Antietam National Battlefield, Maryland
Monocacy National Battlefield, Maryland
Manassas National Battlefield Park, Virginia

National Park Service
U.S. Department of the Interior

Draft
White-tailed Deer Management Plan and Environmental Impact Statement

Spring 2013

UNITED STATES DEPARTMENT OF THE INTERIOR – NATIONAL PARK SERVICE

DRAFT WHITE-TAILED DEER MANAGEMENT PLAN AND ENVIRONMENTAL IMPACT STATEMENT ANTIETAM NATIONAL BATTLEFIELD, MONOCACY NATIONAL BATTLEFIELD, AND MANASSAS NATIONAL BATTLEFIELD PARK, MARYLAND AND VIRGINIA

Lead Agency: National Park Service (NPS), U.S. Department of the Interior

This *Draft White-tailed Deer Management Plan and Environmental Impact Statement* describes four alternatives for the management of deer at Antietam National Battlefield, Monocacy National Battlefield, and Manassas National Battlefield Park, as well as the environment that would be affected by the alternatives and the environmental consequences of implementing these alternatives.

The purpose of this action is to develop a deer management strategy that supports preservation of the cultural landscape through the protection and restoration of native vegetation and other natural and cultural resources. Action is needed at this time because the sizes of deer herds and deer population density have increased substantially over the years at all three battlefields. Results of vegetation monitoring in recent years have documented the effects of the large herd size on forest regeneration in all three battlefields. In addition, deer browsing has resulted in damage to crops and associated vegetation that are key components of the cultural landscapes of the battlefields. It is important to all three battlefields to preserve and restore important cultural landscapes and to preserve agricultural viability within the battlefield grounds. Although the goals vary from battlefield to battlefield, cultural landscape preservation goals are written into the management plans, enabling legislations, and other documents for all three battlefields. In addition, chronic wasting disease (CWD) is proximate to the parks and represents an imminent threat to resources in the parks. There are opportunities to evaluate and plan responses to threats from CWD over the long term.

Under alternative A (no action), existing management would continue, including deer and vegetation monitoring, data management, research, limited fencing, possible repellent use, education and interpretation, and agency/interjurisdictional cooperation. No new actions would be taken to reduce the effects of deer overbrowsing. The existing deer management plan of monitoring, data management, research, and use of protective caging and repellents in landscaped areas would continue; no new deer management actions would be taken. All parks would continue with opportunistic and targeted surveillance for CWD. Antietam and Monocacy would also respond to CWD presence in or near the parks in accordance with the 2009 CWD Detection and Initial Response Plan, and Manassas would work toward creating a similar plan. Under alternative B, the main focus of deer management would be the use of a combination of nonlethal actions including the construction of large-scale deer exclosures (fencing) for the purposes of forest regeneration and the use of nonsurgical reproductive control of does to restrict population growth, using an agent that meets NPS-established criteria. Alternative B would also include several techniques (such as fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning) to prevent adverse deer impacts. Under alternative C, direct reduction of the deer herd would be achieved by sharpshooting, with a very limited use of capture and euthanasia of individual deer if needed in those few circumstances where sharpshooting would not be considered appropriate due to safety concerns, along with the use of the same techniques as listed for alternative B. Alternative D would combine elements from alternatives B and C: sharpshooting and very limited capture/euthanasia would be used initially to quickly reduce deer herd numbers, followed by population maintenance via reproductive control methods if these are available and feasible; if not, sharpshooting would be used as a default option for maintenance. Alternative D would also include the same techniques listed for alternative B (such as fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning). All of the action alternatives include a long-term CWD management plan that provides for a longer-term response to CWD when it is in or within 5 miles of the parks. The plan includes lethal removal of deer to substantially reduce deer density, because high population densities generally support greater rates of disease transmission and have been found to be positively correlated with the prevalence of CWD.

The potential environmental consequences of the alternatives are addressed for vegetation; white-tailed deer; other wildlife and wildlife habitat; special status species; socioeconomics; visitor use and experience; cultural landscapes; health and safety; and park management and operations. Under alternative A, no action would be taken to reverse the expected long-term continued growth in the deer population, and damage to vegetation and cultural landscapes would likely continue.

The *Draft White-tailed Deer Management Plan and Environmental Impact Statement* is available for public and agency review and comment beginning when the U.S. Environmental Protection Agency Notice of Availability is published in the Federal Register. If you wish to comment on the document, you may mail comments to the names and addresses listed below or you may post them electronically at http://parkplanning nps.gov/anti. Before including your address, telephone number, electronic mail address, or other personal identifying information in your comments, you should be aware that your entire comment (including your personal identifying information) may be made publicly available at any time. While you can ask us in your comments to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so. After public review, this document will be revised in response to public comments. A final version of this document will then be released, and a 30-day no-action period will follow. Following the 30-day period, the alternative or actions constituting the approved plan will be documented in a record of decision that will be signed by the Regional Director of the National Capital Region. For further information regarding this document, please contact:

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SUMMARY

PURPOSE OF AND NEED FOR ACTION

The purpose of this plan/EIS is to develop a deer management strategy that supports preservation of the cultural landscape through the protection and restoration of native vegetation and other natural and cultural resources.

Although relatively rare at the turn of the twentieth century, white-tailed deer populations in the Mid-Atlantic region have grown during recent years. Deer thrive on food and shelter available in the "edge" habitat conditions created by suburban development. In addition, fragmentation of the landscape and the increase in developed areas have reduced suitable hunting opportunities. This is particularly true in Maryland's growing suburban areas (MD DNR 1998) and in suburban Northern Virginia near Manassas.

The size of deer herds and deer population density have increased substantially over the years at all three battlefields. Current deer densities are substantially larger than commonly accepted sustainable densities for this region, estimated at about 15–25 deer per square mile (NPS 2010; deCalesta 1997a; Horsley, Stout, and deCalesta 2003). Results of vegetation monitoring in recent years have documented the effects of the large herd size on forest regeneration in all three battlefields. In addition, deer browsing has resulted in damage to crops and associated vegetation that are key components of the cultural landscapes of the battlefields. It is important to all three battlefields to preserve and restore important cultural landscapes and to preserve agricultural viability within the battlefield grounds. Although the goals vary from battlefield to battlefield, cultural landscape preservation goals are written into the management plans, enabling legislations, and other documents for all three battlefields.

This plan is therefore needed because

- Attainment of the parks' cultural landscape preservation goals and mandates are compromised by the high density of white-tailed deer in the parks.
- Browsing of and other damage to native seedlings, saplings, and understory vegetation by deer in the parks has prevented successful forest and riparian buffer regeneration.
- An increasing number of deer in the parks has resulted in adverse impacts on native vegetation and wildlife.
- Opportunities to coordinate with other jurisdictional entities currently implementing deer management actions to benefit the protection of park resources and values can be expanded (e.g., Bull Run Regional Park near Manassas).
- Chronic wasting disease (CWD) is proximate to the parks and represents an imminent threat to resources in the parks. There are opportunities to evaluate and plan responses to threats from CWD over the long term.

OBJECTIVES IN TAKING ACTION

Objectives define what must be achieved for an action to be considered a success. Alternatives selected for detailed analysis must meet all objectives to a large degree and must also resolve the purpose of and need for action. Using the parks' enabling legislation, mandates, and direction in other planning documents, as well as service-wide objectives, management policies, and the Organic Act, the following objectives relative to deer management at the three battlefields were identified:

VEGETATION

- Protect and promote forest regeneration and restoration of the natural abundance, distribution, structure, and composition of native plant communities by reducing excessive deer impacts (e.g., buck rub, trampling, browsing, and invasive seed dispersal).

WILDLIFE AND HABITAT

- Maintain a viable white-tailed deer population within the parks while protecting other park resources.
- Protect and preserve other native wildlife species by promoting the restoration of native plant communities.
- Promote early detection, and reduce the probability of spread of CWD, a transmissible neurological disease of deer and elk that has been detected in the region.

CULTURAL RESOURCES

- Protect the integrity and character of the cultural landscapes, including the spatial patterns of open versus wooded land, and contributing historic views.
- Protect, preserve, and ensure the viability of the historic agricultural landscape, such as crops, orchards, and pasture lands.

VISITOR USE AND EXPERIENCE

- Enhance public awareness and understanding of NPS resource management issues, policies, and mandates, especially as they pertain to deer management.
- Ensure visitors have the opportunity to view and experience the battlefield landscapes within their historic contexts.
- Ensure visitors have the opportunity to view deer in the natural environment at population levels that do not adversely impact visitors' enjoyment of other native species in the natural landscape.

WHITE-TAILED DEER AT THE BATTLEFIELDS

At all three battlefields, deer population trends, density, and health have been assessed through a variety of research and long-term monitoring projects. Deer density remains an important piece of information to indicate if the deer population may be impacting forest vegetation. Deer density has been at the battlefields and other area national park units since 2001. Deer density at the three battlefields has varied from year to year, but remains consistently high, with average densities between 2001 and 2011 of 117 deer per square mile at Antietam, 171 at Monocacy, and 148 at Manassas. Deer densities in 2011 were 131 at Antietam, 236 at Monocacy, and 172 at Manassas (NPS 2010; Bates, pers. comm. 2012).

The large numbers of white-tailed deer within the parks are resulting in a substantial effect on park ecosystems and cultural landscapes due to the deer's heavy browsing of vegetation, including orchards and crops. Studies being conducted by the parks indicate that deer are having adverse effects on tree seedling regeneration and herbaceous cover, which affect habitat quality for other wildlife within the parks that are dependent on this vegetation for food, shelter, and cover.

ALTERNATIVES CONSIDERED

The alternatives under consideration include a required “no action” alternative and three action alternatives that were developed by an interdisciplinary planning team and through feedback from the public and scientific community during the planning process. The three action alternatives would meet, to a large degree, the objectives for this plan and also the purpose of and need for action. The alternatives are described below.

Alternative A: No Action (Continuation of Current Management)—Existing management would continue under alternative A, including deer and vegetation monitoring, data management, research, limited fencing, possible repellent use, education and interpretation, and agency/interjurisdictional cooperation. No new actions would be taken to reduce the effects of deer overbrowsing.

Alternative B: Nonlethal Deer Management—Alternative B would include all actions described under alternative A (with some modifications to monitoring schedules), and would also include several techniques (such as fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning) to prevent adverse deer impacts. However, the main focus of deer management under alternative B is the use of a combination of nonlethal actions to address the impacts of high numbers of deer on vegetation and vegetative cultural landscape elements. These actions include the construction of large-scale deer exclosures (fencing) for the purposes of forest regeneration and the use of nonsurgical reproductive control of does to restrict population growth, using an agent that meets NPS-established criteria.

Alternative C: Lethal Deer Management—Alternative C would include all actions described under alternative A (with some modifications to monitoring schedules) and the additional techniques described under alternative B, but with a primary focus on using lethal deer management actions to reduce the herd size. Direct reduction of the deer herd would be accomplished mainly by sharpshooting with firearms, with a very limited use of capture and euthanasia of individual deer if needed in those few circumstances where sharpshooting would not be considered appropriate due to safety concerns.

Alternative D: Combined Lethal and Nonlethal Deer Management—Alternative D would include all actions described under alternative A (with some modifications to monitoring schedules) and the additional techniques described under alternative B, but with a primary focus of incorporating a combination of lethal and nonlethal deer management actions from alternatives B and C to address high deer density. Lethal actions (including sharpshooting, with very limited capture/euthanasia if necessary) would be taken initially to reduce the deer herd numbers quickly. Population maintenance would be conducted via nonsurgical reproductive control methods if these are available) and meet NPS criteria for use; if not, sharpshooting would be used for maintenance.

ALTERNATIVES - CWD MANAGEMENT

Alternative A: Continuation of Current Management (No Action)—All parks would continue with opportunistic and targeted surveillance for CWD. Antietam and Monocacy would also respond to CWD presence in or near the parks in accordance with the CWD Detection and Initial Response Plan (NPS 2009c), and Manassas would work toward creating a similar plan.

Alternatives B, C, and D (All Action Alternatives)—All of the action alternatives include a long-term CWD management plan that provides for a longer-term response to CWD when it is in or within 5 miles of the parks. The plan includes lethal removal of deer to substantially reduce deer density, because high population densities generally support greater rates of disease transmission (Wilson et al. 2002; Swinton et al. 2002) and have been found to be positively correlated with the prevalence of CWD (e.g., Farnsworth et al. 2005; Conner et al. 2008).

ENVIRONMENTAL CONSEQUENCES

The summary of environmental consequences considers the actions being proposed and the cumulative impacts on resources from occurrences inside and outside the park. The potential environmental consequences of the actions are addressed for vegetation; white-tailed deer, other wildlife and wildlife habitat special status species; socioeconomics; visitor use and experience; cultural landscapes; health and safety; and park management and operations.

SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Impact Topic	Alternative A: Continuation of Current Management (No Action)	Alternative B: Nonlethal Deer Management	Alternative C: Lethal Deer Management	Alternative D: Combined Lethal and Nonlethal Deer Management
Vegetation	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:
	Long-term moderate to major adverse impacts because browsing pressure would be expected to remain high in either all or a large portion of the parks throughout the life of this plan (15 years) due to the lack of deer management actions. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would provide indirect beneficial impacts, but these would not outweigh the adverse effects of not taking deer management actions.	Similar to alternative A. Long-term moderate to major adverse impacts, with short-term negligible impacts from deer management implementation actions such as placement of bait piles and trampling and limited beneficial impacts from use of the techniques available to reduce deer access to crops, fields, and woodlots. Reproductive control would result in only a gradual reduction in the deer population, and although the population goal could be met over the longer term, the risk of not meeting the goal would be high. Therefore, it is expected that the deer population would remain at relatively high density levels in the parks throughout the life of the plan (exceeding the desired density goal). The exclosures would protect only a small portion of the forest in the parks at any one time, requiring 10 years for regrowth above the browse line. Any CWD response that would be taken under the proposed long-term plan would provide indirect beneficial impacts, but these would not outweigh the adverse effects of not taking deer management actions.	Long-term beneficial because the relatively rapid deer herd reduction would allow the abundance and diversity of vegetation throughout the park to recover. There would be short-term negligible impacts (mainly trampling) from deer management implementation actions, and benefits from the limited use of deer management techniques to reduce impacts in certain locations or circumstances. CWD actions would have similar impacts, with short-term negligible impacts (mainly trampling) from surveillance, and benefits from the reduction of deer and deer browse on vegetation.	Same as alternative C. Long-term beneficial effects due to the decrease in the deer herd, limited adverse impacts from the management actions themselves, and limited benefits from the use of the techniques described for all alternatives. CWD actions would have similar impacts, with short-term negligible impacts (mainly trampling) from surveillance, and benefits from the reduction of deer and deer browse on vegetation.
	Cumulative Impact:	*Cumulative Impact*:	*Cumulative Impact*:	*Cumulative Impact*:
	Long-term moderate adverse impacts. Alternative A would contribute appreciable adverse increments to the cumulative impact on vegetation.	Long-term moderate adverse impacts. Alternative B would contribute appreciable adverse increments to the cumulative impact on vegetation.	Long-term beneficial effects. Alternative C would contribute appreciable beneficial increments to the cumulative impact on vegetation.	Long-term beneficial effects. Alternative D would contribute appreciable beneficial increments to the cumulative impact on vegetation.

SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Impact Topic	Alternative A: Continuation of Current Management (No Action)	Alternative B: Nonlethal Deer Management	Alternative C: Lethal Deer Management	Alternative D: Combined Lethal and Nonlethal Deer Management
White-tailed Deer	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:
	Long-term minor to moderate adverse impacts because browsing pressure would likely remain high in the three parks throughout the life of this plan (15 years), with degradation of habitat and loss of food sources. Short-term negligible adverse impacts on deer from deer monitoring actions. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would provide indirect beneficial impacts on the overall deer population, but these would not outweigh the adverse effects of not taking deer management actions.	Similar to alternative A. Long-term minor to moderate adverse impacts. Reproductive control would result in a gradual reduction in the deer population, and consequently the deer population would remain at relatively high levels throughout the life of the plan. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would provide indirect beneficial impacts, but these would not outweigh the adverse effects of not taking deer management actions.	Long-term beneficial effects because the relatively rapid deer herd reduction would allow the abundance and diversity of vegetation throughout the three parks to recover and better protect deer habitat. There would be short-term negligible adverse effects from implementing deer management actions (noise, disturbance) and short-term moderate adverse impacts on the deer population from the large removals in the first years of the plan. CWD actions would have similar impacts, with short-term negligible impacts from surveillance, and long-term benefits from the reduction of the potential for disease amplification, spread and establishment.	Same as alternative C. Long-term beneficial effects due to the relatively rapid deer herd reduction that would allow the abundance and diversity of vegetation throughout the three parks to recover and better protect deer habitat. There would be short-term negligible adverse effects from implementing deer management actions (noise, disturbance) and short-term moderate adverse impacts on the deer population from the large removals in the first years of the plan. CWD actions would have similar impacts, with short-term negligible impacts from surveillance, and long-term benefits from the reduction of the potential for disease amplification, spread and establishment.
	Cumulative Impact:	*Cumulative Impact*:	*Cumulative Impact*:	*Cumulative Impact*:
	Long-term minor to moderate adverse impacts. Alternative A would contribute appreciable adverse increments to the cumulative impact on the white-tailed deer population.	Long-term minor to moderate adverse impacts. Alternative B would contribute appreciable adverse increments to the cumulative impact on the white-tailed deer population.	Long-term beneficial effects. Alternative C would contribute appreciable beneficial increments to the cumulative impact on the white-tailed deer population.	Long-term beneficial effects. Alternative D would contribute appreciable beneficial increments to the cumulative impact on the white-tailed deer population.

SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Impact Topic	Alternative A: Continuation of Current Management (No Action)	Alternative B: Nonlethal Deer Management	Alternative C: Lethal Deer Management	Alternative D: Combined Lethal and Nonlethal Deer Management
Other Wildlife and Wildlife Habitat	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:
	Primarily long-term negligible to potentially major adverse impacts, depending on the species. Species that depend on ground cover and young tree seedlings or understory shrubs for food or cover could be severely reduced or eliminated from the parks, while impacts on species that depend primarily on other habitats (not woodlands) or on the upper canopy for food and cover would be negligible. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would provide indirect beneficial impacts, but these would not outweigh the adverse effects of not taking deer management actions.	Similar to alternative A. Primarily long-term negligible to potentially major adverse impacts, depending on the species. Reproductive control would result in only a gradual reduction in the deer population, and although the population goal could be met over the longer term, the risk of not meeting the goal would be high. Therefore, it is expected that the deer population would remain at relatively high density levels in the parks throughout the life of the plan. Also, the exclosures would protect only a small portion of the forest in the parks at any one time, requiring 10 years for regrowth above the browse line. Species that depend on ground cover and young tree seedlings or understory shrubs for food or cover could be severely reduced or eliminated from the parks, while impacts on species that depend primarily on other habitats (not woodlands) or on the upper canopy for food and cover would be negligible. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would provide indirect beneficial impacts, but these would not outweigh the adverse effects of not taking deer management actions.	Long-term beneficial effects because the relatively rapid deer herd reduction would allow vegetation used as food and cover for many wildlife species to become more abundant. There could be long-term minor adverse impacts on some species that prefer open habitat and short-term negligible adverse impacts from disturbance and noise during the implementation of the action and use of deer management. However, the impacts of deer management actions under alternative C on other wildlife would be mostly long-term beneficial, depending on the species. CWD actions would have similar impacts, with short-term negligible impacts (mainly trampling) from surveillance, and benefits from the reduction of deer and deer browse on vegetation.	Same as alternative C. Long-term beneficial effects due to the decrease in the deer herd, and limited adverse impacts from the management actions themselves. CWD actions would have similar impacts, with short-term negligible impacts (mainly trampling) from surveillance, and benefits from the reduction of deer and deer browse on vegetation/habitat.
	Cumulative Impact	*Cumulative Impact*:	*Cumulative Impact*:	*Cumulative Impact*:
	Long-term moderate adverse impacts. Alternative A would contribute appreciable adverse increments to the cumulative impact on wildlife.	Long-term moderate adverse impacts. Alternative B would contribute appreciable adverse increments to the cumulative impact on wildlife and wildlife habitat.	Long-term beneficial effects. Alternative C would contribute appreciable beneficial increments to the cumulative impact on wildlife and wildlife habitat.	Long-term beneficial effects. Alternative D would contribute appreciable beneficial increments to the cumulative impact on wildlife and wildlife habitats.

SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Impact Topic	Alternative A: Continuation of Current Management (No Action)	Alternative B: Nonlethal Deer Management	Alternative C: Lethal Deer Management	Alternative D: Combined Lethal and Nonlethal Deer Management
Special Status Species	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:
	Primarily long-term negligible to potentially major adverse impacts, depending on the species. Species that depend on ground cover and young tree seedlings or understory shrubs for food or cover or native plants could be severely reduced or eliminated from the parks; whereas, impacts on species that depend primarily on other habitats (not woodlands) or on the upper canopy for food and cover would be negligible. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would provide indirect beneficial impacts for many species, but these would not outweigh the adverse effects of not taking deer management actions.	Similar to alternative A. Primarily long-term negligible to potentially major adverse impacts, depending on the species. Reproductive control would result in only a gradual reduction in the deer population, and although the population goal could be met over the longer term, the risk of not meeting the goal would be high. Therefore, it is expected that the deer population would remain at relatively high density levels in the parks throughout the life of the plan. Also, the exclosures would protect only a small portion of the forest in the parks at any one time, requiring 10 years for regrowth above the browse line. Species that depend on ground cover and young tree seedlings or understory shrubs for food or cover could be severely reduced or eliminated from the parks, while impacts on species that depend primarily on other habitats (not woodlands) or on the upper canopy for food and cover would be negligible. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would provide indirect beneficial impacts, but these would not outweigh the adverse effects of not taking deer management actions.	Mostly long-term beneficial impacts depending on the species. There could be long-term minor adverse effects on some species that prefer open habitat and short-term negligible adverse impacts from disturbance during the implementation of the action. The long-term reduction and controls on deer population growth under alternative C would allow vegetation used as food and cover for sensitive wildlife to become more abundant and would decrease browse on sensitive plants. CWD actions would have similar impacts, with short-term negligible impacts (mainly trampling) from surveillance, and benefits from the reduction of deer and deer browse on vegetation/habitat.	Essentially the same as alternative C. Mostly long-term beneficial effects depending on the species. There could be long-term minor adverse impacts on some species that prefer open habitat and short-term negligible adverse impacts from disturbance during the implementation of the action. CWD actions would have similar impacts, with short-term negligible impacts (mainly trampling) from surveillance, and benefits from the reduction of deer and deer browse on vegetation/habitat.
	Cumulative Impact:	*Cumulative Impact*:	*Cumulative Impact*:	*Cumulative Impact*:
	Long-term minor to potentially major adverse impacts, depending on the species.	Long-term minor to potentially major adverse cumulative impacts, depending on the species.	Long-term beneficial effects, and alternative C would contribute appreciable beneficial increments to the cumulative impact on special status species.	Long-term beneficial effects, and alternative D would contribute appreciable beneficial increments to the cumulative impact on special status species.

Summary of Environmental Consequences

Impact Topic	Alternative A: Continuation of Current Management (No Action)	Alternative B: Nonlethal Deer Management	Alternative C: Lethal Deer Management	Alternative D: Combined Lethal and Nonlethal Deer Management
Socio-economics	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*
	Long-term minor to moderate adverse impacts because of the continued high density of deer expected over the life of this plan and the associated costs of landscape damage, crop loss, and additional costs for fencing, repellents, and other forms of deer control to protect landscaping. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would provide indirect beneficial impacts on neighboring properties, but these would not outweigh the adverse effects of not taking deer management actions.	Similar to alternative A. Long-term moderate adverse impacts but with the additional impact of precluding deer from the large exclosures, which could add to browsing pressure on surrounding lands. Reproductive control would result in only a gradual reduction in the deer population, and although the population goal could be met over the longer term, the risk of not meeting the goal would be high. Therefore, it is expected that the deer population would remain at relatively high density levels in the parks throughout the life of the plan. Any CWD response that would be taken under the proposed long-term plan would provide indirect beneficial impacts, but these would not outweigh the adverse effects of not taking deer management actions.	Long-term beneficial effects because the relatively rapid reduction in deer density would reduce adverse impacts on landowners, due to improved crop yields and preserved landscaping and reduce the need for landscape and crop protection. CWD actions would have similar impacts, with benefits from the reduction of deer and deer browse on adjacent lands.	Essentially the same as alternative C. Long-term beneficial effects due to the decrease in the deer herd, limited adverse impacts from the management actions themselves, and limited benefits from the use of the techniques described for all alternatives. CWD actions would have similar impacts, with benefits from the reduction of deer and deer browse on adjacent lands.
	Cumulative Impact:	*Cumulative Impact:*	*Cumulative Impact:*	*Cumulative Impact:*
	Long-term moderate adverse impacts. Alternative A would contribute appreciable adverse increments to the cumulative impact on socioeconomics/adjacent lands.	Long-term moderate adverse impacts. Alternative B would contribute appreciable adverse increments to the cumulative impact on socioeconomics/adjacent lands.	Long-term beneficial effects. Alternative C would contribute appreciable beneficial increments to the cumulative impact on socioeconomics/adjacent lands.	Long-term beneficial effects. Alternative D would contribute appreciable beneficial increments to the cumulative impact on socioeconomics/ adjacent lands.

SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Impact Topic	Alternative A: Continuation of Current Management (No Action)	Alternative B: Nonlethal Deer Management	Alternative C: Lethal Deer Management	Alternative D: Combined Lethal and Nonlethal Deer Management
Visitor Use and Experience	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*
	Visitors who may be primarily interested in viewing deer would experience beneficial and adverse impacts (beneficial because there would be more deer to see; adverse because the appearance of the deer could be affected by disease or malnutrition). However, there would be long-term minor to moderate adverse overall impacts related to a decreased ability to view scenery (including native vegetation and the historic landscape) and other wildlife, which is important to some visitors using the parks. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would provide indirect beneficial impacts relating to the appearance of vegetation in the parks, but would have adverse effects on visitation; these effects would not outweigh the adverse effects of not taking deer management actions in the long-term.	Similar to alternative A. Visitors would experience beneficial and adverse impacts, since deer would still be present in relatively high numbers for the life of the plan, and possibly longer. Adverse impacts on visitor use and experience from the presence of exclosures and the continued effects of deer overbrowsing would range from negligible to moderate, and impacts related to forest regeneration would gradually become beneficial in the long term, beyond the life of this plan. Visitors may see various aspects of the reproductive control operations, which could result in minor adverse impacts on their visitor experience. Any CWD response that would be taken under the proposed long-term plan would provide indirect beneficial impacts relating to the appearance of vegetation in the parks, but would have adverse effects on visitation; these would not outweigh the adverse effects of not taking deer management actions in the long-term.	Impacts would vary between users, with short- and long-term minor to major adverse impacts on those opposed to lethal deer management within the parks and from disturbance during implementation of the action, but long-term beneficial effects on those who value an increase in vegetative and wildlife diversity and being able to view natural and historic landscapes unaffected by overbrowsing. CWD actions would have similar impacts, with short-term negligible impacts (mainly trampling) from surveillance, benefits from the reduction of deer and deer browse on vegetation, and adverse effects on those visitors who are opposed to lethal deer management.	Similar to alternative C. Impacts would vary between users, with short- and long-term minor to major adverse impacts on those opposed to lethal deer management within the parks and from disturbance during implementation of the action, but long-term beneficial effects on those who value an increase in vegetative and wildlife diversity and being able to view natural and historic landscapes unaffected by overbrowsing. CWD actions would have similar impacts, with short-term negligible impacts (mainly trampling) from surveillance, benefits from the reduction of deer and deer browse on vegetation, and adverse effects on those visitors who are opposed to lethal deer management.
	Cumulative Impact:	*Cumulative Impact:*	*Cumulative Impact:*	*Cumulative Impact:*
	Long-term beneficial effects. Alternative A would contribute appreciable adverse increments to the cumulative impact on visitor use and experience.	Long-term beneficial effects. Alternative B would contribute appreciable adverse increments to the cumulative impact on visitor use and experience.	Long-term beneficial effects. Alternative C would contribute appreciable beneficial increments to the cumulative impact on visitor use and experience.	Long-term beneficial effects. Alternative D would contribute appreciable beneficial increments to the cumulative impact on visitor use and experience.

SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Impact Topic	Alternative A: Continuation of Current Management (No Action)	Alternative B: Nonlethal Deer Management	Alternative C: Lethal Deer Management	Alternative D: Combined Lethal and Nonlethal Deer Management
Cultural Landscapes	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*
	Long-term moderate adverse impacts due to the continued high levels of the deer population and the associated ongoing depredation of plantings and crops by deer in unfenced cultural landscape areas. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would provide indirect beneficial impacts, but these would not outweigh the adverse effects of not taking deer management actions.	Similar to alternative A. Long-term moderate adverse impacts because in the majority of the parks, agricultural crops, and other vegetation would continue to be adversely affected by deer browsing until reproductive controls became effective and the population decreases. Reproductive control would result in only a gradual reduction in the deer population, and although the population goal could be met over the longer term, the risk of not meeting the goal would be high. Therefore, it is expected that the deer population would remain at relatively high density levels in the parks throughout the life of the plan. Also, the exclosures would protect only a small portion of the forest in the parks at any one time, requiring 10 years for regrowth above the browse line, and would have adverse visual impacts on the cultural landscapes if they are visible. Any CWD response that would be taken under the proposed long-term plan would provide indirect beneficial impacts, but these would not outweigh the adverse effects of not taking deer management actions.	Long-term beneficial effects due to decreased browsing and thus decreased deer depredations of agricultural crops. This would lead to increased chances of viability for the parks' farm ventures and maintain the open and closed patterns of the cultural landscape. There would be short-term negligible impacts (mainly trampling) from deer management implementation actions, and benefits from the limited use of deer management techniques to reduce impacts in certain locations or circumstances. CWD actions would have similar impacts, with short-term negligible impacts (mainly trampling) from surveillance, and benefits from the reduction of deer and deer browse on vegetation.	Essentially the same as alternative C. Long-term beneficial effects due to the decreased browsing and thus decreased deer depredations of agricultural crops, which would lead to increased chances of viability for the parks' farm ventures and forest vegetation that maintain the open and closed patterns of the cultural landscape. There would be short-term negligible impacts (mainly trampling) from deer management implementation actions, and benefits from the limited use of deer management techniques to reduce impacts in certain locations or circumstances. CWD actions would have similar impacts, with short-term negligible impacts (mainly trampling) from surveillance, and benefits from the reduction of deer and deer browse on vegetation.
	Cumulative Impact:	*Cumulative Impact:*	*Cumulative Impact:*	*Cumulative Impact:*
	Long-term moderate adverse impacts. Alternative A would contribute appreciable adverse increments to the cumulative impact on cultural landscapes.	Long-term moderate adverse impacts. Alternative B would contribute appreciable adverse increments to the cumulative impact on cultural landscapes.	Long-term beneficial effects. Alternative C would contribute appreciable beneficial increments to the cumulative impact on cultural landscapes.	Long-term beneficial effects. Alternative D would contribute appreciable beneficial increments to the cumulative impact on cultural landscapes.

SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Impact Topic	Alternative A: Continuation of Current Management (No Action)	Alternative B: Nonlethal Deer Management	Alternative C: Lethal Deer Management	Alternative D: Combined Lethal and Nonlethal Deer Management
Health and Safety	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*
	Long-term adverse impacts that range from negligible to potentially major depending on the source and outcome of any accident. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would include additional adverse impacts but provide long-term beneficial impacts related to the risk of collisions, but these would not outweigh the adverse effects of not taking deer management actions.	Similar to alternative A. Long-term adverse impacts ranging from negligible to potentially major, depending on the source and outcome of any accident. Reproductive control would result in only a gradual reduction in the deer population, and although the population goal could be met over the longer term, the risk of not meeting the goal would be high. Impacts on visitor and employee health and safety would be Any CWD response that would be taken under the proposed long-term plan would have some adverse impacts and provide indirect beneficial impacts, but these would not outweigh the adverse effects of not taking deer management actions.	Long-term negligible to minor adverse impacts with beneficial impacts related to a reduced risk of deer-vehicle collisions due to the reduction in deer density. CWD actions under a long-term management plan would have similar impacts, with short-term negligible to minor impacts from the actions themselves, and possible benefits from the reduction of deer tick hosts and the reduced potential for deer-vehicle collisions.	Essentially the same as alternative C. Long-term negligible to minor adverse impacts with beneficial impacts related to a reduced risk of deer-vehicle collisions due to the reduction in deer density. CWD actions under a long-term management plan would have similar impacts, with short-term negligible to minor impacts from the actions themselves, and possible benefits from the reduction of deer tick hosts and the reduced potential for deer-vehicle collisions.
	Cumulative Impact:	*Cumulative Impact:*	*Cumulative Impact:*	*Cumulative Impact:*
	Long-term moderate adverse impacts. Alternative A would contribute appreciable adverse increments to the cumulative impact because of the higher potential for deer-vehicle collisions and possibly Lyme disease transmission.	Long-term moderate adverse impacts. Alternative B would contribute appreciable adverse increments to the overall cumulative impacts because of the continued higher potential for deer-vehicle collisions and possibly Lyme disease transmission.	Long-term negligible adverse impacts. Alternative C would contribute a minimal amount to the overall risks and would add an appreciable beneficial increment to the overall cumulative impact.	Long-term negligible adverse impacts. Alternative D would contribute a minimal amount to the overall risks and would add an appreciable beneficial increment to the overall cumulative impact.

SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Impact Topic	Alternative A: Continuation of Current Management (No Action)	Alternative B: Nonlethal Deer Management	Alternative C: Lethal Deer Management	Alternative D: Combined Lethal and Nonlethal Deer Management
Park Management and Operations	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*
	Long-term minor adverse impacts. Because current deer management actions would continue, each park's deer population is expected to continue to fluctuate and remain at high levels, resulting in long-term demands on park staff and funding for managing the deer herd and protecting other park resources. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would add adverse impacts on park management and operations related to the additional workload and costs, depending on the actions taken.	Long-term moderate to potentially major adverse impacts on park management and operations from installing and maintaining large exclosures and implementing and monitoring reproductive controls. Minor adverse impacts would result from increased educational/interpretive activities and CWD surveillance. Any CWD response that would be taken under the proposed long-term plan would provide short- and long-term moderate adverse impacts on park management and operations.	Moderate adverse impacts during the period of direct reduction efforts because of the need for additional staff time for monitoring and coordinating activities. The use of qualified federal employees or authorized agents would reduce the amount of park staff time needed for implementation, but would still result in increased costs. With the greater reduction of deer over a shorter period of time, park staff would have more time to apply their efforts to other areas of the park when compared to alternative A, which would reduce adverse, long-term impacts from moderate to minor over time. Any CWD response that would be taken under the proposed long-term plan would provide short- and long-term moderate adverse impacts on park management and operations.	Similar to alternative, C - moderate adverse impacts because park staff involvement would be required for coordination and monitoring of the reduction and reproductive control actions. Once the deer herd was reduced, more staff time would be available for other activities, resulting in long-term adverse minor impacts. Any CWD response that would be taken under the proposed long-term plan would provide short- and long-term moderate adverse impacts on park management and operations.
	Cumulative Impact:	*Cumulative Impact:*	*Cumulative Impact:*	*Cumulative Impact:*
	Long-term minor adverse impacts. Alternative A would contribute appreciable adverse increments to the cumulative impact on park management and operations.	Long-term moderate to possibly major adverse impacts. Alternative B would contribute an appreciable adverse amount to the overall cumulative impacts because of the higher demands for staff time and the high costs associated with reproductive control and exclosure construction and maintenance.	Long-term moderate adverse impacts. Alternative C would contribute a moderate amount to the overall adverse effects due to the costs and demands associated with lethal removal.	Long-term moderate adverse impacts. Alternative D would contribute a moderate amount to the overall adverse effects due to the costs and demands associated with lethal removal in the early years and reproductive control after years 5 and 6.

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Acronyms

CDC	Centers for Disease Control and Prevention
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CLI	Cultural Landscape Inventory
CWD	chronic wasting disease
DCAP	Damage Control Assistance Program
EA	environmental assessment
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
FDA	Food and Drug Administration
GIS	geographic information systems
GMP	General Management Plan
GnRH	Gonadotropin Releasing Hormone
I&M	Inventory and Monitoring
MD DNR	Maryland Department of Natural Resources
NCR	National Capital Region
NCRN	National Capital Region Network
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NPS	National Park Service
NRHP	National Register of Historic Places
NWR	National Wildlife Refuge
PEPC	planning, environment, and public comment
plan/EIS	plan / environmental impact statement
PZP	porcine zona pellucida
RCA	resource conditions assessments
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
UVM	Univeristy of Vermont
VDGIF	Virginia Department of Game and Inland Fisheries

Chapter 1: Purpose of and Need for Action

CHAPTER 1: PURPOSE OF AND NEED FOR ACTION

INTRODUCTION

The "Purpose of and Need for Action" chapter explains what this plan intends to accomplish and why the National Park Service (NPS) is taking action at this time. This White-tailed Deer Management Plan and Environmental Impact Statement (plan/EIS) presents three action alternatives for managing white-tailed deer (*Odocoileus virginianus*) at three Civil War battlefields: Antietam National Battlefield, Monocacy National Battlefield, and Manassas National Battlefield Park (hereafter referred to as "the battlefields" or "the parks" collectively), and assesses the impacts that could result from continuation of the current management framework (no action alternative) or implementation of any of the action alternatives. Upon conclusion of the plan and decision-making process, the alternative that is selected will become the white-tailed deer management plan for these parks, which will guide future actions for a period of 15 to 20 years. Brief summaries of the purpose and need are presented here, but more information is available in the "Park Backgrounds" section of this chapter.

A single deer management plan is being developed for three Civil War battlefields in the National Capital Region (NCR). These battlefields share similar mission and purpose and share features common to Civil War battlefields. The three battlefields are also experiencing similar growth in deer population and are experiencing similar encroachment of suburban development, so it is expedient to develop a common plan for all three park units.

PURPOSE OF AND NEED FOR ACTION

PURPOSE OF THE PLAN / ENVIRONMENTAL IMPACT STATEMENT

The purpose of this plan/EIS is to develop a deer management strategy that supports preservation of the cultural landscape through the protection and restoration of native vegetation and other natural and cultural resources.

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NEED FOR ACTION

Although relatively rare at the turn of the twentieth century, white-tailed deer populations in the Mid-Atlantic region have grown during recent years. Deer thrive on food and shelter available in the "edge" habitat conditions created by suburban development. In addition, fragmentation of the landscape and the increase in developed areas have reduced suitable hunting opportunities. This is particularly true in Maryland's growing suburban areas (MD DNR 1998) and in suburban Northern Virginia near Manassas.

The size of deer herds and deer population density have increased substantially over the years at all three battlefields. Current deer densities are substantially larger than commonly accepted sustainable densities for this region, estimated at about 15–25 deer per square mile (Bates 2010; deCalesta 1997a; Horsley, Stout, and deCalesta 2003). Results of vegetation monitoring in recent years have documented the effects of the large herd size on forest regeneration in all three battlefields. In addition, deer browsing has resulted in damage to crops and associated vegetation that are key components of the cultural landscapes of the battlefields. It is important to all three battlefields to preserve and restore important cultural landscapes and to preserve agricultural viability within the battlefield grounds. Although the goals vary from battlefield to battlefield, cultural landscape preservation goals are written into the management plans, enabling legislations, and other documents for all three battlefields.

This plan is therefore needed because

- Attainment of the parks' cultural landscape preservation goals and mandates are compromised by the high density of white-tailed deer in the parks.
- Browsing of and other damage to native seedlings, saplings, and understory vegetation by deer in the parks has prevented successful forest and riparian buffer regeneration.
- An increasing number of deer in the parks has resulted in adverse impacts on native vegetation and wildlife.
- Opportunities to coordinate with other jurisdictional entities currently implementing deer management actions to benefit the protection of park resources and values can be expanded (e.g., Bull Run Regional Park near Manassas).
- Chronic Wasting Disease (CWD) is proximate to the parks and represents an imminent threat to resources in the parks. There are opportunities to evaluate and plan responses to threats from CWD over the long term.

OBJECTIVES IN TAKING ACTION

Objectives define what must be achieved for an action to be considered a success. Alternatives selected for detailed analysis must meet all objectives to a large degree and must also resolve the purpose of and need for action. Using the parks' enabling legislation, mandates, and direction in other planning documents, as well as service-wide objectives, management policies, and the Organic Act, park staff identified the following objectives relative to deer management at the three battlefields:

Vegetation

- Protect and promote forest regeneration and restoration of the natural abundance, distribution, structure, and composition of native plant communities by reducing excessive deer impacts (e.g., buck rub, trampling, browsing, and invasive seed dispersal).

Wildlife and Habitat

- Maintain a viable white-tailed deer population within the parks while protecting other park resources.
- Protect and preserve other native wildlife species by promoting the restoration of native plant communities.
- Promote early detection, and reduce the probability of spread of CWD, a transmissible neurological disease of deer and elk that has been detected in the region.

Cultural Resources

- Protect the integrity and character of the cultural landscapes, including the spatial patterns of open versus wooded land, and contributing historic views.
- Protect, preserve, and ensure the viability of the historic agricultural landscape, such as crops, orchards, and pasture lands.

Visitor Use and Experience

- Enhance public awareness and understanding of NPS resource management issues, policies, and mandates, especially as they pertain to deer management.
- Ensure visitors have the opportunity to view and experience the battlefield landscapes within their historic contexts.
- Ensure visitors have the opportunity to view deer in the natural environment at population levels that do not adversely impact visitors' enjoyment of other native species in the natural landscape.

DESIRED CONDITIONS

This section defines the desired conditions for the parks, which are connected to the purpose, need, and objectives of this plan/EIS. Two objectives were factored into the definition of desired conditions:

> *Two objectives were factored into the definition of desired conditions: (1) sustainable forest and maintenance of cultural and historic landscapes; (2) viable deer populations.*

- **Sustainable forest and maintenance of cultural and historic landscapes**—Several objectives of this plan address the need to reduce adverse effects of deer behavior on native vegetation, including browsing, trampling, buck rub, and seed dispersal, which supports the overall desire for a sustainable forest. For the purposes of this plan, a sustainable forest is defined as a mature eastern deciduous forest with adequate native regeneration and understory growth and minimal invasive species growth. Cultural and historic landscapes are the character-defining features of the land that collectively contribute to the landscape's physical appearance as they have evolved over time (NPS 1994a). At these battlefields, such landscapes are the lands on which the battles took place, and include agricultural fields, forests, woodlots, and farmsteads.
- **Viable deer population**—Deer are a natural part of the ecosystem and play an important role in it. One objective of this plan is to maintain a viable white-tailed deer population in the parks, while protecting other park resources. For the purposes of this plan, a viable population is defined as one that has an age distribution and a sex ratio that resembles other free-ranging white-tailed deer populations in the eastern United States.

PROJECT SITE LOCATION

All three battlefields are located in the NPS NCR within a little over an hour's drive from Washington, D.C. (figure 1). Two of the battlefields are in Maryland northwest of Washington; Antietam is furthest from the city, and most rural, in Sharpsburg, MD, approximately 10 miles south of Hagerstown, Maryland; and Monocacy is just south of Frederick, MD, in a rapidly growing area. The third battlefield, Manassas National Battlefield Park, is in Prince William County, Virginia, south of Washington, and is also in a rapidly developing area.

