Chapter 4

Steve Hillebrand/USFWS

Great blue heron

Environmental Consequences

- **Introduction**
- **Environmental Consequences of Mason Neck Refuge CCP Alternatives**
- **Environmental Consequences of Featherstone Refuge CCP Alternatives**

Introduction

This chapter describes the foreseeable environmental consequences we predict from implementing the refuge management alternatives presented in chapter 3. Part 1 describes the impacts of the three CCP alternatives for Mason Neck Refuge; part 2 the impacts of the two CCP alternatives for Featherstone Refuge. Where detailed information is available, we present a scientific and analytic comparison between alternatives and their anticipated consequences, which we describe as "impacts" or "effects." In the absence of detailed information, we make comparisons based on our professional judgment and experience.

Existing Contexts for Impacts Analyses at Mason Neck and Featherstone Refuges

- Woodbridge, Virginia—6,912 acres
- Fairfax County*—260,480 acres
- Prince William County*—222,720 acres
- Atlantic Coast Joint Venture (ACJV) Lower Potomac River Focus Area—416,551 acres
- Bird Conservation Region (BCR) 30—24,428,000 acres
- Potomac River Tidal Fresh Important Bird Area (IBA)—281,024 acres
- Mason Neck Peninsula—9,000 acres
- Mason Neck Refuge—2,277 acres
  - Little Marsh Road Impoundment—1.5 acres
  - Little Marsh-50 acres
  - Great Marsh—207 acres
  - Existing Trails—3.75 miles
  - Kiosk/sign footprint—< .05 acre
- Featherstone Refuge—325 acres

We focus our discussion in each part on the impacts associated with the goals and key issues identified in chapter 1—Purpose and Need for Action. Direct, indirect, short-term, beneficial and adverse effects likely to occur over the 15-year life span of the plan are discussed. Beyond the 15-year planning horizon, we give a more approximate description of the direct, indirect, and cumulative effects. Table 4.2 summarizes the effects predicted for each Mason Neck Refuge alternative and allows for a side-by-side comparison. Similarly, table 4.3 summarizes the predicted effects for each Featherstone Refuge alternative. Finally, each part of this chapter identifies cumulative impacts, any irreversible and irretrievable commitment of resources and the relationship between short-term uses of the environment and its long-term productivity.

As required by the Council on Environmental Quality (CEQ) and U.S. Fish and Wildlife Service (Service) regulations regarding implementing the National Environmental Policy Act (NEPA), we assessed the importance of the effects of the CCP alternatives based on their context and intensity. The context of the impacts ranges from site-specific to broader regional and eco-regional scales. Although refuge lands comprise a small percentage of these larger regional area contexts, all alternatives were developed to contribute towards conservation goals in these larger contexts. The proposed species and habitat actions are

*Mason Neck NWR is located in Fairfax County; Featherstone NWR in Prince William County

consistent with the State, regional, ecosystem, and watershed conservation plans identified in chapter 1. At varying levels, each of the alternatives would make positive contributions to these larger-scale conservation endeavors.

We based our evaluation of the intensity of the effects of the alternatives on these factors:

- the expected degree or percentage of resource change from current conditions;
- the frequency and duration of the effect;
- the sensitivity of the resource to such an effect or the natural resiliency of the resource to recover from such an effect, and;
- the potential for implementing effective preventative or mitigation measures to reduce the effect.

  The duration of effects vary from those that would occur only once for a brief period of time during the 15-year planning horizon, for example, the effects of road construction, to those that would occur every day during a given season of the year, for example, impacts from hunting or fishing.

There are certain types of actions identified in chapter 3 that do not require additional NEPA analysis because they do not individually, or cumulatively, have a significant effect on the human environment. These actions are "categorically excluded" from further analysis or review and, as such, their consequences are not further described in this chapter. These categorically excluded actions include, but are not limited to, the following:

- environmental education and interpretation programs (unless major construction is involved)
- research, resource inventories, and other resource information collection activities
- operations and maintenance of existing infrastructure and facilities (unless major renovation is involved)
- routine, recurring management activities and improvements
- small construction projects (e.g. fences, berms, small water control structures, interpretative kiosks, development of access for routine management purposes)
- vegetation plantings
- reintroduction of native plants and animals
- minor changes in amounts or types of public use
- issuance of new or revised management plans when only minor changes are planned
- law enforcement activities

The specific environmental impacts of certain aspects of Refuge management discussed in Chapter 3 are not explicitly evaluated herein. These include aspects of management that are both common to all alternatives and do not individually

or cumulatively have a significant effect on the quality of the human environment. They would qualify for exclusion under the FWS' list of categorical exclusions if individually proposed. These elements of Refuge management include: a new youth turkey hunt, invasive plant control, visitor service program enhancements, a new refuge housing facility, recreational vehicle (RV) pad for trailer parking, and research, inventories and monitoring.

We describe in chapter 3—"Alternatives considered including the Service-preferred alternative," under "Additional NEPA analysis" those future management decisions that may require more detailed analysis before a choice is made. We analyze the impacts of the available choices in this document to the extent possible, but more detailed analysis will inform a final choice.

We have organized this chapter by major resource heading so that each section describes the impacts of all management activities proposed under each of the three alternatives that would likely have an effect on a given resource, for example air quality or bald eagles. Under each heading, we discuss the resource context and the types of benefits and adverse impacts we evaluated for our proposed management actions. We then discuss the benefits and adverse effects that would occur regardless of which alternative we select and the benefits and adverse effects of each of the alternatives. Appendix B—Findings of Appropriateness and Compatibility Determinations, should also be referred to as it provides additional details on impacts that might occur for respective refuge uses and activities proposed under the alternatives.

Bill Wallen

Male cardinal

Part 1— Environmental Consequences of Mason Neck Refuge CCP Alternatives

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Great blue heron

Impacts in the Refuge Vicinity

Air Quality Impacts

Chapter 2, "Affected Environment," discusses the status of regional air quality. We evaluated the management actions proposed for each alternative for their potential positive or negative effects on air quality. Potential positive effects include:

- Reducing the Refuge Complex's contribution to carbon emissions by continuing and expanding energy efficient practices, such as using high mileage or low emission vehicles and upgrading lighting, heating and cooling facilities to be more energy efficient
- Reducing sources of emissions and the loss of forest vegetation by promoting regional land conservation to limit the growth of development
- Enhancing carbon sequestration and reducing greenhouse gases by protecting and restoring forest habitat

Potential adverse effects include:

- Increasing emissions from staff vehicles or equipment, and from visitor vehicles
- Increasing emissions from new or upgraded buildings

Air Quality Impacts that would not vary by Alternative

Our air quality analysis considered how refuge management actions may affect criteria air pollutants, visibility, and climate change. We focused on potential adverse impacts and improvements to localized air quality.

A major concern for regional air quality is automobile emissions. Visitors to the refuge and adjacent state park arrive primarily by car. However, once at the refuge, only non-motorized activities are permitted. Additionally, much of the refuge is not open to the public. Approximately 95 percent of the 2,227 acre refuge area is in natural vegetative cover, including 85 percent in mature forest (1,883 acres).This limits additional sources of carbon emissions, enhances carbon sequestration, and reduces greenhouse gases through filtering.

Visibility: None of the proposed management alternatives would cause visibility concerns due to emissions-based haze. In particular, the nearest Class I airsheds—lands that requires the highest level of protection from air pollutants under the Clean Air Act—would not be affected due to prevailing winds and/or distance. The two closest Class I airsheds are Shenandoah National Park in Virginia (88 miles away) and Brigantine Wilderness Area in New Jersey (166 miles away).

Under all alternatives, management actions and public use at the refuge would negligibly contribute to the overall regional and county air emissions levels.

Wildfire: The Mason Neck Peninsula, including the refuge, does not have a history of catastrophic wildfire. Nevertheless, we would seek to minimize the possibility of serious fires on refuge lands and their associated health and safety concerns. We would assess the wildfire hazards along the refuge boundaries common with privately owned land to ensure that our management practices are not creating excessive fuels that would lead to severe fires.

Emissions: Employee travel, visitor travel, and our facilities' heating and cooling systems would continue to contribute new sources of air pollution. However, we would reduce these impacts through the use of energy efficient systems and vehicles. We have already implemented actions such as installing fluorescent lighting, motion-activated night lighting, and low-emittance glass windows. These windows reduce the ultraviolet radiation factor by suppressing radiative heat flow, as well as fluorescent lighting, and motion-activated night lighting. We use "green" bio-degradable solvents whenever feasible. We have also achieved a 60-percent level of recycling of materials on the refuge complex.

Given the refuge's regional context and proximity to urban areas, we do not expect refuge visitors traveling by automobile would measurably add to current regional emissions levels. Under each alternative, we predict some level of increased visitation (see table 4.1). Organized group events, limited in time and duration, are expected to comprise much of the increased visitation. The community-proposed Gunston Road Trail project, if constructed, would also contribute to visitation increases under alternatives B and C. The proposed trail, which would cross part of the refuge, is described in greater detail in chapter 2 "Actions Common to All Alternatives—Community Initiatives."

Table 4.1. Estimate annual visitor days and predicted increases by alternative based on recent visitation reported during years 2005-2008

Fiscal Year	2005	2006	2007	2008
Annual Visitor Days	23,841	16,137	25,000	19,172
CCP Alternative	Alt A	Alt B	Alt C	
Predicted Percent Increase in Annual Visitation	10%	15%	20%	
Projected Number of Annual Visitor Days based on 2007 (highest recorded in recent years)	27,500	28,750	30,000	

We would continue to keep vehicle use on the refuge to a minimum. We would still limit vehicular access to trailhead parking areas for the general public and designated roadside parking locations for hunters. The only exception is during the deer hunt when hunters have vehicular access to other designated refuge areas.

Leaks and Spills:
There is a minimal risk for refuge activities and management operations to result in accidental leaks and spills of chemicals and petroleum products. These leaks and spill could indirectly impact air quality. However, we would diligently follow our leak and spill prevention and emergency clean-up procedures. These procedures would ensure that such occurrences are rare and are addressed immediately, with only short-term effects limited to the immediate location.

In summary, our management activities would not result in short- or long-term measurable negative contributions to regional air quality. None of the alternatives would violate EPA standards for criteria air pollutants; and all alternatives would comply with the Clean Air Act. Visibility of Class I areas would not be affected by management activities. We would comply with all Federal and State permitting requirements applicable to refuge lands. All required permits would be obtained before implementing management activities potentially affecting air quality. There would be no major new stationary or mobile sources of air pollutants at the refuge created under any of the refuge management alternatives.

Alternative A. Current Management

Benefits
Under alternative A, there would be continuing benefits to air quality from maintaining native vegetation on the refuge, including 1,900 acres of uplands and 297 acres of tidal and freshwater marsh. These benefits are two-fold; first, vegetation serves to filter air pollutants and, second, the presence of the refuge precludes development and the introduction of attendant sources of pollutant emissions on refuge lands. Continuing to protect 1,883 acres of mature forest would also provide some additional benefit due to the ability of forests to sequester carbon. Trees serve as long-term carbon "sinks" reducing the amount of atmospheric carbon (i.e. CO_2), which contributes to global climate change (USEPA, 2010).

Adverse Impacts
Ongoing trail maintenance activities would cause negligible short-term, localized effects from dust and vehicle and equipment exhausts. Operation of the refuge maintenance facility would continue to contribute negligibly to local stationary source emissions. Vehicles and equipment used by staff would contribute a negligible amount to local mobile source air emissions and particulates.

Increased annual refuge visitor use (see table 4.1) would slightly increase vehicle emissions on refuge lands over the longer term. These localized increases from refuge activities would be negligible compared to current off-refuge contributions to pollutant levels and likely increases in air emissions in the Fairfax County airshed from land development, road construction and maintenance, and industrial sites over the next 15 years. Any adverse air quality effects from refuge activities would be more than offset by the benefits of maintaining over 2,200 acres of refuge in natural vegetation.

Alternative B. Improved Management for Federal Trust Resources (Service-Preferred Alternative)

Benefits
As in alternative A, there would be continuing benefits to air quality from maintaining natural vegetation on more than 1,900 acres of refuge uplands and 297 acres of tidal and impounded freshwater marsh. Benefits would be

slightly higher because of an increased level of invasive plant control under this alternative. Reducing invasive plants would allow us to better maintain the native vegetation that filters air pollutants. Refuge lands preclude human development and attendant sources of pollutant emissions, and its forest, in particular, contributes to carbon sequestration. Under alternative B, refuge staff would continue to implement energy efficient practices, and additional practices would be adapted as feasible.

Adverse Impacts
Ongoing trail maintenance activities would cause localized and negligible short-term effects from dust and vehicle and equipment exhausts. Operation of the refuge maintenance facility would continue to contribute negligibly to local stationary source emissions. Also, permanent and seasonal staffing and numbers of volunteers would increase while refuge visitation would increase by up to 15 percent based on our predictions. As noted above some of this increase in visitation would be the result of more organized group activities, but most would likely be the result of the community-proposed Gunston Road trail.

The associated increased vehicle use by staff, volunteers and visitors, and increased equipment use by staff, under alternative B would contribute some minimal additional but negligible increment to local mobile source air emissions. Similar to alternative A, the contributions from other sources of air pollution in the Fairfax County and the greater region far outweigh any refuge contributions. As we maintain or construct new facilities we would continue to use energy efficient practices that reduce emissions, and pursue alternative energy sources such as solar and wind power, if practicable and feasible.

Alternative C. Management to Enhance Public Uses

Benefits
Habitat management under alternative C would be the same as alternative A, therefore the benefits to air quality from maintaining natural vegetation would be the same as those described above for alternative A.

Adverse Impacts
Under alternative C, refuge visitation is predicted to increase by 20 percent over current numbers. The amount of staffing would also increase similarly to alternative B. Compared to alternative B, the increase of vehicle and equipment emissions by staff, volunteers, and visitors would negligibly increase local mobile source air emissions, but would still represent a negligible contribution to regional air quality.

Water Quality, Wetlands, and Aquatic Biota Impacts

Good water quality is essential to sustaining healthy ecosystems within the Tidal Potomac River Basin and on the refuge. Water quality problems in the Basin caused by nutrient and sediment loading and chemical pollutants are a major concern. These concerns can directly contribute to a decline or loss of wetlands and aquatic species across the Basin and on the refuge. Please also refer to the section in this chapter under “Refuge-Specific Impacts, Freshwater Marsh Impacts” for additional details on the beneficial and adverse effects we predict to the refuge’s Great Marsh and Little Marsh.

We evaluated the benefits of actions that would protect or restore forested buffers and maintain or restore tidal wetlands which filter water pollutants. Those actions which would maintain or improve water quality include:

- Shoreline protection projects that would reduce the rate of erosion
- Retention of riverside buffers
- Improved water quality monitoring for early problem identification

We evaluated and compared the impacts of the refuge's management actions with the potential to cause adverse effects to water quality including the:

- Use of herbicides to manage invasive species
- Refuge construction projects
- Increases in annual visitation to the refuge
- Constructing new or improved administration and visitor facilities

Water Quality, wetlands, and Aquatic Biota Impacts that Would Not Vary by Alternative

Clean water is a critical and essential resource value on the refuge and its protection would be given full consideration in management planning and operations. All of the alternatives propose protection measures to insure management activities would not cause a decline in water quality, wetlands, or aquatic biota, either on refuge lands or in the Tidal Potomac River Basin. All Federal and State permits required for refuge lands would be obtained before any proposed management actions are taken in wetlands, along the refuge shoreline, or in open water in order to insure compliance with Sections 305(b) and 319 of the Clean Water Act, 33 U.S.C. § 1251 *et seq.* as amended.

Benefits
Our ongoing protection of refuge lands and maintenance of native habitats would continue to benefit water quality in the Tidal Potomac River Basin by excluding development in this portion of the watershed, sustaining natural water filtering vegetation, maintaining forested buffers, and partnering for water quality improvements and tidal marsh protection.

Adverse Impacts
Some potential for adverse impacts is predicted with our visitor activities and facilities. There is also a negligible risk that petroleum products used in staff or visitor vehicles or other chemicals used in daily operations at the refuge would adversely affect water quality or harm aquatic species in the tidal marsh or in other wetlands within the refuge. Risks from the use of selected low-toxicity chemical herbicides for aquatic weed control are also low as is the risk from the use of other herbicides for control of terrestrial invasive plants because precautions would be taken to keep them out of wetlands.

Research studies in aquatic habitats could also directly impact wetlands and aquatic biota, but is expected to be negligible as all studies would only be implemented under a special use permit with stipulations to protect resources. We describe the potential for each of these impacts in more detail below.

While some potential risk exists from the increased visitor activities we are predicting under all alternatives, we believe these would be negligible when managed properly. We recognize that visitor activities near wetlands may directly impact water quality and aquatic biota over the long-term, especially if people wander off trail. However, we regularly conduct outreach and enforcement in visitor areas to minimize this potential. Potential adverse affects to wetlands could also arise if visitor facilities are improperly placed in wetlands habitats, or if erosion is allowed to occur unchecked during maintenance or construction. We try to minimize those effects in a variety of ways. None of our refuge parking lots is located directly adjacent to streams, rivers, or other wetlands. Refuge staff routinely monitors roads and trails for damage and remediate any problems encountered. We are vigilant during maintenance and construction activities to watch for resource damage and will stop activities as soon as they are observed. Where ever there is the potential for runoff we use silt fences or other best management practices to avoid impacts.

Contaminants from routine operations: While managing the refuge, we would closely monitor and mitigate all of our routine activities that have some potential to result in chemical contamination of water directly through leakage and spills,

or indirectly through soil runoff. These include control of weeds and insects around structures, use of chemicals for deicing roads and walkways, and use of soaps and detergents for cleaning vehicles and equipment. We would continue to take the following precautions to minimize the potential for chemicals and petroleum products to be introduced into aquatic systems:

- Ensuring all staff are up-to-date on the spill prevention plan
- Obtaining advanced training in spill prevention and spill response
- Pouring or mixing chemicals or petroleum products will be conducted no closer than 25 feet from surface water

Our spill prevention and emergency clean-up procedures, documented in a plan for the Refuge Complex, should ensure that such occurrences are rare and are addressed immediately, with short-term effects limited to the immediate location.

Wetland invasive plant control with herbicides: Regardless of the alternative selected, the herbicide active ingredient glyphosate, used in a brand-name formulation such as Rodeo®, and the herbicide active ingredient imazapyr, used in the brand-name formulation Habitat®, could be used as chemical treatments to control aquatic invasive plants such as *Phragmites* in the refuge tidal marsh. Both active ingredients are known to have low aquatic toxicity. Herbicides that would be used to control other terrestrial invasive plant species on the refuge would not be used for aquatic weed control and do not pose a direct risk to water quality or aquatic species. Those terrestrial plant herbicides are reviewed in the "Soils" section of this chapter. The Regional Contaminants Specialist, who is responsible for upholding Federal standards for water quality and soil protection, must review pesticide use proposals and approve all use of chemical herbicides on refuge lands.

Glyphosate Effects on Aquatic Species: In some formulations, such as the one in the brand name formula Rodeo®, glyphosate is not a problem aquatic contaminant because it does not contain the toxic adjuvant (auxiliary chemical) that is found in other formulations, such as in the brand name formula Roundup ®. It is also quickly adsorbed to suspended soil particles in water, rapidly making it biologically unavailable. There would be some potential for herbicide concentrations in sediments and backwaters to build up over time. The potential depends on the balance of herbicide input and removal from the aquatic system. Herbicide inputs may occur either through direct application, water inflow, or through resuspension and diffusion from the sediment layer. Herbicide removal from the system may occur through outflow, degradation, volatilization, and settling or diffusion into the underlying sediment (Neitsch et al., 2001).

The rate of herbicide degradation is an important consideration for assessing the effects of a given herbicide on aquatic systems. Glyphosate degrades with a reported half-life of 3.5-70 days in water depending on the rate of transfer to the sediment layer and testing source (USDA-FS, 1996). Based on the relatively short half-life and the large flux in water volume of the tidal marshes, it is not expected that any greater than negligible effects would occur as a result of herbicide treatments.

According to a USDA Forest Service (Forest Service) risk assessment, glyphosate in less toxic formulations typical of refuge operations appears to have a very low potential to cause any adverse effects in aquatic animals (USDA-FS, 2003). The use of less toxic formulations results in hazard quotients that do not approach a level of concern for any species. Nevertheless, use of glyphosate near bodies of water where sensitive species of fish may be found should be conducted with substantial care to avoid contamination of surface water. The likelihood of

direct acute toxic effects on aquatic invertebrates, or longer term direct effects on any fish species, is predicted to be extremely remote based on estimates of even the upper ranges of the hazard quotient (USDA-FS, 2003).

Aquatic plants appear to be less sensitive to glyphosates than most aquatic animals, assuming the less toxic formulations typical of refuge operations are used. There is no indication that adverse effects on non-target aquatic plants are likely (USDA-FS, 2003).

Imazapyr Effects on Aquatic Species: According to the Forest Service, risk assessment, imazapyr appears to have a very low potential to cause any adverse effects in aquatic animals (USDA-FS 2004). Modeled concentrations of imazapyr in ambient water over prolonged periods of time are estimated to be no greater than 0.00045 milligrams/liter and peak concentrations of imazapyr associated with runoff or percolation are estimated to be no more than 0.036 milligrams/liter. Monitoring data from a field application similar to those that may be used in Forest Sevice programs was used as the basis for the peak concentrations that might be expected. The application rates would be similar in refuge operations. All of the hazard quotients (HQ) for aquatic animals are extremely low. The highest hazard quotient of 0.01 is below the level of concern (LOC) at the typical application rate (LOC=1.0) by a factor of 100 and below the level of concern at the highest application rate (LOC=0.36) by a factor of 36. Thus, there is no basis for predicting that effects on non-target aquatic species are a cause for concern.

In the case of an accidental spill of a large amount of imazapyr into a relatively small body of water, mortality in sensitive species of fish is likely. Actual concentrations in the water after a spill would depend on the amount of compound spilled and the size of the water body into which it is spilled (USDA-FS, 2004).

Aquatic plants, particularly macrophytes, are much more sensitive than aquatic animals to imazapyr exposure. For aquatic macrophytes, the upper range of the hazard quotient for peak concentrations (HQ=3) is above the level of concern by a factor of 3 at the typical application rate (LOC=1) and a factor of about 8 at the highest application rate (LOC=0.36, 3÷0.36=8.3). Thus, under foreseeable worst case conditions, acute effects could be seen in aquatic macrophytes. Longer term concentrations of imazapyr, however, result in hazard quotients for macrophytes that are well below a level of concern. Hazard quotients for sensitive species of unicellular algae are below a level of concern based either on peak concentration of imazapyr in water (a hazard quotient of 0.02 at the upper range of exposure) as well as longer term concentrations that might be expected (hazard quotient of 0.003 at the upper range of exposure). Thus, at both the typical application rate (LOC=1), and the maximum application rate (LOC=0.36), the upper ranges of the hazard quotients for sensitive species of algae are substantially below the LOC. Accidental spills of large quantities of imazapyr into relatively small bodies of water could lead to much higher concentrations—i.e., 3 milligrams/liter to 4 milligrams/liter. After spills of this magnitude, adverse effects on aquatic plants could be anticipated from imazapyr in both macrophytes and sensitive species of algae.

Terrestrial invasive plant control with herbicides: There is a slight risk that herbicides used for terrestrial invasive plant control may reach the tidal marsh and affect water quality or harm aquatic species. However, our prediction is that this threat is low given the precautionary measures we would undertake. In addition, the two herbicides currently used are either non-toxic or of low toxicity to aquatic species.

Imazapic Effects on Aquatic Species (Trade Names: Journey®, Plateau®): This herbicide is applied in broadcast and spot treatments with backpack and skid sprayers. Aquatic animals appear to be relatively insensitive to imazapic exposures, with lethal concentration (LC) values of >100 milligrams/liter for both acute toxicity and reproductive effects. Aquatic macrophytes may be much more sensitive, with an acute effective concentration (EC) of 6.1 grams/litrer in duck weed (Lemna gibba). Aquatic algae appear to be much less sensitive, with EC values of greater than 45 grams/liter. Imazapic does not appear to be very toxic to aquatic fish or invertebrates according to Forest Service studies. The evidence suggests that no adverse effects in fish or aquatic invertebrates are plausible using typical or worst-case exposure assumptions at the typical application rate of 0.1 pounds /acre or the maximum application rate of 0.1875 pounds/acre (USDA-FS, 2004).

Triclopyr Effects on Aquatic Species (Trade Name: Garlon®): This herbicide is applied in broadcast, spot treatment, cut stump and basal treatments with backpack and skid sprayers. It cannot be applied to open water or where runoff may occur. It is relatively nontoxic to terrestrial vertebrates and invertebrates, but can be extremely toxic to fish and aquatic invertebrates. For this reason, we use it only as a basal or cut stump application directly on the base of trees and do not use it as a broadcast spray. In soils, it is degraded by photolysis, microbial metabolism, and hydrolysis to the parent compound, triclopyr acid. Triclopyr acid has an intermediate adsorption potential, limiting movement of the acid in the environment. The acid degrades with an average half-life of 30 days. The ester formulation is not water-soluble and can take significantly longer to degrade in water (Tu et al., 2007).

Research Activities: Aquatic habitats and biota might be impacted by research conducted in or near wetlands. Sampling activities may cause soil compaction and the trampling of vegetation near waterways. The establishment of temporary

Little Marsh on Mason Neck Refuge

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foot trails and boat trails through aquatic vegetation beds, disruption of bottom sediments, and minor vegetation damage when equipment is temporarily placed is possible. The removal of vegetation or sediments by core sampling methods may cause increased localized turbidity and disrupt non-target plants and animals. Installation of posts, equipment platforms, collection devices and other research equipment in open water may present a hazard if said items are not adequately marked and/or removed at appropriate times or upon completion of the project. Negligible vehicle emissions, contaminants from vehicle fluids and very minor erosion from roads may result from vehicle access to the research sites.

To minimize the potential for impacts, all research projects would operate under a special use permit, with stipulations as warranted to insure planned activities would not impact aquatic resources. As new and innovative techniques become available, we would encourage researchers to use the least intrusive research methodologies and techniques for testing and or information gathering.

In summary, regardless of the alternative implemented, none of the proposed actions would cause direct adverse impacts to water quality, or to shallow water environments and aquatic species in the vicinity of the refuge or elsewhere in the Potomac River. Rather, our management practices on the refuge and our projects partnering with local communities and other conservation agencies and organizations would continue to provide long-term benefits to the refuge's and regional water quality.

Alternative A. Current Management

Benefits

There would be continued benefits to wetland habitats and aquatic species from protection of the native plant communities on the refuge uplands. These plant communities filter runoff from operations on the refuge and adjacent roadways and developed areas. Benefits would also continue as we work with partners to monitor and maintain the approximately 200 feet of existing refuge shoreline breakwaters, minimize public access to shoreline, and design, fund, and install additional breakwaters and other shoreline protection measures in an effort to reduce erosion.

Adverse Impacts

Shoreline protection measures: Extensive, new shoreline protection measures are not planned under alternative A. However, we would continue to support partner efforts to maintain and monitor the off-shore breakwaters that were installed by the U.S. Army Corps of Engineers (USACOE) as part of the Wilson Bridge project mitigation. These breakwaters currently protect a portion of the refuge's western shoreline. As the unprotected portions of the refuge shoreline continue to be affected through shoreline erosion, there would be a net increase in riverine aquatic habitat. However, the resulting aquatic habitat would be of lower value than the upland and wetland habitats that now exist on the refuge. Shoreline erosion would continue to contribute to the river's sediment load and thereby negatively affect riverine aquatic resources and the habitats they depend upon. In the much longer term, as the refuge shoreline continues to erode, the major predicted environmental consequence to aquatic resources would likely be the loss of substantial portions of the refuge's uplands and tidal marsh and its value in the Potomac River Basin.

Terrestrial invasive plant control with herbicides: Under alternative A, there would be a minimal level of risk of herbicide used in terrestrial invasive plant control contaminating wetland habitats. We would continue to control those invasive plants with herbicides on up to 2 to 3 acres of invasive plants annually, and in total over the 15-year planning horizon, we predict no more than 20 acres

of invasive plants widely dispersed across the refuge would be treated. In the short term, these treatments would have some minimal potential to affect water quality as discussed above. Any potential risk would be mitigated through proper application procedures and because we would use only certified herbicides at an application rate and timing approved by the Regional Contaminants Coordinator. Herbicide use has occurred on the refuge for many years without any accidental spills or detectable non-target impacts.

Visitor services: Under alternative A, annual visitation on the refuge is expected to increase by approximately 10 percent over the next 15 years based on our predictions and regional recreational trend information. This presents an increased potential for contamination through runoff of petroleum products from roads and parking areas and through litter. Staff would remain observant of risks and would minimize threats where possible. Outreach and enforcement would continue at current levels. In particular, littering would continue to be an enforcement priority.

Alternative B. Improved Management for Federal Trust Resources (Service-Preferred Alternative)

Benefits

Compared to alternative A, there would be increased benefits to water quality and aquatic species from increased protection, monitoring, and management of the tidal marsh vegetation and native plant communities on the refuge uplands. Shoreline protection would also become a higher priority for management, with additional funding sought to implement protection measures, by the Service and partners. We also would more actively engage in efforts with refuge partners to address water quality issues in the Tidal Potomac River Basin.

Adverse Impacts

Shoreline protection measures: During construction of shoreline protection measures, which could include additional breakwaters or beneficial use of dredge material, temporary adverse impacts associated with additional turbidity would be expected. Long-term turbidity would be reduced, benefitting aquatic resources and aquatic habitats. Construction and its resulting disturbance would cause the temporary relocation of aquatic resources and the permanent displacement of some species within the footprint of fill material and structures. The use of stone breakwaters would provide hard surfaces as an additional habitat type for epiphytic attachment. Because these types of projects usually create additional shallow water habitat and eventually support emergent marsh vegetation, we expect overall beneficial consequences for aquatic resources in alternative B. The benefits and impacts of any new shoreline protection measures would be analyzed in greater detail in a separate NEPA-compliant document prior to implementation.

Trail building, realignment and maintenance: Trail maintenance and realignment, and kiosk construction activities, would increase the potential for sedimentation and turbidity in down-gradient marsh and shallow waters if erosion occurs from exposed soils. Because these activities would not be conducted immediately adjacent to the shoreline, the potential for these impacts to occur would be low. Proper site preparation and use of standard mitigation practices, such as silt fences, would be implemented and further limit any potential for impacts.

Herbicide use to treat invasive plants: Under alternative B, we would likely increase the acreage treated with herbicide for invasive plant control to the extent that funding and staffing would allow. As such, there would be an increased risk for herbicides to contaminate aquatic habitats compared to alternative A; however, all the provisions for using best management practices

(e.g. application rates and spill prevention) would be in place. All proposals for using herbicides would be annually reviewed and approved by the Regional Contaminants Coordinator before implementation. As noted under alternative A, herbicide use on the refuge has occurred for many years with no spills and no detections of adverse effects on non-target species.

Visitor services: Under alternative B, annual visitation on the refuge is expected to increase by approximately 15 percent over the next 15 years based on our predictions and regional recreational trend information, and enhanced programs. This presents a slightly increased potential above alternative A for contamination of the surrounding shallow water through runoff of petroleum products from roads and parking areas. However, as we mentioned above, a big part of the increase in visitor activity would be attributed the to the Gunston Road Trail which only allows non-motorized use. Outreach and enforcement would be increased commensurate with increased staff that would occur under alternative B. In particular, enforcing access to trails only and against littering would be a priority. Similar to alternative A, refuge staff would remain observant of risks and would minimize threats to water quality when possible.

Alternative C. Management to Enhance Public Uses

Benefits
Alternative C would have the same long term benefits to water quality and aquatic species from vegetation protection and breakwater maintenance, and potential new shoreline protection measures, as described for alternative B.

Adverse Impacts
Shoreline protection measures: Alternative C would have the same short-term adverse impacts of breakwater construction as described for alternative B.

Herbicide use to treat invasive plants: We would continue to control invasive plants with herbicides on the refuge to the extent funding and staffing allows. Thus, predicted impacts from this program would be similar to alternative B.

Visitor services: Under alternative C, annual visitation on the refuge is expected to increase by approximately 20 percent over the next 15 years based on our predictions and regional recreational trend information and enhanced programs. Compared to alternative B, the increased number of visitors coupled with the new trail access to Little Marsh raises the potential magnitude of potential impacts to water quality. As with alternative B, enforcing access to trails only and against littering would be a priority. Refuge staff would remain observant of risks and would minimize threats to water quality when possible. Should monitoring results indicate water quality is threatened by visitor access, we would take measures to limit that use.

Socioeconomic Impacts

We evaluated socioeconomic impacts in terms of the degree to which the proposed alternatives might affect the local economy, refuge-community relations, or quality of life of the local communities on the Mason Neck Peninsula.

To evaluate potential benefits or adverse effects to the local economy from each alternative, we considered changes in:

- Jobs and income to the local community from changes in refuge staffing
- Jobs and income from jobs in temporary construction work on the refuge
- Expenditures into the local and regional economy from changes in public uses of the refuge

- Expenditures into the economy from changes in hunting
- The availability of opportunities for recreational activities that are in high demand by the public

We considered the Service's Division of Economics "Banking on Nature" report (USFWS, 2007) estimates of the economic effects of recreation visits to the refuge in terms of generating employment, income, tax revenue, and final demand in an analysis area defined by the Fairfax County economy. Combined, these factors represent the full "multiplier" effect of initial spending on recreation-related goods and services plus succeeding rounds of spending internal to the local area economy. The County economic effects were derived using the IMPLAN economic model with estimated refuge recreational use of 50,296 visits in 2006 comprised of 32,266 local area resident visits and 18,030 non-resident visits. Those visits were estimated to generate $589,000 in expenditures, 99 percent of which ($583,110) related to non-consumptive uses. Non-residents accounted for $438,800 of all expenditures (75 percent). Those expenditures had an economic effect of generating $775,100 of final demand (through the multiplier effect) in the County economy, with $279,100 in job income based on seven direct and induced jobs.

Additional relevant statistics factored into the analysis were the most recently available economic statistics on business revenues, payroll, and jobs for Fairfax County, which had total personal income (TPI) of more than $67 billion with $14 billion in business income from Federal procurement expenditures alone in FY 2006. The $775,100 in final demand comprises less than 0.002 percent of the Federal procurement expenditures. The seven jobs represent 0.034 percent of the total jobs in the County. Therefore, there would most likely be a negligible impact on the local economy from any increase or decrease of recreational expenditures at the refuge. Because activities at the refuge are more closely connected to the town of Lorton and nearby smaller communities, the economic effects would likely be somewhat increased, but still minor in this smaller local economy, as compared to the larger Fairfax County context. Local impacts are discussed under the alternatives below.

Socioeconomic Impacts that would not vary by Alternative

Regardless of which alternative we select, we would continue to make revenue sharing payments to Fairfax County. The amount of payment is determined by Congress each year; however, these revenue sharing payments would have only a negligible effect on the County budget. Non-resident visitors to the refuge would continue to spend some money in Fairfax County on their way to and from the refuge, thereby benefiting that economy.

We would also continue to meet a substantive portion of the public's demand for some, though not all, wildlife-oriented recreational activities, in particular for hunting, wildlife observation and photography, interpretation, and to a lesser extent environmental education. Hunting opportunities are becoming harder to find on public lands elsewhere in the region because of widespread and pervasive development and population growth. Fishing would continue to be prohibited on refuge lands because there is no safe public access outside of sensitive wildlife areas; however, this activity is accommodated on public lands and waters elsewhere on the Peninsula.

Alternative A. Current Management

Benefits

The local economy would continue to benefit minimally from recreationist expenditures for deer hunting, wildlife observation and photography, and visitor participation in interpretation and education programs. These benefits

would materialize by way of visitor expenditures for auto fuel, meals, hunting gear, binoculars and other wildlife equipment purchases, though many of these purchases would likely be made outside the local area.

We would also continue to contribute to the local economy in terms of refuge staff jobs, income, and expenditures.

We would continue to meet some of the public's demand for wildlife-dependent recreational activities, primarily wildlife observation, nature photography, and hunting. These activities add to the quality of life of the local community and benefit other recreationists and wildlife enthusiasts in the region. These social benefits would continue to positively affect the refuge at a minimum level in terms of sustaining some public goodwill that garners long-term support for refuge management efforts.

