding habitat of red-winged blackbirds includes marshes and upland habitats from southern Alaska and Canada southward to Costa Rica extending from the Pacific to the Atlantic Coast along with the Caribbean Islands (Yasukawa and Searcy 1995). Northern breeding populations of red-winged blackbirds migrate southward during the migration periods but red-winged blackbirds are common throughout the year in states along the Gulf Coast and parts of the western United States (Yasukawa and Searcy 1995). During the migration periods, red-winged blackbirds often form mixed species flocks with other blackbird species. In Delaware, red-winged blackbirds can be found throughout the year (Yasukawa and Searcy 1995). The number of red-winged blackbirds observed during the CBC in the state has shown a variable trend but an overall downward trend since 1966 (NAS 2010).

Since the removal of blackbird species, including red-winged blackbirds can occur without the need for a depredation permit when committing or about to commit damage, the number of red-winged blackbirds lethally removed by non-WS entities in the state is currently unknown. Since red-winged blackbirds often form mixed species flocks with other blackbird species, determining the number of birds of each species present in the mixed species flocks can be difficult. Therefore, the number of red-winged blackbirds dispersed within a mixed flock would be unknown.

Direct, Indirect, and Cumulative Effects:
Based on the best scientific data, WS' proposed annual removal level will have no adverse direct or indirect effects on red-winged blackbird populations. While non-WS removal is unknown, red-winged blackbird populations have remained abundant enough that the USFWS has maintained the Federal Blackbird Depredation Order. Therefore, WS does not anticipate any significant cumulative impacts to red-wing blackbird populations.

Rock Pigeon Biology and Population Impacts

DE population estimate: 19,000	WS proposed removal: 1,000
BBS DE, 1966-2012: -1.89%	BBS New England/Mid-Atlantic Coast, 1966-2012: -3.38%
BBS DE, 2002-2012: -1.97%	BBS New England/Mid-Atlantic Coast, 2002-2012: -2.54%
WS removal as % of state population: 5.26%	

Pigeons are an introduced rather than native species and, therefore they are not protected by federal law. Pigeons are closely associated with humans as human structures and activities provide them with food and sites for roosting, loafing, and nesting (Williams and Corrigan 1994). Thus, they are commonly found around city buildings, bridges, parks, farm yards, grain elevators, feed mills, and other man-made structures (Williams and Corrigan 1994). Additionally, although pigeons are primarily grain and seed eaters, they will readily feed on garbage, livestock manure, spilled grains, insects, and any other available bits of food (Williams and Corrigan 1994). The rock pigeon is a gregarious and year-round resident in Delaware (Ellison 2010). Delaware CBC data from 1966 through 2013 shows a decreasing population trend for wintering populations of pigeons (NAS 2010).

Since pigeons are a non-native species and are, therefore, afforded no protection under the MBTA, the removal of pigeons to alleviate damage or to reduce threats can occur without the need for a depredation permit from the USFWS or DNREC. The number of pigeons lethally removed to alleviate damage or threats in Delaware from non-WS entities is unknown since the reporting of pigeon removal is not required.

Direct, Indirect, and Cumulative Effects:
WS' proposed pigeon damage management activities would be conducted pursuant to Executive Order 13112. The Executive Order states that each federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law; 1) reduce invasion of exotic species and associated damages, 2) monitor invasive species populations, provide for restoration of native species and habitats, 3) conduct research on invasive species and develop technologies to prevent introduction, and 4) provide for environmentally sound control and promote public education on invasive species. WS' proposed annual removal is of a low magnitude compared with the statewide population and therefore will have no adverse direct or indirect effects on rock pigeon populations. Although non-WS removal is unknown, WS does not anticipate any significant adverse cumulative impacts on pigeon populations in Delaware.

Snow Goose Biology and Population Impacts

Snow geese breed across the extreme northern portions of Canada and along the Arctic coast (Mowbray et al. 2000). No breeding populations of snow geese occur in Delaware. However, snow geese are migrants through Delaware with large concentrations of snow geese overwintering in the state (Mowbray et al. 2000). The fall migration period occurs from September through November with the spring migration occurring from late February through the first part of June (Mowbray et al. 2000). The number of snow geese observed overwintering in the state during the CBC has shown a general increasing trend since 1966 (NAS 2010). During the 2012 Atlantic Flyway midwinter survey, 619,951 snow geese were observed in Delaware (DNREC 2017). The average number of snow geese observed in Delaware during midwinter surveys from 2012 to 2016 has been 426,338 geese (DNREC 2017).

Snow geese can be harvested during a regular season, which extends from October through February. During the regular harvest season, up to 25 geese can be harvested daily with no possession limit. Additionally, snow geese can also be harvested during their spring migration period under a Conservation Order established by the USFWS that includes Delaware (50 CFR 21.60), which was authorized under the Arctic Tundra Habitat Emergency Conservation Act (Public Law 106-108, Nov. 24, 1999, 113 Stat. 1491; see also USFWS 2007). The Conservation Order is intended to allow for the maximum number of snow geese to be removed annually in attempts to reduce the overall population of snow geese. The overall population of snow geese has increased dramatically since the mid-1970s and has reached historic highs across their breeding and wintering range. The current population level of snow geese has led to the damage of fragile arctic habitats on their breeding grounds from overgrazing (USFWS 2007). The population is estimated to be around 4.5 million, as of 2017, according to mid-winter survey (USFWS 2017). Under the Conservation Order season, snow geese can be harvested from February through April and there is no daily limit on the number of snow geese that can be harvested and no possession limit (DNREC 2017).

Based upon past requests for WS' assistance and in anticipation of additional efforts to reduce threats associated with snow geese, WS anticipates that no more than 500 snow geese could be lethally removed by WS annually under the proposed action. WS proposed removal would represent 0.12% of the average number of geese observed during the midwinter waterfowl survey (426,338 birds).

Direct, Indirect, and Cumulative Effects:
All removal of snow geese by WS would occur only after a depredation permit had been issued by the USFWS either to WS or to the entities experiencing damage or threats of damage. If a permit was issued to an entity other than WS, WS participation in damage management activities requiring lethal removal would occur as an agent of the cooperating entity under the depredation permit. Given the unlimited removal allowed during the hunting seasons for snow geese and the desire of management agencies to reduce the overall population of snow geese to alleviate damage occurring to fragile habitat on their breeding grounds (USFWS 2007), WS proposed removal is expected to have no adverse direct or indirect effects on snow geese populations. Although all non-WS removal is unknown due to the Conservation Order, WS proposed removal combined with the potential removal by non-WS entities, including annual harvest, is not expected to create adverse cumulative impacts on snow geese populations. Since WS' limited proposed removal is a small percentage of the annual hunter harvest, WS proposed removal is not expected to hinder the ability of those interested persons to harvest snow geese during the hunting seasons.

Snowy Owl Biology and Population Impacts

Snowy owls can be observed during the non-breeding season across southern Canada and the northern portion of the United States (Parmelee 1992). Snowy owls migrate south during winter were they are occasionally observed in Delaware (DNREC 2012). The open habitats of airports provide ideal wintering areas for snowy owls. Their low-flying behavior, along with their large size and body mass, (Parmelee 1992) makes them a significant hazard for a damaging strike (Dolbeer et al. 2013). Because they are arctic breeders no BBS data on snowy owls is available (Sauer et al. 2017). The number of snowy owls observed during the CBC across all areas surveyed in the United States has shown a variable trend over the past 20 years (NAS 2010). The number of snowy owls observed overwintering in Delaware during the CBC since 1966 has shown a slightly increasing trend (NAS 2010); however, only 12 observations have been recorded. The Partners in Flight Science Committee (2013) estimated that the population of snowy owls in North America is approximately 100,000 birds.

From 2009 through 2014, WS did not remove or disperse any snowy owls in Delaware. In 2014, WS live trapped and relocated one snowy owl and transferred custody of four snowy owls that were live captured. During this time, no snowy owls were removed or trapped and relocated by other entities within the state. Based on recent influxes of snowy owls arriving at airports, WS anticipates banding and relocating up to 10 snowy owls and lethally removing up to two snowy owls annually.

Direct, Indirect, and Cumulative Effects:
As part of an integrated approach to reducing threats, WS would first employ nonlethal methods (e.g., pyrotechnics, aversive noise, trap/relocate) to disperse or move snowy owls when appropriate and safe. However, snowy owls are not always responsive to dispersal techniques. Snowy owls on an airfield are a direct, immediate, persistent threat to safe aircraft operations. When snowy owls persist in these areas WS could trap and relocate them. However, trapping may not always be a feasible option. In order for trapping to occur on or adjacent to active runways and taxiways, WS personnel would be subjected to human health and safety risks. If active runways and taxiways were temporarily shut down to allow access by personnel while trapping, this would alter flight patterns, delay schedules, and cause major aberrations to air traffic. While translocation of raptors can be effective, trapping and relocation is not always possible when birds persist on the airfield or when birds return to the airport after being relocated. If snowy owls are deemed an immediate threat to aviation safety (e.g., flying along an active runway) or if repeated nonlethal methods have failed, WS may need to implement lethal removal options.

The live-capture and translocation of owls to appropriate habitat would not create adverse direct or indirect impacts to snowy owl populations since the owls would be unharmed. Based on the best available estimate for the population of snowy owls in North American, the annual removal of up to two snowy owls by WS would represent 0.002% of the population. If the removal by other entities (zero birds) remains stable the average annual cumulative removal by all entities under the proposed action alternative would represent 0.002% of the estimated population and would remain the same. Based on the limited emergency removal proposed, WS' lethal removal of snowy owls is not expected to create adverse direct or indirect impacts on snowy owl populations. Additionally, the limited potential authorized removal from all non-WS entities combined with WS' limited proposed removal is not expected to create adverse cumulative impacts. The removal or translocation of snowy owls can only occur when permitted by the USFWS. Therefore, all removal, including removal by WS, is authorized by the USFWS and occurs at the discretion of the USFWS. The removal of snowy owls would only occur at levels authorized by the USFWS which ensures cumulative removal is considered as part of population management objectives for these birds.

Turkey Vulture Biology and Population Impacts

DE population estimate: 20,000	WS proposed removal: 300 + 5 nests (and eggs)
BBS DE, 1966-2012: 4.03%	BBS New England/Mid-Atlantic Coast, 1966-2012: 3.66%
BBS DE, 2002-2012: 4.1%	BBS New England/Mid-Atlantic Coast, 2002-2012: 4.03%
WS removal as % of state population: 1.5%	

Turkey vultures can be found throughout Mexico, across most of the United States, and along the southern tier of Canada (Wilbur 1983, Rabenhold and Decker 1989). Turkey vultures can be found in virtually all habitats but they are most abundant where forest is interrupted by open land (Brauning 1992). The turkey vulture is by far the most widely distributed and frequently encountered vulture in Delaware (Ellison 2010). The number of turkey vultures observed during the CBC conducted annually in the state has shown a general increasing trend (NAS 2010).

Direct, Indirect, and Cumulative Effects:
Based on the best scientific data, WS proposed annual removal level will have no adverse direct effects on vulture populations. The majority of the direct operational assistance conducted by WS on turkey vultures would occur in the winter when they are in their winter roost and therefore would have no indirect effects on vultures. However, if assistance occurs in the spring, there could be an impact on the nesting and/or breeding success of individuals that are in close proximity to that area; this localized impact would be minimal and therefore would also not cause adverse indirect effects on the state turkey vulture populations. Additionally, the potential authorized removal from all non-WS entities combined with WS proposed removal is not expected to create adverse cumulative impacts. The permitting of the removal by the USFWS and the DNREC pursuant to the MBTA ensures removal by WS and other entities occurs within allowable removal levels to achieve the desired population objectives for turkey vultures in Delaware.

Live-capture and Translocation Species

Several species within Delaware including, American kestrels, barn owls, barred owls, black vultures, broad-winged hawks, Cooper's hawks, northern harriers, red-shouldered hawks, red-tailed hawks, and snowy owls have the potential to pose threats to aviation safety, and most requests WS would receive for these species would be to alleviate the threats these species pose to aircraft. WS would address those requests for assistance primarily with nonlethal dispersal methods and through live-capture and translocation of individuals. Based on the requests for assistance received previously and in anticipation of receiving additional requests for assistance, WS proposes up to 50 American kestrels and red-tailed hawks, and no more than 25 each of barn owls, barred owls, black vultures, broad-winged hawks, Cooper's hawks, northern harriers, red-shouldered hawks, sharp-shinned hawks, and snowy owls can be translocated.

Lethal removal would only be conducted on these species when immediate threats to human safety occur, such as when banned individuals have returned to the same airport twice after translocation, habituation to nonlethal methods, or when diseased individuals threatened human and animal health. In addition, WS could also be requested to employ lethal methods under the proposed action alternative to address damage or threats of damage associated with those species, including damage to property, agricultural resources, and livestock. Based on previous requests for assistance received by WS, as well as anticipated requests, no more than 25 individuals each of barn and barred owls, and no more than five American kestrels, broad-winged hawks, cooper's hawks, northern harriers, red-shouldered hawks, red-tailed hawks, sharp-shinned hawks, and snowy owls can be lethally removed.