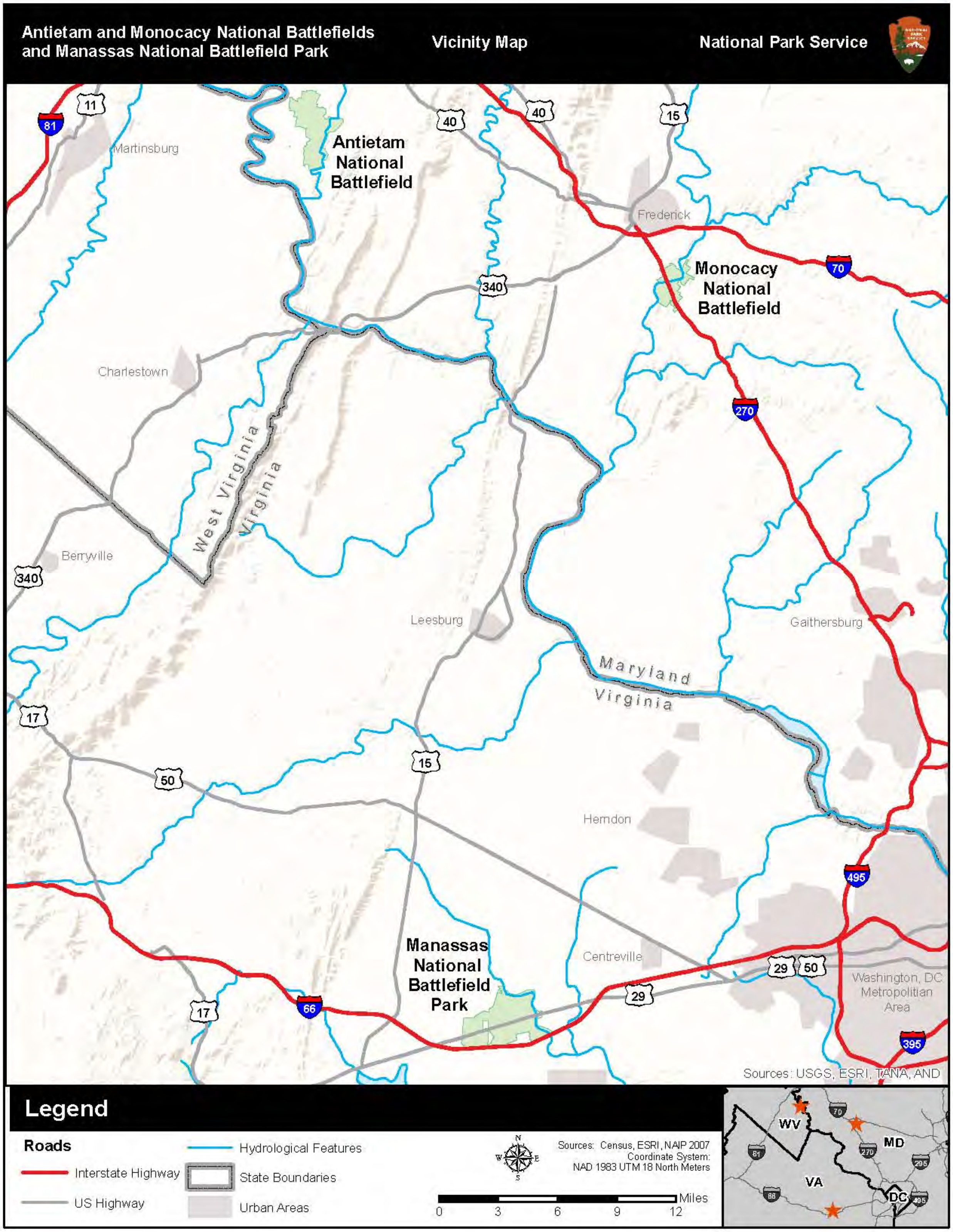


FIGURE 1: VICINITY MAP – ALL THREE BATTLEFIELDS

PARK BACKGROUNDS

The U.S. Congress sets aside as national parks places that represent outstanding aspects of our natural and cultural heritage to ensure they receive the highest standards of protection. Of the fifteen designations for national park system units, battlefields have been given four designations by the U.S. Congress, including National Battlefield (Antietam and Monocacy), and National Battlefield Park (Manassas). These designations commemorate "sites where historic battles were fought on American soil during the armed conflicts that shaped the growth and development of the United States." All three of the battlefields commemorate one or more Civil War battles and the history associated with these battles.

ANTIETAM NATIONAL BATTLEFIELD

History of the Battlefield

Interpretation Tour at Antietam

Congress established Antietam National Battlefield on August 30, 1890, declaring: "All lands acquired by the United States…for the purpose of sites for tablets for marking of the lines of battle of the Army of the Potomac and of the Army of Northern Virginia at Antietam, and of the position of each of the forty-three different commands of the Regular Army engaged in the battle of Antietam, shall be under the care and supervision of the Secretary of the Interior" (16 USC 446, August 30, 1890, and Executive Orders). In 1960, Congress enacted additional legislation stating "…the Secretary finds necessary to preserve, protect and improve the Antietam Battlefield comprising approximately 1,800 acres in the State of Maryland…to assure the public a full and unimpeded view thereof, and to provide for the maintenance of the site in, or its restoration to, substantially the condition in which it was at the time of the battle of Antietam" (16 USC 430oo).

Purpose and Significance of the Battlefield

Park significance statements capture the essence of the park's importance to the nation's natural and cultural heritage. Understanding park significance helps managers make decisions that preserve the resources and values necessary to the park's purpose. The Battle of Antietam, which took place on September 17, 1862, as part of the Civil War, was the bloodiest single-day battle in the history of the United States. During the battle, 23,000 soldiers were killed, wounded, or went missing within a 12-hour period. The battle ended the first invasion of General Robert E. Lee of the Confederate Army of Virginia, and postponed recognition of the Confederacy by Great Britain. President Lincoln issued the preliminary Emancipation Proclamation as a result of this battle. The Emancipation Proclamation gave the Civil War a dual purpose—the reuniting of the United States (preserve the Union) and the freeing of slaves. Although the battle rolled across many acres of farmland and woodlots, much of the battle was centered in a single cornfield, two woodlots, and the Sunken Road (NPS n.d.a).

The purpose of the battlefield is to preserve, protect, and improve the Antietam National Battlefield to assure the public a full and unimpeded view thereof, and to provide for the maintenance of the site in, or its restoration to, substantially the condition in which it was at the time of the battle of Antietam; to inspire and educate future generations through the sacrifice made by soldiers and citizens upon these hallowed grounds; and to preserve in perpetuity Antietam National Cemetery, as the final resting place of the remains of soldiers who fell at the Battle of Antietam and other conflicts (NPS 1992).

Overview of Battlefield Resources

The 3,263.5-acre park is a combination of federally owned property, state lands, and privately held lands with conservation and scenic easements. There are 1,437 acres of agricultural production land, including cropland (50%), pasture (23%), and hay (15%), which are administered through special use permits.

Antietam has transitioned in recent decades to a much higher percentage of federally owned land, and there have been corresponding changes in land management as the land has passed from private ownership to NPS ownership, including discontinuation of hunting. There are currently 1,937.21 acres of federal land, 506.07 acres of privately held land, and 820.21 acres with scenic easements (figure 2).

Park inventory includes important historic and natural landscape components, historic structures, and monuments. There are also archeological resources of interest in the park, as well as various vegetation communities, wildlife, and water resources. Issues of concern related to deer at Antietam include public safety; protection and restoration of cultural landscape values; protection of rare, threatened, and endangered species; and habitat values. In 2010, deer density was reported as approximately 129 deer per square mile. The park is working to protect its agricultural programs, which includes historic cornfields, and creates important field and forest patterns. The park is also working to reforest its historic woodlots to represent the environment at the time of the battle and to enhance visitor understanding of the battle. Although a stark and dramatic browse line is not as noticeable at Antietam as at the other two parks, there are issues with extensively browsed forest understory.

MONOCACY NATIONAL BATTLEFIELD

History of the Battlefield

Monocacy Battlefield

Monocacy National Battlefield is the newest of the three parks, opening to the public in 1991. The Monocacy National Military Park, which later became Monocacy National Battlefield, was created by Congress in 1934 to commemorate the June 21, 1864 Battle of Monocacy, known as the “battle that saved Washington, D.C.” At the time the park was created, no funds were set aside for land acquisition. The battlefield was placed on the National Register of Historic Places (NRHP) in 1975, and land acquisition began in the 1980s. In the years between park designation and 1991, when the park opened, I-270 was constructed between I-495, the beltway around Washington, D.C., and I-70 in Frederick. Interstate-270 bisects the battlefield and limits the ability of the NPS to preserve the landscape of the battlefield as it was during the Civil War.

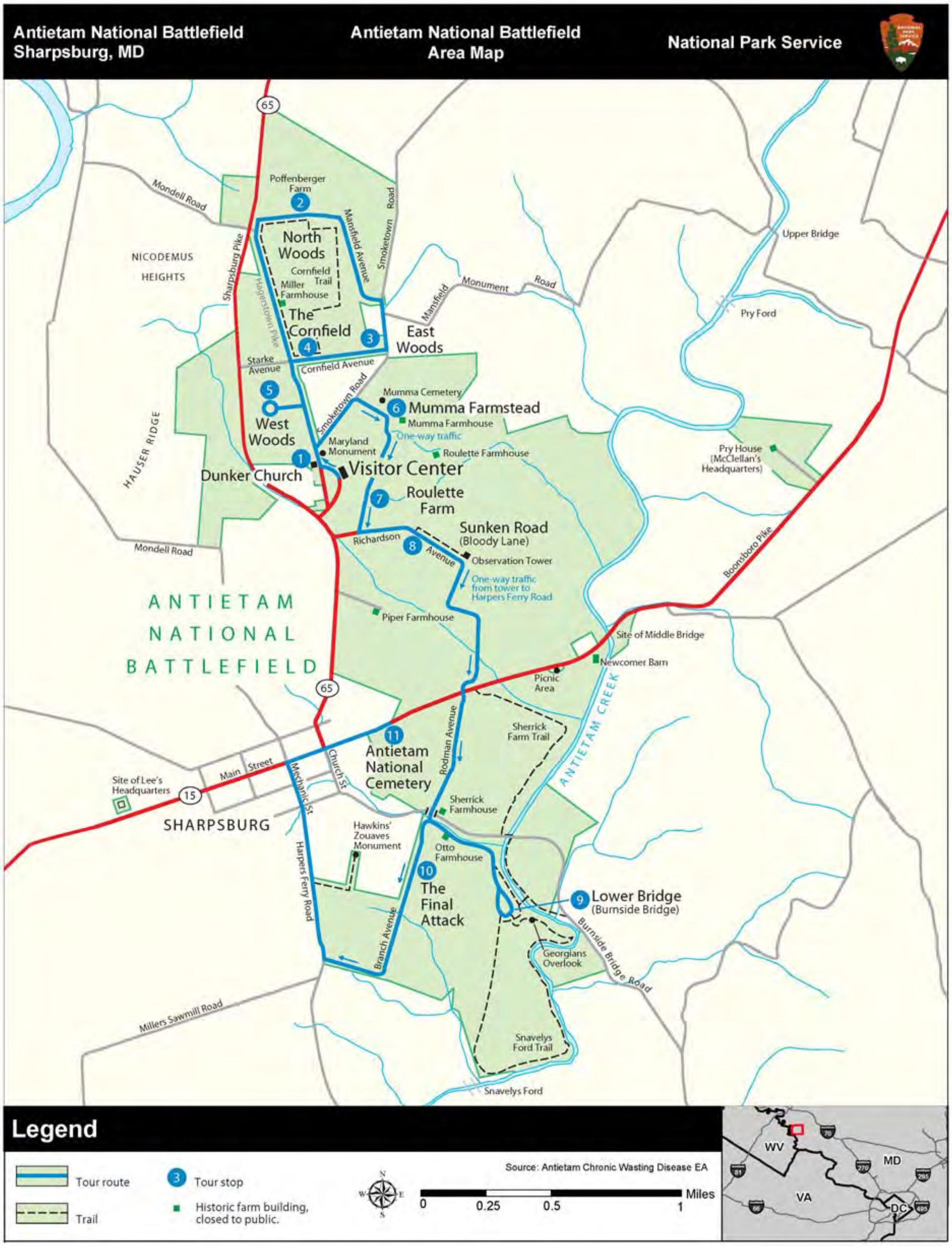


FIGURE 2: ANTIETAM NATIONAL BATTLEFIELD AND VICINITY

Purpose and Significance of the Battlefield

The purpose of the Monocacy National Battlefield is “to preserve for historical purposes the breastworks, earthworks, walls, or other defenses or shelters used by the armies therein, the battlefield at Monocacy.” (Public Law 73-443 HR 7982), as well as “the buildings, roads and outlines of the battlefield, and to provide opportunities for visitors to understand and appreciate the significance of the Battle of Monocacy within the full context of the Civil War and American history” (NPS 1993).

The Monocacy National Battlefield is significant for the July 9, 1864, Civil War battle, during which a small Union army successfully delayed a larger Confederate army’s advance on Washington, D.C., and provided sufficient time for General Ulysses S. Grant to send federal reinforcements to the U.S. capital and prevent its capture. This Confederate campaign, its third and final attempt to bring the war to the North, also was designed to divert pressure from General Robert E. Lee’s besieged army at Petersburg, Virginia, and to lessen President Abraham Lincoln’s chances for reelection.

Monocacy is associated with other important Civil War events, including the 1862 Maryland Campaign, when Confederate General Robert E. Lee and his troops camped at Best Farm and wrote Special Orders 191 outlining his plan of attack. A lost copy of this outline was later found by Union troops whose commanders quickly moved their forces against Lee and engaged the Confederates at South Mountain and ultimately Antietam. During the Gettysburg Campaign in June 1863, Union troops moved through the region, camped on Best Farm, and General Winfield Scott Hancock made the Thomas House his headquarters. In addition, in August 1864, Generals Ulysses S. Grant and Phillip Sheridan met at the Thomas House to plan the Shenandoah Valley Campaign.

The battlefield is also significant for its ability to provide a place where visitors can experience a historic landscape, structures, and transportation corridors that have changed little since the time of the battle. As a result, it offers many opportunities for understanding the evolution of settlement in the region and the Civil War within the broader context of American history (NPS 2011a).

Overview of Battlefield Resources

Similar to Antietam, Monocacy National Battlefield is a mix of land held in fee by the NPS, private in-holdings, and properties protected with scenic easements and other easements (figure 3). There are 1,647 acres within the legislative boundary of the park, of which 1,355 acres are in federal ownership. The remaining acres are a mix of public and private property, many with scenic easements. There are approximately 750 acres in active agriculture, including crops, pasture, and hay; approximately 500 acres of forest; and approximately 60 acres of managed meadows in warm and cool season grasses. Surrounding land uses are a mix of urban and semi-rural. The rapidly developing suburb of Urbana is expanding toward the park’s southern boundary, and the northern boundary of the park abuts the City of Frederick.

Several types of resources are important to the battlefield and to the area. The Monocacy River, for which the battle was named, flows through the battlefield, and there a 52 historic structures, one inventory unit landscape and four component cultural landscapes, and nine prehistoric and historic archeological sites in the park that are important in conveying the history of the battle and the region more generally. Deer are one of more than 138 terrestrial animal species found at Monocacy, and their density in the park was estimated at approximately 142 deer per square mile in 2010 (Bates 2010). The Monocacy General Management Plan (GMP) calls for plant species and landscape management to retain the desirable cultural landscape characteristics, such as vegetation, field patterns, and the composition of wooded and agricultural areas that would have been present during the Civil War and that were present and integral to the battle. The GMP specifically calls for deer management, and for maintaining the park’s agricultural viability and sustainable forest regeneration (NPS 2010; NPS 2009f).

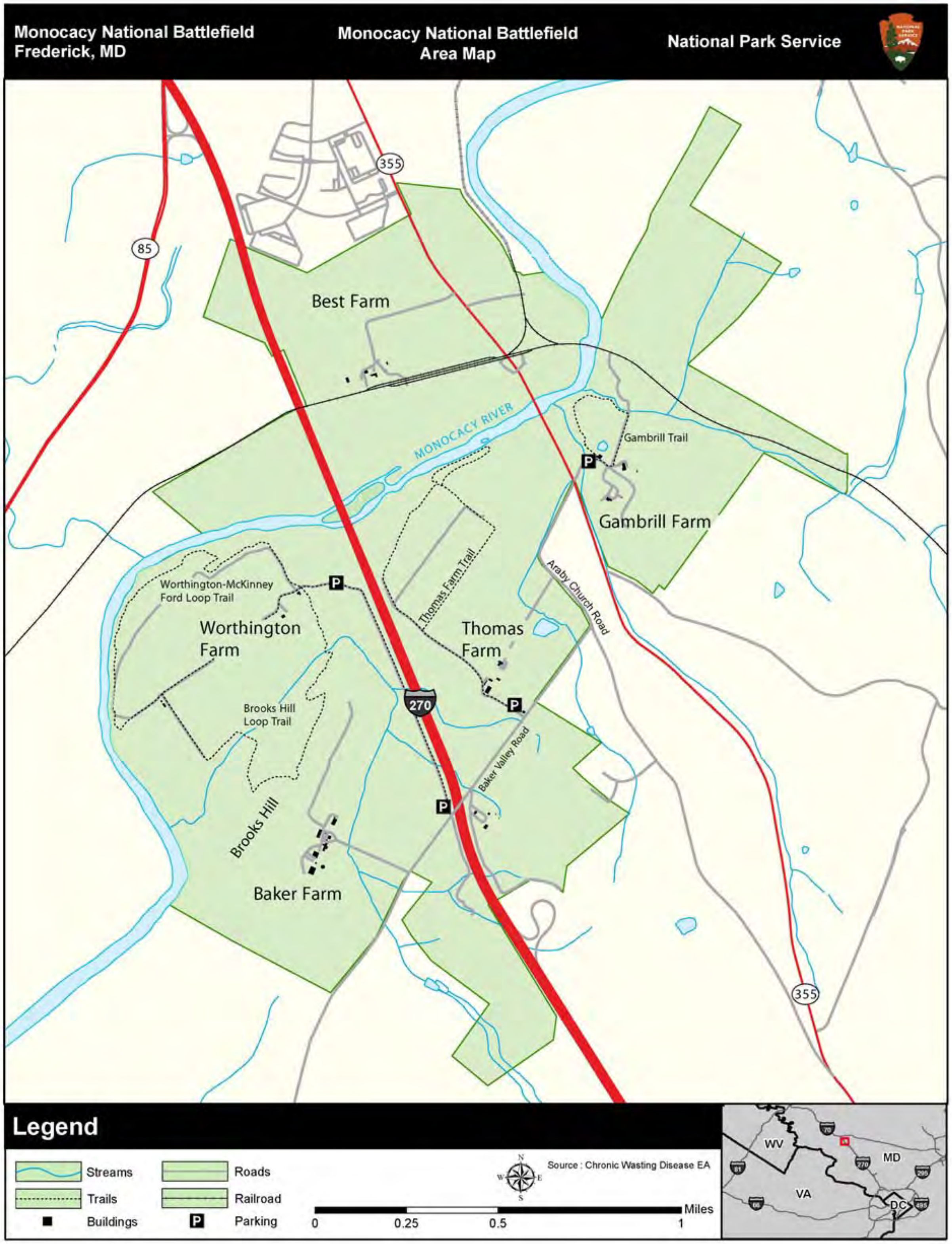


FIGURE 3: MONOCACY NATIONAL BATTLEFIELD AND VICINITY

MANASSAS NATIONAL BATTLEFIELD PARK

History of the Battlefield

Interpretation Demonstration at Manassas

Manassas National Battlefield Park was the site of two important battles during the Civil War. Congress designated Manassas as a national battlefield park in 1940 to preserve the landscape of the time of the two Battles of Manassas.

The initial desire to preserve the Civil War battlefield area included within the park came from the vision of George Carr Round, a Union veteran, who settled in the small Manassas community after the Civil War. Round recognized the need for people to visit the landscape on which the battles took place and he began efforts to get the federal government to legally acquire the battlefield. These efforts were furthered in 1921 when the Sons of Confederate Veterans established the land as Confederate Park, and 14 years later the Franklin D. Roosevelt administration included Confederate Park in a New Deal recreational demonstration area (Zenzen 1998). Finally, on May 10, 1940, the Secretary of Interior, in accordance with authority of Public Law 74-292, designated the area the Manassas National Battlefield Park due to its historical importance as the site of the Battles of First and Second Manassas.

Subsequent congressional legislation preserved the most important historic lands relating to the two battles of Manassas. The legislation that included Stuart's Hill in the park boundary was authorized on November 10, 1988, with enactment of Public Law 100-647. This act vested in the United States all rights, title, and interests to approximately 558 acres of private property near the park.

Purpose and Significance of the Battlefield

The Manassas National Battlefield Park was ultimately created to preserve the historic landscape that encompasses the buildings, objects, and views relating to the historical significance of the Battles of First and Second Manassas. Visitors can see the areas where troops formed, fought, and died (NPS 2008a). The park also provides important cultural landscapes and the historic features that lie within. The park's GMP (NPS 2008a), says that the purpose of the park is "to preserve the historic landscape containing historic sites, buildings, objects, and views that contribute to the national significance of the Battles of First and Second Manassas, for the use, inspiration, and benefit of the public."

Manassas National Battlefield Park is nationally significant because it is the site of the first major battle in the Civil War, the First Battle of Manassas, and was also the site of the Second Battle of Manassas. Many park resources contribute to this national significance, the public's appreciation of the battlefield events, and the public's understanding of the social and economic impacts of the Civil War. The park contains cultural landscapes from the period of the battles (1861–1862) that contain historic features of the battles, as well as woodlands, fields, streams, rolling hills, and certain views or vistas that are representative of the physical setting that existed at the time of the battles. The park also contains cultural landscapes from the period after the battles (1865–1940) that commemorate the battles with monuments and other objects erected in memory of soldiers who fought there.

Overview of Park Resources

The park contains approximately 5,000 acres, including approximately 1,500 acres of grasslands and 2,200 acres of forests, as well as wetlands, ponds, and streams. There are currently approximately 1,300 acres at the park in hay lease. Virginia State Highway 234 and U.S. Highway 29 run perpendicular to each other and divide the park into quarters. Interstate 66 passes along the southern boundary of the park (figure 4). There is suburban and urban encroachment on the borders of the park. Approximately 9,000 acres within 3 miles of park have been developed in last decade. Deer density was estimated at approximately 86 deer per square mile in 2010, and it has been estimated as high as 190 deer per square mile (Bates 2010). There is a noticeable browse line along the edges of all woodlots in the park. An ongoing exclosure study indicates that deer are impacting forest succession in the park.

SCIENTIFIC BACKGROUND: DEER AND VEGETATION MANAGEMENT

DEER MANAGEMENT ISSUES AND RESEARCH OVERVIEW

Park staff have worked with technical experts and researchers to develop and implement methods and protocols for monitoring white-tailed deer population size and the impacts of browsing on forest plant communities. This research, in cooperation with local, state, federal, and regional entities, has informed the development of this plan/EIS. A science team, consisting of scientists and other specialists from a variety of state and federal government organizations, has helped define components of the planning process (team participants are listed in "Chapter 5: Consultation and Coordination"). The team evaluated scientific literature and research on the topic of deer management, established a monitoring protocol for deer populations and other resources at the battlefields, and established a basis for the resource thresholds at which deer management strategies would be implemented. Monitoring protocols and impact thresholds are a component of all action alternatives evaluated in the analysis, helping ensure that the deer population at the battlefields becomes a balanced component of a functioning ecosystem. Information evaluated by the technical experts and background materials provided by the NPS are summarized in the sections that follow. Additional detail is provided in "Chapter 3: Affected Environment."

REGIONAL LANDSCAPE-LEVEL CHANGES

Before European settlement of North America, white-tailed deer populations are estimated to have been between 23 and 34 million (McCabe and McCabe 1984). Deer herds throughout the eastern United States were heavily exploited after the arrival of Europeans around 1600. By 1790, deer populations were low wherever Europeans had settled. However, since the early 1900s, as a result of low mortality rates due to a lack of predators and increased availability of food and habitat, the deer population has increased, as well as stringent game regulations, and shortened hunting seasons. Today the deer density in many areas of the eastern United States exceeds 100 deer per square mile (Porter 1991), and researchers have established that such high deer densities have negative impacts on plant and animal species (Alverson 1988; Anderson 1994; Augustine and Frelich 1998; deCalesta 1994; McShea 2000; McShea and Rappole 2000).

FIGURE 4: MANASSAS NATIONAL BATTLEFIELD PARK AND VICINITY

SCIENTIFIC BACKGROUND: DEER AND VEGETATION MANAGEMENT

DEER MANAGEMENT ISSUES AND RESEARCH OVERVIEW

Park staff have worked with technical experts and researchers to develop and implement methods and protocols for monitoring white-tailed deer population size and the impacts of browsing on forest plant communities. This research, in cooperation with local, state, federal, and regional entities, has informed the development of this plan/EIS. A science team, consisting of scientists and other specialists from a variety of state and federal government organizations, has helped define components of the planning process (team participants are listed in "Chapter 5: Consultation and Coordination"). The team evaluated scientific literature and research on the topic of deer management, established a monitoring protocol for deer populations and other resources at the battlefields, and established a basis for the resource thresholds at which deer management strategies would be implemented. Monitoring protocols and impact thresholds are a component of all action alternatives evaluated in the analysis, helping ensure that the deer population at the battlefields becomes a balanced component of a functioning ecosystem. Information evaluated by the technical experts and background materials provided by the NPS are summarized in the sections that follow. Additional detail is provided in "Chapter 3: Affected Environment."

REGIONAL LANDSCAPE-LEVEL CHANGES

Before European settlement of North America, white-tailed deer populations are estimated to have been between 23 and 34 million (McCabe and McCabe 1984). Deer herds throughout the eastern United States were heavily exploited after the arrival of Europeans around 1600. By 1790, deer populations were low wherever Europeans had settled. However, since the early 1900s, as a result of low mortality rates due to a lack of predators and increased availability of food and habitat, the deer population has increased, as well as stringent game regulations, and shortened hunting seasons. Today the deer density in many areas of the eastern United States exceeds 100 deer per square mile (Porter 1991), and researchers have established that such high deer densities have negative impacts on plant and animal species (Alverson 1988; Anderson 1994; Augustine and Frelich 1998; deCalesta 1994; McShea 2000; McShea and Rappole 2000).

Deer numbers have grown to an estimated current population in excess of 235,000 animals in Maryland (MD DNR 2011b), and in 2007, it was reported that Virginia's statewide deer population had been relatively stable during the past decade, fluctuating between 850,000 and 1,050,000 animals (mean of 945,000) (VDGIF 2007).

Deer thrive on habitat conditions created by suburban development. New roads, housing, and related enterprises fragment forests and farms and create "edge" habitats that provide plenty of food and ample shelter for deer. In addition, in national park system units in the eastern United States, hunting is generally not allowed, and landscapes have traditionally been managed to allow for the preservation and rehabilitation of scenic and historic landscapes. The result is a mixture of forest, fields, shrub, and grassland, which constitutes excellent habitat for white-tailed deer. Direct impacts from intense deer browsing include reductions in plant species richness (number of species), plant density and biomass, height growth, and the development of vertical structure. Loss of plant species and vertical structure, leading to the decline of animal species that depend on these plants, represents a primary effect of browsing (Latham et al. 2005, Alverson 1988; Anderson 1994; Augustine and Frelich 1998; deCalesta 1994; McShea 2000; McShea and Rappole 2000).

POPULATION CHARACTERISTICS OF WHITE-TAILED DEER AT THE BATTLEFIELDS

Distance sampling: An analytical method to estimate population density that involves an observer traveling along a transect and recording how far away objects of interest are.

At all three battlefields, deer population trends, density, and health have been assessed through a variety of research and long-term monitoring projects, which are described in further detail in the "White-tailed Deer" section in the Affected Environment chapter. However, deer density remains the single most important piece of information to indicate if the deer population may be impacting forest vegetation. Deer density has been estimated using the NCR Distance Sampling protocols (NPS 2005a) at the battlefields and other area national park units since 2001.

Deer density at the three battlefields has varied from year to year, but remains consistently high, with average densities between 2001 and 2011 of 117 deer per square mile at Antietam, 171 at Monocacy, and 148 at Manassas. Deer densities in 2011 were 131 at Antietam, 236 at Monocacy, and 172 at Manassas (Bates 2010; Bates, pers. comm. 2012). Chapter 3 discusses the results for all three battlefields in more detail.

EFFECTS OF WHITE-TAILED DEER ON VEGETATION AT THE BATTLEFIELDS

At all three battlefields, deer densities have consistently been higher than deer abundances that interfere with forest regeneration and associated wildlife habitat (Bates 2010). Alverson (1988) and others claim that densities as low as 10.36 deer per square mile (4 deer per square kilometer) can prevent regeneration of some woody species, and deer populations maintained below 18 deer per square mile (7 deer per square kilometer) prevent regeneration failure (Tilghman 1989). Horsley, Stout, and deCalesta (2003) demonstrated negative impacts on vegetation at densities exceeding 21 deer per square mile (8 deer per square kilometer). The NPS National Capital Monitoring Network vital signs monitoring relied on the 21 deer per square mile threshold (Bates 2006). Based on this threshold, ten parks within the NCR exceeded desirable population densities in 2009, including all three battlefields, and many parks have fewer seedlings than would be expected (Schmit and Campbell 2008).

The battlefields have been conducting studies to determine the impacts of deer on other natural resources. Paired plot (fenced and unfenced, or "open" plots) studies have been conducted at all three parks to assess the effects of deer browsing on forest vegetation. Results of these studies are described in detail in the "Vegetation" section in chapter 3 and are summarized below.

A multi-park study (McShea and Bourg 2009) evaluated the impacts of deer browse on park cultural landscapes and natural resources, specifically native woody vegetation, in Antietam and Monocacy, as well as the Chesapeake and Ohio Canal National Historical Park.

Results indicated that for most species there were fewer seedlings in 2009 than 2003, regardless of plot type (open vs. fenced). The majority of the most common sapling species decreased significantly in the open plots from 2003 to 2009, but increased significantly in fenced plots. Although sapling species richness showed two- to ten-fold increases across the parks from 2003 to 2009, this increased richness and abundance was accompanied by an associated increase in richness of invasive saplings in all plots. Based on McShea and Bourg's calculated "stocking thresholds," none of the plots at the two battlefields reached the threshold for successful regeneration (McShea and Bourg 2009).

Cedars Browsed by Deer

At Manassas, there is an ongoing study using open control plots and exclosures in three forest types found in the park. Gorsira, Rossell, and Patch (2006) analyzed the results of the study from 2000 to 2004, and a subsequent study examined the differences in plots between 2001 and 2009 (McShea et al., 2009). Results indicated that deer have significant effects on forest structure and woody seedling composition. Deer browsing suppressed both forb cover and vertical plant cover in each forest type. With few exceptions, annual seedling survival rates were consistently significantly lower in the controls than in the exclosures. Deer browsing adversely affected seedling survival rates of all species except for hackberry (*Celtis occidentalis*), blueberry (*Vaccinium* spp.), and redbud (C*ercis canadensis*). Results also indicate that browsing by white-tailed deer may be impacting the herb and shrub layers in the forest interior to levels that may be detrimental to wildlife species that are dependent on a thick understory to thrive (Gorsira, Rossell, and Patch 2006). The subsequent study showed that by 2009, both open and fenced plots showed increases in species richness, but the exclosures contained significantly more woody and herbaceous species than control (open) plots. Also, exclosures and control plots had significant differences in seedling survival rates.

Crop yield reports demonstrate the effects of deer damage on crops grown on the farms within Antietam Battlefield, which are being maintained as agricultural fields. Data on crop damage has been reported by farmers in the park, because of concern over deer-related crop damage, and compared against expected crop yields published by the Natural Resources Conservation Service in Washington County. When compared with the average crop yields for farms in Washington County, and for soil types more generally, Antietam agricultural cooperators experienced significant to highly significant reductions in corn for grain and silage, soybean, and winter wheat. There were also marginally significant harvest reductions with barley. There was too small a sample size to analyze yields for alfalfa hay. Data show lower harvests overall for all crops at Antietam than county averages (NPS 2011b).

Crop yield reports for Monocacy show that the deer may not be affecting crops as much at Monocacy as at Antietam. Monocacy experienced a significant decrease in corn yield when compared to average crop yields in Frederick County, as well as when compared to expected yields per soil type, but demonstrated a slightly higher (but not statistically significant) yield than the county average for soybeans (NPS 2012d).

DEER MANAGEMENT AT THE BATTLEFIELDS AND SURROUNDING JURISDICTIONS

There are no formal deer management plans for the three battlefields currently, but numerous deer monitoring activities are undertaken by NPS staff. Actions taken to address impacts of deer browsing include the deer population and vegetation monitoring described above, and coordination and communication with state personnel and local agencies and communities to understand and address issues associated with deer overabundance in the region. The parks also conduct limited CWD surveillance and provide interpretative and educational materials regarding the impacts of deer on vegetation and the cultural landscapes of the parks. These actions constitute the “no action” alternative in this plan/EIS, and details about current management actions are described in this document in “Chapter 2: Alternatives” under alternative A.

Antietam and Monocacy National Battlefields are located within the State of Maryland and Manassas is located within the State of Virginia. Maryland and Virginia have formal deer management plans. In addition, certain counties or state parks/forests within each state have developed their own deer management plans.

MARYLAND (ANTIETAM AND MONOCACY NATIONAL BATTLEFIELDS)

Washington and Frederick Counties

Antietam and Monocacy National Battlefields are located within Washington and Frederick Counties, Maryland, respectively. Neither of these counties has a specific deer management plan or program. Deer management in these counties consists primarily of public hunting in accordance with the Maryland White-tailed Deer Management Plan and Maryland Department of Natural Resources (MD DNR) regulations.

Maryland White-tailed Deer Management Plan 2009–2018

The 2009-2018 Maryland White-tailed Deer Management Plan (MD DNR 2009) documents the history of white-tailed deer and white-tailed deer management in Maryland and describes the current status of white-tailed deer in Maryland and the positive and negative impacts of the species. The plan documents the responsibilities of the MD DNR deer management program and other MD DNR staff as they relate to white-tailed deer management, and outlines the goals and objectives for Maryland white-tailed deer management through 2018. The primary responsibilities of the plan can be grouped into five main categories: (1) deer population regulation; (2) deer population monitoring; (3) information and education; (4) addressing constituent demands; and (5) other management activities.

Hunting, particularly of antlerless deer, is a major cornerstone of the Maryland deer management program. The plan states “No other management strategy for regulating deer populations is as effective or as economical as deer hunting, and hunting is necessary to keep deer populations from growing beyond their biological carrying capacity” (McCullough 1979). The plan also recommends and includes other deer management techniques in addition to hunting, recognizing that some communities incur deer problems within landscapes that are not conducive to hunting or other lethal management. The plan states that nonlethal deer management options can be effective in small areas or where deer numbers are not overly abundant, but nonlethal options often are ineffective for managing larger landscapes or reducing a local deer population sufficiently to mitigate conflicts. Within Maryland, the deer population is divided into two management regions: A and B. Frederick County is located entirely within Region B. Washington County was previously located entirely within Region B. However, in 2010 the western half of the county was designated as Region A. In 1998, the Region B population was estimated to be approximately 205,000 deer. This number increased to approximately 238,000 in 2002 before the state implemented liberal antlerless seasons and bag limits. The Region B population was estimated to be 195,000 deer as of 2008.

Maryland’s statewide deer population prior to the 2010–2011 hunting season was estimated at approximately 235,000 deer. The total number of deer harvested in Maryland during the 2010–2011 season was 98,663, which represents a 2% decline from the previous years’ record of 100,663. Harvest counts for Frederick and Washington counties over the nine hunting seasons between 2002 and 2011 are shown in table 1 (MD DNR 2011b and archives). Frederick County had the highest deer harvesting numbers in the state and Washington County represented the third largest deer harvesting numbers.

TABLE 1: DEER HARVEST COUNT FOR FREDERICK AND WASHINGTON COUNTIES

Season	Antlered Deer	Antlerless Deer	Total Harvest
Frederick County			
2002–2003	3,785	4,793	8,578
2003–2004	3,616	4,552	8,168
2004–2005	2,959	4,533	7,492
2005–2006	2,417	4,553	6,970
2006–2007	2,512	4,372	6,884
2007–2008	2,580	4,760	7,340
2008–2009	2,853	5,385	8,238
2009–2010	2,734	5,713	8,447
2010–2011	2,701	5,241	7,942
Washington County			
2002–2003	4,153	3,608	7,761
2003–2004	3,789	3,494	7,283
2004–2005	3,408	6,741	10,149
2005–2006	3,074	5,921	8,995
2006–2007	3,301	5,514	8,815
2007–2008	3,143	5,677	8,820
2008–2009	3,129	6,098	9,227
2009–2010	2,840	5,747	8,587
2010–2011	2,613	3,422	6,035

VIRGINIA (MANASSAS NATIONAL BATTLEFIELD PARK)

Prince William and Fairfax Counties

Manassas is located in Prince William County, Virginia, but abuts Fairfax County's western boundary. Prince William County has no deer management program, and deer removals are done in accordance with the Virginia Deer Management Plan and Virginia Department of Game and Inland Fisheries (VDGIF) regulations. Fairfax County has a well-established deer management program. This section provides a summary of the Virginia and Fairfax County deer management plans.

Virginia Deer Management Plan, Revised 2006

The first Virginia Deer Management Plan was completed in 1999 and subsequently revised in 2005 and 2006. The plan incorporates input from various stakeholders including sportsmen, homeowners, agricultural producers, the commercial timber industry, resource management agencies, and others. The revised deer management plan guides management activities through 2015. The plan summarizes the history of white-tailed deer management, the current population status and hunting statistics and future management initiatives. The plan addresses the deer population, habitat, damage, and deer-related recreation (VDGIF 2007).

The big game checking system is the foundation of Virginia's deer management program. The check system, which is administered by the Wildlife and Law Enforcement Divisions, provides actual harvest numbers per county by requiring hunters to check every harvested deer to receive an official game tag. These check stations collect information on the animal's sex, date of kill, type of weapon used, and county of kill.

The Virginia Deer Management Plan describes several types of management programs in the state, including regulated hunting, mandatory checking, deer management assistance program, kill permits, damage control assistance program (DCAP), and the deer population reduction program. At the state level, deer harvest regulations are evaluated and revised every other year based on management goals. Regulation amendments may include adjustments to season lengths, bag limits, firearms seasons, and sex harvest permits. Deer harvest objectives and regulations are set on a county or management unit basis. Deer management objectives strive to achieve the cultural carrying capacity, which is defined as the number of deer that can coexist compatibly with humans. Most of Virginia's deer herds are below the biological carrying capacity, but exceed the cultural carrying capacity in several areas. In general, the density and health of the state's deer population is managed through antlerless deer hunting.

The revised plan discusses goals established in the original plan and outlines new goals for the 2006–2015 period. In the 1999 plan, the management goal for Fairfax and Prince William counties was to reduce the deer population on private land. According to the revised plan, this objective was not met in either county. Neither county had set goals in 1999 for deer populations on public lands.

According to VDGIF, 219,797 deer were harvested by hunters in Virginia, including 95,543 antlered bucks, 19,191 button bucks, and 105,063 does. The fall 2010 deer kill total was 15% lower than the previous years' reported harvest count and 3% lower than the last 10-year average of 227,430. It is predicted that this decline was based on two factors: (1) successful deer management efforts by the VDGIF over the past five to ten years to increase the number of harvested females, which have led to a decrease in the statewide deer herd and decline in total deer kill numbers; and (2) winter mortality resulting from a poor mast crop in the fall of 2009 combined with heavy snow in 2010. Table 2 shows harvest counts for Fairfax and Prince William counties between 2000 and 2010.

Preliminary data indicates that neither Fairfax nor Prince William Counties were among the top ten counties with the highest harvest counts. In 2010, the total deer harvest for Fairfax County was 1,319 (56.6% female). The total deer harvest for Prince William County was 1,721 (49.7% female).

TABLE 2: DEER HARVEST COUNT FOR FAIRFAX AND PRINCE WILLIAM COUNTIES

Year	Antlered Males	Male Fawns	Females	% Female	Unknown	Total Harvest
Fairfax County						
2000	439	119	451	44	16	1,025
2001	410	109	384	41.8	16	919
2002	323	83	354	45.8	13	773
2003	386	88	396	44.5	19	889
2004	411	96	473	48.3	0	980
2005	471	126	558	48.3	0	1,155
2006	508	128	732	53.5	0	1,368
2007	444	158	668	52.6	0	1,270
2008	500	134	725	53.3	0	1,359
2009	507	106	839	57.8	0	1,452
2010	464	108	747	56.6	0	1,319
Prince William County						
2000	789	201	743	42.6	13	1,746
2001	951	244	837	40.6	32	2,064
2002	807	194	688	40.3	20	1,709
2003	874	204	763	41.1	14	1,855
2004	734	169	655	42	0	1,558
2005	848	158	827	45.1	0	1,833
2006	746	153	780	46.5	0	1,679
2007	694	114	781	49.2	0	1,589
2008	761	177	1056	53	0	1,994
2009	712	162	972	52.7	0	1,846
2010	730	136	855	49.7	0	1,721

Fairfax County Deer Management Program (Virginia)

The primary goal of the Fairfax County Deer Management Program is to control deer populations in public parks. In addition, the county develops an integrated deer management plan to employ sustainable hunting practices at select parks each year. Fairfax County developed their first deer management plan in January 1998. Deer management within the county is under the jurisdiction of the Animal Services Division of the Fairfax County Police Department in coordination with the VDGIF. The county Wildlife Biologist and Animal Services Division coordinate with various land-holding agencies (Northern Virginia Regional Park Authority, Fairfax County Park Authority) and other public authorities to implement the integrated deer management plan on public lands. The Animal Services Division also provides recommendations to residents and private businesses for controlling deer on private property. Federal agencies are responsible for deer management on federally owned lands, including Manassas National Battlefield Park (Fairfax County 2010a).

The Fairfax County Environmental Quality Advisory Council issued their 2010 Annual Report on the Environment in November 2010. Chapter 8 of the annual report discusses the impacts of deer within the county and methods for population control. According to this report, the deer population in Fairfax County is at an unsustainable level. Current data indicates that the deer population is overabundant, meaning that the population levels have adverse impacts on the community and other species. The population is currently not considered to be overpopulated (which would indicate persistent disease and starvation), but is believed to be approaching this level. Prior to the county's deer management program, the population was estimated to be approximately 90 to 419 individuals per square mile. The VDGIF reported that ideal deer densities are 15 to 20 deer per square mile while a 1997 independent consultant report ordered by the county (and scientific literature) states that 8 to 15 deer per square mile is preferable. The county continues to assess the deer population and define local ecological goals (Fairfax County 2010a).

The deer management program allows archery, public managed hunts, and sharpshooting as methods of population control. The archery and managed hunt programs select qualified hunters through a lottery system, with the archery program selecting participants for group hunts. The sharpshooting program consists of special-trained Fairfax County Police Department Special Weapons and Tactics Team officers. Managed hunting occurs primarily in parkland, which has reduced the impact of the deer population on these local ecosystems. However, managed hunts have not made an immediate noticeable impact in the overall deer population. Archery is an effective method of deer control in suburban residential areas, and is permitted year round with off-season permits. The sharpshooter program has been found to be effective in larger parks, but like the managed hunting program, has not substantially impacted the overall deer population. Other methods such as traditional public hunting, trap and kill, trap and relocate, and contraceptives have been evaluated but deemed insufficient or not cost effective for Fairfax County. Although the current methods of deer population control employed by Fairfax County are cost effective and successful in reducing local deer populations, these methods have not been found to significantly impact the countywide population. The county recently took measures to improve the archery program, which should be evaluated for effectiveness over the next few years (Fairfax County 2010a).

In the first eight weeks of the 2010–2011 season, 522 deer were harvested. Of these deer, 481 were harvested during the archery season and 41 were harvested through sharpshooting efforts (Monroe, pers. comm. 2011).

Northern Virginia Regional Planning Commission (Bull Run Regional Park)

Bull Run Regional Park is located just southeast of Manassas National Battlefield Park and is managed by Fairfax County. No park-specific plan exists for Bull Run. Fairfax County conducts managed hunts at the park, including the largest sharpshooting hunt in the county. The first 2011 sharpshooting hunt season started on November 14. In four hours, sharpshooters killed 32 deer (Monroe, pers. comm. 2011).

Conway Robinson State Forest

Conway Robinson State Forest is a 444-acre forest located in Prince William County, adjacent to the Manassas National Battlefield and Route 29. Conway Robinson State Forest is managed by the Virginia Department of Forestry, which initiated a deer management program in 2007. Primary concerns identified within the State Forest include an increasing decline and mortality rate of overstory oak species, invasive species, and a severe lack of desirable regeneration. The poor regeneration levels can be attributed to heavy deer seed, seedlings and sapling browsing. The current deer population density within the State Forest is estimated to range from approximately 140–160 individuals per square mile. The goal of the deer management plan is to increase forest management options, improve forest health, and improve the health and long-range sustainability of the local deer population with active management. Specifically, the program plans to reduce the current deer population from 140 to 160 individuals to 80 individuals per square mile, with a reduction of 60 to 80 individuals in year one (VDOF 2010).

After consulting with the VDGIF, the State Forest determined that a reduction in the number of female deer is necessary to control the population. Based on forest size, herd population, and the reduction target, an organized shotgun hunt was identified as the most appropriate action. Conway Robinson State Forest began by developing relationships with other agencies in Northern Virginia that have similar experience, including the VDGIF, the U.S. Fish and Wildlife Service (USFWS), Fairfax County Game Biologists, the Virginia Department of Conservation and Recreation, and the Northern Virginia Regional Park Authority. With input from these agencies, Conway Robinson developed the "Hunter Protocol."