We would also continue to communicate with the local community on the values of the refuge and opportunities for recreation but on a limited basis due to staffing and funding constraints.

Adverse Impacts
No substantive management changes are planned and no staffing increases are proposed under this alternative. Thus, no appreciable changes to the refuge's contribution to the local economy would occur. We would likely see a minimal increase in public uses of the refuge, which we have indicated could be up to an annual 10 percent increase, and which would, in turn, minimally increase expenditures by those users in the local economy. However, we would not expect the increases to be noticeable as a contribution to the local or regional economies.

Under this alternative, and projecting into the future, we would fall short of meeting the public's increasing demands for wildlife-dependent recreational opportunities at levels projected under alternative A. We would not provide the additional environmental education, staff-led interpretation, or wildlife photography opportunities for which we have received numerous requests. We would not provide any expansion in hunting opportunities to offset the diminishing availability of those opportunities elsewhere in the area. We would continue to not offer fishing, as described under "Actions Common to All Alternatives" in Chapter 3, "Alternatives, Including the Service-preferred Alternative."

Alternative B. Improved Management for Federal Trust Resources (Service-Preferred Alternative)

Benefits
Management to improve habitat conditions under alternative B would also enhance other refuge programs that more directly benefit the local economy and local communities. For example, improved tidal marsh and water quality result in more waterfowl to observe in a quality setting, and contribute habitat to support the hunted population elsewhere in the Occoquan Bay. These increased opportunities on and off the refuge would potentially draw more people to the area and benefit the local economy in terms of expenditures for food, lodging, transportation and equipment.

Adding refuge staff would minimally increase benefits to the local economy in terms of proposed projects to upgrade refuge management infrastructure would also add expenditures to the local economy for labor, materials, and services.

Improved refuge habitat and visitor services programs would be expected to attract more visitors. We estimate up to a 15 percent annual increase in visitation over current levels. The local economy would experience minimally increased

benefits in terms of retail expenditures for auto fuel, food, lodging, and related expenses in the local economy. These increases would be negligible compared to the overall expenditures on these factors in the local and regional economies.

Expanded recreational programs would increase the appeal of the refuge to the public in terms of further enhancing their quality of life and thereby add to the positive feedback needed to sustain refuge programs in the longer term. Additional refuge hunting opportunities, namely a new youth turkey hunt and the potential for a new archery deer season, would help offset the loss of those opportunities at other locations. Expanded interpretive and educational programs would provide public benefits in terms of better understanding of the values of the refuge resources and the Refuge System in general. We would also be in a better position with additional staffing and funding to communicate with the community about the values of the refuge and opportunities for recreation under this alternative.

Adverse Impacts
We would expect an increase in visitation under alternative B that could result in an additional burden in terms of road maintenance, traffic enforcement, and law enforcement expenditures from County tax revenues. We predict those impacts would be negligible, and offset by the local economic benefits contributed by the refuge and described above.

Alternative C. Management to Enhance Public Uses

Benefits
Similar to alternative B, adding refuge staff under alternative C would minimally increase benefits to the local economy in terms of refuge jobs, income, and expenditures. Proposed projects to upgrade refuge management infrastructure would also add expenditures to the local economy for labor, materials, and services at approximately the same amounts as alternative B.

Alternative C would improve visitor services more than alternatives A and B and we predict that up to 20 percent increase in annual visitation would result. The local economy would, therefore, experience minimally increased benefits in terms of retail expenditures for auto fuel, food, lodging and related expenses. These increases would be minimal, however, compared to the other contributors to the overall local economy.

The social benefits of expanded recreational programs would likely be highest under this alternative. Similar to alternative B, expanded recreational programs would increase the appeal of the refuge to the public in terms of further enhancing their quality of life and thereby add to the positive feedback needed to sustain refuge programs in the longer term. Additional hunting opportunities on the refuge would help offset the loss of those opportunities at other locations. Expanded interpretive and educational programs would better meet and satisfy demand for those activities. We would best be able to conduct outreach and communicate the values and opportunities the refuge offers under this alternative because of the emphasis on quality visitor services programs, our increased staffing and funding, and the fact we would have more visitors to contact.

Adverse Impacts
Compared to alternatives A and B, the expected increase in visitation under alternative C would constitute the highest burden in terms of road maintenance, traffic enforcement, and law enforcement expenditures from County tax revenues. We predict, however, that the impacts would be negligible and offset by the local and regional economic benefits described above for alternatives B and C.

Refuge-Specific Impacts

Soil Impacts

Soils are the structural matrix and nutrient source for plant productivity and must be protected to sustain the variety of upland and wetland habitats needed to meet refuge habitat and species management goals. Soil biotic communities consume waste and the remains of dead organisms and recycle their constituent materials that are incorporated into the soil into forms usable by plants. In the process, soil organisms regulate the fluxes of carbon dioxide, methane, and nitrogen oxides in the atmosphere (Daily et al 1997). Productive and healthy soils also regulate groundwater quantity and quality by filtering excess nutrients and contaminants.

Overall, the soils of the refuge are productive and in good condition with little or no compaction or contamination problems. However, certain areas, particularly the shorelines, are experiencing erosion and are susceptible to disturbance. Other areas may be experiencing compaction from human activity. Compaction makes plant root penetration more difficult and may affect regeneration potential for some vegetation. In areas with moderate compaction, plant cover and biomass may be decreased. In areas with high compaction, plant species abundance and diversity is reduced over the long term as only the hardiest and resistant species survive (Liddle 1975). Under all alternatives, we would continue to manage areas of high traffic to minimize human impacts on soils, and implement restoration measures where there are concerns with habitat degradation or loss.

We evaluated and compared the management actions proposed for each of the refuge CCP alternatives on the basis of their potential to benefit or adversely affect refuge soils.

We considered the benefits from:

- Protection of soils from conversion to impervious surfaces or restoration of disturbed sites
- Reduction of erosion along interior water courses and refuge shorelines

We considered the potential adverse impacts to soils from:

- Habitat management activities to benefit bald eagles, great blue herons, waterfowl and other migratory birds
- Construction of new refuge housing
- Realignment and construction of interpretive trails and kiosks
- Refuge visitor activities

Soils Impacts that would not vary by Alternative

Benefits
The soils of the refuge are in good condition and would remain so under all management alternatives. We would continue to maintain the refuge's protective vegetative cover to minimize soil losses through erosion. Native vegetation supports natural functioning and production of the ecological services that improve soil fertility and sustain soil health. For example, healthy soils would also potentially dampen pest and disease outbreaks (Lavelle et al 1997), improve the growth of trees and other plants without additional need for nitrogen input, improve water quality, regulate greenhouse gas emissions, increase carbon sequestration, and increase carbon stock equilibrium of soil vegetation.

We would continue to prohibit high impact recreational activities such as all-terrain vehicle (ATV) use, horse back-riding, or biking off road or off the asphalt High Point Trail, to avoid damage to refuge soils. Hiking trails, wildlife observation areas, parking areas and other high-use areas would continue to be well maintained to keep soil effects to a minimum. Any erosion problems will be noted during routine refuge monitoring and corrected as soon as feasible.

Regardless of which CCP alternative we select, we would continue to use best management practices for all management activities that may affect refuge soils to ensure that we maintain soil productivity. Site conditions, including soil composition, condition, and hydrology, will be the ultimate determinant of what management actions can occur on any particular site on the refuge. No site would be managed in a manner that permanently degrades site conditions.

In general, no soil from off-site will be brought onto the refuge unless bringing in clean soil is determined to be less disturbing to refuge resources than using onsite soils.

Adverse Impacts
There is a potential for adverse impacts from the management tools we propose to use at varying scales under all alternatives to help maintain, enhance or create wildlife habitat. These tools include replanting with native species, mowing, and use of herbicides. Soils in the upland areas could also be affected by trail, parking lot, or other maintenance or construction projects.

Herbicides: All chemical use on the refuge must first be approved through the Pesticide Use Proposal process. The Refuge Manager submits proposals to the Regional Contaminants Coordinator who must approve the chemical, application procedure, and location of all treatments. The following list of herbicides, currently used on the refuge, and their potential effects on soils and soil organisms are derived mainly from the products' labels and material safety data sheets, except where noted:

Glyphosate Effects on Soils and Soil Organisms: This herbicide is applied in broadcast or spot treatment with backpacks or a skid sprayer. It is degraded by microbial action in both soil and water, with an estimated half-life of 30 days in soil. It is highly soluble, but adsorbs rapidly and tightly to soil (USDA-FS, 2003). Glyphosate has low leaching potential because it binds so tightly to soil. Numerous soil bacteria, fungi, invertebrates, and other microorganisms have been studied for effects of glyphosate application. None of these studies suggest glyphosate would adversely affect soil organisms. Glyphosate is readily metabolized by soil microorganisms and some species can use glyphosate as their sole source of carbon (USDA-FS, 2003). Sylvia and Jarstfer (1997) found that after 3 years, pine trees in plots with grassy weeds had 75 percent fewer mycorrhizal root tips than plots that had been treated 3 times per year with a mixture of glyphosate and metsulfuron methyl to remove weeds. Modeling results indicate glyphosate runoff is highest in loam soils with peaks after the first rainfall (USDA-FS, 2003; WSSA, 2002).

Imazapic Effects on Soils and Soil Organisms: This herbicide is a relatively new herbicide, and there are no studies on the effects of imazapic on either soil invertebrates or soil microorganisms. We are also not aware of any reports of secondary signs of injury to microbial populations (USDA-FS, 2004a). Imazapic degrades in soil, with a half-life of about 113 days. Its half-life is decreased by the presence of microflora. Imazapic is primarily degraded by microbes and does not degrade appreciably under anaerobic conditions. Imazapic is weakly adsorbed in high soil pH, but adsorption increases with lower pH (acidic soils) levels and

increasing clay and organic matter content. Field studies indicate that imazapic remains in the top 12 to 18 inches of soil and do not indicate any potential for imazapic to move with surface water. Modeling results indicate imazapic runoff is highest in clay and loam soils with peaks after the first rainfall. Imazapic percolation is highest in sandy soils (USDA-FS, 2004a; WSSA, 2002).

Imazapyr Effects on Soils and Soil Organisms: This herbicide has no studies on its effects on soil invertebrates, and there is incomplete information on the effects on soil microorganisms. One study indicates cellulose decomposition, a function of soil microorganisms, can be decreased by soil concentrations higher than concentrations expected from Forest Service applications (USDA-FS, 2004b). Degradation rates are highly dependent on microbial action. Anaerobic conditions slow degradation. Imazapyr is weakly bound to soil, but adsorption increases with lower pH and increasing clay and organic matter content. Adsorption increases with time as soil dries and is reversible. Field studies indicate that imazapyr remains in the top 20 inches of soil and do not indicate any potential for imazapyr to move with surface water. In forest field studies, imazapyr did not run off and there was no evidence of lateral movement. Modeling results indicate imazapyr runoff is highest in clay and loam soils with peaks after the first rainfall. Imazapyr percolation is highest in sandy soils (USDA-FS, 2004b; WSSA, 2002).

Triclopyr Effects on Soils and Soil Organisms: This herbicide exists in five commercial formulations, in one of two forms, BEE (butoxyethyl ester) or TEA (triethylamine). Triclopyr BEE is much more toxic to aquatic organisms than triclopyr TEA. A breakdown product, TCP (3,5,6-trichloro-2-pyridinol), is more toxic than either form of triclopyr. Site-specific cumulative effects analysis buffer determinations need to consider the form of triclopyr used and the proximity of any aquatic triclopyr applications, as well as toxicity to aquatic organisms (USDA-FS, 2004c). Triclopyr has not been studied on soil invertebrates. Soil fungi growth was inhibited at concentrations 2 to 5 times higher than concentrations expected from Forest Service application rates. Triclopyr has an average half-life in soil of 46 days, while TCP has an average half-life in soil of 70 days. Warmer temperatures decrease the time to degrade triclopyr. Soil adsorption is increased as organic material increases and decreased as pH increases. Triclopyr is weakly adsorbed to soil, though adsorption varies with organic matter and clay content. Both light and microbes degrade triclopyr (USDA-FS, 2004c; WSSA, 2002).

Public Uses: People walking off-trail have the potential over the short term to damage vegetation. If the area is repeatedly trampled on, over the long term, soil productivity could be directly affected by exposing roots, and reducing soil porosity, aeration, and nutrient availability if enough compaction occurs (Kuss 1986, Roovers, et al 2004). Soil compaction can, in turn, affect plant regeneration and revegetation, especially in rare or sensitive plant populations (Hammitt and Cole 1998). Kuss (1986) found that plant species adapted to wet or moist habitats was the most sensitive and increased moisture content reduces the availability of the soil to support recreational traffic.

The hunt program for deer under all alternatives, and the hunt program for turkey under alternatives B and C, has the potential to cause some soil compaction since off-trail foot travel would occur. However, with a limited number of hunters well-dispersed across the refuge during the shotgun deer hunting season (currently 90 hunters with no more than 30 hunters per day proposed during the archery season) and proposed youth turkey hunt season (up to 10 hunters over a 3-day period), the impacts would be minimal based on our monitoring and field observations of hunting impacts over the past 5 years.

Vehicles would continue to be confined to existing refuge roads and parking lots to minimize impacts outside of that developed footprint. Sensitive wildlife areas, such as eagle roosting and wintering sites, would remain closed to hunter access.

Visitors engaged in wildlife observation, wildlife photography, interpretation and environmental education activities and programs would cause localized impacts in trail areas, but with posted refuge regulations stating visitors should remain on trails, coupled with our enforcement of those regulations, we predict only a negligible impact outside of the trail footprint. This is consistent with our field observations and the monitoring we have conducted to date on existing trail use and resulting impacts on this refuge. Most people tend to stay on trails due to a healthy concern with poison ivy and ticks. Furthermore, designated trails are on existing logging roads, gravel roads, or hardened trails used for many years. None of these routes has any known rare or sensitive plant species, nor has soil compaction or erosion been observed.

Alternative A. Current Management

Benefits

Continuing to maintain the existing shoreline breakwaters and armoring structures would help refuge soils in areas protected by these structures from being exposed and eroded away by wave and wind action. Also, maintaining mature forest vegetation on the majority of the refuge would continue to help sustain the productivity of refuge soils and afford further protection against extreme weather events.

There would be minimal loss or damage to soils on the upland portions of the refuge resulting from management under alternative A since no ground disturbing activities are planned.

Adverse Impacts

Soils adjacent to the currently unprotected sections of the shoreline would continue to be at risk of being exposed and eroded away due to wave and wind action. These impacts would be exacerbated given the anticipated effects of climate change (e.g. more frequent and more intense storm events, tide surges, and sea level rise). Our monitoring to identify shoreline erosion areas would continue to be very limited given resources currently available, but we would continue to look for opportunities to work with partners to address shoreline protection in areas at high erosion risk.

We anticipate minimal adverse impacts on refuge soils from continuing current refuge management using best management practices. Refuge staff would continue to mow the 5-acre grassland at the outdoor environmental education site to maintain the area for education activities, managing under conditions that minimize compaction and soil displacement (e.g. avoiding excessively wet periods).

Visitation under alternative A is expected to increase by approximately 10 percent. This presents an increased potential for visitor activities that might impact soils, such as hiking off designated trails. The greatest future threat to soils under alternative A would be unauthorized use and access in sensitive areas. Refuge staff would continue to monitor public use areas to determine if soil erosion may be a problem and take steps to mitigate problems if they occur. Outreach and enforcement to minimize unauthorized activities would continue at current levels.

Alternative B. Improved Management for Federal Trust Resources (Service-Preferred Alternative)

Benefits

Without protection, and anticipating the effects of climate change (e.g. more frequent and more intense storm events, tide surges, and sea level rise), erosion would continue to gradually expose and wear away portions of the refuge

shoreline that are not currently protected. Under alternative B, we would evaluate those shoreline areas most at risk and work with partners to design and implement actions to minimize the threats. This would help prevent the future loss of soils and vegetation along a more extensive area of shoreline compared to what is planned under alternative A.

Adverse Impacts
Very little additional soil disturbance is predicted with management actions under alternative B, as compared to alternative A. Some soil disturbance and localized soil compaction and loss might occur in conjunction with trail projects. However, we would employ management practices to ensure that no long-term problems, such as unchecked erosion, would result.

Increased annual visitation, estimated to be 15 percent under alternative B, would increase the likelihood of disturbance and compaction of soils in areas of the refuge where visitation is allowed. It would also increase the likelihood of unauthorized entry to areas where visitation is not allowed, for example, off trails and along the shoreline where soils might be affected. The design of new and improved trails and other infrastructure would include consideration of the potential to effect soils. We would also increase monitoring of intensive public use areas, and develop more effective signs and brochures to notify people of the times, areas, and reasons for the closure of certain areas, reducing the potential for long-term impacts from unauthorized access. In addition, outreach and enforcement on site would increase once proposed new staff is in place.

Under alternative B, we propose building one new staff quarters on the refuge to reduce driving time from refuge headquarters and the other Refuge Complex units, and to provide affordable housing to seasonal and volunteer staff. More importantly, however, the staff quarters would assure a greater Service presence at Mason Neck Refuge during the year. Site selection for the building would include consideration of subsurface water, geology, water quality and quantity, and compatible soils, along with other necessary surveys to assure proper location of the facility and to minimize the impacts to refuge resources. Current consideration is for a site location north of and adjacent to High Point Road, offset to minimize disturbance to refuge and State Park visitors. The facility would require an upland area of no more than one acre cleared of trees to allow laying a foundation, parking area, storage, and septic system.

Under alternative B, we also propose to build an RV pad near the maintenance shop. Less than one-tenth acre is predicted to be impacted. Concerns and considerations are similar to those identified for the new refuge quarters, but on a smaller scale.

Best management practices would be used to minimize impacts to soils from new construction, but there may be localized compaction and some erosion losses while the site is under construction. While some permanent loss of soil productivity would occur, seeding with native grasses and other protective native vegetation would be used to return open areas of the site to a vegetated status as soon as practicable to protect soils. All Federal, State, and local permits applicable to constructing a facility of this type on refuge lands would be obtained before activities begin.

In addition to building the new refuge staff quarters and RV pad, we would prioritize our list of other refuge improvements and implement projects as funding allows, with the intent to complete them in 10 years. Appendix C lists projects currently in our RONS and SAMMS databases. Soil impacts on these projects would be minimal and localized to areas already developed. Best

management practices to control erosion and minimize compaction would be employed as needed to assure no long term soil loss or damage.

Summary of construction projects under Alternative B

- Realigning Woodmarsh Trail to higher ground along approximately 1,000 feet currently in low, wet areas, restoration of old alignment sections, building viewing platform, improving trail surface to all-weather; making part or all accessible; and, improving boardwalks over wet areas
- Improving Woodmarsh trailhead including: drainage, paving, lighting, gates, the kiosk, and welcome and directional signs
- Reconfiguring Woodmarsh Trail within existing loops to bypass sensitive eagle area, but allow for additional access
- Developing a trail from the Woodmarsh Trail-Sycamore Road kiosk to the end of Sycamore Road and the overlook. Building a viewing platform overlooking Potomac River if feasible. Allow foot travel only.
- Developing Treestand Road as a trail that connects Woodmarsh and Great Marsh Trails; creating a marsh viewing area if minimal vegetation would be impacted. Allow foot travel only.
- Building refuge staff quarters on the refuge off High Point Road
- Building an RV pad near the existing maintenance shed

Alternative C. Management to Enhance Public Uses

Benefits
The same benefits to soils would accrue under alternative C as under alternative A.

Adverse Impacts
Annual refuge visitation would increase by approximately 20 percent under alternative C, as compared to the annual increases predicted under alternatives A (10 percent) and B (15 percent). In addition, allowing seasonal public access via the Little Marsh road to the dike increases the potential for soils impacts in an area that had not previously been open. As a result, there would be the highest potential for localized increases in soil impacts compared to alternatives A and B, especially in areas where public access is new or further enhanced under this alternative. However, the types of impacts from visitors described under alternatives A and B would be the same under alternative C. Careful design, management, and monitoring of the enhanced visitor program, coupled with improved visitor outreach, enforcement, and increased Service visibility given additional staff proposed, would help mitigate the potential for long-term soil impacts.

Also similar to alternative B, alternative C proposes to build refuge housing and the RV pad. The impacts described under alternative B, and the measure we would take to mitigate those impacts, would be the same under alternative C.

Forest Habitat Impacts

The diverse forest habitats on the refuge provide a wide array of wildlife including bald eagles, nesting herons and egrets, forest interior breeding birds, neotropical migrants, and other native wildlife. We evaluated the benefits and adverse impacts on forest habitats from management actions under the three alternatives.

We considered the benefits from:

- Management actions to maintain forest health, such as thinning and invasive plant control
- Fuels management
- Controlling or managing deer populations

We considered the potential for adverse impacts from:

- Unhealthy forest conditions, including the presence of invasive plants
- Facilities construction and maintenance

Forest Habitat Impacts That Would Not Vary by Alternative

Benefits
Regardless of alternative selected, native mature forest habitat would continue to be protected on the refuge contributing to what remains as intact riverine forest habitat along the Potomac River. Thus, the refuge would retain its value to migratory birds and other native forest wildlife where elsewhere in rapidly developing Northern Virginia those values are being lost or degraded. Wherever practicable, we would replace non-native plant species with native forest species capable of growing under the current site conditions to restore the ecological integrity and diversity of the refuge. In addition, deer management under all alternatives would help control excessive browse levels which are impacting forest regeneration (VDF 2009).

Adverse Impacts
Regardless of which alternative we select to manage the refuge, certain activities may affect forest habitat at various levels depending on the alternative:

- Areas where invasive plants are established and where treatment is not planned
- Vegetation treatments to maintain fire breaks
- Refuge infrastructure maintenance and improvements (e.g. roads and trails)

The impacts of existing and planned mechanical methods and herbicides were discussed previously in the sections on water quality and soils. Their affect on other resources is also described in those sections. Both mechanical and herbicide treatments would only be implemented to support goals and objectives for wildlife habitat. Strict best management practices and Service protocols would be followed so as not to affect non-target resources. The alternatives would vary in terms of the extent and frequency of use of these management practices.

A potential long-term negative impact is the unintential introduction or spread of invasive species on the refuge from visitors, including deer hunters who range over large portions of the refuge. People can be vectors for invasive plants by moving seeds or other propagules from one area to another. Once established, invasive plants can out-compete native plants, thereby altering habitats and indirectly impacting wildlife. Refuge staff work diligently to control the most threatening of these plants, as described in chapter 2—Affected Environment. We have identified several projects which may involve seeding or vegetation plantings to control erosion, or to otherwise establish vegetation on a site that was disturbed by refuge activities. Only native vegetation would be used in those instances to avoid the introduction of non-native or invasive species. The threat of invasive plant establishment will always be an issue, and will require annual monitoring, treatment, and hunter and visitor education.

Alternative A. Current Management

Benefits

Under alternative A, benefits would continue to be based mainly from the maintenance of mature forest cover. Protection of the existing 1,883 acres of forested upland is assured through permanent or long-term Service management and conservation. In addition, maintaining the refuge deer hunt would continue to reduce the potential for the adverse effects of diminished forest regeneration on long-term forest health. As noted previously, excessive deer browsing was a major concern in the VDF Forest Health report (VDF 2009). When deer become overabundant they browse forest understory, including emerging seedlings of canopy tree species, thereby reducing forest regeneration and the capability of the forest to establish trees to replace those lost through natural mortality.

Adverse Impacts

There would continue to be a minimal risk to forest vegetation involved with the use of mechanical and herbicide treatments described above. Routine maintenance of roads and facilities, control of invasive plants, and maintaining the grassland education site would continue to affect forest development in those areas; however, they amount to less than 3 percent of the refuge area. Herbicides would be used only under strict application precautions approved by the Regional Contaminants Coordinator, to ensure that only the targeted plants are affected. The routine maintenance of roads and trails may result in the loss of individual trees, but we do not expect the number of trees felled would affect the quality or diversity of forest habitat present.

Alternative B. Improved Management for Federal Trust Resources (Service-preferred Alternative)

Benefits

Under alternative B, implementing a more active program to sustain forest health and diversity would provide the more beneficial impacts over the long-term to forest habitats on the refuge as compared to alternative A. Alternative B would pursue further evaluation and management to implement recommendations in the VDF forest assessment (VDF 2009). We predict that through implementing best management forest practices to thin stands or do small group selection cuts, fuel treatment reductions, and more strategic deer and invasive plant control, we would further enhance the existing health and vigor of the forest. Over the long-term, sustaining a healthy forest would result in less risk of an significant environmental impact from a catastrophic fire event, or pest and pathogen epidemic, and would reduce the need for less ground-disturbing management intervention. We would continue deer management through our public deer hunting program, and by other control means if necessary, to assure long-term forest health objectives are met.

Adverse Impacts

Habitat Management: Similar to alternative A, there would continue to be a minimal level of loss or damage to forest vegetation involved with use of the mechanical and herbicide treatments described above to maintain roads and facilities, reduce forest fuel loads and maintain fire breaks, control invasive plants, or to maintain the grassland education site. As described under alternative A, herbicides would be used only under strict application precautions approved by the Regional Contaminants Coordinator to ensure that only the targeted plants are affected.

Construction projects: Under B we propose to construct a new refuge quarters facility. There would be some permanent loss of forest habitat at the site of the facility. The site is currently proposed off High Point Road, which is the main road accessing part of the refuge and Mason Neck State Park. Less than one acre of land would be cleared for the building, driveway, and septic field. This site loss, which constitutes less than 0.03 percent of the current refuge forest acreage, is not in a sensitive resource area, and would be located near an asphalt road

and other existing developments to minimize new utility corridors. As such, we predict the impacts on the refuge's forest health, biodiversity and integrity, or its long term sustainability, would be negligible.

Road and trail maintenance: Routine maintenance of roads and trails may result in the loss of individual trees, but we do not expect the number of trees felled would affect the quality or diversity of forest habitat present. Trail improvements and the development of two trails (one linking Woodmarsh Trail-Sycamore Road kiosk to the end of Sycamore Road, and the second on Treestand Road, connecting Woodmarsh Trail to Greatmarsh Trail) lie along existing road beds where minimal clearance involving few trees would be needed.

Alternative C. Management to Enhance Public Uses

Benefits
Alternative C would provide the same benefits to the refuge's forest habitats as alternative A.

Adverse Impacts
Alternative C would cause the same adverse impacts to the refuge's forest habitats as discussed under alternative A.

Shoreline Impacts

We evaluated impacts to the refuge's shoreline based on whether refuge management actions would help reduce the rate of shoreline erosion and limit human activities that have the potential to cause increased shoreline erosion. Please also refer to our discussion on Soils earlier in this chapter for additional comments on shoreline impacts.

Factors that would benefit shoreline protection include:

- Maintenance of existing shoreline protection infrastructure
- Plans for additional shoreline protection projects

Factors that may adversely affect the refuge shoreline:

- Unauthorized public access to the shoreline
- Management activities on the refuge that have the potential to increase shoreline erosion

Shoreline Impacts That Would Not Vary by Alternative

Benefits
Regardless of which alternative we select, we would continue to support State efforts to maintain and monitor the off-shore breakwaters. They were installed by the USACOE as part of the Wilson Bridge project mitigation, and currently protect a portion of the refuge's western shoreline. Erosion of the shoreline by tidal and storm flows and the undermining of the bluffs by beach loss and wind and rain erosion has been incrementally removing the substrate and the resulting tree loss shrinks important shoreline and upland habitats. This is especially problematic along the refuge southwestern corner, where tree loss threatens the heron rookery. We would review and evaluate potential stabilization techniques to determine which is most effective and practical for refuge lands. We would also continue to work with State and Federal partners to explore, develop and implement additional shoreline protection projects to further reduce impacts to shoreline.

Adverse Impacts
Under all the alternatives, there is some minimal potential that unauthorized refuge visitors might cause localized shoreline erosion. We would continue to restrict public access to designated trails and prohibit access to the shoreline areas from either the land or river side to avoid shoreline impacts in any location.

The only exception to this restriction is under alternative C where seasonal access to Little Marsh dike is proposed.

Alternative A. Current Management

Benefits
Although we do not propose expanding shoreline protection projects under this alternative, we would continue to conduct outreach to visitors and the media, to express concerns about the need for shoreline protection. We would continue to monitor the existing infrastructure, in conjunction with other refuge work in the area, and alert State partners to any concerns with how it is functioning.

Adverse Impacts
This alternative would not actively pursue and implement new shoreline protection projects. We would depend entirely on other entities to initiate any new shoreline protection efforts. We would continue to have limited capability to quickly respond to erosion threats at any particular locations along the refuge shoreline.

We would continue the closure on public access to the refuge shoreline, but given the limited staff presence on the refuge, there remains a risk that refuge visitors would go off designated trails and enter restricted parts of the refuge where they might inadvertently cause damage to the shoreline and locally accelerate erosion. However, we would continue to post rules and regulations, educate the public about this issue, and address any instances of unauthorized entry that we might encounter.

Alternative B. Improved Management for Federal Trust Resources (Service-Preferred Alternative)

Benefits
Under alternative B, we would expand our involvement in initiating additional shoreline protection efforts to benefit the refuge. We would work with our partners and the Service's Chesapeake Bay Field Office to actively pursue funding sources and seek expertise in designing and installing shoreline protection measures in high risk areas. In particular, we are concerned with the refuge's western and southern shorelines, and we would explore options for protecting or stabilizing them. Providing long-term protection to the refuge's shoreline and tidal marsh habitat are identified under alternative B as one of the highest management priorities to implement over the next 15 years.

Adverse Impacts
Because annual refuge visitation under alternative B would likely increase by 15 percent compared to alternative A, there would be a somewhat increased potential for refuge visitors to gain unauthorized access to unprotected sections of shoreline either from land or boat access. In these instances, there may be minor damage to protective vegetation potentially leading to localized erosion. However, the increased monitoring, outreach, and law enforcement proposed under this alternative would be expected to identify and remedy this type of damage before any substantive long-term or permanent effects result.

Alternative C. Management to Enhance Public Uses

Benefits
The same benefits would accrue under this alternative from partners maintaining the existing breakwaters as described for alternative A.

Adverse Impacts
Because annual refuge visitation is predicted to increase by 20 percent under alternative C, there would be more potential than under alternatives A and B for increased potential for members of the public gaining unauthorized access to unprotected sections of shoreline either from land or boat access. Outreach and enforcement against unauthorized activities would increase in response to these concerns, similar to alternative B. Other impacts would also be similar to alternative B.

Freshwater Marsh Impacts

The Service currently manages the 207-acre Great Marsh, a freshwater tidal marsh, and the 50-acre Little Marsh, an impounded freshwater tidal marsh which is no longer tidally influenced. We evaluated the benefits and adverse impacts of the management actions under the three CCP alternatives on these tidal wetlands.

We considered the benefits from:

- Protecting and restoring tidal marsh habitat
- Maintaining a forested shoreline buffer
- Treating invasive species

We considered the potential adverse impacts of:

- Refuge habitat management activities that may affect the wetlands
- Facilities construction and maintenance
- Unauthorized public access to the wetlands

Freshwater Marsh Impacts That Would Not Vary by Alternative

Benefits

Great Marsh supports breeding bald eagles and marsh birds, provides protective cover for migrating and wintering waterfowl, shorebirds, and other species of conservation concern, and serves as reproductive habitat for fish and other aquatic species in the Tidal Potomac River. Except for the Great Marsh trail that provides a viewing area, the wetland is closed to public use and access. Management activities would continue to emphasize outreach and enforcement against unauthorized activities. We would also continue to monitor the area for external threats and conduct periodic trash removal using volunteers.

Little Marsh provides foraging habitat for nesting bald eagles and colonial nesting great blue herons from the refuge rookery. We would maintain the dike on Little Marsh, including addressing beaver or other animal damage as needed, to ensure the continued integrity of this wetlands area.

Regardless of the management alternative we select, we would continue to conserve these wetlands and the wildlife they support as one of our highest priorities.

Adverse Impacts

Refuge staff would continue to prohibit all public use and access on Great Marsh year round. While seasonal trail access to Little Marsh dike is proposed under alternative C, under all alternatives Little Marsh would remain closed to all public use and access during the nesting season. Of particular concern in these areas are unauthorized fishing and boating which have the potential to adversely affect these marsh areas and associated species through trampling and disturbance. Unauthorized entry to Great Marsh and Little Marsh areas could disturb nesting, roosting, and foraging eagles and herons, or degrade marsh vegetation through trampling. Other examples of degradation include litter from used fishing line, tackle and other forms of trash, or disturbance to bank areas creating erosion and turbidity to the water. Liddle and Scorgie (1980) documented that shoreline trails made by anglers and waterfowl hunters, the two activities we have recorded causing the most violations at Little Marsh, are usually 2-3 feet wide, and typically parallel to the shore at the junction of two vegetation communities. They observed that on little used pathways the dominant native emergent vegetation was present, but that on moderate use pathways, the composition changed to more hardy species, including the higher likelihood

of invasive species. On high use pathways, there was largely bare soil with occasional invasive species.

Refuge signage, flyers, and other public information materials would continue to be used along the major public entry points, including the Woodmarsh and Great Marsh trails, to ensure that the public remains out of sensitive, closed areas. While some people express concern with the restrictions on public access for fishing and boating, these recreational activities are offered at other nearby public facilities on the Peninsula, for example in Occoquan and Pohick bays, and on the Potomac River.

Alternative A. Current Management

Benefits

Continued management of the existing freshwater marsh under alternative A would conserve the wildlife habitat values described above, though no substantive improvements in management and protection of Great Marsh and Little Marsh would be implemented under alternative A.

Adverse Impacts

There are currently no plans to modify existing marsh habitat, whether directly through a restoration or habitat improvement project, or indirectly through other Service projects.

The marsh areas may be at some minimal risk of being indirectly affected by Service activities in adjacent upland areas that drain into them from leaks or spill accidents involving chemicals or petroleum products used in refuge management operations. Our leak and spill prevention and emergency clean-up procedures should ensure that such occurrences are rare and are addressed immediately, with short-term effects limited to the immediate location.

A predicted annual increase in refuge visitation (10 percent over existing levels) would likely result in a somewhat greater potential for adverse impacts to the Great Marsh since the adjacent Great Marsh and Woodmarsh Trails receive the highest public use on the refuge. These impacts include the potential for refuge visitors to leave trash and for unauthorized entry from these trail access points. We would continue to conduct outreach and enforcement within our current staff capability. We would also continue to maintain signage and monitor impacts in high use areas, and enforce against littering and off-trail traffic, to insure adverse impacts are kept to a minimum.

Alternative B. Improved Management for Federal Trust Resources (Service-Preferred Alternative)

Benefits

We would increase benefits to the freshwater marsh habitat and marsh-dependent species under alternative B as compared to alternative A. We would increase our baseline information on the marshes through inventorying the flora and fauna. This information would support development of a more detailed Habitat Management Plan (HMP) and achieve the greatest benefits for wildlife species of conservation concern. For example, increased benefits to waterfowl would accrue from determining the presence, extent, and potential expansion of native marsh and aquatic vegetation, such as spatterdock and wild rice, which are important waterfowl foods.

Water quality issues would be addressed for the marshes and greater Potomac River through more active partnership work with State and Federal agencies. An upgraded comprehensive program of marsh clean-up would also help reduce the trash that tends to degrade the marsh. We would also implement a more comprehensive program of treatment of invasive plants and nuisance wildlife affecting the marsh and other natural areas.

Adverse Impacts
Similar to alternative A, there are no proposals to modify the existing marsh habitat. As such, the extent of this habitat would not change over existing conditions.

The marsh areas may be at some minimal increased risk of indirect effects from increased Service activities in adjacent upland areas that drain into them from leaks or spill accidents involving chemicals or petroleum products used in refuge management operations. However, our leak and spill prevention and emergency clean-up procedures should ensure that such occurrences are rare and are addressed immediately, with short-term effects limited to the immediate location.

We would monitor more intensively for the presence of invasive plants in Great Marsh and Little Marsh and implement a prioritized control program. With a more comprehensive control program, there may be a slightly higher risk to native marsh vegetation from increased use of herbicides as compared to use under alternative A to control invasive plants in the marsh or to control other invasive plants in nearby upland areas. However, we would minimize that risk by using only approved herbicides in the marsh when necessary to control invasive plants that pose a threat of displacing native marsh vegetation. We would use only herbicides approved by our Regional Contaminants Coordinator in this setting to control invasive plants that pose a threat to displace native marsh vegetation. These herbicides are generally non-toxic to fish and other aquatic species and would be used only with strict precautions taken to minimize the potential to affect non-target native plants.