Direct, Indirect, and Cumulative Effects:
American kestrels, barn owls, barred owls, broad-winged hawks, Cooper's hawks, northern harriers, red-shouldered hawks, red-tailed hawks, sharp-shinned hawks, and snowy owls are not expected to be removed by WS at any level that would cause adverse direct effects on the population of those species. These species listed are afforded protection under the MBTA and removal is only allowed through the issuance of a depredation permit and only at those levels stipulated in the permit. Therefore, those birds would be removed in accordance with applicable state and federal laws and regulations authorizing

removal of migratory birds and their nests and eggs, including the USFWS and the DNREC permitting processes.

Although the live-capture and translocation of these species would be a nonlethal method of reducing damage or threats of damage, relocation during the nesting season may lower nesting success. The removal of an individual from a pair can impact nesting success. However, some studies indicate a single parent can successfully raise the offspring, despite the removal of its mate, thereby mitigating the impact on nesting success. Moreover, relocation via WS mostly occurs outside the nesting season. Therefore, significant adverse indirect effects are not expected to occur to these populations. Raptors captured and translocated could be banded for identification purposes using United States Geological Survey approved metal leg-bands appropriate for the species. Banding would occur pursuant to a banding permit issued by the United States Geological Survey. Fair et al. (2010) stated "[w]*hen appropriate* [leg] *band sizes are used, the occurrence and rate of adverse effects on the subjects is ordinarily very low*".

The USFWS, as the agency with management responsibility for migratory birds, could impose restrictions on depredation removal as needed to assure cumulative removal does not adversely affect the continued viability of populations. Since removal of these species, including live-capture and translocation, can only occur when permitted by the USFWS and DNREC pursuant to the MBTA through the issuance of depredation permits, all removal, including removal by WS, would only occur at levels authorized by the USFWS and the DNREC which ensures there are no adverse cumulative impacts on the population of these species in Delaware. This would assure that cumulative impacts on these bird populations would have no significant adverse impact on the quality of the human environment.

Additional Target Species

Target species, in addition to those species analyzed previously, that have been or could be lethally removed in small numbers include the following: American coots, barn swallows, Bonaparte's gulls, blue jays, cattle egrets, chimney swifts, downy woodpeckers, eastern meadowlark, fish crows, gray catbirds, great black-backed gulls, great blue herons, great egrets, great-horned owls, hairy woodpeckers, mute swans, northern cardinals, northern flickers, northern mockingbirds, osprey, pileated woodpeckers, red-bellied woodpeckers, snowy egrets, tree swallows, and yellow-bellied sapsuckers. These species typically do not cause damage to resources and are not considered nuisance species, but individual birds have the potential to cause damage in some situations. Some of these target species have been lethally removed in small numbers by WS and have included no more than 25 individuals and/or no more than 25 nests annually. Based on previous requests for assistance, anticipation of future requests for assistance, and the removal levels necessary to alleviate those requests for assistance, no more than 25 individuals of American coots, chimney swifts, fish crows, great black-backed gulls, great horned owls, mute swans northern flickers, and ospreys would be removed annually by WS. Furthermore, no more than five barn swallows, cattle egrets, downy woodpeckers, eastern meadowlarks, gray catbirds, great blue herons, great egrets, hairy woodpeckers, northern cardinals, northern mockingbirds, snowy egrets, tree swallows, and yellow-bellied sapsuckers, and 25 osprey and mute swan nests (and eggs) would be removed annually by WS personnel.

The proposed removal of up to 25 individuals under the proposed action would be a minor component of the annual removal of American coots during the regulated hunting seasons and therefore is not expected to hinder the ability of those interested persons in harvesting coots during the regular hunting season. Similarly, the proposed limited removal of individuals and nests of the aforementioned target species does not constitute a large enough removal to impact wild populations, and thereby is not likely to adversely affect wild populations.

Summary
Evaluation of WS' activities relative to wildlife populations indicated that program activities will likely have no cumulative adverse effects on populations in Delaware. WS' actions would be occurring simultaneously, over time, with other natural processes and human-generated changes that are currently taking place. Those activities include, but are not limited to:

- Natural mortality of wildlife
- Human-induced mortality through private damage management activities
- Human and naturally induced alterations of wildlife habitat
- Annual and perennial cycles in population densities

All those factors play a role in the dynamics of wildlife populations. In many circumstances, requests for assistance arise when some or all of those elements have contrived to elevate target species populations or place target species at a juncture to cause damage to resources. WS' actions to minimize or eliminate damage are constrained as to scope, duration and intensity, for the purpose of minimizing or avoiding impacts to the environment. WS evaluates damage occurring, including other affected elements and the dynamics of the damaging species; determines appropriate strategies to minimize effects on environmental elements; applies damage management actions; and subsequently monitors and adjusts/ceases damage management actions (Slate et al. 1992). This process allows WS to take into consideration other influences in the environment, such as those listed above, in order to avoid cumulative adverse impacts on target species.

Wildlife Disease Surveillance and Monitoring

The ability to efficiently conduct surveillance for and detect diseases is dependent upon rapid detection of the pathogen if it is introduced. Effective implementation of a surveillance system would facilitate planning and execution at regional and state levels, and coordination of surveillance data for risk assessment. It would also facilitate partnerships between public and private interests, including efforts by federal, state, and local governments as well as non-governmental organizations, universities, and other interest groups.[8] Current information on disease distribution and knowledge of the mixing of birds in migratory flyways has been used to develop a prioritized sampling approach based on the major North American flyways. Surveillance data from all of those areas would be incorporated into national risk assessments, preparedness and response planning to reduce the adverse impacts of a disease outbreak in wild birds, poultry, or humans.

To provide the most useful information and a uniform structure for surveillance, five strategies for collecting samples in birds have been proposed (USDA 2005). Those strategies include:

Investigation of Illness/Death in Birds: A systematic investigation of illness and death in wild birds may be conducted to determine the cause of the illness or the cause of death in birds. This strategy offers the best and earliest probability of detection if a disease is introduced by migratory birds into the United States. Illness and death involving wildlife are often detected by, or reported to natural resource agencies and entities. This strategy capitalizes on existing situations of birds without additional birds being handled or killed.

Surveillance in Live Wild Birds: This strategy involves sampling live-captured, apparently healthy birds to detect the presence of a disease. Bird species that represent the highest risk of being exposed to, or infected with, the disease because of their migratory movement patterns (USDA 2005), or birds that may be in contact with species from areas with reported outbreaks would be targeted. Where possible, this

[8]Data collected by organizations/agencies conducting research and monitoring will provide a broad species and geographic surveillance effort.

sampling effort would be coordinated with local projects that already plan on capturing and handling the desired bird species. Coordinating sampling with ongoing projects currently being conducted by state and federal agencies, universities, and others maximizes use of resources and minimizes the need for additional bird capture and handling.

Surveillance in Hunter-harvested Birds: Check stations for waterfowl hunting or other harvestable bird species provide an opportunity to sample dead birds to determine the presence of a disease, and supplement data collected during surveillance of live wild birds. Sampling of hunter-killed birds would focus on hunted species that are most likely to be exposed to a disease; have relatively direct migratory pathways from those areas to the United States; commingle in Alaska staging areas with species that could bring the virus from other parts of the world;

Sentinel Species: Waterfowl, gamefowl, and poultry flocks reared in backyard facilities may prove to be valuable for early detection and used for surveillance of diseases. Sentinel duck flocks may also be placed in wetland environments where they are potentially exposed to and infected with disease agents as they commingle with wild birds.

Environmental Sampling: Many avian diseases are released by waterfowl through the intestinal tract and can be detected in both feces and the water in which the birds swim, defecate, and feed. This is the principal means of virus spread to new birds and potentially to poultry, livestock, and humans. Analysis of water and fecal material from certain habitats can provide evidence of diseases circulating in wild bird populations, the specific types of diseases, and pathogenicity. Monitoring of water and/or fecal samples gathered from habitat is a reasonably cost effective, technologically achievable means to assess risks to humans, livestock, and other wildlife.

Direct, Indirect, and Cumulative Effects:
Under the disease sampling strategies listed above that could be implemented to detect or monitor avian diseases in the United States, WS' implementation of those sampling strategies would not create adverse direct or indirect effects on avian populations in the state. Sampling strategies that could be employed involve sampling live-captured birds that could be released on site after sampling occurs. The sampling (e.g., drawing blooding, feather sample, fecal sample) and the subsequent release of live-captured birds would not result in adverse direct or indirect effects since those birds are released unharmed on site. In addition, sampling of sick, dying, or hunter harvested birds would not result in the additive lethal removal of birds that would not have already occurred in the absence of a disease sampling program. Therefore, the sampling of birds for diseases would not create adverse cumulative impacts on the populations of any of the birds addressed in this EA nor would result in any removal of birds that would not have already occurred in the absence of disease sampling (e.g., hunter harvest).

Alternative 2 - Bird Damage Management by WS using only Nonlethal Methods

Under this alternative, WS would not use lethal methods to resolve bird damage problems. Although some unintentional mortality might result from the use of bird capture devices, like mist nets, these incidents are likely to be rare and would have negligible impacts on target species populations (Spotswood et al., 2012). Individuals, agencies and organizations would still be able to obtain permits for lethal bird removal from the USFWS and DNREC. Efforts to reduce or prevent damage and risks to livestock and/or human health and safety risks would likely be higher than with Alternative 1. If BDM is conducted by individuals with limited training or experience, it is possible that additional birds may be removed in the course of attempts to resolve damage problems.

Direct, Indirect, and Cumulative Effects:
Depending upon the experience, training and methods available to the individuals conducting the BDM, potential adverse direct and indirect impacts on target bird populations would likely be the same or greater than with Alternative 1. However, for the same reasons shown under Alternative 1, it is unlikely that significant adverse direct or indirect effects would occur to target species' by implementation of this alternative. Direct and indirect impacts and potential risks of illegal toxicant use would be greater under this alternative than Alternative 1. DRC-1339 is currently only available for use by WS employees and would not be available under this alternative, although Starlicide, a product similar to DRC-1339 would be available for use by licensed pesticide applicators. It is possible that frustration caused by the inability to reduce damage by the public would lead to illegal use of toxicants which could increase adverse direct, indirect, or cumulative effects, however to an unknown degree. Because WS would be able to provide assistance with nonlethal BDM, risks of adverse cumulative impacts from actions by non-WS entities are lower than with Alternative 3.

Alternative 3 – No Bird Damage Management Conducted by WS

Under this alternative, WS would not conduct bird damage management activities. WS would have no direct involvement with any aspect of addressing damage caused by birds and would provide no technical assistance. No removal of birds by WS would occur. Birds could continue to be lethally removed to resolve damage and/or threats occurring either through depredation permits issued by the USFWS, under the blackbird and cormorant depredation orders, under the control order for Muscovy ducks, during the regulated hunting seasons, or in the case of non-native species, removal could occur anytime using legally available methods. Management actions taken by non-federal entities would be considered the *environmental status quo*.

Direct, Indirect, and Cumulative Effects:
Local bird populations could decline, stay the same, or increase depending on actions taken by those persons experiencing bird damage. The direct and indirect effects on bird populations would be variable and unknown. Some resource/property owners may take illegal, unsafe, or environmentally harmful action against local populations of birds out of frustration or ignorance. While WS would provide no assistance under this alternative, other individuals or entities could conduct lethal damage management resulting in direct or indirect impacts similar to the proposed action.

Since birds would still be removed under this alternative, the potential direct, indirect, and cumulative effects on the populations of those bird species would be similar among all the alternatives for this issue. WS' involvement would not be additive to removal that could occur since the cooperator requesting WS' assistance could conduct bird damage management activities without WS' direct involvement. Therefore, any actions to resolve damage or reduce threats associated with birds could occur by other entities despite WS' lack of involvement under this alternative, and therefore the cumulative impact on those bird species could be similar to Alternative 1.

Issue 2 - Effects of Damage Management Activities on Nontarget Wildlife Species Populations, Including T&E Species

A concern is often raised about the potential impacts to nontarget species, including T&E species, from the use of methods to resolve damage caused by birds. The potential effects on the populations of nontarget wildlife species, including T&E species, are analyzed below.

Alternative 1 - Continuing the Current Integrated Approach to Managing Bird Damage (Proposed Action/No Action)

The potential adverse effects to nontargets occur from the employment of methods to address bird damage. Under the proposed action, WS could provide both technical assistance and direct operational assistance to those persons requesting assistance. The use of nonlethal methods as part of an integrated direct operational assistance program would be similar to those risks to nontargets discussed in the other alternatives.

WS personnel are experienced and trained in wildlife identification and to select the most appropriate methods for taking targeted animals and excluding nontarget species. To reduce the likelihood of capturing nontarget wildlife, WS would employ the most selective methods for the target species, would employ the use of attractants that are as specific to target species as possible, and determine placement of methods to avoid exposure to nontargets. SOPs to prevent and reduce any potential adverse impacts on nontargets are discussed in Chapter 3 of this EA. Despite the best efforts to minimize nontarget removal during program activities, the potential for adverse impacts to nontargets exists when applying both nonlethal and lethal methods to manage damage or reduce threats to safety.