The Hunter Protocol is modified annually based on the previous years' results. The protocol restricted hunting to three Mondays in November and December. A total of 17 hunters and 20 alternatives ages 18 and older were selected through a lottery system. Hunters were required to obtain a State Forest Use Permit and conduct hunting from a portable tree stand, which must be removed at the end of each day. Several safety provisions are outlined in the protocol including use of blaze orange, safety harnesses, and attendance at a pre-hunt orientation and safety meeting. Hunters were permitted to use shotguns only, and were required to qualify their guns and certify themselves using specified criteria. To ensure safety, hunters were restricted from hunting within a certain distance from property boundaries, roads, utility right-of-ways and parking areas. Harvesting of antlerless deer was unrestricted. Only those antlered deer with a minimum of five points on one side could be harvested (VDOF 2010).

Goals for 2010 included (1) harvesting 15 deer per day; (2) increasing oak regeneration and improving forest health; (3) demonstrating responsible deer herd management; and (4) ensuring the safety of hunters, managers, neighbors and non-hunting users of the State Forest. Between 2008 and 2010, the program closed the State Forest to non-hunters and allowed hunting for a set number of days (initially four days, but reduced to three in 2010), restricted the number of hunters permitted per day, and allowed unrestricted hunting of female deer during this period.

After year three of the program, the State Forest determined that two of the goals were met (goals 3 and 4), one is in process and demonstrating promise (goal 2), and one was missed (goal 1). The total number of deer harvested fell short of the goal of 15 individuals per day. The program reported the number and type of deer harvested per year, but has not reported the new total herd estimate. The total number of individuals harvested per year of the program ranged from 32 to 37. Going forward, the program will address the poor turn-out from hunters by adjusting the open hunting dates, allowing different hunters each day, and modifying the antlered deer policy (VDOF 2010). Table 3 presents the deer harvesting results for Conway Robinson State Forest between 2008 and 2010.

TABLE 3: DEER HARVEST COUNT FOR CONWAY ROBINSON STATE FOREST

Year	Antlered Males	Antlerless Males	Females	% Female	Unknown	Total Kill
2010	6	4	22	69		**32**
2009	3	11	23			**37**
2008–2009	6	1	28			**35**

Deer Management Efforts within the National Park Service

Other national park system units have been involved in management planning efforts for deer and other ungulates. White-tailed deer plans and associated environmental impact statements (EISs) have been completed, and implementation is under way at several park units in the region, including Gettysburg National Military Park and Eisenhower National Historic Site, Valley Forge National Historical Park in Pennsylvania, and Catoctin Mountain Park in Maryland. These parks have similar settings and habitat to what is found at the three battlefields that are the topic of this plan/EIS. Catoctin is approximately 25 miles from Monocacy, and 30 miles from Antietam. Gettysburg is approximately 42 miles from Monocacy, and 50 miles from Antietam.

In addition, Rock Creek Park in Washington, D.C., completed a deer management plan in 2012, and deer management planning and environmental review efforts are in progress at several other parks. The selected alternatives at all parks include sharpshooting to quickly reduce the number of deer, and some parks include reproductive control as a maintenance action to be used once the herd has been reduced to the desired deer density (assuming that there is an available reproductive control agent that is effective and meets use criteria established by the NPS). Gettysburg has the longest history of deer management; sharpshooting started in 1995. Results to date indicate that reducing deer density at Gettysburg has resulted in tree seedling regeneration and recruitment to sapling size and has made a substantial impact on the health of the forest and agricultural crops (Koenig, pers. comm. 2011). After three removal actions that began in 2010, Catoctin has seen a noticeable decrease in deer population, from 123 to 66 deer per square mile, and vegetation monitoring indicates that seedling density has increased since deer management began. Although it is still early to judge the long term impacts of deer management at Catoctin, these results are consistent with an improvement in forest regeneration. However, it is possible that the increases in seedling density are temporary and unrelated to deer management. Continued monitoring will reveal if this trend continues (Donaldson, pers. comm. 2013; Schmit, Parrish, and Campbell et al. 2012).

Deer Management and Research by Other State and Federal Agencies

Direct reduction: Lethal removal of deer; may include sharpshooting or capture/euthanasia.

The Wildlife Services program of the Animal and Plant Health Inspection Service, within the U.S. Department of Agriculture (USDA), has been involved in the evaluation and/or implementation of a number of deer management plans on federal properties in the eastern United States. The USDA Agricultural Research Service Beltsville Agricultural Research Center has been conducting managed deer hunts since 1995. Average annual removal of deer is 200 to 400 (Dudley, pers. comm. 2008, reported in S. Bates, pers. comm. 2008). Studies conducted for the states of New Jersey and Virginia concluded that direct reduction of the deer population was the preferred alternative (USDA 2000a, 2000b). In Pennsylvania the resulting management plan included a wide range of management options to assist landowners with damage control (USDA 2003).

The Mason Neck National Wildlife Refuge (NWR), located in northeastern Virginia, approximately 30 miles from Manassas, has been conducting managed deer hunts since 1989. The refuge is managed as part of the Potomac River NWR Complex, which includes Mason Neck, Occoquan Bay, and Featherstone NWRs. The Occoquan Bay NWR also initiated its first managed deer hunt in 2002. The managed hunts at both NWRs are in response to overabundance of white-tailed deer. The purpose of these hunting programs is to improve the quality of the habitat and protect the nesting habitat for bald eagles (*Haliaeetus leucocephalus*) at Mason Neck and migratory bird species at Occoquan Bay. The refuge hunting program facilitates this goal by reducing the local deer herd through removal of a higher percentage of females and young deer (USFWS et al. 2005a, 2005b, 2005c).

The MD DNR has issued two permits to conduct reproductive control studies, one to the USDA-Wildlife Services for research on the effectiveness of GonaCon™ immunocontraceptive vaccine on female white-tailed deer in the White Oaks Federal Research Center in White Oak, Maryland, just outside Washington, D.C., and the second to the Humane Society of the United States to test the effectiveness of different forms of porcine zona pellucida (PZP) on female white-tailed deer in the National Institute of Standards and Technologies site in Gaithersburg, Maryland, approximately 20 miles south of Monocacy. Animal and Plant Health Inspection Service conducted the research at the White Oak site, which is about 1 square mile in size and has a fenced perimeter that is relatively impermeable to deer. In 2004, female deer were individually darted with an immobilization drug and then treated with a Gonadotropin Releasing Hormone (GnRH) vaccine, GonaCon™. GnRH needs to be injected 8 to 10 weeks prior to rutting. This product has shown 0 to 4 years of effectiveness without boosters in some studies. Twenty-five does were treated and 15 does were marked as a control group. Each doe received a radio collar and ear tags to mark the animals. During the spring following initial treatment, 11 out of 15 control animals had fawns, where only 3 out of the 25 treated does gave birth. In the second year at White Oak, more than half (54%) of the treated does gave birth (Gionfriddo et al. 2009). These numbers give some sense of the current effectiveness of this product, which is discussed in more detail in "Chapter 2: Alternatives."

The National Institute of Standards and Technologies site and the NPS Fire Island National Seashore used PZP in contraceptive control research studies. SpayVac™, a vaccine containing PZP, does not need a booster, but is no longer available on the market. PZP is not currently registered with the Food and Drug Administration (FDA). The FDA is trying to transfer registration responsibility to the U.S. Environmental Protection Agency (EPA). Registration for non-research use may be available in five or more years.

SCOPING PROCESS AND PUBLIC PARTICIPATION

Regulations implementing National Environmental Policy Act (NEPA) require an "early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action." To determine the scope of issues to be analyzed in depth in this plan, meetings were conducted with park staff and other parties associated with preparing this document. As a result of this scoping effort, several issues were identified as requiring further analysis in this plan/EIS. These issues represent existing concerns as well as concerns that might arise during consideration and analysis of alternatives. The scoping process is fully described in "Chapter 5: Consultation and Coordination."

The issues and impact topics developed during scoping are presented further in "Issues and Impact Topics." These issues formed the basis for the impact topics discussed in chapters 3 and 4 of this plan/EIS.

INTERNAL SCOPING AND PLANNING

An internal scoping meeting was held in October 2010 to initiate the plan/EIS process (discussed in more detail in chapter 5), and to establish the purpose of the plan, as well as need and objectives, and to begin discussion of the alternatives. The planning team met again in December 2011 to review science team and public input and to develop the alternatives that are considered in this plan/EIS. The internal scoping process is documented in reports that are available in the administrative record and is further described in "Chapter 5: Consultation and Coordination."

SCIENCE TEAM

The NPS assembled a science team to evaluate scientific literature and research on the topic of deer management and to provide technical support for establishing a monitoring protocol for park deer populations and other park resources and a basis for the resource thresholds at which deer management strategies would be implemented. The team was composed of scientists and other specialists from a variety of state and federal government organizations (see "List of Preparers and Consultants" in chapter 5). The first science team meeting was held on July 14, 2011, and two additional meetings were held on August 1, 2011, and on September 6, 2011. Science team members provided input on alternatives development and adaptive management thresholds and actions. During the calls, participants discussed alternative options considered in preliminary scoping (including options dismissed and options to be considered for inclusion with larger alternative concepts), issues such as CWD and tickborne diseases. Also discussed were thresholds for action relating to forest regeneration and deer density. Science team meeting notes and the science team report are included in the administrative record for this plan/EIS.

PUBLIC SCOPING AND OUTREACH

Public scoping meetings were held in May 2011 at each of the parks following release in March 2011 of a public scoping newsletter for the draft plan/EIS, with the public comment period held open through the beginning of September 2011. The official notice of intent was published in the Federal Register on July 19, 2011.

> *Public scoping meetings were held in May 2011 and the public comment period was held open through the beginning of September 2011. During the scoping period, nearly 200 correspondences were received.*

During the scoping period, nearly 200 correspondences were received. A substantial number of commenters opposed trapping of white-tailed deer or lethally managing the white-tailed deer population. Several commenters supported lethal management, advocated use of managed hunts, or supported reproductive control options. Still others provided alternative elements to be considered in addition to those included in the scoping newsletter. Additional information regarding public scoping is available in "Chapter 5: Consultation and Coordination."

ISSUES AND IMPACT TOPICS

Issues identified by the interdisciplinary team regarding potential impacts from deer or deer management actions are discussed below. These issues formed the basis for the impact topics discussed in chapters 3 and 4 of this plan/EIS.

IMPACT TOPICS RETAINED FOR FURTHER ANALYSIS

Vegetation (Including Important Communities, Wetlands, and Invasive Plant Species)

An overabundance of deer are affecting forest regeneration patterns in the parks, as well as the diversity of species within the parks, by reducing the understory and affecting the natural diversity of dominant tree species. Studies of deer impacts at the Maryland battlefields demonstrated that all plots were below the level of seedling density that is required for forest regeneration under current high deer densities. Similar studies at Manassas showed that deer have significant effects on forest structure and seedling survival rates. These impacts can be directly attributed to deer browsing and indicate deer are affecting the integrity of the understory structure and species composition, diminishing the value of habitat for other wildlife. While the browse line is not as distinct at Antietam as at the other two battlefields, trends indicate that an unmanaged deer population could lead to these problems, as are currently being faced by similar eastern national parks such as Catoctin Mountain Park in Maryland. Furthermore, park observations of impacts on crops indicate that deer will eat corn and other planted row crops, with damage affecting desired cultural landscape plantings. Finally, there are some important communities and special vegetation present at the battlefields that are of concern, including state-designated communities at Manassas and witness trees (trees present during the American Civil War).

White-tailed Deer

Maintaining a viable deer population while protecting other park resources within the parks is important to the NPS. The parks have monitored the population trends and density of the deer population through distance sampling, and survey results in all parks indicate an overabundance of deer. Although high deer densities may adversely affect plants and other wildlife species, deer themselves are an important resource. It is important that this plan maintain a deer population in the parks while taking action to reduce adverse effects on the deer population itself.

Piebald Deer at Monocacy

In addition to the reduction in the population, the proposed actions may also impact the movement and behavior of the deer population. Fencing, the use of darts for reproductive control treatments, or any lethal actions, could cause deer to avoid certain areas in the parks, and implementation of certain reproductive controls also could result in unanticipated physiological and behavioral changes within the deer population.

CWD, although not found in the battlefields, is a potential future concern for the battlefields and the deer within them. CWD is a fatal neurological disease that affects behavior and body condition and has been identified in both free-ranging and captive white-tailed deer, mule deer, elk, and moose. Although not studied in white-tailed deer populations, CWD prevalence in mule deer can exceed 20% in deer populations, increase mortality, and contribute to lower population growth rates (Miller et al. 2008). Under appropriate conditions, this could lead to the local extirpation of deer (Almberg et al. 2011).

The closest known cases of CWD to the three parks are in white-tailed deer in Slanesville, West Virginia, in Maryland in Green Ridge State Forest, and a recent case of CWD found in a captive deer in New Oxford, Pennsylvania, near Gettysburg National Military Park. Green Ridge State Forest is approximately 10-20 miles north of Slanesville and across the Potomac River. These occurrences place CWD within 36 miles of Antietam, 39 miles of Monocacy, and 51 miles of Manassas. While much is still unknown about the spread of the disease and the long-term effects, there is currently no evidence that the disease can be transmitted to humans or domestic livestock.

Other Wildlife and Wildlife Habitat

At certain levels, deer overabundance adversely affects other wildlife and/or habitat indirectly by altering habitat and decreasing heterogeneity of the forest and plant structure through activities such as browsing, trampling, and seed dispersal. Studies have linked high deer densities to undesirable effects on other wildlife species, such as migratory and forest interior dwelling bird species (deCalesta 1994; McShea 2000; McShea and Rappole 2000; Newson et al. 2011). A study in 1996–1997 at Cuyahoga National Park documented impacts of deer density on forest songbirds, showing that in areas of high deer density, the abundance of songbirds was less than in low-density areas (Petit 1998).

American Goldfinch at Manassas

Although there are currently no park-specific data to verify that impacts on the habitats of these forest interior dwelling species have occurred from deer browsing, in their study that looked at population declines of woodland birds in lowland England, Newson et al. (2011) reviewed several studies indicate that overabundance of deer adversely impact bird populations (2011). Deer management activities could also impact other wildlife and wildlife habitat. The use of bait piles could provide an additional food source for some species, while fencing could restrict access to certain wildlife habitat. In addition, the presence of increased human activities and associated noise during specific time periods could result in temporary behavior changes and the avoidance of management areas. Deer can also affect small mammal populations through competition for food such as acorns (McShea and Rappole 2000), and browsing may affect herpetofauna (reptiles and amphibians) and invertebrates, although these impacts have not been well studied (Greenwald, Petit, and Waite 2008).

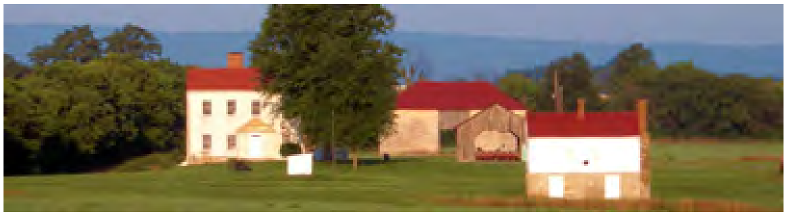
Special Status Species

No federally endangered or threatened species occur in the parks (see the “Issues and Impact Topics Considered but Dismissed from Further Analysis” section in this chapter). However, there are special status plant species (state-listed threatened or endangered species, rare and unusual species, or special status species) confirmed within the battlefields. Some of these could be affected by deer overbrowsing (direct impacts on plants or change in habitat) and/or by deer management actions that disturb the understory or involve foot traffic and trampling. Additional details regarding these species are contained in “Chapter 3: Affected Environment.” Antietam has 33 state-listed plant species, and Monocacy has 9; Manassas has 6 plants and 20 state-listed animals, mostly birds.

Cultural Landscapes

In some cases the presence and activities of high numbers of deer may affect the character of the cultural landscapes of the parks. A cultural landscape is defined by the Secretary of the Interior’s standards as a geographic area (including both cultural and natural resources and the wildlife or domestic animals therein) associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values (NPS 1996). Agricultural special use permits are issued to farmers at all three parks as a means of managing the cultural landscapes and maintaining land use similar to what was present at the time of the battles. Antietam and Monocacy have cropland, hay, and grazing, while Manassas has hay crops. Deer browsing impacts the cultural landscapes within the battlefields by changing vegetation patterns and affecting crop yield, crop appearance, and economic and/or feed value return to the farmers. Additionally, certain deer management activities that result in fence construction or landscape alteration (e.g., vegetation changes) could impact the parks' cultural landscapes.

Neighboring Land Use/Socioeconomics (agricultural leases, crops, landscaping)


Best Farm at Monocacy

Impacts from deer browsing could affect park neighbors, as well as farmers who operate on NPS land at the battlefields under special use permits, by causing damage to landscaping and crops, which would have economic consequences. Damage to landscaping from deer could result in the need to replace ornamental vegetation in and on lands around the parks, causing aesthetic and economic impacts. Agricultural special use permit holders have erected fences to protect crops from deer, and farmers on land surrounding the parks make use of depredation permits that allow deer to be shot out of season if there is evidence of deer-caused damage to crops, although NPS agricultural cooperators do not use depredation permits on leased tracts within the parks. Individual land owners and Homeowners Associations have complained about impacts at Manassas (Gorsira, pers. comm. 2010), and Antietam and Monocacy report that neighbors and farmers within the parks have switched crops due to deer damage. Many are now growing milo (sorghum), rather than corn (Banasik and Wenschhof, pers. comm. 2010).

Visitor Use and Experience

If deer management activities were to decrease the number of deer in the parks, chance sightings by visitors would also decrease. Some visitors to the parks may view deer sightings as an integral part of their visit. Deer management actions may decrease the potential for visitors to observe deer within the parks, causing less visitor satisfaction. Conversely, an overabundance of deer may decrease visitor satisfaction because deer browsing would prevent successful restoration of the landscape as a whole. An overabundance of deer may also have an indirect impact on other park visitors by altering the habitat of other species (i.e., changing the understory so that there are fewer migratory birds) and changing the visitor experience for those visitors who come to see species within that habitat. Increased deer browsing has the potential to impact these other resources and impact the satisfaction of these visitors.

Proposed deer management activities may require certain areas of the parks to be closed to the general public during management activities, affecting visitor use and experience as well.

Health and Safety

Various health and safety concerns could result from implementation of the alternatives described in this plan/EIS. Health and safety applies to park visitors, local residents, and park employees and volunteers. All deer management activities would need to be conducted in a manner that would ensure the safety of park visitors, employees, local residents, and volunteers.

A primary safety issue for visitors and local residents related to this plan involves injuries from deer-vehicle collisions. High densities of deer could affect the safety of visitors, employees, and volunteers using park roads. Several studies have shown that deer-vehicle collisions increase as local deer populations increase (DeNicola and Williams 2008; Rutberg and Naugle 2008).

Deer-related diseases may also pose health risks to park visitors or area residents. Black-legged ticks (*Ixodes scapularis*), also known commonly as deer ticks, carry Lyme disease, and deer and rodents are preferred hosts depending on the stage of the tick's life cycle. Mice are the principal reservoirs of the spirochete *Borrelia burgdorferi*, the agent for Lyme disease. Though the deer cannot transmit the disease to humans or ticks, a high deer population provides more hosts and there is concern that this could support a higher than normal tick population compared to lower deer densities (CDC 2007).

Park Management and Operations

Park Staff Monitoring Damage to Vegetation by Deer

Deer management activities have the potential to impact staffing levels and the operating budget necessary to conduct park operations. Park management and operations refers to the current staff available to adequately protect and preserve vital park resources and provide for an effective visitor experience. Natural resource management staff currently devote a sizeable portion of their time to deer management activities, which include annual fall spotlight surveys, vegetation monitoring, and data management and analysis, and they would have even more responsibilities under any of the alternatives considered. Additional deer management activities undertaken by park staff could affect other areas of park operations. Deer management actions at the parks would also require staff time for coordination with the appropriate local and private entities and interpretation/public education.

Issues and Impact Topics Considered but Dismissed From Further Analysis

The following issues were reviewed and subsequently eliminated from further discussion because potential deer management strategies would cause few, if any, changes to these resources.

Soils

Continued overbrowsing by deer is expected to result in continued loss of vegetation cover, possibly leading to increased soil erosion and runoff. Reducing deer population numbers through the implementation of alternatives C and D, resulting in an increase in vegetation cover, may decrease soil erosion and runoff, a beneficial impact. Alternatives A and B would have adverse impacts due to continued deer browsing and associated loss of vegetation cover that holds soils in place. However, these impacts would not be at a scale great enough to be measured or evaluated in this plan/EIS, and the impacts from deer browsing alone are hard to discern from other forces that contribute to compaction or erosion of soils in the parks. Similarly, implementing the proposed alternatives may increase soil disturbance due to human activities when constructing exclosures or when removing or tracking deer or conducting deer population surveys. During these activities, soils would primarily be subject to the trampling or shearing forces of human footfalls, but any soil compaction or erosion from these activities would be short term, localized, and negligible, and similar to the effects of routine maintenance actions.

Because adverse impacts on soils attributable to deer and deer management would be hard to discern, the topic of soils was dismissed from further analysis.

Water Resources (Quality or Quantity)

Human activities when conducting deer management alternatives may result in increased erosion and soil runoff, leading to short-term minor impacts on water quality. Loss of vegetation cover due to overbrowsing by deer would continue to occur under alternatives A and B, and deer trails would continue to be noticeable across the streams, which could result in increased soil erosion and sedimentation, resulting in small localized adverse effects on water quality, although it would be difficult to discern which impacts would be attributable to deer, and which impacts would be associated with other causes. There is insufficient information to assess the potential impact on water quality from deer feces, but the increase in bacterial contamination is likely not significant in comparison to non-point runoff sources such as livestock, fertilizers, and residential septic systems. Lethal and reproductive control of deer population numbers, as proposed in alternatives C and D, would reduce vegetation loss, thus reducing the potential for soil erosion and sedimentation of park streams, resulting in long-term beneficial impacts on water quality. None of the alternatives would be expected to affect water quantity. Because adverse impacts on water resources attributable to deer would not be discernable, water resources was dismissed from further analysis.

Soundscapes

Management strategies, especially sharpshooting, could affect visitors and wildlife because of associated noise. Deer population and vegetation monitoring activities along with the construction/maintenance of fencing would be consistent with the parks' current ambient (i.e., background) noise levels. The impacts would be limited mainly to the temporary displacement/disturbance as a result of the noise associated with these activities. As a result, the adverse impacts would not be particularly discernable. Few noise impacts would be expected from administering reproductive control options. There would be some noise resulting from vehicles used to set up bait stations, construction activities to set up holding pens, and firing of dart guns. The noise generated by these activities would likely result in temporary, localized disturbance only. For those alternatives that include the use of firearms, any firearm noise would be temporary, and it is unlikely that firearm noise would be substantial. Although firearm use could occur at night, when background noise is reduced, suppressors would be used to reduce noise from firearm discharges. In addition, deer management activities encompassing firearm use would take place primarily during late fall and winter months, when fewer visitors are in the parks. Noise impacts on visitors are addressed in conjunction with the Visitor Use and Experience topic. Because noise impacts related to deer management would be short term, very localized, and small in scale, and the Visitor Use and Experience topic considers noise, the impact topic of soundscapes was dismissed from detailed analysis.

Air Quality

Section 118 of the 1963 Clean Air Act (42 USC 7401 et seq.) requires a national park system unit to meet all federal, state, and local air pollution standards. Further, the Clean Air Act provides that the federal land manager has an affirmative responsibility to protect air quality–related values (including visibility, plants, animals, soils, water quality, cultural resources, and visitor health) from adverse pollution impacts. NPS *Management Policies 2006* directs NPS to seek the best air quality possible in its park units in order to "preserve natural resources and systems; preserve cultural resources; and sustain visitor enjoyment, human health, and scenic vistas" (NPS 2006a).

Deer management activities as described under the proposed alternatives would result in few impacts on air quality. Although some activities, such as vehicle and gun use, can create small amounts of emissions, these would be very limited and short term, with little or no effect on regional air quality. Therefore, air quality was dismissed as an issue.

Prime or Unique Farmland

No “unnecessary and irreversible conversion of farmland to nonagricultural uses” (Farmland Protection Policy Act of 1980) is expected under this plan. Thus, no impacts on prime and unique farmlands are expected.

Paleontological Resources

Paleontological resources (fossils and their associated data) are a major source of evidence of past life. Although there may be paleontological resources at the parks, no significant fossils have been discovered, and such resources would not be affected by most deer management actions. Similar to archeological resources, construction monitoring would occur in potentially sensitive areas subject to subsurface excavation, and should any paleontological resources be discovered, fencing installation would stop, and further evaluation of the resources would occur. Therefore, potential impacts on paleontological resources are not analyzed in further detail.

Floodplains

The NPS *Procedural Manual 77-2: Floodplain Management* (NPS 2002a) provides agency-specific guidance for implementing Executive Order 11988, “Floodplain Management.” According to the guideline, an action class and applicable regulatory floodplain must be identified for a proposed action that is either subject to possible harm from flooding or has the potential for adverse floodplain impacts.

No occupancy, modification, or development of floodplains is expected under this plan. The removal of ground vegetation through deer browsing could increase stormwater runoff, which could contribute to flood events. However, the expected increase in runoff due to browsing would be small and difficult to discern. Therefore, this topic was dismissed from further analysis.

Cultural Resources Other Than Cultural Landscapes

The term “cultural resources” includes historic structures, archeological resources, museum collections, ethnographic resources, and cultural landscapes. Cultural landscapes are included for detailed analysis in this plan/EIS, as previously noted. The other types of cultural resources of the parks were dismissed from detailed analysis, as further explained below.

Historic Structures

According to Director’s Order 28: Cultural Resource Management, structures are defined as material assemblies that extend the limits of human capability. In plain language, this means a constructed work, usually immovable by nature or design, consciously created to serve some human activity. Examples are buildings, monuments, dams, roads, railroad tracks, canals, millraces, bridges, tunnels, locomotives, nautical vessels, stockades, forts and associated earthworks, Indian mounds, ruins, fences, and outdoor sculpture. Although the battlefields contain historic structures, they would not be affected by deer browsing impacts or by proposed actions related to managing deer.

Archeological Resources

Archeological resources, a type of cultural resources, are the remains of past human activity. The discipline of archeology documents the scientific analysis of these remains. Implementation of some of the proposed actions would have the potential to disturb archeological resources, but measures would be taken to avoid or minimize adverse effects. Archeological surveys would be conducted and any proposed fencing would be located away from known sites. Additionally, construction monitoring would occur in potentially sensitive areas subject to subsurface excavation. Should any archeological resources be discovered, fencing installation would stop, and resources would be further evaluated and protected. Deer entrails would be buried only if there is an appropriate location that would not disturb archeological sites or potential resources, for example, a previously disturbed area; otherwise, the entrails would be taken off site in barrels. Deer carcasses and waste not suitable for donation for consumption or for surface disposal would continue to be disposed of at an approved local landfill, not on site. Therefore, because any impacts on park archeological resources as a result of deer management activities would be minimal, and measures would be taken to avoid impacts, this topic was dismissed from further analysis.

Ethnographic Resources

Ethnographic resources are landscapes, objects, plants and animals, or sites and structures that are important to a people’s sense of purpose or way of life. Ethnographic resources have a special importance for a specific group of people different from that enjoyed by the public. There are no known ethnographic resources at the three battlefields, and they would not be affected by deer management. Therefore, ethnographic resources was dismissed from further analysis.

Museum Collections

Museum collections (prehistoric and historic objects, artifacts, works of art, archival material, and natural history specimens) would be unaffected by any of the proposed actions. None of the alternatives would affect how museum collections are acquired, accessioned and cataloged, preserved, protected, and made available for access and use. Therefore, this topic was dismissed from further analysis.

Federally Listed Species

There are no federally protected species as determined through Section 7 consultation with the USFWS under the Endangered Species Act that are known to occur in the battlefields.

Fish and Other Aquatic Species

Although there are fish present in battlefields streams, no or negligible impacts on fish are expected. Under alternatives A and B, continued deer overbrowsing could adversely affect the habitat for aquatic species by increasing erosion and soil runoff; however, these impacts are expected to be localized and would not noticeably affect fish and aquatic habitat. Similarly, management activities under all alternatives could result in increased erosion and soil runoff through construction of fencing or trampling, which could lead to temporary small-scale adverse impacts on aquatic habitat if water bodies are nearby. Alternatives C and D would likely reduce the potential for soil erosion and sedimentation of aquatic habitat due to reduced vegetation loss over many years, resulting in long-term beneficial impacts on fish and other aquatic species. Because adverse impacts on fish and other aquatic species would be small, the topic of fish and other aquatic species was dismissed from further analysis.

Neighboring Land Use

Actions taken under this plan have the potential to affect adjacent park neighbors, including farmers and residence owners, but these impacts would be primarily financial and related to potential loss of landscaping or crops. There would be no impacts on land use itself, and minimal noise effects (see discussion of Soundscapes dismissal). Implementation of a white-tailed deer management plan would not affect how surrounding land is used including occupancy, income, ownership, or type of use. Therefore, impacts related to economic effects on park neighbors are discussed in this plan under the socioeconomic resources discussion, and land use was dismissed from further analysis.

Environmental Justice

Presidential Executive Order 12898, General Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires all federal agencies to incorporate environmental justice into their missions by identifying and addressing the disproportionately high and/or adverse human health or environmental effects of their programs and policies on minorities and low-income populations and communities. According to the EPA, 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 laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies. The goal of this "fair treatment" is not to shift risks among populations, but to identify potentially disproportionately high and adverse effects and identify alternatives that may mitigate these impacts (EPA 1997).

The communities surrounding the battlefields contain both minority and low-income populations; however, environmental justice is dismissed as an impact topic for the following reasons:

- The park staff and planning team actively solicited public participation as part of the planning process and gave equal consideration to input from all people regardless of age, race, income status, or other socioeconomic or demographic factors.
- Implementation of the proposed alternative would not result in any identifiable adverse human health effects. Therefore, there would be no direct or indirect adverse effects on any minority or low-income population.
- The impacts associated with implementation of the preferred alternative would not disproportionately affect any minority or low-income population or community.
- Implementation of the preferred alternative would not result in any identified effects that would be specific to any minority or low-income community.
- The impacts on the socioeconomic environment resulting from implementation of any of the action alternatives would be beneficial. In addition, the park staff and planning team do not anticipate the impacts on the socioeconomic environment to appreciably alter the physical and social structure of the nearby communities.

Greenhouse Gas Emissions and Climate Change

There is strong evidence linking global climate change to human activities, especially greenhouse gas emissions associated with the burning of fossil fuels (Intergovernmental Panel on Climate Change 2007). Some of the activities associated with deer management, such as the use of vehicles to assist in carrying out management activities, may result in fossil fuel consumption. However, greenhouse gas emissions associated with the plan would be negligible in comparison to park-related, local, and regional greenhouse gas emissions. Furthermore, implementation of any action alternative that preserves the ability of the forest to replace itself by maintaining its regeneration phase sustains the value that forest has in storing greenhouse gases. Therefore, the issue of the contribution of deer management activities to climate change through greenhouse gas emissions was dismissed from further analysis. As for the impact of climate change on park resources that could be impacted by the project, these potential changes have been addressed under “Vegetation” in chapter 3.

RELATED LAWS, POLICIES, PLANS, AND CONSTRAINTS

NATIONAL PARK SERVICE ORGANIC ACT

By enacting the *Organic Act of 1916*, Congress directed the U.S. Department of the Interior and NPS to manage units of the national park system “to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations” (16 USC 1). The 1978 *Redwood Amendment* reiterates this mandate by stating that the NPS must conduct its actions in a manner that will ensure no “derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress” (16 USC 1 a-1). Congress intended the language of the *Redwood Amendment* to reiterate the provisions of the *Organic Act*, not to create a substantively different management standard. The House Committee report described the *Redwood Amendment* as a “declaration by Congress” that the promotion and regulation of the national park system is to be consistent with the *Organic Act*. The Senate Committee report stated that under the *Redwood Amendment*, “The Secretary has an absolute duty, which is not to be compromised, to fulfill the mandate of the 1916 Act to take whatever actions and seek whatever relief as will safeguard the units of the national park system.” Although the *Organic Act* and the *Redwood Amendment* use different wording (“unimpaired” and “derogation”) to describe what the NPS must avoid, both acts define a single standard for the management of the national park system—not two different standards. For simplicity, NPS *Management Policies 2006* uses “impairment,” not both statutory phrases, to refer to that single standard.

Park managers must also not allow uses that would cause unacceptable impacts (NPS 2006a, Section 1.4.7, 12). These are impacts that fall short of impairment, but are still not acceptable within a particular park’s environment. For the purposes of these policies, unacceptable impacts are impacts that, individually or cumulatively, would

- be inconsistent with a park’s purposes or values, or
- impede the attainment of a park’s desired future conditions for natural and cultural resources as identified through the park’s planning process, or
- create an unsafe or unhealthful environment for visitors or employees, or
- diminish opportunities for current or future generations to enjoy, learn about, or be inspired by park resources or values, or

- unreasonably interfere with
  - park programs or activities, or
  - an appropriate use, or
  - the atmosphere of peace and tranquility, or the natural soundscape maintained in wilderness and natural, historic, or commemorative locations within the park, or
  - NPS concessioner or contractor operations or services.

Because park units vary based on their enabling legislation, natural resources, cultural resources, and missions, management activities appropriate for each unit, and for areas in each unit, vary as well. An action appropriate in one unit could impair or cause unacceptable impacts on resources in another unit.

NATIONAL PARK SERVICE MANAGEMENT POLICIES 2006

Several sections from the NPS *Management Policies 2006* (NPS 2006a) are relevant to deer management in the parks, as described below.

NPS *Management Policies 2006* instruct park units to maintain as parts of the natural ecosystems of parks all native plants and animals. The NPS achieves this maintenance by "preserving and restoring the natural abundances, diversities, dynamics, distributions, habitats, and behaviors of native plant and animal populations and the communities and ecosystems in which they occur" (NPS 2006a, Section 4.4.1).

Deer management activities are supported by Section 4.1 of the NPS *Management Policies 2006*, which state that "biological or physical processes altered in the past by human activities may need to be actively managed to restore them to a natural condition or to maintain the closest approximation of the natural condition when a truly natural system is no longer attainable. Prescribed burning and the control of ungulates when predators have been extirpated are two examples."

Furthermore, the NPS "will adopt park resource preservation, development, and use management strategies that are intended to maintain the natural population fluctuations and processes that influence the dynamics of individual plant and animal populations, groups of plant and animal populations, and migratory animal populations in parks" (NPS 2006a, Section 4.4.1.1).

Whenever the NPS identifies a possible need for reducing the size of a park plant or animal population, the decision will be based on scientifically valid resource information that has been obtained through consultation with technical experts, literature review, inventory, monitoring, or research (NPS 2006a, Section 4.4.2.1). The science team was assembled to complete this task.

Section 4.4.2 of the NPS *Management Policies 2006* also states:

> Whenever possible, natural processes will be relied upon to maintain native plant and animal species and influence natural fluctuations in populations of these species. The NPS may intervene to manage individuals or populations of native species only when such intervention will not cause unacceptable impacts on the populations of the species or to other components and processes of the ecosystems that support them. The second is that at least one of the following conditions exists (NPS 2006a, Section 4.4.2):

- Management is necessary
  - because a population occurs in unnaturally high or low concentration as a result of human influences (such as loss of seasonal habitat, the extirpation of predators, the creation of highly productive habitat through agriculture or urban landscapes) and it is not possible to mitigate the effects of the human influences
  - to protect specific cultural resources
  - to protect rare, threatened, or endangered species

Section 4.4.2.1 of the NPS *Management Policies 2006* states:

> Where visitor use or other human activities cannot be modified or curtailed, the [NPS] may directly reduce the animal population by using several animal population management techniques, either separately or together. These techniques include relocation, public hunting on lands outside a park or where legislatively authorized within a park, habitat management, predator restoration, reproductive intervention, and destruction of animals by NPS personnel or their authorized agents. Where animal populations are reduced, destroyed animals may be left in natural areas of the park to decompose unless there are human safety concerns regarding attraction of potentially harmful scavengers to populated sites or trails or other human health and sanitary concerns associated with decomposition (NPS 2006a, sec. 4.4.2.1).

Director's Order 12: Conservation Planning, Environmental Impact Analysis, and Decision Making and Handbook

NPS Director's Order 12 (NPS 2011c), updated in 2011, and its accompanying handbook (NPS 2001) for the earlier version of the Director's Order 12 lay the groundwork for how the NPS complies with NEPA. Director's Order 12 and the handbook set forth a planning process for incorporating scientific and technical information and establishing a solid administrative record for NPS projects.

NPS Director's Order 12 requires that impacts on park resources be analyzed in terms of their context, duration, and intensity. It is crucial for the public and decision makers to understand the implications of those impacts in the short and long term, cumulatively, and within context, based on an understanding and interpretation by resource professionals and specialists.

National Environmental Policy Act of 1969, as Amended

NEPA Section 102(2)(c) requires that an EIS be prepared for proposed major federal actions that may significantly affect the quality of the human environment.

Natural Resources Reference Manual, NPS-77 (1991, in transition)

The *Natural Resource Reference Manual 77* (NPS 1991, in transition), which supersedes the 1991 NPS 77: *Natural Resource Management Guideline*, provides guidance for NPS employees responsible for managing, conserving, and protecting the natural resources found in national park system units.

DIRECTOR'S ORDER 28: CULTURAL RESOURCE MANAGEMENT (2002)

This Director's Order (NPS 2002b) sets forth the guidelines for management of cultural resources, including cultural landscapes, archeological resources, historic and prehistoric structures, museum objects, and ethnographic resources. This order calls for the NPS to protect and manage cultural resources in its custody through effective research, planning, and stewardship in accordance with the policies and principals contained in the NPS *Management Policies 2006*.

OTHER LEGISLATION, COMPLIANCE, AND NPS POLICY

Endangered Species Act of 1973, as Amended

The purpose of the Endangered Species Act is to conserve "the ecosystems upon which endangered and threatened species depend" and to conserve and recover listed species. Under the law, species may be listed as either "endangered" or "threatened." Endangered means a species is in danger of extinction; threatened means a species is likely to become endangered. All federal agencies are required to protect listed species and preserve their habitats. The law also requires federal agencies to consult with the USFWS to ensure that the actions they take, including actions chosen under this deer management plan, will not jeopardize listed species.

National Historic Preservation Act of 1966, as Amended

Section 106 of the National Historic Preservation Act (NHPA) requires that federal agencies consider the effects of their undertakings on properties listed or potentially eligible for listing in the NRHP. All actions affecting the park's cultural resources must comply with this regulation.

Historic Sites, Buildings, and Antiquities Act, 1935

The Historic Sites, Buildings, and Antiquities Act establishes "national policy to preserve for public use historic sites, buildings and objects of national significance." It gives the Secretary of the Interior broad powers to protect these properties, including the authority to establish and acquire nationally significant historic sites.

Federal Noxious Weed Act, 1975

The Federal Noxious Weed Act (7 USC 2801-2814, January 3, 1975, as amended 1988 and 1994) provides for the control and management of nonindigenous weeds that injure or have the potential to injure the interests of agriculture and commerce, wildlife resources, or the public health. Since actions of deer or management actions could affect the distribution of noxious weeds through seed dispersal, this act was considered in the development of this plan.

Code of Federal Regulations, Title 43

Title 43 of the Code of Federal Regulations (CFR) part 24 describes the four major systems of federal lands administered by the Department of the Interior.

In addition, Section 24.4 (i) instructs all federal agencies of the Department of the Interior, among other things, to "[p]repare fish and wildlife management plans in cooperation with State fish and wildlife agencies and other Federal (non-Interior) agencies where appropriate." It also directs agencies to "[c]onsult with the States and comply with State permit requirements … except in instances where the

Secretary of the Interior determines that such compliance would prevent him from carrying out his statutory responsibilities."

Code of Federal Regulations, Title 36

Title 36, Chapter 1, provides the regulations "for the proper use, management, government, and protection of persons, property, and natural and cultural resources within areas under the jurisdiction of the National Park Service" (36 CFR 1.1(a)). This includes wildlife management, hunting and permits.

Executive Order 11990, Protection of Wetlands

Executive Order 11990 directs federal agencies to avoid to the extent possible the long- and short-term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative.

Executive Order 11988, Floodplain Management

This executive order directs federal agencies to avoid, to the extent possible, long- and short-term impacts associated with occupying and modifying floodplains through development, where a practicable alternative exists.

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations

The NPS must address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities, including planning projects, on minority populations and low-income populations.

Executive Order 13112, Invasive Species

This executive order requires the NPS to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause.

Migratory Bird Treaty Act of 1918

The Migratory Bird Treaty Act of 1918 implements various treaties and conventions between the United States and Canada, Japan, Mexico, and the former Soviet Union for the protection of migratory birds. Under this act it is prohibited, unless permitted by regulations, to "pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess…any migratory bird, included in the terms of this Convention…for the protection of migratory birds…or any part, nest, or egg of any such bird" (16 USC 703). Since actions of deer or management actions could affect habitat for or disturb migratory birds, this act was considered in the development of this plan.

Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds

Executive Order 13186 was established on the premise that migratory birds contribute to biological diversity, bring enjoyment to millions of Americans, and are of great ecological and economic value to this county and to other countries. Under this order, federal agencies taking actions that have, or are likely to have, a measurable negative effect on the migratory bird population are directed to develop and implement a Memorandum of Understanding with the USFWS that promotes the conservation of migratory bird populations. This executive order also requires that the environmental analysis of federal actions required by NPS or other established environmental review processes evaluate the effects of the action and agency plans on migratory birds, with an emphasis on special status species. A memorandum of understanding between the USFWS and NPS is currently in place.

Animal Welfare Act, as Amended (7 USC, 2131-2159)

The Animal Welfare Act requires that minimum standards of care and treatment be provided for certain animals bred for commercial sale, used in research, transported commercially, or exhibited to the public. Individuals who operate facilities in these categories must provide their animals with adequate care and treatment in the areas of housing, handling, sanitation, nutrition, water, veterinary care, and protection from extreme weather and temperatures. Although federal requirements establish acceptable standards, they are not ideal. Regulated businesses are encouraged to exceed the specified minimum standards. Deer management alternatives that include trapping, euthanasia, or administration of reproductive controls could be regulated by this act.

RELATIONSHIP TO OTHER PLANNING DOCUMENTS FOR THE THREE BATTLEFIELDS AND ADMINISTERED UNITS

GENERAL MANAGEMENT PLANS

Antietam National Battlefield General Management Plan/Final Environmental Impact Statement (1992)

The NPS approved the GMP (NPS 1992) for Antietam National Battlefield in August 1992, and implementation continues on most elements of the plan. The purpose of this plan is to provide for future management, use, and interpretation of the area in ways that will best serve visitors while preserving the historic character and appearance of the battlefield.

The GMP identifies a number of issues and concerns identified by the public, other agencies, and the NPS. Of these issues and concerns, those related to natural resources, expressed as follows, would be considered when developing potential deer management plans: the woods, creek, and other natural features within the battlefield that contribute to its pastoral setting; preservation of these natural features is an important goal of planning.

To this extent the NPS preferred alternative called for reestablishing vegetation patterns on the battlefield (farm fields, woods, and orchards) to resemble conditions just before the battle, and also provided specific natural resource management actions to increase habitat for sensitive species. Ultimately, the restoration of Antietam National Battlefield to 1862 conditions would increase the diversity of wildlife habitat at the park unit. The GMP did note that orchards might attract deer, which could require that young trees be fenced.

Monocacy National Battlefield General Management Plan/EIS (2009)

In 2009, the NPS finalized the Monocacy National Battlefield General Management Plan/EIS (NPS 2009f) with adoption of the “Abbreviated Final General Management Plan/Environmental Impact Statement,” that incorporates the 2008 draft management plan by reference. The purpose of this management plan is to guide the decision making and problem solving related to resource protection and the visitor experience at Monocacy National Battlefield. The approved plan provides a framework for proactive decision-making, including decisions about visitor use and the management of natural and cultural resources and development.