A predicted increase in annual refuge visitation (15 percent over existing levels) would likely result in a greater potential for impact to both Great Marsh and Little Marsh. The types of impacts are the same as those described under alternative A, namely unauthorized use and access, and accumulated trash. However, we would continue to maintain signage and increase our capacity to conduct outreach and enforcement commensurate with our proposed staffing increases, and prioritize monitoring in high use areas to insure adverse impacts are kept to a minimum.

Alternative C. Management to Enhance Public Uses

Benefits
Alternative C would lead to the same benefits to the refuge freshwater marshes as alternative A.

Adverse Impacts
The types of impacts described under alternative B would be the same for alternative C; however, the scope and magnitude of impacts attributed to authorized and unauthorized visitor access would be highest (a 20 percent increase over existing levels) under this alternative. In addition, a slightly higher risk of impact would be attributed to allowing seasonal trail access along the 1.0 mile Little Marsh road. This area has not been open to the public. Similar to alternative B, we would maintain signage and increase our capacity to conduct outreach and enforcement commensurate with our proposed staffing increases, and prioritize monitoring in high use and new use areas to insure adverse impacts are kept to a minimum. Should monitoring results indicate unacceptable impacts are occurring, we would implement restrictions as warranted.

Impacts to Birds

Bald Eagle Impacts

The refuge was established to protect bald eagles which nest, roost, and winter along in the Potomac River and elsewhere in the Chesapeake Bay. Although the species is no longer on the Federal list of endangered and threatened species, bald eagles are still listed as State threatened by Virginia and federally

protected under the Migratory Bird Treaty Act and the Bald Eagle and Golden Eagle Protection Act.

Bald Eagle Impacts That Would Not Vary by Alternative
Benefits
The bald eagle was removed from the Federal list of endangered and threatened species in 1997. Nevertheless, we would continue to ensure the species' sustained recovery through habitat management, conservation partnerships, and limiting human disturbances to nesting, roosting, and foraging areas under all alternatives. There are currently three nesting pairs on the refuge, we would continue to work with our partners to monitor the nests and breeding activities and prohibit the public from disturbing them.


USFWS
Bald eagle on a snag

Adverse Impacts
Regardless of alternative selected, breeding, wintering, and migrating bald eagles may be adversely affected by management activities occurring in the area, such as mowing, applying herbicides to control invasive plants, or by the minor construction projects such as trail work. None of these activities typically occurs within one-quarter mile of nest sites, and there has been no documentation of failed nests or loss of productivity due to management activities.

Alternative A. Current Management
Benefits
Under alternative A, we would continue long-term benefits to bald eagles by ensuring protection of 1,883 acres of forest, which provides nesting and roosting habitat, and 297 acres of freshwater marsh, which provides foraging habitat. We would also benefit bald eagles from our continued efforts to protect and maintain a forested shoreline, protect active nests from human disturbance, and annual active nest searches.

Adverse Impacts
Trail management activities, including proposed realignments, would potentially cause negligible short-term, localized effects to bald eagles by creating a disturbance. We would not conduct trail or other refuge management activities, such as herbicide treatments for invasive plant control, when there is likelihood that the activity might disturb nesting birds. In addition, regardless of season, we would attempt to minimize the time we are working in the area to the extent possible. Disturbance impacts from unauthorized public access may increase commensurately with the predicted increase (10 percent annual over existing levels) in annual refuge visitation. The decline in forest stand conditions, namely the poor tree regeneration that exists, identified by VDF in their forest health assessment (VDF 2009) may result in a loss of quality bald eagle habitat over the long-term.

Alternative B. Improved Management for Federal Trust Resources (Service-preferred Alternative)
Benefits
Under alternative B, bald eagles would benefit from our proposed plans to implement actions to improve forest health and stand conditions. Stand

treatments, which may include thinnings, small created openings, and fuel reductions, would enhance the potential for sustaining larger nest and roost trees over the long-term, and would reduce the potential for windthrow or wildfire losses. Alternative B also proposes to develop nest and roost site management plans as part of the HMP.

Adverse Impacts
The types of adverse impacts are similar to A, but their scope may be greater due to the increased management activities planned and the predicted 15 percent increase in annual refuge visitation. Concerns with disturbing bald eagles during routine maintenance would be the same as those described under alternative A. Additionally, alternative B proposes some new trail work and construction of a new refuge quarters and RV pad. Neither the proposed location of the refuge quarters, or the RV pad are within one-half mile of known nesting or roosting eagles. Therefore, disturbance is predicted to be negligible both during construction and in their use afterwards. None of the proposed new trail construction would occur within one-quarter mile of known nesting sites; however, we would avoid or minimize trail work during the nesting season, but if work is necessary during this time, we would monitor bird response to construction activities and adjust our work if the birds appear agitated or disturbed. Once construction is complete, we would continue to monitor bald eagle activity in the area to ensure visitor proximity is not creating a disturbance. The potential for disturbance to nest sites would be slightly higher under alternative B, compared to alternative A, because of the expected increase in visitation and the greater potential for unauthorized use and access. However, under alternative B, with our increased capabilities in outreach and law enforcement capabilities, and or increased visibility with staff on site more regularly, we would expect violations to be at a minimum.

Alternative C. Management to Enhance Public Uses
Benefits
Benefits under alternative C would be the same as those described for alternative B.

Adverse Impacts
The types of adverse impacts described under alternative B would be the same under alternative C. However, the predicted annual increase in visitors under alternative C (20 percent over existing levels) would pose a higher degree of risk of human disturbance to bald eagles than under alternatives A or B.

Forest Dependent Bird Impacts

The refuge is an important site in the region for breeding and migrating forest dependent songbirds, and for breeding and wintering raptors. Many of these species are listed as birds of conservation concern by the Service and VDGIF, including the Acadian flycatcher, prothonotary warbler, and red-headed woodpecker.

Great horned owl fledging

Bill Wallen/USFWS

Forest Dependent Bird Impacts That Would Not Vary by Alternative
Benefits
Continued protection of the 1,883 acres of refuge forest habitat under all alternatives would benefit forest dependent birds that use the refuge for breeding, wintering or migration. Maintaining the deer hunt to reduce deer overbrowsing of forest regeneration and other understory vegetation would also benefit forest birds. Overbrowsing reduces the forest physical structure and diversity. Casey and Hein (1983) have found greatly reduced bird species diversity in areas with long term, high density populations of deer. These changes were mainly attributed to habitual landscape alteration with pronounced browse line and sparse cover caused by overbrowsing. DeCalesta (1997) also found that deer browsing affects vegetation that songbirds need for foraging surfaces, escape cover, and nesting. DeCalesta noted that species

richness and abundance of intermediate canopy nesting songbirds was reduced in areas with higher deer density. Intermediate canopy-nesting birds declined 37 percent in abundance and 27 percent in species diversity at higher deer densities. Five species of birds were found to disappear at densities of 38.1 deer per square mile and another two disappeared at 63.7 deer per square mile. Casey and Hein (1983) found that three species of birds were lost in a research preserve stocked with high densities of ungulates and that the densities of several other species of birds were lower than in an adjacent areas with lower deer density.

Adverse Impacts
Regardless of alternative selected, breeding, wintering, and migrating forest birds may be adversely affected by current management activities such as mowing or the application of herbicides to control invasive plants. These activities would at least temporarily disturb or displace birds from treatment areas, because of the disturbance from human activity and equipment. Also, if any nests are present near treatment areas, they might be damaged or destroyed by equipment. However, given that mowing and brush cutting occur on a rotational basis, would not result in a habitat type conversion, and avoids sensitive areas during the bird nesting season, the impacts are predicted to be minor, highly localized and short-term with no long-term threats to the long-term viability of bird populations due to adult bird mortality or breeding failure. No significant loss of habitat would occur from management, and we predict that birds would come back to the area within days of management activities.

Construction of the new staff quarters would permanently displace birds from the location due to the need to clear the trees from the site. The site clearing and footprint would constitute less than .02 percent acres in an area already disturbed by High Point Road, the main road accessing Mason Neck State Park.

Refuge visitor activities may disturb birds, occasionally to the point of abandonment, along roads and trails, especially where there is concentrated human activity. However, not all bird species are impacted similarly, and documented sensitivity to human presence ranges widely.

Gutzwiller et al. (1994) found that singing behavior of some songbird species was altered by low levels of human intrusion. Some studies have found that some bird species habituate to repeated intrusion; frequently disturbed individuals of some species have been found to vocalize more aggressively, have higher body masses, or tend to remain in place longer (Cairns and McLaren, 1980). Disturbance may affect the reproductive fitness of males by hampering territory defense, mate attraction and other reproductive functions of song (Arrese, 1987). Disturbance, which leads to reduced singing activity, would make males rely more heavily on physical deterrents in defending territories which are time and energy consuming (Ewald and Carpenter, 1978).

Travel routes can disturb wildlife outside the immediate trail corridor (Miller et al., 2001). Miller et al. (1998) found bird abundance and nesting activities (including nest success) increased as distance from a recreational trail increased in both grassland and forested habitats. Bird communities in this study were apparently affected by the presence of recreational trails, where “generalists” (American robins) were found near trails and “specialist” species (grasshopper sparrows) were found farther from trails. Nest predation was also found to be greater near trails (Miller et al., 1998).

Disturbance can cause shifts in habitat use, abandonment of habitat and increase energy demands on affected wildlife (Knight and Cole, 1991). Flight in response to disturbance can lower nesting productivity and cause disease and death. Hammitt and Cole (1998) conclude that the frequent presence of humans in “wildland” areas can dramatically change the normal behavior of wildlife mostly through “unintentional harassment.”

Seasonal sensitivities can compound the effect of disturbance on wildlife. Examples include regularly flushing birds during nesting. The Delaware Natural Heritage Program, Division of Fish & Wildlife and the Department of Natural Resources and Environmental Control prepared a document on the "The Effects of Recreation on Birds: A Literature Review" which was completed in April of 1999. The following information was obtained from that document:

Several studies have examined the effects of recreationists on birds using shallow-water habitats adjacent to trails and roads through wildlife refuges and coastal habitats in the eastern United States (Burger, 1981; Klein 1993; Burger et al., 1995; Klein et al., 1995; Rodgers & Smith, 1995, 1997; Burger & Gochfeld, 1998). Overall, the existing research clearly demonstrates that disturbance from recreation activities always has at least temporary effects on the behavior and movement of birds within a habitat or localized area (Burger, 1981, 1986; Klein, 1993; Burger et al., 1995; Klein et al., 1995; Rodgers & Smith, 1997; Burger & Gochfeld, 1998). The findings that were reported in these studies are summarized below in terms of visitor activity and avian response to disturbance.

- Presence: Birds avoided places where people were present and when visitor activity was high (Burger, 1981; Klein et al., 1995; Burger & Gochfeld, 1998).

- Distance: Disturbance increased with decreased distance between visitors and birds (Burger, 1986), though exact measurements were not reported.

- Approach Angle: Visitors directly approaching birds on foot caused more disturbance than visitors driving by in vehicles, stopping vehicles near birds, and stopping vehicles and getting out without approaching birds (Klein, 1993). Direct approaches may also cause greater disturbance than tangential approaches to birds (Burger & Gochfeld, 1981; Burger et al., 1995; Knight & Cole, 1995; Rodgers & Smith, 1995, 1997).

- Type and Speed of Activity: Joggers and landscapers caused birds to flush more than fishermen, clammers, sunbathers, and some pedestrians, possibly because the former groups move quickly (joggers) or create more noise (landscapers). The latter groups tend to move more slowly or stay in one place for longer periods, and thus birds likely perceive these activities as less threatening (Burger, 1981, 1986; Burger et al., 1995; Knight and Cole, 1995). Alternatively, birds may tolerate passing by with unabated speed whereas if the activity stops or slacks birds may flush (Burger et al., 1995).

- Noise: Noise caused by visitors resulted in increased levels of disturbance (Burger, 1986; Klein 1993; Burger & Gochfeld, 1998), though noise was not correlated with visitor group size (Burger & Gochfeld, 1998).

Dogs on-leash on designated trails would continue to be allowed under all altenratives. Even if dogs do not give chase to wildlife, studies show that dog presence can cause disturbance to wildlife species in the form of disruption, harassment, and displacement (Sime 1999). Dogs extend the zone of impact from an individual visitor, especially if the dogs are off leash or running, barking, or jumping. Dogs alone may be less of a threat to songbirds than dogs with people, as indicated in two studies, as the authors surmised that songbirds viewed the dogs as a coyote or fox (Leach and Frazier 1953, Andelt et al. 1987). Leashed or not, disturbance from dogs was noted to be greater off trail than on trail.

While all of the above impacts are well-documented, the scope and scale of activities on this refuge are important to keep in mind. Approximately 1.85 miles of trail (approximately 2.2 acres) would be open to public access, and use is only allowed on those designated trails or in parking areas, with the exception of hunting during fall. Deer hunting, however, occurs after bird nesting season and when many migratory birds have already left the area.

We would take all necessary measures to mitigate these effects and avoid or minimize long-term impacts. Sensitive bird areas, such as bald eagle nesting sites and wintering waterfowl concentration areas, would continue to be closed to public access. When group activities are planned, they would be held in areas and during seasons where minimal impact would occur. Periodic evaluation of sites and programs will be conducted to assess if objectives are being met and to prevent site degradation. If evidence of unacceptable adverse impacts appears, the location(s) of activities would be rotated with secondary sites, curtailed or discontinued. Refuge regulations will be posted and enforced. Closed areas will be established, posted and enforced. The known presence of a threatened or endangered species would preclude the use of an area until the Refuge Manager determines otherwise.

Special use permits would continue to be issued to organizations conducting environmental education or interpretive and/or wildlife observation and photography tours or activities on the refuge. The areas used by such tours would continue to be closely monitored to evaluate the impacts on the resource. If adverse impacts appear, the activity would be moved to secondary locations, curtailed or discontinued. Specific conditions may apply depending upon the requested activity and would be addressed through the special use permit.

All photographers would continue to be required to follow refuge regulations. Photographers allowed via special use permit into closed areas must follow the conditions outlined in the permit which normally includes notification of refuge personnel each time any activities occur in closed areas. No baits, calls, or scents would be allowed. All litter would have to be removed daily. Law enforcement patrol of public use areas would continue to minimize the above-mentioned types of violations.

Research activities that would be supported under all the alternatives may also disturb fish and wildlife through observation, a variety of wildlife capture techniques, banding, and accessing the study area by foot or vehicle. For example, the presence of researchers may cause disruption of birds on nests or breeding territories, or increase predation on nests. Efforts to capture birds may cause disturbance, injury, or death to groups or to individual birds. The energy cost of disturbance may be appreciable in terms of disruption of feeding, displacement from preferred habitat, and the added energy expended to avoid disturbance. It is possible that direct or indirect mortality could result as a by-product of research activities. Mist-netting or other wildlife capture techniques, for example, may cause mortality directly through the capture method or in-trap predation, and indirectly through capture injury or stress caused to the organism. Even if such mortalities to individual birds do occur, the total number of birds impacted would be negligible relative to the overall local or regional population of any bird forest dependent bird species.

An indirect long term impact is the potential for visitors to unintentionally introduce and/or spread invasive species. Once established, invasive plants can out-compete native plants, thereby altering habitats and adversely affecting birds and other wildlife. The threat of invasive plant establishment would likely continue to be an issue over the long term and will require annual monitoring, treatment, and public outreach and education.

Alternative A. Current Management

Benefits

Under alternative A we would continue to benefit refuge bird species by permanently protecting from development over 1,883 acres of contiguous forest cover.

Adverse Impacts

The potential impacts from alternative A are described above. In summary, there would be short-term localized impacts to bird habitat and temporary

displacement of birds from management activities such as mowing or herbicide treatments for invasive plant control. Trail maintenance activities would also cause negligible short-term, localized effects from disturbance. Impacts from visitor disturbance may increase minimally in volume due to a predicted 10 percent increase in refuge visitation; however, visitors would continue to be required to stay on designated roads and trails.

Alternative B. Improved Management for Federal Trust Resources (Service-preferred Alternative)

Benefits

In addition to the benefits mentioned under alternative A, there would be increased long-term benefits to forest dependent birds under alternative B due to plans to more actively manage forest health. This would include implementing stand treatments recommended by VDF to restore the native forest composition, age class, and structure that support a diversity of wintering, migrating, and breeding forest dependent birds. For example, thinning and fuel reduction treatments would be considered that would help sustain the predominantly mature forest and maintain the large, older trees while reducing the risk of a catastrophic fire, pest or pathogen event. Stand treatments that improve forest regeneration would also be a priority to implement if determined feasible and practicable. In addition, monitoring and managing the effects of the deer herd and invasive plants on forest understory composition would be implemented as another means of protecting forest health. Understory vegetation, particularly native shrubs, is a critical component of the foraging and breeding habitat for a number of forest dependent birds. Ensuring these native shrubs are maintained and regenerating would be an important contribution to protecting forest dependent bird diversity and productivity.

Adverse Impacts

A review of potential impacts, regardless of alternative, is described above. We also described some mitigations measures we would implement to reduce those impacts. In general, management activities used to maintain or restore habitats, or prevent encroachment of invasive species, may affect individual birds by temporary displacing them or result in a short-term loss of a negligible amount of habitat. These effects would be very local, and we would not predict any long-term impact to the viability of regional species' populations. Measures to minimize risk to forest dependent birds includes avoiding activities during the nesting season when the majority of birds are building nests, incubating, eggs or feeding nestlings.

Visitor disturbance along roads and trails would also increase because of the projected 15 percent increase in visitation and because of the increased access from new and improved refuge visitor amenities. Unauthorized off-trail access could occur, which if excessive, might result directly affect birds that are nesting in shrubs or on the ground. Trampling of vegetation might also indirectly impact those shrub and ground nesting birds by affecting vegetation to the point it reduces protective cover or changes light and moisture regimes.

There would be some removal of vegetation to locate new trails or trail improvements, and build the new refuge housing, observation platforms or photo blinds under alternative B. Approximately 15 acres total would be impacted with respect to trails and associated developments. These activities would cause an increased degree of disturbance to birds and remove an additional 4 acres of natural habitat in trails as compared to alternative A. Placement of kiosks at trailheads and junctions may impact additional small areas of vegetation. Kiosks would be placed where minimal disturbance and vegetation removal would occur.

Under alternative B, we would also support a new youth turkey hunt in an effort to connect youth with nature and the outdoors. The hunt would be limited to approximately 10 youth hunters over a 3-day hunt season in designated areas. We anticipate an annual harvest of about 8-10 turkeys. The greater likelihood of disturbance to forest dependent birds would occur if we implement a spring turkey season; otherwise, a fall turkey season would occur when many forest dependent migrant birds have left the area. In either case, however, we predict only a negligible impact on other forest dependent birds and their habitat given the limited number of participants, and the fact the hunt would be monitored closely. With regards to the turkey population, we would work with VDGIF to insure the harvest would not reduce the Mason Neck Peninsula turkey population to a level below which it is not self-sustaining. Approximately one hundred years ago, wild turkeys had become a rarity in the State due to habitat loss and market hunting. Trapping and relocation of wild turkeys into the State has resulted in a successful reestablishment of a healthy wild turkey population. The VDGIF supports this proposed youth hunt and would help coordinate it, along with the National Wild Turkey Federation.

The management and mitigation measures we describe under "impacts that would not vary by alternative" would help reduce the long term affects of management on forest dependent birds under alternative B. Monitoring and evaluation of wildlife impacts would be a critical component of our adaptive management strategy. In the event monitoring results indicate a disturbance to habitat or wildlife, the activity would be restricted or discontinued. Finally, any of the impacts predicted above would be mostly offset by the overall protection afforded forest birds on refuge lands.

Alternative C. Management to Enhance Public Uses

Benefits

Benefits under alternative C would be the similar to those described for alternative B for forest-dependent birds.

Adverse Impacts

Adverse effects under alternative C would be similar to those described for alternative B for forest-dependent birds except that the predicted 20 percent increase in annual visitation, and the addition of a 1.0 mile trail along Little Marsh road (non-nesting season access only), would likely cause the magnitude of the impacts to increase over those identified under alternative B. However, as with alternative B, the monitoring and evaluation of wildlife impacts would be a critical component of our adaptive management strategy. In the event monitoring results indicate a disturbance to habitat or wildlife, the activity would be restricted or discontinued.

Waterbird, wading Bird, and Waterfowl Impacts

We evaluated the management actions under each alternative for their potential to benefit marsh birds, wading birds, and waterfowl or their habitat. Both Great Marsh and Little Marsh provide high quality habitat for a wide variety of these bird groups. The refuge also hosts one of the largest breeding colonies of great blue herons in the Atlantic Coast States on Little Marsh. The rookery grew as large as 1,400 nests, but has recently declined to less than 800 nests in 2008. Our objective is to manage the rookery to sustain and potentially expand the colony.

The benefits we considered included:

- Protection, maintenance, and improvements to Great Marsh or Little Marsh
- Protection, maintenance and improvement of the Little Marsh Road impoundment

- Prohibition on public access to refuge marshes and impoundments

Some impacts to marsh habitat and water birds were described previously in this chapter under the sections on "Water Quality" and "Soils."

We evaluated the potential adverse effects on these birds from the management alternatives, including impacts from:

- Construction projects that might affect species habitats

- Public activities on the refuge that might damage habitat or disturb the species

Waterbird, wading Bird, and Waterfowl Impacts That Would Not Vary by Alternative

Benefits

Regardless of which alternative we select, our ongoing protection and management of the refuge marshes and uplands will continue to benefit marsh birds, wading birds and migratory and wintering waterfowl. These areas will remain protected and undeveloped in native vegetated cover, thereby sustaining the refuge's important contribution to a reserve of migratory and wintering bird habitats in the Tidal Potomac River Basin that would otherwise almost certainly be intensively developed.

Adverse Impacts

Water quality affects the aquatic invertebrates, plants, and fish on which wintering and migrating waterfowl and water and wading birds depend. The water quality of the Tidal Potomac River Basin will continue to reflect the level of point and non-point source pollution and the effectiveness of pollution controls in the different communities of the watershed overall. We would continue to partner with agencies that are attempting to address water pollution, but we do not have jurisdiction to directly control any major upstream sources of pollution.

Under all alternatives, removal of invasive plants may cause minor, short-term water quality impacts such as increased turbidity and elevated nutrient levels. These effects would not likely add measurably to general turbidity and nutrient levels in the Potomac River Basin. Also, under all alternatives, some temporary disturbance to birds nesting in the Little Marsh heron rookery would continue to occur from the Service-managed surveys, but there has been no indication over the decade of survey work that survey activities are causing permanent abandonment or other long-term adverse effects to the birds' productivity or breeding success.

Visitors to the refuge would continue to cause some minor level of disturbance to water and wading birds and waterfowl at locations on the refuge where trails, specifically the Woodmarsh and Great Marsh trails, are near habitats used by the birds. Potential impacts are described below.

The effects of human visitation on wading and waterbirds have been studied at J.N. "Ding" Darling National Wildlife Refuge in Florida. Klein (1989) found resident wading and waterbirds to be less sensitive to disturbance than migrant birds. Klein also found that sensitivity varied according to species, and would differ among individuals within species. Ardeids (herons, egrets and bitterns) as a family of birds were generally tolerant of people, although appeared less tolerant and were more likely to be disturbed when they were hunting prey. Within that family of birds, great blue herons, tricolored herons, great egrets, and little blue herons were observed to be disturbed to the point of flight more than other birds. Kushlan (1978) found that when these birds

move frequently while feeding, it is more likely to disrupt interspecific and intraspecific relationships. In addition, Batten (1977) and Burger (1981) found that wading birds were extremely sensitive to disturbance. Klein (1993), in studying waterbird response to human disturbance, found that as intensity of disturbance increased, avoidance response by the birds increased. He also found that out-of-vehicle activity is more disruptive than vehicular traffic. Freddy et al. (1986) and Vaske (1983) also found this to be true. Burger (1981) found various gull species to be apparently insensitive to human disturbance, while Klein (1989) also found this true of gulls, and found the same results with sandpipers.

McNeil et al. (1992) found that many waterfowl species avoid disturbance by feeding at night instead of during the day. Klein (1989) found migratory dabbling ducks to be the most sensitive to disturbance and migrant ducks to be more sensitive when they first arrived in the late fall, than later in winter. Disturbance may displace individual waterfowl to other parts of the refuge; however, this disturbance would be limited in scope due to the limited number of areas accessible to visitors.

Fishing and recreational boating cause disturbance to waterfowl and so would continue to be prohibited on the refuge. Recreational fishing opportunities along the shoreline may cause temporary disturbances such as the flushing of feeding, resting, or nesting birds, especially waterfowl, and other wildlife species.

Most visitors understand the protection afforded by the refuge, and the Service would continue to provide educational materials and adequate signage, these instances should remain rare. We have not observed that the level of visitor activity would to any degree constitute a substantive adverse impact to species survival or reproduction. Through refuge literature and signage, people are directed to stay on trails and to be sensitive to disturbing wildlife. Outreach, education, and if necessary, law enforcement, will continue to be tools to insure significant impacts do not occur.

Mute swans are invasive species that often out-compete native waterfowl for forage and nesting areas. Under all alternatives, mute swans would be controlled with a goal of zero productivity to reduce, if not eliminate, their threat to native waterfowl.

Alternative A. Current Management

Benefits

Continued protection of the 207-acre Great Marsh and 50-acre Little Marsh under alternative A would benefit marsh birds, wading and water birds, and waterfowl by ensuring these habitats exist for the long-term and are permanently protected from development. The great blue heron rookery would also benefit from our continued protection of the sites and from our partners who monitor and maintain the current breakwaters that are helping to stem the loss of trees along the forested bluff that include rookery nest trees. Our law enforcement officers would continue to conduct outreach and enforce the prohibition on public entry to the rookery site.

Adverse Impacts

An increase in refuge visitation would minimally elevate the potential for impacts to the refuge freshwater marsh and disturbance to marsh and wading birds and waterfowl. The potential for disturbance from refuge maintenance projects and staff using motor vehicles to monitor the marsh would be negligible.

Given our limited biological program staff, we would continue to be unable to effectively monitor wintering waterfowl and to study the rookery to determine what is causing the recent decline in nesting heron numbers. Our involvement with partners to develop and implement management plans to reverse the current trend would also be limited.

Alternative B. Improved Management for Federal Trust Resources (Service-preferred Alternative)

Benefits

In addition to alternative A benefits, the quality of habitat for water and wading birds and waterfowl should improve in the refuge's marshes and wetlands over the long term under alternative B. Increasing our monitoring of on-site and off-site threats to water quality and vegetation, coupled with invasive plant control and greater vigilance of visitor impacts (e.g. litter control) in the vicinity of the 207-acre Great Marsh and 50-acre Little Marsh, would increase protection of the health and integrity of these refuge wetlands. This, in turn, would directly benefit foraging, resting, breeding, and resting habitat for the many species of marsh, shore, and wading birds and waterfowl.

Under alternative B, we would continue to conduct our annual rookery surveys and track the numbers of great blue heron nests on the rookery site. Using GIS capabilities, we would also map and track the configuration of the rookery site over time, monitoring even subtle shifts in nest sites, in an attempt to identify the factors influencing the size and distribution of the rookery and the reasons for the apparent decline in the size of the colony over the last 10 years. In addition, we would work with partners to expand refuge shoreline and bluff protection to reduce the loss of future potential nesting trees.

Adverse Impacts

The common impacts described above for all alternatives, and those described under alternative A, would also apply under alternative B. In addition, the anticipated increase in refuge annual visitation by 15 percent due to expanded public use programs under this alternative would minimally elevate the potential for impacts to the refuge freshwater marsh and disturbance to marsh and wading birds and waterfowl. However, our proposed actions to minimize the loss and degradation of habitat, and maintaining the area closures, would help offset the potential impacts. We would also mitigate the elevated risk by increasing our outreach to the visiting public and our enforcement of unauthorized access and uses. Our ability to conduct those activities actions would be commensurate with the increased staffing proposed under alternative B. We expect violations would be kept to a minimum.

The potential for disturbance from refuge maintenance projects and staff use of motor vehicles to monitor the marsh would continue to be negligible.

Alternative C. Management to Enhance Public Uses

Benefits

Same as alternative B.

Adverse Impacts

The types of adverse impacts described under alternative B would be the same under alternative C. However, the predicted annual increase in visitors under alternative C (20 percent over existing levels) would pose a higher degree of risk of human disturbance to water and wading birds, and waterfowl than under alternatives A or B. In addition, the proposed seasonal access to Little Marsh via a trail along Little Marsh road would increase the likelihood of disturbing herons, other waterbirds, and waterfowl using the area. While trail use would not be allowed during the critical nesting season, we would predict that herons and other water birds and waterfowl that use the area year round, would still be disturbed by visitors outside of the nesting season. We would expect the birds to

be temporarily displaced and move out of the area to avoid human encounters. If monitoring results indicate disturbances are at unacceptable levels, we would implement restrictions on public access as warranted.

Similar to alternative B, outreach to the visiting public and enforcement of unauthorized access and uses would be increased commensurate with the increased staffing proposed under alternative C. We would work to keep violations to a minimum.

Impacts to Other Native Wildlife

Native mammals at the refuge—including white-tailed deer, beaver, muskrats, woodchucks, squirrels, bats, shrews, and mice—are an integral part of the natural ecosystems we work to sustain on the refuge, and their presence reflects the refuge's biological diversity, integrity and environmental health. Many of the small mammals are particularly important as they are the prey base for diurnal and nocturnal raptors. White-tailed deer is the only mammal hunted on the refuge.

Reptiles, amphibians, and invertebrates are also important components of diversity on the refuge. Amphibians known on the refuge are relatively common in the region; none are listed as species of greatest conservation need by the State of Virginia. However, three reptiles that occur on the refuge are listed as species of global conservation need (GCN) by VDGIF: the spotted turtle (Tier III species), eastern box turtle (Tier III species), and eastern hognose snake (Tier IV species).

John Mosesso, Jr., NBII

Eastern box turtle

The refuge and adjacent tidally-influenced river and bay waters are also host to a wide variety of invertebrate species, from the butterflies and spiders that populate our forested, grassland, and shrubby areas to the freshwater mussels and aquatic arthropods in the shallow waters of the marshes. Invertebrates are critical food items for insectivorous birds, bats, moles, shrews, raccoons, fish, and a number of other refuge wildlife species. This great diversity is a major portion of the food biomass on which refuge wildlife species depend. A number of invertebrate species are rare or declining and are of special management concern.

Pollinating insects are a group of particular and increasing concern by the Service. Insect pollinators support native plant food production, contribute to nutrient recycling, and serve as direct prey for migrating and breeding birds. They include butterflies and moths (*Lepidoptera*), bees and wasps (*Hymenoptera*), beetles, (*Coleoptera*) and flies (*Diptera*). Concern about the decline of pollinators, especially of wild native insect species, has prompted the Service to collaborate with the North America Pollinator Protection Campaign (NAPPC). The Refuge System is taking a lead in conserving pollinators, recognized as the guardians of biological integrity, diversity, and environmental health of natural ecosystems (Higgins & Adamcik 2006). We are including insect pollinator conservation in future refuge habitat management planning, strategies, and conservation actions.

We considered the benefits from:

- Protection of diverse refuge habitats
- Measures to improve water quality

We considered the potential for adverse effects from:

- Refuge habitat management activities
- Construction or maintenance projects
- Public use and access

Native Wildlife Impacts That Would Not Vary by Alternative

Benefits

Regardless of which alternative we select, we would continue to permanently protect a natural landscape with a diversity of uplands and wetlands habitats to support existing populations of native mammalian, amphibian, reptile, and insect species. The conservation of Federal trust species and species of conservation concern in Virginia would continue to be a priority for our management.

Monitoring infestations of pathogens and pests, such as gypsy moth, and controlling their spread, will continue to be important to sustaining quality forest habitat over the long term. Unchecked infestations could lead to catastrophic loss of forest habitat. For example, the threat from gypsy moth is well known in the area. Gypsy moths prefer oaks as a host but also feed on and defoliate many deciduous tree species found in Virginia. Once trees are defoliated multiple times during the growing season they become stressed. The stressed trees are then extremely prone to other stressors including diseases. Death of large numbers of oak trees can ultimately occur if left untreated. This would have a substantial impact to many species of wildlife; including deer, squirrels, and mice that rely heavily on these trees as a food source (USDA, 1995).

Adverse Impacts

Refuge management activities such as manual pulling, mechanical removal (e.g. mowing), and herbicide applications to control invasive plants, and mowing and brushogging fields may potentially kill individual small mammals, such as mice, moles, and shrews, as well as amphibians, reptiles, and invertebrates that are not very mobile within a treated area. This may be especially true during the warmer months. Contaminants that might run-off into refuge vernal ponds or wetlands as a result of maintenance operations, or from visitor vehicles on roads and parking areas, could adversely affect amphibians and aquatic arthropods. However, spill plans, monitoring, and immediate corrective measures would continue to ensure contaminated run-off does not become a problem. While mortality is the worst case for some, lesser impacts could be temporary disturbance or displacement of others in treatment areas. In our professional judgment, there would be no significant mortality or loss of local populations from habitat management activities to jeopardize their viability over the long term because these actions would be done on a rotational basis, no major habitat alterations would occur in any given year, and individual treatment areas would be 15 acres or less. More mobile species would be expected to repopulate the area within days.

Impacts to native wildlife may also occur during the fall deer hunting season, which will continue under all alternatives. Shotgun noise from hunting may cause disturbance to some wildlife. Also, non-target species in the pathway of hunters tracking deer may be temporarily disturbed and frightened or forced to flee. We predict that rarely would mortality occur to non-target, less mobile species as a result of hunters walking through the woods. And, more often, mobile wildlife would just temporarily move from the path of hunters, but not permanently leave the area. Hibernation or torpor by reptiles and amphibians limits their

activity during the hunting season when temperatures are low, so risk to those individuals is predicted to be minimal. In our observations, hunters rarely encounter reptiles and amphibians during most of the hunting season. Insect populations are also diminished during the cooler fall temperatures and their populations would be at low risk. Some small mammals may be active depending on the weather conditions, but like reptiles and amphibians, many will be starting to hibernate in burrows, under logs, or in trees, during the fall.

Deer hunting would obviously result in deer mortality. However, deer are abundant across their range in the Mid-Atlantic States and in many areas, including portions of the Mason Neck Peninsula, deer populations exceed their ecological carrying capacity and are degrading habitat values for other native wildlife due to their overabundance. We will continue to adhere to State seasons which account for deer population dynamics and trends to minimize any possible long term threat to deer populations from hunting on the refuge. As such, deer populations would be reduced during the deer hunt, but the deer population on the refuge and across the peninsula would not be adversely affected permanently, or over the long-term, because we would continue to monitor the peninsula population in coordination with VDGIF, and modify our management actions as necessary to insure they are not reduced to the point that the population is decimated. In addition, we would adapt our hunt program when deer populations have been reduced to levels where maintenance of the existing population is the goal, rather than the current goal of herd reduction.

In addition to hunting, other refuge visitor activities and facilities to support them may cause minor temporary negative direct and indirect impacts on wildlife and their habitat. Wildlife disturbances from human presence from non-hunting visitor activities typically result in only temporary displacement without long term effects on individuals or populations. Some species will avoid the areas people frequent, such as developed trails and buildings, while others may be unaffected or even drawn to the presence of humans. Roads and trails can be barriers to movement for some species. For example, salamanders may not cross openings that are too wide or that consist of dry bare ground (Vinson 1998). Gravel roads or trails, even if permeable, may act as a barrier to salamander movement (Marsh et al 2005). Refuge trails are generally a gravel surface, except for the multi-purpose, asphalt High Point trail, and are laid out on level terrain with good drainage. Disturbance to basking turtles may also occur where trails come into proximity to ponded water or the marsh habitat. However, the locations of our trails are designed to minimize crossing wet areas and small ravines that would be favored by salamanders, and they minimize access to open water where basking turtles may be present. Vernal pools, which are important to many native amphibians and reptiles, would be avoided when maintaining or constructing trails and facilities.

Dogs may also cause disturbance to many wildlife, even when on a leash. We described some of the potential impact from dogs in the section above on ‘Forest birds.” In addition to what is described there, studies have shown that ungulates, such as deer, respond to the presence of dogs by running, which can be very stressful and expend a lot of energy. Ungulates demonstrated more pronounced reactions to unanticipated disturbances, such as dogs off leash.