***Direct, Indirect, and Cumulative Effects*:**
While every precaution is taken to safeguard against taking nontargets during operational use of methods and techniques for resolving damage and reducing threats caused by birds, the use of such methods can result in the incidental removal of unintended species. Those occurrences are rare and should not affect the overall populations of any species under the proposed action. WS' removal of nontarget species during activities to reduce damage or threats to human safety associated with birds is expected to be extremely low to nonexistent. WS would monitor the removal of nontarget species to ensure program activities or methodologies used in bird damage management do not create direct effects on nontarget populations. Methods available to resolve and prevent bird damage or threats when employed by trained, knowledgeable personnel are selective for target species. WS would annually report to the USFWS and/or the DNREC any nontarget removal to ensure removal by WS is considered as part of management objectives established. The potential impacts to nontargets are similar to the other alternatives and are considered to be minimal to nonexistent.

Nonlethal methods have the potential to cause adverse direct effects to nontargets primarily through exclusion, harassment, and dispersal. The use of auditory and visual dispersal methods used to reduce damage or threats caused by birds are also likely to disperse nontargets in the immediate area the methods are employed. Therefore, nontargets may be dispersed from an area while employing nonlethal dispersal techniques. However, like target species, the potential direct impacts on nontarget species are expected to be temporary with target and nontarget species often returning after the cessation of dispersal methods. Nonlethal methods would not be employed over large geographical areas or applied at such intensity that essential resources (e.g., food sources, habitat) would be unavailable for extended durations or over a wide geographical scope that long-term adverse effects would occur to a species' population. Nonlethal methods are generally regarded as having minimal direct impacts on overall populations of wildlife since individuals of those species are unharmed. Any exclusionary device erected to prevent access of target species also potentially excludes species that are not the primary reason the exclusion was erected; therefore, if the area is large enough, adverse indirect effects on nontarget species may occur, but these are expected to be minimal. The use of nonlethal methods would not have significant adverse impacts on nontarget populations under any of the alternatives.

Other nonlethal methods available for use under this alternative include live traps, nets, nest/egg destruction, translocation, and repellents. Live traps (e.g., cage traps, walk-in traps, decoy traps) and nets restrain wildlife once captured and are considered live-capture methods. Live traps have the potential to capture nontarget species. Trap and net placement in areas where target species are active and the use of target-specific attractants would likely minimize the capture of nontargets. If traps and nets are attended to appropriately, most nontargets captured can be released on site unharmed. Therefore, no direct effects are expected on nontargets.

Only those repellents registered with the EPA pursuant to the FIFRA and registered for use in the state would be recommended and used by WS under this alternative. Therefore, the use and recommendation of repellents would not have negative direct or indirect effects on nontarget species when used according to label requirements. Most repellents for birds are derived from natural ingredients that pose a very low risk to nontargets when exposed to or when ingested. Two chemicals commonly registered with the EPA as bird repellents are methyl anthranilate and anthraquinone. Methyl anthranilate naturally occurs in grapes. Methyl anthranilate has been used to flavor food, candy, and soft drinks. Anthraquinone naturally occurs in plants like aloe. Anthraquinone can be used to make dye. Both products claim to be unpalatable to many bird species. Several products are registered for use to reduce bird damage containing either methyl anthranilate or anthraquinone. Formulations containing those chemicals are liquids that are applied directly to susceptible resources. Similarly, when used in accordance with the label requirements, the use of Avitrol would also not create adverse direct effects on nontargets based on restrictions on baiting locations.

WS would also employ and/or recommend lethal methods under the proposed action alternative to alleviate damage. Lethal methods available for use to manage damage caused by birds under this alternative would include shooting and DRC-1339. In addition, birds could be euthanized once live-captured by other methods. Available methods and the application of those methods to resolve bird damage is further discussed in Appendix B.

The use of firearms is essentially selective for target species since animals are identified prior to application; therefore, no adverse direct or indirect effects to nontargets would be anticipated from use of this method. The euthanasia of birds by WS' personnel would be conducted in accordance with WS Directive 2.505. Chemical methods used for euthanasia would be limited to carbon dioxide administered in an enclosed chamber after birds have been live-captured. Since live-capture of birds using other methods occurs prior to the administering of euthanasia chemicals, no adverse direct or indirect effects to nontargets would occur under this alternative. WS' recommendation that birds be harvested during the regulated season by private entities to alleviate damage would not increase risks to nontargets.

During the migration period, eagles occur throughout the United States and parts of Mexico (Buehler 2000). Under the Bald and Golden Eagle Act, activities that could result in the "take" of eagles cannot occur unless the United States Fish and Wildlife Service allow those activities to occur through the issuance of a permit. Take could occur through purposeful take (e.g., harassing an eagle from an airport using pyrotechnics to alleviate aircraft strike hazards) or non-purposeful take (e.g., unintentionally capturing an eagle in a trap). Both purposeful take and non-purposeful take require a permit from the United States Fish and Wildlife Service (see 50 CFR 22.26, 50 CFR 22.27). In those cases where purposeful take could occur or where there is a high likelihood of non-purposeful take occurring, WS would apply for a permit for those activities.

However, routine activities conducted by WS' personnel under the proposed action alternative could occur in areas where bald eagles were present, which could disrupt the current behavior of an eagle or eagles that were nearby during those activities. As discussed previously, "take" as defined by the Bald and Golden Eagle Protection Act, include those actions that "disturb" eagles. Disturb has been defined under 50 CFR 22.3 as those actions that cause or are likely to cause injury to an eagle, a decrease in productivity, or nest abandonment by substantially interfering with their normal breeding, feeding, or sheltering behavior.

WS has reviewed those methods available under the proposed action alternative and the use patterns of those methods. The routine measures that WS conducts would not meet the definition of disturb requiring a permit for the non-purposeful take of bald eagles. The USFWS states, "Eagles are unlikely to be disturbed by routine use of roads, homes, or other facilities where such use was present before an eagle pair nesting in a given area. For instance, if eagles build a nest near your existing home, cabin, or place of business you do not need a permit" (USFWS 2012). Therefore, activities that are species specific and are not of a duration and intensity that would result in disturbance as defined by the Act would not result in non-purposeful take. Activities, such as walking to a site, discharging a firearm, or riding an ATV along a trail, generally represent short-term disturbances to sites where those activities take place. WS would conduct activities that were located near eagle nests using the National Bald Eagle Management Guidelines (USFWS 2007). The categories that would encompass most of these activities are Category D (Off-road vehicle use), Category F (Non-motorized recreation and human entry), and Category H (Blasting and other loud, intermittent noises). These categories generally call for a buffer of 330 to 660 feet for category D and F, and a ½-mile buffer for category H. WS would take active measures to avoid disturbance of bald eagle nests by following the National Bald Eagle Management Guidelines. However, other routine activities conducted by WS do not meet the definition of "disturb" as defined under 50 CFR 22.3. Those methods and activities would not cause injuries to eagles and would not substantially interfere with the normal breeding, feeding, or sheltering behavior of bald eagles.

A common concern regarding the use of DRC-1339 is the potential nontarget risks. All label requirements of DRC-1339 would be followed to minimize nontarget hazards. As required by the label, all potential bait sites are pre-baited and monitored for nontarget use as outlined in the pre-treatment observations section of the label. If nontargets are observed feeding on the pre-bait, the plots are abandoned and no baiting would occur at those locations. Treated bait is mixed with untreated bait per label requirements when applied to bait sites to minimize the likelihood of nontargets finding and consuming bait that has been treated. The bait type selected can also limit the likelihood that nontarget species would consume treated bait since some bait types are not preferred by nontarget species.

By acclimating target bird species to a feeding schedule, baiting can occur at specific times to ensure bait placed is quickly consumed by target bird species, especially when large flocks of target species are present. The acclimation period allows treated bait to be present only when birds are conditioned to be present at the site and provides a higher likelihood that treated bait would be consumed by the target species, which makes it unavailable to nontargets. In addition, many bird species when present in large numbers tend to exclude nontargets from a feeding area due to their aggressive behavior and by the large number of conspecifics present at the location. Therefore, risks to nontarget species from consuming treated bait only occurs when treated bait is present at a bait location. Any treated bait remaining at the location after target birds had finished feeding would be removed to avoid attracting nontargets. WS would retrieve all dead birds to the extent possible following treatment with DRC-1339.

DRC-1339 Primary Hazard Profile - DRC-1339 was selected for reducing bird damage because of its high toxicity to blackbirds (DeCino et al. 1966, West et al. 1967, Schafer, Jr. 1972) and low toxicity to most mammals, sparrows, and finches (Schafer, Jr. and Cunningham 1966, Apostolou 1969, Schafer, Jr. 1972, Schafer, Jr. et al. 1977, Matteson 1978, Cunningham et al. 1979, Cummings et al. 1992, Sterner et al. 1992). The likelihood of a nontarget bird obtaining a lethal dose is dependent on: (1) frequency of encountering the bait, (2) length of feeding bout, (3) the bait dilution rate, (4) the bird's propensity to select against the treated bait, and (5) the susceptibility of the nontarget species to the toxicant. Birds that ingest DRC-1339 probably die because of irreversible necrosis of the kidney and subsequent inability to excrete uric acid (*i.e.*, uremic poisoning) (DeCino et al. 1966, Felsenstein et al. 1974, Knittle et al. 1990). Birds ingesting a lethal dose of DRC-1339 usually die in one to three days.

The median acute lethal dose (LD_{50})[9] values for starlings, blackbirds, and magpies (Corvidae) range from one to five mg/kg (Eisemann et al. 2003). For American crows, the median acute lethal dose has been estimated at 1.33 mg/kg (DeCino et al. 1966). The acute oral toxicity (LD_{50}) of DRC-1339 has been estimated for over 55 species of birds (Eisemann et al. 2003). DRC-1339 is toxic to mourning doves, pigeons, quail (*Coturnix coturnix*), chickens and ducks (*Anas* spp.) at ≥5.6 mg/kg (DeCino et al. 1966). In cage trials, Cummings et al. (1992) found that 2% DRC-1339-treated rice did not kill savannah sparrows (*Passerculus sandwichensis*). Gallinaceous birds and waterfowl may be more resistant to DRC-1339 than blackbirds, and their large size may reduce the chances of ingesting a lethal dose (DeCino et al. 1966). Avian reproduction does not appear to be affected from ingestion of DRC-1339 treated baits until levels are ingested where toxicity is expressed (USDA 2001).

There have been concerns expressed about the study designs used to derive acute lethal doses of DRC-1339 for some bird species (Gamble et al. 2003). The appropriateness of study designs used to determine acute toxicity to pesticides has many views (Lipnick et al. 1995). The use of small sample sizes was the preferred method of screening for toxicity beginning as early as 1948 to minimize the number of animals involved (Dixon and Mood 1948). In 1982, the EPA established standardized methods for testing for acute toxicity that favored larger sample sizes (EPA 1982). More recently, regulatory agencies have again begun to debate the appropriate level of sample sizes in determining acute toxicity based on a growing public concern for the number of animals used for scientific purposes.

Based on those concerns, the Ecological Committee on FIFRA Risk Assessment (ECOFRAM) was established by the EPA to provide guidance on ecological risk assessment methods (EPA 1999). The committee report recommended to the EPA that only one definitive LD_{50} be used in toxicity screening either on the mallard or northern bobwhite and recommended further testing be conducted using the up-and-down method (EPA 1999). Many of the screening methods used for DRC-1339 prior to the establishment of EPA guidelines in 1982 used the up-and-down method of screening (Eisemann et al. 2003).

A review of the literature shows that LD_{50} research using smaller sample sizes conducted prior to EPA established guidelines are good indicators of LD_{50} derived from more rigorous designs (Bruce 1985, Bruce 1987, Lipnick et al. 1995). Therefore, acute and chronic toxicity data gathered prior to EPA guidance remain valid and to ignore the data would be inappropriate and wasteful of animal life (Eisemann et al. 2003).

DRC-1339 Secondary Hazards - Secondary poisoning has not been observed with DRC-1339 treated baits. During research studies, carcasses of birds that died from DRC-1339 were fed to raptors and scavenger mammals for 30 to 200 days with no symptoms of secondary poisoning observed (Cunningham et al. 1979). This can be attributed to relatively low toxicity to species that might scavenge on blackbirds killed by DRC-1339 and its tendency to be almost completely metabolized in the target birds which leaves little residue to be ingested by scavengers.

DRC-1339 is rapidly metabolized and excreted and does not bioaccumulate, which probably accounts for its low secondary hazard profile (Schafer, Jr. 1991). For example, cats, owls, and magpies would be at risk only after exclusively eating DRC-1339-poisoned starlings for 30 continuous days (Cunningham et al. 1979). No probable risk is expected to American kestrels based on the low hazard quotient value for marsh hawks used as a surrogate species (Schafer, Jr. 1970). The risk to mammalian predators from feeding on birds killed with DRC-1339 appears to be low (Johnston et al. 1999).

[9] An LD_{50} is the dosage in milligrams of material per kilogram of body weight required to cause death in 50% of a test population of a species.