The GMP/EIS identifies several planning issues related to preserving the battlefield landscape and protecting important natural resource areas. It also recognizes the contributions that natural resources make to the landscape of Monocacy National Battlefield, and identifies several external threats to these resources. At issue is finding ways to preserve the landscape and enhance the qualities that make it significant while at the same time minimizing effects on resources from surrounding development (NPS 2009f). In addition, the GMP/EIS identifies the effects of deer browsing as an issue because it can alter the historic appearance at the battlefield by forcing farmers to change agricultural practices to those less favorable to the deer. Browsing also can alter regrowth in forested areas, further changing the prominent historic patterns and suppressing the regeneration of native trees (NPS 2009f). The GMP/EIS also states that natural resources provide considerable resource value aside from their important role in the cultural landscape. Although the primary management direction for the national battlefield is to protect and preserve the historical values, the natural resource areas also require considerable attention because they are important to the region's ecology (NPS 2009f). Natural resource areas are also important, as stated in NPS-77 Natural Resource Management Guidelines,

> For historic zones in parks where a historical perspective is not essential to the management goals or original purposes for the area, or the intent of the enabling legislation, the area should be managed as a natural area to the largest extent possible and consistent with Sections 106 and 110 of the National Historic Preservation Act (NPS 1991).

Manassas National Battlefield Park: Final General Management Plan/Environmental Impact Statement (April 2008)

Within the GMP, the NPS proposed alternatives to promote the continued longevity, enjoyment, and historic preservation of the park. These alternatives considered the natural environment (including air quality, soundscapes, vegetation, wildlife, and water resources); cultural environment (including historic structures, cultural landscapes, and archeological resources); transportation and traffic (including roadway characteristics, traffic counts, and level of service, safety, and emergency response); socioeconomic environment (including population, economy, employment, per capita income, and poverty); recreation; visitor experience (including visitation use and patterns, visitor profile, and projection of future use); and park operations and maintenance.

White-tailed deer are identified as one of the most prominent wildlife species found within the park, and are discussed at length in the wildlife section. The report indicates that deer pose a number of resource management challenges in the park because of their impacts on the vegetative community. The large deer population has impacted the ability of the park to reforest historically wooded areas, establish streamside buffers, and create vegetative buffers from development. The foraging activity disrupts natural forest succession processes in the park and removes woody vegetation cover needed for ground-nesting birds. At the time the report was written, the park maintenance division estimated that deer consume between 75 and 90% of newly installed perennials and annuals. The report indicates that the 2008 deer density of 67 deer per square kilometer greatly exceeds the estimated carrying capacity of 15.4 deer per square kilometer for the Virginia Piedmont. The plan reports the results of the deer exclosure studies started in 2000, which indicate that deer are having a substantial adverse impact on the structure and woody seedling composition of forests in the park. In each forest type, the forb cover and vertical plant cover were suppressed, and the species richness and seedling survival rates were reduced. In addition, private property owners and local governments in the vicinity have expressed concern about the deer population.

Manassas National Battlefield Park, Park Operations Plan (2009)

The Park Operations Plan for Manassas National Battlefield Park lays out operations goals and a work plan for the park. Priority goals include expanded interpretation programs at the park and observation of the 150th anniversary of the Civil War and the battles at Manassas, as well as promotion of stewardship and rehabilitation and protection of landscapes within the park. Although deer management contributes to proper management and protection of landscapes, deer are not discussed in this plan (NPS 2009b).

RESOURCE MANAGEMENT PLANS / RESOURCE STEWARDSHIP STRATEGIES/ RESOURCE CONDITION ASSESSMENTS

All three battlefields have resource management plans that describe strategies for management of important resources at the parks, and more recently completed resource condition assessments (RCAs), in which key park habitats are defined, and important resource issues are explored. A Resource Stewardship Strategy report has also been completed for Monocacy. Relevant information from these reports is summarized below.

Antietam National Battlefield Resources Management Plan (1995)

The Resources Management Plan (NPS 1995a) provides a specific management objective for the landscape and resources at the battlefield:

> The Antietam National Battlefield will be managed to provide for the restoration and preservation of the battlefield landscape to substantially the condition in which it was on the eve of the Battle of Antietam. The preserved battlefield will include within a natural setting those essential features of the rural agricultural landscape (cultural landscape) which existed at the time (e.g., orchards, fences, field patterns, woods), remaining historic structures and resources, and those post-battle elements necessary for the administration, commemoration and visitor understanding of the battlefield (e.g., monuments, visitor and administrative structures and facilities, roads).

The plan also contains a project statement titled “Integrated Pest Management” that addresses impacts on vegetation from white-tailed deer and suggests a monitoring program early while deer impacts are still low. A separate project statement recommends an annual monitoring program for population numbers and construction of exclosures to monitor changes in natural vegetation and crop fields resulting from deer browsing.

Antietam Natural Resource Condition Assessment (2011)

The Natural Resource Condition Assessment for Antietam (NPS 2011j) defines key habitats in the park, including both natural and agricultural habitats, and looks at such issues as water quality, connectivity of forest patches, and the potential for supporting populations of forest interior dwelling bird species. Among other issues, including non native and invasive species, the report discusses the high deer density at the park and the impacts the deer population is having on the natural and agricultural resources of the park. The report recommends actions to monitor and improve the condition of these habitats and resources.

Monocacy National Battlefield Resource Management Plan (1993)

The Resource Management Plan for Monocacy National Battlefield (NPS 1993) provides specific management objectives for the landscape and resources at the battlefield:

- preserve and protect as a cultural resource the historic battlefield scene as well as the significant historic structures and archeological resources therein;
- provide visitor orientation to the park resources and interpretation of the battle at Monocacy in relation to the American Civil War; and
- preserve and protect the natural resources in the area and allow public use of these resources in such a manner that is compatible with the legislative intent of the battlefield.

The plan addresses the damage by white-tailed deer to row crops that are planted to maintain the cultural landscape of the battlefield. The plan recommends protocols, monitoring, and aerial observations of deer populations and trends of impacts on vegetation.

Monocacy National Battlefield Resource Stewardship Strategy (2010)

The Resource Stewardship Strategy for Monocacy sets forth a comprehensive strategy for stewardship and management of both natural and cultural resources at the battlefield, which is particularly important at all the battlefields in this plan/EIS, as the natural and cultural landscapes are crucial to understanding the battles these parks commemorate. The strategy specifically mentions the need for deer management to preserve the park's biodiversity and protect battle-related landscapes.

Monocacy National Battlefield – Natural Resource Condition Assessment (2011)

The Monocacy RCA (NPS 2011k) follows the Resource Stewardship Strategy, and defines the key habitats within the park, including those habitats managed for natural resource values, and those managed for agricultural values, and then evaluates the condition of the natural resources within the battlefield. The assessment looks at such issues as water quality, connectivity of forest patches, and the potential for supporting populations of forest interior dwelling bird species. The assessment also speaks to the high deer populations and the stress they are placing on both the natural and agricultural habitats throughout the park. Among other measures, the RCA recommends implementation of deer reduction strategies to alleviate the stress on important habitats at the park.

Manassas National Battlefield Park Natural Resources Management Plan (2006 Draft)

The Resource Management Plan (NPS 2006f) reflects the mission and long-term goals of the NPS and the Manassas National Battlefield Park GMP. The plan is specifically tailored to reflect the role, function, and responsibilities of the Resource Management Division in carrying out the NPS mission within the park. White-tailed deer are identified as one of the most prominent mammals in the Manassas National Battlefield Park. The mosaic of woodlands and fields within the park is ideal deer habitat. When this plan was prepared, white-tailed deer densities in the park were approximately 1 deer per 4 acres (63.4 ± 7.7 deer per square kilometer), which greatly exceeded the estimated carrying capacity of 15.4 deer per square kilometer for the Virginia Piedmont. The plan states that white-tailed deer are having a significant impact on the structure of woody seedling composition forests within the park and are changing the forest successional process. Forb cover and vertical plant cover are suppressed, and species richness and seedling survival rates are reduced. The plan includes management alternatives to address the white-tailed deer population, all of which were considered in the development of this plan/EIS. Alternatives include fencing, repellents, reproductive control, direct reduction and a combination of these management strategies. Direct reduction management consists of deer hunting by NPS personnel and authorized agents. Cooperative management is the combined effort of the NPS, Virginia Game Commission and nearby private landowners to increase public hunting opportunities outside the park. The plan indicates that the combination of shooting deer inside and outside the park would be the most successful strategy to reduce the deer population within the park. This action would reduce the park deer population so park management objectives can be achieved and would enhance the protection and preservation of the historic, cultural and other natural resources of the park.

Manassas National Battlefield Park Natural Resource Condition Assessment (2011)

> *Herbaceous plants are non-woody plants, including grasses, wildflowers, and sedges and rushes (grass-like plants).*

As promulgated by the 2003 Federal Appropriations Act, the NPS conducts natural RCAs to provide a basis for actions that reduce or prevent impairment of park resources. The RCA uses existing information sources to evaluate the condition of park natural resources, identifies current or potential stressors to park natural resources and identifies gaps or inventory and research needs. The Manassas RCA (NPS 2011l) specifically identifies deer overpopulation as a problem and recommends the implementation of deer management control measures. The deer density within the park (61 deer per square kilometer reported in this plan) well exceeds the recommended carrying capacity for the Piedmont region of Virginia (15 deer per square kilometer) as well as the general recommended forest threshold of 8 deer per square kilometer. The plan reports that there is widespread evidence of overbrowsing by deer in the park. Indirect effects of overbrowsing observed in the park include: open understories with lack of structural diversity and sparse representation of tree saplings; complete absence of tree seedlings on some sites; sparse herb layers, even on some fertile, mesic sites; widespread populations of herbaceous species that show below-average size and vigor and consisting of vegetative individuals that do not flower; and areas of extensive, visible browse damage to plants. Deer overpopulation has significantly reduced woodland understory vegetation, which could potentially result in negative consequences on the park's woodland bird population.

Manassas National Battlefield Park Inventory, Classification, and Map of Forested Ecology Communities at Manassas National Battlefield Park, Virginia (2003)

The forest inventory completed in 2003 (Fleming and Weber 2003) documented the forested ecological communities at Manassas, and discussed forest health and management. Herbivory was specifically cited, along with insect and fungal pathogens, as contributing stressors to the health of forest resources at Manassas. The report cited indirect evidence of major herbivory impacts, including open understories with lack of structural diversity, sparse herb layers, absence of tree seedlings, and areas with extensive, visible browse damage.

Cultural Landscape Reports and Inventories

All three parks have prepared extensive cultural landscape reports and inventories, which are summarized in this section. The cultural landscape reports detail management challenges and strategies for the landscapes; whereas, the inventories document describes the significance, history, and existing condition of the landscapes. Manassas also prepared two additional cultural landscape inventories (CLIs) for the park prior to the introduction of the current database, but they are not included in this list.

Antietam Cultural Landscape Inventories

The park has completed several cultural landscape reports or inventories that document the history and existing condition of the landscapes and analyze and evaluate the landscape resources. The results and recommendations of these reports were taken into consideration when developing this plan/EIS. These reports include the following:

- Mumma Farmstead Cultural Landscapes Inventory (NPS 2009g). The Mumma Farm consists of nearly all the property associated with the Samuel Mumma Farmstead at the time of the Battle of Antietam (Sharpsburg) on September 17, 1862. Specifically, the farmstead includes a cluster of domestic and agricultural outbuildings situated on a ninety-degree turn in Mumma Lane, which connects the farm with Smoketown Road and the Sunken Road, better known by its Civil War connotation “Bloody Lane.” The landscape’s integrity is considered to be very good with the exception of changes along the western boundary. Aside from the military significance of the Farmstead, another area of significance is the preservation of a historic agrarian landscape.
- Antietam National Cemetery (NPS 2011p). The Antietam National Cemetery lies along the south side of Maryland Route 34, the Boonsboro-Shepherdstown Pike, opposite the Sharpsburg town cemetery. In general the cemetery is considered to be in fair condition. While the cemetery has changed significantly over the years, it retains many character-defining features: its original layout, vegetation management, much planting material, the perimeter wall, lodge and the graves. It retains the integrity of location, design, setting, materials, feeling and association.
- D.R. Miller Farmstead (NPS 2011m). The D.R. Miller Farmstead is located approximately 1.5 miles north of Sharpsburg. The site consists of 141.41 acres of the property constituting the D.R. Miller Farmstead as it existed at the time of the Battle of Antietam. The property was donated to the NPS in 1990 by a non-profit conservation organization and is situated within the boundaries of the Antietam National Battlefield. The farmstead is significant in military history, conservation for its association with early Civil War battlefield preservation efforts, and as an area of agricultural history as a late eighteenth/early nineteenth century agricultural landscape.
- Roulette Farmstead (NPS 2009h). The Roulette Farmstead is located approximately 1.5 miles north of Sharpsburg. The site consists of the entire 179.5 acres of the Roulette Farmstead property as it existed at the time of the Battle of Antietam. The NPS acquired the property in 1998 in fee simple from a private landowner, and the property is within the boundaries of the park. The farmstead is important for three distinct areas, including its role in the Battle of Antietam, conservation and preservation efforts of Civil War battlefields, and the property’s integrity as an intact late 18th/early 19th century agricultural landscape. The Roulette Farmstead figured prominently in the fighting during the battle. The farm abuts the sunken road, where Confederate soldiers had entrenched themselves, and was the focus of the battle for much of the day. Union troops approached the Sunken Road from the Roulette farm.
- Joseph Poffenberger Farmstead (NPS 2008b). The Joseph Poffenberger Farmstead is located approximately 2 miles north of Sharpsburg, and the current property consists of nearly all the land associated with the farmstead as it existed at the time of the Battle of Antietam. The NPS acquired the property in fee simple from a private landowner in 2000, and it is within the park boundaries. The importance of the Poffenberger Farmstead is its role in the Battle of Antietam and its involvement in early Civil War battlefield preservation efforts (1890-1910). Union troops spent the night on the farmstead the night before the battle, and the Union Army positioned artillery on a ridgeline behind the cluster of farm buildings. The Union Army continued to occupy the farm in the weeks after the battle.

After the war, the farmstead was important in the battlefield conservation movement, with the 1890s addition of a battlefield tour road along the southern boundary of the farm, and the installation of several monuments by veterans groups in the early 1900s. The remainder of the property is still farmed.

- Parks Farmstead (NPS 2011n). The Parks Farmstead, also known as Cunningham Farm, is approximately 2 miles north of Sharpsburg, and adjacent to the Roulette Farmstead. The current property consists of nearly all the land associated with the Parks Farmstead as it existed at the time of the Battle of Antietam. The NPS acquired the property in 1988, and the farmstead is located within the park boundaries. The Parks Farmstead cultural landscape is significant for its role in the Battle of Antietam. The farmstead has been continuously farmed since the late 18th century, and remains relatively unchanged, with the field patterns remaining almost the same as they were during the Civil War. Although the farmstead was not the scene of heavy fighting, it lay well within the Federal lines and Union troops moved over the property before and during battle, and artillery batteries established positions on the southern and western edges of the farm. Farm buildings may have been used to house the wounded.
- Newcomer Farmstead (NPS 2012a). The Newcomer Farmstead is approximately 2 miles east of Sharpsburg, and the current property consists of approximately three quarters of the land associated with the Newcomer Farmstead as it existed at the time of the Battle of Antietam. The NPS acquired the 101.68 acres between 2000 and 2008. The property is within the park boundaries. The cultural landscape of the Newcomer Farmstead is significant in three areas of history. It is primarily important for its role in the Battle of Antietam, and secondly, it is important as an agricultural landscape that has been farmed continuously since the late 18th century and has remained relatively unchanged. The property also includes the site of one of the earliest mills along Antietam Creek. Finally, the farmstead is important in early Civil War battlefield preservation efforts. The proximity of the farm to the Middle Bridge meant the farm was an important strategic location in the battle, as Confederate troops traveled across the bridge early, and Federal troops arrived later the first day of battle and took up position on the farm to defend the bridge from Confederate forces.

Antietam West Woods Restoration Report

There were several woodlots at Antietam during the time of the battle. Woodlots are wooded areas that were historically actively managed for timber, and were typically had more open understory than natural forest). These woodlots are important elements of the Antietam landscape mosaic, and the woodlots played an important role in the battle (NPS 1994b). The woodlots have returned to forest, or have been removed or reduced over the course of time, as property has changed hands, monuments were constructed, and other changes took place in the area. The 1992 GMP recognized the need to reestablish the woodlots at the Battlefield. The West Woods Restoration Report documents the threats to the woodlots, including the fragmentation, encroachment of exotic species like tree-of-heaven (*Ailanthus altissima*), and lays out recommendations for restoring the woodlots and establishing an appropriate balance of forest and understory species. Although the plan does not speak to deer-related damage to existing wooded areas, it does detail ways to protect newly planted areas from deer-related damage.

Antietam North Woods Restoration Report

Antietam prepared a restoration report for the North Woods, another woodlot present during the time of the battle. The report identifies the physical and cultural characteristics of the North Woods woodlot at the time of the battle. The North Woods served as a major strategic position during the Battle of Antietam, with Union troops moving through the woods, and the Poffenberger Farmhouse adjacent to the woods was used as a hospital. The eastern section woodlot decreased markedly after the war, as property owners harvested the woodlot, possibly to make up for crops destroyed during the battle. The report serves as the guide to restoration of the woods. NPS proposes using the same management principles that were used in the 1880s. Like the West Woods report, this document lays out recommendations for restoring the woodlots and establishing an appropriate balance of forest and understory species.

Monocacy National Battlefield Cultural Landscapes Inventories

The park has completed several cultural landscape reports or inventories that document the history and existing condition of the landscapes and analyze and evaluate the landscape resources, including an overall inventory for the battlefield, and one for Thomas Farm. The results and recommendations of these reports were taken into consideration when developing this plan/EIS.

- Monocacy National Battlefield Cultural Landscapes Inventory (NPS 2000) Monocacy National Battlefield forms an overall cultural landscape that represents most of the area where, in July 1864, the “Battle that saved Washington” took place. The cultural landscape at Monocacy National Battlefield contains four component landscapes (the Hermitage (Best Farm), Araby, Clifton, and Baker Farm component landscapes) defined by individual histories, characteristics, and significance (NPS 2000). While the analysis and evaluation of the cultural landscape in this inventory addresses natural systems and features, topography, and vegetation, it does not directly address deer or other wildlife. However, in discussing vegetation that grows between fields and in old fence lines at the battlefield, the inventory does note the distinctive deer browse lines that are visible long the edge of the fields on Clifton, Baker, and Hill farms.

- Monocacy National Battlefield Cultural Landscape Inventory for Thomas Farm (Araby) (NPS 2009a). This cultural landscape condition report documents threats to cultural landscape at Thomas Farm from development pressures and declining vegetation. It does not mention damage by deer as a cause of the vegetation decline.

Monocacy National Battlefield Best Farm Cultural Landscape Report (2005)

A Cultural Landscape Report has been prepared for the Best Farm at Monocacy National Battlefield (NPS 2005d). Best Farm is significant for its French-influenced colonial architecture. In addition, the farm served as camp for Confederate General Robert E. Lee and his troops in 1862; Lee established his headquarters in the wooded area known as Best Grove. The report documents the history and significance of the property, its structures and landscape, and presents treatment recommendations. This report does not mention deer in its treatment recommendations.

Monocacy National Battlefield Thomas and Worthington Farmsteads Cultural Landscape Report (2012)

The Thomas and Worthington farm properties at Monocacy National Battlefield provide a unique opportunity for visitors to gain a better understanding of the evolution of settlement in the region and significance of the battle of Monocacy. The battlefield is faced with many challenges related to effectively interpreting the battlefield landscape, altering circulation to provide accessibility, development pressures beyond the park boundaries, white-tailed deer control, and balancing natural and cultural values. The intent of the Cultural Landscape Report for the Thomas and Worthington Farms is to provide direction for the long-term management of the battlefield landscape (NPS 2012d).

Building upon previous documentation found in the CLIs for Monocacy Battlefield and Thomas Farm, this report defines a framework for treatment of the Thomas and Worthington farms, provides general treatment recommendations, and describes specific guidelines and tasks to enhance historic character in keeping with applicable national legislation, policies, guidelines, and planning. Specific direction on the treatment of these properties is built largely upon the actions outlined in the park's GMP (2010), long-range interpretive plan (2010) and other planning documents that inform future treatment of the battlefield landscape. One issue noted is the effect of high deer populations at the battlefield overall, and this cultural landscape report discusses the effects of the high density of the deer population, particularly from extensive deer browsing, on the Thomas and Worthington Farmsteads, and recommends methods for addressing these impacts, including exclusion, scare devices, and/or repellents.

Manassas National Battlefield Park, Brawner Farmstead, Cultural Landscape Report (2005)

The Cultural Landscape Report for the Brawner Farmstead documents the significance of the farm (NPS 2005c). Brawner Farmstead, and documents and analyzes its landscape, identifies management issues, and recommends treatment strategies. The farm, which is approximately 319 acres, was the site of the opening conflict of the Second Battle of Manassas. It is likely that the original main house on the site was demolished as the result of damage incurred during the battle. Deer are not mentioned in the report (NPS 2004f).

Manassas National Battlefield Park, Field, Fences and Forests Cultural Landscape Report (2012)

The Manassas National Battlefield Park Fences, Fields and Forests Cultural Landscape Report is a parkwide document that, as the name suggests, focuses on fence and vegetation management at Manassas (NPS 2012e). The report will likely include recommendations to install additional fences, and to convert forest cover into native warm season grass cover. The majority of the deforestation recommended in this report will be consistent with what has previously been recommended in the GMP.

The recommendations in this report will affect the amount and distribution of suitable habitat for deer (forest and field). The fence component of the cultural landscape report will presumably have little or no effect on the resident deer population.

RELATED STATE LAWS, REGULATIONS, AND POLICIES

State CWD Plans and Policies

The states of Maryland, Virginia, West Virginia, and Pennsylvania have developed response plans to address CWD in white-tailed deer populations. These four jurisdictions have been testing for CWD and implementing surveillance programs in recent years. The following summarizes the response and surveillance plans of these states.

Deer with CWD

Maryland Department of Natural Resources Wildlife and Heritage Service CWD Response Plan

This response plan was issued by the MD DNR Wildlife and Heritage Service and outlines Wildlife and Heritage Service management activities that address the disease's presence, determine the magnitude and geographic extent of the infection, and attempt to eliminate or control transmission of the disease.

In 2005, the MD DNR developed a CWD response plan that outlines management activities intended to address the presence of CWD, help determine the magnitude and geographic extent of infection, and attempt to eliminate or control transmission of CWD. This plan is updated annually to reflect the current knowledge concerning CWD. The current plan is dated February 2011 (MD DNR 2011a). Included in this plan are general responses about CWD such as how to address the media and public relations, how to respond to positive CWD cases in free-ranging and captive deer in Maryland, and how to respond to discovery of CWD within 20 miles and 5 miles of the Maryland border (MD DNR 2011a).

The Maryland CWD response plan details a systematic approach to detecting and determining the extent of CWD. If a positive CWD case is found, a surveillance area would be established and the state would begin sampling deer to determine the prevalence of CWD. If additional cases are detected, the surveillance area would be expanded. If no new cases are detected within the surveillance area within five years, the area would be considered CWD free. The state of Maryland has also established a program for responding to the potential discovery of CWD within 20 miles and 5 miles of the state border. Enhanced surveillance activities would be conducted if CWD is detected within these areas.

MD DNR began sampling sick or injured deer for CWD in 1999 and expanded the sampling to random hunter-harvested deer statewide in 2002. Currently, the state deer population is separated into “high-risk” and “low-risk” populations with the high risk population found in the eight counties that border Pennsylvania. These are considered high-risk populations because of the substantial presence of captive deer facilities both in Maryland and Pennsylvania and the relatively high density of free-ranging deer. The deer population in the remaining 15 counties of the state is considered low-risk because there are fewer captive deer facilities and the densities of free-ranging deer are lower (MD DNR 2009).

However, beginning in 2010, sampling shifted to focus on Allegany and western Washington counties. These two counties were considered “high-risk” due to the growing incidence of CWD in Hampshire County, West Virginia, where CWD has been detected within approximately 6 miles of the Maryland border. CWD was also detected in Frederick County, Virginia, which is adjacent to the original West Virginia outbreak, in 2009 and 2010. The deer population in the remaining 13 counties of the state is considered low-risk because there are fewer captive deer facilities and the densities of free-ranging deer are lower (MD DNR 2011a).

Currently, MD DNR collects 50 random samples from hunter-harvested deer in each of the 10 high-risk counties and 30 samples from each of the 13 low-risk counties. Between 2002 and 2009, a total of 6,785 deer have been tested in the state with no positive results (MD DNR 2011a). As of the plan’s publication, the state of Maryland was awaiting results for approximately 360 samples collected from deer during the 2010–2011 hunting season. However, according to the 2010–2011 Maryland Annual Deer Report, the first Maryland case of CWD was detected in Allegany County on February 10, 2011. The deer was reportedly harvested near where CWD is present in West Virginia. West Virginia confirmed CWD in free-ranging deer during 2005 in Hampshire County, approximately 9.5 miles south of the Maryland-West Virginia border of Allegany County.

Virginia CWD Plan

The state of Virginia is focused on preventing CWD introduction. If CWD is identified in Virginia or within 5 miles of the Virginia border the VDGIF is responsible for implementing a CWD response plan in the state. This plan outlines management activities to determine the prevalence and geographic extent of CWD infection and to control transmission of the disease (VDGIF 2010). Acknowledging the fact that other states have not been able to eradicate CWD from free-ranging deer populations, the goal of the Virginia CWD response plan is to contain or slow the spread of the disease in free-ranging deer (VDGIF 2010). The plan also contains provisions for captive populations.

If a positive CWD case is found, a surveillance area would be established and the state would begin sampling deer to determine the prevalence of CWD. During the first hunting season following the confirmed diagnosis of CWD in Virginia, or within 5 miles of the Virginia border, mandatory testing of all hunter-harvested free-ranging deer greater than 6 months of age within the 79 square mile surveillance area would be implemented. If the one-year mandatory testing in the CWD surveillance area yields no new positive CWD cases, the state would conduct limited testing on hunter-killed deer for the next several years. If additional positive cases are detected within the surveillance area, the plan would establish a containment area. The objectives for the containment area will be to monitor the prevalence and geographic extent of the CWD and contain or slow the spread of the disease. To achieve CWD containment, multiple management techniques would be employed including, but not limited to, population reduction, extended deer season and increased bag limits, mandatory CWD testing surveillance areas, special designated CWD check station, prohibition of deer rehabilitation and deer feeding, prohibition of carcass transportation, and implementation of necessary depopulation and indemnification of captive cervids, fence security, and quarantine of cervid facilities. Containment areas would be considered CWD free after 5 consecutive years of no new detections (VDGIF 2010).

The Virginia plan includes response actions for discovery of CWD within 50 miles of the state border as well. This plan includes identifying all Virginia counties that are partially or wholly included in the 50-mile radius of the first positive CWD case as high-risk areas and surveillance would be initiated per the VDGIF surveillance plan. The plan also contains provisions for captive populations.

Due to the 2005 positive CWD case in West Virginia that was within 50 miles of the Virginia border, the state of Virginia partially activated its CWD response plan. As a result, approximately 1,000 square miles of the western and northern portions of the Shenandoah, Frederick, Clarke, and Loudoun counties were designated as an active surveillance area. Surveillance of road-killed and hunter-harvested deer in this area resulted in the collection of 559 samples. In addition, enhanced targeted surveillance was conducted in the high-risk and medium-risk areas, and targeted surveillance was conducted in the low-risk areas. Furthermore, CWD testing of elk and captive cervids was continued. This resulted in the collection of 749 samples during 2005. In 2006 the same surveillance strategies were conducted; however, limited statewide active surveillance of road-killed white-tailed deer was performed. As a result, 919 samples were collected during 2006. In 2007, statewide active surveillance of road-killed and hunter-harvested deer was conducted with an emphasis on sampling deer from western Frederick County as well as statewide targeted surveillance (VDGIF 2009). The first CWD positive deer identified in Virginia was detected in Frederick County in 2009. A second positive CWD case was detected in Frederick County during the 2010 hunting season, less than two miles away from the first. As a result of these detections, the VDGIF has designated a CWD Containment Area and initiated a CWD Response Management Action plan. Virginia plans to conduct statewide active CWD surveillance during the 2011–2012 hunting season.

West Virginia CWD Plan

In September 2005, CWD was detected in a road-killed deer in Hampshire County, West Virginia, near Slanesville. The West Virginia Division of Natural Resources immediately implemented its CWD response plan designed to accomplish the following objectives:

- determine the distribution and prevalence of CWD through enhanced surveillance efforts;
- communicate and coordinate with the public and other appropriate agencies on issues relating to CWD and the steps being taken to respond to this disease; and
- initiate appropriate management actions necessary to control the spread of this disease, prevent further introduction of the disease, and possibly eliminate the disease from the state (WVDNR 2006).

The state's goal is to estimate the CWD prevalence with 98% confidence that CWD occurs at less than 1% prevalence in the area where the disease is found. In addition the state will sample deer state-wide to be 98% confident that if the disease is present at or above 1% prevalence it will be detected. This plan also outlines communication and coordination procedures, disease management actions, and immediate logistical needs (WVDNR 2006).

The plan was updated in 2006 and includes increasing CWD surveillance in a 5-mile radius around the initial positive CWD detection, and a 1-mile radius around subsequent positive detections. Samples from the remainder of Hampshire County are obtained primarily from hunter-harvested deer. In surrounding counties, samples come primarily from road-killed deer and deer taken due to crop damage. In these counties, approximately 300 animals would be tested to establish with 95% confidence that if CWD occurs at 1% prevalence or greater, it will be detected through sampling efforts. In Jefferson, Berkley, and Morgan Counties, all of which are close to Antietam National Battlefield, the state goal is to sample approximately 259 road-killed deer to determine with 95% confidence that if CWD is present in the population at or above 1% prevalence, it will be detected (WVDNR 2007).

Implementation of this plan has resulted in identification of 37 additional positive CWD cases, all located within Hampshire County. The 37 total positive test results came from two road-killed deer, one in 2005 and one in 2008; 12 hunter-killed deer, one during the 2006 season, six during the 2007 season and five during the 2008 season; and 23 deer collected by West Virginia Division of Natural Resources staff, four in 2005, five in 2006, three in 2007, and 11 in 2008. Since 2002 a total of 8,485 deer have been tested (Crum, pers. comm. 2009).

Based on this surveillance, West Virginia Division of Natural Resources has identified a 4% to 5% prevalence rate within a 1-mile radius of any known CWD positive deer. The state expects to sample for 3 years to determine prevalence with greater confidence; their current confidence level is unknown. The aggressive sampling/surveillance strategy has reduced deer density from 44 deer per square mile to 28–34 deer per square mile in Hampshire County. The reduction in deer density could help reduce CWD transmission. The plan also contains provisions for captive populations.

Pennsylvania CWD Plan

The state of Pennsylvania updates its CWD response plan annually. The most current revision was completed in August 2008. This plan calls for targeted and active surveillance for CWD in free-ranging cervids (PAGC 2008a). The Pennsylvania Department of Agriculture is responsible for surveillance of captive cervids. The Pennsylvania Department of Agriculture has two programs available for farmed cervids relative to CWD (more information is available from the Pennsylvania Department of Agriculture on these programs):

1. The CWD Herd Certification Program is a five-year plan intended to achieve CWD certified status for a herd. Requirements include annual herd inventories, mandatory official identification, and postmortem (after death) testing of all deer that are 12 months or older.
2. The CWD Herd Monitoring Program is a surveillance program for farmed cervid herds that cannot meet the requirements of the program.

In the event of a positive detection in either captive or free-ranging cervids (deer or elk), the state would establish a surveillance zone and begin testing. If no further detections occur, CWD testing would continue in the surveillance zone for no less than 5 years, with samples coming from hunter-harvested deer and elk, as well as road-killed cervids (PAGC 2008a). If another CWD positive animal were found in the surveillance zone, a containment zone would be established around this case. At this phase in CWD response, containment of the disease and reduction of the prevalence rate are the priorities. Population reduction would be implemented, and all deer greater than 6 months of age would be tested. If there are no additional detections in the containment zone, CWD testing would continue for five years with samples from hunter-harvested animals. If additional detections occur in the containment zone, it would be expanded and CWD surveillance and population reduction would continue. Ultimately, as effective environmental decontamination methods are identified by research, or based on the experience of other states, efforts may be made to apply different decontamination methods to the containment zone (PAGC 2008a).

The whole state is considered high risk for CWD, with the biggest focus on the border with West Virginia. This border area is popular with hunters who may take their kill to other nearby states, which can impede testing. In 2007 4,251 hunter-killed deer were sampled with no CWD positive cases. In total, as of June 2007 the state has tested 18,069 hunter-harvested deer and 260 hunter-harvested elk with no results positive for CWD, not including 39 samples taken by the NPS at Gettysburg National Military Park, which were also negative for CWD. As of June 2007 the state has also tested more than 750 deer and elk dying for unknown reasons with no positive results for CWD, and as of May 2008 no CWD was found in the more than 7,200 farmed cervids that were tested (PAGC 2008b).

STATE HUNTING REGULATIONS

The following provides information about hunting regulations and guidelines in the states of Maryland and Virginia. While the states have the legal mandate and authority over deer populations, that does not preclude the NPS from managing natural resources within park boundaries, including deer. As a general rule, the NPS has broad authority to manage wildlife and other natural resources within the boundaries of units of the national park system. 16 USC 1 states that NPS “shall promote and regulate the use of the Federal areas known as national parks…by such means and measures as conform to the fundamental purpose of the parks…to conserve the scenery and natural and historic objects and the wild life therein….” This ability to manage natural resources, specifically wildlife within park boundaries was upheld by *New Mexico State Game Commission v. Udall,* supra, whereby the 10th Circuit of Appeals reversed and remanded a lower court’s ruling, stating that the killing of deer within Carlsbad Caverns National Park is allowed pursuant to 16 USC 3, if it is for the purpose of protecting park resources from animals that have a negative impact on its lands. The NPS ability to manage wildlife resources has also been upheld in *Kleppe v. New Mexico* and *United States v. Moore*, even despite conflicting state laws.

Maryland Guide to Hunting and Trapping and Deer Regulations

The MD DNR Wildlife Division has the legal mandate and legislated authority to manage deer populations throughout the state of Maryland. As part of this function they set the goals and regulations for deer management in the state. The long-term goal of the state is to ensure the present and future well-being of deer and their habitat; to maintain deer populations at levels necessary to ensure compatibility with human land uses and natural communities; to encourage and promote the recreational use and enjoyment of the deer resource; and to inform and educate Maryland citizens about deer biology, management options, and the effects that deer have on landscapes and people. Deer regulations in the state of Maryland cover hunting hours, licensing and stamp requirements, daily limits, legal hunting devices, and the use of dogs in hunting. These regulations are explained in the yearly Guide to Hunting & Trapping in Maryland, along with any new regulations or updates to existing regulations.

Virginia Hunting and Trapping Regulations

The VDGIF has the legal mandate and legislated authority to manage deer populations throughout the state of Virginia. As part of this function they set the goals and regulations for deer management in the state. Deer regulations in the state of Virginia cover hunting seasons, hours, licensing and stamp requirements, bag limits, legal hunting devices, the use of dogs in hunting, and safety requirements. No Sunday hunting is permitted in the state. A valid deer hunting license is required for most hunters. In addition, other licenses may be required depending on the type of hunting. The state requires hunter education courses for most new hunters, provides tree stand safety guidelines and requires blaze orange clothing. Firearms and archery provisions are specified on the VDGIF website. The VDGIF also restricts feeding of deer. It is illegal to feed deer certain months of the year statewide. In Frederick County, feeding deer is prohibited year-round. Hunting is prohibited in all national parks in Virginia. These regulations are explained in the yearly Hunting and Trapping in Virginia digest, along with any new regulations or updates to existing regulations.

Chapter 2: Alternatives

CHAPTER 2: ALTERNATIVES

This chapter describes the various actions that could be implemented for current and future management of white-tailed deer (*Odocoileus virginianus*) in Antietam National Battlefield, Monocacy National Battlefield, and Manassas National Battlefield Park, including a plan to respond to chronic wasting disease (CWD) occurring in or near the parks. The National Environmental Policy Act (NEPA) requires federal agencies to explore a range of reasonable alternatives and to analyze what impacts the alternatives could have on the human environment, which the act defines as the natural and physical environment and the relationship of people with that environment. The analysis of impacts is presented in "Chapter 4: Environmental Consequences," and the conclusions are summarized in the summary of environmental consequences table later in this chapter.

The alternatives under consideration must include a "no action" alternative, as prescribed by NEPA regulations in 40 CFR 1502.14. The no action alternative in this document is the continuation of the parks' current management actions and policies related to deer, their effects on vegetation and landscapes within the parks, and ongoing CWD surveillance and management.

No-action alternative: The alternative in which baseline conditions and trends are projected into the future without any substantive changes in management.

The interdisciplinary planning team developed three action alternatives for deer management. The public and the science team provided feedback during the planning process. These alternatives meet the objectives developed for this plan and the purpose of and need for action as stated in "Chapter 1: Purpose of and Need for Action." Because these action alternatives would be technically and economically feasible, and show evidence of common sense, they are considered reasonable (CEQ 1981).

INTRODUCTION AND OVERVIEW OF ALTERNATIVES

This chapter describes the alternatives developed by the interdisciplinary team for this White-tailed Deer Management Plan / Environmental Impact Statement (plan/EIS), which include various deer management actions as well as actions that address detection and response to CWD, which has now been found within 36 miles of Antietam, 39 miles of Monocacy, and 51 miles of Manassas. The chapter provides background information used in setting a deer density goal and action thresholds for implementing the preferred alternative. The science team recommended thresholds/metrics related to forest regeneration for all three parks, and National Park Service (NPS) cultural resources experts and park resources staff developed additional thresholds/metrics related to crop yield and orchard damage for Antietam and Monocacy. The chapter also provides a summary of adaptive management approaches, discusses alternatives considered but dismissed, and identifies the NPS preferred and the environmentally preferred alternative.

The alternatives selected for detailed analysis are briefly summarized below, with the deer management actions described first, followed by CWD management components that would be included in the alternatives.

ALTERNATIVES - DEER MANAGEMENT

Alternative A: No Action (Continuation of Current Management)—Existing management would continue under alternative A, including deer and vegetation monitoring, data management, research, limited fencing, possible repellent use, education and interpretation, and agency/interjurisdictional cooperation. No new actions would be taken to reduce the effects of deer overbrowsing.

> *Exclosure: A large area enclosed by fencing to keep out deer and allow vegetation to regenerate.*

Alternative B: Nonlethal Deer Management—Alternative B would include all actions described under alternative A (with some modifications to monitoring schedules), and would also include several techniques (such as fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning) to prevent adverse deer impacts. However, the main focus of deer management under alternative B is the use of a combination of nonlethal actions to address the impacts of high numbers of deer on vegetation and vegetative cultural landscape elements. These actions include the construction of large-scale deer exclosures (fencing) for the purposes of forest regeneration and the use of nonsurgical reproductive control of does to restrict population growth, using an agent that meets NPS-established criteria.

Alternative C: Lethal Deer Management—Alternative C would include all actions described under alternative A (with some modifications to monitoring schedules) and the additional techniques described under alternative B, but with a primary focus on using lethal deer management actions to reduce the herd size. Direct reduction of the deer herd would be accomplished mainly by sharpshooting with firearms, with a very limited use of capture and euthanasia of individual deer if needed in those few circumstances where sharpshooting would not be considered appropriate due to safety concerns.

Alternative D: Combined Lethal and Nonlethal Deer Management—Alternative D would include all actions described under alternative A (with some modifications to monitoring schedules) and the additional techniques described under alternative B, but with a primary focus of incorporating a combination of lethal and nonlethal deer management actions from alternatives B and C to address high deer density. Lethal actions (including sharpshooting, with very limited capture/euthanasia if necessary) would be taken initially to reduce the deer herd numbers quickly. Population maintenance would be conducted via nonsurgical reproductive control methods (if these are available) and meet NPS criteria for use; if not, sharpshooting would be used for maintenance.

ALTERNATIVES – CHRONIC WASTING DISEASE MANAGEMENT

Alternative A: Continuation of Current Management (No Action)—The NPS would continue with opportunistic and targeted surveillance for CWD at all three parks. Antietam and Monocacy would also respond to CWD presence in or near the parks in accordance with the CWD Detection and Initial Response Plan (NPS 2009c), and Manassas would work toward creating a similar plan.

Alternatives B, C, and D (All Action Alternatives)—All of the action alternatives include a long-term CWD management plan that provides for a longer-term response to CWD when it is in or within 5 miles of the parks. The plan includes lethal removal of deer to substantially reduce deer density, because high population densities generally support greater rates of disease transmission (Wilson et al. 2002; Swinton et al. 2002) and have been found to be positively correlated with the prevalence of CWD (e.g., Farnsworth et al. 2005; Conner et al. 2008).

THRESHOLDS FOR TAKING ACTION UNDER ALTERNATIVES B, C, AND D AND THE DEER DENSITY GOAL FOR DEER MANAGEMENT

The action alternatives (B, C, and D) contain actions to support forest regeneration and to protect cultural landscapes. Before an action alternative can be implemented, the park must determine (1) where an action needs to be implemented; (2) when the action needs to be taken or modified (i.e., when damage to forest vegetation or cultural landscapes could approach unacceptable levels); and (3) how many deer would need to be treated (for those alternatives that include reproductive control) or removed (for those alternatives that include deer removal). The following discussion describes the thresholds for taking action (which are related to vegetation damage from deer browsing), and the deer density goal (which would be used to determine the number of deer that would be treated or removed) that were selected by the planning team, based on science team input and other research.

THRESHOLDS FOR TAKING ACTION - DEER DAMAGE TO VEGETATION (INCLUDING CULTURAL LANDSCAPES)

Forest Regeneration Thresholds

The science team discussed methods of identifying an appropriate threshold for taking action to protect park vegetation, both woody and herbaceous, which could then be considered by the NPS for use at the parks. Because the deer population is to be managed based on the success of forest regeneration, vegetation must be monitored to determine at what point browsing impacts would warrant implementation of the selected management alternative. The point at which action would be needed is called the threshold for taking action, or the action threshold.

The regeneration standard adopted by the planning team was developed based on research by Dr. Susan Stout (1998) in a similar eastern hardwood forest environment in Cuyahoga National Recreation Area, now known as Cuyahoga Valley National Park (McWilliams et al. 1995). Although ecological histories may vary, there are many similarities between the forests at Cuyahoga and the battlefield forests, which support the use of this research. Dr. Stout’s method measures the number of tree seedlings and their heights in circular (1-meter [3.28-foot] radius) sampling plots under both high and low levels of deer density and associated herbivory. Low deer density is defined as 13 to 21 deer per square mile relative to levels observed in the Mid-Atlantic Region (Horsley, Stout, and deCalesta 2003) and is in the range of the desired deer density proposed for this plan. High deer density is defined as 56 to 64 deer per square mile (Horsley, Stout, and deCalesta 2003).

The thresholds developed by Dr. Stout were modified to account for the different to plot sizes used at the parks. All three battlefields use plots that are 4 square meters (either a single 2 meters × 2 meters plot, or four 1 meter × 1 meter plots), while Dr. Stout used circular 1-meter radius plots covered 3.14 square meters. With adjustments made for plot size, the tree seedling thresholds would be defined as shown in table 4.

TABLE 4: MINIMUM NUMBER OF SEEDLINGS PER PLOT

Deer Density [a] (deer/mi^2)	Seedling Thresholds per Stout's (3.14 square meters) Monitoring Plot	Seedling Thresholds per Battlefield Parks (4 square meters) Monitoring Plot
Low	10	12.7
High	30	38.1

Source: Stout 1998; McWilliams et al. 1995

Low density = 13–20 deer/mi^2; High density = 56–64 deer/mi^2 Source: Horsley, Stout, and deCalesta 2003

The NPS planning team decided to use Stout's suggested regeneration standard as the threshold for taking action under this plan. Therefore, to restore tree seedling recruitment to acceptable levels, monitoring would need to show that at least 67% of plots have more than 38.1 seedlings/plot at high deer density. (Dr. Stout adapted from McWilliams et al. 1995). The NPS would determine the level of regeneration every three years from data collected from the plots, as described in the monitoring plan presented in appendix A.

Cultural Landscape Thresholds

Because of the cultural significance of the parks, the planning team decided to develop another action threshold or thresholds that could be used to indicate the need to take action based on effects of deer on key elements of the parks' cultural landscapes. The planning team felt it was important to have a foundation for management based not only on tree regeneration, but also on the protection of cultural landscapes that are so clearly linked with the parks' missions and enabling legislation, as well as the NPS Organic Act and Management Policies. The group discussed the options for indicators or monitoring metrics that would show the effects of deer on crops (changes in yield), orchards (damage to trees), and the visual appearance of the landscape (distinctive browse line at the forest edges).