The parking lots that are illuminated may impact wildlife. Artificial illumination may have both positive and negative impacts depending on the species being considered. One study indicates that artificial illumination may enhance prey detection for some species, hurt predator avoidance, cause aggression between individuals for the same species, cause temporary blindness in frogs, disrupt or confuse migration to or from ponds for salamanders (Wise and Buchanan 2002), or inhibit reproduction by frogs adapted to low illumination (Buchanan 2002).

We would continue to illuminate the Great Marsh trailhead parking lot due to concerns with visitor safety and to enhance law enforcement of the area.

The majority of the disturbances noted above would occur in close proximity to trails and parking areas, and are thus confined in space. No loss of populations or major impacts on rare or sensitive species is predicted. Long term impacts are anticipated to be minimal and localized since the majority of the refuge is closed to the public and access is only on designated trails (except by hunters). The public is excluded from the most sensitive wildlife areas on the refuge.

Individual beavers may need to be occasionally removed if they are causing road flooding or other serious refuge management problems. Beaver are capable of girdling and felling large diameter trees and can decimate a small stand. This could have implications to important bird nesting areas, such as the heron rookery or bald eagle sites. We would remove problem animals through lethal means only when necessary. Removal would be conducted by Refuge personnel or their designated agent.

Outreach and education programs would continue to be used to inform the general public and nearby landowners of the need for, importance of, and ecological soundness of hunting and animal damage control measures. We will also continue to emphasize in our education and outreach programs the importance that refuge wetlands, vernal pools, and contiguous habitat are to many species of wildlife.

Alternative A. Current Management

Benefits

Mammals, reptiles, amphibians, and invertebrate species would benefit as we continue to permanently protect a diversity of upland and wetland refuge habitats under alternative A. Continuing to allow public access on only the designated Great Marsh and Woodmarsh Trails, except during the deer hunt, maintains over 2,000 acres on the refuge free from human disturbance.

We predict that maintaining 15 total acres of grass/shrub lands under alternative A, including the 5-acre environmental education site, would help maintain a diversity of native wildlife species since the refuge is otherwise predominantly forested. However, the particular species using the grass/shrub area is not well-documented through systematic inventories. We also predict that maintenance of refuge impoundments and tidal marsh would continue to be a major benefit to a wide diversity of dragonflies and damselflies and other aquatic-dependent native wildlife species.

Adverse Impacts

The potential adverse impacts noted above for all alternatives summarize those we would expect under alternative A. Manual, mechanical, and herbicide methods for invasive plant control or habitat management would cause short term impacts, killing some slow moving wildlife in treatment areas, but we would expect these areas to be repopulated within weeks as source populations for these mostly common species are nearby. No long-term effects on the viability of any local populations are predicted.

Alternative B. Improved Management for Federal Trust Resources (Service-Preferred Alternative)

Benefits

Mammals, reptiles, amphibians, and insects would benefit to a greater degree from refuge management under alternative B than under the other alternatives. This is primarily due to increased effort in inventorying and monitoring wildlife and habitats, managing to improve forest health, and proposing only a moderate increase of visitors in designated areas. We would identify, map, and digitally

track important habitat features including vernal pools and den trees, mast trees, snags, and downed logs that provide breeding or escape cover, food, or other survival requirements.

Maintenance of the 15 acres of grassland/shrub areas would provide the same benefits predicted under alternative A. Increased protection and management of the health and integrity of wetlands and forest on the refuge would commensurately increase the habitat quality benefits to native aquatic and forested wildlife.

Adverse Impacts
The potential adverse impacts noted above for all alternatives would pertain to alternative B. Manual pulling, mechanical, and herbicide methods for invasive plant control, fuels management and maintenance of the grassland area near the outdoor education site would cause similar short term impacts, to native wildlife that are not mobile on treatment areas, similar to alternative A. However, over the long term, controlling invasive plant species benefits native wildlife by maintaining the balance of food resources and native vegetative communities with which they evolved or adapted for cover, nesting, and quality food resources. Those invasive species that pose the biggest threats to native wildlife are those that quickly colonize an area and form dense, monotypic stands.

Under alternative B, there is a potential to increase the impacts noted above from deer hunting if the hunt program is modified to extend the season or allow additional hunters. However, this increase in hunting pressure would only result after an evaluation that declining forest health and vegetations conditions caused by deer warrant an increased deer harvest. The alteration and degradation of habitat from deer over-browsing can have detrimental impacts on other native wildlife communities that depend on understory vegetation for breeding, nesting, cover, or forage (VDGIF 1999). Waller and Alverson (1997) found that by competing with squirrels and other fruit eating animals for oak mast, there is a likelihood that deer many further affect many other species of animals and insects that rely on the same food resources.

Compared to alternative A, there is an increased potential to impact native wildlife, primarily in the form of disturbance and displacement, as a result of new and enhanced trail projects and from the new, proposed 3-day youth turkey hunt. Some impacts from trail use are described above under the section “impacts that would not vary by alternative.” The proposed new trails would introduce these impacts to new areas on the refuge.

In particular, the trail improvements and additions proposed under alternative B have the potential to impact amphibians and reptiles more than would occur under alternative A. Mowing and brushing of access roads and public use trails occasionally kills turtles, snakes or frogs if conducted during times of movement (warm months). We attempt to minimize this direct type of negative impact by keeping these pathways mowed short so that they do not become attractive habitat. However, in many cases it will be impossible to find a perfect time to carry out maintenance actions that will completely avoid conflict for wildlife. Enhancement and expansion of the trail systems for public use also poses the potential threat of blocking access between different habitat types. Some salamander species will not cross openings that are too wide or that consist of dry, bare ground (Vinson 1998); thus earthen trails, if exposed to sunlight could become dry enough to form a barrier. Gravel roads or trails, even though thought to be permeable, may also act as a barrier to salamander movement (Marsh et al. 2005). Consideration will be given during the development and construction of new trails to avoid disruption to movements of amphibians and reptiles.

Disturbance to basking or nesting turtles may occur where public use is concentrated at points where land and water interface. Basking turtles can

usually find alternate resting surfaces. Nesting turtles, once engaged in the act of digging usually will not allow their attention to be drawn to anything else, and at such time are vulnerable to predators. A turtle wishing to make landfall to attempt egg-laying, however, may be dissuaded by the presence of humans at the site.

We would plan to mitigate all of the potential trail impacts by continuing to require that visitors stay on designated trails (except during hunting season), and through increased monitoring, outreach and enforcement to insure the scope and scale of those impacts does not reach unacceptable levels.

The proposed new hunt would be tightly monitored with the help of VDGIF and the National Wild Turkey Federation, allowing up to 10 hunters access at any one time during state seasons, and distributing those hunters to minimize impacts on natural resources and on other public use programs.

Alternative C. Management to Enhance Public Uses
Benefits
Benefits to other native wildlife under alternative C would be the same as those predicted above for alternative A because our habitat and species management programs would be the same under both alternatives. Our emphasis on forest and wetland protection and maintenance of diversity and health would benefit native over the long term.

Adverse Impacts
Similar to alternative B, manual pulling, mechanical, and herbicide treatments for invasive plant control or other habitat objectives would cause short term impacts, potentially killing or displacing numbers of slow moving wildlife species in treatment areas. However, we predict that these areas would begin to recover rapidly and no long term effects to the viability of populations of local native wildlife would occur.

Under alternative C, annual deer mortality would increase from implementing a new muzzle-loader hunt. This increase in annual mortality would have a short term effect on the local deer population, in particular. We predict that any short term increase in mortality would be offset in subsequent years, perhaps in 5-10 years, when the Mason Neck Peninsula deer herd would then become somewhat stabilized and annual hunter harvest would stabilize commensurately. If this occurs, we may directly reduce the hunt mortality by reducing the parameters of the muzzleloader hunt or shotgun hunt if we determine, in coordination with the Mason Neck Refuge management group and VDGIF, that such a reduction in hunting pressure is warranted. There may be some minimal effects to other native wildlife, including disturbance and displacement, by additional deer hunters walking through the refuge and firing their weapons. However, over the long term, with the goal to bring deer populations to within the ecological carrying capacity and to improve forest diversity, structure and regeneration, other native forest wildlife would directly benefit. .

Under alternative C, the potential impacts to native wildlife from public use on trails would increase over those proposed under alternative B because refuge annual visitation would be 5 percent higher and an additional 1.0 mile of trail is planned. Therefore, while the types of impacts would be the same as in alternative B, their scope would reach to new areas on the refuge, including along Little Marsh Road.

The Service recognizes the importance of continued compliance with the National Historic Preservation Act, and other Federal laws and mandates protecting

Archaeological and Historic Resources Impacts

archaeological, historical and cultural resources, to ensure that known sites are protected and that any sites found in the course of refuge management and public use are properly addressed.

Archaeological and Historic Resources Impacts That Would Not Vary by Alternative

Benefits
Areas that are likely to contain cultural, archaeological, or historic resources would be protected regardless of which alternative we select. We would continue to conduct outreach and education, and use law enforcement if necessary, to protect against loss or damage to these resources.

Adverse Impacts
Increased visitation and opportunities for consumptive and non-consumptive uses would also increase the likelihood of damage or disturbance of cultural and historic resources on the refuge. However, those effects should not be significant, since all public uses except hunting would occur in designated areas on the refuge, such as refuge trails. Hunting would not involve ground disturbance. We would take all necessary precautions to identify and preserve properties that are eligible for listing on National Register of Historic Places. This EA will be sent to the Virginia SHPO for review of NHPA Section 106 compliance, and we will also continue to do Section 106 compliance for all individual projects.

Alternative A. Current Management

Benefits
Continued Service protection of refuge lands would benefit cultural resources by ensuring that none of the substantial impacts related to development for other uses would affect known or unrecorded cultural, archaeological, and historic resources on those lands.

Adverse Impacts
There is some risk that refuge visitors may inadvertently or intentionally damage or disturb known or unrecorded cultural artifacts or historic properties on the refuge. We would manage these resources to protect sites and objects of importance for scientific study, public appreciation and socio-cultural use by complying with Section 106 of the NHPA, as amended, promoting academic research on, or relating to, refuge lands, adding Archaeological Resource Protection Act (ARPA) language to appropriate public use materials to warn visitors that looting is unlawful and by maintaining law enforcement personnel trained in ARPA enforcement.

Alternative B. Improved Management for Federal Trust Resources (Service-Preferred Alternative)

Benefits
There would be increased benefits to archaeological and historic resources under alternative B because we plan to complete a refuge-wide inventory of all our archaeological and historic sites and resources. We plan to work with State, County and professional archaeological societies willing to assist in performing surface surveys of selected refuge sites and the shoreline to locate archaeological resources at risk. We plan to ensure that archaeological and historic resources are protected from looting, and we would develop site management and protection plans as warranted. At least one law enforcement staff person would receive ARPA training. We would also use the proposed new Sycamore Road Trail as an opportunity to interpret archaeological sites.

Adverse Impacts
We would perform archaeological reviews, surveys, or studies of trail construction and improvement projects and other proposed projects as needed or recommended by the Service's Regional Archeologist and consult with the Virginia SHPO regarding refuge undertakings that have potential to affect archaeological resources. Increased visitation and increased opportunities for consumptive and non-consumptive uses would combine to increase the likelihood

of damage or disturbance of cultural and historic resources on the refuge. We would monitor known archaeological and historic sites on the refuge to protect from looting and other ARPA violations.

Alternative C. Management to Enhance Public Uses

Benefits and adverse effects to cultural and historic resources would be similar to alternative B. Benefits would increase as we develop a prioritized program to perform additional surveys and research as funding allows, including a systematic program to monitor erosion impacts on resources. We would perform archaeological reviews, surveys, or studies of project areas as needed or as recommended by the Service's Regional Archeologist and consult with the Virginia SHPO regarding refuge undertakings that have potential to affect archaeological resources. Increased visitation would increase the potential for impacts to cultural resources.

Impacts on or Between Refuge Users

Providing opportunities for compatible public uses, including hunting, environmental education, interpretation, wildlife observation and photography is integral to our overall management of this refuge. These uses are priority uses of the Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57). Fishing is a sixth priority public use for the Refuge System. However, we do not offer a fishing program on this refuge because there is no safe public access to the shoreline outside of closed, sensitive areas.

In this section we evaluate the differences in visitor opportunities between the alternatives, including predicting the interaction among and between visitors engaged in proposed refuge programs. The potential impacts that visitors would have on natural and physical resources from proposed visitor programs are described under respective headings for those natural and physical resources. We evaluate the alternatives by considering the extent to which refuge access for pursuing priority uses would stay the same, improve, or diminish under each alternative, as well as the opportunities for appropriate and compatible non-priority uses. Given regional recreational trend information, and our expectations of what would result based on current and proposed visitor services, we predict that over the next 15 years annual visitation to the refuge would increase by 10 percent, 15 percent and 20 percent under alternatives A, B, and C, respectively.

Other uses that have frequently been requested by individuals have been determined not appropriate. Appendix B—Findings of Appropriateness and Compatibility Determinations provides rationales for denying the use. Activities not allowed include horseback riding, berry picking, mushroom harvesting, flower picking, and medicinal harvesting, bicycling off designated trails, jogging, non-wildlife dependent group gatherings group activities, organized or facility-supported picnicking, swimming and sunbathing.

Wildlife Observation & Photography

Wildlife Observation & Photography Impacts That Would Not Vary by Alternative

Benefits

Regardless of the alternative, we would continue to provide safe public access and infrastructure for wildlife observation and photography opportunities. Public involvement in these priority public uses will result in a better appreciation and more complete understanding of refuge wildlife and habitats, which in turn, translates into more widespread, stronger support for the Refuge Complex, the Refuge System, and the Service. There is no substitute for visitors to be able to observe and experience wildlife in their natural habitats in person, and to learn about wildlife and wild lands at their own pace in an unstructured environment. We would continue to maintain existing refuge facilities so they are safe and


Bill Wallen

Northern flicker

aesthetically pleasing, including the foot trails and parking areas, observation platforms, and kiosks. We believe, despite predicted increases in annual visitation over the next 15 years, that we can accommodate those increases without impacting natural resources or diminishing the quality of experience for other visitors. This is based on our current monitoring and observations of visitor behavior on the refuge. It is rare for visitors to go off designated trails during much of the year, in part because of concerns with ticks and poison ivy. We would continue to manage increased visitation by encouraging group activities and programs, attempting to distribute and schedule those activities throughout the year, and continuing our outreach, education, and law enforcement activities.

Adverse Impacts

We do not predict any major conflicts between or among visitors engaged in various activities on the refuge regardless of alternative. This is based on our observations that few conflicts have been documented to date under our current programs and we are not proposing to appreciably change existing programs to the extent we would predict a new conflict. Seasonal area closures to protect wildlife from disturbance during sensitive times of the year may result in some complaints by those visitors who want access during that time, but most people understand the need and value of this inconvenience and respect our decision. Refuge closures during deer hunting would continue to occur for approximately 3 to 5 days a year at most, but these closures have not resulted in any complaints over the last few years. Other short, temporary closures have occurred at other times to clean up, repair, or maintain trails and parking areas, but this inconvenience has not been raised by the public as a significant concern.

Alternative A—Current Management

Benefits

There would be no changes to public use as it is currently conducted under alternative A. The same benefits noted above would continue.

Adverse Impacts

There continues to be increasing development pressure resulting in increased demand for outdoor recreational opportunities in Fairfax County and other parts of northern Virginia. These could possibly lead to an increase in user conflicts and enforcement issues on the refuge if no improvements or additional opportunities are provided.

Alternative B. Improved Management for Federal Trust Resources (Service-Preferred Alternative)

Benefits

Benefits to public users would increase under alternative B. We plan to increase public use opportunities by providing access to new areas and improving the quality of existing programs. The quality of interpretive materials would improve at existing trails.

In alternative B, new trails would expand opportunities for the public to participate in wildlife observation and photography. The new trails would help satisfy demand for wildlife observation and photography and provide access

that is regularly requested by the public. We would hire visitor services and maintenance staff to support improved refuge facilities, increased and enhanced visitor and outreach programs, and other expanded public uses and outreach.

Adverse Impacts
Increased refuge visitation, and increased compatible wildlife-oriented opportunities for non-consumptive uses would combine to increase the risk of human-wildlife conflicts. There would likely be more instances of trespassing in unauthorized areas of the refuge. There would be a greater likelihood of minor injuries or accidents by trail users. There may be associated parking issues during times of heavy use when parking areas fill and people attempt to park in unauthorized locations. The refuge would continue to be closed during the current deer shotgun hunting season which inconveniences some visitors who do not hunt. To mitigate those concerns we make sure advance notification of the upcoming deer hunt is well advertised and distributed so people can plans ahead of time.

We do not predict that the new deer archery hunt would affect visitors engaged in wildlife observation and photography since hunters would be distributed into areas not otherwise open to the public. Buffer zones would occur between roads and trails during the hunt for safety as well as to avoid or minimize hunter encounters with other visiting public. This would avoid the concern that some non-hunting people have with viewing hunting gear or harvested game. Our increased staff capability over time should help us conduct more effective outreach and education to better explain the purpose of the closed areas, the impacts refuge users have on wildlife, and the importance of protecting and conserving natural resources on refuge lands.

Alternative C. Management to Enhance Public Uses
Benefits
There would be additional benefits in terms of increased public use opportunities under alternative C similar to, but slightly higher than, alternative B. We would create an additional trail on Little Marsh Road that would afford visitors new opportunities for wildlife observation and photography and provide additional accessible locations for interpretation and education.

Adverse Impacts
Adverse impacts would be similar to, but slightly higher than, those identified for alternative B due to the increase in numbers of visitors.

Environmental Education and Interpretation

Environmental Education and Interpretation Impacts that would not Vary by Alternative
Regardless of the alternative we select, we would continue to provide opportunities for environmental education and interpretation on the refuge. We anticipate that the Friends of Potomac River Refuges, volunteers, regional educational institutions, and researchers will continue to help us support these activities on the refuge because of the importance of the resources on the refuge and the proximity of the major Washington, DC metropolitan area. We expect that continuing to educate the public and interpret the wildlife resources of Mason Neck Refuge under all alternatives will promote long term stewardship of the refuge.

Alternative A. Current Management
We would be able to provide only a minor increase in efforts to support environmental education and interpretation opportunities under alternative A.

Alternative B. Improved Management for Federal Trust Resources (Service-Preferred Alternative)

Benefits

With the hiring of visitor services and maintenance staff and additional volunteer involvement, we would be able to provide substantially increase our efforts to support environmental education and interpretation opportunities on the refuge under alternative B. These activities are in huge demand in our area, based on the number of requests we get each year, and we have been unable to even closely meet demand. Implementing alternative B would help us better meet this demand with the increased staff planned. These activities are important to our goal of working with the public to provide outdoor nature-based experiences that promote understanding of the natural features and processes at work on the refuge. In turn, our ability to offer more and higher quality opportunities would benefit the refuge and the Service over the long term by engendering an increased understanding and support for the priority work of the refuge and the mission of the Refuge System.

Adverse Impacts

Our increased efforts to support environmental education and interpretation opportunities on the refuge would likely increase visitation on the refuge and result in a minor increase in human-wildlife conflicts. We would plan to continue to manage increased visitation by encouraging group activities and programs, attempting to distribute and schedule those activities throughout the year. Group activities would be led by our staff, educators or other partners in order to minimize conflicts with wildlife and other users.

Alternative C. Management to Enhance Public Uses

Alternative C would result in the same type of impacts as alternative B. The level of impact would be slightly higher due to our prediction that approximately 1,250 more visitors would come to the refuge each year. However, given the access restrictions we would continue to implement to protect natural resources and minimize inter-user conflicts, the increase in visitation is not considered significantly different from alternative B.

Hunting

Hunting Impacts That Would Not Vary by Alternative

Under all alternatives, we would continue to provide deer hunting opportunities in designated areas for the public in a program coordinated with Mason Neck State Park. The Little Marsh area and areas around refuge facilities would continue to be closed to hunting. The refuge would continue to be closed to other public uses during the deer hunt.

Deer hunting is currently the most effective tool we have to manage the health of the deer population, and sustain the integrity, diversity and health of forest habitats on the refuge. We implement a hunt program as part of a larger partnership of land management agencies on Mason Neck Peninsula; agencies which also have goals to sustain healthy deer populations and forest habitat conditions. VDGIF surveys have documented that deer herd composition and health does not currently meet their goals. Our own observations on the refuge of the impacts of deer overbrowsing on forest composition and structure supports the need for continued deer management.

Deer hunting also provides a wildlife-dependent recreational opportunity that is in decline within the urban setting of Northern Virginia. Providing this opportunity helps preserve the cultural heritage of the refuge area, where people have hunted for generations, and allows people to connect with nature in an

outdoor natural setting where it is becoming increasingly difficult to find access to undeveloped lands. We would continue to use this program to inform hunters about the value of our inter-agency partnership in managing deer populations and the direct benefit to refuge habitats and other native species.

Alternative A. Current Management

Benefits

Approximately 90 hunters (about 370 total hunter visits) would continue to benefit each year by participating in the annual deer hunt enjoying an outdoor recreational opportunity in an area where such opportunities are diminishing on other public lands. We are meeting a need and at least partially satisfying a demand because all available permits are issued each year and there is often a waiting list.

Adverse Effects

The existing program provides an opportunity for a public hunt with minimal impacts on other refuge visitors. We have not received any complaints over the last few years from users unable to access the refuge on the days the hunt is underway. We do, however, recognize there is a segment of the public that does not support hunting for ethical reasons. Maintaining our hunt program would continue to disturb people who have this opinion.

Based on our observations of habitat condition and VDGIF's evaluation of deer health from deer harvested on the refuge, our current hunt program is only minimally sustaining existing habitat and deer health conditions from further decline; it is not markedly improving conditions. A more flexible and expanded hunt program, as proposed under alternatives B and C, would be more effective, provide more opportunities for hunters, and improve habitat conditions and aesthetics for other refuges.

Alternative B. Improved Management for Federal Trust Resources (Service-preferred Alternative)

Benefits

We predict that deer hunters would directly benefit from the proposed deer hunt program changes under alternative B which are designed to increase the overall effectiveness of our deer management. We would strive to meet and sustain VDGIF herd health and deer population goals, and our refuge goals and objectives for quality forested habitat, by using a variety of new strategies, including diversifying the hunting season. Archery hunting, which is not currently allowed on the refuge, but has been offered in the past on the refuge, would be allowed under alternative B once staffing, partners, and support resources are in place. This would open up a new opportunity for many hunters and one that has been regularly requested over the years. Furthermore, we believe our enhanced hunt program, with improved outreach and communications, would result in greater hunter satisfaction. Our discussions over the years with hunters indicate that when they understand the hunt contributes to larger ecological and conservation goals, their experience is enhanced and their overall satisfaction increases. Hunters would also directly benefit in the long-term from harvesting healthier more robust deer.

Alternative B also includes a new youth turkey hunt. This program facilitates an important Service initiative to get youth outdoors and involved with nature. It also promotes an activity of historical and traditional values. A turkey hunt would further increase the diversity of hunting opportunity on the refuge compared to what is allowed today under current management. During the turkey hunt, refuge trails would remain open because hunters would be distributed away in areas normally closed to the non-hunting public.

Adverse Effects
The adverse impacts described under alternative A related to inter-user conflicts and on people opposed to hunting, would increase under alternative B since the hunt program would be expanded. The refuge is closed to other visitors during the existing deer hunt, and we would attempt to implement expanded deer hunting programs to avoid additional refuge closures; however, there is the potential that there may be up to 3 more days when the refuge is closed to other activities. As we mentioned above, trails would remain open to the non-hunting public during the turkey hunt. We would distribute turkey hunters so as to avoid or minimize contact with the non-hunting public. This would avoid the concern that some people have with viewing hunting gear and seeing harvested game. However, we can not guarantee however, that chance encounters might not occur.

The addition of an archery deer hunt and youth turkey hunt would likely offend those members of the public opposed to hunting regardless of whether or not they visit the refuge.

Alternative C. Management to Enhance Public Uses
Benefits
Benefits would be similar to alternative B except the addition of a muzzleloader deer hunt would provide additional flexibility to meet VDGIF herd and population goals, as well as our habitat goals and objectives, and would further diversify the hunting opportunity.

Adverse Effects
Adverse effects would be the same as described for alternative B except for the possibility that the refuge may be closed up to 3 more days to accommodate the new hunt, and thus, creating that many more days of potential conflict with other refuge visitors and members of the public opposed to hunting.

Cumulative Impacts

According to the Council on Environmental Quality NEPA implementing regulations at 40 CFR 1508.7, "cumulative impact" is the impact on the environment which results 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 can result from individually minor but collectively significant actions taking place over a period of time.

This cumulative impacts assessment includes other agencies' or organizations' actions if they are interrelated and influence the same environment. Thus, this analysis considers the interaction of activities at Mason Neck Refuge with other actions occurring over a larger spatial and temporal frame of reference.

Air Quality

Short-term, negligible, localized air quality effects would be expected from air emissions of motor vehicles used by staff and refuge visitors and from equipment such as mowers used by refuge staff in maintenance and habitat management projects. However, none of the activities on the refuge is expected to contribute to any measurable incremental increase in air pollutant levels. None of the alternatives are expected to cause any greater than negligible cumulative adverse impacts on air quality locally in the vicinity of Mason Neck Refuge or regionally.

We predict no cumulative impacts to Class I airsheds from our actions. Visibility concerns due to emission-caused haze, at the nearest Class I airshed, would not be affected by any of the proposed management alternatives. Although prevailing

weather patterns are from the west, air emissions from Fairfax County would be completely dispersed before reaching that Class I area.

The combined natural areas on the Mason Neck Peninsula in Federal and State ownership, and along this section of the Potomac River, will continue to contribute to improving air quality through management of native upland and wetland vegetation which assures these areas will continue to filter out many air pollutants harmful to humans and the environment.

Water Quality

There would be no significant adverse cumulative impacts to water quality under any of the alternatives. Best management practices and erosion and sediment control measures would be used during project work to minimize or avoid soil disturbance and th e potential to create erosion and run off. All Federal and State permits required of national wildlife refuges would be secured before activities are initiated.

Similar to the discussion above under air quality, the combined natural areas on the Mason Neck Peninsula in Federal and State ownership, and along this section of the Potomac River will continue to contribute to improving water quality through management of native upland and wetland vegetation which assures these areas will continue to filter out water pollutants harmful to humans and the environment.

Socioeconomic Resources

We expect none of the alternatives to have a significant adverse cumulative impact on the economy of the Mason Neck community or of Fairfax County, Virginia. None of the three proposed alternatives would be expected to substantially alter the local community's demographic characteristics. As a result, no impacts would be associated with changes in the community character or demographic composition.

Implementation of any of the alternatives would result in several minor beneficial impacts for the communities near the refuge and in the region as a whole. Public use of the refuge would be expected to increase, thereby increasing the number of visitor days spent in the area and correspondingly the level of visitor spending in the local community. Fully funding the additional staffing under alternatives B and C would also make a small, incremental contribution to employment and income in the local community.

The refuge makes an important local and regional contribution to recreation and outdoor activities which would continue under all alternatives. In comparison to the other public lands on Mason Neck peninsula, the refuge is more conservative in terms of what recreational opportunities are offered. People primarily come to the refuge specifically to observe or photograph wildlife in natural surroundings and a quiet setting. This is a particular, unique niche of recreational opportunity that the refuge provides in high quality on the Peninsula compared to the other ownerships. This niche complements the full range of opportunities, including those that require more development or support larger groups, offered elsewhere across the other public ownerships. When considered together, this diversity of recreational types across all public ownerships reflects a significant recreational resource for the region.

Soils

Refuge lands, in combination with other public ownerships and protected, undeveloped lands, significantly contribute to long-term protection of soil productivity in the region. Refuge soils are in good condition with minimal impacts from historic land uses in the area. We will continue to use best management practices to minimize impacts from our management program under all alternatives while keeping the remainder of the refuge in native plant communities that would otherwise have been under development if the refuge

had not been created On the refuge, before any ground disturbance occurs, all Federal and State permits required of national wildlife refuges would be secured before activities are initiated.

Protected Habitats and Species

The amount and distribution of undeveloped public lands on Mason Neck peninsula significantly contributes to high quality habitats for a wide range of native species in the region. The cumulative effects of land protection and management include benefits to uplands, shoreline and wetlands habitats and associated species along this section of the Tidal Potomac River. The refuge would continue to lead by example among public land agencies in the protection and maintenance of the integrity, diversity and health of those areas that would potentially be lost or severely degraded over the long term given the level of urban development and pressures in the area.

Biological resources that we would manage to control, prevent, or eliminate, such as invasive plants or mute swans, are not natural components of the Refuge's wetlands or upland ecosystems, so losses of those biotic components where they occur would not be considered adverse under any of the alternatives.

The habitats that we would protect on the refuge and maintain under the different alternatives would all contribute at least minimally to sustaining those habitats in the tidal Potomac River watershed and Chesapeake Bay region and would be a long-term beneficial cumulative impact.

Our observations of declining forest health on the refuge and elsewhere from deer overbrowsing, and VDGIF's evaluation of deer herd health, reveals that deer populations in the recent past have exceeded the carrying capacity of the habitat to support them in the region. Active management of deer on the refuge through a new archery hunt, cooperatively managed with VDGIF, would help contribute to maintaining the biological diversity, integrity and health of forest habitats and native wildlife on the refuge, and provide a priority wildlife-dependent recreational opportunity that is becoming increasingly limited in this urban landscape. We would work with VDGIF and other adjacent landowners to evaluate the effectiveness of our hunt program. We will employ an adaptive management decision and implementation process to take advantage of, and respond to, what we learn.

Our efforts to effectively reduce the impacts of the deer population on the refuge and across the Mason Neck Peninsula are hampered by the fact that not all public ownerships have a hunt or are otherwise undertaking aggressive deer control action. Our hunt, which is administered with and includes the State Park, only temporarily reduces the local herd and offers short term relief, but within 1-3 years, the herd builds back up. The population has never been suppressed to the point it stays low. Under Alternatives B and C we would have the potential for a greater cumulative beneficial impact from reduced deer numbers through an expanded hunt program on refuge and State Park lands, and by offering assistance to other public lands in pursuing similar hunt programs across the Peninsula.

Public activities on the refuge associated with trail use and primarily wildlife observation and photography, and fishing may cause local cumulative impacts on natural resources. Although the impacts could be minor when considered alone, they may be potentially important when considered collectively. Our principal concern is repeated disruptions of nesting, resting, or foraging birds such as bald eagles, wading and waterbirds, and wintering waterfowl. We would implement monitoring strategies to observe the impact those activities have on wildlife and adjust management to eliminate or minimize them. We have not observed significant resource degradation, long-term consequences, or cumulative effects

on any of these programs where they occur elsewhere in the Refuge Complex. However, we would remain vigilant to any indication those impacts are occurring. We plan to increase monitoring, outreach, enforcement and education on the refuge, and if concerns are documented, we would respond as necessary. Our response may include permanently or temporarily closing additional areas. We will also utilize volunteers, partners, and researchers to help monitor and evaluate the impacts of our on wildlife and habitats.

Cultural, Archaeological, and Historic Resources

We expect none of the alternatives to have significant adverse cumulative impact on cultural resources on the refuge. Beneficial impacts would occur at various levels, depending on the alternative, because of proposed shoreline erosion monitoring and control efforts, environmental education and interpretation programs, and increased field surveys to identify and protect any discovered sites.

Climate Change

Department of the Interior Secretarial Order 3226 states that "there is a consensus in the international community that global climate change is occurring and that it should be addressed in governmental decision making. This Order ensures that climate change impacts are taken into account in connection with Departmental planning and decision making." Additionally, it calls for the incorporation of climate change into long-term planning documents such as refuge CCPs:

> "Each bureau and office of the Department will consider and analyze potential climate change impacts when undertaking long-range planning exercises, when setting priorities for research and investigations, when developing multi-year management plans, and /or when making major decisions regarding the potential utilization of resources under the Department's purview. Departmental activities covered by this Order include, but are not limited to, programmatic and long-term environmental reviews undertaken by the Department, management plans and activities developed for public lands, planning and management activities associated with oil, gas and mineral development of public lands, and planning and management activities of water projects and water resources (USFWS, 2009)."

We will continue to monitor and analyze the available information about sea-level rise and potential effects in the tidal Potomac River Basin recognizing that rising tidal levels over the long term would incrementally jeopardize current refuge habitats, particularly wetlands, and we would have to prepare to address that eventuality.

We predict that the refuge would be a net carbon sink over the 15 year CCP period, with the high sequestration capacity of its mature forest habitat; the most dominant habitat type on the refuge. The amount of carbon that would potentially be released by the refuge as a result of associated energy use was not estimated for this EA. However, under each alternative, we would continue to lower our carbon emissions and footprint through the use of energy efficient practices. We will work to implement many of the strategies for achieving Service-wide carbon-neutrality by 2020 as per the Service's Draft Strategic Plan for Climate Change (USFWS 2009). We plan to replace our fleet with hybrid vehicles to the extent possible, upgrade our appliances, equipment, and facilities to more energy efficient models, conduct video-conferencing to the extent possible, and purchase recycled products. These actions, combined with those of other Service offices would likely result in a beneficial reduction in the rate of greenhouse gas emissions from Service sources.

In terms of preparing for the predicted impacts of climate change, we would manage Refuge Complex lands to increase resiliency and redundancy, and improve the diversity, integrity and health of its habitats. These objectives incorporate strategies that improve the ability of the land to adapt to more extreme weather events and shifting climate zones which are important components of the Service's response to predicted impacts, as recommended in various regional, national, and international reports:

- Draft Strategic Plan for Climate Change (USFWS 2009)
- Preliminary review of adaptation options for climate-sensitive ecosystems and resources (U.S. Climate Change Science 2008)
- Climate Change 2007: Impacts, Adaptation and Vulnerability (International Panel on Climate Change 2007)

Our CCP strategies include maintaining a strong, cooperative working relationship with VDGIF and our conservation partners. As we develop plans to improve forest health on the Refuge Complex we will share what we learn, and offer assistance, to the other public ownerships on the Peninsula, and adjacent to the other refuges in the hopes of benefiting adjacent forests in the region. These relationships will increase the connections within this geographic area and our capability to identify and address issues related to natural resources.

Relationship Between Short-term Uses of the Human Environment and Enhancement of Long-term Productivity

In this section we consider the relationship between local, short-term uses of the human environment and maintaining long-term productivity of the environment. By long-term we mean that the impact would extend beyond the 15-year planning horizon of this draft CCP/EA.

Under all of the alternatives, our primary aim is to maintain or enhance the long-term productivity and sustainability of natural resources on the refuge, in the Tidal Potomac River Basin, and for migratory birds and interjurisdictional fish and other far ranging species, across the whole range of each species. Short term human uses of the refuge are of far lower, secondary importance. We allow those uses only if they are compatible with the resource protection goals. The Service strives to protect Federal trust species and the habitats they depend on, as evidenced by the public use restrictions on access and prohibition of types of use other than foot traffic. Outreach and education programs would encourage visitors to be better stewards of our environment.

The dedication of certain areas for new trails and parking areas on the refuge represents a loss of long-term productivity in a few localized areas, most of which do not fully support natural habitats, but this is not considered significant given the comparative refuge size.

In summary, we predict that all of the alternatives would contribute positively to maintaining or enhancing the long-term productivity of the environment.

Unavoidable Adverse Impacts

Unavoidable adverse effects are the effects of those actions that could cause harm to the human environment and that cannot be avoided, even with mitigation measures. There would be some minor, localized unavoidable adverse effects under all the alternatives. For example, there would be minor, short term, localized adverse effects of site clearing and constructing the new refuge staff quarters, driveway, and septic field. The minor localized effects of fuels management activities, grassland maintenance and invasive plant control would be unavoidable. There would continue to be property tax losses to the local community under all alternatives and increased visitation under all alternatives that could have unavoidable effects.

Potential Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those which cannot be reversed, except perhaps in the extreme long term or under unpredictable circumstances. An example of an irreversible commitment is an action which contributes to a species' extinction. Once extinct, it can never be replaced.

In comparison, irretrievable commitments of resources are those which can be reversed, given sufficient time and resources, but represent a loss in production or use for a period of time.

No irreversible commitments of resources are predicted as a result of management activities on Mason Neck Refuge.

Environmental Justice

President Clinton signed into Executive Order No. 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" on February 11, 1994, to focus federal attention on the environmental and human health conditions of minority and low income populations, with the goal of achieving environmental protection for all communities.