The risks associated with nontarget animal exposure to DRC-1339 baits have been evaluated in rice fields in Louisiana (Glahn et al. 1990, Cummings et al. 1992, Glahn and Wilson 1992), poultry and cattle feedlots in several western states (Besser 1964, Ford 1967, Royall et al. 1967), ripening sunflower fields in North Dakota (Linz et al. 2000), and around blackbird staging areas in east-central South Dakota (Knutsen 1998, Linz et al. 1995, Smith 1999). Smith (1999) used field personnel and dogs to search for dead nontarget animals and found no nontarget carcasses that exhibited histological signs consistent with DRC-1339 poisoning. The other studies also failed to detect any nontarget birds that had succumbed to DRC-1339. However, DRC-1339 is a slow-acting avicide and thus, some birds could move to areas not searched by the study participants before dying.

DRC-1339 Environmental Degradation - DRC-1339 is unstable in the environment and degrades rapidly when exposed to sunlight, heat, or ultra violet radiation and has a half-life of less than two days. DRC-1339 is highly soluble in water but does not hydrolyze and degradation occurs rapidly in water. The chemical tightly binds to soil and has low mobility. The half-life is about 25 hours, which means it is nearly 100% broken down within a week, and identified metabolites (i.e., degradation chemicals) have low toxicity. Aquatic and invertebrate toxicity is low (EPA 1995). Therefore, WS does not expect any adverse indirect effects on nontarget species through chemical contamination from soil or water supplies.

Additional concerns have been raised regarding the risks to nontarget wildlife associated with crows caching bait treated with DRC-1339. Crows are known to cache surplus food usually by making a small hole in the soil using the bill, by pushing the food item under the substrate, or covering items with debris (Verbeek and Caffrey 2002). Distances traveled from where the food items were gathered to where the item is cached varies, but some studies suggests crows can travel up to 100 meters (Kilham 1989) and up to 2 kilometers (Cristol 2001, Cristol 2005). Caching activities appear to occur throughout the year, but may increase when food supplies are low. Therefore, the potential for treated baits to be carried from a bait site to surrounding areas exists as part of the food cache behavior exhibited by crows.

Several mitigating factors must be overcome for nontarget risks to occur from bait cached by a crow. Those factors being: (1) the nontarget wildlife species would have to locate the cached bait, (2) the bait-type used to target crows would have to be palatable or selected for by the nontarget wildlife, (3) the nontarget wildlife species consuming the treated bait would have to consume a lethal dose from a single bait, and (4) if a lethal dose is not achieved by eating a single treated cached bait, the nontarget wildlife would have to ingest several treated baits (either from cached bait or from the bait site) to obtain a lethal dose which could vary by the species.

Summary

WS does not anticipate any adverse cumulative impacts on nontarget species from the implementation of the proposed bird damage management methods. Based on the methods available to resolve bird damage and/or threats, WS does not anticipate the number of nontargets removed to reach a magnitude where declines in those species' populations would occur. Therefore, removal under the proposed action of nontargets will not create adverse cumulative effects on nontarget species. DRC-1339 is currently only available for use by WS employees; therefore, no adverse cumulative impacts are expected from the use of these chemicals due to no additional contribution of these chemicals into the environment from non-WS entities. Starlicide, a product similar to DRC-1339, would be available for use by licensed pesticide applicators. However, no adverse cumulative impacts are expected because Starlicide has a similar hazard profile to DRC-1339.

The proposed bird damage management could benefit many other wildlife species that are impacted by predation or competition for resources. For example, crows are generally very aggressive nesting area colonizers and will force other species from prime nesting areas. American crows and fish crows often feed on the eggs, nestlings, and fledglings of other bird species. Fish crows are known to feed heavily on colonial waterbird eggs (McGowan 2001). This alternative has the greatest possibility of successfully reducing bird damage and conflicts to wildlife species since all available methods could possibly be implemented or recommended by WS.

T&E Species Effects

Special efforts are made to avoid jeopardizing T&E species through biological evaluations of the potential effects and the establishment of special restrictions or minimization measures. SOPs to avoid T&E effects are described in Chapter 3 of this EA.

Federally Listed Species –The current list of species designated as threatened and endangered in Delaware as determined by the USFWS and the National Marine Fisheries Service was obtained and reviewed during the development of this EA. Appendix D contains the list of species currently listed in the state along with common and scientific names. As part of the development of the EA, WS consulted with the USFWS under Section 7 of the ESA. The USFWS concurred with WS' determination that activities conducted pursuant to the proposed action would not likely adversely affect those species currently listed in the state or their critical habitats (G. LaRouche, USFWS, pers. comm. 2013).

State Listed Species – The current list of state listed species designated as endangered or threatened in the State as determined by the DNREC (see Appendix D) was reviewed during the development of the EA. Based on the review of species listed in the state, WS has determined that the proposed activities would not adversely affect those species currently listed.

Alternative 2 - Bird Damage Management by WS using only Nonlethal Methods

Under this alternative, risks to nontarget species from WS actions would likely be limited to the use of frightening devices, exclusionary devices, and the risks of unintentional capture of a bird in a live-capture device as outlined under Alternative 1. Although the availability of WS assistance with nonlethal BDM methods could decrease incentives for non-WS entities to use lethal BDM methods, non-WS efforts to reduce or prevent damage could result in less experienced persons implementing bird damage management methods and lead to a greater removal of nontarget wildlife.

Direct, Indirect, and Cumulative Effects:
Similar to Alternative 3, it is possible that frustration from the resource owner due to the inability to reduce losses could lead to illegal use of toxicants, or other non-specific damage management methods by others could lead to unknown direct or indirect effects to nontarget species populations, including T&E species (Appendix D). Hazards to T&E species could be more variable under this alternative than Alternative 1. Potential direct or indirect effects to nontarget species could therefore be greater under this alternative if methods that are less selective or toxicants that cause secondary poisoning are used by non-WS entities. Direct effects on nontargets from nonlethal methods of bird damage management conducted by WS would be similar to Alternative 1. Since WS would be able to employ nonlethal methods under this alternative, indirect effects on nontarget species could occur when implementing exclusionary devices if the area is large enough, but these indirect effects are expected to be minimal. The ability to reduce negative effects caused by birds to wildlife species and their habitats, including T&E species, would be variable based upon the skills and abilities of the person implementing BDM programs. It is possible that frustration caused by the inability to reduce losses would lead to non-specific damage management methods or illegal use of toxicants by others which could increase adverse cumulative impacts, however to unknown degree. While cumulative impacts would be variable, WS does not anticipate any significant cumulative impacts from this alternative.

Alternative 3 – No Bird Damage Management Conducted by WS

Under this alternative, birds could continue to be removed under depredation permits issued by the USFWS and the DNREC, removal would continue to occur during the regulated harvest season, non-native bird species could continue to be removed without the need for a permit, blackbirds and cormorants could still be removed under the depredation orders, and Muscovy ducks could be lethally removed under the control order. Risks to nontargets and T&E species would continue to occur from those who implement bird damage management activities on their own or through recommendations by the other federal, state, and private entities. Although some risks occur from those people that implement bird damage management in the absence of any involvement by WS, those risks are likely low and are similar to those under the other alternatives.

Direct, Indirect, and Cumulative Effects:
Under this alternative, WS would not be directly involved with damage management activities. Therefore, no direct or indirect impacts to nontargets or T&E species would occur by WS under this alternative. The ability to reduce damage and threats of damage caused by birds to other wildlife species and their habitats, including T&E species, would be variable based upon the skills and abilities of the person implementing damage management actions under this alternative. The risks to nontargets and T&E species would be similar across the alternatives since most of those methods described in Appendix B would be available across the alternatives. If those methods available were applied as intended, direct, indirect, and cumulative effects to nontargets would be minimal to nonexistent. If methods available were applied incorrectly or applied without knowledge of bird behavior, risks to nontarget wildlife would be higher under this alternative. If frustration from the lack of available assistance causes those persons experiencing bird damage to use methods that were not legally available for use, direct, indirect, and cumulative effects on nontargets would be higher under this alternative. People have resorted to the use of illegal methods to resolve wildlife damage that have resulted in the lethal removal of nontarget wildlife (e.g., White et al. 1989, USFWS 2001, FDA 2003). Therefore, adverse direct, indirect, or cumulative impacts to nontargets, including T&E species, could occur under this alternative; however WS does not anticipate any significant cumulative impacts.

Issue 3 - Effects of Damage Management Methods on Human Health and Safety

A common concern is the potential adverse effects that available methods could have on human health and safety. The threats to human safety of methods available under the alternatives are evaluated below by each of the alternatives.

Alternative 1 - Continuing the Current Integrated Approach to Managing Bird Damage (Proposed Action/No Action)

The cooperator requesting assistance is made aware through a MOU, cooperative service agreement, inter-agency agreement, or a similar document that those methods agreed upon could potentially be used on property owned or managed by the cooperator; thereby, making the cooperator aware of the use of those methods on property they own or manage to identify any risks to human safety associated with the use of those methods.

WS would use the Decision Model to determine the appropriate method or methods that would effectively resolve the request for assistance. Those methods would be continually evaluated for effectiveness and if necessary, additional methods could be employed. Risks to human safety from technical assistance conducted by WS would be similar to those risks addressed under the other alternatives. The use of nonlethal methods as part of an integrated approach to managing damage that would be employed as part of direct operational assistance by WS would be similar to those risks addressed by the other alternatives.

Lethal methods available under the proposed action would include the use of firearms, DRC-1339, live-capture followed by euthanasia, and the recommendation that birds be harvested during the regulated hunting season established for those species by the USFWS and the DNREC. Although some formulations of the avicide DRC-1339 are restricted to use by WS only, a similar product containing the same active ingredient as DRC-1339 could be available for use as a restricted use pesticide by other entities.

WS' employees who conduct activities would be knowledgeable in the use of methods, wildlife species responsible for causing damage or threats, and WS' directives. That knowledge would be incorporated into the decision-making process inherent with the WS' Decision Model that would be applied when addressing threats and damage caused by birds. Prior to and during the utilization of lethal methods, WS' employees would consider risks to human safety based on location and method. Risks to human safety from the use of methods would likely be greater in urban areas when compared to rural areas that are less densely populated. Consideration would also be given to the location where damage management activities would be conducted based on property ownership. If locations where methods would be employed occur on private property in rural areas where access to the property is controlled and monitored, the risks to human safety from the use of methods would likely be less. If damage management activities occur at parks or near other public use areas, then risks of the public encountering damage management methods and the corresponding risk to human safety increases. Activities would generally be conducted when human activity is minimal (e.g., early mornings, at night) or in areas where human activities are minimal (e.g., in areas closed to the public).

The use of live-capture traps has also been identified as a potential issue. Live-capture traps are typically set in situations where human activity is minimal to ensure public safety. Traps rarely cause serious injury and are triggered through direct activation of the device. Live-capture traps available for birds are typically walk-in style traps where birds enter, but are unable to exit. Therefore, human safety concerns associated with live traps used to capture birds require direct contact to cause bodily harm.

Other live-capture devices, such as cannon nets, pose minor safety hazards to the public since activation of the device occurs by trained personnel after target species are observed in the capture area of the net. Lasers also pose minimal risks to the public since application occurs directly to target species by trained personnel; thereby, limiting exposure of the public to misuse of the method.

Safety issues can arise related to misusing firearms and the potential human hazards associated with firearm use when employed to reduce damage and threats. To help ensure safe use and awareness, WS' employees who use firearms to conduct official duties are required to attend an approved firearm safety training course and to remain certified for firearm use, WS' employees must attend a re-certification safety training course in accordance with WS Directive 2.615. WS' employees who carry and use firearms as a condition of employment are required to attest that they have not been convicted of a misdemeanor crime of domestic violence. A thorough safety assessment would be conducted before firearms were deemed appropriate to alleviate or reduce damage and threats to human safety when conducting activities. WS would work closely with cooperators requesting assistance to ensure all safety issues were considered before the use of firearms was deemed appropriate. All methods, including firearms, must be agreed upon with the cooperator to ensure the safe use of methods.

All WS' personnel who handle and administer chemical methods would be properly trained in the use of those methods. Training and adherence to agency directives would ensure the safety of employees applying chemical methods. Birds euthanized by WS or removed using chemical methods would be disposed of in accordance with WS Directive 2.515 and applicable federal and state permits. All euthanasia would occur in the absence of the public to further minimize risks. SOPs are further described in Chapter 3 of this EA.

The recommendation of repellents or the use of those repellents registered for use to disperse birds could occur under the proposed action as part of an integrated approach to managing bird damage. Those chemical repellents that would be available to recommend for use or be directly used by WS under this alternative would also be available under any of the alternatives. Therefore, risks to human safety from the recommendation of repellents or the direct use of repellents would be similar across all the alternatives. WS' involvement, either through recommending the use of repellents or the direct use of repellents, would ensure that label requirements of those repellents are discussed with those persons requesting assistance when recommended through technical assistance or would be specifically adhered to by WS' personnel when using those chemical methods. Therefore, the risks to human safety associated with the recommendation of or direct use of repellents could be lessened through WS' participation.

Risks to human safety from the use of avicides could occur either through direct exposure of the chemical or exposure to the chemical from birds that have been lethally removed. DRC-1339 is currently registered for use only by WS to be used for bird damage management in Delaware. The mixing, drying, and storage of DRC-1339 treated bait occurs in controlled areas that are not accessible by the public. Therefore, risks to public safety from the preparation of DRC-1339 are minimal. Some risks do occur to the handlers during the mixing process from inhalation and direct exposure on the skin and eyes. Adherence to label requirements during the mixing and handling of DRC-1339 treated bait for use of personal protective equipment ensures the safety of WS' personnel handling and mixing treated bait. Therefore, risks to handlers and mixers that adhere to the personal protective equipment requirements of the label are low.