After discussion with internal NPS cultural resources specialists, it was determined that the current cultural resources condition assessments that are conducted at least every six years would not suffice as monitoring metrics, but these could be built upon to develop action and monitoring thresholds related to cultural values. Periodic photographic analysis of key photo points was discussed, and it was decided to incorporate that into the cultural landscape condition assessment process for all three parks, but not to use visual assessment of damage as a metric in this deer management plan. Manassas has no crops or orchards, and its main concerns could be covered by the seedling thresholds and the future photographic documentation. However, Antietam has both orchards and crops, and crop damage is also a large concern at Monocacy. Therefore, NPS decided on several indicators of deer browse impact for only those two parks and established the following thresholds for taking action:

Crop Yield Threshold (Antietam and Monocacy)

A crop field's cultural resource values include its spatial arrangement, healthy appearance, and type of crop (e.g., corn, hay, small grain). A crop field's economic value to the special use permittee/farmer is its yield either in bushels per acre or tons per acre. The success of the farmers at Antietam and Monocacy is critical to retaining them as partners in managing NPS lands, and crop yield is a measure of that success. Crop yields are measured by machinery, by sampling, or by sale. There is an expected yield per acre based on soil type, soil fertility, and crop species and variety. Farmers annually report their yield to park natural resources managers and the national and state agricultural statistics offices. Farmer reports are used for insurance purposes as well as federal and state agricultural program benefits. There is an economic threshold for acceptable yield loss. Farm returns are either profit from crop harvest and sale or crop harvest and use for feed for livestock.

At Gettysburg during the early deer management planning, damage to winter wheat and field corn was assessed (Vecellio, Yahner, and Storm 1994) and an objective of achieving 75% of potential yield for crops was established based on an economic review. Antietam has recorded 5-year average crop yield reductions for corn (grain) of 39%, corn (silage) of 48%, soybeans of 26%, wheat of 35% (percentage below county averages) (NPS 2011b). Between 2000 and 2011, Monocacy crop yield data showed a statistically significant reduction in corn productivity compared to the county average, although no decrease in soybean productivity (NPS 2012d).

Based on the information above, the planning team agreed to use a threshold tied to crop yield at Antietam and Monocacy. Action would be taken when the 3-year average crop yield from farms within the park unit falls below 75% of the average yield reported by the county for similar agricultural production.

Deer management action will be taken when the 3-year average crop yield from farms within Antietam or Monocacy falls below 75% of the average yield reported by the county for similar agricultural production.

Orchard Threshold (Antietam Only)

At Antietam, key historic landscape features include woodlots and forested areas, agricultural fields, and orchards. Orchards have been particularly hard hit by deer, and the orchard trees are protected by fencing around each individual tree in highly visible areas. Damage to just new growth (current growing season's tissue) is the most severe type of damage to trees (compared to damage to terminal leaders, older wood, or trunks) and this can drastically affect the ability of trees to survive (Dolan, pers. comm. 2012).

Based on this assessment, the team decided to use a measure of damage to current growth as an indicator that action needed to be taken to protect orchard trees. Action would be taken when more than 30% of the current growth is removed by deer browse in one year. This is based on horticultural standards identifying the loss of more than 25% of live tissue from any given tree in a single year having the likelihood that the tree would not be able to survive. The park conducts deadwood/winter pruning annually, and there is an opportunity to conduct this monitoring in conjunction with the pruning cycle.

Initial Deer Density Goal

The deer density goal for the parks is defined as the number of deer per square mile that would allow for natural forest regeneration and preservation or enhancement of the cultural landscape components that contribute to the open/closed pattern of historic uses. This density is used as an initial goal under the action alternatives. Distance sampling at the parks shows that from 2001 to 2011, the deer density (in deer per square mile) ranged from 91 to 137 for Antietam; 121 to 236 for Monocacy; and 86 to 190 for Manassas. In 2011, deer densities in the parks were as follows: Antietam: 131 deer per square mile; Monocacy: 236 deer per square mile; and Manassas: 172 deer per square mile.

Based on the science team's recommendation and recent research in forest types similar to those in the parks, the planning team adopted a range of 15 to 20 deer per square mile as the initial deer density goal.

Research has been conducted on tree regeneration and the impact of white-tailed deer on different forest types in the eastern United States. The predominant forest type in the three parks is oak (*Quercus* spp.) / hickory (*Carya* spp.) forest, with American beech (*Fagus grandifolia*), maple (*Acer* spp.), and tulip poplar (*Liriodendron tulipifera*). American sycamore (*Platanus occidentalis*), hackberry (*Celtis occidentalis*), ash (*Fraxinus* spp.), and American elm (*Ulmus americana*) can be found in bottomlands and stream corridors. Research has suggested that in cherry (*Prunus* spp.) / maple forest types in the Allegheny Plateau (western Pennsylvania, West Virginia, and eastern Ohio), deer density should be 20 to 40 deer per square mile in unmanaged areas, and 15 to 18 deer per square mile in managed timber areas, to maintain natural regeneration (Tilghman 1989). Marquis, Ernst, and Stout (1992) suggested that tree regeneration fails with deer densities at 32 deer per square mile. This research also demonstrated that a shift in plant species composition occurs in beech/birch (*Betula* spp.) / maple forests when there are 18 deer per square mile, while an oak/hickory forest successfully regenerates at 6 deer per square mile (Marquis, Ernst, and Stout 1992). Research by deCalesta (1992, 1994) showed that seedling richness (the number of species in an area) begins to decline with just 10 deer per square mile, and that songbird habitat is negatively impacted with 20 to 39 deer per square mile in a cherry/maple forest. In a study in the Central Adirondacks that examined deer and forest regeneration in maple/beech/birch, hemlock (*Tsuga* spp.) / birch, and spruce (*Picea* spp.) / fir (*Abies* spp.) forest types, Sage, Porter, and Underwood (2003) found successful tree regeneration with a density of 13 deer per square mile from 1954 to 2001. Horsley, Stout, and deCalesta (2003) showed that negative impacts began in cherry/maple forests at 20.73 deer per square mile within the Allegheny Plateau from 1979 to 1989. In that study, impacts on forest vegetation were examined at various deer densities (10, 20, 39, and 65 deer per square mile) and data were collected 3, 5, and 10 years after the exclosures were established (Horsley, Stout, and deCalesta 2003). The NPS National Capital Region Network vital signs monitoring used the 20.73 deer per square mile threshold in its analysis (Bates 2006). Based on this threshold, ten parks within the National Capital Region (NCR) exceeded desirable population densities in 2009, including all three parks that are the subject of this plan. The National Capital Region Network (NCRN) monitoring shows that many parks have fewer seedlings than would be expected with natural regeneration levels (Schmit and Campbell 2008).

As described in chapter 1, a science team consisting of scientists and other specialists from a variety of state and federal agencies was formed to provide technical information and input into the planning process (see the “Scientific Background: Deer and Vegetation Management” section in chapter 1), including a review of density information. The science team suggested that a range would be appropriate for the initial density goal and recommended a range of 15 to 20 deer per square mile. Based on the science team’s recommendation and recent research in forest types similar to those in the parks, the planning team adopted a range of 15 to 20 deer per square mile as the initial deer density goal. This goal may be adjusted based on the results of vegetation and deer population monitoring, as described in the “Adaptive Management Approaches Included in the Alternatives” section in this chapter.

ALTERNATIVES – DEER MANAGEMENT

ALTERNATIVE A: CONTINUATION OF EXISTING MANAGEMENT (NO ACTION)

The no action alternative is required in NEPA analyses to provide a benchmark against which to compare the impacts of the action alternatives. Current management actions that would continue to be implemented include deer population monitoring (e.g., distance sampling), vegetation monitoring, and activities to protect plantings and crops (e.g., protective tree tubes, fencing, repellents). Monitoring efforts would continue to assess forest regeneration and/or deer population numbers within the park, although specific monitoring actions would vary from park to park and could be modified or discontinued over time, depending on the results and the need for monitoring. Educational and interpretive activities would continue to be used to inform the public about deer ecology and park resource issues, and cooperation with regional entities and stakeholders would continue. No additional deer management actions would take place under this alternative. This alternative serves as the baseline for analyzing and comparing the effects of the other alternatives.

The actions that would continue under alternative A are described below in detail. These actions would be common to all action alternatives as well.

Current Actions

Monitoring, Data Management, and Research

Current monitoring of both vegetation impacts and deer population levels would continue and could be modified as necessary to better understand any correlations between the two or to account for current conditions. Monitoring and data collection activities include any or all of the following methods:

- Monitoring deer numbers by parkwide sampling, using the established Distance 5.1 protocol to estimate the deer population density annually (Underwood, Verret, and Fischer 1998).
- Using spotlight surveys (conducted as part of distance sampling) to monitor population composition (e.g., sex ratios).
- Monitoring tree seedlings using an existing vegetation monitoring protocol to determine the status of forest regeneration. Paired plots are present at all three parks: Monocacy has 6 paired plots; Antietam has 12 paired plots, and Manassas has 18 paired plots. Antietam and Monocacy plan to continue monitoring every 5 years; Manassas is currently monitoring its plots every 3 years, and recently installed two additional 50-foot × 50-foot plots. All parks also have long-term monitoring plots (open plots; not paired) that are part of the NCRN and are monitored by the network staff periodically.
- Tracking of research related to deer management, including the outcome of actions being taken in neighboring jurisdictions, and the latest research on various deer management methods, including reproductive control.
- Monitoring deer health if the population shows signs of disease, or if a disease has been discovered within the region (see discussion specific to CWD, below).
- Monitoring the costs of the monitoring actions, including staff time, training, administrative, legal, and public communications costs.

Specific deer population and vegetation monitoring methods that would be used under alternative A, as well as the other alternatives, are described in appendix A.

Small Area Protective Fencing / Tree Tubes

Landscape plantings, orchards, and small areas containing tree plantings or rare species would be protected from browsing by placing tree tubes around individual plants or small-scale fencing around planted areas. Landscape plantings typically consist of ornamental vegetation in and around buildings and in other park developed areas. Park staff may erect small cages or tree tubes around trees or seedlings that have been recently planted in restoration areas or in orchards. If rare understory plant species that deer browse are found in the park, they would be protected with fencing.

Tree Tubes are Placed around Newly Planted Tree Seedlings at Antietam to Protect against Animal Browsing

The fencing used would be limited to the immediate area around the plants to be protected, typically less than 43 square feet (4 square meters) total, and would generally consist of a 5-foot-high, woven wire fence (typically a 1-inch by 2-inch mesh), with netting or other covering over the top as appropriate. Fencing would typically be at least 5 feet tall to allow trees to grow beyond deer browsing height, at which point it would be removed. Tubes vary in height (generally from 3 to 4 feet) depending on the park and the species to be protected.

Limited Application of Deer Repellents

The NPS may consider use of small amounts of commercially available deer repellents on landscaped areas, restoration plantings, or crops at each park. Repellents could also be used on plantings in cultural landscape areas where fencing would be undesirable because of its visual impact. Currently, Antietam uses a deer repellent (Liquid Fence™) on a small area of wildflowers in a restoration site; Manassas currently uses none or very limited amounts of repellents, and Monocacy does not use repellents, but NPS could consider this as a technique to protect plantings in the future.

Repellents work by reducing the attractiveness and palatability of treated plants to a level lower than that for other available forage. Repellents are more effective on less palatable plant species than on highly preferred species (Swihart and Conover 1991). Repellent performance seems to be negatively correlated with deer density, meaning that the higher the abundance of deer, the less likely the repellent would be effective. Success with repellents is measured as a reduction in damage; total elimination of damage should not be expected (Craven and Hygnstrom 1994).

Deer repellent products are generally either odor- or taste-based. Odor-based repellents incorporate a smell that offensive to deer, such as human hair, soaps, garlic, rotten eggs, blood meal, or seaweed, and they tend to work best in areas where deer have not adapted to close human interaction. Taste-based repellents incorporate a compound such as capsaicin that is offensive to deer. These repellents tend to work in areas where deer have adapted to close human interaction and where odor-based repellents are not effective.

Both repellent types are available in chemical and organic forms. The organic repellents are biodegradable and are expected to be the least harmful to the environment. Some of the more recently available products have the longest residence time (period of effectiveness between applications). Different brands may provide different results; therefore, park staff would experiment with the available products to determine which worked best in each application area. Both types of repellents can have a short residence time when applied to plant material and must be monitored and applied frequently to retain their effectiveness.

Commercially available deer repellents could be used in selected park areas where fencing would cause unacceptable visual impacts and where repellents would likely have some success. Repellents would be applied during the growing season and limited to hand-held sprays or tablets that can be placed in the ground. Repeated applications of spray repellents may be necessary due to weather and emergence of new growth. Large-scale application of repellents over forested areas is not practical due to high application cost, label restrictions on use, and variable effectiveness.

Educational and Interpretive Measures

Communication and input from other organizations and the public would be a key component of alternative A, as well as the other alternatives. Such activities would include continuing education and interpretive programs, displaying exhibits at visitor gathering areas, and producing brochures and publications about deer management issues. Park websites would also be used to discuss NPS activities related to deer management. Relevant articles may be published in local newspapers.

Continued Agency and Interjurisdictional Cooperation

The park would continue to coordinate with other agencies involved in deer or wildlife management (e.g., Maryland Department of Natural Resources (MD DNR), Virginia Department of Game and Inland Fisheries (VDGIF), and county and local governments) on the implementation of deer management efforts. This coordination currently includes sharing study results and data on deer densities, as well as results of removal efforts.

Implementation Costs – Alternative A

The costs associated with alternative A over the 15-year planning period would primarily be for monitoring, plus limited protection of plantings. Cost estimates and assumptions for all three parks are provided in tables 5A, 5B, and 5C (for Antietam, Monocacy, and Manassas, respectively). Costs of education and coordination are assumed to be covered in existing labor costs and thus are not included in the tables.

TABLE 5A: COST ESTIMATE FOR ANTIETAM NATIONAL BATTLEFIELD—ALTERNATIVE A

Action	Assumptions	Annual Cost ($)	Cost for the 15-Year Planning Period ($)
Monitoring, Data Management, and Research			
Distance sampling/ spotlight surveys	4 staff (avg. GS 9 at approx. $28/hr.) for 5 hours per night; 3 nights of survey = $1,680; plus data analysis (20 hours at $28/hr = $560)	2,240	33,600
Vegetation monitoring of existing plots	Data collection and analysis of 12 paired plots every 5 years 4 staff (GS 9 at approx. $ 28/hr) for 40 hours = 160 hours = $4,480 plus botanist for data analysis (20 hours at $28/hr = $560) Long- term plots read by Inventory and Monitoring (I&M) – no cost to park	5,040 every 5 years; assume done 3 times over life of plan	15,120
Maintenance of existing monitoring plots	4 visits per year per plot; minimal materials cost (assume 16 hours, 4 staff; total of 64 hours at approx. $28/hr) = $1792	1,792	26,880
Protection of Plantings			
Labor, materials, and staffing costs	Installation of protective tree shelters: avg. 100/year, $5/shelter = $500 plus 16 hours for each of 2 staff =32 hours total (GS 9 at approx. $28/hr) = $896	1,396	20,940
Limited Repellent Use	5 gallons per year @ $100/gallon - $500, plus 15 hours of staff time at GS 11 at approx. $34/hour = $510; with volunteers as needed	1,010	15,150
		TOTAL	**111,690**

TABLE 5B: COST ESTIMATE FOR MONOCACY NATIONAL BATTLEFIELD—ALTERNATIVE A

Action	Assumptions	Annual Cost ($)	Cost for the 15-Year Planning Period ($)
Monitoring, Data Management, and Research			
Distance sampling/ spotlight surveys	4 staff (avg. GS 9 at approx. $28/hr.) for 5 hours per night; 4 nights of survey = $2,240; plus data analysis (20 hours at $28/hr = $560)	2,800	42,000
Vegetation monitoring of existing plots	Data collection and analysis of 6 paired plots every 5 years 4 staff (GS 9 at approx. $ 28/hr) for 20 hours = 80 hours = $2,240 plus botanist for data analysis (10 hour at $28/hr = $280) Long- term plots read by I&M – no cost to park	2,520 every 5 years; assume done 3 times over life of plan	7,560
Maintenance of existing monitoring plots	4 visits per year per plot; minimal materials cost (assume 16 hours, 2 staff; total of 32 hours at approx. $28/hr) = $896	896	13,440
Protection of Plantings			
Labor, materials, and staffing costs	Installation of protective tree shelters: avg. 100 per year, $5 per shelter = $500 plus 16 hours for each of 2 staff =32 hours total (GS 7 at approx. $23/hr) = $736	1,236	18,540
		TOTAL	**81,540**

TABLE 5C: COST ESTIMATE FOR MANASSAS NATIONAL BATTLEFIELD PARK—ALTERNATIVE A

Action	Assumptions	Annual Cost ($)	Cost for the 15-Year Planning Period ($)
Monitoring, Data Management, and Research			
Distance sampling/ spotlight surveys	4 staff (avg. GS 9 at approx. $28/hr.) for 5 hours per night; 2 nights of survey = $1,120; plus data analysis (20 hours at $28/hr = $560)	1,680	25,200
Vegetation monitoring of existing plots	Data collection and analysis of 18 paired plots and 2 new monitoring plots every 3 years 10 days each year, 2 seasonal staff (GS 5 at approx. $18/hr) = $2,880 plus botanist for data analysis and write-up (120 hours every 10 years at $28/hr = $3,360) Long- term plots read by I&M – no cost to park	2,880 every 3 years; assume done 5 times over life of plan, plus $3,360 one time during life of plan	17,760
Maintenance of existing monitoring plots	2–3 visits per year per plot; minimal materials cost (assume 16 hours at $28/hr = $448)	448	6,720
Protection of Plantings			
Labor, materials, and staffing costs	Installation of replacement trees and protection: avg. 50 trees/yr; $125 per tree (contract price) = $6,250 plus 2 staff hours for GS 12 at $41/hr = $82	6,332	94,980
		TOTAL	**144,660**

ALTERNATIVE B: NONLETHAL DEER MANAGEMENT

Alternative B would include all actions described under alternative A (with some modifications to monitoring schedules), and would also include several techniques to prevent adverse deer impacts. However, the main focus of alternative B is the use of a combination of nonlethal actions including the construction of large-scale deer exclosures (fencing) for the purposes of forest regeneration and the use of nonsurgical reproductive control of does to restrict population growth. The NPS would implement nonsurgical reproductive control of does if an appropriate reproductive control agent meets the criteria listed under this alternative.

Additional Proposed Actions Under Alternative B

Additional Techniques to Reduce Deer Impacts

The planning team identified several actions that could be helpful in certain situations to reduce the adverse effects of deer browsing at the parks. Although these actions may be implemented more frequently under alternative B, they are available as specific techniques that can be used under any action alternative. These include the following:

- **Fencing of crops and woodlots**—Larger areas (woodlots and crops) could be fenced where protection is the most needed and where fencing can be installed with minimal impacts. This would include fencing some woodlots with black unobtrusive fencing placed slightly inside the woodlot boundary so it cannot be seen from a distance, and using fencing around fields containing susceptible crops.
- **Crop protection—**This would include changing the types of crops grown to substitute crops that are less palatable to deer, such as changing wheat varieties or growing milo instead of corn, and planting sacrificial rows of alternative crops at the edges of fields.
- **Aversive conditioning—**This involves scaring deer out of certain areas using noise or motion (e.g., alarms, sprinklers, and "deer scarecrows") This option would be used only in specific areas for a short amount of time where there is a need for temporary protection.

Large-Scale Exclosures

In addition to the small areas or individual trees that would be fenced or protected by tree tubes, larger fenced exclosures would be constructed under alternative B to temporarily remove deer browsing impacts and allow forest regeneration. A large deer exclosure is defined as a fenced area of one or more acres constructed for the purpose of excluding deer from entering. It has been suggested that the minimum area that would need to be fenced at one time to meet the parks' forest regeneration goal would be from 5 to 10% of the forested area (Bowersox, pers. comm. 2005). Based on this and on past deer management plans conducted for the

Small-scale Deer Exclosure; Large-scale Exclosures would be Similar in Appearance, but Cover a Much Larger Area

NPS, the NPS decided to target a range of 5 to 20% of the forested areas of the parks (forest cover totals about 300 acres at Antietam, 500 acres at Monocacy, and 2,174 acres at Manassas).

The NPS would construct large exclosures of various configurations to fit the landscape, located throughout the parks, with locations based on several criteria: they are relatively easy to access, yet away from high use visitor areas or scenic views; they fit into the parks' topography and current trails systems; and they avoid steep slopes and existing vegetation monitoring plots. Areas containing valuable habitats (rare community types, restored woodlots, reforested areas, riparian areas, high quality woodlands, and other managed landscapes such as orchards) would be targeted for protection. Potential deer exclosure locations for the three parks are shown in figures 5–7 and are listed in table 6.

Fencing for large exclosures would be about 8 feet high and would consist of woven wire with openings that would allow most other wildlife to move freely through the fence. Metal and wood posts would be used as supports. It is expected that the technical details (e.g., type of footer, post type and spacing) related to fence installation would vary based on factors such as site topography, geologic substrate, access, potential visibility, and presence of archeological resources. Electric fencing would not be used in the parks because of concerns related to visitor safety, difficulty in accessing a power source, and long-term maintenance requirements.

Deer would be driven out of the exclosures by park staff before completion by having staff line up and walk toward the remaining open side of the exclosure, thereby herding any remaining deer out of the area before the last side is erected. All exclosures would be maintained by park staff. Maintenance would consist of visual inspection for fence integrity at least four times per year and after any major storm event. Park staff and/or qualified volunteers would drive out any deer found within an exclosure or any other animals that appear to be trapped within an enclosure. Visitors would not be able to use the areas inside exclosures during or after construction, unless special access is provided in special circumstances.

Based on the experience of park staff and the regrowth noted in park vegetation monitoring exclosures over the past years, it is estimated that about 10 years would be required for adequate seedling recruitment and growth in the exclosures to exceed the typical deer browsing height—approximately 60 inches. This timeframe is supported by data from Horsley, Stout, and deCalesta (2003), as well as Webster, Jenkins, and Rock (2005), which showed that browse-tolerant species had substantial recovery after eight years, and more browse-sensitive species were not able to recolonize well. Annani, Klips, and Curtis (2006) also found that generalist species could recover in about a 14-year period, so a 10-year timeframe appears reasonable. After seedlings exceeded browse height, the exclosures could be moved to immediately adjacent areas in order to reuse one side of the previous exclosure, thus minimizing relocation and labor costs. This would happen once during the life of this plan.

It is assumed that most of the recovered woody vegetation in the exclosures would persist after 10 years in most of the exclosures. Therefore, for purposes of the plan and the impact analysis presented in "Chapter 4: Environmental Consequences," it is assumed that within the exclosures proposed in alternative B, woody forest regeneration and associated landscape goals would be achieved in about 10 to 20% of the park forested areas over the 15-year life of the plan (about 10% originally fenced for the first 10 years that has grown beyond the reach of deer, plus an additional 10% fenced in the second round of fencing during years 11 through 15 and beyond). However, the herbaceous layer in the original exclosures would be exposed to deer browsing pressure after the exclosure was removed; therefore, herbaceous regeneration and associated cultural landscape goals would be met within a maximum of about 10% of the entire forested area at any one time.

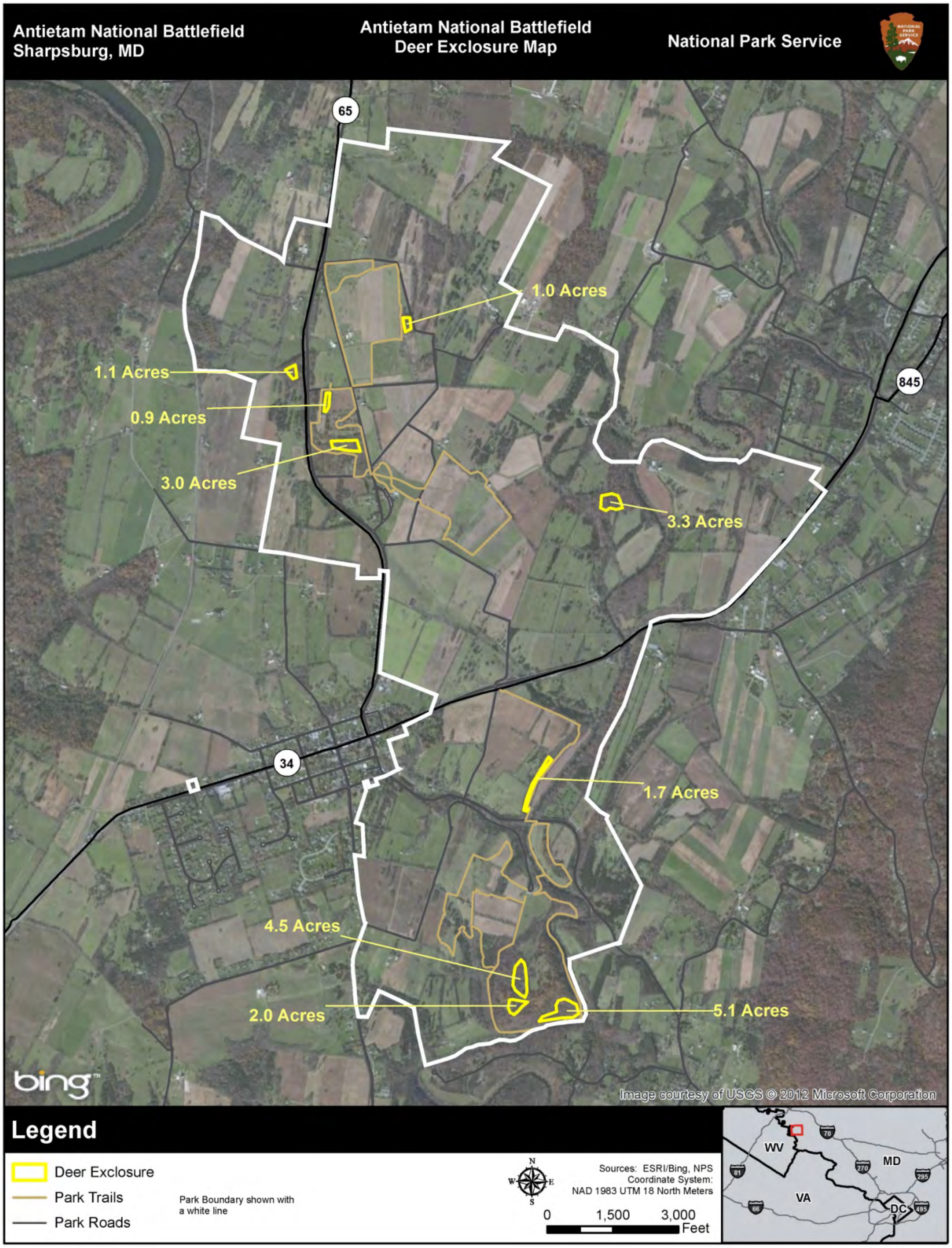


FIGURE 5: ANTIETAM NATIONAL BATTLEFIELD—POTENTIAL DEER EXCLOSURES

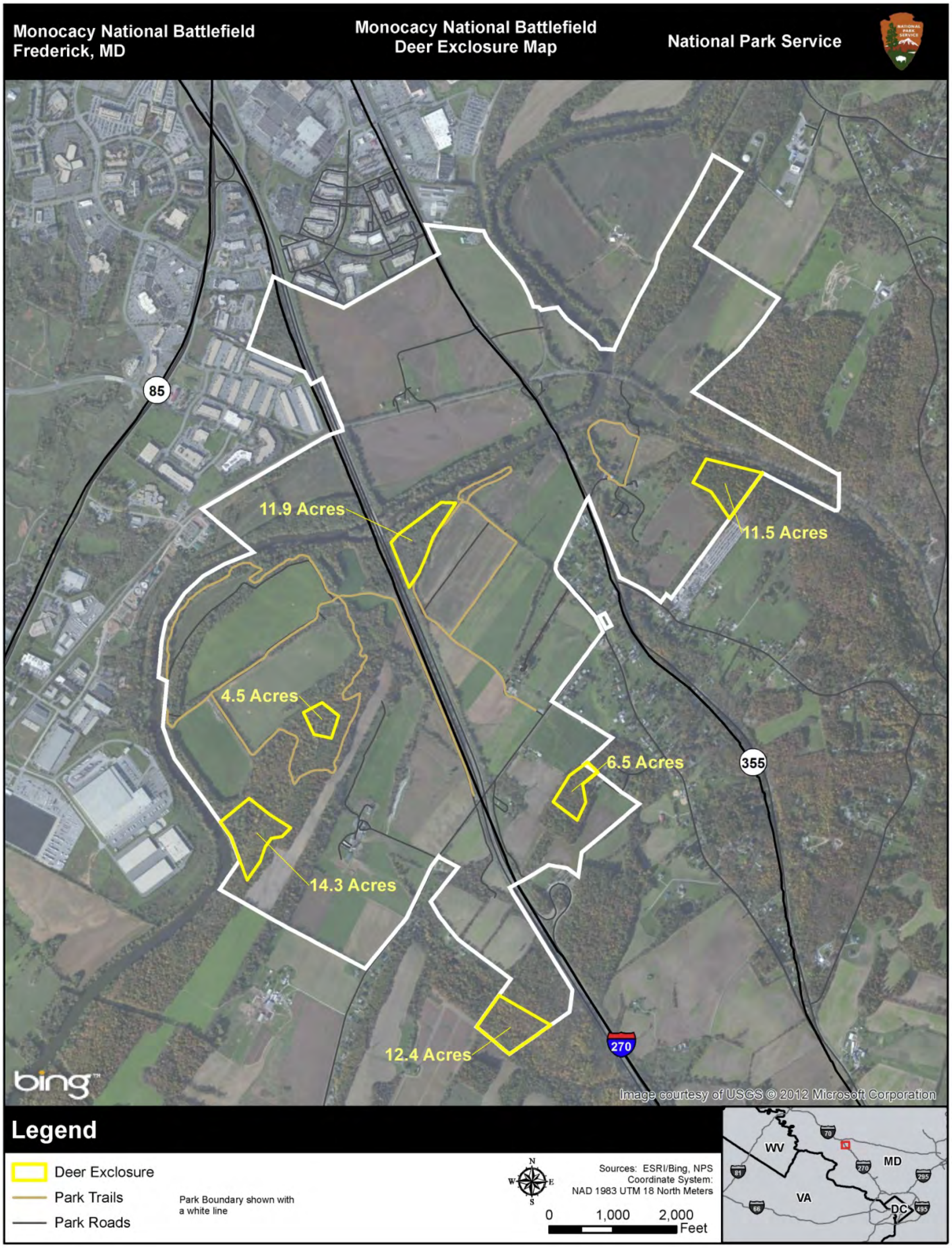


FIGURE 6: MONOCACY NATIONAL BATTLEFIELD—POTENTIAL DEER EXCLOSURES

FIGURE 7: MANASSAS NATIONAL BATTLEFIELD PARK—POTENTIAL DEER EXCLOSURES

TABLE 6: POTENTIAL DEER EXCLOSURES FOR ALL THREE PARKS

Exclosure Area	Approximate Perimeter in Linear Feet	Approximate Acres	% of Forested Acres Fenced
Antietam National Battlefield			
East Woods	892	1.0	0.3%
West Woods 1	1,653	3.0	1.0%
West Woods 2	1,008	0.9	0.3%
West Woods 3	908	1.1	0.4%
Cunningham	1,505	3.3	1.1%
Sherrick Woods	2,930	1.7	0.6%
Snavely 1	1,943	4.5	1.5%
Snavely 2	1,246	2.0	0.7%
Snavely 3	2,334	5.1	1.7%
TOTAL	**14,419**	**22.6**	**7.6% (of 300 acres)**
Monocacy National Battlefield			
Brooks Hill 1	1,703	4.4	0.9%
Brooks Hill 2	3,526	14.3	2.9%
Gambrill	3,053	11.5	2.3%
Thomas	3,523	11.9	2.4%
Lewis West	3,006	12.4	2.5%
Lewis East	2,450	6.5	1.3%
TOTAL	**17,261**	**61.0**	**12.2% (of 500 acres)**
Manassas National Battlefield Park			
Carter Woods	**5,755**	15.3	0.7%
Bull Run	**4,627**	21.9	1.0%
Chinn Ridge	**5,755**	47.8	2.2%
Stuart's Hill	**3,833**	14.8	0.7%
TOTAL	**17,526**	**99.8**	**4.6% (of 2,174 acres)**

Nonsurgical Reproductive Control of Does

Several reproductive control agents are currently being developed and tested for use in deer population control (Fraker et al. 2002). Those that could be considered for use are described briefly in table 7 and discussed in more detail in appendix B, which provides an overview of nonsurgical reproductive control technologies for deer management. Although particular product names are mentioned in this plan, the NPS is not limited to using the particular products listed and would evaluate products based on their ability to meet criteria (as described below) to determine whether a suitable agent exists for implementation.

TABLE 7: CURRENT REPRODUCTIVE CONTROL AGENTS

Issue	Standard (Native) PZP Vaccine	SpayVac ™ (PZP Vaccine)	GonaCon ™ (GnRH Vaccine)	Leuprolide (GnRH Agonist)
Mode of action	Blocks sperm penetration and fertilization; estrous cycles continue	Blocks sperm penetration and fertilization; estrous cycles continue	Prevents secondary hormone (luteinizing hormone and follicle stimulating hormone) secretion, which stops folliculogenesis and ovulation	Prevents secondary hormone (luteinizing hormone and follicle stimulating hormone) secretion, which stops folliculogenesis and ovulation
How administered	Injection	Injection	Injection	Injection
Number of doses	Twice initially and an annual booster	Once initially and booster every 3–5 years	Likely a single injection initially; if and when antibodies decline, retreatment would be required	Current formulation — annually
Time of administration	Treat before breeding season and allow sufficient time for antibody development	Treat before breeding season and allow sufficient time for antibody develop-ment	Treat before breeding season and allow sufficient time for antibody development	Treat immediately before breeding season on an annual basis

Alternative B would include treating female deer with a chemical reproductive control agent to reduce population growth. The current status of research related to nonsurgical reproductive control technologies (immunological and nonimmunological) provides results that are highly variable related to key elements such as efficacy and duration of contraceptive effect. There are also logistical issues related to the administration of these drugs that could affect success of implementation and sustainability of a reproductive control program at the parks. Therefore, only when the criteria listed in table 8 are met would reproductive control be implemented as a management technique.

No reproductive control agents are currently available that meet these criteria (see table B-1 in appendix B). Currently, the agent that comes closest to meeting all the criteria is GonaCon ™, which was approved and registered by the U.S. Environmental Protection Agency (EPA) in 2009 for use as a contraceptive for controlling white-tailed deer populations (EPA 2009). However, it is possible that an agent that meets all the criteria could be developed during the lifetime of this plan, and therefore, this option has been considered for detailed analysis. For the purposes of this discussion and environmental impact analysis, it is assumed that a reproductive control agent that meets these criteria would be available. The use of any reproductive control agents for population management would require approval from the EPA.

TABLE 8: REPRODUCTIVE CONTROL AGENT CRITERIA

Reproductive Control Agent Criteria	Rationale for Criteria
1. There is a federally approved fertility control agent for application to free-ranging populations.	It is critical that all aspects of a fertility control program be consistent with federal laws and regulations and NPS policies.
2. The agent provides multiyear (3–5 years) efficacy.	Modeling efforts have clearly demonstrated that (1) "the efficacy of fertility control as a management technique depends strongly on the [multiyear] persistence of … the fertility control agent" and (2) the only scenarios in which fertility control is more efficient than culling at maintaining population size is when a multiyear efficacy is achieved (Hobbs, Bowden, and Baker 2000).
3. The agent can be administered through remote injection.	Remote delivery reduces the frequency of stressful capture and/or drug delivery operations. Capture would be necessary for the initial application because the animals would need to be marked, but the agent should be able to be delivered remotely for any subsequent doses.
4. The agent would leave no hormonal residue in the meat (i.e., meat derived from treated animals should be safe for human consumption according to applicable regulatory agencies, and safe for consumption by other animals).	Any fertility control agent applied in free-ranging wildlife populations that are contiguous with areas or with the same species that are hunted must be safe for human consumption, and there should be minimal ecological impacts on other species that could eat deer.
5. Overall, there is substantial proof of success with limited behavioral impacts in a free-ranging population, based on scientific review and NPS policy.	No study has demonstrated that fertility control works to reduce deer numbers in free-ranging populations to the extent needed at the park to allow for tree regeneration, so it is important that proof of success be demonstrated. Also, it is important that any agent used meet NPS policies, including those regarding altered behavior (NPS 2006a, Section 4.4.1).

The NPS would review the status of ongoing reproductive control research on a periodic basis through consultation with subject matter experts and review of new publications. When there are advances in technology that could benefit deer management in the parks, the choice of an appropriate agent would be determined based on how well the criteria were met, availability, cost, efficacy, duration, safety, and feasibility. See appendix B for a detailed overview of reproductive control agents and methods.

Administration of Reproductive Control

Timing of Application—Timing of application would depend on the agent used; however, many of the current agents require administration prior to the breeding season. For the purposes of this analysis, it is assumed the selected agent would be administered during the months of October through March. This is when the deer are easier to capture, when the least number of visitors would be in the parks, and when there would be less stress on the deer. Summer months would be avoided because of potential heat stress on the deer. Based on the criteria established for use of an agent, it is conservatively assumed that the selected agent would need to be reapplied every 3 years, although it is recognized that efficacy may vary and this frequency could be adjusted. If long-term studies show that efficacy is prolonged with repeated vaccinations, reapplication may be less intensive.

Number of Does Treated—To effectively reduce population size, treatment with a reproductive control agent must decrease the reproductive rate to less than the mortality rate, which is approximately 10% in urban deer populations. Under this alternative, it is assumed that it would be necessary to treat at least

90% of the does in order to reduce population growth (Hobbs, Bowden, and Baker 2000; Rudolph, Porter, and Underwood 2000). After several years of application at this rate of treatment, a small (e.g., 5 %) reduction in the population could be expected (Hobbs, Bowden, and Baker 2000). In another deer management plan completed at Valley Forge National Historical Park, a population model indicated that the reduction in the population using a reproductive control agent could be more than that, possibly up to 33% after 5 years and up to 60% after 10 years (NPS 2009d). For this analysis, a range of cost estimates is provided; the first is a "high-end" cost that assumes a very slight reduction in population (with no change in the number of does treated each time the agent is administered), and the second is a "low-end" cost that assumes the agent is more effective and the number of does decreases over time, with a reduction in the population occurring at about 33% after year 5, and about 60% after year 10.

The following provides nonsurgical reproductive control scenarios for each park:

- **Antietam**—The park's 2011 deer population was estimated at 391 deer, based on the density of about 130 deer per square mile and the federal lands surveyed (about 3.01 square miles). Deer density survey data collected by the NPS indicate that approximately 55% of the deer in the park (215 deer) are does. The number of does that could be treated ranges from 194 does (90% of 215) every 3 years, assuming minimal population reduction, to the following, assuming a population reduction similar to what was predicted at Valley Forge National Historical Park: years 1 and 4: 194 does treated; years 7 and 10: 130 does treated; year 13: 78 does treated).
- **Monocacy**—The park's 2011 deer population was estimated at 498 deer, based on the density of about 235 deer per square mile and the federal lands surveyed (about 2.12 square miles). Deer density survey data collected by the NPS indicate that approximately 50% of the deer in the park (249 deer) are does. The number of does that could be treated ranges from 224 does (90% of 249) every 3 years to the following, assuming a population reduction similar to what was predicted at Valley Forge National Historical Park: years 1 and 4: 224 does treated; years 7 and 10: 150 does treated; year 13: 90 does treated.
- **Manassas**—The park's 2011 deer population was estimated at 1,209 deer, based on the density of about 172 deer per square mile and the federal lands surveyed (about 7.03 square miles). Deer density survey data collected by the NPS indicate that approximately 71% of the deer in the park (858 deer) are does. The number of does that could be treated ranges from 772 does (90% of 858) every 3 years, assuming minimal population reduction, to the following, assuming a population reduction similar to what was predicted at Valley Forge National Historical Park: years 1 and 4: 772 does treated; years 7 and 10: 517 does treated; year 13: 309 does treated. Note that is may not be feasible to treat the many does in one year, as further explained below.

For initial applications that require capture in order to mark the deer, it is assumed that about four does can be treated per day, using two teams of two to three people (an estimate based on experience with capture and tagging at Valley Forge National Historical Park (NPS 2009d)). Assuming the teams would work 5 days a week, about 20 does per week could be treated. At Antietam and Monocacy, all of the does could be treated within a 2.5- to 3-month period. However, for Manassas, given the large number of does to be treated and the desire to accomplish this in the 6-month period from approximately October to March, it is assumed that the park would treat half of the does scheduled for treatment in the following year (i.e., for the first application, 386 would be treated in year 1, and 386 in year 2; both groups of does would then be treated every three years).

Application Procedures—Assuming a reproductive control agent is used that meets all criteria, does would need to be initially captured for marking to avoid multiple treatments of the same does in the same year and to facilitate tracking for future applications in subsequent years. Several methods of wildlife trapping could be used, including but not limited to drop nets and box traps. Deer could also be immobilized by darting with a tranquilizer gun (Schwartz et al. 1997). This method could be used in cases where deer had not been successfully attracted to a trap area.

Most trapping methods involve using bait to attract deer to a specific area or trap. Box traps involve a confined space that safely holds the deer so that staff can approach it. Drop net traps also often use bait to attract deer to the drop zone, where suspended nets are triggered to drop over the deer and restrain it for staff to approach (Lopez et al. 1998). The method of capture would be selected based on the specific circumstances (e.g., location, number of deer, accessibility) for each deer or group to be removed. Given the large number of does that would need to be treated, bait piles would be used to concentrate does in certain locations to make the trapping process as efficient as possible. Marking would likely be accomplished using ear tags. Some capture and handling-related mortality could occur under this method due to tranquilizer use and stress on the doe (DeNicola and Swihart 1997; Kilpatrick, Spohr, and DeNicola 1997); generally, a mortality rate of 2% or less would be expected (Peterson et al. 2003; Kreeger and Arnemo 2012).

After the first application, the agent would be delivered by remote injection. Injection would likely be remotely delivered by dart or biobullet (plastic bullets impregnated with an immunocontraceptive), using a dart-type gun (similar to a shotgun). With the biobullet method, the biobullets remain with the doe and it is not necessary to recover spent darts.

Immunocontraceptive: A contraceptive agent that causes an animal to produce antibodies against some protein or peptide involved in reproduction. The antibodies hinder or prevent some aspect of the reproductive process.

As many does as possible would be treated daily until 90% of the does were treated. Visitor access would be restricted in certain areas of the parks during the treatment period. The areas targeted for treatment would be chosen based on maximizing deer presence and accessibility while minimizing visitor inconvenience.

Monitoring

Vegetation—As deer were excluded from feeding within the large exclosures, open areas (areas outside the large exclosures) would be monitored for changes in vegetation because of probable increased browsing pressure. Forest regeneration would be monitored both inside and outside the exclosures as described under alternative A. Additional monitoring of the large exclosures would also be conducted, with several large exclosures monitored each year for a select set of variables.

Reproductive Control—The ability to achieve target levels of infertility in the deer population would require knowledge of the fertility status of individual deer that had been treated (Hobbs, Bowden, and Baker 2000). The park would conduct fawn surveys during the summer to monitor reproductive control effectiveness, in addition to the ongoing spotlight/distance sampling. Data collected would include numbers of fawns observed during a 3-night survey in the summer, as well as numbers observed for the duration of the spotlight surveys. When possible, additional data used to estimate pregnancy rates would be collected from observations of the reproductive status of treated deer that are killed by vehicle collisions on roadways within the parks.

Implementation Costs

Costs of implementing alternative B would include the same costs described under alternative A with more frequent vegetation plot monitoring. In addition, alternative B includes the costs of the additional deer management techniques, the costs of constructing and maintaining the large exclosures, and the costs of reproductive control. Cost estimates and assumptions for all three parks are provided in tables 9A, 9B, and 9C (for Antietam, Monocacy, and Manassas, respectively).

Costs to implement the various techniques that could be used to reduce impacts are not possible to predict for the three parks at this time because these are options that may or may not be used depending on a park's particular needs. Generally, these costs would add only a minimal amount to the overall cost of any alternative. For example, deer fencing including posts is estimated to cost about $6 per linear foot; deer scarecrow devices are listed about $50 on various internet sites (Deerbusters.com 2011; Amazon.com 2011); and crop substitutions may not increase any costs. Therefore, these costs are not itemized in tables 9A, 9B, or 9C. The bulk of the costs of alternative B are for the exclosures and for nonsurgical reproductive control. These are described in more detail below.

Large-scale Exclosure Costs

Large deer exclosures covering one to several acres would be used in selected areas to allow forest regeneration. Material and installation costs are estimated at $6 per linear foot of fence (Ferebee, pers. comm. 2008; Petit, pers. comm. 2011; NDTC 2009). It is estimated that all exclosures would be constructed in the first year. Labor to inspect and maintain the large exclosures is also estimated, and costs are provided for relocation of the exclosures once during the life of the plan (estimated at once every 10 years).