The order directs federal agencies to develop environmental justice strategies to aid in identifying and addressing disproportionately high, adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations. The order is also intended to promote nondiscrimination in federal programs substantially affecting human health and the environment, and to provide minority and low-income community's access to public information and participation in matters relating to human health or the environment.

The United States EPA Office of Environmental Justice defines it as follows:

> *"Environmental Justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental law, regulations, and policies. EPA has this goal for all communities and persons across this Nation. It will be achieved when everyone enjoys the same degree of protection from environmental and health hazards and equal access to the decision-making process to have a healthy environment in which to live, learn, and work." (http://www.epa.gov/environmentaljustice)*

We believe, based on our socioeconomic and environmental consequences analysis, that none of our proposed alternatives would place a disproportionately high, adverse environmental, economic, social, or health effects on minority or low-income persons. Fairfax County has a substantial minority population (38.0%), as well as a small percentage (5.6%) of residents living below the poverty line. However, all identified socioeconomic and environmental impacts would not be localized nor be placed primarily or unequally on minority and low-income populations Persons who reside near Mason Neck Refuge and in Fairfax County would bear very minor adverse effects and some beneficial effects if the refuge is managed under any of the three proposed alternatives. Adverse impacts, such as anticipated minor increases in traffic and related emissions due to visitation if the refuge is opened to the public as proposed under alternatives B and C, negligible contributions to local mobile source air emissions from refuge equipment and vehicles, would not disproportionately affect minority and low-income populations compared to other segments of the general population. Beneficial impacts include maintaining natural vegetation that improves air and water quality through filtering, paying refuge-revenue sharing payments to the County to offset property tax loses, and providing desired public uses under alternative B and C.

Before we make any decisions to make major changes in habitat management or the environment we always inform all of our publics, equally, and our programs and facilities are open to all who are willing to adhere to the established Refuge rules and regulations. We do not discriminate in our responses for technical or practical information on conservation issues or when providing technical assistance in managing private lands. Additionally, all refuge uses proposed under alternatives B and C would be open to all members of the public and the refuge does not charge any fees to visitors. The Service is also an equal opportunity employer.

Summary of the Impacts of the Alternatives

The following table 4.2 summarizes the benefits and adverse impacts we described above in chapter 4 for specific resources or programs proposed for Elizabeth Hartwell Mason Neck Refuge under each of the alternatives. For our discussion on cumulative impacts, the relationship between short-term uses of the human environment and enhancement of long-term productivity, unavoidable adverse impacts, potential irreversible and irretrievable commitments of resources, and environmental justice, please refer to the chapter 4 narratives above.

USFWS

Habitat diversity on Mason Neck refuge

Table 4.2. Summary impact comparison of Mason Neck Refuge CCP Alternatives

	Alternative A Current Management	**Alternative B Improved Management for Federal Trust Resources (Service-Preferred Alternative)**	**Alternative C Management to Enhance Public Uses**
Regional Air Quality	Continuing benefits to air quality from maintaining natural vegetation on more than 1,900 acres of refuge uplands and 297 acres of marsh. Major benefit from protecting most of the 1,900 acres in mature forest which enhances carbon sequestration and reduce greenhouse gases. Localized increases in vehicle and equipment emissions from staff and visitor activities would be negligible compared to current off-refuge contributions to pollutant levels. Significance of air emissions in the Fairfax County created from land development and urban population centers far outweighs refuge impact. Negligible adverse effects contributed by refuge activities are more than offset by benefits of maintaining the refuge in natural vegetation.	Continuing benefits to air quality similar to alternative A Minimal increase in vehicle and equipment emissions compared to alternative A due to predicted 15 percent increase in visitation; however, contribution would still be negligible given regional urban sources.	Same continuing benefits to air quality as alternative A Greatest increase in vehicle and equipment emissions compared to alternative B due to predicted 20 percent increase in visitation; however, similar to alternative B, contribution would still be negligible given regional urban sources.
	---------- Air Quality Impacts That Would Not Vary By Alternative ----------		
	Adverse impacts to regional air quality would be negligible from current and proposed refuge management activities. None of the alternatives would violate EPA standards for criteria air pollutants; all three alternatives would be in compliance with the Clean Air Act. Administrative and visitor vehicle use at the refuge would contribute a negligible increment to overall Fairfax County emissions. Visibility concerns due to emission-caused haze at the nearest Class I airsheds, Brigantine Wilderness Area (New Jersey) or Shenandoah National Park (Virginia), would not be affected. Use of energy efficient practices would continue at the refuge to support the Service's 2020 goal of becoming carbon neutral.		

	Alternative A **Current Management**	**Alternative B** **Improved Management for Federal Trust Resources (Service-Preferred Alternative)**	**Alternative C** **Management to Enhance Public Uses**
Regional Water Quality, Wetlands, and Aquatic Biota	Continued benefit to water quality, wetlands, and aquatic biota in Basin by excluding development and sustaining natural water filtering vegetation, maintaining forest buffers, and partnering for water quality improvements and tidal marsh protection. Negligible risk to water quality and aquatic biota from petroleum products used in staff or visitor vehicles, and or from other chemicals used in daily operations at the refuge, including selected low-toxicity, approved chemical herbicides for invasive plant control. Risk is further minimized, however, with precautions against spills and against impacting non-target species in place. Additional potential risk from predicted 10% increase in annual visitation, especially if visitors go off trail near water or litter. Impacts are expected to be negligible based on current management, including requirement to stay on trails, as well as current outreach and enforcement programs. Any research studies in aquatic habitats include stipulations to minimize impacts.	Benefits to water quality, wetlands, and aquatic species increased from alternative A due to systematic monitoring of diversity, integrity, and health of wetlands allowing quicker response to concerns. Shoreline protection would become a higher priority, with additional shoreline protection measures pursued with partners. More active in efforts with refuge partners to address water quality issues in Tidal Potomac River Basin. Some negligible risk to water quality, wetlands, and aquatic biota from trail improvements and kiosk construction. Activities have potential to increase sedimentation and turbidity in marsh and shallow waters. However, activities not planned immediately adjacent to marsh or shoreline, so impacts unlikely. Site prep and mitigation practices, such as silt fences, would further reduce risk. Increase in acreages treated with herbicides for invasive plant control may result in slight increase in risk from herbicides. Predicted 15% increase in annual visitors may result in increased potential for impact to water through runoff of petroleum products from roads and parking areas. Similar to alternative A, refuge staff would monitor, conduct outreach, and actively enforce against littering and off trail use.	Same long term benefits to water quality, wetlands, and aquatic species as alternative A. Same adverse impacts as described under alternative A, except increased potential risk from visitors since the predicted annual increase in visitors would be 20%. This increased risk would be mitigated by increased outreach and enforcement programs.
	----------Water Quality, Wetlands, and Aquatic Biota Impacts That Would Not Vary By Alternative----------		
	Protecting or improving water quality is a priority under all alternatives. Refuge actions are at extremely low risk of contributing to existing point and non-point pollutant sources elsewhere in the Tidal Potomac River Basin. Refuge lands would continue to benefit water quality in the Basin by excluding development in this area of the watershed and protecting native forest and wetlands vegetation, including riparian and shoreline buffers, which sustains natural water filtering properties. Also, refuge staff would work in partnership with others to promote additional land conservation and long-term beneficial water quality improvements.		

	Alternative A Current Management	**Alternative B Improved Management for Federal Trust Resources (Service-Preferred Alternative)**	**Alternative C Management to Enhance Public Uses**
Socio-economic	Minor incremental benefits to local economy from visitor expenditures on auto fuel, meals, hunting gear, binoculars and other wildlife equipment purchases. However, some visitors may purchase expensive equipment outside of local area. Refuge would continue to contribute to the local economy in terms of jobs, income, and expenditures. Presence of refuge and activities allowed contribute positively to local quality of life and that of other visitors and wildlife enthusiasts in the region. Outreach by refuge staff would continue to promote values of the refuge, recreational opportunities, and garner support for the Refuge System, but on a limited basis due to staffing and funding constraints. Some public demands for access and opportunities unmet due to limited staff, funding, and decisions on compatibility. In particular, increased demands for compatible environmental education, interpretation, and photography would not be met. There would also not be an expansion in hunting opportunities to offset the diminishing availability of those opportunities elsewhere in the area.	Contributions to the local economy from refuge and visitor expenditures would increase over alternative A, but would still be a negligible contribution due to the size of the economy. Refuge revenue sharing payments would be the same as alternative A. Expanding refuge programs and infrastructure would support predicted 15% annual increase in visitation and better meet current demand. Enhanced habitat management and new and enhanced trails would increase wildlife viewing and photography opportunities compared to alternative A. Improved programs would increase the appeal of the refuge to many and positively reflect on the Refuge System. Additional staffing and funding, and commensurate increase in outreach and education would also raise the visibility of the Service and the importance of the Refuge Complex to conserving natural resources in the region. Additional refuge hunting opportunities under alternative B would help offset the loss of those opportunities elsewhere in the region.	Impacts to the local economy are similar to alternative B, with slight increases in benefits from accommodating the predicted 20% increase in annual visitation. One new trail and a potential new muzzleloader deer hunt are opportunities only provided under alternative C. These activities further expand the opportunities provided by the refuge and help satisfy demand. Other benefits to visitors from increased staffing, funding, outreach and education are the same as alternative B.
	---------- Socio-economic Impacts That Would Not Vary By Alternative ----------		
	Refuge revenue sharing payments to Fairfax County would continue. Refuge management jobs, income, and purchase of goods and services would continue to contribute negligibly to local economy. Direct benefits from refuge visitor expenditures in the local community would occur, but would also be only a negligible contribution given the urban context and diversity of the local setting.		

	Alternative A **Current Management**	**Alternative B** **Improved Management for Federal Trust Resources (Service-Preferred Alternative)**	**Alternative C** **Management to Enhance Public Uses**
Soils	Working with partners to maintain existing shoreline breakwater would continue to prevent soils adjacent to that portion of the shoreline from being exposed and eroded away by wave and wind action. Maintaining the vegetated portions of the refuge would continue to protect the soils in those areas. Negligible impacts might occur from routine maintenance (e.g. mowing, trail and road work), but no major activities planned to affect soils under alternative A. Soils adjacent to unprotected sections of the shoreline would continue to be at risk of being exposed and eroded away due to wave and wind action. Annual visitation increase predicted to be 10%, so slight potential for increased risk if visitors walk off designated trails or violate other closures. However, we would continue to monitor public use areas at present levels, and take steps to mitigate problems when they occur.	Working with partners to expand shoreline protection measures would increase those benefits over alternative A. New construction activities associated with trails and refuge quarters pose a greater risk than alternative A, but would be mitigated by strictly adhering to soil protection BMPs to ensure that no long term, major soil problems such as unchecked erosion, would result. New refuge quarters would result in up to 1 acre of additional impermeable surface. The 15% increase in annual visitation under alternative B enhances the risk of soil disturbance and compaction caused by visitors. It also increases the likelihood of unauthorized entry to closed areas, including along refuge shoreline. However, this increased risk would be mitigated by plans to increase staff and raise their visibility by conducting more outreach, education, and enforcement, especially in high probability areas.	The same benefits to soils from protecting the shoreline and maintaining native habitats would result as described under alternative A. Predicted annual visitation would increase by 20%s, so associated visitor impacts from increased numbers would be commensurately higher than under alternative B. Measures to mitigate these impacts would be the same as those under alternative B. The potential for impacts from new construction is higher than alternative B because of the addition of a new trail. As such, there would be increased risk along the new trail area (e.g. Little Marsh road). Design, monitoring, outreach, education and enforcement would help mitigate the potential for long-term soil impacts.
	---------- Soil Impacts That Would Not Vary By Alternative ----------		
	Soils on the refuge are in good condition and would remain so under all alternatives. Protective vegetative cover that minimizes soil losses through erosion would rarely be disturbed. We would continue to prohibit recreational activities such as ATVs, horses, or off trail biking or walking that would damage soils on the refuge. Hiking trails, wildlife observation areas, parking areas and other high-use areas would continue to be well maintained to keep soil effects to a minimum. Any erosion problems will be noted during routine refuge monitoring and corrected as soon as feasible. Regardless of which CCP alternative we select, we would continue to use best management practices in all management activities that might affect refuge soils to ensure that we maintain soil productivity. Site conditions including soil composition, condition and hydrology will be the ultimate determinant of the management potential for any particular site on the refuge. No site would be managed in a manner inconsistent with its recognized potential. No soil from off-site will be brought onto the refuge unless bringing in clean soil is determined to be less disturbing to refuge resources than using onsite soils.		

	Alternative A Current Management	**Alternative B Improved Management for Federal Trust Resources (Service-Preferred Alternative)**	**Alternative C Management to Enhance Public Uses**
Forest Habitat	Except for routine maintenance, no alteration of forest habitat is planned. Protection of the existing 1,883 acres of forested habitat would continue. Invasive plant control, deer hunting to reduce overbrowsing from excessive deer populations, and monitoring for pests and pathogens would continue to be primary management strategies to protect the forest. There would continue to be some minimal level of risk of loss or damage to forest vegetation from wildfire due to high forest fuel loads. Routine maintenance of roads and trails may result in the loss of individual trees, but the number of trees felled would not affect the quality or diversity of forest habitat present.	Increased monitoring of forest health, and developing management plans to sustain it over the long term, would provide quicker responses to concerns with greater benefits to forest habitat compared to alternative A. Stand treatments, adhering to best management forest practices, fuel reductions, and invasive plant control, would be planned to enhance the health and vigor of the forest over the long term and reduce the risk from catastrophic events (e.g. wildfire or pest or pathogen epidemic). Additional deer hunting would be pursued as an additional strategy to improve forest health and condition. Routine maintenance of roads and trails would result in similar losses as described under alternative A. In addition, up to 1 acre of forest would be impacted from the proposed new refuge quarters. Some further loss may occur with clearing for new trails on existing old roadbeds. However, in total, we do not expect the number of trees felled would affect the quality or diversity of forest habitat present.	Alternative C would provide similar benefits to the refuge's forest habitats as alternative A, except for it provides the greatest potential among all the alternatives to affect deer numbers by offering the most expansive hunting program. Alternative C would provide slightly increased adverse impacts to the refuge's forest habitats compared to those discussed under alternative B since one additional trail (e.g. Little Marsh road) would be maintained open for public use.
	----------Forest Habitat Impacts That Would Not Vary By Alternative----------		
	Protecting and maintaining forest diversity, integrity and health is a priority under all alternatives. Activities to control invasive plants, manage overabundant deer populations via hunting, and monitor for pest and pathogen outbreaks would continue to be implemented to support this goal. Some minor tree loss would occur during refuge infrastructure maintenance and improvements (e.g. roads and trails)		

	Alternative A Current Management	**Alternative B Improved Management for Federal Trust Resources (Service-Preferred Alternative)**	**Alternative C Management to Enhance Public Uses**
Shoreline	We would continue to work with partners to monitor and maintain the existing breakwater to insure their effectiveness in protecting the shoreline. We would continue to conduct outreach, education, and enforce against access to the refuge shoreline from boat or land to minimize additional shoreline erosion and trampling vegetation. Signs posting the closure on Little Marsh dike would continue to be maintained	Under alternative B we would pursue additional shoreline protection with partners by seeking funding and assistance to protect high risk areas. This is especially problematic along the refuge southwestern corner, where tree loss threatens the heron nesting area. We would explore and evaluate stabilization techniques to determine which is most effective and practical for refuge lands. Measures to protect shoreline and tidal marsh are identified in alternative B as the highest management priorities to implement. We would increase monitoring, outreach, education and enforcement of refuge shoreline and other closures and trail restrictions to minimize additional shoreline erosion and trampling vegetation. This would be necessary as the predicted increase in visitation raises the risk of visitors violating closures.	The same benefits would accrue under this alternative from the Army Corps of Engineers maintaining our current breakwaters as described for alternative A. Because refuge public use would likely increase under alternative C, there would be an increased potential for members of the public gaining unauthorized access to unprotected sections of shoreline either from the land side or in watercraft. Impacts would be similar to alternative B.
	----------Shoreline Impacts That Would Not Vary By Alternative ----------		
	Under all alternatives we would continue to work with partners to maintain the off-shore breakwaters that were installed by the Army Corps of Engineers as part of the Wilson Bridge project mitigation. These breakwaters currently protect a portion of the refuge's western shoreline. We would continue to enforce against unauthorized refuge access and off-trail use.		

	Alternative A Current Management	**Alternative B Improved Management for Federal Trust Resources (Service-Preferred Alternative)**	**Alternative C Management to Enhance Public Uses**
Freshwater Marsh	Management would continue to focus on protecting Great Marsh and Little Marsh from unauthorized public access. Visitors could disturb bald eagles and herons or otherwise degrade these areas, through fishing and other litter, or by trampling shoreline areas Outreach and enforcement would continue at present levels. Refuge signage, flyers, and other public information materials are provided at public entry points to the Great Marsh, the Woodmarsh and Great Marsh Trails, to ensure that the public remains out of these areas. We would continue to maintain the dike to ensure the continued integrity of Little Marsh and we would continue to conduct periodic trash removal in the Great Marsh. Some minimal risk of being impacted by Service activities associated with invasive plant control or use of equipment in adjacent upland areas. We would continue to use only herbicides approved for wetlands and target invasive plants that pose a threat to native marsh vegetation. These herbicides are generally non-toxic to fish and other aquatic species and would be used only with strict precautions taken to minimize the potential to affect non-target native plants. Maintenance activities in adjacent uplands would be implemented with oil and spill prevention plans in place and BMP practices to reduce erosion and runoff.	Increased monitoring of freshwater marsh integrity and health, and developing plans to sustain it over the long term, would allow a quicker response to concerns and provide greater benefits to freshwater marsh habitat compared to alternative A. Greater benefits to waterfowl would accrue from determining the presence and extent of native marsh and aquatic vegetation, such as spatterdock and wild rice, which are important waterfowl foods. We would implement a more comprehensive program of cleaning up trash that accumulates in Great Marsh and increase treatments on invasive plants and nuisance wildlife affecting the marsh and other natural areas. Prioritizing treatments and target areas would make management more effective compared to alternative A. Precautions followed and the types of herbicides used would be the same as alternative A. As under alternative A, there would be some minimal risk from Service activities associated with the use of equipment in adjacent uplands. However, the same mitigation measures would apply. Predicted 15% increase in annual visitors poses greater risk of impact than expected under alternative A. However, proposed increases in staffing and funding, and enhance outreach, education, and enforcement would mitigate that risk from visitors conducting unauthorized activities. We would continue to maintain signage and monitor impacts in restored areas to insure adverse impacts are kept to a minimum area.	Alternative C would lead to the same benefits to the refuge freshwater marshes as alternative A. The impacts described under alternative B would be the same for alternative C except they may be slightly higher than alternative B because refuge visitation would be expected to be highest under this alternative.
	----------Freshwater Marsh Impacts That Would Not Vary By Alternative----------		
	We would continue to conserve the Great Marsh and Little Marsh wetlands and the wildlife they support as one of our highest priorities under all alternatives. We would maintain the Little Marsh dike, including addressing beaver or other animal damage as needed, to protect its integrity. We would continue to prohibit fishing and boating in Great Marsh and Little Marsh because of the potential to adversely affect these sensitive areas. People wishing to engage in those activities would be directed to other public facilities on the peninsula, in Occoquan and Pohick Bay, and on the Potomac River.		

	Alternative A Current Management	**Alternative B Improved Management for Federal Trust Resources (Service-Preferred Alternative)**	**Alternative C Management to Enhance Public Uses**
Birds–Bald Eagle	Continued protection of the nearly 1,900 acres of forest habitat and 297 acres of freshwater marsh benefits bald eagles over the long term. Shoreline protection measures, monitoring of nesting activity and the prohibition of public access to nesting areas also provide long term benefits. Routine maintenance would continue to be scheduled to minimize impacts to bald eagles although negligible short-term, localized effects from disturbance may occur. Despite outreach and enforcement, some impacts from visitor disturbance may increase minimally due to a predicted 10% increase in refuge visitation.	Measures identified above under forest habitat would also result in increased benefits to bald eagles over alternative A. In addition, we would work with VDGIF to identify measures to enhance current and potential nest tree and roost stands. The potential for disturbance to bald eagles would be slightly higher than those under alternative A because annual visitation is expected to increase by 15%. However, increased staffing to conducting monitoring, outreach, education and enforcement would help offset the increased risk.	Benefits under alternative C would be the same as those described for alternative B. Increased public use under alternative C would pose a slightly higher degree of risk of human disturbance to bald eagles than under alternative B. However, measures identified under alternative B to mitigate that risk would also be implemented under alternative C.
	---------- Bald Eagle Impacts That Would Not Vary By Alternative ----------		
	We would continue to protect nesting, roosting, and wintering bald eagles and their habitat on the refuge under all alternatives. There are currently three nesting pairs and we would continue working with VDGIF to monitor nest activities to insure no avoidable human-induced threats occur, and to act quickly should enforcement against disturbing activities be needed. Also, continuing to prohibit public access near bald eagle nests to avoid disturbance would continue under all alternatives. Routine maintenance activities involving Service equipment or staff presence may disturb bald eagles foraging or resting since they could be anywhere on refuge; however, no Service activities intentionally occur near bald eagle activity during the nesting season.		

	Alternative A Current Management	**Alternative B Improved Management for Federal Trust Resources (Service-Preferred Alternative)**	**Alternative C Management to Enhance Public Uses**
Birds–Forest Dependent	Under alternative A, we would continue to benefit forest dependent birds on the refuge over the long term by permanently protecting nearly 1,900 acres of forest habitat. There would be short-term localized impacts to bird habitat and temporary displacement of birds from management activities such as mowing or herbicide treatments for invasive plant control. Trail maintenance activities would also cause negligible short-term, localized effects from disturbance. Impacts from visitor disturbance may increase minimally due to the predicted 10% increase in annual refuge visitation.	Similar to alternative A, benefits to forest dependent birds would occur from permanently protecting forest habitats. Under alternative B, those benefits would be further enhanced by the additional steps to manage forest health and to maintain or restore forest diversity and structure. This, in turn, would increase the potential diversity of breeding forest birds. See discussion under forest habitat above. Some forest dependent bird habitat may be impacted by the minor tree removal that would occur with construction and maintenance of trails and roads, and due to the new refuge quarters planned on less than 1 acre. In addition to some negligible habitat loss, these activities may cause disturbance to birds while they are underway. As predicted under alternative A the disturbance from maintenance work is expected to be negligible short-term, and localized. Under alternative B, there will also be an increased potential impact from visitors since there is a predicted 15% annual increase likely.	Benefits to forest dependent birds under alternative C would be the similar to those described for alternative A. Adverse effects to forest dependent birds under alternative C would be the higher than alternative B due to the greatest predicted increase in visitation and the greater potential for visitors to disturb birds especially along roads and trails and in areas not previously open to refuge visitors.
	---------- Forest Dependent Bird Impacts That Would Not Vary By Alternative ----------		
	Continued protection of the 1,883 acres of refuge forest habitat under all alternatives would benefit forest birds that use the refuge to breed, winter, or migrate through. Routine maintenance activities involving Service equipment or staff presence may disturb forest dependent birds since they could be anywhere on refuge; however, no Service activities intentionally occur near nesting sites where birds or young could be less mobile or nests could be damaged or destroyed. Generally, we predict these impacts would temporarily displace birds from treated locations and would be minor, highly localized and short-term with no threats to bird populations in terms of adult mortality or breeding success. Visitor activities may cause minor negative impacts by disturbing birds along trails and roads or by trampling vegetation used by birds. These disturbances typically result in temporary displacement without long-term effects on individuals or populations. Some species will avoid the areas people frequent, such as the developed trails and the buildings, while others seem unaffected by or even drawn to the presence of humans. Long term impacts to forest dependent birds on the refuge are anticipated to be minimal since the majority of the refuge would remain closed to public access.		

	Alternative A Current Management	**Alternative B Improved Management for Federal Trust Resources (Service-Preferred Alternative)**	**Alternative C Management to Enhance Public Uses**
Birds–Wading, Waterbirds, and Waterfowl	Continued permanent protection of the 207-acre Great Marsh and 50-acre Little Marsh would provide long term benefits to wading birds, waterbirds, and waterfowl throughout the year. We would continue to monitor the heron rookery and maintain the Little Marsh water control structure to insure no human-induced disturbances occur to nesting birds. We would also continue to monitor for causes of decreased productivity to improve our knowledge base about their nesting requirements. Some potential for increased disturbance from predicted 10% increase in annual visitors if off trail use near water occurs. We would continue to monitor, conduct outreach and enforcement at current levels. The potential for disturbance from refuge maintenance projects and staff using motor vehicles to monitor the marsh would be negligible.	Similar to alternative A, permanent protection of the 207-acre Great Marsh and 50-acre Little would provide long term benefits to wading, waterbirds and waterfowl. Increased monitoring and protection of the integrity of marsh habitat, and management to improve native aquatic vegetation proposed under alternative B, would further enhance habitat quality for these species over the long term. Under alternative B we would enhance our monitoring of the heron rookery to improve our knowledge base about their requirements and allow us to make more informed decisions on what to do to enhance habitat conditions to sustain them. We would continue to track nesting birds, but would also improve data gathering of site conditions, shifts in use, and analyze factors influencing the size and distribution of the rookery and the reasons for their decline over the last 10 years. We would expand shoreline and bluff protection to reduce the loss of nesting trees. Collectively, the results could help us take action to minimize future losses in the number of nest sites and nesting productivity. The predicted 15% increase in annual refuge visitors has the potential to elevate impacts to the refuge freshwater marsh and disturbance to marsh and wading birds and waterfowl. However, the increased staff and funding would enhance outreach, education, and enforcement to help mitigate impacts.	Benefits from protecting Great Marsh and Little Marsh would be the same as alternative A. The potential negative impacts from visitor use and access would be the highest under alternative C because of the predicted 20% increase in annual visitors, and the expanded public use programs. In particular opening Little Marsh Road as a trail for access to Little Marsh and the dike area would result in a much greater potential to affect wading birds, waterbirds and waterfowl compared to alternatives B and C. However, similar to alternative B, increased staff and funding would enhance outreach, education, and enforcement to help mitigate impacts.
	---------- Impacts That Would Not Vary By Alternative ----------		
	Protecting the regionally significant heron rookery in Little Marsh would continue to be a management priority under all alternatives. Ongoing protection and management of refuge marshes and adjacent uplands would continue to benefit wading birds, waterbirds and migratory and wintering waterfowl. These areas will remain undeveloped thereby sustaining a reserve of migratory and wintering bird habitats in the Tidal Potomac River Basin that would otherwise almost certainly be intensively developed. Refuge lands would also remain a waterfowl no-hunting zone to provide a sanctuary in an area that is otherwise heavily hunted. Visitors would continue to have the potential to disturb birds along refuge trails, specifically the Woodmarsh and Great Marsh Trails, which are near habitats used by the birds.		

	Alternative A Current Management	Alternative B Improved Management for Federal Trust Resources (Service-Preferred Alternative)	Alternative C Management to Enhance Public Uses
Other Native Wildlife	Protecting refuge habitats from development benefits all native wildlife on the refuge. In addition, continuing to restrict public access on the refuge to the Great Marsh and Woodmarsh Trails, except for the 3 days of the deer hunt assures over 2,000 acres of habitat where wildlife are undisturbed by human intrusion. The potential adverse impacts from refuge management activities are described below for all alternatives. Deer populations would be reduced during the deer hunt but the deer population on the refuge and across the peninsula would not be adversely affected because we would continue to monitor the status of the peninsula population in coordination with VDGIF and would reduce or eliminate the hunt if it appeared warranted to allow the herd to rebuild. Human disturbance to native wildlife would slightly increase due to the predicted 10% increase in annual refuge visitors. These impacts would be expected to primarily occur along roads and trails and be short term and result in only temporary displacement of animals. Individual beaver may need to be removed if they are causing road flooding or other serious refuge management problems. We would remove problem animals through lethal means only when necessary.	In addition to alternative A benefits, mammals, reptiles, amphibians, and invertebrates would benefit to a greater degree under alternative B because substantial effort would be devoted to monitoring, inventories, and mapping to improve future management. Habitat features important to many wildlife would be a focus of protection, including vernal pools, den trees, mast trees, snags, and downed logs that provide breeding or escape cover, food, or other survival requirements. Similar to alternative A, mowing, road and trail maintenance, and invasive plant control treatments may continue to disturb, displace, and occasionally injure or kill individual animals, but would not result in a loss of viability or persistence of any regional population. Deer hunting and associated impacts would increase under alternative B, however, we would continue to work with VDGIF to monitor deer populations to insure over-hunting does not occur. A new turkey hunt is also proposed with a maximum predicted turkey harvest of 10 birds per year. Other visitor impacts would also increase under alternative B with a predicated 15% increase in annual visitors. The types of impacts are similar to alternative A and would primarily occur along roads and trails.	Benefits to native wildlife under alternative C would generally be the same as those predicted for alternative A. An incremental benefit may result for those wildlife that would respond to a more healthy, diverse understory since more deer would be harvested and less overbrowsing damage would occur; however, the full extent of this benefit is not predictable. Alternative C, in offering the most expansive deer hunt, would result in the greatest impact to deer and, indirectly to other wildlife, from hunter access and activity. We would predict increased deer mortality in the short term from implementing the new muzzle-loader hunt. However, any short-term increase in harvest may be potentially offset in subsequent years, either directly or indirectly, as herd size is reduced. Other visitor impacts would be similar to those described under alternative B, however, given the predicted 20% increase in annual visitors and the new trail in an area previously closed to public access, the impacts are likely to increase in magnitude.

	Alternative A Current Management	**Alternative B Improved Management for Federal Trust Resources (Service-Preferred Alternative)**	**Alternative C Management to Enhance Public Uses**
Other Native Wildlife (cont.)	---------- Other Native Wildlife Impacts That Would Not Vary By Alternative ----------		
	We would continue to provide a natural landscape with habitats to support a wide diversity of mammalian, amphibian, reptile and invertebrate species native to the area. Protecting the integrity of those habitats would provide long term benefits to all taxa. Continued monitoring and research by partners would improve our knowledge of the array of species present, including those of conservation concern. For example, the refuge provides year-round habitat for at least three State-listed reptile species: the eastern hog-nosed snake, spotted turtle, and eastern box turtle. Refuge habitat management activities such as mowing, road and trail maintenance, and invasive plant control work, may kill individual native wildlife that are less mobile, or may cause temporary disturbance or displacement of others, but there would be no significant mortality or loss of local populations because these actions would be done on a rotational basis, no habitat conversions would occur, and less than 5% of the refuge would be affected in any given year. Wildlife would continue to experience some minimal level of human disturbance from refuge staff and from visitors, regardless of alternative, especially along roads and trails. Those impacts are likely to be temporary displacement that is short term and localized. Deer hunting, which would continue under all alternatives, also could impact wildlife across a wider area during the deer hunting season, if wildlife occur in the pathway of hunters tracking prey. Shotgun noise from hunting may also cause wildlife disturbance. Deer mortality would necessarily occur as a result of hunting. However, deer are overabundant in the area as evidenced by overbrowsing and vegetation impacts. We would continue to partner with VDGIF to develop our hunt program in response to deer populations and trends to minimize any possible long term threat to deer populations from hunting on the refuge.		

	Alternative A Current Management	**Alternative B Improved Management for Federal Trust Resources (Service-Preferred Alternative)**	**Alternative C Management to Enhance Public Uses**
Archaeological and Historic Resources	Continued protection of refuge lands against digging, looting, or unauthorized surveys would benefit cultural resources by ensuring that no substantial impacts on known, or as yet undiscovered, cultural, archaeological, and historic resources occurs. There is some increased risk that refuge visitors may inadvertently or intentionally damage or disturb cultural artifacts or historic properties on the refuge given the projected 10% increase in visitation. However, continued outreach and enforcement would help minimize those risks.	In addition to the protection and enforcement measures under alternative A, alternative B would result in increased benefits to archaeological and historic resources because of plans for a refuge-wide inventory of all archaeological and historic sites and resources. We would work with State, County and professional archaeological societies willing to assist in performing surface surveys of selected refuge sites and the shoreline to locate archaeological resources at risk. We would develop site management and protection plans as warranted to insure protection into the future. At least one law enforcement staff person would receive ARPA training to enhance our ability to protect and enforce sensitive sites. We would also use the proposed new Sycamore Road trail as an opportunity to interpret archaeological sites with the intent that a more informed public would assist in protection of resources.	Benefits and adverse effects to cultural and historic resources would be similar to alternative B, with slightly increased risk given the predicted 20% annual increase in visitation. Additional benefits would be derived with plans to develop a prioritized program to perform additional surveys and research as funding allows; including a systematic program to monitor erosion impacts on resources.
	---------- Archeological and Historic Resource Impacts That Would Not Vary By Alternative ----------		
	Areas with potential to contain cultural, archaeological, or historic resources would be protected under all alternatives. We would take all necessary precautions to ensure that no properties considered eligible for listing on National Register of Historic Places would be affected. Planned ground disturbing activities would undergo a review from the Service's Regional Archeologist or state historic preservation office as warranted prior to implementation. We would continue to conduct outreach and education, and use law enforcement if necessary, to protect against loss or damage to these resources.		

	Alternative A Current Management	**Alternative B Improved Management for Federal Trust Resources (Service-Preferred Alternative)**	**Alternative C Management to Enhance Public Uses**
Refuge Users—Wildlife Observation and Photography	There would be no changes in management to these activities, nor any changes in infrastructure under alternative A, and demand would mostly be met given the predicted 10% increase in annual visitation. There is a negligible potential for increased user conflicts and enforcement issues on the refuge if we underestimated demand.	Benefits to visitors engaged in these activities would increase under alternative B. New trails would be opened to facilitate the predicted 15% increase in annual visitation and improvements to observation and photography structures would occur. Increased number of visitors also increases the potential for user conflicts and enforcement issues, but we predict these would be minimal and infrequent.	Benefits would be slightly higher than alternative B with the addition of another new trail along Little Marsh road. Adverse impacts would be similar to but slightly higher than those identified for alternative B due to the predicted 20% increase in annual visitors and due to the extra 3-5 days the refuge may be closed to an expanded deer hunting season.
	---------- Wildlife Observation and Photography Impacts That Would Not Vary By Alternative ----------		
	Wildlife observation and photography opportunities would continue to be one of the primary reasons visitors come to the refuge year round with concentrations during the spring, summer and early fall. We would continue to maintain existing refuge facilities including foot trails and parking areas, observation platforms, and kiosks. We believe, despite predicted increases in annual visitation over the next 15 years under all alternatives, that we can accommodate those increases without impacting natural resources or diminishing the quality of experience for other visitors. This would be managed by encouraging group activities and programs, attempting to distribute those activities throughout the year, and increased outreach and education. We do not predict any major conflicts between or among visitors engaged in these and other various activities on the refuge regardless of alternative. One potential conflict could arise during hunting season when the refuge is closed to all non-hunting visitors. However, wildlife viewing and photography are most popular outside of hunting season. Area closures to protect wildlife from disturbance during sensitive times of the year may result in a few complaints by some visitors who want access, but most people understand the need for this inconvenience.		

	Alternative A Current Management	**Alternative B Improved Management for Federal Trust Resources (Service-Preferred Alternative)**	**Alternative C Management to Enhance Public Uses**
Refuge Users—Environmental Education and Interpretation	We would maintain existing interpretive facilities along trails and in parking areas. Annual maintenance would continue to insure quality is sustained. Demand for environmental education opportunities is high in the area and it is not being met on the refuge to any appreciable degree. Educator-led programs with limited refuge staff involvement are the most frequent programs offered.	Increased benefits would occur under alternative B with the proposed increased staff that would focus on improving the quality of programs and existing infrastructure, and more strategically manage partnerships and volunteer support. Improved programs would reach more people, a greater diversity of audiences, and increase participants understanding of the natural resources and ecosystems on the refuge. Better programming would also encourage more support for refuge goals and objectives and the mission of the Refuge System. Increased efforts to support environmental education and interpretation opportunities would help accommodate the predicted 15% annual increase in visitation and better meet demand for these activities in the area.	Benefits and impacts would be the same as alternative B.
	----------Environmental Education and Interpretation Impacts That Would Not Vary By Alternative----------		
	We would continue to provide opportunities for environmental education and interpretation on the refuge. We anticipate that the Friends of Mason Neck Refuge, volunteers, regional educational institutions, and researchers would continue to help us support these activities on the refuge to promote conservation in an urban setting and take advantage of the refuge's proximity in the populated Washington DC metropolitan area. We expect that offering environmental education opportunities and interpreting wildlife resources on Mason Neck Refuge will promote long term stewardship of natural resources, and increase support for the refuge that will more than offset any disturbance these programs might cause and any staff and resource commitments we must make.		