Locations where treated bait may be placed are determined based on product label requirements (*e.g.*, distance from water, specific location restrictions), the target bird species use of the site (determined through prebaiting and an acclimation period), on nontarget use of the area (areas with nontarget activity are not used or abandoned), and based on human safety (e.g., in areas restricted or inaccessible by the public or where warning signs have been placed). Once appropriate locations were determined, treated baits would be placed in feeding stations or would be broadcast using mechanical methods (ground-based equipment or hand spreaders) and by manual broadcast (distributed by hand) per label requirements. Once baited using the diluted mixture (treated bait and untreated bait) when required by the label, locations would be monitored for nontarget activity and to ensure the safety of the public. After each baiting session, all uneaten bait would be retrieved. The prebaiting period allows treated bait to be placed at a location only when target birds were conditioned to be present at the site and provides a higher likelihood that treated bait would be consumed by the target species, which makes it unavailable for potential exposure to humans. To be exposed to the bait, someone would have to approach a bait site and handle treated bait. If the bait had been consumed by target species or was removed by WS, then treated bait would no longer be available and human exposure to the bait could not occur. Therefore, direct exposure to treated bait during the baiting process would only occur if someone approached a bait site that contained bait and if treated bait was present, would have to handle treated bait.

Factors that minimize any risk of public health problems from the use of DRC-1339 are: 1) its use is prohibited within 50 feet of standing water and cannot be applied directly to food or feed crops (contrary to some misconceptions, DRC-1339 is not applied to feed materials that livestock can feed upon), 2) DRC-1339 is highly unstable and degrades rapidly when exposed to sunlight, heat, or ultraviolet radiation. The half-life is about 25 hours; in general, DRC-1339 on treated bait material is almost completely broken down within a week if not consumed or retrieved, 3) the chemical is more than 90% metabolized in target birds within the first few hours after they consume the bait. Therefore, little material is left in bird carcasses that may be found or retrieved by people, 4) application rates are extremely low (EPA 1995), 5) a human would need to ingest the internal organs of birds found dead from DRC-1339 to be exposed, and 6) the EPA has concluded that, based on mutagenicity (the tendency to cause gene mutations in cells) studies, this chemical is not a mutagen or a carcinogen (i.e., cancer-causing agent) (EPA 1995).

Of additional concern is the potential exposure of people to crows harvested during the regulated hunting season that have ingested DRC-1339 treated bait. The hunting season for crows occurs from mid-August through mid-March. . Under the proposed action, baiting using DRC-1339 to reduce crow damage could occur during the period of time when crows can be harvested. Although baiting could occur in rural areas during those periods, most requests for assistance to manage crow damage during the period of time when crows can be harvested occur in urban areas associated with urban crow roosts. Crows using urban communal roost locations often travel long distances to forage before returning to the roost location during the evening.

For a crow that ingested DRC-1339 treated bait to pose a potential risk to human safety to someone harvesting crows during the hunting season, a hunter would have to harvest a crow that ingested DRC-1339 treated bait and subsequently consume certain portions of the crow. The mode of action of DRC-1339 requires ingestion by crows so handling a crow harvested or found dead would not pose any primary risks to human safety. Although not specifically known for crows, in other sensitive species, DRC-1339 is metabolized and/or excreted quickly once ingested. In starlings, nearly 90% of the DRC-1339 administered dosages well above the LD_{50} for starlings was metabolized or excreted within 30 minutes of dosage (Cunningham et al. 1979). In one study, more than 98% of a DRC-1339 dose delivered to starlings could be detected in the feces within 2.5 hours (Peoples and Apostolou 1967) with similar results found for other bird species (Eisemann et al. 2003). Once death occurs, DRC-1339 concentrations appear to be highest in the gastrointestinal tract of birds, but some residue could be found in other tissue of carcasses examined (Giri et al. 1976, Cunningham et al. 1979, Johnston et al. 1999) with residues diminishing more slowly in the kidneys (Eisemann et al. 2003). However, most residue tests to detect DRC-1339 in tissues of birds have been completed using DRC-1339 dosages that far exceeded the known acute lethal oral dose for those species tested and far exceeds the level of DRC-1339 that would be ingested from treated bait. Johnston et al. (1999) found DRC-1339 residues in breast tissue of boat-tailed grackles (*Quiscalus major*) using acute doses ranging from 40 to 863 mg/kg. The acute lethal oral dose of DRC-1339 for boat-tailed grackles has been estimated to be ≤ 1 mg/kg, which is similar to the LD_{50} for crows (Eisemann et al. 2003). In those boat-tailed grackles consuming a trace of DRC-1339 up to 22 mg/kg, no DRC-1339 residues were found in the gastrointestinal track nor found in breast tissue (Johnston et al. 1999).

In summary, nearly all of the DRC-1339 ingested by sensitive species is metabolized or excreted quickly, normally within a few hours. Residues of DRC-1339 have been found in the tissues of birds consuming DRC-1339 at very high dosage rates that exceed current acute lethal dosages achieved under the label requirements of DRC-1339. Residues of DRC-1339 ingested by birds appear to be primarily located in the gastrointestinal tract of birds.

Under the proposed action, the controlled and limited circumstances in which DRC-1339 would be used would prevent any exposure of the public to this chemical. Based on current information, the human health risks from the use of DRC-1339 would be virtually nonexistent under this alternative.

The recommendation by WS that birds be harvested during the regulated hunting season, which is established by the DNREC under frameworks determined by the USFWS, would not increase risks to human safety above those risks already inherent with hunting those species. Recommendations of allowing hunting on property owned or managed by a cooperator to reduce bird populations, which could then reduce damage or threats would not increase risks to human safety. Safety requirements established by the DNREC for the regulated hunting season would further minimize risks associated with hunting. Although hunting accidents do occur, the recommendation of allowing hunting to reduce localized populations of birds would not increase those risks.

Direct, Indirect, and Cumulative Effects:
No adverse direct or indirect effects to human safety have occurred from WS' use of methods to alleviate bird damage from FY 2010 through FY 2014. The risks to human safety from the use of nonlethal and lethal methods, when used appropriately and by trained personnel, is considered low. No adverse direct effects to human health and safety are expected through the use of live-capture traps and devices or other nonlethal methods. Since WS personnel are required to complete and maintain firearms safety training, no adverse direct effects to human health and safety are expected as a result of the misuse of firearms by WS personnel. Additionally, all WS personnel are properly trained on all chemicals handled and administered in the field, ensuring their safety as well as the safety of the public. Therefore, adverse direct effects to human health and safety from chemicals used by WS are anticipated to be very low. The amount of chemicals used or stored by WS and cooperating agencies would be minimal to ensure human safety. No adverse indirect effects are anticipated from the application of any of the chemicals available for WS. According to the hazard profile for DCR-1339, it is not likely to cause contaminant of the water supply, especially when used in accordance to label requirements. Based on potential use patterns, the chemical and physical characteristics of the above mentioned toxicants and repellents, and factors related to the environmental fate, no cumulative impacts are expected from the chemical components used or recommended by the WS program in Delaware. Since DCR-1339 is only available to WS and Starlicide, which is available to licensed pesticide applicators, has a similar hazard profile to DCR-1339, WS does not anticipate any adverse cumulative impacts to human health and safety from the use of these chemicals. Since the DNREC requires hunter and trapper safety training for all sportsmen, WS does not expect any additional adverse cumulative impacts to human safety from the use of firearms when recommending that birds be harvested during regulated hunting seasons to help alleviate damage.

Alternative 2 - Bird Damage Management by WS using only Nonlethal Methods

Under this alternative, WS would not use lethal BDM methods. Concerns about human health risks from WS' use of lethal bird damage management methods would be alleviated because no such use would occur. However, Avitrol and the toxicant "Starlicide" which has the same active ingredient as DRC-1339 would be available to licensed pesticide applicators. Benefits to the public from WS BDM activities will depend on the ability of WS to resolve problems using nonlethal methods and the effectiveness of non-WS BDM efforts. In situations where risks to human health and safety from birds cannot be resolved using nonlethal methods, benefits to the public will depend on the efficacy of non-WS use of lethal BDM methods. If lethal BDM programs are implemented by individuals with less experience than WS, they may not be able to effectively resolve the problem or it may take longer to resolve the problem than with a WS program.

Direct, Indirect, and Cumulative Effects:
Since most methods available to resolve or prevent bird damage or threats are available to anyone, the direct, indirect, and cumulative effects to human safety from the use of those methods are similar between the alternatives. Private efforts to reduce or prevent damage would be expected to increase, and would likely result in less experienced persons implementing chemical or other damage management methods which may have variable adverse direct, indirect, and/or cumulative effects to human and pet health and safety than under Alternative 1. Ignorance and/or frustration caused by the inability to reduce losses could lead to illegal use of toxicants by others which could lead to unknown direct, indirect, and/or cumulative impacts to humans and pets. DRC-1339 would not be available under this alternative to non-WS entities experiencing damage or threats from birds and WS would not use DCR-1339 under this

alternative since it is lethal, therefore no cumulative impacts to human health and safety should occur from these chemicals.

Alternative 3 – No Bird Damage Management Conducted by WS

Under the no bird damage management alternative, WS would not be involved with any aspect of managing damage associated with birds, including technical assistance. Due to the lack of involvement in managing damage caused by birds, no impacts to human safety would occur directly from WS. This alternative would not prevent those entities experiencing threats or damage from birds from conducting damage management activities in the absence of WS' assistance. Many of the methods discussed in Appendix B would be available to those persons experiencing damage or threats and could be used to remove birds if permitted by the USFWS and/or the DNREC. The direct burden of implementing permitted methods would be placed on those experiencing damage.

***Direct, Indirect, and Cumulative Effects*:**
Since most methods available to resolve or prevent bird damage or threats are available to anyone, the adverse direct, indirect, and cumulative effects to human safety from the use of those methods are similar between the alternatives. Non-chemical methods available to alleviate or prevent damage associated with birds generally do not pose risks to human safety. Since most non-chemical methods available for bird damage management involve the live-capture or harassment of birds, those methods are generally regarded as posing minimal adverse direct and indirect effects to human safety. Habitat modification and harassment methods are also generally regarded as posing minimal adverse direct and indirect effects to human safety. Although some risks to safety are likely to occur with the use of pyrotechnics, propane cannons, and exclusion devices, those risks are minimal when those methods are used appropriately and in consideration of human safety. DRC-1339 would not be available under this alternative to those experiencing damage or threats from birds, therefore no adverse direct, indirect, or cumulative impacts to human health and safety should occur from these chemicals. The only methods that would be available under this alternative that would involve the direct lethal taking of birds are shooting, publicly available pesticides and repellents, and nest destruction. Under this alternative, shooting and nest destruction would be available to those persons experiencing damage or threats of damage when permitted by the USFWS and the DNREC. Firearms, when handled appropriately and with consideration for safety, pose minimal risks to human safety. However, methods employed by those persons not experienced in the use of methods or are not trained in their proper use, could increase the adverse direct, indirect, and/or cumulative impacts to human safety. Overall, the methods available to the public, when applied correctly and appropriately, pose minimal risks to human safety.

Issue 4 - Effects of Damage Management Activities on the Aesthetic Value of Birds

People often enjoy viewing, watching, and knowing birds exist as part of the natural environment and gain aesthetic enjoyment in such activities. Those methods available to alleviate damage are intended to disperse and/or remove birds. Nonlethal methods are intended to exclude or make an area less attractive, which disperses birds to other areas. Similarly, lethal methods are intended to remove those birds identified as causing damage or posing a threat of damage. The effects on the aesthetic value of birds as it relates to the alternatives are discussed below.

Alternative 1 - Continuing the Current Integrated Approach to Managing Bird Damage (Proposed Action/No Action)

Under the proposed action, methods would be employed that would result in the dispersal, exclusion, or removal of individuals or small groups of birds to resolve damage and threats. In some instances where birds are dispersed or removed, the ability of interested persons to observe and enjoy those birds would likely temporarily decline. Even the use of exclusionary devices can lead to the dispersal of wildlife if the resource being damaged was acting as an attractant. Thus, once the attractant has been removed or made unavailable, the wildlife would likely disperse to other areas where resources are more available.

The use of lethal methods would result in temporary declines in local populations resulting from the removal of birds to address or prevent damage and threats. The goal under the proposed action is to respond to requests for assistance and to manage those birds responsible for the resulting damage. Therefore, the ability to view and enjoy birds would remain if a reasonable effort is made to locate birds outside the area in which damage management activities occurred. Those birds removed by WS are those that could be removed by the person experiencing damage.

All activities are conducted where a request for assistance has been received and only after agreement for such services have been agreed upon by the cooperator. Some aesthetic value would be gained by the removal of birds and the return of a more natural environment, including the return of native wildlife and plant species that may be suppressed or displaced by high bird densities.