Nonsurgical Reproductive Control Costs

Costs per deer would include costs for the reproductive control agent, labor and equipment, and bait piles. The cost of the selected agent would likely be minimal compared to labor costs for the effort; for example, the GonaCon™ vaccine is currently estimated at $2 to $10 per dose (USDA-APHIS 2010). The main cost is associated with capturing the deer to deliver the injection; this cost is estimated at $500 to $1,000 per deer if capture and marking are required (USDA-APHIS 2010). Other control methods that might become available in the future have similar costs currently. A study in New York (one of the few studies conducted on a suburban free-ranging deer population) estimated that the minimum annual time commitment per deer for reproductive control (using PZP) was approximately 20 hours, costing in the range of $450 to $1,000 per deer (Rudolph, Porter, and Underwood 2000). At Cleveland Metroparks (where PZP was used), the cost of labor was about $450 per deer, and the cost of vaccines and equipment was approximately $450 per deer (DeNicola, pers. comm. 2004a). Vaccine trials in Connecticut cost $1,128 per deer for 30 deer over 2 years; 64% of that cost was for labor (Walter, Kilpatrick, and Gregonis 2002). Costs for remote delivery would likely be less, but with the uncertainty of the ease of identifying and darting deer that have become wary of human presence; an estimate of $750 per deer including all labor and materials was assumed for either treatment option. However, these costs could vary based on improved technology and efficiency of capture or darting. The cost of additional monitoring required for reproductive control would be for two NPS staff members to conduct 3 days of spotlight surveys during the summer to document the number of fawns.

TABLE 9A: COST ESTIMATE FOR ANTIETAM NATIONAL BATTLEFIELD—ALTERNATIVE B

Action	Assumptions	Annual Cost ($)	Cost for the 15-year Planning Period ($)
Same actions as described for alternative A (included in all alternatives) with more frequent vegetation plot monitoring	See alternative A, table 5A for all costs minus vegetation monitoring- new cost provided below for the action alternatives		96,570
Vegetation monitoring of existing plots	Data collection and analysis of 12 paired plots every 3 years 40 hours, 4 staff at GS 9 at approx. $28/hr = $4,480 plus botanist for data analysis (20 hour at $28/hr = $560) Long- term plots read by I&M; no cost to park	5,040 every 3 years; assume done 5 times over life of plan	25,200
Large-scale exclosures: construction	9 exclosures for a total of 14,419 linear ft. at $6 per linear ft	86,514 (first year only)	86,514
Relocation of large-scale exclosures	Every 10 years at 75% of original cost	64,885 (once every 10 years)	64,886
Maintenance of large-scale exclosures	Labor to inspect and maintain exclosures (estimated at 1 person, half time for the year = 1,040 hours at GS 7 at approx. $23/hr.); material costs vary by year	23,920	358,800
Vegetation monitoring in large-scale exclosures	Monitor 3 exclosures/year, 8 hours per exclosure using 3 staff at avg. GS 9 = 72 hours at approx. $28/hour	2,016	30,240
Nonsurgical reproductive control of does	Cost dependent on how many deer treated and on current available technology Assume 90% of does (194) treated every 3 years at $750 per doe High-end cost: assume 194 does treated every 3 years: 194 does treated in years 1,4,7,10,13	High-end cost: 145,500 for 5 years = 727,500	High-end cost: 727,500
	Low-end cost: Years 1, 4: 194 does treated Years 7, 10: 130 does treated Year 13: 78 does treated	Low-end cost: 145,500 in years 1, 4 = 291,000 97,500 in years 7, 10 = 195,000 58,500 in year 13	Low-end cost: 544,500[a]
Reproduction monitoring	2 staff; 3 nights; 5 hours per night of fawn surveys using GS 9 at $28/hr; plus data analysis each summer = 20 hrs at $28/hr	1,400	21,000
		TOTAL	**1,227,710–1,410,710**

[a] Total cost could be reduced considerably if reproductive control costs could be decreased based on improved technology or improved efficiency of capture.

TABLE 9B: COST ESTIMATE FOR MONOCACY NATIONAL BATTLEFIELD—ALTERNATIVE B

Action	Assumptions	Annual Cost ($)	Cost for the 15-Year Planning Period ($)
Same actions as described for alternative A (included in all alternatives) with more frequent vegetation plot monitoring	See alternative A, table 5B, for all costs minus vegetation monitoring- new cost provided below for the action alternatives		73,980
Vegetation monitoring of existing plots	Data collection and analysis of 6 paired plots every 3 years 4 staff (GS 9 at approx. $ 28/hr) for 20 hours = 80 hours = $2,240 plus botanist for data analysis (10 hours at $28/hr = $280) Long- term plots read by I&M – no cost to park	2,520 every 3 years; assume done 5 times over life of plan	12,600
Large-scale exclosures	6 exclosures for a total of 17,261 linear ft. at $6 per linear ft.	103,566 (first year only)	103,566
Relocation of exclosures	Every 10 years at 75% of original cost	77,675 (once every 10 years)	77,675
Maintenance of large-scale exclosures	Labor to inspect and maintain exclosures (estimated at 1 person, half time for the year = 1,040 hours at GS 7 at approx. $23/hr); material costs vary by year	23,920	358,800
Vegetation monitoring in large scale exclosures	Monitor 2 exclosures /year, 8 hours per exclosure using 3 staff at avg. GS 9 = 48 hours at approx. $28/hour	1,344	20,160
Nonsurgical reproductive control of does	Cost dependent on how many deer treated and on current available technology Assume 90% of does (224) treated every 3 years at $750 per doe High-end cost: assume 224 does treated every 3 years: 224 does treated in years 1,4,7,10,13 Low-end cost: Years 1, 4: 224 does treated Years 7, 10: 150 does treated Year 13: 90 does treated	High-end cost: 168,000 for 5 years = 840,000 Low-end cost: 168,000 in years 1, 4 = 336,000 112,500 in years 7, 10 = 225,000 67,500 in year 13	High-end cost: 840,000 Low-end cost: 628,500[a]
Reproduction monitoring	2 staff; 3 nights; 5 hours per night of fawn surveys using GS 7 at $23/hr; plus data analysis each summer = 20 hrs GS 11 at $34/hr	1,370	20,550
		TOTAL	**1,295,831–1,507,331**

[a] Total cost could be reduced considerably if reproductive control costs could be decreased based on improved technology or improved efficiency of capture.

TABLE 9C: COST ESTIMATE FOR MANASSAS NATIONAL BATTLEFIELD PARK—ALTERNATIVE B

Action	Assumptions	Annual Cost ($)	Cost for the 15-Year Planning Period ($)
Same actions as described for alternative A (included in all alternatives)- same frequency of vegetation monitoring (every 3 years)	See alternative A, table 5C		153,060
Large-scale exclosures	4 exclosures for a total of 17,526 linear ft. at $6 per linear ft.	105,156 (first year only)	105,156
Relocation of exclosures	Every 10 years at 75% of original cost	78,867 (once every 10 years)	78,867
Maintenance of large-scale exclosures	Labor to inspect and maintain exclosures (estimated at 1 person, half time for the year = 1,040 hours at GS 9 at approx. $28/hr.); material costs vary by year	29,120	436,800
Vegetation monitoring in large scale exclosures	Monitor 2 exclosures /year, 16 hours per exclosure using 3 staff at avg. GS 9 = 96 hours at approx. $28/hour	2,688	40,320
Nonsurgical reproductive control of does	Cost dependent on how many deer treated and on current available technology Assume 90% of does (approx. 772) treated; one-half (386) treated every other year, at $750 per doe High-end cost: assume 386 does treated every 3 years; one group in years 1,4,7,10, and 13; the other in years 2,5,8,11,14 Low-end cost: Years 1, 4, and 2, 5: 386 does treated Years 7, 10 and 8, 11: 259 does treated Years 13 and 14: 309 does treated	High-end cost: 289,500 each year for a total of 10 years = 2,895,000 Low-end cost: 289,500 in years 1, 4, 2, 5 = 1,158,000 194,250 in years 7, 10, 8, 11 = 777,000 231,750 in years 13, 14 = 463,500	High-end cost: 2,895,000[a] Low-end cost: 2,398,500
Reproduction monitoring	2 staff; 3 nights; 5 hours per night of fawn surveys using GS9 at $28/hr; plus data analysis each summer = 20 hrs at $28/hr	1,400	21,000
		TOTAL	**3,233,803–3,730,303**

[a] Total cost could be reduced considerably if reproductive control costs could be decreased based on improved technology or improved efficiency of capture.

ALTERNATIVE C: LETHAL DEER MANAGEMENT

Alternative C would include all actions described under alternative A (with some modifications to monitoring schedules) and the additional techniques described under alternative B, but with a primary focus on using lethal deer management actions to reduce the herd size. Direct reduction of the deer herd would be accomplished mainly by sharpshooting with firearms, with a limited use of capture and euthanasia if sharpshooting is not considered appropriate due to safety concerns. These actions would be used to achieve initial deer density goals of 15–20 deer per square mile, and the population would be maintained at an appropriate density over time by sharpshooting, as determined by adaptive management.

Additional Proposed Actions under Alternative C

Additional Techniques to Reduce Deer Impacts

The same techniques described under alternative B could be used by the NPS in certain circumstances under alternative C. These actions include fencing of crops and woodlots; changing the types of crops grown to substitute crops that are less palatable to deer; planting sacrificial rows of alternative crops at the edges of fields; and aversive conditioning. These techniques are described in more detail under alternative B.

Sharpshooting

Methods—Sharpshooting would be used to initially reduce the deer population in the parks and as a maintenance treatment as needed. Qualified federal employees or contractors would be used to implement this alternative. All employees or contractors used would be experienced with sharpshooting methods and would have the necessary sharpshooting qualifications. Training would also address safety measures to protect both visitors and NPS employees. The employees or contractors would be expected to coordinate all details related to sharpshooting actions, such as setting up bait stations, locating deer, sharpshooting, and disposition of the deer (donation of meat and/or disposal of waste or carcasses).

In most locations, high-powered, small-caliber rifles would be used from close range. Nonlead ammunition would be used for any lethal removal of deer in order to preserve the opportunity to donate the meat or to leave it in the field for scavenging wildlife. Every effort would be made to make the shootings as humane as possible. Deer injured during the operation would be put down as quickly as possible to minimize suffering. Noise suppression devices (silencers) and night vision equipment would be used to reduce disturbance to the public. Activities would be conducted in compliance with all relevant firearm laws and regulations.

Sharpshooting would primarily occur at night (between dusk and dawn) during late fall and winter months when deer are more visible and few visitors are in the parks. In some areas, sharpshooting might be conducted during the day or at other times of year if needed to maximize effectiveness and minimize overall time of visitor restrictions. Areas could be temporarily closed to park visitors, and NPS park rangers would patrol public areas to ensure compliance with park closures and public safety measures. The public would be notified of any park closures in advance. Information regarding deer management would be available at visitor contact facilities posted on the parks' websites to inform the public of deer management actions. If more than one shooting location were used, areas would be adequately separated to ensure safety.

Bait stations could be used to attract deer to safe removal locations and would consist of small grains, apples, hay, or other food placed on the ground. The stations would be placed in park-approved locations away from public use areas to maximize the efficiency and safety of the reduction program. The amount of bait placed in any one location would vary depending on the bait used and the number of deer in the immediate area.

Number of Deer Removed—Park staff would determine the number of deer to be removed from the parks based on the most recent population survey and the initial deer density goal of 15 to 20 deer per square mile, as well as past experience of other deer management programs, technical feasibility, and success of forest regeneration in later years of plan implementation. Based on 2011 deer density reports for the three parks and the experience with lethal removal at other NPS parks such as Valley Forge National Historical Park, it is estimated that the desired deer density goal could be reached at Antietam and Monocacy in 3–5 years and at Manassas in 4–6 years. These estimates are based on the technical, financial, and logistic feasibility of removal at all three parks, as well as the subsequent expected increase in the park deer populations resulting from both reproduction and immigration. It is recognized that removal could proceed more rapidly if it is possible to remove more deer in each year and if the deer population numbers do not rebound as much as estimated.

This section describes a likely scenario for the removal actions at each park, beginning with the 2011 deer population numbers. To develop this scenario, a random number generator was used for estimating the annual increase to the herd from reproduction (table 10). The scenario assumes that essentially all deer would be removed using sharpshooting, with capture and euthanasia used sparingly if at all, given the past experience of park staff and the lack of areas at the parks where sharpshooting would be limited. Removal would be targeted for the 5-month period from October through March.

As previously noted, several factors could influence the number of years required to reach the initial deer density goal. The numbers presented above are estimates based on 2011 deer density and estimates of annual growth, as well as what experienced staff believe is reasonable. These numbers will vary when the plan is implemented. For example, as the deer population numbers decrease through successful reduction efforts, deer might become adapted to the sharpshooting operations and become more evasive, increasing the effort necessary to reach the removal numbers in any year. Existing reproduction/ mortality rates might differ from the estimates used in this projection. If reproduction rates were higher and mortality lower than estimated, the population growth would be greater, and more deer would need to be removed; this would potentially increase the time to reach the initial density goal or call for a greater number of deer to be removed, if feasible given available resources. The converse would be true if reproduction rates were lower and mortality rates higher than estimated, resulting in removing fewer deer and reaching the deer density goal in less time. Immigration of deer into the park property could also vary, and this would have an effect on the number of deer to be removed (Porter, Underwood, and Woodard 2004). Thus, monitoring would be an essential part of this alternative, and actions could be adjusted as described in the "Adaptive Management Approaches Included in the Alternatives" section.

The number of deer removed in years following attainment of the desired density goal would be adjusted as described in the "Adaptive Management Approaches Included in the Alternatives" section. This number may vary annually depending on success of previous removal efforts, deer adaptations to removal efforts, regeneration response, and other factors.

Gender Preference—Both does and bucks would be removed based on opportunity, although there would be a preference for removing does, especially initially, because this would reduce the population level more efficiently over the long term. Buck-only removal would not control population growth, as deer populations are largely dependent on the number of does with potential for reproduction (West Virginia University 1985).

TABLE 10: ESTIMATED DEER REMOVALS BY YEAR – ALTERNATIVE C

Year	Total Number of Deer	% Removed[a]	Number Removed	Post-removal Number	Post-removal Density (Deer per Square Mile)[b]	Reproduction[c]	Pre-removal Total for the Following Year
Antietam deer removals based on 1,926 acres (3.01 square miles) Starting deer density: 130 deer per square mile							
1	393	62	243	150	49.83	82	232
2	232	51	118	114	38	48	162
3	162	59	140	66	21	29	95
4	95	51	49	46	15		
Monocacy deer removals based on 1,355 acres (2.12 square miles) Starting deer density: 235 deer per square mile							
1	497	56	278	219	103	86	305
2	305	47	143	162	77	68	230
3	230	61	140	90	42	28	112
4	112	48	54	58	27	28	85
5	85	.52	44	41	19		
Manassas deer removals based on 4,500 acres (7.03 square miles) Starting deer density: 172 deer per square mile							
1	1209	54	652	557	78	239	796
2	796	51	405	391	55	113	504
3	504	.46	231	273	38	112	385
4	385	57	219	166	23	88	254
5	254	54	138	106	15		

[a] Random number between 0.45-0.65 (i.e., 45–65%)

[b] After the post-removal density reaches the desired 15-20 deer per square mile range, the parks would remove smaller numbers of deer each of the remaining years of the plan to maintain the herd at the desired density; this example predicts the following maintenance removals:

Antietam: 14-29 deer per year (years 5-15)

Monocacy: 10-21 deer per year (years 6-15)

Manassas: 35-73 deer per year (years 6-15)

[c] Random number between 0.10-0.35 × post-removal number

The age and gender of all deer removed from the parks would be recorded to aid in defining the local population composition. This information would be compared with composition data collected during park population surveys.

Capture and Euthanasia

Capture and euthanasia would be used in very limited circumstances where sharpshooting would not be appropriate due to safety or security concerns. Because capture and euthanasia would typically result in increased stress levels in captured deer compared to sharpshooting, this method of population control would be used only in select situations and would supplement the sharpshooting method described earlier only when necessary. None of the parks expects to use this, but it is in the plan in case its use is necessary. At most, 5 to 10 deer each year would be taken in this manner, so these numbers are not itemized in the removal estimates or in the costs.

If capture and euthanasia were required, the preferred technique for this method would be for qualified federal employees or authorized agents to trap the deer, approach them on foot, and euthanize them. Activities would be conducted at dawn or dusk when fewer visitors are in the parks. The number of deer removed by capture and euthanasia would be recorded, as well as the age and sex of the deer, location of removal, circumstances requiring removal and capture, and lethal method used.

Deer would be captured with nets or traps, similar to the trapping described under the reproductive control option for the initial administration of the selected agent. Deer could also be immobilized by darting with a tranquilizer gun (Schwartz et al. 1997). The method of capture would be selected based on the specific circumstances (e.g., location, number of deer, accessibility, and reasons that sharpshooting is not advised) for each deer or group to be removed. Captured deer would be euthanized as humanely as possible, in accordance with current veterinary recommendations such as those published by American Veterinary Medical Association.

Euthanasia methods could include a combination of penetrating captive bolt gun and potassium chloride, firearm technique, or other humane technique. If for some reason the penetrating captive bolt gun or firearm technique could not be used to euthanize a trapped animal, injecting a lethal dose of a drug (under supervision of a veterinarian or NPS park practitioner) could be used. However, if chemicals were used either for immobilization or for euthanasia, it might not be possible to donate the meat from that animal as food, and the carcass might be unsuitable for surface disposal. In this case, the carcasses would be taken to a local landfill.

Only NPS staff and authorized agents trained in the use of penetrating captive bolt guns, firearms, or tranquilizer guns would perform these euthanasia actions. Training would include safety measures to protect authorized agents, visitors, and NPS employees. Authorized agents may also need to be qualified to handle live deer in order to prevent disease transmission and prevent any harm to the handler. Appropriate safety measures would be followed when setting drop nets or box traps.

Disposal

The NPS would donate deer meat (e.g., to local charitable organizations, nonprofit food banks) to the maximum extent possible or practical, as permitted by regulations and NPS guidelines (NPS 2007). If donation were not possible, then carcasses would be disposed of. When donating meat, the parks would follow current guidance from the NPS Office of Public Health and the Biological Resource Management Division with regard to donation of meat from areas affected by CWD, in addition to state and local requirements. Since the parks are within 60 miles of a known CWD case, CWD testing would be conducted to the extent needed to have 99% confidence that CWD is not present at more than 1% prevalence (NPS 2007) before any carcasses are considered for donation. Deer would be donated for consumption only if they are confirmed CWD-negative or if the required detection confidence level indicates that CWD is not present within the population.

If meat were suitable for donation, the animals would be field dressed in the parks. The entrails (internal parts) would be buried if there were an appropriate location; otherwise, entrails would be placed in drums for disposal at a processing or other appropriate facility. If the location were particularly remote, entrails could be left on the surface to decay or be scavenged. Carcasses brought back to the staging area would be stored in a refrigerated unit until any required CWD testing results are obtained and then transported to a butcher for processing.

Any deer carcasses that are not suitable for consumption or for surface disposal would to be disposed of at an approved local landfill or other disposal facility that accepts deer carcasses. The parks would investigate appropriate landfills and costs as the need arises. In the few cases where a deer has been euthanized (without chemical use) at a given site, the waste or carcasses may be moved away from roads and trails or to a remote location and left on the surface to be naturally scavenged and/or decompose. The selected disposal option would be dependent on whether chemicals were used, suitability of meat for donation, amount of waste or carcasses, and distance from trails, roads, and nearby facilities and residences.

Should CWD be found within 5 miles of one of the parks, or should a CWD-positive case be identified within a park's deer population, the park would initiate the long-term CWD response plan (see "Alternatives - CWD Management," below) and associated disposal in accordance with the NPS Public Health guidelines for an area where CWD is known to occur (NPS 2007). Any CWD-positive carcasses, any processing batches containing a positive carcass, and any other deer parts would be disposed of off-site through alkaline digestion, incineration, or disposal at a local licensed municipal lined solid waste landfill. The Public Health guidelines preclude the donation of meat to food pantries, soup kitchens, or any entity that intends to redistribute the meat if the deer carcass is from an area where CWD is known to occur.

Monitoring

Vegetation—Throughout the removal actions, vegetation monitoring would be conducted to document any changes in the intensity of deer browsing and forest regeneration that might result from reduced deer numbers, following the monitoring protocol outlined in appendix A. Vegetation monitoring would be conducted at least as frequently as every 3 years to document vegetation recovery. If the park objectives were being met and forest regeneration was successful at the initial deer density goal, removal efforts would be maintained at the level necessary to keep the deer population at the target density. However, it would take several years for seedling numbers to respond to lower deer numbers and this response would directly depend on how quickly the population was reduced. Likewise, the number of deer to be removed in subsequent years would be adjusted based on the success of previous removal efforts, projected population size, and vegetation and deer monitoring results. Park management could adjust the removal goal in either direction from the initial density goal depending on how well the parks' forest regeneration objectives had been met (see the "Adaptive Management Approaches Included in the Alternatives" section).

Deer Population—Deer population numbers would be monitored through the ongoing monitoring efforts discussed under the no action alternative and in "Chapter 1: Purpose of and Need for Action." The parks would use distance sampling to document trends in population size.

Implementation Costs

Costs of implementing alternative C would include the same costs described under alternative A and the costs of the CWD response plan, plus the costs of sharpshooting and capture/euthanasia. Cost estimates and assumptions for all three parks are provided in tables 11A, 11B, and 11C (for Antietam, Monocacy, and Manassas, respectively). Costs to implement the various techniques that could be used to reduce impacts are not possible to predict for the three parks at this time because these are options that may or may not be used depending on a park's particular needs. Generally, these costs would add only a minimal amount to the overall cost of any alternative, and so these costs are not included on tables 11A, 11B, or 11C.

TABLE 11A: COST ESTIMATE FOR ANTIETAM NATIONAL BATTLEFIELD—ALTERNATIVE C

Action	Assumptions	Annual Cost ($)	Cost for the 15-year Planning Period ($)
Same actions as described for alternative A (included in all alternatives) with more frequent vegetation plot monitoring	See alternative A, table 5A, for all costs minus vegetation monitoring - new cost provided below for the action alternatives		96,570
Vegetation monitoring of existing plots	Same as alternative B; see table 9A		25,200
Sharpshooting[a]	Years 1–4: 550 deer removed (yr 1 = 243; yr 2 = 118; yr 3 = 140; yr 4 = 49; $200/deer) Years 5–15: about 22 deer[b] removed each year for 11 years ($400/deer)	Years 1–4: 110,000 Years 5–15: –8,800 annually = 96,800	206,800
	Park staff for park closure and safety – see text for assumption details	Year 1: 15,120 Year 2: 7,560 Year 3: 7,560 Year 4: 3,024 (Years 1–4: 33,264) Years 5–15: 1.512 × 11 years = 16,632	49,896
Donation/Disposal	792 deer (total) at $70/deer		55,440
		TOTAL	**433,906**

[a]Cost would be further influenced by whether or not volunteers are used to assist with supporting duties (e.g., non-shooting assistance such as bait pile construction). Costs could also change if it takes less or more than five years to reach the desired deer density goal. Five years is based on calculations that estimate deer removals, as well as annual increases to the herd through reproduction and immigration, within reasonably expected ranges (see text).

[b]Number to be removed each year to maintain deer density at 15-20 deer per square mile is estimated at 14-29 per year; 22 is used for cost estimating purposes.

TABLE 11B: COST ESTIMATE FOR MONOCACY NATIONAL BATTLEFIELD—ALTERNATIVE C

Action	Assumptions	Annual Cost ($)	Cost for the 15-year Planning Period ($)
Same actions as described for alternative A (included in all alternatives) with more frequent vegetation plot monitoring	See alternative A, table 5B, for all costs minus vegetation monitoring-new cost provided below for the action alternatives		73,980
Vegetation monitoring of existing plots	Data collection and analysis of 6 paired plots every 3 years 4 staff (GS 9 at approx. $ 28/hr) for 20 hours = 80 hours = $2,240 plus botanist for data analysis (10 hour at $28/hr = $280) Long- term plots read by I&M – no cost to park	2,520 every 3 years; assume done 5 times over life of plan	12,600
Sharpshooting[a]	Years 1–5: 659 deer removed (yr 1 = 278; yr 2 = 143; yr 3 = 140; yr 4 = 54; yr 5 = 44; $200/deer) Years 6–15: about 16 deer[b] removed each year for 10 years ($400/deer)	Years 1–5: 131,800 Years 6–15: –4,800 annually = 64,000	195,800
	Park staff for park closure and safety – see text for assumption details	Year 1: 15,120 Year 2: 7,560 Year 3: 7,560 Year 4: 3,024 Year 5: 3,024 (Years 1–5: 36,288) Years 6–15: 1,512 × 10 years = 15,120	51,408
Donation/Disposal	819 (total) deer at $70/deer	Will vary with number removed each year	57,330
		TOTAL	**391,118**

[a]Cost would be further influenced by whether or not volunteers are used to assist with supporting duties (e.g., non-shooting assistance such as bait pile construction). Costs could also change if it takes less or more than five years to reach the desired deer density goal. Five years is based on calculations that estimate deer removals, as well as annual increases to the herd through reproduction and immigration, within reasonably expected ranges (see text).

[b]Number to be removed each year to maintain deer density at 15-20 deer per square mile is estimated at 10-21 per year; 16 is used for cost estimating purposes.

TABLE 11C: COST ESTIMATE FOR MANASSAS NATIONAL BATTLEFIELD PARK—ALTERNATIVE C

Action	Assumptions	Annual Cost ($)	Cost for the 15-year Planning Period ($)
Same actions as described for alternative A (included in all alternatives)	See alternative A, table 5C		153,060
Sharpshooting[a]	Years 1–5: 1,645 deer removed (yr 1 = 652; yr 2 = 405; yr 3 = 231; yr 4 = 219; year 5 = 138; $200/deer) Years 6–15: about 54 deer[b] removed each year for 10 years ($400/deer)	Years 1–5: 329,000 Years 6–15: –21,600 annually = 216,000	545,000
	Additional park staff for park closure and safety – see text for assumption details	Year 1: 45,360 Year 2: 30,240 Year 3: 15,120 Year 4: 15,120 Year 5- 7,560 (Years 1–5: 113,400) Years 6–1: 3,024 × 10 years = 30,240	143,640
Donation/Disposal	2,185 deer (total) at $70/deer	Will vary with number removed each year	152,950
		TOTAL	**994,650**

[a]Cost would be further influenced by whether or not volunteers are used to assist with supporting duties (e.g., non-shooting assistance such as bait pile construction). Costs could also change if it takes less or more than five years to reach the desired deer density goal. Five years is based on calculations that estimate deer removals, as well as annual increases to the herd through reproduction and immigration, within reasonably expected ranges (see text).

[b]Number to be removed each year to maintain deer density at 15-20 deer per square mile is estimated at 35-73 per year; 54 is used for cost estimating purposes.

Sharpshooting Costs

Factors affecting the cost of implementing this alternative include deer density, the number of deer to be removed, the ease of access to deer, the number and location of bait stations, equipment availability, the amount of data to be collected from deer, and processing requirements. Higher costs would generally be expected when deer and bait stations are difficult to access, deer are evasive of humans, removal areas are large, and/or deer densities are lower (requiring more time to find each deer). Conversely, lower costs could be expected when the removal area was smaller, deer density was high (requiring less time to find each deer), and deer were accustomed to human activities (DeNicola, pers. comm. 2004b). For cost estimating it is assumed that a qualified federal employee or contractor would conduct the lethal removal activities, process the deer, collect biological data, prepare meat for transfer to a local food bank (as appropriate), and/or arrange for disposal of deer carcasses.

Costs and efficiencies of sharpshooting programs have been assessed in the literature and costs estimates are available from programs that have involved sharpshooting of deer over the past few years. One study documented that costs ranged from $72 to $260 per deer harvested (Warren 1997). A study in Minnesota compared methods to reduce deer abundance, and sharpshooting averaged $121 per deer harvested (Doerr, McAnnich, and Wiggers 2001). Gettysburg National Military Park recently reported costs of about $200 per deer, not including processing and deer monitoring (Bolitho, pers. comm. 2010; Koenig, pers. comm. 2011), and the staff at Valley Forge National Historical Park confirmed the reasonableness of a $200 per deer estimate (Heister, pers. comm. 2011). Estimates provided by Cleveland Metroparks, which conducts deer removals in Ohio near another national park, indicate costs (including labor for site security) at about $150 to $232 per deer, based on the overall dollars reported spent (Tyler, pers. comm. 2011b). Gettysburg staff report that they have not seen a big increase in cost per deer over the years, even though the deer numbers have declined substantially. However, increased costs could be expected to find and remove fewer deer as the years progress and deer numbers fall within the 15 to 20 deer per square mile range, and this is accounted for in the cost estimates.

Based on this information, it is estimated that sharpshooting would cost $200 per deer for the first years of the program, and up to $400 per deer in later years after the deer density has been reduced and deer may be harder to find and remove. It is recognized that costs will vary depending on availability of capital equipment, contract vs. park labor, need for site security, and number of deer.

Costs for additional staffing to close off the park during sharpshooting were estimated assuming that there would be 3 rangers needed during a 6-hour night shift to close off all or parts of the park, and that the number of nights needed to reach the goal number of deer would vary from 2 to 60 nights, depending on the number to be removed. For example, for Manassas, it was assumed that deer removal would require 60 nights in year 1, 40 nights in year 2, 20 nights in years 3 and 4, 10 nights in year 5, and 4 nights in subsequent years. For Antietam and Monocacy, it was assumed that deer removal would require 20 nights in year 1, 10 nights in years 2 and 3, 4 nights in years 4 (and year 5 at Monocacy) and 2 nights in subsequent years. Staff costs were estimated at a GS 9 level and it was assumed that overtime pay would be required. In general, each night was assumed to coat an additional $756 (3 staff at about $42/hour, for 6 hours).

Capture and Euthanasia Costs

Because the NPS does not anticipate using this option and expect very few, if any, deer to be removed by capture and euthanasia, costs for this action are not itemized in the table.

Donation/Disposal Costs

For the purposes of this analysis, it is assumed that meat would be donated to the maximum extent possible. It is assumed that the refrigerated storage would be provided as part of the contract for deer removal, and that it costs about $70 per carcass for transport and processing (Donaldson, pers. comm. 2012).

Should a confirmed case of CWD be located within the parks, costs would still be incurred by CWD testing to determine prevalence. However, costs of processing the meat for donation may vary or may not be incurred at all, depending on guidance from public health officials. (Donation to third-party entities for distribution would be prohibited if CWD were confirmed within the park's deer population.) In this case, CWD-positive deer would be disposed of through alkaline digestion, incineration, or disposal at a local approved landfill.

ALTERNATIVE D: COMBINED LETHAL AND NONLETHAL DEER MANAGEMENT

Alternative D would include all actions described under alternative A (with some modifications to monitoring schedules) and the additional techniques described under alternative B, but with a primary focus on incorporating a combination of lethal and nonlethal actions to address high deer density. Lethal actions (including sharpshooting, with very limited capture/euthanasia if necessary) would be taken initially to reduce the deer herd numbers quickly. Population maintenance would be conducted via nonsurgical reproductive control methods (if these are available) and meet NPS criteria for use; if not, sharpshooting would be used for maintenance.

Additional Proposed Actions under Alternative D

Additional Techniques to Reduce Deer Impacts

The same techniques described under alternative B could be used by the parks in certain circumstances under alternative C. These techniques include fencing of crops and woodlots; changing the types of crops grown to substitute crops that are less palatable to deer, and planting sacrificial rows of alternative crops at the edges of fields; and aversive conditioning. These techniques are described in more detail under alternative B.

Sharpshooting

Direct reduction by sharpshooting would be used to initially reduce the deer population in the parks and as a maintenance treatment if needed. Methods described in alternative C would be implemented. This action would begin in the first year of the plan, and for maintenance purposes could still be used depending on the deer density and availability of an acceptable reproductive control agent.

Capture and Euthanasia

Capture and euthanasia would be implemented very sparingly in areas where sharpshooting is not possible, as described under alternative C. This procedure would include trapping or immobilizing deer using a technique designed to create the least amount of stress. It is assumed that few deer, if any, would need to be taken this way.

Nonsurgical Reproductive Control

As described under alternative B, nonsurgical reproductive control would be implemented to maintain the deer population at the deer density goal if an acceptable reproductive control agent is available. Reproductive control may need to be implemented in conjunction with lethal efforts as a back-up method.

As described under Alternative B, the NPS would review the status of ongoing reproductive control research on a periodic basis through consultation with subject matter experts and review of new publications. When there are advances in technology that could benefit deer management in the parks, the choice of an appropriate agent would be determined based on how well the criteria were met, availability, cost, efficacy, duration, safety, and feasibility.

It is assumed that reproductive control would be initiated when the parks' deer population densities had reached the desired deer densities (see table 10). Assuming the proportion of does in the remaining deer remains the same as described under alternative B, and based on the results reported by Hobbs, Bowden, and Baker (2000), it would be necessary to treat 70 to 90% of the does to maintain the population at the lowered density. Taking a conservative approach of treating 90 % of the remaining does, the NPS would treat 23 does (90% of 25) at Antietam, 19 does (90% of 21) at Monocacy, and 68 does (90% of 75) at Manassas. Does would need to be treated every 3 years and marked for identification for subsequent retreatment during the initial application in order to keep the population at the desired level.

The NPS would continue to monitor the deer population for growth. If the deer population increased during the reproductive control application under this alternative, periodic direct reduction may need to be conducted in conjunction with the reproductive control to maintain the population density at the identified goal.

The success of implementing reproductive control on a population that had undergone direct reduction for several years would depend on advances in reproductive control technology, sensitivity of the deer herd to humans, methods used by the sharpshooters, changes in immigration with reduced deer density, and general deer movement behavior (Porter, Underwood, and Woodard 2004; Naugle et al. 2002).

Monitoring

Monitoring would include the same techniques described under alternative C for sharpshooting and capture and euthanasia described under alternative B for reproductive control. Monitoring techniques would also include the current actions described under alternative A.

Implementation Costs

Alternative D would include the same costs described under alternative A, plus additional costs for sharpshooting, capture and euthanasia, reproductive control, and monitoring. Cost estimates and assumptions for all three parks are provided in tables 12A, 12B, and 12C (for Antietam, Monocacy, and Manassas, respectively). Costs to implement the various techniques that could be used to reduce impacts are not possible to predict for the three parks at this time because these are options that may or may not be used depending on a park's particular needs. Generally, these costs would add only a minimal amount to the overall cost of any alternative, and so these costs are not included on tables 12A, 12B, or 12C.

Sharpshooting Costs

Assumptions related to costs for sharpshooting to reduce the overall population size would be the same as described in alternative C.

Capture and Euthanasia Costs

Because few if any deer are expected to be removed by capture and euthanasia, costs are not itemized in the table for this action.

Nonsurgical Reproductive Control Costs

For the purposes of this analysis, it is assumed that 90% of does would be treated with the selected reproductive control agent every 3 years after the initial deer density was met to maintain the population level. Costs could be reduced considerably depending on direct reduction efforts and the cost per deer based on current technology. See alternative B for a description of the cost per deer assumptions.

Monitoring costs would be the same as those described in alternative C.

Donation/Disposal Costs

The NPS would donate deer meat or dispose of carcasses as described in alternative C, with the intention of donating as much meat as possible.

TABLE 12A: COST ESTIMATE FOR ANTIETAM NATIONAL BATTLEFIELD—ALTERNATIVE D

Action	Assumptions	Annual Cost ($)	Cost for the 15-Year Planning Period ($)
Same actions as described for alternative A (included in all alternatives) with more frequent vegetation plot monitoring	See alternative A, table 5A, for all costs minus vegetation monitoring-new cost provided below for the action alternatives		96,570
Vegetation monitoring of existing plots	Same as alternative B; see table 9A		25,200
Sharpshooting [a]	Years 1-4: 550 deer removed ($200/deer)	Years 1–4: 110,000	110,000
	Park staff for park closure and safety Years 1–4 (see alternative C)	33,264	33,264
Nonsurgical reproductive control	Years 5–15: 23 does treated every two years Cost dependent on number of deer treated and current available technology (assumes $1,000/doe)	Years 5–15: 23,000 every 2 years; assume 6 treatments in years 5,7,9,11,13,15	138,000 [b]
Reproduction monitoring	2 staff; 3 nights; 5 hours per night of fawn surveys using GS9 at $28/hr; plus data analysis each summer = 20 hrs at $28/hr in years 6 through 15 (10 years)	1,400	14,000
Donation/ disposal	Years 1–4: 550 deer at $70/deer	Years 1–4: 38,500	38,500
		TOTAL	**455,534**

[a] Cost would be further influenced by whether or not volunteers are used to assist with supporting duties (e.g., non-shooting assistance such as bait pile construction). Costs could also change if it takes less or more than four years to reach the desired deer density goal. Four years is based on calculations that estimate deer removals, as well as annual increases to the herd through reproduction and immigration, within reasonably expected ranges (see text).

[b] Reproductive control costs could be reduced considerably with improved technology or improved efficiency of capture.

TABLE 12B: COST ESTIMATE FOR MONOCACY NATIONAL BATTLEFIELD—ALTERNATIVE D

Action	Assumptions	Annual Cost ($)	Cost for the 15-Year Planning Period ($)
Same actions as described for alternative A (included in all alternatives) with more frequent vegetation plot monitoring	See alternative A, table 5A, for all costs minus vegetation monitoring; new cost provided below for the action alternatives		73,980
Vegetation monitoring of existing plots	Data collection and analysis of 6 paired plots every 3 years 4 staff (GS 9 at approx. $ 28/hr) for 20 hours = 80 hours = $2,240 plus botanist for data analysis (10 hour at $28/hr = $280) Long- term plots read by I&M – no cost to park	2,520 every 3 years – assume done 5 times over life of plan	12,600
Sharpshooting [a]	Years 1–5: 659 deer removed ($200/deer)	Year 1–5: 131,800	131,800
	Park staff for park closure and safety Years 1–5 (see alternative C)	36,288	36,288
Nonsurgical reproductive control	Years 6–15: 19 does treated every two years Cost dependent on number of deer treated and current available technology (assumes $1,000/doe)	Years 6–15: 19,000 every 2 years; assume 5 treatments in years 6,8,10,12,14	95,000 [b]
Reproduction monitoring	2 staff; 3 nights; 5 hr per night of fawn surveys using GS7 at $23/hr; plus data analysis each summer = 20 hrs at GS 11 $34/hr - in years 6 through 15 (10 years)	1,370	20,550
Donation/ disposal	Years 1–5: 659 deer at $70/deer	Years 1–5: 46,130	46,130
		TOTAL	**416,348**

[a] Cost would be further influenced by whether or not volunteers are used to assist with supporting duties (e.g., non-shooting assistance such as bait pile construction). Costs could also change if it takes less or more than five years to reach the desired deer density goal. Five years is based on calculations that estimate deer removals, as well as annual increases to the herd through reproduction and immigration, within reasonably expected ranges (see text).

[b] Reproductive control costs could be reduced considerably with improved technology or improved efficiency of capture.

TABLE 12C: COST ESTIMATE FOR MANASSAS NATIONAL BATTLEFIELD PARK—ALTERNATIVE D

Action	Assumptions	Annual Cost ($)	Cost for the 15-year Planning Period ($)
Same actions as described for alternative A (included in all alternatives)	See alternative A, table 5C		153,060
Sharpshooting [a]	Years 1–5: 1,645 deer removed ($200/deer)	Years 1–5: 329,000	329,000
	Park staff for park closure and safety Years 1–5 (see alternative C)	113,400	113,400
Nonsurgical reproductive control	Years 6–15: 68 does treated every two years Cost dependent on number of deer treated and current available technology (assumes $1,000/doe)	Years 6–15: 68,000 every 2 years- assume 5 treatments in years 6,8,10,12,14	340,000 [b]
Reproduction monitoring	2 staff; 3 nights; 5 hr per night of fawn surveys using GS9 at $28/hr; plus data analysis each summer = 20 hrs at $28/hr in years 6 through 15 (10 years)	1,700	17,000
Donation/ disposal	Years 1–5: 1,645 deer at $70/deer	Year 1–5: 115,150	115,150
		TOTAL	**1,067,610**

[a] Cost would be further influenced by whether or not volunteers are used to assist with supporting duties (e.g., non-shooting assistance such as bait pile construction). Costs could also change if it takes less or more than five years to reach the desired deer density goal. Five years is based on calculations that estimate deer removals, as well as annual increases to the herd through reproduction and immigration, within reasonably expected ranges (see text).

[b] Reproductive control costs could be reduced considerably with improved technology or improved efficiency of capture.

ALTERNATIVES—CHRONIC WASTING DISEASE MANAGEMENT

CWD is in the family of diseases known as the transmissible spongiform encephalopathies or prion diseases. Other transmissible spongiform encephalopathies include scrapie in sheep, bovine spongiform encephalopathy (BSE or mad cow disease), and Creutzfeldt-Jakob disease in humans. CWD causes brain lesions that result in progressive weight loss, behavioral changes, and eventually death in affected cervids, including deer. There is currently no evidence that the disease is transmissible to humans or domestic livestock; however, the disease could limit populations of deer. Also, although wildlife biologists are still learning about this relatively new disease, there is strong evidence that greater densities of deer and other ungulates increase the likelihood of transmission of CWD (see appendix C).

Generally, the NPS has identified two levels of action pertaining to CWD based on risk of transmission (see appendix C): (1) when the disease is not known to occur within a 60-mile radius of the park; and (2) when the disease is known to occur within the park or within a 60-mile radius of the park. As of late 2012, the nearest known case of CWD in free-ranging deer was about 36 miles from Antietam, 39 miles from Monocacy, and 51 miles from Manassas (Monello, pers. comm. 2012).

Alternative A: Continuation of Existing Management (No Action)

Under the no action alternative, NPS would continue CWD monitoring, which consists of opportunistic and targeted surveillance, at all three parks. If deer test positive for CWD closer to Antietam or Monocacy, the park would follow the CWD Detection and Initial Response Plan. There is no such plan in place for Manassas at this time, but the park would develop a similar plan under this alternative.

Opportunistic and Targeted Surveillance and Testing

> *Opportunistic surveillance: Taking diagnostic samples for CWD testing from deer found dead or harvested through a management activity within a national park unit.*

The NPS would continue to perform opportunistic surveillance on available carcasses. Opportunistic surveillance involves taking diagnostic samples for CWD testing from deer found dead or harvested within a national park system unit. Cause of death may be hunting, culling, predators, disease, trauma (e.g., from deer-vehicle collision), or undetermined. Over the past 5 years (since about 2007), Antietam has collected 80 deer through opportunistic surveillance (78 CWD tests were negative; 2 are pending); Monocacy has taken 50 (all CWD tests were negative). Manassas has not yet taken any samples for opportunistic surveillance; deer that have been struck by vehicles are collected by the state. Opportunistic surveillance would have little, if any, negative impact on current populations (NPS 2007). Opportunistic sampling is likely to be a more sensitive measure of disease detection compared to targeted surveillance, because it includes testing animals that may have not been able to react quickly to oncoming vehicles or predators due to the effects of the disease.

> *Targeted surveillance: Lethal removal of deer that exhibit clinical signs of CWD, such as changes in behavior and body condition, and testing to determine if CWD is present.*

In addition, the NPS would conduct targeted surveillance, which involves lethal removal and testing of any deer exhibiting clinical signs consistent with CWD. Targeted surveillance would have negligible adverse effects on the current deer populations in the parks, would remove a potential source of CWD infection, and would be an efficient means of detecting new foci of infection. NPS staff would look for deer exhibiting clinical signs of CWD during their daily work activities, which often involve travel throughout the park or direct interaction with deer (e.g., deer surveys, deer-vehicle collision response). Under targeted surveillance, NPS staff would remove deer exhibiting clinical signs of CWD under the existing protocol for euthanasia of wildlife using an appropriate firearm. As of early 2012, there have been very few instances warranting targeted surveillance at the parks. Both Monocacy and Manassas had each sampled one deer exhibiting some of the clinical signs of CWD (wobbly gait, trouble standing, frothy mouth), and the results were negative; Antietam has sampled two deer, and both were negative for CWD.