	Alternative A Current Management	**Alternative B Improved Management for Federal Trust Resources (Service-Preferred Alternative)**	**Alternative C Management to Enhance Public Uses**
Refuge Users—Hunting	Existing deer shotgun hunting opportunities would continue to be offered in partnership with VDGIF and Mason Neck State Park. Deer hunting helps control the local deer population which is overbrowsing forest habitat and adversely affecting regeneration and forest health. Hunters would continue to benefit from this outdoor recreational opportunity in an area where such opportunities are diminishing on other public lands. Some conflicts would occur with non-hunting visitors wishing to use the area or with people opposed to hunting at any time.	There would be increased benefits to the hunting public because we would expand hunting opportunities under alternative B. In addition to potentially extending the length of the existing deer shotgun hunt, we would evaluate an archery hunt. We would also offer a new youth turkey hunt. This new opportunity would help connect youth with nature and the outdoors which is a major initiative of the Service. Increased deer hunting would help improve forest health over the long term, which would enhance the experience for many visitors knowledgeable about ecology. Conflicts with the non-hunting public would potentially increase. The refuge would be closed up to 3 additional days to accommodate an expanded deer hunting program. Non-hunting visitors would not be impacted by the proposed youth turkey hunt as hunt units would be in areas otherwise closed to visitors. Increased concern from people opposed to hunting would be expected.	The hunting public would benefit the most under alternative C since, in addition to the new and expanded hunts under alternative B, a deer muzzleloader hunt would be offered. Other benefits to hunters and habitat would be similar to those described under alternative B, but slightly increased. Adverse effects would be the same as though described for alternative B.
	----------Hunting Impacts That Would Not Vary By Alternative----------		
	Deer hunting would continue under all alternatives in cooperation with Mason Neck State Park and VDGIF. Hunting is a wildlife-dependent recreational opportunity that helps preserve the cultural heritage of the refuge area, where people have hunted for generations, and where hunting opportunities on other public lands are diminishing. It is a priority public use for the Refuge System and helps meet a Director's Order on Hunting Heritage to offer compatible hunting opportunities where possible. The refuge would continue to be closed to non-hunting visitors during the hunting season. Some complaints from non-hunters wishing to access the refuge would continue, as would comments from people opposed to hunting at all times for ethical reasons. A few areas would remain closed to hunters, including areas around refuge facilities, and in sensitive wildlife areas.		

Part 2—Environmental Consequences of Featherstone Refuge CCP Alternatives

Steve Maslowski/USFWS

Bald Eagle

Impacts in the Refuge Vicinity

Air Quality Impacts

Chapter 2—Affected Environment, discusses the status of air quality in the landscape around Featherstone Refuge. We evaluated the management actions each alternative proposes for their potential positive or negative effects on air quality, including:

- The potential of refuge land conservation to limit the growth of development, thereby limiting sources of emissions and reducing losses of forest vegetation
- The potential of refuge forest management to enhance carbon sequestration and reduce greenhouse gases
- The potential for management activities, vehicles and equipment to increase emissions

Air Quality Impacts that would not vary by Alternative

Our analysis of air quality impacts considered how Refuge activities might affect criteria air pollutants, visibility, and global climate change, focusing on the potential for localized air quality adverse impacts or improvements. Management activities are not predicted to result in a measurable negative contribution to regional air quality. None of the alternatives would violate EPA standards; both would comply with the Clean Air Act. There would be no new major sources of air pollutants at the refuge created under any of the refuge management

alternatives. The alternatives would either continue to prohibit public access or strictly limit public uses of the refuge to compatible wildlife-oriented activities. Given the low level of activity coupled with the fact that more than 92 percent of 325-acre refuge area is in a natural vegetative cover, any additional adverse affects to short term or long term air quality conditions from refuge management would be negligible under any alternative.

Visibility concerns due to emission-caused haze at the nearest Class I airsheds—Shenandoah National Park in Virginia and Brigantine Wilderness Area in New Jersey—would not be affected by any of the proposed management alternatives.

Featherstone Refuge does not pose any substantive risk of catastrophic wildfire due to its relatively small size, proximity to the river, and adjacency to development. However, a drought year or excessive fuel loading over time could dramatically increase that risk. Nevertheless, we would seek to minimize the possibility of serious fires and their associated health and safety concerns. We would continue to assess the hazards associated with the wildland-urban interface along the refuge boundaries to ensure that our management practices are not creating excessive fuel loading that could lead to severe fires.

We do not expect that Refuge Complex staff or refuge visitors traveling in motor vehicles would add measurably to current emissions. Under both alternatives, we would continue to keep vehicle use on the refuge to a minimum. Vehicular access to the refuge is limited to authorized personnel only. Presently, there are no developed facilities and no public access or parking, nor is there boat access. Opportunities are being pursued for parking, however, and include the possibility of off-refuge parking. If secured, only non-motorized access would occur on refuge trails. Boat access would potentially be allowed for fishing and hunting.

There is a minimal risk that Service activities will indirectly affect air quality through leak or spill accidents involving chemicals or petroleum products used in refuge management operations. However, we would assiduously follow our leak and spill prevention and emergency clean-up procedures to ensure that such occurrences are rare, addressed immediately, and that short-term effects are limited to the immediate location.

Alternative A. Current Management

Benefits

There would be continuing benefits to air quality under alternative A from maintaining natural vegetation on 80 acres of forested upland and 220 acres of forested and emergent wetlands. These benefits are twofold; first, natural vegetation serves to filter air pollutants and, second, the presence of the refuge precludes development and the introduction of attendant sources of pollutant emissions on refuge lands. Continuing to protect forest habitats would also provide some additional benefit due to the ability of forests to sequester carbon. Trees serve as long-term carbon "sinks" reducing the amount of atmospheric carbon (i.e. CO_2), which contributes to global climate change (EPA, 2010).

Under alternative A energy efficient practices for vehicles, equipment and facilities would continue to be implemented across the Refuge Complex and additional practices would be pursued in the future as feasible.

Adverse Impacts

Vehicles and equipment used by staff would contribute a negligible amount to local mobile source air emissions and particulates. These localized increases from refuge activities would be undetectable over the next 15 years compared to current off-refuge contributions to pollutant air emissions from transportation sources and land development in the highly urbanized and developed Woodbridge

area, as well as overall Prince William County. Any adverse air quality effects from refuge activities would be offset by the benefits of maintaining the refuge in natural vegetation.

Alternative B. Enhanced Management

Benefits
As in alternative A, there would be continuing benefits to air quality under alternative B from maintaining the natural vegetation on 80 acres of refuge forested uplands and 220 acres of forested and emergent wetland. Maintaining the vegetation would continue to serve to filter air pollutants, preclude human development and attendant sources of pollutant emissions, and contribute to carbon sequestration. Under alternative B, Refuge staff would continue energy efficient practices and additional practices would be pursued in the future.

Adverse Impacts
Trail construction and maintenance activities on approximately 1.85 mile of trail would cause negligible short-term, localized effects from dust and vehicle and equipment exhausts. Vehicles and increased equipment use by staff under alternative B would negligibly increase local mobile source air emissions.

Water Quality, Wetlands, and Aquatic Biota Impacts

Good water quality is essential to sustaining healthy ecosystems on the refuge and within the Occoquan Bay and larger Tidal Potomac River Basin. Water quality problems in the Basin caused by nutrient and sediment loading and chemical pollutants are a concern. These impacts, in turn, may contribute to a decline or loss of aquatic species on the refuge and in the Basin.

We evaluated the benefits of actions that would protect or restore forested buffers, maintain or restore tidal wetlands and their role in filtering water pollutants, and otherwise maintain or improve water quality including:

- Shoreline protection projects that would reduce the rate of erosion
- Retention of riverside buffers
- Improved water quality monitoring for early problem identification

We evaluated and compared the impacts of the refuge's management actions with the potential to cause adverse effects to water quality and aquatic species including:

- Use of herbicides to manage invasive species
- Runoff and sedimentation from refuge construction projects
- Mortality to fish from recreational fishing
- Changes in recreational use that might lead to contamination with petroleum products

Water Quality, Wetlands, and Aquatic Biota Impacts that Would Not Vary by Alternative

Clean water is a critical and essential resource value on the refuge and its protection would be given full consideration in management planning and operations. Regardless of alternative implemented, none of the proposed actions would cause direct, long term adverse impacts to water quality or aquatic species in the vicinity of the refuge or elsewhere in the Potomac River. Rather, our management practices on the refuge and our partnering with local communities, Federal and State agencies, and conservation organizations would continue to benefit water quality over the next 15 years and beyond. We would adhere to all Federal and State regulations, and obtain all permits required for refuge lands, before implanting activities in order to insure compliance Sections 305(b) and 319 of the Clean Water Act, 33 U.S.C. § 1251 *et seq.* as amended.

All of the alternatives propose protection measures to insure management activities would not cause a decline in water quality, either on refuge lands or in the Tidal Potomac River Basin.

Benefits
Refuge lands would continue to benefit water quality in the Tidal Potomac River Basin by excluding development in this portion of the watershed, sustaining natural water filtering vegetation, and maintaining a forested buffer between Farm Creek and Occoquan Bay and developed areas upslope from the refuge.

Adverse Impacts
Because Refuge staff entry by vehicle would be limited to the single, existing upland access road, there is a negligible risk to water quality and aquatic biota from leaking petroleum products which could adversely affect water quality or harm aquatic species in the refuge tidal marsh. Risks from the use of selected low-toxicity chemical herbicides for aquatic weed control are also low as are risks from the use of other herbicides for control of terrestrial invasive plants. In addition, we would keep current our leak and spill prevention plans.

Wetland invasive plant control with herbicides: Regardless of the alternative selected, the herbicide active ingredient glyphosate, used in a formulation such as Rodeo® and the herbicide active ingredient imazapyr, used in the brand-name formulation Habitat®, would be used as one method to control aquatic invasive plants such as *Phragmites* in the tidal marsh. Both active ingredients are known to have low aquatic toxicity (see discussion below). Herbicides that would be used to control other invasive plant species on the refuge would not be used for aquatic weed control and do not pose a direct risk to water quality or aquatic species. Those terrestrial plant herbicides are reviewed in the Soils section of this chapter. The Regional Contaminants Specialist, who is responsible for upholding Federal standards for water quality and soil protection, must review proposals and approve all use of chemical herbicides on refuge lands.

Glyphosate Effects on Aquatic Species: In some formulations, such as the one in the brand name formula Rodeo®, glyphosate is not a problem aquatic contaminant because it does not contain the toxic adjuvant that is found in other formulations, such as in the brand name formula Roundup®. It is also quickly adsorbed to suspended soil particles in water, rapidly making it biologically unavailable. There would be some potential for herbicide concentrations in sediments and backwaters to build up over time. The potential depends on the balance of herbicide input and removal from the aquatic system. Herbicide inputs may occur either through direct application, water inflow, or through resuspension and diffusion from the sediment layer. Herbicide removal from the system may occur through outflow, degradation, volatilization, and settling or diffusion into the underlying sediment (Neitsch et al., 2001).

The rate of herbicide degradation is an important consideration for assessing the effects of a given herbicide on aquatic systems. Glyphosate degrades with a reported half-life in water that ranges from 3.5 to 70 days depending on the rate of transfer to the sediment layer and testing source (USDA-FS 1996). Based on the relatively short half-life and the large flux in water volume of the tidal marshes, it is not expected that any greater than negligible effects would occur as a result of herbicide treatments.

According to a Forest Service risk assessment glyphosate in less toxic formulations appears to have a very low potential to cause any adverse effects in aquatic animals (USDA-FS, 2003). The use of less toxic formulations results in hazard quotients that do not approach a level of concern for any species.

Nevertheless, use of glyphosate near bodies of water where sensitive species of fish may be found should be conducted with substantial care to avoid contamination of surface water. The likelihood of direct acute toxic effects on aquatic invertebrates or longer term direct effects on any fish species seems extremely remote based on central estimates of the hazard quotient and unlikely base on upper ranges of the hazard quotient (USDA-FS, 2003).

Aquatic plants appear to be somewhat less sensitive to glyphosate than the most sensitive aquatic animals. There is no indication that adverse effects on aquatic plants are likely (USDA-FS, 2003).

Imazapyr Effects on Aquatic Species: According to the Forest Service risk assessment, imazapyr appears to have a very low potential to cause any adverse effects in aquatic animals (USDA-FS, 2004b). Modeled concentrations of imazapyr in ambient water over prolonged periods of time are estimated to be no greater than 0.00045 milligrams/liter and peak concentration of imazapyr associated with runoff or percolation are estimated to be no more than 0.036 milligrams/liters. Monitoring data from a field application similar to those that may be used in Forest Service programs was used as the basis for the peak concentrations that might be expected. All of the hazard quotients for aquatic animals are extremely low. Thus, there is no basis for asserting that effects on nontarget aquatic species are plausible. The highest hazard quotient of 0.01 is below the level of concern at the typical application rate (LOC=1.0) by a factor of 100 and below the level of concern at the highest application rate (LOC=0.36) by a factor of 36. In the case of an accidental spill of a large amount of imazapyr into a relatively small body of water, mortality in sensitive species of fish is plausible. Actual concentrations in the water after a spill would depend on the amount of compound spilled and the size of the water body into which it is spilled (USDA-FS, 2004b).

Aquatic plants, particularly macrophytes, are much more sensitive than aquatic animals to imazapyr exposure. For aquatic macrophytes, the upper range of the hazard quotient for peak concentrations (HQ=3) is above the level of concern by a factor of 3 at the typical application rate (LOC=1) and a factor of about 8 at the highest application rate (LOC=0.36, 3÷0.36=8.3). Thus, under foreseeable worst case conditions, acute effects could be seen in aquatic macrophytes. Longer term concentrations of imazapyr, however, result in hazard quotients for macrophytes that are well below a level of concern. Hazard quotients for sensitive species of unicellular algae are below a level of concern based either on peak concentration of imazapyr in water (a hazard quotient of 0.02 at the upper range of exposure) as well as longer term concentrations that might be expected (hazard quotient of 0.003 at the upper range of exposure). Thus, at both the typical application rate (LOC=1) and the maximum application rate (LOC=0.36), the upper ranges of the hazard quotients for sensitive species of algae are substantially below the LOC. Accidental spills of large quantities of imazapyr into relatively small bodies of water could lead to much higher concentrations—i.e., 3 milligrams/liters to 4 milligrams/liters. After spills of this magnitude, adverse effects on aquatic plants could be anticipated from imazapyr in both macrophytes and sensitive species of algae.

Terrestrial invasive plant control with herbicides: There is some slight risk that herbicides used for terrestrial invasive plant control may reach the tidal marsh and affect water quality or harm aquatic species. The two herbicides proposed for use in uplands are non-toxic or of low toxicity to aquatic species.

Imazapic Effects on Aquatic Species (Trade Names: Journey®, Plateau®): This herbicide is applied in broadcast and spot treatments with backpack and

skid sprayers. Aquatic animals appear to be relatively insensitive to imazapic exposures, with LC values of >100 milligrams/liters for both acute toxicity and reproductive effects. Aquatic macrophytes may be much more sensitive, with an acute EC of 6.1grams/liters in duck weed (*Lemna gibba*). Aquatic algae appear to be much less sensitive, with EC values of greater than 45 grams/liters. Imazapic does not appear to be very toxic to aquatic fish or invertebrates. The weight of evidence suggests that no adverse effects in fish or aquatic invertebrates are plausible using typical or worst-case exposure assumptions at the typical application rate of 0.1 pounds/acre or the maximum application rate of 0.1875 pounds/acre (USDA-FS, 2004a).

Triclopyr Effects on Aquatic Species (Trade Name: Garlon®): This herbicide is applied in broadcast, spot treatment, cut stump and basal treatments with backpack and skid sprayers. It cannot be applied to open water or where runoff may occur. It is relatively non-toxic to terrestrial vertebrates and invertebrates, but can be extremely toxic to fish and aquatic invertebrates. For this reason, we use it only as a basal or cut stump application directly on the base of trees and do not use it as a broadcast spray. In soils, it is degraded by photolysis, microbial metabolism, and hydrolysis to the parent compound, triclopyr acid. Triclopyr acid has an intermediate adsorption potential, limiting movement of the acid in the environment. The acid degrades with an average half-life of 30 days. The ester formulation is not water-soluble and can take significantly longer to degrade in water (Tu et al., 2007).

Research: Aquatic habitats and biota may also be impacted by research. Sampling activities may cause soil compaction, erosion, and the trampling of vegetation where runoff can affect waterways. The creation of temporary foot trails and boat trails through aquatic vegetation beds, disruption of bottom sediments, and minor vegetation damage when equipment is temporarily placed is possible. The removal of vegetation or sediments by core sampling methods may cause increased localized turbidity and disrupt non-target plants and animals. Installation of posts, equipment platforms, collection devices and other research equipment in open water may present a hazard if said items are not adequately marked and/or removed at appropriate times or upon completion of the project. Negligible vehicle emissions, contaminants from vehicle fluids and very minor erosion from roads may result from vehicle access to the research sites. To minimize the potential for impacts, all research projects will operate under a special use permit, with stipulations as warranted to insure planned activities would not impact aquatic resources. As new and innovative techniques become available, we would encourage researchers to use the least intrusive research methodologies and techniques.

Alternative A. Current Management

Benefits
There would be continued benefits to water quality and aquatic biota from protection of the native plant communities on the refuge uplands which filter runoff from adjacent land uses, roadways, and residential areas. The restrictions on public access to the refuge shoreline would continue to directly benefit water quality and aquatic biota over the long term.

Adverse Impacts
Unauthorized shoreline access for wildlife viewing and fishing has the highest likelihood of impacting water quality and aquatic biota over the long-term, so our outreach and enforcement programs are focused here. Under alternative A, we would continue to only allow limited, infrequent group outings under a special use permit with stipulations to protect resources. Permits allowing research studies in aquatic habitats would also include stipulations to minimize impacts to these resources.

Although we do not propose expanded shoreline protection projects under this alternative, we would continue to raise awareness about shoreline protection to the media, our partners and the public at every opportunity. We would also respond to partner efforts to implement shoreline protection as funding and material sources become available to them.

Shoreline erosion caused by wind and wave action would continue to contribute to the river's sediment load and thereby negatively affect riverine aquatic resources and the habitats they depend upon. Over the long term, as the refuge shoreline remains unprotected and continues to erode, there would likely be the loss of substantial portions of the refuge tidal marsh and its value in the Potomac River basin.

Under alternative A, there would be a minimal level of risk of contaminating water quality and aquatic biota from herbicides used in invasive plant control. Any potential risk would be mitigated through a leak and spill prevention plan, proper application procedures, and from using only certified herbicides approved by the Regional Contaminants Coordinator for use in aquatic habitats.

Alternative B. Enhanced Management

Benefits

Compared to alternative A, there would be increased benefits to water quality and aquatic biota from enhanced protection and monitoring of refuge habitats, and working with partners to collectively address water quality issues in the Tidal Potomac River Basin. The number of unauthorized persons entering the refuge and the accompanying trash and makeshift temporary structures that have been problematic on the refuge for some time would be virtually eliminated with increased enforcement and management for authorized public uses. Construction of designated trails and the installation of signage cautioning refuge users to stay on the trails would substantially reduce the use of unauthorized "social" trails that are sources of soil erosion, especially along the refuge shoreline.

Adverse Impacts

Shoreline protection measures, if developed, funded, and implemented, may result in additional sedimentation and turbidity while construction is occurring. Depending on the type of construction and its resulting disturbance, there may also be a temporary displacement of aquatic resources and the permanent loss of habitat to some species within the footprint of fill material and structures. However, without a specific proposal, detailed impacts can not be described. Additional analysis would occur once a specific proposal for shoreline protection is in place.

Trails planned for the refuge under this alternative include an approximately 1.1mile segment of the PHNS Trail, 3 spur trails off the PHNS Trail to overlooks on the Potomac River and Farm Creek, and a trail that leads to Neabsco Creek. We estimate approximately 1.85 miles of trail (approximately 2.2. acres) would be maintained. We would also plan to construct up to four observation/photography platforms (approx 900 sq ft, or .02 acres, each) as indicated on map 3.3. Trail and platform building and kiosk trailhead construction activities would increase the temporary, short term potential for sedimentation and turbidity in adjacent waters from erosion of exposed soils. Proper site preparation and use of standard best management and mitigation practices would limit the potential for impacts.

Under alternative B there would be direct effects to fish populations from a new public recreational fishing program. While the day-to-day activity of fishing would result in harvest of individual fish, we predict it would not affect the viability of local fish populations as numbers harvested from the refuge would not

be expected to affect future productivity. We would adhere to state regulations in developing the program. There would also be a negligible direct impact on wading birds, water birds and other birds that eat fish due to loss of prey and from anglers disturbing birds. However, due to the limited extent of shoreline that could be accessed by anglers, this is expected to be of minimal impact.

Under alternative B, increased herbicide treatment for invasive plants would occur so there would be a slightly increased risk for herbicides to contaminate water quality and aquatic biota. However, all the provisions for using best management practices (e.g. application rates and spill prevention) would be in place. All proposals for using herbicides would be annually reviewed and approved by the Regional Contaminants Coordinator before implementation. Herbicide use elsewhere on the Refuge Complex has occurred for many years with no spills and no detections of adverse effects on non-target species.

Under alternative B, if a hunt program is implemented upon further analysis and approval, some hunters may present a slightly increased potential above alternative A for affecting the surrounding shallow water from off-trail soil compaction and erosion. Other refuge visitors would be restricted to trail access only; however, there would still be some potential for unauthorized off-trail entry, soil compaction, and possibly littering. Similar to alternative A, but at a higher level with advantage of additional staff, increased outreach, education, and enforcement would minimize threats to water quality and aquatic biota from all unauthorized activities.

Socioeconomic Impacts

We evaluated the socioeconomic impacts of each alternative proposed for Featherstone Refuge might affect the local economy, social structures, or quality of life of the local community area within Woodbridge and the surrounding area.

To evaluate potential benefits or adverse effects to the local economy from each alternative, we considered how the alternatives might contribute:

- Jobs and income to the local community from differences in refuge staffing
- Jobs and income from expenditures for temporary construction work on the refuge
- Expenditures into the local economy from public uses of the refuge
- Expenditures into the economy from hunting and fishing
- The availability of opportunities for recreational activities that are in high demand by the public

Socioeconomic Impacts that would not vary by Alternative

Benefits

Regardless of which alternative we select, we would continue to make Refuge Revenue Sharing Payments to Prince William County. The amount of payment is determined by Congress each year; however, these revenue sharing payments would have a negligible effect on the County budget, which totals $1.7 billion (PWC, 2007). We would also continue to contribute marginally to the local economy of Woodbridge and other communities near Featherstone Refuge in terms of Potomac Refuge Complex staff jobs, income, and expenditures because the current refuge Headquarters is located in Woodbridge, as is the new planned facility on Occoquan Bay Refuge. There would be little change in job related expenditures in the Woodbridge area under any of the alternatives.

Adverse Impacts
The presence of the refuge prevents the local community from developing refuge lands in ways that could be more economically advantageous. This impact is what the Revenue Sharing Payments are meant to mitigate. Because its location is physically separated from the local community by the railroad line and because it is predominantly wetland, its value in terms of development potential is lower than any comparable parcel of riverside upland which is readily accessible. Therefore, the adverse effects to the community of not being able to develop refuge lands site are minimal compared to other comparable locations in the local city and county area.

Alternative A. Current Management

Benefits
Prince William County would continue to benefit minimally from Refuge Revenue Sharing payments. A small portion of the annual hours spent by Refuge Complex staff would continue to be devoted to monitoring existing conditions and enforcement actions at Featherstone Refuge.

Adverse Impacts
Public access to the refuge would continue to be prohibited. Therefore, there would be no economic benefits to the local community in terms of visitor expenditures for auto fuel, meals, hunting gear, and other wildlife equipment purchases. There would likely continue to be unauthorized uses of Featherstone Refuge which would continue to incur costs for other local area enforcement agencies that might otherwise be reduced under the other alternatives.

Apart from purely economic considerations, the public would also have to continue to experience ongoing dissatisfaction with unmet demand for wildlife-dependent recreation opportunities literally within walking distance of an otherwise highly developed landscape. These opportunities would enhance the public quality of life and highlight and reinforce the environmental values of the refuge to the broader Woodbridge and Prince William County community that is known now to only a few members of that community. Opportunities for hunting, an activity with diminishing opportunity on lands elsewhere in the area, would remain unavailable here as well.

Alternative B. Enhanced Management

Benefits
Because Featherstone Refuge does not currently allow public access, we do not have a baseline to compare alternative B against. We have no estimates in terms of new visitors generating employment, income, tax revenue, and final demand in the analysis area defined by the local economy. Combined, these factors would represent the full "multiplier" effect of initial spending on recreation-related goods and services plus succeeding rounds of spending internal to the local economy.

However, it is reasonable to assume that the demand for wildlife dependant recreation will remain high in the local area and translate to a substantial number of visitors to the Refuge once public access is made available. If we assume that, at a minimum, the visitation would be one-tenth that of Mason Neck Refuge, and that the resident/non-resident split would be the same, an estimate of economic effects could be extrapolated from the Mason Neck Refuge analysis presented earlier in this chapter. Featherstone Refuge is approximately 14% the size of Mason Neck Refuge in terms of land area. A direct 10-percent extrapolation would translate to a minimum estimated refuge recreational use of 7,041 annual visits comprised of 4,517 local area resident visits and 2,254 non-resident visits. Those visits would generate $82,460 in expenditures with an economic effect of generating $108,514 of final demand (through the multiplier

effect) in the County economy, with $27,910 in job income based on 1 direct and induced job. In strict economic terms, this effect would be negligible.

Designing, construction, and maintaining new refuge infrastructure would minimally increase benefits to the local economy in terms of expenditures for labor, materials, and services.

Providing public access to the refuge would be an important gain to the local community quality of life because it would enhance the attractiveness of the neighborhood, help engender a spirit of public stewardship of the refuge which is not now possible, and provide a venue to promote increased understanding and concern for the Refuge System.

Adverse Impacts
We would expect that refuge visitation under alternative B would constitute a negligible, but additional burden in terms of local expenditures for road maintenance, traffic enforcement, and related infrastructure maintenance and law enforcement expenditures from County tax revenues. These minimal incremental expenditures would be offset, in part, by Refuge Revenue sharing payments and the local economic benefits described above.

Refuge-Specific Impacts

Soil Impacts

Soils are the structural matrix and nutrient source for plant productivity and must be protected to sustain the variety of upland and wetland habitats that would meet refuge habitat and species management goals. Soil biotic communities consume waste and the remains of dead organisms and recycle their constituent materials that are incorporated into the soil into forms usable by plants. In the process, soil organisms regulate the fluxes of carbon dioxide, methane, and nitrogen oxides in the atmosphere (Daily et al 1997). Productive and healthy soils also regulate groundwater quantity and quality by filtering excess nutrients and contaminants.

Overall, the soils of the refuge are productive and in good condition with no noticeable permanent compaction or contaminants problems. However, the creek banks and shoreline are experiencing some erosion; a result of wind and wave action and from unauthorized access. We would continue under both alternatives to manage these areas to minimize human disturbance and to mitigate for natural processes that result in loss of valuable habitats.

We evaluated and compared the management actions proposed for each of the refuge CCP alternatives on the basis of their potential to benefit or adversely affect refuge soils.

We considered the benefits from:

- Protection of soils from conversion to impervious surfaces or restoration of disturbed sites
- Reduction of erosion along interior water courses and refuge shoreline

We considered the potential adverse impacts to soils from:

- Habitat management activities

- Construction of trails, platforms and kiosks
- Refuge visitor activities

Soils Impacts that would not vary by Alternative

Benefits
The soils of the refuge are in good condition and would remain so under all management alternatives. We would continue to maintain the refuge protective vegetative cover that minimizes soil losses through erosion. Native vegetation supports natural functioning and production of the ecological services that improve soil fertility and sustain soil health. For example, healthy soils would also potentially dampen pest and disease outbreaks (Lavelle et al 1997), improve the growth of trees and other plants without additional need for nitrogen input, improve water quality, regulate greenhouse gas emissions, increase carbon sequestration, and increase carbon stock equilibrium of soil vegetation.

We would continue to prohibit recreational activities such as ATV use or motorized access that would damage soils on the refuge. Under alternative B, all newly constructed trails, viewing platforms, parking areas, and other high-use areas would be well maintained to keep soil effects to a minimum. Any erosion problems will be noted during routine refuge monitoring and corrected as soon as feasible.

Regardless of which CCP alternative we select, we would continue to use best management practices in all our activities that might affect refuge soils to ensure that we maintain soil productivity and health. Site conditions, including soil composition, condition, and hydrology would continue to influence where and how management activities should occur. No site would be managed in a manner inconsistent with its recognized potential.

In general, no soil from off-site will be brought onto the refuge unless bringing in clean soil is determined to be less disturbing to refuge resources than using soil from on site.

Adverse Impacts
There is a potential under both alternatives for adverse impacts from invasive plant control techniques including manual, mechanical, and herbicide treatments. Some additional disturbance may occur in treated areas where we are restoring them by replanting with native species.

Herbicides: All chemical use on the refuge must first be approved through the Pesticide Use Proposal process. The Refuge Manager submits proposals to the Regional Contaminants Coordinator, who must approve the chemical, application procedure, and location of all treatments. The following list of herbicides and their potential effects on soils and water is derived mainly from the products' labels and material safety data sheets, except where noted:

Glyphosate Effects on Soils and Soil Organisms: This herbicide is applied in broadcast or spot treatment with backpacks or skid sprayer. It is degraded by microbial action in both soil and water, and degrades in soil with an estimated half-life of 30 days. It is highly soluble, but adsorbs rapidly and tightly to soil (USDA-FS, 2003). Numerous soil bacteria, fungi, invertebrates, and other microorganisms have been studied for effects of glyphosate application. There is nothing to suggest glyphosate would adversely affect soil organisms. Glyphosate is readily metabolized by soil microorganisms and some species can use glyphosate as a sole source of carbon (USDA-FS, 2003). Sylvia and Jarstfer (1997) found that after 3 years, pine trees in plots with grassy weeds had 75 percent fewer mycorrhizal root tips than plots that had been treated three times per year with a mixture of glyphosate and metsulfuron methyl to remove weeds.

Glyphosate degrades in soil, with an estimated half-life of 30 days. Glyphosate is highly soluble, but adsorbs rapidly and tightly to soil. Glyphosate has low leaching potential because it binds so tightly to soil. Modeling results indicate glyphosate runoff is highest in loam soils with peaks after the first rainfall (USDA-FS, 2003; WSSA, 2002).

Imazapic Effects on Soils and Soil Organisms: This herbicide is a relatively new herbicide, and there are no studies on the effects of imazapic on either soil invertebrates or soil microorganisms. If imazapic was extremely toxic to soil microorganisms, it is reasonable to assume that secondary signs of injury to microbial populations would have been reported (USDA-FS, 2004a). Imazapic degrades in soil, with a half-life of about 113 days. Half-life is decreased by the presence of microflora. Imazapic is primarily degraded by microbes and it does not degrade appreciably under anaerobic conditions. Imazapic is weakly adsorbed in high soil pH, but adsorption increases with lower pH (acidic soils) and increasing clay and organic matter content. Field studies indicate that imazapic remains in the top 12 to 18 inches of soil and do not indicate any potential for imazapic to move with surface water. Modeling results indicate imazapic runoff is highest in clay and loam soils with peaks after the first rainfall. Imazapic percolation is highest in sandy soils (USDA-FS, 2004a; WSSA, 2002).

ImazapyrEffects on Soils and Soil Organisms: This herbicide has not been studied as to its effects on soil invertebrates, and there is incomplete information on the effects on soil microorganisms. One study indicates cellulose decomposition, a function of soil microorganisms, can be decreased by soil concentrations higher than concentrations expected from Forest Service applications.

There is no basis for asserting adverse effects to soil microorganisms (USDA-FS, 2004b). Degradation rates are highly dependent on microbial action. Anaerobic conditions slow degradation. Imazapyr is weakly bound to soil, but adsorption increases with lower pH and increasing clay and organic matter content. Adsorption increases with time as soil dries and is reversible. Field studies indicate that imazapyr remains in the top 20 inches of soil and do not indicate any potential for imazapyr to move with surface water. In forest field studies, imazapyr did not run off and there was no evidence of lateral movement. Modeling results indicate imazapyr runoff is highest in clay and loam soils with peaks after the first rainfall. Imazapyr *percolation* is highest in sandy soils (USDA-FS, 2004b; WSSA, 2002).

Triclopyr Effects on Soils and Soil Organisms: The five commercial formulations of triclopyr contain one of two forms of triclopyr, BEE (butoxyethyl ester) or TEA (triethylamine). Triclopyr BEE is much more toxic to aquatic organisms than triclopyr TEA. A breakdown product, TCP (3,5,6-trichloro-2-pyridinol), is more toxic than either form of triclopyr. Site-specific cumulative effects analysis buffer determinations need to consider the form of triclopyr used and the proximity of any aquatic triclopyr applications, as well as toxicity to aquatic organisms (USDA-FS, 2004c). Triclopyr has not been studied on soil invertebrates. Soil fungi growth was inhibited at concentrations 2 to 5 times higher than concentrations expected from Forest Service application rates. Triclopyr has an average half-life in soil of 46 days, while TCP has an average half-life in soil of 70 days. Warmer temperatures decrease the time to degrade triclopyr. Soil adsorption is increased as organic material increases and decreased as pH increases. Triclopyr is weakly adsorbed to soil, though adsorption varies with organic matter and clay content. Both light and microbes degrade triclopyr (USDA-FS, 2004c; WSSA, 2002).

Alternative A. Current Management

Benefits
There would be minimal to no loss or damage to soils on the upland portions of the refuge under alternative A since very little management activity is occurring. Maintaining the naturally vegetated portions of the refuge would continue to protect the soils in those areas.

Continued prohibition of public access and continued enforcement actions against unauthorized refuge users would help protect the refuge creek banks and river shoreline and prevent soils adjacent to those areas from being exposed and eroded away by runoff and tidal action.

Adverse Impacts
Soils adjacent to unprotected shoreline would continue to be at risk of being exposed and eroded away. We would continue to monitor erosion and when possible through partnering establish shoreline protection in areas at high erosion risk.

Refuge staff may employ herbicides to control invasive plants but those would be selected, pre-approved, and applied at rates to ensure negligible adverse effects to soil productivity or soil organisms.

Some level of unauthorized visitation is expected to occur under alternative A, so activities that might impact soils, such as use of unauthorized, undesignated trails, unauthorized camping and illegal use of the shoreline for fishing would continue to be a concern. We would continue to monitor refuge conditions particularly in areas frequented by unauthorized users in the past to determine if soil erosion may be a problem and would take steps to mitigate the problem if it occurs.

Alternative B. Enhanced Management

Benefits
Similar to alternative A, maintaining the naturally vegetated portions of the refuge, particularly along the shoreline, would continue to protect the soils in those areas. Continued enforcement actions against unauthorized refuge users along the refuge creek banks and river shoreline would prevent soils adjacent to those areas from being exposed and eroded away by runoff and tidal action.

Adverse Impacts
Refuge visitor activities under alternative B would increase the likelihood of disturbance and compaction of soils in areas of the refuge where visitors are allowed. It may also increase the likelihood of unauthorized entry to areas where visitation is not allowed, off trails and along the shoreline where soils might be affected. People walking off-trail have the potential over the short term to damage vegetation. Over the long term, if the area is repeatedly trampled on and enough compaction occurs, soil productivity could be directly affected by exposing roots, and reducing soil porosity, aeration, and nutrient availability (Kuss 1986, Roovers, et al 2004). Soil compaction can, in turn, affect plant regeneration and revegetation, especially in rare or sensitive plant populations (Hammitt and Cole 1998). Kuss (1986) found that plant species adapted to wet or moist habitats was the most sensitive and increased moisture content reduces the availability of the soil to support recreational traffic.