***Direct, Indirect, and Cumulative Effects*:**
Since those birds removed by WS under this alternative could be removed with a depredation permit issued by the USFWS, under depredation orders, under control orders, without the need for a permit (non-native species), or the regulated hunting seasons, WS' involvement in taking those birds would not likely be additive to the number of birds that could be removed in the absence of WS' involvement. WS' activities are not likely additive to the birds that would be removed in the absence of WS' involvement. Given the limited removal proposed by WS under this alternative when compared to the known sources of mortality of birds, WS' bird damage management activities conducted pursuant to the proposed action is not expected to cause adverse direct or indirect effects on the aesthetic value of birds. However, WS involvement could lead to positive indirect effects resulting in the return of additional native bird species that otherwise would not be there, which would increase the enjoyment of viewing the birds. The impact on the aesthetic value of birds and the ability of the public to view and enjoy birds under the proposed action would be similar to the other alternatives and is likely insignificant.

When damage caused by birds has occurred, any removal of birds by the property or resource owner would likely occur whether WS was involved with taking the birds or not. Therefore, the activities of WS are not expected to have any adverse cumulative impacts on this element of the human environment if occurring at the request of a property owner and/or manager. No significant cumulative impact is expected because the bird populations are a renewable resource and therefore will be replaced with new birds in the following years. The purpose of WS involvement is to alleviate the damage caused by the bird, not to eradicate the species.

Alternative 2 - Bird Damage Management by WS using only Nonlethal Methods

Under this alternative, WS would not conduct any lethal BDM, but may conduct harassment of birds that are causing damage. Other nonlethal methods may be conducted as well under this alternative to help alleviate damage caused by birds.

***Direct, Indirect, and Cumulative Effects*:**
Although WS would not perform any lethal activities under this alternative, other private entities would likely conduct BDM activities similar to those that would no longer be conducted by WS, which means the direct and indirect effects would then be similar to the Proposed Action Alternative. Cumulative impacts are expected to be similar to Alternative 1 as well.

Assuming property owners would choose to allow and pay for the implementation of nonlethal methods by WS, this alternative could result in birds relocating to other sites where they would likely cause or aggravate similar problems for other property owners. Thus, this alternative would likely result in more property owners experiencing adverse direct and/or indirect effects on the aesthetic values of their properties than the Proposed Action Alternative. If WS is providing direct operational assistance in relocating such birds, coordination with local authorities may be conducted to assure they do not re-establish in other undesirable locations.

Alternative 3 – No Bird Damage Management Conducted by WS

Under the no bird damage management by WS alternative, the actions of WS would have no impact on the aesthetic value of birds. Those persons experiencing damage or threats from birds would be responsible for researching, obtaining, and using all methods as permitted by federal, state, and local laws and regulations. The degree to which damage management activities would occur in the absence of assistance by any agency is unknown but likely lower compared to damage management activities that would occur where some level of assistance was provided. Birds could still be dispersed or removed under this alternative by those persons experiencing damage or threats of damage. Removal could also occur during the regulated harvest season, pursuant to the blackbird and cormorant depredation orders, pursuant to the Muscovy duck control order, and in the case of non-native species, removal could occur any time without the need for a depredation permit.

Direct, Indirect, and Cumulative Effects:
The potential direct and indirect effects on the aesthetic values of birds could be similar to the proposed action if similar levels of damage management activities are conducted by those persons experiencing damage or threats or is provided by other entities. If no action is taken or if activities are not permitted by the USFWS and the DNREC, then no direct or indirect effect on the aesthetic value of birds would occur under this alternative.

Since birds could continue to be removed under this alternative, despite WS' lack of involvement, the ability to view and enjoy birds would likely be similar to the other alternatives. The lack of WS' involvement would not lead to a reduction in the number of birds dispersed or removed since WS' has no authority to regulate removal or the harassment of birds. The USFWS and the DNREC with management authority over birds would continue to adjust all removal levels based on population objectives for those bird species. Therefore, the number of birds lethally removed annually through hunting, under the depredation/control orders, and pursuant to depredation permits are regulated and adjusted by the USFWS and the DNREC. The cumulative impacts to the aesthetic value of birds would be similar to the other alternatives.

Summary
No significant cumulative environmental impacts are expected from any of the proposed actions analyzed in this EA. Under the Current/Proposed Action, the lethal removal of birds by WS has not and would not have a significant impact on overall bird populations in Delaware or nationwide, but some local reductions may occur. No risk to public safety is expected when WS' services are provided and accepted by continuing the BDM program with the included supplemental actions since only trained and experienced wildlife biologists/specialists would conduct and recommend bird damage management activities. Although some persons will likely be opposed to WS' participation in bird damage management activities on public and private lands, the analysis in this EA indicates that WS integrated bird damage management program would not result in significant adverse cumulative impacts on the quality of the human environment.

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APPENDIX A

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APPENDIX B

BIRD DAMAGE MANAGEMENT METHODS AVAILABLE FOR USE

NONLETHAL METHODS - NONCHEMICAL

Agricultural producer and property owner practices. These consist primarily of nonlethal preventive methods such as cultural methods and habitat modification. Cultural methods and other management techniques are implemented by the agricultural producer or property owners/managers. Resource owners/managers may be encouraged to use these methods, based on the level of risk, need, and professional judgment on their effectiveness and practicality. These methods include:

Cultural methods. These may include altering planting dates so that crops are not young and more vulnerable to damage when the damage-causing species is present, or the planting of crops that are less attractive or less vulnerable to such species. At feedlots or dairies, cultural methods generally involve modifications to the level of care or attention given to livestock which may vary depending on the age and size of the livestock. Animal husbandry practices include, but are not limited to, techniques such as night feeding, indoor feeding, closed barns or corrals, removal of spilled grain or standing water, and use of bird proof feeders (Johnson and Glahn 1994).

Environmental/Habitat modification can be an integral part of bird damage management. Wildlife production and/or presence are directly related to the type, quality, and quantity of suitable habitat. Therefore, habitat can be managed to reduce or eliminate the production or attraction of certain bird species or to repel certain birds. In most cases, the resource or property owner is responsible for implementing habitat modifications, and WS only provides advice on the type of modifications that have the best chance of achieving the desired effect. Habitat management is most often a primary component of bird damage management strategies at or near airports to reduce bird aircraft strike problems by eliminating bird nesting, roosting, loafing, or feeding sites. Generally, many bird problems on airport properties can be minimized through management of vegetation and water from areas adjacent to aircraft runways. Habitat management is often necessary to minimize damage caused by crows and blackbirds that form large roosts during late autumn and winter. Bird activity can be greatly reduced at roost sites by removing all the trees or selectively thinning the stand.

Animal behavior modification. This refers to tactics that alter the behavior of wildlife to reduce damage. Animal behavior modification may involve use of scare tactics or fencing to deter or repel animals that cause loss or damage (Twedt and Glahn 1982). Some but not all methods that are included by this category are bird-proof barriers, electronic guards, propane exploders, pyrotechnics, distress calls and sound producing devices, chemical frightening agents, repellents, scarecrows, mylar tape, lasers, and eye-spot balloons.

These techniques are generally only practical for small areas. Scaring devices such as distress calls, helium-filled eyespot balloons, raptor effigies and silhouettes, mirrors, and moving disks can be effective, but usually for only a short time before birds become accustomed and learn to ignore them (Arhart 1972, Rossbach 1975, Conover 1982, Schmidt and Johnson 1983, Mott 1985, Graves and Andelt 1987, Bomford 1990). Mylar tape has produced mixed results in its effectiveness to frighten birds (Dolbeer et al. 1986, Tobin et al. 1988).

Paintball guns are used as a nonlethal harassment method to disperse birds from areas using physical harassment. Paintballs are most often used to harass waterfowl. Paintballs can be used to produce physically and visually negative-reinforcing stimuli that can aid in the dispersal of birds from areas where damages or threats of damages are occurring.

Bird proof barriers can be effective, but are often cost-prohibitive, particularly because of the aerial mobility of birds which requires overhead barriers as well as peripheral fencing or netting. Exclusion adequate to stop bird movements can also restrict movements of livestock, people and other wildlife (Fuller-Perrine and Tobin 1993).

Overhead wire grids can deter crow use of specific areas where they are causing a nuisance (Johnson 1994). The birds apparently fear colliding with the wires and thus avoid flying into areas where the method has been employed. Netting can be used to exclude birds from a specific area by the placement of bird proof netting over and around the specific resource to be protected. Exclusion may be impractical in most settings (e.g., commercial agriculture), however it can be practical in small areas (e.g., personal gardens) or for high-value crops (e.g., grapes) (Johnson 1994). Although this alternative would provide short-term relief from damage, it may not completely deter birds from feeding, loafing, staging, or roosting at that site. A few people would find exclusionary devices such as netting unsightly, trashy, and cause a decreased aesthetic value of the neighborhood when used over personal gardens.

Auditory scaring devices such as propane exploders, pyrotechnics, electronic guards, scare crows, and audio distress/predator vocalizations are effective in many situations for dispersing damage-causing bird species. These devices are sometimes effective, but usually only for a short period of time before birds become accustomed and learn to ignore them (Arhart 1972, Rossbach 1975, Schmidt and Johnson 1983, Mott 1985, Bomford 1990). Williams (1983) reported an approximate 50% reduction in blackbirds at two south Texas feedlots as a result of pyrotechnics and propane cannon use. However, they are often not practical in dairy or feedlot situations because of the disturbance to livestock, although livestock can generally be expected to habituate to the noise. Birds, too, quickly learn to ignore scaring devices if the birds' fear of the methods is not reinforced with shooting or other tactics.

Visual scaring techniques such as use of Mylar tape (highly reflective surface produces flashes of light that startles birds), eye-spot balloons (the large eyes supposedly give birds a visual cue that a large predator is present), flags, effigies (scarecrows), sometimes are effective in reducing bird damage. Mylar tape has produced mixed results in its effectiveness to frighten birds (Dolbeer et al. 1986, and Tobin et al. 1988). Birds quickly learn to ignore visual and other scaring devices if the birds' fear of the methods is not reinforced with shooting or other tactics.

Lasers are a nonlethal technique recently evaluated by the NWRC (Glahn et al. 2000, Blackwell et al. 2002). For best results and to disperse numerous birds from a roost, the laser is most effectively used in periods of low light, such as after sunset and before sunrise. In the daytime, the laser can also be used during overcast conditions or in shaded areas to move individual and small numbers of birds, although the effective range of the laser is much diminished. Blackwell et al. (2002) tested lasers on several bird species and observed varied results among species. Lasers were ineffective at dispersing mallards with birds habituating in approximately 5 minutes and 20 minutes, respectively (Blackwell et al. 2002). As with other bird damage management tools lasers are most effective when used as part of an integrated management program.

Live traps (although live traps are nonlethal, birds may be euthanized upon capture). In most situations, live trapped birds are subsequently euthanized. Relocation to other areas following live capture would not generally be effective because problem bird species are highly mobile and can easily return to damage sites from long distances; habitats in other areas are generally already occupied; and relocation would most likely result in bird damage problems at the new location. Translocation of wildlife is also discouraged by WS' policy (WS Directive 2.501) because of stress to the relocated animal, poor survival rates, and difficulties in adapting to new locations or habitats. Live traps include:

Decoy traps are used by WS for preventive and corrective damage management. Decoy traps are similar in design to the Australian Crow Trap as reported by McCracken (1972) and Johnson and Glahn (1994). Live decoy birds of the same species that are being targeted are usually placed in the trap with sufficient food and water to assure their survival. Perches are configured in the trap to allow birds to roost above the ground and in a more natural position. Feeding behavior and calls of the decoy birds attract other birds which enter and become trapped themselves. Active decoy traps are monitored daily to remove and euthanize excess birds and to replenish bait and water. Decoy traps and other cage/live traps, as applied and used by WS, pose no danger to pets or the public and if a pet is accidentally captured in such traps, it can be released unharmed.

Nest box traps may be used by WS for corrective damage management and are effective in capturing cavity nesting birds (DeHaven and Guarino 1969, Knittle and Guarino 1976).

Mist nets are more commonly used for capturing small-sized birds, but can be used to capture larger birds such as ducks and ring-neck pheasants or even smaller nuisance hawks and owls. It was introduced into the United States in the 1950s from Asia and the Mediterranean where it was used to capture birds for the market (Day et al. 1980). The mist net is a fine black silk or nylon net usually 3 to 10 feet wide and 25 to 35 feet long. Net mesh size determines which birds can be caught and overlapping pockets in the net cause birds to entangle themselves when they fly into the net.

Cannon nets are normally used for larger birds and use mortar projectiles to propel a net up and over birds which have been baited to a particular site.

Raptor traps are varied in form and function and includes but is not limited to Bal-chatri, Dho Gaza traps, Phai hoop traps, and Swedish goshawk traps. These traps could be used specifically to live-trap raptors.

Corral traps could be used to live-capture birds, primarily geese and other waterfowl. Corral traps can be effectively used to live capture Canada geese during the annual molt when birds are unable to fly. Each year for a few weeks in the summer, geese are flightless as they are growing new flight feathers. Therefore, geese can be slowly guided into corral-traps.