Additional Detection and Initial Response to CWD

Antietam and Monocacy are following the actions specified in the CWD Detection and Initial Response Plan (NPS 2009c). In this plan, the selected alternative includes additional techniques beyond opportunistic and targeted surveillance to enhance detection and to provide for an initial (not long-term) response to reduce deer density to comparable levels with surrounding areas should CWD be confirmed within 20 miles of the parks. If CWD were found within 5 to 20 miles of the parks, response actions would include continued opportunistic and targeted surveillance, live testing, and lethal removal of deer to supplement state sampling. If CWD were found within 5 miles of the parks, response actions would be the same but the lethal removal of deer could include a one-time population reduction to bring the deer density inside the parks to a density similar to the surrounding areas (estimated at 25-45 deer per square mile at the time the plan was completed) over several years. Based on 2008 deer density data, this would involve removing about 250 deer at each park over three years. Details of these actions can be found in the CWD Detection and Initial Response Plan (NPS 2009c). To date, the parks have not gone beyond opportunistic and targeted surveillance and have not taken any additional actions. However, given the 36 to 55-mile distance of a confirmed CWD case from these two parks, lethal removals could be done before this long-term plan is completed.

Manassas currently has no CWD plan in place, but would take action under this alternative to develop a similar CWD Detection and Response Plan.

Coordination with State Agencies Regarding CWD

Park staff would coordinate with the appropriate state agency (MD DNR or VDGIF) and certified laboratories as necessary regarding surveillance methods, sample sizes, testing, and results. Antietam and Monocacy would follow the protocols outlined in the CWD Detection and Initial Response Plan (NPS 2009c). If there were positive test results from deer in or near the parks, Antietam and Monocacy would implement the response portion of the CWD Detection and Initial Response Plan (NPS 2009c), available on the Antietam website (http://www.nps.gov/anti/parkmgmt/cwd.htm) and the planning, environment, and public comment (PEPC) website: (http://parkplanning.nps.gov/projectHome.cfm?projectID=17511); at Manassas, the park would coordinate with the state in deciding on the need to collect deer for further testing. If there were no positive results, the NPS would continue to conduct opportunistic and/or targeted surveillance depending on the proximity of the nearest positive case at all three parks.

Disposal/Consumption of Deer Tested for CWD

The parks would follow NPS Public Health Service guidance pertaining to the donation of meat from a documented CWD area (NPS 2005e). Any deer confirmed with CWD would be disposed of in accordance with NPS Public Health Service disposal guidelines, and the NPS would coordinate with state agencies (MD DNR or VDGIF) as appropriate. Details regarding handling of deer tested can be found in the CWD Detection and Initial Response Plan (NPS 2009c) for Antietam and Monocacy; Manassas would generally follow the same procedures for surveillance sampling. If possible and allowable, given applicable policy, guidance, and regulatory requirements in place at the time larger removals are done under Antietam's and Monocacy's plan, meat from CWD-negative deer could be donated. Otherwise, carcasses that are CWD negative would either be allowed to decompose in place for ecological benefit, or would be disposed of using traditional methods (i.e., on-site burial in previously disturbed areas, away from any visitor use areas, or in landfills), depending on the circumstances (location, number of carcasses, etc.). If any positive results are obtained, carcasses would be disposed of off-site at approved landfills (if any) or by incineration, alkaline (tissue) digestion, or other method approved for disposal at the time disposal occurs (see "Testing and Carcass Disposal" in the section below titled "Alternatives B, C, and D - Long-Term CWD Response Plan").

Implementation Costs—CWD Management Under Alternative A-No Action

Costs associated with CWD surveillance would be minimal, based on the low number of deer sampled to date and because it is assumed that lab testing to meet statistical sampling requirements would be conducted by the NPS Biological Research Management Division at no cost to the parks. Also, the collection cost (physical collection of a sample from the carcass) is expected to be minimal because the staff is trained in proper sample collection and handling, and the time needed for this overlaps with labor costs to dispose of the carcass. Therefore, it is assumed that the cost of CWD monitoring and testing would be covered in existing labor costs and these have not been itemized.

If Antietam and Monocacy were to elevate the level of action in their existing CWD plan, costs would be higher. There are estimated costs provided in the 2009 plan (NPS 2009c), which is included here by reference. Copies of this plan are available from the parks and also at the PEPC website (http://parkplanning.nps.gov/document.cfm?parkID=173&projectID=17511&documentID=28828).

ALTERNATIVES B, C, AND D —LONG-TERM CHRONIC WASTING DISEASE RESPONSE PLAN

Background

Under any of the action alternatives, the actions described under alternative A would continue (surveillance and testing and implementation of the Antietam/Monocacy CWD Detection and Initial Response Plan); however, a long-term CWD management plan would be adopted under any of the action alternatives to address concerns about CWD and its proximity to the parks.

Although the primary purpose of this plan/EIS is to reduce impacts from deer on vegetation and habitat for other wildlife, integration of a long-term CWD response plan into the action alternatives is considered necessary due to an elevated risk of CWD near the parks and because of planning efficiencies and cost savings associated integration of the two plans. The direct relationship between the objectives, alternatives, and impact analysis of the deer management plan, and the goals, response strategies, and environmental impacts of the CWD response plan, make this integration both feasible and cost-effective. The NPS planning team consulted with members of the NPS Biological Resources Management Division to decide if a long-term CWD response plan should be included as part of the overall deer management planning effort for the three parks. It was decided that all three parks are in need of a longer-term plan that allows them to take action to reduce the numbers of deer to densities similar to those outside park boundaries or perhaps to lower levels in response to an immediate threat of CWD in or near the parks.

The long-term CWD management plan is based on evidence that high deer population densities generally support greater rates of disease transmission (Wilson et al. 2002; Swinton et al. 2002) and have been found to be positively correlated with the prevalence of CWD (e.g., Farnsworth et al. 2005; Conner et al. 2008), and that immediate action would be needed to reduce the deer population rapidly in order to reduce amplification of CWD and to coordinate with the states on sampling needed to assess the situation. It should be clearly stated that CWD is not currently known to be present in the parks, but positive cases have been found within 36–51 miles of the parks. Integration of CWD response represents an effort on the part of the NPS to be proactive and fully prepared given the high level of risk. All actions across any implementation zones would be closely coordinated with the states, due to the scale identified in state CWD plans as necessary to address CWD (minimum 79 square miles) relative to the size of the parks (2.6 square miles at Monocacy, 5.1 square miles at Antietam, and 7.8 square miles at Manassas, including all federal and non-federal properties within the park legislative boundaries). Cooperation with state efforts to address CWD would continue as long as these actions do not conflict with NPS or park mission and mandates, and actions taken within the park boundary may be conducted independently of state actions. A review of CWD including scientific background and related NPS guidance is included as appendix C.

Threshold for Taking Action—Long-term CWD Response

The threshold for taking action to address the presence of CWD in or near the parks is different from the thresholds for taking action related to deer impacts on vegetation described earlier. The threshold for taking action under the long-term CWD response plan would be tied to the distance of a confirmed case from the park boundary and location of the park in relation to a state-established CWD containment area (a 5-mile buffer around a documented CWD-positive case). For all three parks, the NPS planning team decided that the long-term CWD response plan would be triggered only if a positive case of CWD is found within park boundaries or within 5 miles of the park boundaries, which means that the parks would fall within a state CWD containment area. The plan would allow parks the option to reduce the deer population to a density similar to that found outside the parks or even to a lower level as needed to cooperate with state program and testing requirements. However, the deer population would not be reduced below 10 deer per square mile (see below). Removals would be done quickly, similar to the removals proposed under the lethal alternative for deer management described later in this plan (under alternative C). The same threshold and the same actions apply to any of the action alternatives, even the nonlethal deer management alternative B, because it is necessary to reduce deer density quickly to reduce the threat of CWD presence or amplification. Deer would be removed for surveillance monitoring in subsequent years, with number removed dependent on the conditions at the time and coordination with the state.

CWD Response

The actions would be carried out as described under alternative C for deer management (i.e., sharpshooting with very limited capture and euthanasia). Sharpshooting activities would initially target areas immediately surrounding or closest to the positive case to ensure removal of animals that have been in contact with CWD-positive animals to potentially decrease the local prevalence of CWD. Areas where deer movements across the park boundary into surrounding communities are frequent and areas with higher concentrations of deer also may be targeted for removal activities to reduce the probability of spread and promote elimination of the disease, if possible. During initial removal efforts, both male and female adult deer would be targeted due to the increased probability of infection in older animals and the spread potential posed by males (which have a larger home range than does). Removal actions would be carried out rapidly, and most likely in coordination with state efforts to reduce deer populations, so it is not possible to predict exactly how many deer would be removed or how long the action would last. It is expected that removals would be essentially the same as those shown for alternatives C and D for all parks, realistically taking about 4-6 years to accomplish. However, removals could be accelerated, for example, if needed to better coordinate with state response efforts. This would be dependent on available staffing and resources.

Reduction to Ten Deer per Square Mile as a Lower Limit

Implementation of a more intense reduction of the deer population to not less than 10 deer per square mile would be an option and would be based on coordination with the state. For the purpose of disease response, the NPS does not want to reduce the number of deer within the parks to a density far below that outside the parks because it may increase the likelihood of potentially infected deer repopulating the parks from surrounding areas. However, the NPS also does not want to maintain a deer density that is substantially higher than that in surrounding communities, because that may increase the likelihood of disease amplification and spread into the parks. This approach allows the parks flexibility to work cooperatively with the state to address CWD if the state is able to achieve a population density lower than 15–20 deer per square mile in areas surrounding the parks. A deer density of 10 deer per square mile is considered appropriate as a lower limit for this action because it is consistent with recommendations in the scientific literature related to appropriate deer density to ensure adequate forest regeneration, which ranges from 10–40 deer per square mile. It is also consistent with the stated objective of the plan/EIS to maintain a deer population in the parks. The parks would also have the option to maintain the population density as low as 10 deer per square mile to remain consistent with surrounding deer densities and continued need to avoid amplification of the disease. Additional removals that are part of this reduction would be based on available staffing and resources and may take more time to achieve, depending on the state's actions to reduce the deer population outside the parks.

Testing and Carcass Disposal

Carcasses would be disposed of in accordance with NPS Public Health Program guidelines for donation of meat from an area affected by CWD for the purpose of human consumption (NPS 2012f) and the current state CWD response plan. Public health guidelines require that the people consuming the meat be fully informed and take full responsibility for any long-term unanticipated effects of eating meat from animals coming from a CWD-affected area. When CWD is within 5 miles of the parks, these guidelines preclude the donation of meat to food pantries, soup kitchens, or any entity that intends to redistribute the meat (NPS 2012f). Park staff would remain in close contact with appropriate state agencies regarding disposal of CWD-positive deer and integration of the park and state approaches to carcass disposal. Three disposal methods are appropriate for CWD-positive carcasses: land filling (in licensed lined landfills if they are available and accepting deer carcasses), incineration, and alkaline (tissue) digestion. These methods would be carried out at off-site disposal facilities. Carcasses would be kept at the parks in refrigerated units pending test results, and transported to off-site disposal facilities that accept the deer carcasses (either negative or positive).

Minimizing Environmental Contamination

Although it is unlikely that CWD prions can be completely removed from the landscape once introduced, actions can be taken to minimize potential environmental contamination by human activities. These actions would remain consistent with the constantly improving state of knowledge on this subject, which is monitored by the NPS Biological Resources Management Division staff who are involved with addressing CWD issues nationwide. The following additional activities would be required under all deer management alternatives to minimize environmental contamination during carcass handling and disposal.

- Surface disposal would be eliminated as a carcass disposal method.
- Temporary storage areas for carcasses would be impervious to minimize the transfer of body fluids onto the ground.
- Deer carcasses obtained through lethal removal actions would not be gutted and would be removed from the landscape immediately.
- Deer carcasses obtained through other means (e.g., deer-vehicle collisions) would be removed from the landscape as soon as possible (many are unreported and thus may not be noticed immediately).
- Handling of deer to obtain samples for CWD testing would occur on plastic tarps or other impervious surface to minimize the transfer of body fluids onto the ground.

Implementation Costs—Long-term CWD Management Plan

Costs of implementing the long-term CWD response plan could be substantial and would depend on the number of deer present, rapidity of the removals, the level of coordination with the state, and the cost of disposal at the time a CWD response is initiated. Costs cannot be accurately estimated at this time, but it is expected that costs for CWD plan implementation would be similar to the costs provided for sharpshooting and disposal under alternative C, above, with some additional costs related to disposal by incineration, digestion, or other method approved at the time the plan is implemented.

ADAPTIVE MANAGEMENT APPROACHES INCLUDED IN THE ALTERNATIVES

> *Adaptive management: The rigorous application of management, research, and monitoring to gain information and experience necessary to assess and modify management activities. A process that uses feedback from research and the periodic evaluation of management actions and the conditions they produce to either reinforce the viability of objectives, strategies, and actions prescribed in a plan or to modify strategies and actions in order to more effectively accomplish management objectives.*

The Department of the Interior requires its agencies to incorporate adaptive management principles, as appropriate, into policies and plans for the management of natural resources, and "conduct appropriate environmental monitoring to…evaluate progress toward achieving objectives whenever using adaptive management" (522 Departmental Manual [DM] 1, 1.5, B,C [NPS 2008f]; 43 CFR 46.145). In addition, the department has recently outlined the adaptive management approach in a technical guide developed to provide guidance to all of its bureaus and agencies (Williams, Szaro, and Shapiro 2007).

According to this technical guide,

> Adaptive management is a systematic approach for improving resource management by learning from management outcomes…An adaptive approach involves exploring ways to meet management objectives, predicting the outcomes of alternatives based on the current state of knowledge, implementing one or more of these alternatives, monitoring to learn about the impacts of management actions, and then using the results to update knowledge and adjust management actions. Adaptive management focuses on learning and adapting, through partnerships of managers, scientists, and other stakeholders who learn together how to create and maintain sustainable resource systems. Adaptive management should be used when decisions must be made despite uncertainty and where there is a commitment to using this approach. In addition to these two primary conditions, adaptive management should be used when (1) there is a real management choice to be made, (2) there is an opportunity to apply learning, (3) clear and understandable objectives can be identified, (4) the value of information gained is high, (5) uncertainty can be expressed as models that can be tested, and (6) monitoring is in place or can be put in place to reduce uncertainty (Williams, Szaro, and Shapiro 2007).

The deer management situation at the three parks meets all these conditions, and adaptive management would be used in this planning effort, primarily in implementing the actions focused on deer impacts on vegetation.

USING THE ADAPTIVE MANAGEMENT PROCESS

Adaptive management requires examination of the hypothesis to be tested. For this plan, adaptive management starts with the hypothesis that deer density is the primary factor limiting woody and herbaceous vegetation propagation, which affects forest regeneration and cultural landscape integrity. Monitoring under this plan would test for seedling stem density in open plots. If the action threshold is exceeded, then deer management actions would be taken as described in the sections that discuss thresholds for taking action. Data would also be collected to compare open plots and fenced plots. If there were no differences between the plots, data would be examined to identify the most important variables affecting plant regeneration. These could include light penetration, soil quality, or impacts of other organisms, in addition to deer density.

In addition, monitoring would be done to assess whether the cultural resource-related thresholds established by the planning team were exceeded. This would consist of monitoring crop yields at both Antietam and Monocacy (see appendix A) and also by examining orchard damage at Antietam indicated by removal of new growth by deer browsing.

There are two phases involved for a successful adaptive management plan: the set-up phase and the iterative phase (see figure 8) (Williams, Szaro, and Shapiro 2007). The next section demonstrates how the parks would implement adaptive management through each of the two phases, following the technical guidance.

Set-up Phase

Step 1—Without active **stakeholder involvement**, an adaptive management process is unlikely to be effective. Stakeholders were identified during internal scoping and were conferred with during the public scoping process through public meetings and comments. In addition, the NPS convened a science team to assist in developing action thresholds and the initial deer density goal.

Step 2—**Objectives** were prepared at the internal scoping meeting as part of the NEPA process and are described in "Chapter 1: Purpose of and Need for Action." Thresholds/metrics relating to vegetation condition and deer density were developed to measure success in meeting plan objectives.

Step 3—Alternative **management actions** were defined in an alternatives development meeting, using input from the public scoping comments and the science team. Actions of the alternatives were discussed and refined by the interdisciplinary team throughout the NEPA process. These actions were developed to test management hypotheses relating to deer management.

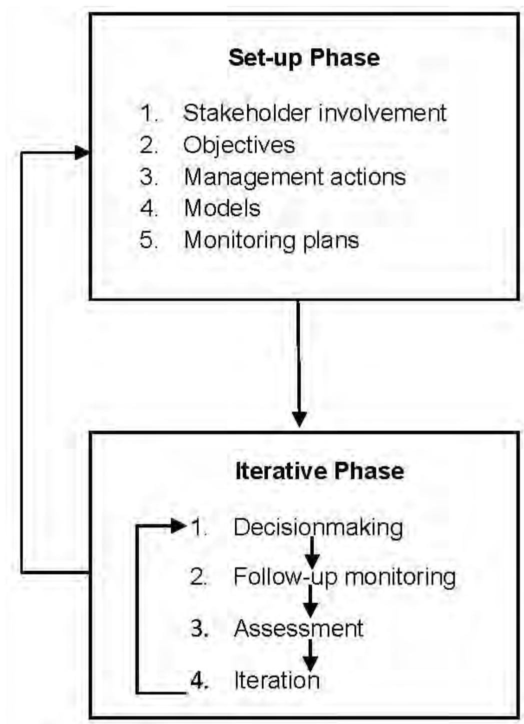


FIGURE 8: AN ILLUSTRATION OF THE ADAPTIVE MANAGEMENT APPROACH

Step 4—The NPS and the science team discussed the natural resource system dynamics in terms of how deer and management actions could impact the parks' resources, and developed conceptual **models** to evaluate response. Questions that will be monitored through existing and proposed monitoring actions in this plan will help better understand system dynamics at the parks. These questions include the following:

- What is the magnitude of white-tailed deer effects on forest growth? (tree seedling number and growth monitoring)
- What is the change in vegetation over time? (Ecological monitoring of changes in forest vegetation and tree regeneration, as well as in crop yields and orchard damage)
- What is the change in density of deer in the parks over time? (Existing deer distance sampling)

Step 5—Monitoring programs are created to collect data related to the testing of hypotheses and to enhance operational models. The data are used later in the iterative phase to assess whether the objectives are being met. The vegetation data in deer exclosures and vegetation monitoring plots would be used in this assessment, as well as the assessments of crop yields and orchard damage. Monitoring data are documented and made available to the public.

Young Trees

Iterative Phase

Step 1—A management action would be recommended by the park staff (preferred alternative) and a **decision** made by the Regional Director. A Record of Decision is completed, in which the NPS announces the decision made on the selected alternative. A plan is developed to implement the selected alternative and to monitor the results (changes in the resources expected from reduced deer density).

Step 2—The parks will **implement their monitoring plans** outlined in appendix A and collect data on key elements that will measure the success of the selected action and of the parks meeting the plan objectives.

Step 3—The parks will evaluate and **assess** the results of the monitoring, comparing actual outcome with desired forest regeneration or other objectives. Monitoring data are analyzed and made available to the public. Based on the assessment, the NPS may change models, modify the action (e.g., increase or decrease the number of deer taken) or make adjustments in monitoring (look at different parameters or species to measure).

Step 4—This **iteration** step can lead back to the set-up phase if substantial changes are needed or to step 1 of the iterative phase if there is a need to adjust the management action through subsequent decision making.

Potential Adaptive Management Approaches

The following describe some examples of how the adaptive management approach would be used.

Forest Regeneration Action Threshold—The action threshold could be modified based on the best available data for forest regeneration in a similar forest type, results of monitoring plot data, and deer density changes. Monitoring data would be compared to expectations (that forest regeneration would increase as deer density decreased). It is expected that it would take at least 10 years from the time that deer density was lowered until forest regeneration results would be realized in the monitored plots. If results after 10 years following achievement of the initial deer density goal did not meet expectations based on the action thresholds, the action threshold would be evaluated along with the monitoring data to determine what adjustments might be necessary.

Deer Removal Goal—For alternatives that would directly reduce the deer population through removal, the number of deer to be removed annually would be adjusted based on the monitoring of forest regeneration, deer population density surveys, and growth projections. When a management action was first triggered, the approximate number of deer to be removed would be defined by the difference between the estimated deer population density and the initial density goal selected (15 to 20 deer per square mile). However, because this density goal may not be achieved in the estimated number of years, annual removal goals would be revised based on the number of deer remaining in the herd after each year's removal actions and factoring in expected annual growth due to reproduction and immigration. This process of determining the number of deer to be removed each year would be repeated until the herd density goal was reached.

However, because the goal is to manage for successful forest regeneration and cultural landscape integrity within the parks, not for deer density, the results of removal would be documented by vegetation monitoring at least every 3 years. The number of deer to be removed could then be adjusted based on the response of the vegetation to a higher or lower deer density. If vegetation were observed to be regenerating before the lower deer density was reached, and cultural landscape thresholds were not exceeded, management actions could then be modified or adjusted. Similarly, management actions would be adjusted if no change in the vegetation were observed after implementation. It is noted that deer densities in the parks may drop based on actions of other parties that are removing deer on their properties that are located within the park boundaries (inholdings). If deer density goals were reached, then adaptive management would consist of moving into maintenance actions as long as the forest regeneration (vegetation) and cultural landscape monitoring supports this. The following are examples of how an adaptive management approach could be implemented based on different outcomes related to forest regeneration:

- If the tree seedling regeneration threshold is met or exceeded prior to meeting the initial deer density goal, the deer density goal would be adjusted upward to the density that would still allow regeneration to occur, or different goals could be assigned to different areas of the parks depending on vegetation monitoring results.
- If there was insufficient forest regeneration within 10 years after the initial deer density goal was reached, then methods and protocols would be reviewed to identify the variables that were limiting expected results, The methods used would then be adjusted as necessary to correct for such factors. The goal would not be adjusted by any more than 5 additional deer per square mile until after a 6-year monitoring period, at which point the density goal could be adjusted further.
- If the initial deer density goal of 15 to 20 deer per square mile were not reached within the expected timeframe, additional efforts would be made to reach the desired density through the use of other methods of removal or possibly by concentrating efforts more in one area and coordinating with entities outside the parks that are removing deer near that area.

Deer Exclosures—Large exclosures are proposed under alternative B. As some areas are exclosed, deer browsing pressure in other areas could increase. Areas inside and outside the proposed large exclosures would be monitored according to the protocol described for alternative A. If vegetation damage due to deer browsing increased significantly in unfenced areas, NPS staff at the parks could consider additional exclosures or other actions to reduce browse in unfenced areas.

Nonsurgical Reproductive Control—Reproductive control is proposed under alternatives B and D. However, there is limited information regarding its effectiveness as a long-term management technique for large, free-ranging populations. As science advances in this area, additional agents could be developed and tested for reproductive control on free-ranging deer, or more efficient delivery methods could be approved. The NPS will review the science at that time to determine if an agent is appropriate for controlling the deer herd. The size, scale, and location of the application would depend on the specifications and efficacy of the drug.

Implementing Actions of the Plan/EIS—A number of the actions in the plan/EIS are based on recent vegetation monitoring, current deer density at the parks, existing technology, knowledge of deer population dynamics, and CWD. During the life of the plan, it is assumed that knowledge and experience with these issues will increase. Improved knowledge and experience may result in adjustments being made to the timing of actions (e.g., timing of lethal reduction, implementation of reproductive control, CWD response, or any of the other actions included in the plan/EIS.) For example, alternative D (combined lethal and nonlethal actions) would be adjusted for each individual action as required to maximize forest regeneration. These actions could also be adjusted to incorporate new technologies or research. The initial plan would be to focus on direct reduction to decrease deer population density as quickly as possible, to minimize the number of deer to be removed over time, and to test action thresholds within a reasonable timeframe. After deer density was reduced to the initial goal, and if vegetation monitoring indicated that the tree seedling regeneration threshold is met or exceeded, maintenance of deer numbers might be achieved through reproductive control, depending on the state of the technology and as noted in the adaptive management parameters described above.

SUMMARY OF ALTERNATIVES AND HOW THEY MEET THE PLAN OBJECTIVES

Table 13 compares the alternatives by summarizing the actions being considered within each alternative, and table 14 compares how each of the alternatives described in this chapter would meet the plan objectives. The action alternatives analyzed must meet all objectives, as stated in "Chapter 1: Purpose of and Need for Action," and they must address the stated purpose of taking action and resolve the need for action. Therefore, the alternatives were individually assessed in light of how well they would meet the objectives for this plan/EIS, which are stated in the "Objectives in Taking Action" section in chapter 1. Alternatives that did not meet the objectives were not analyzed further (see the "Alternatives Considered but Dismissed from Further Detailed Analysis" section).

The environmental analysis described in "Chapter 4: Environmental Consequences" looks at the effects of each alternative on each impact topic; these impacts are summarized in table 15.

TABLE 13: SUMMARY OF ALTERNATIVES

Management Activity	Alternative A: Continuation of Current Management (No Action)	Alternative B: Nonlethal Deer Management	Alternative C: Lethal Deer Management	Alternative D: Combined Lethal and Nonlethal Deer Management
Deer Management Actions				
General Description of Deer Management Actions	This alternative would continue current management of deer at the parks. This includes • Deer monitoring, vegetation monitoring, data gathering, data management and research. • Continued limited use of small-scale fencing and repellents (at some parks) to protect known sensitive species or plantings. • Educational and interpretive measures. • Continued agency and jurisdictional cooperation.	Actions under alternative A, plus: • Nonlethal deer reduction efforts – implement nonsurgical reproductive control of does when an acceptable reproductive control agent is available that meets NPS established criteria; assume use of an agent that meets all criteria for analysis purposes. • Large exclosures - construct large-scale exclosures (larger than several acres) to protect about 5–20% of the forested area of the parks to allow reforestation. After majority of plant area of seedlings exceeds top limit of deer browse height, the fencing would be relocated (approximately every 10 years). • Additional techniques for minimizing deer impacts: – Fencing of crops and woodlots: where protection most needed and where can install with minimal impacts. Would include fencing some woodlots with black unobtrusive fencing slightly inside the woodlot boundary, using fencing around crops. – Crop Protection: change crop configurations or types of crops; use sacrificial rows of alternative crops. – Aversive Conditioning: scaring deer out of certain areas with noise, motion; part of crop protection and maintenance – use only in specific areas where need temporary protection.	Actions under alternative A, techniques for minimizing deer impacts as described under alternative B, plus: • Use sharpshooting with firearms (possibly capture/euthanasia in very limited circumstances where sharpshooting would not be advisable) to reduce deer population to desired level and to maintain it at that level. • Donate meat, if possible (given any concerns/restriction related to CWD)	Actions under alternative A, techniques for minimizing deer impacts as described under alternative B, plus: • Using lethal means (sharpshooting with firearms any possibly very limited capture/euthanasia) to reduce deer population to the desired deer density. • Once this density has been reached, use nonsurgical reproductive control to maintain the deer population at the target density, when an acceptable reproductive control agent becomes available; if an acceptable reproductive control agent is not available or is ineffective, continue lethal actions to maintain deer population.
Reduction in Deer Population	None, other than mortality.	Potentially reduce deer population if nonsurgical reproductive controls are successful and then only after the first several years of treatment or until natural mortality exceeded reproduction and reduced the population; population reduction would be gradual. Would not expect to reach desired deer density within life of plan.	Antietam and Monocacy – would reduce to desired deer density in 3-5 years by removing 44-278 deer each year. Manassas – would reduce to desired deer density in about 4–6 years, removing 138-652 deer if done in 5 years. To maintain the population at the desired level, remove an estimated 10–73 deer annually (will vary by park; see text for more detail). Capture and euthanasia would be used minimally if at all- possibly 0–5 deer per year.	Similar to alternative C. Potential for future reductions through nonsurgical reproductive control (if feasible) used as a population maintenance technique, with sharpshooting available as needed to maintain the desired deer density.
Time Required to Achieve Desired Forest Regeneration	Forest regeneration cannot be achieved without reducing browsing impacts.	Long time – about 10% - 20% of the woody vegetation in each park would be protected or regenerated by end of the plan due to exclosures; reproductive control would contribute to additional forest regeneration by gradually limiting deer numbers, but desired deer density and subsequent forest regeneration would not likely be achieved within life of this plan.	Regeneration changes expected about 3–4 years after deer density goal is reached (based on results seen at Gettysburg National Military Park) and trends toward regeneration success by end of plan, so expect to see results within 6–9 years at Antietam and Monocacy and 7–10 years at Manassas.	Same as alternative C.
Handling of Deer	Limited handling for research or injured deer.	Physical trapping of deer would be required for the initial application to allow for marking of deer, but would use remote delivery in subsequent years. Handling and chemical applications would follow American Veterinary Medical Association recommendations, but there would be increased stress levels in captured deer.	No capture required for sharpshooting activities. For capture and euthanasia, minimized stress in accordance with American Veterinary Medical Association recommendations. Increased stress levels in captured deer compared to sharpshooting method.	Same as alternative B for reproductive control, and same as alternative C for other actions.

TABLE 13: SUMMARY OF ALTERNATIVES

Management Activity	Alternative A: Continuation of Current Management (No Action)	Alternative B: Nonlethal Deer Management	Alternative C: Lethal Deer Management	Alternative D: Combined Lethal and Nonlethal Deer Management
Monitoring -- Deer Management Results	Continued vegetation inventory and monitoring of deer population numbers to assess impacts.	Monitoring of vegetation and deer similar to alternative A common to all, plus: • monitoring for impacts on cultural landscape in addition to seedling/ forest regeneration monitoring • For reproductive control, monitor treated deer using additional surveys to determine reproductive control effectiveness (deer productivity) or other effects of immunocontraceptive agents (behavior, physiology, etc.). • Monitoring of vegetation for signs of recovery within larger exclosures.	Same as alternative B.	Same as alternative B, plus: • Implement monitoring of deer productivity and behavior when reproductive control is implemented.
Donation for consumption or disposal of carcasses	Carcasses that are CWD negative would be allowed to decompose in place or would be disposed of using traditional methods (i.e., on-site burial in previously disturbed areas, away from any visitor use areas, or in landfills.	Similar to alternative A. Criteria require that the reproductive control agent used will allow meat to be safe for human and animal consumption.	Donation of meat for consumption would be to the maximum extent possible. Any deer carcasses are not suitable for consumption or for surface disposal would to be disposed of at an approved local landfill or other disposal facility that accepts deer carcasses.	Same as alternatives B and C.
Regulatory Considerations	None.	Must follow all label restrictions for the selected agent and would require EPA approval for any agent used. Additional requirements could be prescribed by NPS (e.g., marking).	All work would be done in compliance with all relevant firearms laws and regulations. Coordination with state/local/nonprofit/private entities might be needed to donate meat. Follow NPS, state, and local public health guidelines for CWD.	Same as alternatives B and C.
Park Closure or Restricted Access	None.	Restricted access within large exclosures areas (duration is long term – probably 10 years) and temporary, restricted access within areas of active reproductive control activities-months may vary with agent used, but would likely be in fall to winter. May include some restricted access to fenced woodlots or groups of rare plants or where aversive conditioning is occurring.	Areas temporarily closed or access restricted during lethal removal activities; closures or restrictions for deer management would be minimized by conducting activities in winter during periods between dusk and dawn and primarily in fall/winter months for larger reductions. Same as alternative B for actions related to fenced areas and aversive conditioning.	Same as alternatives B and C.
Adaptive Management	No specific adaptive management related to deer management is included under this alternative.	Changes in action thresholds or deer density goals; possible change in the reproductive control agent used and its application procedures; changes in numbers or locations of large exclosures. Could consider changes to crops or crop planting practices, or new aversive conditioning techniques based on deer damage results.	Changes in action thresholds or deer density goals or possible changes to implementation procedures. Could consider changes to crops or crop planting practices, or new aversive conditioning techniques based on deer damage results.	Changes in action thresholds or deer density goals, possible change in the reproductive control agent used and its application procedures, as well as the number or type of removal actions needed. This would include determining whether sharpshooting or reproductive control would be used for population maintenance. Could consider changes to crops or crop planting practices, or new aversive conditioning techniques based on deer damage results.
Estimated Cost of Deer Management (15 year plan)	Antietam: $111,690 Monocacy: $81,540 Manassas: $144,660	Antietam: $1,227,710–1,410,710 Monocacy: $1,295,831–1,507,331 Manassas: $3,233,803–3,730,303	Antietam: $433,906 Monocacy: $391,118 Manassas: $994,650	Antietam: $455,534 Monocacy: $416,348 Manassas: $1,067,610

TABLE 13: SUMMARY OF ALTERNATIVES

Management Activity	Alternative A: Continuation of Current Management (No Action)	Alternative B: Nonlethal Deer Management	Alternative C: Lethal Deer Management	Alternative D: Combined Lethal and Nonlethal Deer Management
CWD Management Actions				
CWD Detection and Response	Targeted and opportunistic surveillance, coordinated with the state. The CWD Detection and Initial Response Plan (NPS 2009c) is in place for Antietam and Monocacy; there is currently no similar plan at Manassas. The Antietam and Monocacy CWD Detection and Initial Response Plan includes a range of actions. Currently only opportunistic and targeted surveillance are being conducted, but the plan provides for live testing and for lethal removal of deer if CWD gets closer to the parks.	Continue targeted and opportunistic surveillance, and continued actions under any current initial detection and response plans. Add a **long-term CWD response plan** that includes the following: • Lethally reduce the deer population to decrease potential for CWD transmittal and spread ONLY FOR CWD management purposes and ONLY IF CWD is confirmed in or within 5 miles of parks (i.e., the park falls in a state CWD containment area). • Could reduce population to 15–20 deer per square mile or as needed to cooperate with state program and testing requirements, but no less than 10 deer per square mile; reductions done as quickly as possible for all parks. • Test all dead deer for CWD and pool samples with the state.	Same as alternative B.	Same as alternative B.
Reduction in Deer Population for CWD Response	Current initial response plan for Antietam and Monocacy includes removal of 67-88% of deer at Antietam and 80-88% of deer at Monocacy (possibly about 250 deer at each park) over 3 years as part of a one-time population reduction, and possibly 32-110 deer at Antietam and 36-83 deer at Monocacy per monitoring surveillance effort in subsequent years.	Antietam and Monocacy – would reduce to about 15-20 deer per square mile in at least 3-5 years by removing 44-278 deer each year. Manassas – would reduce to desired deer density in at least 4-6 years, removing 138-652 deer if done in 5 years. The NPS may continue to remove additional deer to reach and maintain a density of 10 deer per square mile in an effort to coordinate disease management efforts with the state wildlife agency, but would not go below that density.	Same as alternative B.	Same as alternative B.
Regulatory Considerations	Must follow NPS, state, and local public health guidelines for any response under the Antietam/Monocacy CWD Detection and Initial Response Plan.	Must follow NPS, state, and local public health guidelines for CWD.	Same as alternative B.	Same as alternative B.
Park Closure or Restricted Access	Closures related to implementation of CWD response under the current plan (Antietam and Monocacy).	Areas closed during lethal removal actions.	Same as alternative B.	Same as alternative B.

Table 14: Analysis of How the Alternatives Meet Plan Objectives

Objective	Alternative A: Continuation of Current Management (No Action)	Alternative B: Nonlethal Deer Management	Alternative C: Lethal Deer Management	Alternative D: Combined Lethal and Nonlethal Deer Management
Vegetation				
Protect and promote forest regeneration and restoration of the natural abundance, distribution, structure, and composition of native plant communities by reducing excessive deer impacts (e.g., buck rub, trampling, browsing, and invasive seed dispersal).	Does not meet objective; current management approaches do not reduce excessive deer impacts, and therefore do not protect and promote forest regeneration and restoration of plant communities.	Partially meets objective by protecting about 10% of forested areas, and some crop areas, restoration and regeneration can occur in those areas. By using reproductive control methods, browsing pressure would not be relieved for some time.	Meets objective; deer population density would be reduced, allowing for fewer deer impacts, creating opportunities for regeneration and restoration.	Meets objective; same as alternative C.
Wildlife and Wildlife Habitat				
Maintain a viable white-tailed deer population within the park while protecting other park resources.	Does not meet objective; continuation of current management measures does not protect other park resources.	Partially meets objective; fencing protects some other park resources for some amounts of time.	Meets objective; allows for a sustainable deer population, and reduced deer densities allow for protection of other park resources.	Meets objective; same as alternative C.
Protect and preserve other native wildlife species by promoting the restoration of native plant communities (e.g., bird and other mammal habitat—providing basic food and cover).	Does not meet objective; continuation of current management measures has adverse effects on forest interior dwelling bird habitat (particularly birds that prefer the lower layers of the forest), and habitat for small mammals, and increases opportunities for establishment of nonnative and invasive plant species.	Minimally or partially meets objective; there would be gradual restoration in the fenced areas, but not parkwide; would not meet habitat goals throughout the parks.	Meets objective; there would likely be an issue with exotic/invasive plant species initially, as they have established themselves in the parks, and would be opportunistic.	Meets objective; same as alternative C.

TABLE 14: ANALYSIS OF HOW THE ALTERNATIVES MEET PLAN OBJECTIVES

Objective	Alternative A: Continuation of Current Management (No Action)	Alternative B: Nonlethal Deer Management	Alternative C: Lethal Deer Management	Alternative D: Combined Lethal and Nonlethal Deer Management
Promote early detection, and reduce the probability of spread of CWD.	Partially meets objective; there is a detection and initial response plan in place for two of the three parks.	Meets objective; there is a detection and initial response plan in place for two parks, and this alternative would establish protocols for long term measures for addressing the disease at all parks. The alternative would also promote early detection because deer would be tested immediately without having to wait until the disease is within 5 miles of the parks, as is the case under the plan currently in place for Monocacy and Antietam.	Meets objective with long-term management for addressing CWD at all parks; same as alternative B.	Meets objective; same as alternative B.
Cultural Resources				
Protect the integrity and character of the cultural landscapes, including the spatial patterns of open versus wooded land.	Does not meet objective; there would be continued deer pressure, etc., that would threaten the integrity of the cultural landscapes at the parks.	Partial/extremely limited ability to meet objective; fencing and tree tubes create separate immediate, although temporary, adverse impacts. Reproductive controls gradually reduce deer density, but over an extended amount of time, limiting the ability of the alternative to protect the integrity of the cultural landscapes.	Meets objective; reduces browsing pressure, which would protect cultural landscapes.	Meets objective; same as alternative C.

TABLE 14: ANALYSIS OF HOW THE ALTERNATIVES MEET PLAN OBJECTIVES

Objective	Alternative A: Continuation of Current Management (No Action)	Alternative B: Nonlethal Deer Management	Alternative C: Lethal Deer Management	Alternative D: Combined Lethal and Nonlethal Deer Management
Protect, preserve and ensure the viability of the historic agricultural landscape, such as crops, orchards, and pasture lands. **Note**: the battlefield missions are different with respect to the extent they are to protect or restore cultural landscapes: Antietam has very specific restoration goals for the woodlots, including species composition and forest structure, so that ability to interpret movement of troops through the woods is maximized.	Does not meet objective; current management practices would not decrease browsing pressure, and crops and other agricultural lands would continue to be adversely affected.	Partially meets objective; would include crop management measures and some fencing, but also short term adverse visual impacts from fencing and tree tubes, excluding deer from forested areas away from the cultural landscapes could increase browsing pressure on the agricultural areas that are not fenced.	Meets objective; reduces deer population density and browsing pressure, allowing less damage to agricultural areas.	Meets objective; same as alternative C.
Visitor Use and Experience				
Enhance public awareness and understanding of NPS resource management issues, policies, and mandates, especially as they pertain to deer management.	Meets objectives; there are continued interpretive efforts on tree tubes, crops, etc.	Meets objective; there would be initial outreach on the management efforts, reasons, and goals for deer management.	Meets objective; same as alternative B.	Meets objective; same as alternative B.
Ensure visitors have the opportunity to view and experience the battlefield landscapes within their historic contexts.	Does not meet objective; there are currently very visual management measures in place, such as tree tubes, and there are obvious browse lines, exotic plant species, and very high numbers of deer at all three parks.	Partially meets objective, or has the potential to meet objective over time. Does not meet objective in the short term, as it would be several years before deer pressure is reduced, and interim measures (exclosures, tree tubes, etc.) are very visible.	Meets objective; reduced deer population density allows for fewer visible protective measures, and an opportunity for regeneration of vegetation that would have been present historically.	Meets objective; same as alternative C.

TABLE 14: ANALYSIS OF HOW THE ALTERNATIVES MEET PLAN OBJECTIVES

Objective	Alternative A: Continuation of Current Management (No Action)	Alternative B: Nonlethal Deer Management	Alternative C: Lethal Deer Management	Alternative D: Combined Lethal and Nonlethal Deer Management
Ensure visitors have the opportunity to view deer in the natural environment at population levels that do not adversely impact visitors' enjoyment of other native species in the natural landscape.	Does not meet objective; current management measures are not controlling deer populations, and deer are adversely affecting the habitat of other native species.	Partially meet objective; the horizon for success is very long term, and measures would be very intrusive visually, etc. in the short term.	Meets objective; see above habitat objective for reasons.	Meets objective; same as alternative C.

TABLE 15: SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Impact Topic	Alternative A: Continuation of Current Management (No Action)	Alternative B: Nonlethal Deer Management	Alternative C: Lethal Deer Management	Alternative D: Combined Lethal and Nonlethal Deer Management
Vegetation	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:
	Long-term moderate to major adverse impacts because browsing pressure would be expected to remain high in either all or a large portion of the parks throughout the life of this plan (15 years) due to the lack of deer management actions. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would provide indirect beneficial impacts, but these would not outweigh the adverse effects of not taking deer management actions.	Similar to alternative A. Long-term moderate to major adverse impacts, with short-term negligible impacts from deer management implementation actions such as placement of bait piles and trampling and limited beneficial impacts from use of the techniques available to reduce deer access to crops, fields, and woodlots. Reproductive control would result in only a gradual reduction in the deer population, and although the population goal could be met over the longer term, the risk of not meeting the goal would be high. Therefore, it is expected that the deer population would remain at relatively high density levels in the parks throughout the life of the plan (exceeding the desired density goal). The exclosures would protect only a small portion of the forest in the parks at any one time, requiring 10 years for regrowth above the browse line. Any CWD response that would be taken under the proposed long-term plan would provide indirect beneficial impacts, but these would not outweigh the adverse effects of not taking deer management actions.	Long-term beneficial because the relatively rapid deer herd reduction would allow the abundance and diversity of vegetation throughout the park to recover. There would be short-term negligible impacts (mainly trampling) from deer management implementation actions, and benefits from the limited use of deer management techniques to reduce impacts in certain locations or circumstances. CWD actions would have similar impacts, with short-term negligible impacts (mainly trampling) from surveillance, and benefits from the reduction of deer and deer browse on vegetation.	Same as alternative C. Long-term beneficial effects due to the decrease in the deer herd, limited adverse impacts from the management actions themselves, and limited benefits from the use of the techniques described for all alternatives. CWD actions would have similar impacts, with short-term negligible impacts (mainly trampling) from surveillance, and benefits from the reduction of deer and deer browse on vegetation.
	Cumulative Impact:	*Cumulative Impact*:	*Cumulative Impact*:	*Cumulative Impact*:
	Long-term moderate adverse impacts. Alternative A would contribute appreciable adverse increments to the cumulative impact on vegetation.	Long-term moderate adverse impacts. Alternative B would contribute appreciable adverse increments to the cumulative impact on vegetation.	Long-term beneficial effects. Alternative C would contribute appreciable beneficial increments to the cumulative impact on vegetation.	Long-term beneficial effects. Alternative D would contribute appreciable beneficial increments to the cumulative impact on vegetation.

TABLE 15: SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Impact Topic	Alternative A: Continuation of Current Management (No Action)	Alternative B: Nonlethal Deer Management	Alternative C: Lethal Deer Management	Alternative D: Combined Lethal and Nonlethal Deer Management
White-tailed Deer	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:
	Long-term minor to moderate adverse impacts because browsing pressure would likely remain high in the three parks throughout the life of this plan (15 years), with degradation of habitat and loss of food sources. Short-term negligible adverse impacts on deer from deer monitoring actions. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would provide indirect beneficial impacts on the overall deer population, but these would not outweigh the adverse effects of not taking deer management actions.	Similar to alternative A. Long-term minor to moderate adverse impacts. Reproductive control would result in a gradual reduction in the deer population, and consequently the deer population would remain at relatively high levels throughout the life of the plan. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would provide indirect beneficial impacts, but these would not outweigh the adverse effects of not taking deer management actions.	Long-term beneficial effects because the relatively rapid deer herd reduction would allow the abundance and diversity of vegetation throughout the three parks to recover and better protect deer habitat. There would be short-term negligible adverse effects from implementing deer management actions (noise, disturbance) and short-term moderate adverse impacts on the deer population from the large removals in the first years of the plan. CWD actions would have similar impacts, with short-term negligible impacts from surveillance, and long-term benefits from the reduction of the potential for disease amplification, spread and establishment.	Same as alternative C. Long-term beneficial effects due to the relatively rapid deer herd reduction that would allow the abundance and diversity of vegetation throughout the three parks to recover and better protect deer habitat. There would be short-term negligible adverse effects from implementing deer management actions (noise, disturbance) and short-term moderate adverse impacts on the deer population from the large removals in the first years of the plan. CWD actions would have similar impacts, with short-term negligible impacts from surveillance, and long-term benefits from the reduction of the potential for disease amplification, spread and establishment.
	Cumulative Impact:	*Cumulative Impact*:	*Cumulative Impact*:	*Cumulative Impact*:
	Long-term minor to moderate adverse impacts. Alternative A would contribute appreciable adverse increments to the cumulative impact on the white-tailed deer population.	Long-term minor to moderate adverse impacts. Alternative B would contribute appreciable adverse increments to the cumulative impact on the white-tailed deer population.	Long-term beneficial effects. Alternative C would contribute appreciable beneficial increments to the cumulative impact on the white-tailed deer population.	Long-term beneficial effects. Alternative D would contribute appreciable beneficial increments to the cumulative impact on the white-tailed deer population.