A summary of what is proposed under alternative B for public use infrastructure follows:

- 1.1 mile of PHNS Trail (approx 1.6 acres); would likely be an impermeable surface with access for pedestrians and bicycles

- 0.75 mile of new trail (approx 0.6 acres) in 2 spur trails to Potomac River, one spur trail to Farm Creek, and a short trail to Neabsco Creek. All spur trails would be dirt or stone dust

- Up to 4 platforms for observation/photography/fishing (approx 900 sq ft, or .02 acres, each)

Trails would be designed to minimize adverse soils effects, although some compaction or soil loss would occur, especially with development of the estimated 1.1 mile segment of the PHNS Trail. That trail segment is proposed along an existing old road bed, and adjacent to an active railroad line, and would likely be developed with an impermeable surface to accommodate all forms of pedestrian and bicycle access. Monitoring of these more intensive public use areas, and effective signage and brochures to reduce entry to unauthorized areas, would mitigate against any potential for long-term off trail impacts. Nevertheless, there would be long term localized impacts to soils in the footprint of the PHNS Trail and other proposed new refuge foot trails and platforms. The total footprint area to be impacted by new trails and platforms is estimated to be less than 3 acres (or <0.1% of refuge).

As mentioned, the hunt programs, if implemented upon further analysis and approval, would lead to off-trail effects. However, given the limited number of hunters that would be accommodated and well-dispersed across the refuge during the hunting season, the impacts would be minimal based on our monitoring and field observations of hunting impacts on other refuge units. Monitoring of these uses would identify where there might be problems with soil erosion and corrective measures would be taken.

The fishing program would be allowed only at designated locations. Unauthorized fishing along the creek banks and river shoreline might cause erosion, but instances should diminish compared to the current situation because of the increased presence of VDGIF and Service staff, warning signage, and members of the public who are likely to warn the offenders or report their presence to staff.

Administrative access and maintenance equipment may lead to localized soil compaction and short term soil losses from erosion, but we would employ best management practices, such as not operating in saturated soil conditions, to ensure that no long term, major soil problems—such as unchecked erosion—result. All Federal, State, and local permits applicable to constructing trails on refuge lands would be obtained before activities begin.

Forest Habitat Impacts

The forest habitats of the refuge provide a diversity of habitat components to support breeding birds and other wildlife. We evaluated the benefits and adverse impacts of the management actions under the three alternatives on forest habitats.

We considered the benefits from:

- Controlling invasive plants
- Fuels management

We considered the potential for adverse impacts from:

- Unhealthy forest conditions
- Facilities construction and maintenance

Forest Habitat Impacts That Would Not Vary by Alternative

Benefits
Regardless of alternative selected, forest habitat would continue to be protected on the refuge to contribute to what remains of intact native riverine forest habitat along the Potomac River. Thus, the refuge would retain its value to migratory birds and other native forest wildlife, while elsewhere in rapidly developing northern Virginia; those values are being lost or degraded. Wherever practicable, we would control non-native plant species and encourage native forest species capable of growing under the current site conditions in an effort to restore the ecological integrity and diversity of the refuge.

Adverse Impacts
Regardless of which alternative we select to manage the refuge, certain activities may affect forest habitat at various levels depending on the alternative:

- Use of mechanical and herbicide treatments to control invasive plants
- Refuge infrastructure maintenance and improvements (e.g. roads and trails)

The impacts of controlling invasive plants were discussed previously in the section on Soils. Our long-term concern with invasive plants is that once established, they can out-compete native plants, thereby altering habitats and impacting wildlife. We would continue work on controlling invasive plants and establishing native forest species capable of growing under the current site conditions in an effort to restore the ecological integrity and diversity of the refuge. Control measures would be implemented using strict procedures and protocols so as not to affect non-target resources or otherwise degrade wildlife habitat. The alternatives would vary in terms of the extent and frequency of using control practices

Alternative A. Current Management

Benefits
Under alternative A, benefits would be limited to protection of refuge lands. Priorities would continue to be maintaining forest cover. Protection of the existing forested upland and wetlands under this alternative is assured through Service management and conservation.

Adverse Impacts
There would continue to be some minimal level of risk of loss or damage to forest vegetation from invasive plant control as described above. Because of its toxicity to trees, imazapyr would not be used to control *Phragmites* or other invasive plant species where there is a risk of trees being inadvertently sprayed. Herbicides would be used only under strict application precautions to ensure that only the targeted plants are affected.

Routine maintenance of the administrative access road may result in the loss of individual trees, but we do not expect the number of trees felled would affect the quality or diversity of forest habitat present.

Since no public access would be allowed, there would be no impacts from visitor activities. Impacts to forest regeneration from deer overbrowsing would continue, and hunting would not be an option for their control.

Alternative B. Enhanced Management

Benefits
Forested upland and wetland habitats would be better protected under alternative B because of the increased presence of staff required to implement public access and maintain refuge habitat and visitor programs. Should a hunt program be pursued after further analysis and approval, forest health would also benefit from implementation of a deer hunt because deer in the area are known to be an important factor in suppressing forest regeneration. A deer hunt would

allow for direct control of deer should forest regeneration become problematic for maintaining forest health.

Adverse Impacts
Providing public access and establishing public infrastructure on the refuge may involve cutting of individual trees. This effect would be minimal because we plan to use the old railroad roadbed as part of the new PHNS Trail footprint and we would otherwise orient other new sections of trail to avoid having to cut trees. The loss of trees predicted would not affect the quality or diversity of forest habitat present. At the most, 3 acres would be impacted (0.1% of refuge acres).

A long-term concern with allowing public acces is the potential for refuge visitors to unintentionally introduce and/or spread invasive species. Once established, invasive plants can out-compete native plants, thereby altering habitats and impacting wildlife. This is especially a concern with hunters because they move through portions of the refuge not generally accessible to other visitors. The threat of invasive plant establishment will likely continue to be an issue over the long term and will require annual monitoring, treatment and hunter and visitor education.

Wetland Impacts

The Service currently manages about 220 acres of forested and emergent wetlands and 25 acres of open water on the refuge. The refuge wetlands and open water habitats support reproductive habitat for fish and other aquatic species, wading and waterbirds foraging areas, and resting and foraging areas for waterfowl. Protection of the refuge wetlands is also very important to maintaining the integrity of the refuge shoreline because they buffer the erosive effects of the river and Farm Creek. We evaluated the benefits and adverse impacts of the management actions under the three CCP alternatives on these wetlands.

We considered the benefits from:

- Protecting wetland habitat
- Maintaining a forested upland buffer
- Treating invasive species

We considered the potential adverse impacts of:

- Wetlands habitat management activities
- Adjacent upland habitat management activities
- Trail and platform construction and maintenance
- Unauthorized public access to wetlands

Wetland Impacts That Would Not Vary by Alternative

Benefits
Regardless of the management alternative we select, we would continue to conserve these wetlands and the wildlife they support as one of our highest priorities. We would also continue to monitor the area for external threats and conduct periodic trash removal using volunteers.

Adverse Impacts
The refuge would continue to address potential harm from unauthorized refuge uses. In particular, unauthorized fishing may adversely affect the wetlands and associated species. Law enforcement issues related to fishing include littering, illegal trespass and fires. Discarded fishing line and other fishing litter can entangle migratory birds and mammals and cause injury and death (Gregory, 1991). Additionally, litter affects water quality which may harm aquatic plants,

invertebrates, and fish. Litter may also affect the visual experience of refuge visitors (Marion and Lime, 1986).

Alternative A. Current Management

Benefits
Management of the refuge wetlands under alternative A would continue to conserve the values discussed above, though improvements in management and protection of these wetland areas would be limited. Management would include treating invasive *Phragmites,* and working with volunteers and partners to restore the marsh to native species to the extent feasible based on staff and funding.

Adverse Impacts
There would be negligible direct impacts to refuge wetlands under alternative A. The current acreage of wetlands would be maintained. There would be no alteration of these habitats by cutting, filling, or other means to achieve any other Service goals and objectives.

The refuge wetlands may be at some negligible risk of being indirectly affected by Service activities in upland areas; however, given the limited activities occurring, and the fact we have a leak and spill prevention and emergency procedures in place, should insure that such occurrences are rare and are addressed immediately, with short-term effects limited to the immediate location.

Alternative B. Enhanced Management

Benefits
Benefits to wetland habitat and wetland-dependant wildlife species would increase under alternative B as compared to alternative A. First, both the Service and VDGIF, through their cooperative management of hunting and fishing programs, would provide a greater management presence on the refuge thereby reducing incidents of unauthorized uses, particularly unauthorized fishing, that are likely to harm the wetlands. Second, projects to protect refuge shorelines and creek banks would be more actively pursued with partners under alternative B, which in turn, would further enhance wetlands habitat.

Adverse Impacts
The impacts to the emergent wetlands and forested wetlands currently managed on the refuge would be predicted to be negligible under alternative B. The impacts of installing trails and platforms near the water would be temporary and short-term, with some localized turbidity and some minimal loss of wetlands plants, but no substantive habitat alteration or degradation would occur.

Authorized visitation on designated trails has the potential to create additional impact from unauthorized off-trail movement, but we would be vigilant in monitoring that use to insure this is kept to a minimum. Should a hunt program be implemented after further analysis and approval, some impacts from hunting would likely occur, but with establishing designated hunting areas and clear regulations on low impact hunting in sensitive wetland areas (e.g. boat and blind anchoring and shoreline access), those impacts should be kept to a minimum. Impacts to wildlife from discarded fishing line and litter would still occur to some degree, even under an authorized fishing program, but would be mitigated under this alternative with implementation of a Monofilament Recovery and Recycling Program at refuge designated fishing areas.

As with alternative A, chemical or oil leak and spill prevention and emergency clean-up procedures should ensure that such occurrences are rare and are addressed immediately, with effects limited to the immediate location.

Impacts to Birds

Featherstone Refuge supports breeding forest dependent birds as well as wetland dependent species. Bald eagles are known to have nested in the vicinity in recent years. The refuge also provides habitat for other breeding and wintering raptors, neo-tropical migrants, waterbirds, and migrating waterfowl.

Bird Impacts That Would Not Vary by Alternative

Benefits
Continued protection of refuge lands under both alternatives would generally benefit birds that use the refuge to breed or winter or migrate through. The bald eagle, which is documented nesting in the vicinity of the refuge and may forage and roost on the refuge, was recently removed from the Federal list of threatened and endangered species. Nevertheless, we would protect nesting and foraging bald eagles should they establish on the refuge under both alternatives.

Adverse Impacts
Regardless of alternative selected, breeding, wintering, and migrating birds may be adversely affected by management methods, such as mowing and the use of herbicides to control invasive plants. These methods would displace birds from treated locations and if any active nests are present they could be damaged or destroyed. The impacts would be minor, highly localized and short-term with no threats to bird populations in terms of adult mortality or breeding success. Treated habitats would be improved over the long term and this would benefit bird populations.

Special use permits would continue to be issued on a limited basis to organizations conducting environmental education or interpretive and/or wildlife observation and photography tours or activities on the refuge. The areas used by such tours will be closely monitored to evaluate the impacts on the resource; if adverse impacts appear, the activity would be moved to secondary locations or curtailed or discontinued. Specific conditions may apply depending upon the requested activity and would be addressed through the special use permit.


Bill Wallen

Water pipit

Research activities that would be supported under all the alternatives may disturb fish and wildlife through observation, a variety of wildlife capture techniques, banding, and accessing the study area by foot or vehicle. For example, the presence of researchers may cause disruption of birds on nests or breeding territories, or increase predation on nests. Efforts to capture birds may cause disturbance, injury, or death to groups or to individual birds. The energy cost of disturbance may be appreciable in terms of disruption of feeding, displacement from preferred habitat, and the added energy expended to avoid disturbance. It is possible that direct or indirect mortality could result as a by-product of research activities. Mist-netting or other wildlife capture techniques, for example, may cause mortality directly through the capture method or in-trap predation, and indirectly through capture injury or stress caused to the organism. Stipulations in Refuge special use permits issued for these activities would include a provision that mortality due to research activities would not exceed that allowed in the required Federal take permit issued by the Migratory Bird program.

Alternative A. Current Management

Benefits
Under alternative A, we would continue to benefit refuge bird species by managing for and permanently protecting 80 acres of upland forest, 220 acres of forested and emergent wetland, and 25 acres of open water habitat over the long term.

Adverse Impacts
There would be short-term localized impacts to bird habitat and temporary displacement of birds from management practices such as mowing or herbicide treatments for invasive plant control.

Alternative B. Enhanced Management

Benefits

Benefits to birds would increase under this alternative compared to alternative A. We would continue to protect the 80 acres of upland forest, 220 acres of forested and emergent wetlands, and 25 acres of open water habitat over the long term. And, through VDGIF and our presence combined, we would better address the issues of illegal trespass, vandalism, and deposition of trash that damage bird habitat and disturb nesting and foraging birds.

If a deer hunt is pursued after further analysis and approval, it would help reduce deer overbrowsing of forest regeneration and other understory vegetation to the benefit of forest birds. Overbrowing reduces the forest physical structure and diversity. Casey and Hein (1983) have found greatly reduced bird species diversity in areas with long term, high density populations of deer. These changes were mainly attributed to habitual landscape alteration with pronounced browse line and sparse cover caused by overbrowsing.

DeCalesta (1997) also found that deer browsing affects vegetation that songbirds need for foraging surfaces, escape cover, and nesting. DeCalesta noted that species richness and abundance of intermediate canopy nesting songbirds was reduced in areas with higher deer density. Intermediate canopy-nesting birds declined 37 percent in abundance and 27 percent in species diversity at higher deer densities. Five species of birds were found to disappear at densities of 38.1 deer per square mile and another two disappeared at 63.7 deer per square mile. Casey and Hein (1983) found that three species of birds were lost in a research preserve stocked with high densities of ungulates and that the densities of several other species of birds were lower than in an adjacent areas with lower deer density.

Adverse Impacts

Habitat management methods used to maintain or restore habitats or prevent encroachment of invasive species may affect individual birds. These activities would at least temporarily disturb or displace birds from treatment areas, because of the disturbance from human activity and equipment. Also, if any nests are present near treatment areas, they might be damaged or destroyed by equipment. However, given that mowing and brush cutting occur on a rotational basis, would not result in a habitat type conversion, and avoids sensitive areas during the bird nesting season, the impacts are predicted to be minor, highly localized and short-term with no long-term threats to the long-term viability of bird populations due to adult bird mortality or breeding failure. No significant loss of habitat would occur from management, and we predict that birds would come back to the area within days of management activities.

Trail and platform construction and maintenance projects proposed under alternative B, would cause disturbance to birds, but affect less than 3 acres of natural habitat. There would be some removal of vegetation to place any new trails, kiosk, and observation platforms; however, all would sited where minimal disturbance to vegetation and loss of bird habitat would occur.

Refuge visitor activities may disturb birds, occasionally to the point of abandonment, along roads and trails, especially where there is concentrated human activity. However, not all bird species are impacted similarly, and documented sensitivity to human presence ranges widely.

Gutzwiller et al. (1994) found that singing behavior of some songbird species was altered by low levels of human intrusion. Some studies have found that some bird species habituate to repeated intrusion; frequently disturbed individuals of some species have been found to vocalize more aggressively, have higher body masses,

or tend to remain in place longer (Cairns and McLaren, 1980). Disturbance may affect the reproductive fitness of males by hampering territory defense, male attraction and other reproductive functions of song (Arrese, 1987). Disturbance, which leads to reduced singing activity, would make males rely more heavily on physical deterrents in defending territories which are time and energy consuming (Ewald and Carpenter, 1978).

Travel routes can disturb wildlife outside the immediate trail corridor (Miller et al., 2001). Miller et al. (1998) found bird abundance and nesting activities (including nest success) increased as distance from a recreational trail increased in both grassland and forested habitats. Bird communities in this study were apparently affected by the presence of recreational trails, where "generalists" (American robins) were found near trails and "specialist" species (grasshopper sparrows) were found farther from trails. Nest predation was also found to be greater near trails (Miller et al., 1998).

Disturbance can cause shifts in habitat use, abandonment of habitat and increase energy demands on affected wildlife (Knight and Cole, 1991). Flight in response to disturbance can lower nesting productivity and cause disease and death. Hammitt and Cole (1998) conclude that the frequent presence of humans in "wildland" areas can dramatically change the normal behavior of wildlife mostly through "unintentional harassment."

Seasonal sensitivities can compound the effect of disturbance on wildlife. Examples include regularly flushing birds during nesting. The Delaware Natural Heritage Program, Division of Fish & Wildlife and the Department of Natural Resources and Environmental Control prepared a document on the "The Effects of Recreation on Birds: A Literature Review" which was completed in April of 1999. The following information was obtained from that document:

Several studies have examined the effects of recreationists on birds using shallow-water habitats adjacent to trails and roads through wildlife refuges and coastal habitats in the eastern United States (Burger, 1981; Klein 1993; Burger et al., 1995; Klein et al., 1995; Rodgers & Smith, 1995, 1997; Burger & Gochfeld, 1998). Overall, the existing research clearly demonstrates that disturbance from recreation activities always has at least temporary effects on the behavior and movement of birds within a habitat or localized area (Burger, 1981, 1986; Klein, 1993; Burger et al., 1995; Klein et al., 1995; Rodgers & Smith, 1997; Burger & Gochfeld, 1998). The findings that were reported in these studies are summarized below in terms of visitor activity and avian response to disturbance.

- Presence: Birds avoided places where people were present and when visitor activity was high (Burger, 1981; Klein et al., 1995; Burger & Gochfeld, 1998).

- Distance: Disturbance increased with decreased distance between visitors and (Burger, 1986), though exact measurements were not reported.

- Approach Angle: Visitors directly approaching birds on foot caused more disturbance than visitors driving by in vehicles, stopping vehicles near birds, and stopping vehicles and getting out without approaching birds (Klein, 1993). Direct approaches may also cause greater disturbance than tangential approaches to birds (Burger & Gochfeld, 1981; Burger et al., 1995; Knight & Cole, 1995; Rodgers & Smith, 1995, 1997).

- Type and Speed of Activity: Joggers and landscapers caused birds to flush more than fishermen, clammers, sunbathers, and some pedestrians, possibly because the former groups move quickly (joggers) or create more noise

(landscapers). The latter groups tend to move more slowly or stay in one place for longer periods, and thus birds likely perceive these activities as less threatening (Burger, 1981, 1986; Burger et al., 1995; Knight and Cole, 1995). Alternatively, birds may tolerate passing by with unabated speed whereas if the activity stops or slacks birds may flush (Burger et al., 1995).

- Noise: Noise caused by visitors resulted in increased levels of disturbance (Burger, 1986; Klein 1993; Burger & Gochfeld, 1998), though noise was not correlated with visitor group size (Burger & Gochfeld, 1998).

Dogs on-leash on designated trails would be allowed. Even if dogs do not give chase to wildlife, studies show that dog presence can cause disturbance to wildlife species in the form of disruption, harassment, and displacement (Sime 1999). Dogs extend the zone of impact from an individual visitor, especially if the dogs are off leash or running, barking, or jumping. Dogs alone may less of a threat to songbirds than dogs with people, as indicated in two studies, as the authors surmised that songbirds viewed the dogs as a coyote or fox (Leach and Frazier 1953, Andelt et al 1987). Leashed or not, disturbance from dogs was noted to be greater off trail than on trail.

The effects of human visitation on wading and waterbirds have been studied at J.N. "Ding" Darling National Wildlife Refuge in Florida. Klein (1989) found resident wading and waterbirds to be less sensitive to disturbance than migrant birds. Klein also found that sensitivity varied according to species, and would differ among individuals within species. Ardeids (herons, egrets and bitterns) as a family of birds were generally tolerant of people, although appeared less tolerant and were more likely to be disturbed when they were hunting prey. Within that family of birds, great blue herons, tricolored herons, great egrets, and little blue herons were observed to be disturbed to the point of flight more than other birds. Kushlan (1978) found that when these birds move frequently while feeding, it is more likely to disrupt interspecific and intraspecific relationships. In addition, Batten (1977) and Burger (1981) found that wading birds were extremely sensitive to disturbance. Klein (1993), in studying waterbird response to human disturbance, found that as intensity of disturbance increased, avoidance response by the birds increased. He also found that out-of-vehicle activity is more disruptive than vehicular traffic. Freddy et al. (1986) and Vaske (1983) also found this to be true. Burger (1981) found various gull species to be apparently insensitive to human disturbance, while Klein (1989) also found this true of gulls, and found the same results with sandpipers.

McNeil et al. (1992) found that many waterfowl species avoid disturbance by feeding at night instead of during the day. Klein (1989) found migratory dabbling ducks to be the most sensitive to disturbance and migrant ducks to be more sensitive when they first arrived in the late fall, than later in winter. Disturbance may displace individual waterfowl to other parts of the refuge; however, this disturbance would be limited in scope due to the limited number of areas accessible to visitors.

Should waterfowl hunting be approved in the future, associated boat activity could cause disturbance to wading and water birds and waterfowl. Recreational fishing opportunities along the shoreline may also cause temporary disturbances such as the flushing of feeding, resting, or nesting birds, wintering waterfowl, and other wildlife species.

While all of the above impacts are well-documented, the scope and scale of activities on this refuge are important to keep in mind. Of the 325 acres, less than 3 acres would be exposed to authorized public access on land, including fishing from designated areas on the shore. The only exception is additional areas

that would be open to hunting during fall if a hunt program is implemented in the future upon further analysis and approval. Deer hunting, however, would occur after bird nesting season and when many migratory birds have already left the area. If waterfowl hunting is approved in the future, Farm Creek could be accessed by waterfowl hunters in boats or blinds. This would likely cause additional impact to birds on or near the water, but the extent of that impact would be described in the separate NEPA analysis planned for evaluating a hunt program.

We would take all necessary measures to mitigate these effects and avoid or minimize long-term impacts. Sensitive bird areas, such as bald eagle nesting sites and wintering waterfowl concentration areas, would continue to be closed to public access when necessary for their protection. When group activities are planned, they would be held in areas and during seasons where minimal impact would occur. Periodic evaluation of sites and programs will be conducted to assess if objectives are being met and to prevent site degradation. If evidence of unacceptable adverse impacts appears, the location(s) of activities would be rotated with secondary sites, curtailed or discontinued. Refuge regulations will be posted and enforced. Closed areas will be established, posted and enforced. The known presence of a threatened or endangered species would preclude the use of an area until the Refuge Manager determines otherwise.

Special use permits would continue to be issued to organizations conducting environmental education or interpretive and/or wildlife observation and photography tours or activities on the refuge. The areas used by such tours would continue to be closely monitored to evaluate the impacts on the resource. If adverse impacts appear, the activity would be moved to secondary locations, curtailed or discontinued. Specific conditions may apply depending upon the requested activity and would be addressed through the special use permit.

All photographers would continue to be required to follow refuge regulations. Photographers allowed via special use permit into closed areas must follow the conditions outlined in the permit which normally includes notification of refuge personnel each time any activities occur in closed areas. No baits, calls, or scents would be allowed. All litter would have to be removed daily. Law enforcement patrol of public use areas would continue to minimize the above-mentioned types of violations.

Allowing public access would raise awareness of the refuge, its resources and the Refuge System mission. This awareness and knowledge may improve the willingness of the public to support refuge programs, resources, and compliance with regulations. In the event of persistent disturbance to habitat or to wildlife the activity would be restricted or discontinued. Disturbance of birds would also increase because of the newly authorized visitation. However, these effects would be more than offset by the overall protection afforded these birds on refuge lands.

Impacts to Other Native Wildlife

Native mammals at the refuge—including white-tailed deer, beaver, muskrats, woodchucks, squirrels, bats, shrews, and mice—are an integral part of the natural ecosystems we work to sustain on the refuge, and their presence reflects the refuge's biological diversity, integrity and environmental health. Many of the small mammals are particularly important as they are the prey base for diurnal and nocturnal raptors.

Reptiles and amphibians are also important components of diversity on the refuge. Amphibians documented or suspected on the refuge are relatively common in the region; none are listed as species of greatest conservation need by

the State of Virginia. However, three reptiles that may occur on the refuge are listed as species of global conservation need (GCN) by VDGIF: the spotted turtle (Tier III species), eastern box turtle (Tier III species), and eastern hognose snake (Tier IV species).

The refuge and adjacent riverine habitat are also host to a wide variety of invertebrate species, from the butterflies and spiders that populate our forested, grassland, and shrubby areas to the freshwater mussels and aquatic arthropods in the shallow waters of the marshes. Invertebrates are critical food items for insectivorous birds, bats, moles, shrews, raccoons, fish, and a number of other refuge wildlife species. This great diversity of species provides a major portion of the food biomass on which other native wildlife species depend. While a number of invertebrate species are rare or declining in Virginia, none are known on the refuge. One species, the dwarf wedgemussel (*Alasmidonta heterodon*), is Federal-listed as an endangered invertebrate species and is documented in Prince William County. We would continue to be on the lookout for its presence.

Pollinating insects are a group of particular and increasing concern by the Service. Insect pollinators support native plant food production, contribute to nutrient recycling, and serve as direct prey for migrating and breeding birds. They include butterflies and moths (*Lepidoptera*), bees and wasps (*Hymenoptera*), beetles, (*Coleoptera*) and flies (*Diptera*). Concern about the decline of pollinators, especially of wild native insect species, has prompted the Service to collaborate with the North America Pollinator Protection Campaign (NAPPC). The Refuge System is taking a lead in conserving pollinators, recognized as the guardians of biological integrity, diversity, and environmental health of natural ecosystems (Higgins & Adamcik 2006). We are including insect pollinator conservation in future refuge habitat management planning, strategies, and conservation actions.

We considered the benefits from:

- Protection of diverse refuge habitats
- Measures to improve water quality
- We considered the potential for adverse effects from:
- Refuge habitat management activities
- Construction or maintenance projects
- Public use and access

Native Wildlife Impacts That Would Not Vary by Alternative

Benefits
Regardless of which alternative we select, we would continue to provide a natural landscape with required habitats to support the mammalian, amphibian, reptile and invertebrate species found here. Vernal pools, wildlife cavity trees, snags and downed logs are important stand-level features that would be protected to the benefit of many species. The conservation of Federal trust species and species of conservation concern in Virginia would continue to be a priority for our management.

Adverse Impacts
Refuge habitat management activities using mechanical equipment may kill individual small mammals, such as mice, moles, and shrews, as well as any amphibians, reptiles, or invertebrates using those locations and would cause temporary disturbance or displacement of others, but there would be no significant mortality or loss of local populations because these actions would be done on a rotational basis meaning, no major habitat components would occur, and we would attempt to avoid animals to the extent possible.

Contaminants that might run-off into refuge wetlands from herbicide-treated areas could adversely affect amphibians and invertebrates. Monitoring and corrective measures would continue to be taken to ensure contaminated run-off does not become a problem.

Alternative A. Current Management

Benefits
Mammalian, reptile, amphibian, and invertebrate species would continue to benefit as we continue to manage a diversity of refuge habitats for the benefit of wildlife under alternative A.

Adverse Impacts
The potential adverse impacts noted above for both alternatives would pertain to alternative A.

Mowing or herbicide use would occasionally injure or kill individual animals less mobile in treatment areas.

We would remove problem animals, such as beaver, through lethal means only when necessary. Outreach and education programs would continue to be used to inform the general public and nearby landowners of the need for and ecological soundness of animal damage control measures.

Alternative B. Enhanced Management

Benefits
Mammals, reptiles, amphibians, and invertebrate species would continue to benefit from the permanent protection of a diversity of habitats afforded under alternative B.

Adverse Impacts
Refuge visitors may impose minor negative impacts on vegetation and wildlife as previously described affecting wildlife habitat. Visitors on designated trails also could disturb wildlife that are sensitive to human presence. Those wildlife disturbances typically result in a temporary displacement without long-term effects on individuals or populations. Some species would avoid the areas people frequent, such as the developed trails, while others may be unaffected by or even drawn to the presence of humans. Roads and trails can be barriers to movement for some species. For example, salamanders may not cross openings that are too wide or that consist of dry bare ground (Vinson 1998). Gravel roads or trails, even if permeable, may act as a barrier to salamander movement (Marsh et al 2005). Refuge trails would likely be surfaced with dirt or stone dust, except for the possibility of the PHNS Trail which may be a more hardened surface such as asphalt. Disturbance to basking turtles may also occur where trails come into proximity to ponded water or the marsh habitat. However, trail loations would be designed to minimize crossing wet areas and small ravines that would be favored by salamanders, and minimize access to open water where basking turtles may be present. Vernal pools, which are important to many native amphibians and reptiles, would be avoided when maintaining or constructing trails and facilities.

Dogs may also cause disturbance to many wildlife, even when on a leash. We described some of the potential impact from dogs in the section above on ‘Forest birds.” In addition to what is described there, studies have shown that ungulates, such as deer, respond to the presence of dogs by running, which can be very stressful and expend a lot of energy. Ungulates demonstrated more pronounced reactions to unanticipated disturbances, such as dogs off leash.

Long term impacts would primarily be confined to trail footprints and their immediate vicinity, which would comprise approximately 3 acres. The remainder of the refuge would be closed, unless our separate NEPA analysis for a hunt

program results in its approval, and we implement a deer hunting season that allows hunters to traverse the majority of the refuge. Impacts to native wildlife could occur during a fall deer hunting season. Non-target species in the pathway of hunters tracking deer may be temporarily disturbed and frightened or forced to flee. We predict that rarely would mortality occur to non-target, less mobile species as a result of hunters walking through the woods. And, more often, mobile wildlife would just temporarily move from the path of hunters, but not permanently leave the area. Hibernation or torpor by reptiles and amphibians limits their activity during the hunting season when temperatures are low, so risk to those individuals is predicted to be minimal. In our observations, hunters rarely encounter reptiles and amphibians during most of the hunting season. Insect populations are also diminished during the cooler fall temperatures and their populations would be at low risk. Some small mammals may be active depending on the weather conditions, but like reptiles and amphibians, many will be starting to hibernate in burrows, under logs, or in trees, during the fall.

Deer hunting would necessarily result in deer mortality. However, deer are abundant across their range and in many areas, including northern Virginia, deer degrade habitat values due to their overabundance, and the limited deer hunting that might occur on the refuge would not affect their overall population. We would adhere to State seasons which account for species populations and trends so there would be no long term threat to deer populations from hunting on the refuge.

An indirect long term impact is the potential for all visitors to unintentionally introduce and/or spread invasive species. Once established, invasive plants can out-compete native plants, thereby altering habitats and adversely affecting wildlife. Those invasive species that pose the biggest threats to native wildlife are those that quickly colonize an area and form dense, monotypic stands. However, over the long term, we would try to mitigate these impacts through regular treatment of invasive plants. In that way we hope to benefit native wildlife by maintaining the balance of food resources and native vegetative communities with which they evolved or adapted for cover, nesting, and quality food resources. The threat of invasive plant establishment will likely continue to be an issue over the long term and will require annual monitoring, treatment and public education.

Archaeological and Historic Resources Impacts

The Service recognizes the importance of continued compliance with the National Historic Preservation Act, and other Federal laws and mandates protecting these resources, to ensure that known sites are protected and that any sites found in the course of refuge management and public use are properly addressed.

Archaeological and Historic Resources Impacts That Would Not Vary by Alternative

Benefits
Areas that are likely to contain archaeological or historic resources would be protected regardless of which alternative we select. We would continue to conduct outreach and education, and use law enforcement if necessary, to protect against loss or damage to these resources.

Adverse Impacts
Increased visitation and opportunities for consumptive and non-consumptive uses would also increase the likelihood of damage or disturbance of cultural and historic resources on the refuge. However, those effects should not be significant, since all public uses except hunting would occur in designated areas on the refuge, such as refuge trails. Hunting would not involve ground disturbance. We would take all necessary precautions to identify and preserve properties that are eligible for listing on National Register of Historic Places. This EA will be sent to the Virginia SHPO for review of NHPA Section 106 compliance, and we will also continue to do Section 106 compliance for all individual projects.

Alternative A. Current Management

Benefits
Continued Service protection of refuge lands would benefit cultural resources by ensuring that none of the substantial impacts related to development for other uses would affect known or unrecorded archaeological or historic resources on those lands.

Adverse Impacts
Unauthorized entry and use of the refuge under current management would continue to occur. With a reduced Service and public presence, the risk of impacts to archaeological and historic resources is potentially greater than under the other alternatives.

Alternative B. Enhanced Management

Benefits
There would be increased benefits to archaeological and historic resources under alternative B because of our increased partnering efforts to locate and protect those resources, particularly those at high risk of damage along the refuge shoreline, and because we would seek to foster greater appreciation of their value by the general public. Under alternative B, we would plan to work with State, County and professional archaeological societies willing to assist in performing surface surveys of selected refuge sites and the shoreline to locate archaeological resources at risk. We plan to ensure that archaeological and historic resources are protected from looting, and we would develop site management and protection plans as warranted. At least one law enforcement staff person would receive ARPA training.

Adverse Impacts
Increased visitation with its opportunities for consumptive and non-consumptive uses would also increase the likelihood of damage or disturbance of archaeological and historic resources on the refuge. However, those effects should not be significant, since almost all public uses would occur in specific footprints on the refuge, such as refuge trails. We would perform archaeological reviews, surveys, or studies of project areas as needed or recommended by the Service's Regional Archeologist and consult with the Virginia SHPO regarding refuge undertakings that have potential to affect archaeological resources. We would monitor known sites on the refuge to protect from looting and other ARPA violations.

Impacts On or Between Refuge Users

The alternatives differ greatly in providing opportunities for compatible public uses, in particular, those that are considered priority uses of the Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57).

In this section we evaluate this difference in visitor opportunity between the alternatives, including predicting the interaction among and between visitors engaged in proposed refuge programs. The potential impacts that visitors would have on natural and physical resources from proposed visitor programs are described under respective headings for those natural and physical resources.

There are some other refuge uses that have frequently been requested by individuals have been determined not appropriate and are not analyzed further. Appendix B—Findings of Appropriateness and Compatibility Determinations provides documentation for uses allowed and denied. Activities not allowed include horseback riding, berry picking, mushroom harvesting, flower picking, and medicinal harvesting, bicycling off designated trails, jogging, non-wildlife dependent group gatherings group activities, organized or facility-supported picnicking, swimming and sunbathing.

Use Impacts that would not vary by Alternative

Benefits
Regardless of the alternative, we would continue to allow partner led, organized group wildlife observation and photography opportunities on a limited basis under special use permit.

Adverse Impacts
Some local residents, especially refuge neighbors, would continue to be frustrated by restricted or limited access. Some residents view the refuge as a public space that should be used and open to all for a wide range of activities, similar to a town or State park.

Alternative A—Current Management

Benefits
Public benefits would continue to be limited to those few members of the public who visit as part of an organized group under special use permit to observe and photograph wildlife.

Adverse Impacts
This alternative would continue to prohibit access to the general public, except as noted above for organized groups under a special use permit. This closure, which has been in place since the refuge was established, has caused frustration to many, especially neighbors, who would like to opportunistically walk the old road to observe and photograph wildlife or access the shoreline for fishing. Fishing access, in particular, is the most desired activity as evidenced by reports or observations by law enforcement. Demand for this activity is high and this alternative would not meet that demand in any way. In addition, the lack of access, outreach, or information exchange on site misses an opportunity to raise awareness and interest in the Refuge System or the important natural resources conserved by this refuge.

Alternative B. Enhanced Management

Benefits
Benefits to the public would greatly increase under alternative B with our proposal to provide trail access for wildlife observation and nature photography, and to allow fishing at up to four designated sites. Limited interpretation and environmental education programs would also occur. These activities on public lands are highly sought after in the highly developed setting of Northern Virginia. With increased Service and authorized public access, we predict there would be fewer incidences of trespassing and unauthorized activities, such as dumping waste, on refuge lands. We also propose to evaluate, within 5 years, a proposal to open the refuge to hunting consistent with state seasons in partnership with VDGIF. Hunting opportunities are widely sought after in this area since so few public opportunities exist.

Another benefit is that increasing public involvement on the refuge would result in a better appreciation and more complete understanding of refuge wildlife and habitats, which in turn, translates into more widespread, stronger support for the Refuge Complex, the Refuge System, and the Service. There is no substitute for visitors to be able to observe and experience wildlife in their natural habitats in person, and to learn about wildlife and wild lands at their own pace in an unstructured environment. We would develop refuge facilities so they are safe and aesthetically pleasing, including foot trails and platforms for observation, photography and fishing.

Adverse Impacts
While public access to new programs would occur, seasonal area closures to protect wildlife from disturbance during sensitive times of the year may be necessary. Some people may be frustrated by this limited access, but we would expect most people to understand the need and value of this inconvenience.