Funnel traps could be used to live-capture waterfowl. Traps are set up in shallow water and baited. Funnel traps allow waterfowl to enter the trap but prevents the ducks from exiting. Traps would be checked regularly to address live-captured waterfowl. Captured ducks can be relocated or euthanized.

Nest/egg destruction is the removal of nesting materials during the construction phase of the nesting cycle. Nest destruction is generally only applied when dealing with a single bird or very few birds. This method is used to discourage birds from constructing nests in areas, which may create nuisances or safety issues for home and business owners. Removal of nests is intended to deter birds from nesting in the same area again. Birds generally attempt to re-nest, so the method may need to be conducted repeatedly throughout the nesting season, and over several years. Heusmann and Bellville (1978) reported that nest removal was an effective, but time-consuming, method because problem bird species are highly mobile and can easily return to damage sites from long distances, or because of high populations. This method poses no imminent danger to pets or the public.

Egg Treatment (addling/shaking, puncturing, or oiling) is a method of suppressing reproduction in local nuisance bird populations by destroying egg embryos to arrest their development and eliminate hatching. Treated eggs are returned to the nest and the adult bird remains attached to the nest site. Treatment of eggs is typically done where the current number of birds is tolerable, but additional birds would not be.

Treatment of eggs will not reduce the overall problem bird population, but may slow its growth and make adult birds more responsive to harassment (also see *Egg oiling* below).

Lure crops/alternate foods. When damage cannot be avoided by careful crop selection or modified planting schedules, lure crops can sometimes be used to mitigate the loss potential. Lure crops are planted or left for consumption by wildlife as an alternative food source. This approach provides relief for critical crops by sacrificing less important or specifically planted fields. Establishing lure crops is sometimes expensive, requires considerable time and planning to implement, and may attract other unwanted species to the area.

NONLETHAL METHODS - CHEMICAL

Avitrol is a chemical frightening agent (repellent) that is effective in a single dose when mixed with untreated baits, normally in a 1:9 ratio. Avitrol, however, is not completely nonlethal in that a small portion of the birds are generally killed (Johnson and Glahn 1994). Prebaiting is usually necessary to achieve effective bait acceptance by the target species. This chemical is registered for use on pigeons, crows, blackbirds, starlings, and house sparrows in various situations. Avitrol treated bait is placed in an area where the targeted birds are feeding. When a treated particle is consumed, affected birds begin to broadcast distress vocalizations and display abnormal flying behavior, thereby frightening the remaining flock away.

Avitrol is a restricted-use pesticide that can only be sold to certified applicators and is available in several bait formulations where only a small portion of the individual grains carry the chemical. It can be used during anytime of the year, but is used most often during winter and spring. Any granivorous bird associated with the target species could be affected by Avitrol. Avitrol is water soluble, but laboratory studies demonstrated that Avitrol is strongly absorbed onto soil colloids and has moderately low mobility. Biodegradation is expected to be slow in soil and water, with a half-life ranging from three to 22 months. However, Avitrol may form covalent bonds with humic materials, which may serve to reduce its availability for intake by organisms from water, is non-accumulative in tissues and rapidly metabolized by many species (Schafer, Jr. 1991).

Avitrol is acutely toxic to avian and mammalian species, however, blackbirds are more sensitive to the chemical and there is little evidence of chronic toxicity. Laboratory studies with predator and scavenger species have shown minimal potential for secondary poisoning and during field use only magpies and crows appear to have been affected (Schafer, Jr. 1991). However, a laboratory study by Schafer, Jr. et al. (1974) showed that magpies exposed to two to 3.2 times the published LD_{50} in contaminated prey for 20 days were not adversely affected and three American kestrels that were fed contaminated blackbirds for seven to 45 days were not adversely affected. Some hazards may occur to predatory species consuming unabsorbed chemical in the GI tract of affected or dead birds (Schafer, Jr. 1981, Holler and Shafer 1982).

Methyl anthranilate (artificial grape flavoring used in foods and soft drinks for human consumption) could be used or recommended by WS as a bird repellent. Methyl anthranilate (MA) (artificial grape flavoring food additive) has been shown to be a promising repellent for many bird species, including waterfowl (Dolbeer et al. 1993). Cummings et al. (1995) found effectiveness of MA declined significantly after 7 days. Belant et al. (1996) found MA ineffective as a bird grazing repellent, even when applied at triple the recommended label rate. MA is also under investigation as a potential bird taste repellent. MA may become available for use as a livestock feed additive (Mason et al. 1984, Mason et al. 1989). It is registered for applications to turf or to surface water areas used by unwanted birds. The material has been shown to be nontoxic to bees (LD_{50} > 25 micrograms/bee[10]), nontoxic to rats in an inhalation study (LC_{50} > 2.8 mg/L[11]), and of relatively low toxicity to fish and other invertebrates. Methyl anthranilate is naturally occurring in concord grapes and in the blossoms of several species of flowers and is used as a food additive and perfume ingredient (Dolbeer et al. 1992). It has been listed as "*Generally Recognized as Safe*" by the U.S. Food and Drug Administration (Dolbeer et al. 1992).

Water surface and turf applications of MA are generally considered expensive. For example, the least intensive application rate required by label directions is 20 lbs. of product (8 lbs. active ingredient) per acre of surface water at a cost of about $64/lb. with retreating required every 3-4 weeks. Cost of treating turf areas would be similar on a per acre basis. In addition, MA completely degrades in about 3 days when applied to water, which indicates the repellent effect is short-lived.

Another potentially more cost effective method of MA application is by use of a fog-producing machine (Vogt 1997). The fog drifts over the area to be treated and is irritating to the birds, while being non-irritating to any humans that might be exposed. Fogging applications must generally be repeated 3-5 times after the initial treatment before the birds abandon a treatment site. Applied at a rate of about 0.25 lb/acre of water surface, the cost is considerably less than when using the turf or water treatment methods.

MA is also being investigated as a livestock feed additive to reduce or prevent feed consumption by birds. Such chemicals undergo rigorous testing and research to prove safety, effectiveness, and low environmental risks before they would be registered by EPA or the FDA.

Other chemical repellents. A number of other chemicals have shown bird repellent capabilities. Anthraquinone, a naturally occurring chemical found in many plant species and in some invertebrates as a natural predator defense mechanism, has shown effectiveness in protecting rice seed from red-winged blackbirds and boat-tailed grackles (Avery et al. 1997). It has also shown effectiveness as a foraging repellent against Canada goose grazing on turf and as a seed repellent against brown-headed cowbirds (Dolbeer et al. 1998).

Tactile repellents. A number of tactile repellent products are on the market which reportedly deters birds from roosting on certain structural surfaces by presenting a tacky or sticky surface that the birds avoid. However, experimental data in support of this claim are sparse (Mason and Clark 1992). The repellency of tactile products is generally short-lived because of dust, and they sometimes cause aesthetic problems and expensive clean-up costs by running down the sides of buildings in hot weather.

Egg oiling is a method for suppressing reproduction of nuisance birds by spraying a small quantity of food grade vegetable oil or mineral oil on eggs in nests. The oil prevents exchange of gases and causes asphyxiation of developing embryos and has been found to be 96-100% effective in reducing hatchability (Pochop 1998, Pochop et al. 1998). The method has an advantage over nest or egg destruction in that the incubating birds generally continue incubation and do not re-nest. The EPA has ruled that use of corn oil for this purpose is exempt from registration requirements under FIFRA. To be most effective, the oil should be applied anytime between the fifth day after the laying of the last egg in a nest and at least five days before anticipated hatching. This method is extremely target specific and is less labor intensive than egg addling.

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[10] An LD_{50} is the dosage in milligrams of material per kilogram of body weight, or, in this case in micrograms per individual bee, required to cause death in 50% of a test population of a species.

[11] An LC_{50} is the dosage in milligrams of material per liter of air required to cause death in 50% of a test population of a species through inhalation.

Resource Management. Resource management includes a variety of practices that may be used by resource owners to reduce the potential for wildlife damage. Implementation of these practices is appropriate when the potential for damage can be reduced without significantly increasing a resource owner's costs or diminishing his/her ability to manage resources pursuant to goals. Resource management recommendations are made through WS technical assistance efforts.

LETHAL METHODS - MECHANICAL

Shooting is more effective as a dispersal technique than as a way to reduce bird densities when large numbers of birds are present. Normally shooting is conducted with shotguns, rifles or air rifles. Shooting is a very individual specific method and is normally used to remove a single offending bird. However, at times, a few birds could be shot from a flock to make the remainder of the birds more wary and to help reinforce nonlethal methods. It is selective for target species and may be used in conjunction with the use of spotlights, decoys, and calling. Shooting with shotguns, air rifles, or rim and center fire rifles is sometimes used to manage bird damage problems when lethal methods are determined to be appropriate. The birds are killed as quickly and humanely as possible. All firearm safety precautions are followed by WS when conducting bird damage management activities and all laws and regulations governing the lawful use of firearms are strictly complied with.

Firearm use is very sensitive and a public concern because of safety issues relating to the public and misuse. To ensure safe use and awareness, WS' employees who use firearms to conduct official duties are required to attend an approved firearms safety and use training program within 3 months of their appointment and a refresher course every 2 years afterwards (WS Directive 2.615). WS' employees, who carry firearms as a condition of employment, are required to sign a form certifying that they meet the criteria as stated in the *Lautenberg Amendment* which prohibits firearm possession by anyone who has been convicted of a misdemeanor crime of domestic violence.

Sport hunting is sometimes recommended by WS as a viable damage management method when the target species can be legally hunted. A valid hunting license and other licenses or permits may be required by the DNREC and the USFWS for certain species. This method provides sport and food for hunters and requires no cost to the landowner. Sport hunting is occasionally recommended if it can be conducted safely for crow damage management around crops or other resources.

Cervical dislocation is sometimes used to euthanize birds which are captured in live traps. The bird is stretched and the neck is hyper-extended and dorsally twisted to separate the first cervical vertebrae from the skull. The AVMA approves this technique as a humane method of euthanasia and states that cervical dislocation when properly executed is a humane technique for euthanasia of poultry and other small birds (Beaver et al. 2001). Cervical dislocation is a technique that may induce rapid unconsciousness, does not chemically contaminate tissue, and is rapidly accomplished (Beaver et al. 2001).

Snap traps are modified rat snap traps used to remove individual birds, and other cavity using birds. The trap treadle is baited with peanut butter or other food attractants and attached near the damage area caused by the offending bird. These traps pose no imminent danger to pets or the public, and are usually located in positions inaccessible to people and most non-avian animals. They are very selective because they are usually set in the defended territory of the target birds.

LETHAL METHODS - CHEMICAL

All chemicals used by WS are registered as required by the FIFRA (administered by the EPA). WS' personnel that use restricted-use chemical methods are certified as pesticide applicators by the State of Delaware and are required to adhere to all certification requirements set forth in FIFRA and Delaware pesticide control laws and regulations. Chemicals are only used on private, public, or tribal property sites with authorization from the property owner/manager.

CO_2 is sometimes used to euthanize birds which are captured in live traps. Live birds are placed in a container such as a plastic 5-gallon bucket or chamber and sealed shut. CO_2 gas is released into the bucket or chamber and birds quickly die after inhaling the gas. This method is approved as a euthanizing agent by the AVMA (Beaver et al. 2001). CO_2 gas is a byproduct of animal respiration, is common in the atmosphere, and is required by plants for photosynthesis. It is used to carbonate beverages for human consumption and is also the gas released by dry ice. The use of CO_2 by WS for euthanasia purposes is exceedingly minor and inconsequential to the amounts used for other purposes by society.

DRC-1339. For more than 30 years, DRC-1339 (3-chloro-p-toluidine hydrochloride) has proven to be an effective method of starling, blackbird, gull, and pigeon control at feedlots, dairies, airports, and in urban areas (DeCino et al. 1966, Besser et al. 1967, West et al. 1967). Studies continue to document the effectiveness of DRC-1339 in resolving blackbird/starling problems at feedlots (West and Besser 1976, Glahn 1982, Glahn et al. 1987), and dispersing crow roosts in urban/suburban areas (Boyd and Hall 1987). Glahn and Wilson (1992) noted that baiting with DRC-1339 is a cost-effective method of reducing damage by blackbirds to sprouting rice.

DRC-1339 is a slow acting avicide that is registered with the EPA for reducing damage from several species of birds, including blackbirds, starlings, pigeons, crows, ravens, magpies, and gulls. DRC-1339 was developed as an avicide because of its differential toxicity to mammals. DRC-1339 is highly toxic to sensitive species but only slightly toxic to non-sensitive birds, predatory birds, and mammals (Schafer, Jr. 1981, Schafer, Jr. 1991, Johnston et al. 1999). For example, starlings, a highly sensitive species, require a dose of only 0.3 mg/bird to cause death (Royall et al. 1967). Most bird species that are responsible for damage, including starlings, blackbirds, pigeons, crows, magpies, and ravens are highly sensitive to DRC-1339. Many other bird species such as raptors (Schafer, Jr. 1981), sparrows, and eagles are classified as non-sensitive. Numerous studies show that DRC-1339 poses minimal risk of primary poisoning to nontarget and T&E species (EPA 1995). Secondary poisoning has not been observed with DRC-1339 treated baits, except crows eating gut contents of pigeons (Kreps 1974). During research studies, carcasses of birds which died from DRC-1339 were fed to raptors and scavenger mammals for 30 to 200 days with no symptoms of secondary poisoning observed (Cunningham et al. 1981). This can be attributed to relatively low toxicity to species that might scavenge on blackbirds and starlings killed by DRC-1339 and its tendency to be almost completely metabolized in the target birds which leaves little residue to be ingested by scavengers. Secondary hazards of DRC-1339 are almost nonexistent (Schafer, Jr. 1984, Schafer, Jr. 1991, Johnston et al. 1999). DRC-1339 acts in a humane manner producing a quiet and apparently painless death.