Establishing visitor programs on a refuge that is only 325 acres may require partitioning of uses to certain areas, times of day, day of week, or season to accommodate safety and minimize inter-user conflicts. Other short, temporary closures may need to occur at other times to clean up, repair, or maintain trails and infrastructure. In our experience with managing a refuge, this latter inconvenience is not likely to be a significant concern as long as it is not a prolonged closure with no outreach or explanation given. Hunting is the activity most likely to impact other refuge visitors, especially if a deer hunt is pursued. Those user groups that are not accommodated at any given time would likely become frustrated if they are not alerted to restrictions in advance, or do not support the activity causing the closure.

Cumulative Impacts

According to the Council on Environmental Quality NEPA implementing regulations at 40 CFR 1508.7, a "cumulative impact" is the impact on the environment which results 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 can result from individually minor but collectively significant actions taking place over a period of time.

This cumulative impacts assessment includes other agencies' or organizations' actions if they are interrelated and influence the same environment. Thus, this analysis considers the interaction of activities at Featherstone Refuge with other actions occurring over a larger spatial and temporal frame of reference.

Air Quality

Short-term, negligible, localized air quality effects would be expected from air emissions of motor vehicles used by staff and refuge visitors. However, none of the activities on the refuge is expected to contribute to any measurable incremental increase in air pollutant levels. None of the alternatives are expected to cause any greater than negligible cumulative adverse impacts on air quality locally in the vicinity of Featherstone Refuge or regionally.

We predict no cumulative impacts to Class I airsheds from our actions. Visibility concerns due to emission-caused haze, at the nearest Class I airsheds, Shenandoah National Park (Virginia) and Brigantine Wilderness (New Jersey) would not be affected by any of the proposed management alternatives. Prevailing weather patterns from the west would tend to carry air emissions from the refuge and other sources in Prince William County toward Brigantine Wilderness but the distance is so great and the emissions sufficiently limited that they would be completely dispersed before reaching that Class I area.

The combined natural areas along this section of the Potomac River in Federal and State ownership, including the other refuges in the Refuge Complex, and other public lands on Mason Neck peninsula, make important contributions to improving air quality in the region. Maintaining undeveloped lands with native upland and wetland vegetation assures these areas will continue to filter out many other air pollutants harmful to humans and the environment.

Water Quality

There would be no significant adverse cumulative impacts to water quality under any of the alternatives. Best management practices and erosion and sediment control measures would continue to be used in refuge operations and on construction sites to ensure impacts are minimized or avoid soil disturbance and the potential to create erosion and run off. All Federal and State permits required of national wildlife refuges would be secured before activities are initiated.

Similar to our discussion above under air quality, the combined natural areas along this section of the Potomac River in Federal and State ownership make important contributions to improving water quality in the region. Maintaining undeveloped lands with native upland and wetland vegetation assures these areas will continue to filter out many other water pollutants harmful to humans and the environment.

Socioeconomic Resources

Given that there is very little open space or natural lands in the surrounding community, the refuge contributes positively to the quality of life in the area. This contribution would be further enhanced under alternative B if public access occurs. In comparison to other public lands in the region, the refuge would offer opportunities for wildlife observation, nature photography, interpretation, and fishing in natural surroundings and a quiet setting. This is a particular, unique niche of recreational opportunity that the refuge could provide in high quality compared to other ownerships. This niche complements the full range of opportunities, including those that require more development or support larger groups, offered elsewhere on other public ownerships. When considered together, this diversity of recreational types across all public ownerships reflects a significant recreational resource for the region.

Implementation of alternative B would result in other minor beneficial impacts for the local communities near the refuge and in the region as a whole. Public use of the refuge would be expected to result in visitor spending in the local community. Fully funding the additional staffing under alternative B would also make a small, incremental contribution to employment and income in the local community. Construction activities associated with alternative B would contribute to local expenditures for supplies, and possibly labor, but these benefits would likely be insignificant given the local economy. Neither alternative would alter the local or regional demographic characteristics.

Soils

Refuge lands, in combination with other public ownerships and protected, undeveloped lands, significantly contribute to long-term protection of soil productivity in this area of the Tidal Potomac River. Refuge soils are generally in good condition based on field observations, although there are concerns with impacts from adjacent land uses in the area. The refuge is surrounded by a highly urbanized and developed area. We will continue to use best management practices to minimize impacts from our management programs while keeping the remainder of the refuge in native plant communities that may otherwise have been under development if the refuge had not been created. On the refuge, before any ground disturbance occurs, all Federal and State permits required of national wildlife refuges would be secured before activities are initiated.

Protected Habitats and Species

The uplands and wetlands that we would maintain under both alternatives would contribute at least minimally to sustaining important habitats along this section of the Potomac River. When evaluated independently, this 325-acre refuge surrounded by development may not appear to play an important role. However, when considered together with other undeveloped public lands in the area, its contribution to high quality habitats for a wide range of native species in the region increases in importance. The refuge would continue to lead by example among public land agencies in the protection and maintenance of the integrity, diversity and health of habitats that would potentially be lost or severely degraded over the long term given the level of urban development and pressures in the area.

Under alternative B, increased activity would occur on the refuge, including those from an enhanced research and monitoring program, and public recreation. Cumulative impacts from research would only occur if multiple research projects were occurring on the same resources at the same time or if the duration of the research is excessive. No cumulative impacts are expected and the Refuge

Complex Project Leader can control the potential for cumulative impacts through special use permits. Managers retain the option to prohibit research on the refuge which does not contribute to the purposes of the refuge or the mission of the Refuge System, or causes undo resource disturbance or harm.

Under alternative B, public activities on the refuge associated with wildlife observation, nature photography, interpretation, environmental education, and fishing may cause cumulative impacts: minor when considered alone, but important when considered collectively. Our principal concern is repeated disruptions of nesting, resting, or foraging birds. We have not observed significant resource degradation, long-term consequences, or cumulative effects on any of the other refuges with established programs. However, opening refuge lands to public use can often result in littering, vandalism, or other illegal activities on the refuges. In this instance though, opening the refuge to the public is more likely to result in a decrease in damaging impacts because unauthorized uses that are an ongoing problem now would likely decrease under management of public use programs.

Although we do not expect substantial cumulative resource impacts on refuge lands from these five priority uses in the near term, it will be important for refuge staff to monitor those uses and, if necessary, respond to conserve high-quality wildlife resources. Refuge staff, in collaboration with volunteers, will monitor and evaluate the effects of these priorities public uses to discern and respond to any unacceptable impacts on wildlife or habitats. To mitigate those impacts, the refuge will close areas where such birds as eagles are nesting.

Archaeological and Historic Resources

We expect none of the alternatives to have significant adverse cumulative impact on cultural resources on the refuge. Beneficial impacts would occur at various levels, depending on the alternative, because of proposed shoreline erosion monitoring and control efforts, environmental education and interpretation programs, and increased field surveys to identify and protect any discovered sites.

Climate Change

Department of the Interior Secretarial Order 3226 states that "there is a consensus in the international community that global climate change is occurring and that it should be addressed in governmental decision making…This Order ensures that climate change impacts are taken into account in connection with Departmental planning and decision making". Additionally, it calls for the incorporation of climate change into long-term planning documents such as the CCP.

One of the issues in integrating climate change in planning is that the predicted impacts are varied and changing as new information is incorporated into new and improved models. While the magnitude of the impact is uncertain, it is clear is that sea levels will rise, storm events will become more frequent, precipitation rates will change, and daily and seasonal temperatures will be higher (fewer days of freezing and snow cover). This will result in coastal areas becoming inundated, more frequent flooding, wildlife species range shifts, and changes to vegetation and habitat in response to environmental influences. Some of these effects will occur more rapidly than others. Some species of plants and animals, especially those with very specific or narrow environmental or habitat requirements may not be able to adapt fast enough to survive these changes.

To incorporate climate change into planning documents requires management to consider a variety of factors to determine the appropriate response. These include such things as the species, its range and habitat requirements, predicted range shifts, predicted changes in habitat, species status (threatened/

endangered), current refuge management, ability to provide, restore, or enhance habitat for predicted conditions (both locally and regionally), refuge purposes, and the likelihood of having the resources to support the management decision. For each species and/or habitat, management will have three basic options: 1. Do nothing—let the impacts of climate change occur and implement short term actions based on "current conditions" (i.e. manage for 10 to 15 year time blocks); 2. Decide that habitat or species are of critical importance and spend the time and resources needed to maintain existing conditions (i.e. construct dikes to protect existing habitat or land forms or undertake annual restoration of habitat that provides critical nesting habitat); 3. Plan for the effects and implement actions that mitigate some of the impacts (i.e. expand refuge boundaries to offset habitat loss due to sea level rise or implement restoration projects that target habitat that will be more tolerant of predicted conditions).

Each of these options will have an appropriate application in providing for the future of our natural resources but deciding on which option to implement may involve some very difficult decisions which will be complicated as new species or habitat types become imperiled.

In the short term, for the purposes of this CCP, adaptive management principles will be used to help mitigate potential effects of climate change as these effects become more defined. The sea level affecting marsh management (SLAMM) analysis conducted, along with new data on climate change impacts, will be used in the implementation of the objectives in this document. Some objectives may be modified to accommodate the new information. However, since our current management (and proposed management objectives) is focused more on diversity or groups of species as opposed to single species management, we do not expect that integrating climate change impacts will significantly alter the objectives in the CCP.

Over the long term, objectives may change based on more refined impacts and the resulting changes to habitat and species ranges, abundance, and status. However, in general, for Mason Neck Refuge we will continue to manage for mature forest habitat realizing that the species composition of the forest and forest nesting species may change over time. We will continue to pursue protection of the shoreline to mitigate sea level rise due to the significance of the amount of land that can be lost and the contributing impacts on sediment loading, loss of aquatic vegetation and fisheries habitat.

There is a clear possibility that some substantial portion of the wetlands on the Refuge Complex will be impacted by the rising waters of the tidal Potomac River. Due to its lower elevation, this would have a greater impact on Featherstone Refuge. Existing wetlands may become open water or may gradually transform from one type to another (i.e. from forested to emergent marsh). Specific management actions related to this impact will be developed once the extent of wetland loss and impact to trust resources is more defined. In view of that possibility, the Service may seek to begin replacing some of the future lost wildlife values of the refuge with other areas in the Potomac River watershed that could replace these habitats that are vital to Service trust species.

Relationship Between Short-term Uses of the Human Environment and Enhancement of Long-term Productivity

In this section we consider the relationship between local, short-term uses of the human environment and maintaining long-term productivity of the environment. By long-term we mean that the impact would extend beyond the 15-year planning horizon of this draft CCP/EA.

Under all of the alternatives, our primary aim is to maintain or enhance the long-term productivity and sustainability of natural resources on the refuge, in

the Tidal Potomac River Basin, and for migratory birds and interjurisdictional fish and other far ranging species, across the whole range of each of the species. Short term human uses of the refuge are of secondary importance. We allow those uses only if they can be safely supported through access via the PHNS Trail and only if they are compatible with the resource protection goals. The Service strives to protect Federal trust species and the habitats they depend on, as evidenced by the public use restrictions on access and prohibition of types of use other than foot traffic. Outreach and environmental education in alternative B would encourage visitors to be better stewards of our environment.

The dedication of certain areas for new trails on the refuge under alternative B would represent a loss of long-term productivity on a certain few localized areas, but is not considered significant given the comparative refuge size.

In summary, we predict that both of the alternatives would contribute positively to maintaining or enhancing the long-term productivity of the environment.

Unavoidable Adverse Impacts

Unavoidable adverse effects are the effects of those actions that could cause harm to the human environment and that cannot be avoided, even with mitigation measures. There would be some minor, localized short term unavoidable adverse effects associated with trail construction and invasive plant control. Impacts from opening the refuge to certain public activities could also result in some unavoidable effects. However, none of these effects would rise to the level of "significant" and all would be mitigated to some extent. As such, there would be no long-term significant unavoidable adverse impacts that would result under any of the alternatives.

Potential Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those which cannot be reversed, except perhaps in the extreme long term or under unpredictable circumstances. An example of an irreversible commitment is an action which contributes to a species' extinction. Once extinct, it can never be replaced.

In comparison, irretrievable commitments of resources are those which can be reversed, given sufficient time and resources, but represent a loss in production or use for a period of time. An example of an irretrievable commitment is the development of a segment of the PHNS Trail through the refuge. This regional trail along the Potomac River has national status and a significant number of advocates. This proposed segment through the refuge is an important missing link because there are so few options in the area. Once approved and developed on the refuge it would be very difficult to close or relocate it if for some reason it no longer was compatible and was materially affecting wildlife or habitat. While restoration of the trail to native habitat would be technically feasible, it would be a challenge both in the public opinion arena and because of cost.

Environmental Justice

President Clinton signed into Executive Order No. 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" on February 11, 1994, to focus federal attention on the environmental and human health conditions of minority and low income populations, with the goal of achieving environmental protection for all communities.

The order directs federal agencies to develop environmental justice strategies to aid in identifying and addressing disproportionately high, adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations. The order is also intended to promote nondiscrimination in federal programs substantially affecting human health and the environment, and to provide minority and low-income community's access to

public information and participation in matters relating to human health or the environment.

The United States EPA Office of Environmental Justice defines it as follows:

> *"Environmental Justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental law, regulations, and policies. EPA has this goal for all communities and persons across this Nation. It will be achieved when everyone enjoys the same degree of protection from environmental and health hazards and equal access to the decision-making process to have a healthy environment in which to live, learn, and work." (http://www.epa.gov/environmentaljustice)*

We believe, based on our socioeconomic and environmental consequences analysis, that neither of our proposed alternatives would place a disproportionately high, adverse environmental, economic, social, or health effects on minority or low-income persons. Prince William County has a substantial minority population, as well as a small percentage of residents living below the poverty line. However, all identified socioeconomic and environmental impacts would not be localized nor be placed primarily or unequally on minority and low-income populations Persons who reside near Featherstone Refuge and in Prince William County would bear very minor adverse effects and some beneficial effects if the refuge is managed under either of the two proposed alternatives. Adverse impacts, such as anticipated minor increases in traffic and related emissions due to visitation if the refuge is opened to the public as proposed under alternative B, negligible contributions to local mobile source air emissions from refuge equipment and vehicles, would not disproportionately affect minority and low-income populations compared to other segments of the general population. Beneficial impacts include maintaining natural vegetation that improves air and water quality through filtering, paying refuge-revenue sharing payments to the County to offset property tax loses, and providing desired public uses under alternative B.

Before we make any decisions to make major changes in habitat management or the environment we always inform all of our publics, equally, and our programs and facilities are open to all who are willing to adhere to the established Refuge rules and regulations. We do not discriminate in our responses for technical or practical information on conservation issues or when providing technical assistance in managing private lands. Additionally, all refuge uses proposed under alternative B would be open to all members of the public and the refuge does not charge any fees to visitors. The Service is also an equal opportunity employer.

Summary of the Impacts of the Alternatives

The following table 4.3 summarizes the benefits and adverse impacts we described above in chapter 4 for specific resources or programs proposed for Featherstone Refuge under each of the alternatives. For our discussion on cumulative impacts, the relationship between short-term uses of the human environment and enhancement of long-term productivity, unavoidable adverse impacts, potential irreversible and irretrievable commitments of resources, and environmental justice, please refer to the chapter 4 narratives above.

Table 4.3. Summary impact comparison of Featherstone Refuge CCP Alternatives

	Alternative A **Current Management**	**Alternative B** **Enhanced Management**
Regional Air Quality	Natural vegetation on refuge's 80 acres of forested upland and 220 acres of forest and emergent wetland would be maintained. Air quality would benefit from pollution filtering properties of vegetation and protecting land from development that would otherwise contribute attendant sources of pollutant emissions. Some minimal benefits from protecting forest land due to carbon sequestration; trees serve as long-term carbon "sinks" that reduce atmospheric carbon that contributes to global climate change. Refuge would continue energy efficient practices and additional practices adapted as feasible. Staff vehicles and equipment would contribute a negligible amount to local mobile source air emissions and particulates. Refuge contributions would not be measurable when compared to current off-refuge contributions to pollutant levels from surrounding urban setting with transportation sources and land development.	Same benefits as described under alternative A. Trail construction and maintenance activities on approximately 1.85 mile of trail would cause negligible short-term, localized effects from dust and vehicle and equipment exhausts. Vehicle use by both staff and visitors, and increased equipment use by staff, under alternative B would contribute some minimal additional but negligible increment to local mobile source air emissions.
	---------- Air Quality Impacts That Would Not Vary By Alternative ----------	
	Under both alternatives, our management activities should not result in a measurable negative contribution to regional air quality. None of the alternatives would violate EPA standards; all three would comply with the Clean Air Act. There would be no new major stationary or mobile sources of air pollutants at the refuge created under any of the refuge management alternatives. On the contrary, the alternatives range from either continued prohibition on public use to strict limits on refuge uses. Those limits would curtail the potential of contributing man-made sources of emissions by maintaining more than 92 percent of refuge area in natural vegetative cover. The analysis of air quality impacts considered only how the Service's actions at the refuge might affect criteria air pollutants, visibility, and global climate change to a minimal degree, focusing on the potential for localized air quality impacts or improvement. Visibility concerns due to emission-caused haze at the nearest Class I airsheds—Shenandoah National Park in Virginia and Brigantine Wilderness Area in New Jersey—would not be affected by any of the proposed management alternatives. Management actions and public uses at the refuge under both alternatives would contribute a negligible increment to the overall Prince William County, or greater regional, air emissions levels.	

	Alternative A **Current Management**	**Alternative B** **Enhanced Management**
Regional Water Quality, Wetlands, and Aquatic Biota	Long term benefits from protecting 325 acres of natural habitat including forested riparian areas. Vegetation filters runoff from operations on the refuge and adjacent roadways and developed areas. Benefits would also continue with prohibiting public access to the refuge shoreline. Unauthorized public access has the highest likelihood of impacting water quality and aquatic biota over the long-term. Enforcement program attempts to mitigate this concern. Research studies would continue to include stipulations to minimize impacts to shoreline and waterbodies. Lack off-shore shoreline protection measures would continue to subject area to erosion from wind and wave action. Erosion contributes to the river's sediment load and thereby negatively affecting wetlands and aquatic resources and dependent wildlife. Minimal risk from herbicide use to control invasive plants. Any potential risk would be mitigated through proper application procedures, current leak and spill prevention plans, and using only certified herbicides approved by the Regional Contaminants Coordinator.	Compared to alternative A, there would be increased benefits to water quality and aquatic species from enhanced protection of the riparian forest and wetlands. Off shore shoreline protection measures would be pursued with partners in lead. If projects implemented, some temporary adverse impacts associated with additional turbidity and disturbance to wildlife would be expected. Unauthorized activities would be better controlled with increased Service and VDGIF presence and enforcement. We also would more actively engage in efforts with refuge partners to address water quality issues in the Tidal Potomac River Basin. New trail construction, approx 1.85 miles affecting 3 acres, may cause short term localized impacts with potential for sedimentation and turbidity in adjacent waters. Proper site preparation and use of standard mitigation practices would limit the potential for impacts. Under alternative B, direct impacts on fish given proposed new recreational fishing program implemented under state regulations. Some individual fish harvested, but levels are not expected to affect viability of populations. Some impact on fish eating birds due to harvest and through human disturbance. However, impacts expected to be temporary, short term and localized. Under alternative B, we would likely increase the acreage treated with herbicide for invasive plant control so there would be a minimal, but slightly, increased risk for herbicide to contaminate aquatic habitats compared to alternative A. Under alternative B, hunters would present a slightly increased potential for affecting wetland and aquatic biota compared to alternative A if off-trail soil compaction and erosion occurs. Other public users would be restricted to trail and platform access; however, off trail impacts may still occur in the form of soil compaction, and possibly littering. Outreach, education, and enforcement would be increased compared to alternative A, to minimize threats from authorized and unauthorized activities. Potential impacts from research activities same as alternative A.
	---------- Water Quality and Aquatic Biota Impacts That Would Not Vary By Alternative ----------	
	Under both alternatives, no direct, long term adverse impacts to water quality or aquatic species would occur in the vicinity of the refuge or elsewhere in the Potomac River over the long term. We would adhere to all Federal and State regulations, and obtain all permits required for refuge lands, before implementing activities in order to insure compliance with Sections 305(b) and 319 of the Clean Water Act, 33 U.S.C. § 1251 et seq as amended. Refuge lands would continue to benefit water quality in the Basin by excluding development in this area of the watershed and sustaining natural water filtering vegetation, maintaining a forested buffer between Farm Creek and Occoquan Bay and developed areas upslope from the refuge. Because staff entry by vehicle would be limited to the single upland access road, there is a negligible risk to water quality and aquatic biota from leaking petroleum products. Risks from the use of selected low-toxicity chemical herbicides approved for aquatic weed control are low as are risks from herbicide use in adjacent uplands. Leak and spill prevention plans would be kept current under both alternatives.	

	Alternative A **Current Management**	**Alternative B** **Enhanced Management**
Socio-economic	Refuge revenue sharing payments would continue. Limited Service presence benefits neighborhood with helping to enforce against illicit activities, but that presence lowest among the alternatives. Given prohibition on public access, no benefits derived from visitor expenditures in local community. Local community would continue to be frustrated with lack of access. Demand for priority public uses would continue to be unmet. Lack of opportunity for Service to conduct outreach and education about refuge and Refuge System.	Assuming access can be secured; alternative B would increase contributions to local economy compared to alternative A in the form of Refuge and visitor expenditures. For example, proposed refuge trail work would add expenditures to the local economy for labor, materials, and services. Some public demand for recreation would be met by allowing priority public uses. However, some visitors would be impacted with management need to partition uses, and not all the public would approve of new activities. Increased outreach, education and enforcement would help engender a spirit of public stewardship of the refuge which is not now possible, and provide a venue to promote increased understanding and support for the Refuge System.
	---------- Socio-economic Impacts That Would Not Vary By Alternative ----------	
	Under both alternatives, we would continue to make Refuge revenue sharing payments to Prince William County. We would also continue to contribute a negligible amount to the local economy of Woodbridge and other communities near Featherstone Refuge in form of staff jobs, income, and expenditures. Protecting land from development in federal ownership has both advantages and disadvantages. Some economic disadvantage with protection since land could be developed to be more advantageous economically, although potential is limited given Refuge location and wetlands. Others would continue to benefit from presence green space in otherwise highly developed urban setting.	

	Alternative A **Current Management**	**Alternative B** **Enhanced Management**
Soils	Beneficial impacts to refuge soils predicted given protection of vegetation and enforcement against unauthorized activities. However, not all activities would be stopped given limited Service presence. Some continued soil loss along shoreline with wind and water impacts, since no off shore protection planned. Invasive plant control measures, including herbicide applications, could affect soils, but only those approved by Regional Contaminants Coordinator would be used.	Benefits from protecting native vegetation would be similar to alternative A. Outreach, education, and enforcement programs would be increased to help minimize authorized and unauthorized visitor impacts. Refuge visitor program would increase the likelihood of disturbance and compaction of soils in areas of the refuge where facilities are built and visitors allowed. Trail location and design would feature soil protection. The proposed fishing program, and the hunt program, if approved in the future after additional NEPA analysis, may lead to off trail effects; however, hunters would be well dispersed and anglers would be in designated areas. A monitoring program with Service and VDGIF staff would help identify problems and increase response time for corrective actions. Management and maintenance activities would increase, thus increasing potential for those activities to affect soils. We would employ best management practices to ensure that no long term, major soil problems—such as unchecked erosion or compaction—result.
	---------- Soil Impacts That Would Not Vary By Alternative ----------	
	Under both alternatives, we would continue to maintain protective vegetative cover, and use best management practices in all management activities to maintain soil productivity and health. Site conditions, including soil composition, condition, and hydrology would continue to influence where and how management activities should occur. No site would be managed in a manner inconsistent with its recognized potential. In general, no soil from off-site will be brought onto the refuge unless bringing in clean soil is determined to be less disturbing to refuge resources than using soils on site. There is a potential for adverse impacts from treating invasive plants using herbicides, or mechanical and manual treatments. Impacts would be negligible with preventive measures, and would be limited in scope and scale given small treatment areas.	

	Alternative A **Current Management**	**Alternative B** **Enhanced Management**
Forest Habitat	Under alternative A, benefits would be limited to the long term protection of refuge forest habitat which includes 80 acres of forested upland and 220 acres of forested and emergent wetlands. Some minimal level of risk of loss or damage to forest vegetation involved with invasive plant control activities, including herbicides. However, herbicides would be used only under strict application precautions to ensure that only the targeted plants are affected. Routine maintenance of the access road may result in the loss of individual trees, but we do not expect to affect the quality or diversity of forest habitat present.	Under alternative B there would be increased long-term protection of forest habitats compared to alternative A because of increased presence of staff to conduct outreach and reduce unauthorized activities, increased monitoring of forest health. In addition, if a deer hunt is approved in the future, field reconnaissance by Refuge and VDGIF staff would occur. Forest health would benefit from a deer hunt because deer are suppressing forest regeneration. Developing trails and other infrastructure would result in tree loss; however, this impact would be minimized by using old railroad beds, road bed, and existing unauthorized trails.
	----------Forest Habitat Impacts That Would Not Vary By Alternative----------	
	Under both alternatives, we would continue work on controlling invasive plants and establishing native forest species capable of growing under the current site conditions in an effort to restore the ecological integrity and diversity of the refuge. Control measures would be implemented using strict procedures and protocols so as not to affect non-target resources or otherwise degrade wildlife habitat. The alternatives would vary in terms of the extent and frequency of using control practices.	

	Alternative A **Current Management**	**Alternative B** **Enhanced Management**
Wetlands	Long term protection of refuge lands benefits wetlands on the refuge. Control of invasive plants has some negligible potential to impact wetlands; however, impact is minimal given precautions in place and use of only herbicides approved for aquatic systems. A leak and spill prevention and emergency clean-up procedures would ensure that such occurrences are rare and are addressed immediately, with short-term effects limited to the immediate location. Unauthorized public access has the highest likelihood of impacting wetlands over the long-term. Enforcement program attempts to mitigate this concern. Research studies would continue to include stipulations to minimize impacts to shoreline and wetlands. Some continued minimal impacts from unauthorized activities.	Under alternative B there would be increased long-term protection of wetlands compared to alternative A because of increased presence of Service and VDGIF staff to conduct outreach, education, and enforcement, reduce unauthorized activities, and increase monitoring of wetlands health. Additional protection afforded with plans to work with partners to explore opportunities to design and implement shoreline and wetlands protection measures. Developing trails and other infrastructure could result in impacts to wetlands; however, this impact would be minimized by design and placement in areas less sensitive. Impacts are predicted to be short-term, with localized turbidity and some minimal loss of wetlands plants, but no substantive habitat alteration or degradation would occur. Unauthorized off trail activities and littering that could impact wetlands would be minimized with increased monitoring, outreach, education and enforcement. As with alternative A, chemical or oil leak and spill prevention and emergency clean-up procedures should ensure that such occurrences are rare and are addressed immediately, with effects limited to the immediate location.
	---------- Wetland Impacts That Would Not Vary By Alternative ----------	
	Under both alternatives, refuge wetlands and open water habitats are a priority for protection since they support reproductive habitat for fish and other aquatic species, wading and waterbirds foraging areas, and resting and foraging areas for waterfowl. Refuge wetlands also buffer the shoreline from the erosive effects of the river and Farm Creek. Regardless of the management alternative we select, we would continue to conserve these wetlands and the wildlife they support as one of our highest priorities. We would continue to address impacts from unauthorized refuge uses, in particular, unauthorized fishing. Law enforcement issues related to fishing include littering, illegal trespass and fires. Discarded fishing line and other fishing litter can entangle migratory birds and mammals and cause injury and death (Gregory 1991). Additionally, litter affects water quality which may harm aquatic plants, invertebrates, and fish.	

	Alternative A **Current Management**	**Alternative B** **Enhanced Management**
Birds	Under alternative A, we would continue to benefit birds of conservation concern by protecting 80 acres of upland forest and 220 acres of forested and emergent wetlands, and 25 acres of open water habitat over the long term. There would be short-term localized impacts to bird habitat, and temporary displacement of birds, from management practices such as mowing or herbicide treatments for invasive plant control. Unauthorized activities, particularly during the nesting season, could disturb birds or result in nest abandonment. Enforcement program attempts to mitigate this concern. Research activities have the potential to impact birds, with the extent of the impact dependent on the time of year and techniques used. However, research special use permits would include stipulations to minimize disturbance to birds and habitats.	Under alternative B, increased benefits to birds of conservation concern compared to alternative A due to increased Service presence to enforce against unauthorized activities. Greater presence would better address the issues of illegal trespass, vandalism, and deposition of trash that damage bird habitat and disturb nesting and foraging birds. Invasive plant management activities may affect individual birds by temporary displacement and short-term loss of their specific habitat. These activities would be planned to avoid the main nesting season, so adverse impacts to bird reproduction would not occur. Habitat improvements, particularly control of invasive plants, would benefit many bird species over the long term. Proposed new trails (1.85 miles) and their maintenance would disturb birds and remove more acreage from natural habitat than alternative A. Habitat removal would be minimized with use of old railroad bed, road beds, and existing trails. Opening the refuge to public uses, and allowing dogs on leash, on designated trails would potentially result in additional bird disturbance, disruption, and abandonment on up to 3 acres of trail area. Boat access for hunting and fishing may disturb birds on or near the water. Wildlife disturbances typically result in a temporary displacement without long-term effects on individuals or populations. Some species would avoid the areas people frequent, such as the developed trails, while others may be unaffected by or even drawn to the presence of humans. Long term impacts are anticipated to be minimal since only certain areas are open to the public, and sensitive areas, such as bald eagle nesting sites if they are found in the future, would be closed as needed. In the event of persistent disturbance that may be affecting population viability, activities may be modified or curtailed. Deer hunting, if allowed in the future, would reduce deer impacts on forest regeneration and understory development which are important habitat components for many bird species.
	----------Impacts to Birds of Conservation Concern That Would Not Vary By Alternative ----------	
	Under both alternatives, continued protection of 325 refuge acres would benefit birds of conservation concern that use the refuge to breed or winter or migrate through. Birds may be adversely affected by management methods, such as mowing and the use of herbicides to control invasive plants. These methods would displace birds from treated locations and if any active nests are present they could be damaged or destroyed. The impacts would be minor, highly localized and short-term with no threats to bird populations in terms of adult mortality or breeding success. Treated habitats would be improved over the long term and this would benefit bird populations. Research activities may disturb birds depending on season of use and techniques. For example, the presence of researchers may cause disruption of birds on nests or breeding territories, or increase predation on nests. Efforts to capture birds may also cause disturbance, injury, or death to groups or to individual birds. While mortality is possible, the level would not be predicted to result in a loss of population viability for any species. Permit stipulations would also insure impacts are minimized.	

	Alternative A **Current Management**	**Alternative B** **Enhanced Management**
Other Native Wildlife	Mammalian, reptile, amphibian, and invertebrate species would continue to benefit long term with refuge land protection Mowing or herbicide use would occasionally disturb, injure or kill individual animals, particularly those that are less mobile in treatment locations.	In addition to impacts described for alternative A: Proposed new trails (1.85 miles) and their maintenance would disturb wildlife and remove more acreage from natural habitat than alternative A. Habitat removal would be minimized with use of old railroad bed, road beds, and existing trails. Opening the refuge to public uses, and allowing dogs on leash, on designated trails would potentially result in additional wildlife disturbance, disruption, and abandonment on up to 3 acres of trail area. Boat access for hunting and fishing may disturb wildlife on or near the water. Wildlife disturbances typically result in a temporary displacement without long-term effects on individuals or populations. Some species would avoid the areas people frequent, such as the developed trails, while others may be unaffected by or even drawn to the presence of humans. Long term impacts are anticipated to be minimal since only certain areas are open to the public and sensitive areas would be closed as needed. In the event of persistent disturbance that may be affecting population viability, activities may be modified or curtailed. Deer hunting, if allowed in the future, would reduce deer impacts on forest regeneration and understory development which are important habitat components for many wildlife species. We would adhere to state regulations and not reduce deer numbers to the point they cannot recover. Allowing hunting may result in hunters disturbing non-target species in the course of tracking prey, trampling of vegetation, possible creation of unauthorized trails, and a potential for littering, vandalism and subsequent erosion. Shotgun noise from hunting could cause some wildlife disturbance as well. An indirect long term impact is the potential for visitors to unintentionally introduce and/or spread invasive species. The threat of invasive plant establishment will likely continue to be an issue over the long term and will require annual monitoring, treatment and public education.
	----------Impacts to Other Native Wildlife That Would Not Vary By Alternative----------	
	Under both alternatives, we would continue to protect refuge lands to support a diversity of ecosystem components and native biodiversity, including all wildlife taxa. Vernal pools, wildlife cavity trees, snags and downed logs are important stand-level features that would be protected to the benefit of many species. The conservation of Federal trust species and species of conservation concern in Virginia would continue to be a priority for our management. Some losses of individual animals would occur from current management activities, but these losses would continue to be negligible, highly localized, and short-term. We do not predict significant mortality or loss of local populations because these actions would be done on a rotational basis, no cover type conversions would occur, and we would avoid animals to the extent possible. Contaminants that might run-off into refuge wetlands from herbicide-treated areas could adversely affect amphibians. Monitoring and corrective measures would continue to be taken to ensure contaminated run-off does not become a problem. We would remove problem animals, such as beaver, through lethal means only when necessary. Outreach and education programs would continue to be used to inform the general public and nearby landowners of the need for and ecological soundness of animal damage control measures. Research activities have the potential to impact wildlife, with the extent of the impact dependent on the time of year and techniques used. However, research special use permits would include stipulations to minimize disturbance to wildlife and habitats.	

	Alternative A **Current Management**	**Alternative B** **Enhanced Management**
Archaeological and Historical Resources	Continued Service protection refuge lands would benefit cultural resources by ensuring that none of the substantial impacts related to development for other uses would affect known or as yet undiscovered archaeological or historic resources on those lands. The higher likelihood of unauthorized entry and use of the refuge under current management would cause the risk of impacts to archaeological and historic resources to be greater than under the other alternatives.	There would be increased benefits to archaeological and historic resources under alternative B because of our increased partnering efforts to locate and protect those resources, particularly those at high risk of damage along the refuge shoreline, and because we would seek to foster greater appreciation of their value by the general public. Some mininimal risk from visitors damaging or disturbing archaeological and historic resources on the refuge, although impact is low with requirement to stay on designated routes. Increased staff would be present to conduct outreach, education and enforcement against unauthroized activities impacting these resrouces. We would perform archaeological reviews, surveys, or studies of project areas as needed or recommended by the Service's Regional Archeologist and consult with the Virginia SHPO regarding refuge undertakings that have potential to affect archaeological resources. We would monitor known sites on the refuge to protect from looting and other ARPA violations.
	---------- Archaeological and Historical Resource Impacts That Would Not Vary By Alternative ----------	
	Under both alternatives we would protect areas with archaeological or historic resources. We would continue to conduct outreach and education, and use law enforcement if necessary, to protect against loss or damage to these resources. We would take all necessary precautions to ensure that no sites considered eligible for listing on National Register of Historic Places would be affected. This EA will be sent to the Virginia SHPO for review of NHPA Section 106 compliance, and we will also continue to do Section 106 compliance for all individual projects.	
Refuge Users	Limited benefits to select individuals who participate in partner-led group programs under a special use permit. permit With general closure in place, continued unmet demand for priority public uses. Adjacent community residents, in particular, would continue to be frustrated by lack of access.	Benefits to the public would be substantial under alternative B since the refuge would be open to all priority public uses, assuming public access is secured. We would work cooperatively with VDGIF to provide public hunting and fishing opportunities on the refuge as the first priority. These are two activities where public access is rapidly diminishing in the region due to losses from development. With increased Service and VDGIF presence, and authorized access by the public, we predict there would be fewer incidences of trespassing and unauthorized activities, such as dumping waste, on refuge lands which has been a concern by Refuge neighbors. Partitioning of uses and seasonal area closures may be necessary to accommodate all activities and protect wildlife from disturbance during sensitive times of the year. This may result in a few complaints by some visitors who want access and are inconvenienced, or from those who do not support a particular allowed use.
	---------- Impacts on or Between Refuge Users That Would Not Vary By Alternative ----------	
	Under both alternatives, we would continue to enforce against unauthorized activities.	