DRC-1339 is unstable in the environment and degrades rapidly when exposed to sunlight, heat, or ultra violet radiation. DRC-1339 is highly soluble in water but does not hydrolyze and degradation occurs rapidly in water. DRC-1339 tightly binds to soil and has low mobility. The half-life is about 25 hours, which means it is nearly 100% broken down within a week, and identified metabolites (*i.e.*, degradation chemicals) have low toxicity. Although DRC-1339 is highly toxic to aquatic invertebrates (EPA 1995), following labeling requirements eliminates the risks to nontarget mussel species. These label requirements include application more than 50 feet from a body of water, observation and pre-baiting to ensure the rapid uptake of treated bait by the target bird species.

APPENDIX C

Bird Species Evaluated in the Environmental Assessment for Delaware

Species		Species	
American coot	*Fulica americana*	Hairy Woodpecker	*Picoides villosus*
American crow	*Corvus brachyrhynchos*	House finch	*Haemorhous mexicanus*
American kestrel	*Falco sparverius*	House sparrow (English)	*Passer domesticus*
Bank swallow	*Riparia riparia*	Killdeer	*Charadrius vociferous*
Barn owl	*Tyto alba*	Laughing gull	*Leucophaeus atricilla*
Barn swallow	*Hirundo rustica*	Mallard (domestic/wild)	*Anas platyrhynchos*
Barred owl	*Strix varia*	Mourning dove	*Zenaida macroura*
Black vulture	*Coragyps atratus*	Mute swan	*Cygnus olor*
Blue jay	*Cyanocitta cristata*	Northern cardinal	*Cardinalis cardinalis*
Bonaparte's gull	*Chroicocephalus philadelphia*	Northern flicker	*Colaptes auratus*
Broad-winged hawk	*Buteo platypterus*	Northern harrier	*Circus cyaneus*
Brown-headed cowbird	*Molothrus ater*	Northern mockingbird	*Mimus polyglottos*
Canada goose	*Branta canadensis*	Osprey	*Pandion haliaetus*
Cattle egret	*Bubulcus ibis*	Pileated woodpecker	*Dryocopus pileatus*
Chimney swift	*Chaetura pelagica*	Red-bellied woodpecker	*Melanerpes carolinus*
Common grackle	*Quiscalus quiscula*	Red-shouldered hawk	*Buteo lineatus*
Cooper's hawk	*Accipiter cooperii*	Red-tailed hawk	*Buteo jamaicensis*
Double-crested cormorant	*Phalacrocorax auritus*	Red-winged blackbird	*Agelaius phoeniceus*
Downy woodpecker	*Picoides pubescens*	Ring-billed gull	*Larus delawarensis*
Eastern meadowlark	*Sturnella magna*	Rock pigeon (feral)	*Columba livia*
European starling	*Sturnus vulgaris*	Sharp-shinned hawk	*Accipter striatus*
Fish crow	*Corvus ossifragus*	Snow goose	*Chen caerulescens*
Free-ranging or feral domestic waterfowl[12]		Snowy egret	*Egretta thula*
Gray catbird	*Durnetella carolinensis*	Snowy owl	*Bubo scandiacus*
Great black-backed gull	*Larus marinus*	Tree swallow	*Tachycineta bicolor*
Great blue heron	*Ardea herodias*	Turkey vulture	*Cathartes aura*
Great egret	*Ardea alba*	Yellow-bellied sapsucker	***Sphyrapicus varius***
Great-horned Owil	*Bubo virginanus*		

[12] Free-ranging or feral domestic waterfowl refers to captive-reared, domestic, of some domestic genetic stock, or domesticated breeds of ducks, geese, and swans. Examples of domestic waterfowl include, but are not limited to, mute swans, Muscovy ducks, Pekin ducks, Rouen ducks, Cayuga ducks, Swedish ducks, Chinese geese, Toulouse geese, Khaki Campbell ducks, Embden geese, and pilgrim geese. Feral ducks may include a combination of mallards, Muscovy duck, and mallard-Muscovy hybrids.

APPENDIX D

USFWS Listing of Threatened and Endangered Species in Delaware

Summary of Animals listings

Status	Species/Listing Name
E	Atlantic Ridley Turtle (*Lepidochelys kempi*)
T	Bog Turtle (*Clemmys muhlenbergii*)
E	Delmarva Fox Squirrel (*Sciurus niger cinereus*)
E	Finback Whale (*Balaenoptera physalus*)
T	Green Turtle (*Chelonia mydas*)
E	Hawksbill Turtle (*Eretmochelys imbricate*)
E	Humpback Whale (*Megaptera novaeangliae*)
E	Leatherback Turtle (*Dermochelys coriacea*)
T	Loggerhead Turtle (*Caretta caretta*)
T	Piping Plover (*Charadrius melodus*)
E	Right Whale (*Eubalaena spp.*)
E	Shortnose Sturgeon (*Acipenser brvirostrum*)

Summary of Plant listings

Status	Species/Listing Name
C	Bog Asphodel (*Narthecium americanum*)
E	Canby's Dropwort (*Oxypolis canbyi*)
C	Hirsts' Panic Grass (*Dichanthelium hirstii*)
T	Knieskerns Beackrush (*Rhynchospora knieskernii*)
T	Seabeach Amaranth (*amaranthus pumilus*)
T	Small-whorled Pogonia (*Isotria medeoloides*)
T	Swamp Pink (*Helonius bullata*)

Notes:

- **As of 01/28/2011 the data in this report has been updated to use a different set of information. Results are based on where the species is believed to or known to occur. The FWS feels utilizing this data set is a better representation of species occurrence. Note: there may be other federally listed species that are not currently known or expected to occur in this state but are covered by the ESA wherever they are found; Thus if new surveys detected them in this state they are still covered by the ESA. The FWS is using the best information available on this date to generate this list.**

- This report shows listed species or populations believed to or known to occur in Delaware
- This list does not include experimental populations and similarity of appearance listings.
- This list includes species or populations under the sole jurisdiction of the National Marine Fisheries Service.
- Click on the highlighted scientific names below to view a Species Profile for each listing.

Obtained from the USFWS website at https://www.fws.gov/chesapeakebay/endsppweb/lists/DEspeciesList.pdf on 10/03/2017.

APPENDIX E

DELAWARE'S ENDANGERED ANIMALS

Delaware Natural Resources and Environmental Control
Wildlife Species Conservation and Research Program

Mollusks		
Dwarf wedge mussel	***Alasmidonta heterodon***	**Endangered**
Triangle floater	***Alasmidonta undulate***	**Endangered**
Brook floater	***Alasmidonta varicosa***	**Endangered**
Yellow Lampmussel	***Lampsilis cariosa***	**Endangered**
Eastern Lampmussel	***Lampsilis radiate***	**Endangered**
Tidewater Mucket	***Leptodea ochracea***	**Endangered**
Eastern Pondmussel	***Ligumia nasuta***	**Endangered**
Insects		
Black-tipped Darner	***Aeshna tuberculifera***	**Endangered**
Marbled Underwing	***Catocala marmorata***	**Endangered**
Ulalume Underwing	***Catocala ulalume***	**Endangered**
Little White Tiger Beetle	***Cicindela Iepida***	**Endangered**
White Tiger Beetle	***Cicinidela dorsalis***	**Endangered**
Brown Spiketail	***Cordulegaster bilineata***	**Endangered**
Burgundy Bluet	***Enallagma dubium***	**Endangered**
Pale Bluet	***Enallagma pallidum***	**Endangered**
Baltimore Checkerspot	***Euphydryas phaeton***	**Endangered**
Black Dash	***Euphyes conspicua***	**Endangered**
Taper-tailed Darner	***Gomphaeschna antelope***	**Endangered**
Banner Clubtail	***Gomphus apomyius***	**Endangered**
Midland Clubtail	***Gomphus fraternus***	**Endangered**
Sable Clubtail	***Gomphus rogersi***	**Endangered**
Sely's Sundragon	***Helocordulia selysii***	**Endangered**
Seth Forest Scavenger Beetle	***Hydrochus spangleri***	**Endangered**
Frosted Elfin	***Incisalia irus***	**Endangered**
Hessel's Hairstreak	***Mitoura hesseli***	**Endangered**
Elfin Skimmer	***Nannothemis bella***	**Endangered**
Pitcher Plant Borer Moth	***Papaipema appassionata***	**Endangered**
Aralia Shoot Borer Moth	***Papaipema araliae***	**Endangered**
Yellow Stoneroot Borer Moth	***Papaipema astute***	**Endangered**
Dark Stoneroot Borer Moth	***Papaipema duplicatus***	**Endangered**
Maritime Sunflower Borer Moth	***Papaipema maritima***	**Endangered**
Bethany Beach Firefly	***Photuris bethaniensis***	**Endangered**
Chermock's Mulberry Wing	***Poanes massasoit chermocki***	**Endangered**
Mulberry Wing	***Poanes massasoit massasoit***	**Endangered**
Rare Skipper	***Problema bulenta***	**Endangered**
King's Hairstreak	***Satyrium kingi***	**Endangered**
Treetop Emerald	***Somatochlora provocans***	**Endangered**
Laura's Clubtail	***Stylurus laurae***	**Endangered**

Fish		
Shortnose Sturgeon	***Acipenser brevirostrum***	
Atlantic Sturgeon	***Acipenser oxyrhynchus***	**Endangered**
Blueridge Sculpin	***Cottus caeruleomentum***	**Endangered**
Blackbanded Sunfish	***Enneacanthus chaetodon***	**Endangered**
Glassy Darter	***Etheostoma vitreum***	**Endangered**
Bridled Shiner	***Notropis bifrenatus***	**Endangered**
Ironcolor Shiner	***Notropis chalybaeus***	**Endangered**
Amphibians		
Eastern Tiger Salamander	***Ambystoma tigrinum tigrinum***	**Endangered**
Barking Treefrog	***Hyla gratiosa***	**Endangered**
Eastern Mud Salamander	***Myotis lucifugus***	**Endangered**
Reptiles		
Loggerhead Turtle	***Caretta caretta***	**Endangered**
Eastern Scarlet Snake	***Cemophora coccinea***	**Endangered**
Green Turtle	***Chelonia mydas***	**Endangered**
Bog turtle	***Clemmys muhlenbergii***	**Endangered**
Leatherback Turtle	***Demochels coriacea***	**Endangered**
Kemp's Ridley Turtle	***Lepidochelys kempii***	**Endangered**
Redbelly Watersnake	***Nerodia erythogaster***	**Endangered**
Corn Snake	***Pantherophis guttata guttata***	**Endangered**
Birds		
Henslow's Sparrow	***Ammodramus henslowii***	**Endangered**
Short-eared Owl	***Asio flammeus***	**Endangered**
Upland Sandpiper	***Bartramia longicauda***	**Endangered**
Broad-winged Hawk	***Buteo platypterus***	**Endangered**
Red Knot	***Calidris canutus***	**Endangered**
Piping Plover	***Charadrius melodus***	**Endangered**
Northern Harrier	***Circus cyaneus***	**Endangered**
Sedge Wren	***Cistothorus platensis***	**Endangered**
American Kestrel	***Falco sparverius***	**Endangered**
American Oystercatcher	***Haematopus palliates***	**Endangered**
Black Rail	***Laterallus jamaicensis***	**Endangered**
Swainson's Warbler	***Limnothlypis swainsonii***	**Endangered**
Yellow-Crowned Night-Heron	***Nyctanassa violacea***	**Endangered**
Black-Crowned Night-Heron	***Nycticorax nycticorax***	**Endangered**
Pied-billed Grebe	***Podilymbus podiceps***	**Endangered**
Black Skimmer	***Rynchops niger***	**Endangered**
Cerulean Warbler	***Setophaga cerulea***	**Endangered**
Hooded Warbler	***Setophaga citrina***	**Endangered**
Least Tern	***Sterna antillarum***	**Endangered**
Forster's Tern	***Sterna forsteri***	**Endangered**
Common Tern	***Sterna hirundo***	**Endangered**

Mammals

Sei Whale	***Balaenoptera borealis***	**Endangered**
Blue Whale	***Balaenoptera musculius***	**Endangered**
Fin Whale	***Balaenoptera physalus***	**Endangered**
North Atlantic Right Whale	***Eubalaena glacialis***	**Endangered**
Humpback Whale	***Megaptera novaengliae***	**Endangered**
Little Brown Bat	***Myotis lucifugus***	**Endangered**
Northern Long-eared Bat	***Myotis septentrionalis***	**Endangered**
Sperm Whale	***Physeter macrocephalius***	**Endangered**
Delmarva Fox Squirrel	***Sciurus niger cinereus***	**Endangered**