TABLE 15: SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Impact Topic	Alternative A: Continuation of Current Management (No Action)	Alternative B: Nonlethal Deer Management	Alternative C: Lethal Deer Management	Alternative D: Combined Lethal and Nonlethal Deer Management
Other Wildlife and Wildlife Habitat	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*
	Primarily long-term negligible to potentially major adverse impacts, depending on the species. Species that depend on ground cover and young tree seedlings or understory shrubs for food or cover could be severely reduced or eliminated from the parks, while impacts on species that depend primarily on other habitats (not woodlands) or on the upper canopy for food and cover would be negligible. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would provide indirect beneficial impacts, but these would not outweigh the adverse effects of not taking deer management actions.	Similar to alternative A. Primarily long-term negligible to potentially major adverse impacts, depending on the species. Reproductive control would result in only a gradual reduction in the deer population, and although the population goal could be met over the longer term, the risk of not meeting the goal would be high. Therefore, it is expected that the deer population would remain at relatively high density levels in the parks throughout the life of the plan. Also, the exclosures would protect only a small portion of the forest in the parks at any one time, requiring 10 years for regrowth above the browse line. Species that depend on ground cover and young tree seedlings or understory shrubs for food or cover could be severely reduced or eliminated from the parks, while impacts on species that depend primarily on other habitats (not woodlands) or on the upper canopy for food and cover would be negligible. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would provide indirect beneficial impacts, but these would not outweigh the adverse effects of not taking deer management actions.	Long-term beneficial effects because the relatively rapid deer herd reduction would allow vegetation used as food and cover for many wildlife species to become more abundant. There could be long-term minor adverse impacts on some species that prefer open habitat and short-term negligible adverse impacts from disturbance and noise during the implementation of the action and use of deer management. However, the impacts of deer management actions under alternative C on other wildlife would be mostly long-term beneficial, depending on the species. CWD actions would have similar impacts, with short-term negligible impacts (mainly trampling) from surveillance, and benefits from the reduction of deer and deer browse on vegetation.	Same as alternative C. Long-term beneficial effects due to the decrease in the deer herd, and limited adverse impacts from the management actions themselves. CWD actions would have similar impacts, with short-term negligible impacts (mainly trampling) from surveillance, and benefits from the reduction of deer and deer browse on vegetation/habitat.
	Cumulative Impact	*Cumulative Impact:*	*Cumulative Impact:*	*Cumulative Impact:*
	Long-term moderate adverse impacts. Alternative A would contribute appreciable adverse increments to the cumulative impact on wildlife.	Long-term moderate adverse impacts. Alternative B would contribute appreciable adverse increments to the cumulative impact on wildlife and wildlife habitat.	Long-term beneficial effects. Alternative C would contribute appreciable beneficial increments to the cumulative impact on wildlife and wildlife habitat.	Long-term beneficial effects. Alternative D would contribute appreciable beneficial increments to the cumulative impact on wildlife and wildlife habitats.

TABLE 15: SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Impact Topic	Alternative A: Continuation of Current Management (No Action)	Alternative B: Nonlethal Deer Management	Alternative C: Lethal Deer Management	Alternative D: Combined Lethal and Nonlethal Deer Management
Special Status Species	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:	*Direct/Indirect Impact*:
	Primarily long-term negligible to potentially major adverse impacts, depending on the species. Species that depend on ground cover and young tree seedlings or understory shrubs for food or cover or native plants could be severely reduced or eliminated from the parks; whereas, impacts on species that depend primarily on other habitats (not woodlands) or on the upper canopy for food and cover would be negligible. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would provide indirect beneficial impacts for many species, but these would not outweigh the adverse effects of not taking deer management actions.	Similar to alternative A. Primarily long-term negligible to potentially major adverse impacts, depending on the species. Reproductive control would result in only a gradual reduction in the deer population, and although the population goal could be met over the longer term, the risk of not meeting the goal would be high. Therefore, it is expected that the deer population would remain at relatively high density levels in the parks throughout the life of the plan. Also, the exclosures would protect only a small portion of the forest in the parks at any one time, requiring 10 years for regrowth above the browse line. Species that depend on ground cover and young tree seedlings or understory shrubs for food or cover could be severely reduced or eliminated from the parks, while impacts on species that depend primarily on other habitats (not woodlands) or on the upper canopy for food and cover would be negligible. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would provide indirect beneficial impacts, but these would not outweigh the adverse effects of not taking deer management actions.	Mostly long-term beneficial impacts depending on the species. There could be long-term minor adverse effects on some species that prefer open habitat and short-term negligible adverse impacts from disturbance during the implementation of the action. The long-term reduction and controls on deer population growth under alternative C would allow vegetation used as food and cover for sensitive wildlife to become more abundant and would decrease browse on sensitive plants. CWD actions would have similar impacts, with short-term negligible impacts (mainly trampling) from surveillance, and benefits from the reduction of deer and deer browse on vegetation/habitat.	Essentially the same as alternative C. Mostly long-term beneficial effects depending on the species. There could be long-term minor adverse impacts on some species that prefer open habitat and short-term negligible adverse impacts from disturbance during the implementation of the action. CWD actions would have similar impacts, with short-term negligible impacts (mainly trampling) from surveillance, and benefits from the reduction of deer and deer browse on vegetation/habitat.
	Cumulative Impact:	*Cumulative Impact*:	*Cumulative Impact*:	*Cumulative Impact*:
	Long-term minor to potentially major adverse impacts, depending on the species.	Long-term minor to potentially major adverse cumulative impacts, depending on the species.	Long-term beneficial effects, and alternative C would contribute appreciable beneficial increments to the cumulative impact on special status species.	Long-term beneficial effects, and alternative D would contribute appreciable beneficial increments to the cumulative impact on special status species.

TABLE 15: SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Impact Topic	Alternative A: Continuation of Current Management (No Action)	Alternative B: Nonlethal Deer Management	Alternative C: Lethal Deer Management	Alternative D: Combined Lethal and Nonlethal Deer Management
Socio-economics	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*
	Long-term minor to moderate adverse impacts because of the continued high density of deer expected over the life of this plan and the associated costs of landscape damage, crop loss, and additional costs for fencing, repellents, and other forms of deer control to protect landscaping. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would provide indirect beneficial impacts on neighboring properties, but these would not outweigh the adverse effects of not taking deer management actions.	Similar to alternative A. Long-term moderate adverse impacts but with the additional impact of precluding deer from the large exclosures, which could add to browsing pressure on surrounding lands. Reproductive control would result in only a gradual reduction in the deer population, and although the population goal could be met over the longer term, the risk of not meeting the goal would be high. Therefore, it is expected that the deer population would remain at relatively high density levels in the parks throughout the life of the plan. Any CWD response that would be taken under the proposed long-term plan would provide indirect beneficial impacts, but these would not outweigh the adverse effects of not taking deer management actions.	Long-term beneficial effects because the relatively rapid reduction in deer density would reduce adverse impacts on landowners, due to improved crop yields and preserved landscaping and reduce the need for landscape and crop protection. CWD actions would have similar impacts, with benefits from the reduction of deer and deer browse on adjacent lands.	Essentially the same as alternative C. Long-term beneficial effects due to the decrease in the deer herd, limited adverse impacts from the management actions themselves, and limited benefits from the use of the techniques described for all alternatives. CWD actions would have similar impacts, with benefits from the reduction of deer and deer browse on adjacent lands.
	Cumulative Impact:	*Cumulative Impact:*	*Cumulative Impact:*	*Cumulative Impact:*
	Long-term moderate adverse impacts. Alternative A would contribute appreciable adverse increments to the cumulative impact on socioeconomics/adjacent lands.	Long-term moderate adverse impacts. Alternative B would contribute appreciable adverse increments to the cumulative impact on socioeconomics/adjacent lands.	Long-term beneficial effects. Alternative C would contribute appreciable beneficial increments to the cumulative impact on socioeconomics/adjacent lands.	Long-term beneficial effects. Alternative D would contribute appreciable beneficial increments to the cumulative impact on socioeconomics/ adjacent lands.

TABLE 15: SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Impact Topic	Alternative A: Continuation of Current Management (No Action)	Alternative B: Nonlethal Deer Management	Alternative C: Lethal Deer Management	Alternative D: Combined Lethal and Nonlethal Deer Management
Visitor Use and Experience	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*
	Visitors who may be primarily interested in viewing deer would experience beneficial and adverse impacts (beneficial because there would be more deer to see; adverse because the appearance of the deer could be affected by disease or malnutrition). However, there would be long-term minor to moderate adverse overall impacts related to a decreased ability to view scenery (including native vegetation and the historic landscape) and other wildlife, which is important to some visitors using the parks. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would provide indirect beneficial impacts relating to the appearance of vegetation in the parks, but would have adverse effects on visitation; these effects would not outweigh the adverse effects of not taking deer management actions in the long-term.	Similar to alternative A. Visitors would experience beneficial and adverse impacts, since deer would still be present in relatively high numbers for the life of the plan, and possibly longer. Adverse impacts on visitor use and experience from the presence of exclosures and the continued effects of deer overbrowsing would range from negligible to moderate, and impacts related to forest regeneration would gradually become beneficial in the long term, beyond the life of this plan. Visitors may see various aspects of the reproductive control operations, which could result in minor adverse impacts on their visitor experience. Any CWD response that would be taken under the proposed long-term plan would provide indirect beneficial impacts relating to the appearance of vegetation in the parks, but would have adverse effects on visitation; these would not outweigh the adverse effects of not taking deer management actions in the long-term.	Impacts would vary between users, with short- and long-term minor to major adverse impacts on those opposed to lethal deer management within the parks and from disturbance during implementation of the action, but long-term beneficial effects on those who value an increase in vegetative and wildlife diversity and being able to view natural and historic landscapes unaffected by overbrowsing. CWD actions would have similar impacts, with short-term negligible impacts (mainly trampling) from surveillance, benefits from the reduction of deer and deer browse on vegetation, and adverse effects on those visitors who are opposed to lethal deer management.	Similar to alternative C. Impacts would vary between users, with short- and long-term minor to major adverse impacts on those opposed to lethal deer management within the parks and from disturbance during implementation of the action, but long-term beneficial effects on those who value an increase in vegetative and wildlife diversity and being able to view natural and historic landscapes unaffected by overbrowsing. CWD actions would have similar impacts, with short-term negligible impacts (mainly trampling) from surveillance, benefits from the reduction of deer and deer browse on vegetation, and adverse effects on those visitors who are opposed to lethal deer management.
	Cumulative Impact:	*Cumulative Impact:*	*Cumulative Impact:*	*Cumulative Impact:*
	Long-term beneficial effects. Alternative A would contribute appreciable adverse increments to the cumulative impact on visitor use and experience.	Long-term beneficial effects. Alternative B would contribute appreciable adverse increments to the cumulative impact on visitor use and experience.	Long-term beneficial effects. Alternative C would contribute appreciable beneficial increments to the cumulative impact on visitor use and experience.	Long-term beneficial effects. Alternative D would contribute appreciable beneficial increments to the cumulative impact on visitor use and experience.

TABLE 15: SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Impact Topic	Alternative A: Continuation of Current Management (No Action)	Alternative B: Nonlethal Deer Management	Alternative C: Lethal Deer Management	Alternative D: Combined Lethal and Nonlethal Deer Management
Cultural Landscapes	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*
	Long-term moderate adverse impacts due to the continued high levels of the deer population and the associated ongoing depredation of plantings and crops by deer in unfenced cultural landscape areas. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would provide indirect beneficial impacts, but these would not outweigh the adverse effects of not taking deer management actions.	Similar to alternative A. Long-term moderate adverse impacts because in the majority of the parks, agricultural crops, and other vegetation would continue to be adversely affected by deer browsing until reproductive controls became effective and the population decreases. Reproductive control would result in only a gradual reduction in the deer population, and although the population goal could be met over the longer term, the risk of not meeting the goal would be high. Therefore, it is expected that the deer population would remain at relatively high density levels in the parks throughout the life of the plan. Also, the exclosures would protect only a small portion of the forest in the parks at any one time, requiring 10 years for regrowth above the browse line, and would have adverse visual impacts on the cultural landscapes if they are visible. Any CWD response that would be taken under the proposed long-term plan would provide indirect beneficial impacts, but these would not outweigh the adverse effects of not taking deer management actions.	Long-term beneficial effects due to decreased browsing and thus decreased deer depredations of agricultural crops. This would lead to increased chances of viability for the parks' farm ventures and maintain the open and closed patterns of the cultural landscape. There would be short-term negligible impacts (mainly trampling) from deer management implementation actions, and benefits from the limited use of deer management techniques to reduce impacts in certain locations or circumstances. CWD actions would have similar impacts, with short-term negligible impacts (mainly trampling) from surveillance, and benefits from the reduction of deer and deer browse on vegetation.	Essentially the same as alternative C. Long-term beneficial effects due to the decreased browsing and thus decreased deer depredations of agricultural crops, which would lead to increased chances of viability for the parks' farm ventures and forest vegetation that maintain the open and closed patterns of the cultural landscape. There would be short-term negligible impacts (mainly trampling) from deer management implementation actions, and benefits from the limited use of deer management techniques to reduce impacts in certain locations or circumstances. CWD actions would have similar impacts, with short-term negligible impacts (mainly trampling) from surveillance, and benefits from the reduction of deer and deer browse on vegetation.
	Cumulative Impact:	*Cumulative Impact:*	*Cumulative Impact:*	*Cumulative Impact:*
	Long-term moderate adverse impacts. Alternative A would contribute appreciable adverse increments to the cumulative impact on cultural landscapes.	Long-term moderate adverse impacts. Alternative B would contribute appreciable adverse increments to the cumulative impact on cultural landscapes.	Long-term beneficial effects. Alternative C would contribute appreciable beneficial increments to the cumulative impact on cultural landscapes.	Long-term beneficial effects. Alternative D would contribute appreciable beneficial increments to the cumulative impact on cultural landscapes.

TABLE 15: SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Impact Topic	Alternative A: Continuation of Current Management (No Action)	Alternative B: Nonlethal Deer Management	Alternative C: Lethal Deer Management	Alternative D: Combined Lethal and Nonlethal Deer Management
Health and Safety	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*
	Long-term adverse impacts that range from negligible to potentially major depending on the source and outcome of any accident. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would include additional adverse impacts but provide long-term beneficial impacts related to the risk of collisions, but these would not outweigh the adverse effects of not taking deer management actions.	Similar to alternative A. Long-term adverse impacts ranging from negligible to potentially major, depending on the source and outcome of any accident. Reproductive control would result in only a gradual reduction in the deer population, and although the population goal could be met over the longer term, the risk of not meeting the goal would be high. Impacts on visitor and employee health and safety would be Any CWD response that would be taken under the proposed long-term plan would have some adverse impacts and provide indirect beneficial impacts, but these would not outweigh the adverse effects of not taking deer management actions.	Long-term negligible to minor adverse impacts with beneficial impacts related to a reduced risk of deer-vehicle collisions due to the reduction in deer density. CWD actions under a long-term management plan would have similar impacts, with short-term negligible to minor impacts from the actions themselves, and possible benefits from the reduction of deer tick hosts and the reduced potential for deer-vehicle collisions.	Essentially the same as alternative C. Long-term negligible to minor adverse impacts with beneficial impacts related to a reduced risk of deer-vehicle collisions due to the reduction in deer density. CWD actions under a long-term management plan would have similar impacts, with short-term negligible to minor impacts from the actions themselves, and possible benefits from the reduction of deer tick hosts and the reduced potential for deer-vehicle collisions.
	Cumulative Impact:	*Cumulative Impact:*	*Cumulative Impact:*	*Cumulative Impact:*
	Long-term moderate adverse impacts. Alternative A would contribute appreciable adverse increments to the cumulative impact because of the higher potential for deer-vehicle collisions and possibly Lyme disease transmission.	Long-term moderate adverse impacts. Alternative B would contribute appreciable adverse increments to the overall cumulative impacts because of the continued higher potential for deer-vehicle collisions and possibly Lyme disease transmission.	Long-term negligible adverse impacts. Alternative C would contribute a minimal amount to the overall risks and would add an appreciable beneficial increment to the overall cumulative impact.	Long-term negligible adverse impacts. Alternative D would contribute a minimal amount to the overall risks and would add an appreciable beneficial increment to the overall cumulative impact.

TABLE 15: SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Impact Topic	Alternative A: Continuation of Current Management (No Action)	Alternative B: Nonlethal Deer Management	Alternative C: Lethal Deer Management	Alternative D: Combined Lethal and Nonlethal Deer Management
Park Management and Operations	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*	*Direct/Indirect Impact:*
	Long-term minor adverse impacts. Because current deer management actions would continue, each park's deer population is expected to continue to fluctuate and remain at high levels, resulting in long-term demands on park staff and funding for managing the deer herd and protecting other park resources. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would add adverse impacts on park management and operations related to the additional workload and costs, depending on the actions taken.	Long-term moderate to potentially major adverse impacts on park management and operations from installing and maintaining large exclosures and implementing and monitoring reproductive controls. Minor adverse impacts would result from increased educational/interpretive activities and CWD surveillance. Any CWD response that would be taken under the proposed long-term plan would provide short- and long-term moderate adverse impacts on park management and operations.	Moderate adverse impacts during the period of direct reduction efforts because of the need for additional staff time for monitoring and coordinating activities. The use of qualified federal employees or authorized agents would reduce the amount of park staff time needed for implementation, but would still result in increased costs. With the greater reduction of deer over a shorter period of time, park staff would have more time to apply their efforts to other areas of the park when compared to alternative A, which would reduce adverse, long-term impacts from moderate to minor over time. Any CWD response that would be taken under the proposed long-term plan would provide short- and long-term moderate adverse impacts on park management and operations.	Similar to alternative, C - moderate adverse impacts because park staff involvement would be required for coordination and monitoring of the reduction and reproductive control actions. Once the deer herd was reduced, more staff time would be available for other activities, resulting in long-term adverse minor impacts. Any CWD response that would be taken under the proposed long-term plan would provide short- and long-term moderate adverse impacts on park management and operations.
	Cumulative Impact:	*Cumulative Impact:*	*Cumulative Impact:*	*Cumulative Impact:*
	Long-term minor adverse impacts. Alternative A would contribute appreciable adverse increments to the cumulative impact on park management and operations.	Long-term moderate to possibly major adverse impacts. Alternative B would contribute an appreciable adverse amount to the overall cumulative impacts because of the higher demands for staff time and the high costs associated with reproductive control and exclosure construction and maintenance.	Long-term moderate adverse impacts. Alternative C would contribute a moderate amount to the overall adverse effects due to the costs and demands associated with lethal removal.	Long-term moderate adverse impacts. Alternative D would contribute a moderate amount to the overall adverse effects due to the costs and demands associated with lethal removal in the early years and reproductive control after years 5 and 6.

ALTERNATIVES CONSIDERED BUT DISMISSED FROM FURTHER DETAILED ANALYSIS

The following alternatives were considered but dismissed from further detailed analysis for reasons explained below.

MANAGED HUNT/PUBLIC HUNTING

Public hunting was considered but not carried forward for further analysis because it is not mandated by federal law for these park units. In 1984, after careful consideration of congressional intent with respect to hunting in national parks, the NPS adopted a policy that allows public hunting in national park areas only where “specifically mandated by Federal statutory law” (36 CFR 2.2). The NPS reaffirmed this approach in the NPS *Management Policies 2006* (NPS 2006a). The management policies (Section 8.2.2.6) state that “hunting, trapping, or any other methods of harvesting wildlife by the public will be allowed where it is specifically mandated by federal law. Where hunting activity is not mandated but is authorized on a discretionary basis under federal law, it may take place only after the Service has determined that the activity is an appropriate use and can be managed consistent with sound resource management principles.” Congress has not authorized hunting in any legislation for Antietam, Monocacy, or Manassas, and the likelihood that the law would be changed by Congress, or that the NPS would change its long-standing servicewide policies and regulations regarding hunting in parks is remote and speculative.

For this reason, public hunting was eliminated from further consideration.

USE OF VOLUNTEERS TO ASSIST WITH LETHAL REDUCTION (SHARPSHOOTING)

The use of skilled or specially trained volunteers may be considered by the NPS depending on the activity being implemented. However, for the purposes of this plan/EIS, volunteers would not be used to assist with lethal reduction (sharpshooting).

While some other areas administered by the NPS have proposed or begun the implementation of use of volunteers as sharpshooters in lethal reduction activities, not all locations within National Park System Units are suitable for use of volunteers to engage in such activities. Typically, those national park system units that are allowing for participation of volunteers as sharpshooters are located in areas with scattered and sparse populations. Additionally, these areas have expanses of wilderness and backcountry that are less likely to have concentrations of users that may inadvertently enter closed areas.

Many places surrounding Antietam, Monocacy, and Manassas are occupied by residential development and commercial land uses, and regional highways go through all three parks. There are safety concerns related to this proximity of park boundaries to developed areas, high visitation in the parks, and topography/landscapes that inhibit clear lines of sight and complete closure of access. Additionally, sharpshooters meeting NPS requirements would be required to demonstrate the necessary proficiency and experience in wildlife population management including lethal reduction actions. As a result of challenges associated with park topography, human presence along the park boundaries, the nature of recreational use in the parks, and the number of deer to be removed, it is essential that accuracy and demonstrated professional experience by full-time sharpshooters be assured for maximum success in lethal removal and to ensure public safety. The parks would incur substantial costs and impacts on schedule to develop volunteer training and provide supervision of volunteer performance to reduce risk and provide for the necessary level of public safety. Based on all these factors, the NPS decided that the use of volunteers for assistance with lethal removal activities would not be included as an option in this plan.

PREDATOR REINTRODUCTION OR AUGMENTATION

Relationships between predators and prey are complex, and the impact of predators on herbivore populations is variable (McCullough 1979). Coyotes (*Canis latrans*) and black bears (*Ursus americanus*) are potential deer predators that reside throughout much of North America, and these predators are present in and around the parks. However, these species appear to be opportunists that take advantage of specific periods of deer vulnerability, and none of these predators has demonstrated a consistent ability to control deer populations. Even though coyote populations have increased and the coyote's range has expanded in the past 20 years, both deer and coyote populations have increased simultaneously in many areas. Biologists believe that coyotes are partly responsible for declining deer numbers in some areas, but changes in deer populations in other areas appear unrelated to coyote density. Coyotes hunt individually and are territorial, so large deer are generally not taken by individual coyotes. Introduction of more coyotes would not increase local populations in the parks or increase predation on deer.

Wolves are efficient deer predators, but they have been eliminated from much of the United States. Introducing or augmenting their presence in the parks would not be feasible due to a lack of suitable habitat. Wolves have home ranges averaging 30 square miles when deer are the primary prey (Mech 1991). Also, most of the parks' lands (especially Monocacy and Manassas) are surrounded by and include an urban or suburban environment, making it impractical for predators such as wolves or coyotes to be reintroduced. There are issues with possible adverse effects on surrounding rural or suburban residents, especially safety of pets, children, and small farm animals. The reasons described above relating to effectiveness, habitat limitations, and human safety concerns led this alternative to be dismissed.

USE OF POISON

Under this alternative, poison would be mixed with food sources such as grains to kill deer. Death from poisoning is often considered inhumane (UVM 1997). Death is not immediate, and health concerns resulting from people potentially hunting and eating poisoned deer that have wandered out of the parks could be an issue. Currently no toxicants, poisons, or lethal baits are registered for deer control. In addition, nontarget native wildlife or roaming pets could potentially eat a tainted carcass or the poison itself (Bishop et al. 1999). Therefore, this alternative was dismissed.

CAPTURE AND RELOCATION

Capturing deer within the parks and relocating them would be in violation of NPS policy regarding translocation and the prevention of disease spread (NPS 2002c), and the state agencies are also not likely to support this option. Even if the policy were not in effect, permits would be required to relocate deer to areas a sufficient distance from the parks to ensure that they would not return. Given the abundance of deer in Maryland and Virginia, and most of the United States, areas for relocation would be very limited or nonexistent. Also, live capture and relocation methods can cause stress that can result in high mortality rates among captured and/or relocated deer. Implementation of this alternative could result in the death of more than 50% of the deer during the first year after release (Jones and Witham 1990). In one study only 15% of the relocated deer survived one year after relocation (O'Bryan and McCullough 1985). In addition, due to potential concerns related to CWD, it is possible that quarantine processes would be required. The concerns discussed above relating to policy, costs, feasibility, and high mortality, capture and release caused this alternative to be dismissed as a viable option.

SUPPLEMENTAL FEEDING

Providing supplemental food to deer is often suggested as a way of reducing damage to natural or ornamental vegetation. However, the NPS *Management Policies 2006*, Section 4.4.1, "General Principles for Managing Biological Resources," and Section 4.4.2, "Management of Native Plants and Animals," are aimed at allowing natural processes to occur whenever possible (NPS 2006a) and would not support the concept of supplemental feeding. In addition, although providing alternative food sources could provide temporary relief from browsing to plants needing protection, it would not provide a long-term solution. Supplemental feeding could facilitate disease transmission. Supplemental feeding would increase survivability and reproduction in the deer population, thus compounding problems that already exist. It encourages increased deer population growth and negative impacts on habitat and other wildlife, as well as greater deer-human conflict (NDTC 2009), and is therefore in conflict with the goals of this plan. For these reasons, this alternative was dismissed.

FENCING THE ENTIRE PARK (OR EXCLUSIVE USE OF FENCING)

Fencing the entire park for any of the parks would not effectively prevent deer from entering or leaving the parks, given the number of potential entry points (e.g., roads, driveways) and fragmentation of the parks. Fences approximately 8 feet high would be needed to prevent deer from jumping over the barriers, and fences of this height and extent would have adverse effects on the cultural landscapes of the parks. Even if an entire park were fenced, vegetation within the park would continue to suffer the effects of deer browsing because the deer population within the fenced area would continue to increase and the health of the contained herd would suffer. Therefore, either all deer within the fenced area would need to be removed, which would be inconsistent with NPS policy, or the deer population within the fence would need to be managed with other methods to meet the objectives of the management plan. For these reasons, this alternative was dismissed.

Exclusive use of fencing would not be sufficient to protect sensitive plant species and allow for forest regeneration. To protect sufficient area, fencing would need to cover a large portion of the parks, and this would result in unacceptable impacts on visitor use, visual quality of the parks, cultural landscapes of the parks, and other wildlife species. Areas not fenced would be subject to increased pressures from deer browsing. For these reasons, exclusive use of fencing without other actions included to reduce deer numbers was eliminated as a reasonable alternative, but fencing was included as a component of alternative B.

LANDSCAPE MODIFICATION / USE OF DEER RESISTANT PLANTINGS

Landscape modification or habitat management was reviewed as a potential alternative. Deer are attracted to highly fragmented habitat; therefore, reducing fragmentation would possibly lead to less desirable forested habitat. Deer populations in a forested habitat could not be sustained at levels currently supported by the food resources available in the fragmented landscape. Over time, the deer population would decline because of lower food availability. This alternative would involve modifying the entire park landscape to reduce fragmentation of forests by fencing or restoring old field areas in strategic locations to allow forest succession to occur. This approach would reduce the total acreage of unforested land and create larger blocks of contiguous forest to manipulate deer feeding behavior and movements. It would also include changing agricultural practices within the parks to either reduce total acreage or change the types of crops planted to types that are less palatable to deer, thereby reducing food availability for deer across the landscape of the parks.

However, these parks all have a relatively high edge-to- interior ratio with fragmented landscapes surrounding the boundaries. Landscape use would need to change outside of the park boundary in a wider buffer around the parks to effectively alter deer population in the parks. In addition, white-tailed deer are very adaptable animals, adjusting their diets to use available food sources. Also, introducing plantings of non-palatable species on a parkwide scale would not be feasible. Typically, non-palatable plants are those that are nonnative and often invasive, which is counter to the resource management goals of the parks. The effort needed to replace existing palatable vegetation with non-palatable would be extensive, and the result expected is that deer would eventually adapt to the available food source. Additionally, removal of large areas of existing vegetation would have adverse effects on other wildlife species. Alteration of the landscape to increase forest and introduce non-palatable plantings would also affect the nature of the cultural landscapes at all parks, and would therefore fail to meet the objectives of this plan and would be inconsistent with enabling legislation for the parks, which promotes maintaining the landscape as it was historically.

Even if fragmentation could be reduced, deer numbers would decline so slowly that browsing damage to existing forests would still occur and likely even increase in certain areas. Furthermore, the degree to which fragmentation can be reduced within these parks is limited by other factors such as roads and private land uses. Therefore, trying to manage a deer population by managing the habitat to manipulate deer feeding behavior and movements in a highly fragmented environment surrounded by agricultural and suburban land uses would be extremely complex, inefficient, and likely unsuccessful.

This alternative was not carried forward for analysis since it would not meet the objectives of the plan/EIS and did not address the current deer damage to vegetation and other resources due to browsing in areas that would not be fenced.

REPRODUCTIVE CONTROL (AS A STAND-ALONE ALTERNATIVE)

Reproductive Control of Does

Reproductive control options to restrict the growth of the deer population were considered and were incorporated into alternatives B and D. However, reproductive control as a stand-alone alternative was dismissed because it would not meet the objectives of the plan in a timely manner due to the length of time reproductive control would take to reduce the deer population. The following reproductive control methods were not considered for further analysis for the reasons described below.

Surgical Sterilization—This alternative would initially implement a phased approach to surgically sterilizing does within the parks to potentially reduce the size of the population over a number of years through natural mortality. Even though both sexes can be treated, surgical sterilization of females is more effective for population control in polygamous species like white-tailed deer. In addition, males are generally more difficult to capture because they are more wary and less gregarious than does. Sterilization of does is an invasive procedure, requiring either the surgical removal of ovaries or tubal ligation. Procedures require full anesthesia and must be conducted by a veterinarian. It is possible to conduct the surgery in the field. However, complications could result due to a relatively high incidence of infection, and mortality of individual deer could occur. If field surgery is required, a temporary or mobile field station could be set up to minimize the potential for infection and reduce impacts on visitors.

Surgical sterilization has several downsides including the following: treating a number of deer on a large scale is difficult; success is unlikely if deer are moving in and out of the parks (Merrill, Cooch, and Stout 2006); and the procedure is labor-intensive, taking approximately 6 to 8 hours per deer to capture, transport, treat, and return to release. Even though this treatment is permanent for individuals, annual sweeps would be needed to treat new deer recruited into the area.

This alternative would have the advantage of permanently sterilizing individual does, and, because surgical sterilization is permanent, the animal would be handled only once. Does would be captured, tagged, surgically sterilized, and then released back into the parks. In addition to the stress of the capture, individual animals would also be stressed by tranquilizers/anesthesia, surgical procedures, and recovery, which could increase mortality rates of sterilized individuals. Additionally, the long-term effects of this alternative on population genetics or behavior have not been well documented. Some researchers suggest that, depending on the type of sterilization used, changes in animal behavior would be expected (Warren and Warnell 2000). Removal of the ovaries, thus changing hormone production in the treated animal, would result in altered behavior. With a ligation procedure, normal hormone production would remain; however, this has been shown to result in repeated estrous cycles during the breeding season (Knox, Miller, and Marchinton 1988), extending the rut by modifying the male response behavior.

Due to the high numbers of deer needing treatment and the amount of labor required to manage does by surgical sterilization, this issue was considered and dismissed because of concerns about feasibility, stress to the animals, and long-term effects on population genetics and behavior.

Contragestives—A contragestive is a drug that is applied after a doe becomes pregnant and that terminates the pregnancy. This method would need to be administered annually. Contragestive agents differ in two ways from contraceptive control methods: the time of application (during pregnancy rather than before) and the potential harm to the deer. If the drug is administered too late in the pregnancy, it could make the delivery of a dead fetus difficult, potentially harming the doe. However, if the contragestive is applied too early, the doe could become pregnant again. Efficacy is approximately 75 to 80%, depending on timing. This method could be used to supplement the effectiveness of contraceptives, essentially treating animals missed with contraceptive treatments or those for which the treatment was not effective. The difficulty would then become how to determine which deer are pregnant. This would require either extensive monitoring/observation of the deer or recapturing does to check for pregnancy.

Given the number of deer in the area and the size of the parks, large-scale implementation of contragestives would not be feasible due to the amount of staff time and monitoring required to make the practice effective. Even on a limited scale, the use of other reproductive control measures would provide greater efficacy than contragestives. In addition, contragestives may be considered inhumane because of their mode of action, and their potential to harm the doe. There is also concern about potential effects to nontarget species (through food chain transfer). Therefore, the parks dismissed the use of contragestives as a reproductive control option.

Reproductive Control of Bucks

Another form of reproductive control includes sterilization of bucks. In a study of sterilization of feral horses, sterilizing only dominant harem stallions resulted in relatively modest reductions in population growth. Substantial reproduction may occur even when 100% of the dominant harem stallions are sterilized if other males perform as little as 10% of the breeding. Adequate suppression of population growth may be attained only if a large proportion of all males in the population are sterilized (Garrott and Siniff 1992).

Another study on the use of vasectomy on wolves suggested that population reduction depends largely on the degree of annual immigration. With high immigration (which could be expected at the parks because of the presence of deer on neighboring lands), periodic sterilization produced only moderate reductions in population size relative to an untreated population. Similar reductions in population size were obtained by periodically removing large numbers of wolves (Haight and Mech 1997).

Under this alternative, long-term population stability would become an issue along with genetic variability (a few nondominant bucks could breed the entire herd). If females did not become pregnant, their estrous cycle could be extended, resulting in later pregnancies and lower survival for fawns born later in the year (as a result of a higher winterkill potential). The population dynamic and makeup of the herd could suffer under this alternative. Because of the concerns relating to effectiveness, population stability, and genetic variability, this alternative was dismissed from detailed analysis.

NO ADDITIONAL ACTION, BUT WITH ENHANCED RESEARCH AND MONITORING

This alternative option would not solve the problem related to high deer densities and browse impacts on park vegetation. This is, in essence, a natural regulation alternative, with accompanying research, and would not meet the purpose, need, or objectives of the plan related to protection of the vegetation and the cultural landscapes of the parks.

OTHER OPTIONS FOR LONG-TERM MANAGEMENT OF CHRONIC WASTING DISEASE

Since the long-term CWD management plan is common to all action alternatives and includes the use of lethal removal, the team examined other options that could possibly be considered for the long-term management of CWD to see if other alternatives for this part of the plan should be carried through for analysis. These options include those that are being discussed within NPS for similar long-term CWD management planning and include the following: demographic culling; test and cull; reproductive control; use of predators; changing habitat and land use strategies, and reducing environmental contamination. For the reasons discussed below, it is the opinion of the planning team that none of these options would be sufficient or effective as a long-term management alternative if CWD were found in or within 5 miles of the park units.

Demographic culling (focusing on removal of males) was considered because there is some research that suggests the disease has higher prevalence in males when it first enters the population. However, females control the population and need to be targeted to decrease deer numbers. Testing deer for the presence of the disease and then removing any infected individuals (“test and cull”) was suggested, but although this may work in some unique situations, there are a number of logistical issues that may prevent the use of this strategy as an effective disease management alternative (Wolfe, Miller, and Williams 2004). Use of just reproductive control or use of predators to reduce the deer population would not be effective in reducing the deer population to the extent needed for disease control for the same reasons that these were dismissed as general deer management methods. Also, reproductive control leaves a potentially infected animal on the landscape. Predation would not have a great enough impact on drive disease dynamics, and fawn predation would likely increase reproductive rates (a density dependent response).

Ideas regarding changing habitat or land use strategies that should be considered include reducing feeding and/or mineral licks, eliminating cervid farms, and changing meadows or crop lands into habitat that is less attractive to deer. There are no feeding areas or deer farms in or near the parks now, and education would emphasize the importance of not feeding deer in general. Changing the habitat may not be possible without adversely impacting the cultural landscapes of the parks or would not be effective, as described above under “Landscape Modification” for deer management options. Very little, if anything, has been published on the results of taking a piece of land altered by human activity and trying to restore it to a more natural condition to see what the result is on CWD (Powers, pers. comm. 2012). Research has shown the opposite. Human alteration of the environment (creating edge habitat) has attracted deer, and with deer comes the possibility of CWD. Changing the mowing frequency, height of mowing, or use of prescribed burns would not be expected to have any meaningful impact on making areas less attractive to deer to the extent that would influence the spread of disease. Finally, reducing potential environmental contamination by providing education and appropriate enforcement regarding the dumping of deer carcasses, gut piles, etc. on or near the parks is a good idea, but would not be effective as a stand-alone alternative. While it is illegal to dump gut piles on NPS land, it is difficult to prevent people from doing so. This practice would be targeted in educational materials by both the parks and likely the states if the area was to become a CWD containment area.

To summarize, none of the other options, including nonlethal options, were considered to be effective for the long-term management of CWD. The only option that would be considered potentially effective against the spread of CWD was population reduction, and this was therefore included as the CWD plan for all the deer management alternatives.

CONSISTENCY WITH THE PURPOSES OF THE NATIONAL ENVIRONMENTAL POLICY ACT

NEPA requires an analysis of how each alternative meets or achieves the purposes of the act (Section 101[b]). Each alternative analyzed in a NEPA document must be assessed as to how it meets the following purposes:

1. fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;
2. assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings;
3. attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences;
4. preserve important historic, cultural, and natural aspects of our national heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice;
5. achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities; and
6. enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources (42 USC 4331).

The CEQ has promulgated regulations for federal agencies' implementation of NEPA (40 CFR 1500–1508). Section 1500.2 states that federal agencies shall, to the fullest extent possible, interpret and administer the policies, regulations, and public laws of the United States in accordance with the policies set forth in the act (Sections 101[b] and 102[1]); therefore, other acts and NPS policies are referenced as applicable in the following discussion.

ALTERNATIVE A: CONTINUATION OF CURRENT MANAGEMENT (NO ACTION)

Alternative A would meet the purpose of NEPA to some degree because limited protection of certain rare species and plantings would be continued, as well as the monitoring program and CWD monitoring in all three parks. It would not fulfill the responsibilities of each generation as the trustee of the environment for succeeding generations and in preserving important aspects of our national heritage (purposes 1 and 4), because damage to forest vegetation and cultural landscapes would continue as a result of excessive browsing by continued high numbers of deer. Alternative A would do little to enhance the quality of renewable forest resources (purpose 6), and the expected long-term adverse impacts on vegetation, wildlife, and wildlife habitat would not ensure healthful, productive, or aesthetically pleasing surroundings (purpose 2). The parks would continue to attain a wide array of beneficial uses (purpose 3), although there would be continued degradation of natural and cultural resources. There would be an adverse impact on resources by allowing excessive deer browsing, which would not do anything to maintain a balance between population and resources (purpose 5).

ALTERNATIVE B: NONLETHAL DEER MANAGEMENT

This alternative would meet many of the purposes in NEPA to some degree, or even to a moderate degree when considering long-term results. However, it would provide only limited direct protection for forest resources (only about 10 to 20% of woody vegetation would be protected by exclosures over the life of the plan, and herbaceous vegetation would not be protected once exclosures are moved), and it would rely heavily on an unproven technology (nonsurgical reproductive control) that might not be successfully implemented for a large, free-ranging deer population. Therefore, the NEPA purposes would not be met to a large degree. In particular, the exclosures would detract from aesthetically pleasing surroundings and the cultural landscapes of the parks (purpose 2) and reproductive control methods would present an element of risk to health or safety and might have other unintended consequences (purpose 3). Alternative B would require closures of some areas of the parks to construct the exclosures, which would limit park use in some areas by visitors The lack of protection for a large percentage of the parks and the time it would take for any reproductive control to be effective would mean that succeeding generations might not see desired results for some time (purpose 1), although the inclusion of a long-term CWD plan would help to fulfill the responsibilities of each generation as trustee of the environment for succeeding generations. The adaptive management component of alternative B would help achieve some balance between population and resource use (purpose 5), but the limited history of reproductive control success in free-ranging populations such as the deer herd at the parks and the limits on how much forest vegetation can be included in exclosures means that it would not be possible to completely approach the maximum attainable recycling of resources (purpose 6).

ALTERNATIVE C: LETHAL DEER MANAGEMENT

Alternative C would succeed to a large extent in meeting all of the purposes in NEPA within the life of the plan. By immediately reducing deer browsing pressure, the alternative would allow vegetation in the parks to regenerate for the benefit and enjoyment of future generations (purpose 1). The immediate reduction in the deer population and subsequent improvements in the natural environment and cultural landscapes of the parks, and the inclusion of the long-term CWD plan, would provide a great deal of benefit. There would be some safety concerns associated with implementing alternative C. However, by implementing proper controls, these concerns could be minimized. The result would be safer conditions on local roads and more aesthetically pleasing conditions throughout the parks (purpose 2). Alternative C would require closures of some areas of the parks during reduction activities, which would limit their use by visitors. However, these closures would occur at times and places that were not high visitation periods and primarily at night when the parks is closed or visitation is low. This alternative also would avoid undesirable consequences (e.g., potential behavioral changes from reproductive controls) and maximize forest regeneration by immediately reducing deer browsing (purpose 3). The closures within the parks would limit individual choice, but only for limited periods of time. These closures would allow for the reduction of the deer population, which would protect the parks' natural and cultural resources and provide greater choices in the future (purpose 4). This alternative would help to achieve a balance between population and the surrounding park resources by allowing for regeneration to occur at a higher rate than is currently occurring (purpose 5). Finally, by immediately reducing the deer browsing pressure and promoting forest regeneration, this alternative would enhance the quality of renewable resources (purpose 6).

ALTERNATIVE D: COMBINED LETHAL AND NONLETHAL DEER MANAGEMENT

Alternative D is similar to alternative C in the extent to which it would meet the purposes of NEPA. Both would fulfill the responsibilities of each generation as a trustee of the environment for succeeding generations (purpose 1) to a large degree, because both would immediately reduce deer numbers and sustain that reduction through maintenance actions and include the long-term CWD response plan. As with alternative C, alternative D would also result in safer conditions on local roads and more aesthetically pleasing conditions throughout the parks (purpose 2). As with alternative B, alternative D involves some concern about unintended consequences (purpose 3), because an acceptable reproductive control agent is not currently available and it would rely on technology that has not been proven effective in large, free-ranging deer populations as a long-term management technique. Although the planning team recognized the uncertainties associated with reproductive control agents, it was recognized that the science associated with this technology is developing rapidly and would provide additional information in the near future. Any safety concerns would be reduced through proper safety controls. As with alternative C, alternative D would also preserve important historic, cultural, and natural aspects of our national heritage in the long term (purpose 4). Alternative D would help to achieve a balance between population and the surrounding park resources by allowing for regeneration to occur at a higher rate than is currently occurring. Finally, although through a different manner than alternative C, alternative D would approach the maximum attainable regeneration of depletable resources (i.e., forest vegetation) by reducing and maintaining the deer population density (purpose 6).

NATIONAL PARK SERVICE PREFERRED ALTERNATIVE

The preferred alternative is the alternative "which the agency believes would fulfill its statutory mission and responsibilities, giving consideration to economic environmental, technical, and other factors" (CEQ 1981). The NPS has identified alternative D as its preferred alternative upon consideration of factors such as the degree to which alternatives would meet plan objectives (see table 14), environmental impacts (see "Chapter 4: Environmental Consequences"), the degree to which alternatives provide management flexibility, and costs.

Alternatives C and D both meet the plan objectives and are very close in their relative impacts. However, alternative D provides for the opportunity to use a wider variety of management methods, including reproductive control, which would be an option when the criteria established by the NPS are met. Alternative D provides for an efficient initial removal of deer and also flexibility in management methods to address future removals in different ways. Costs of alternative D are slightly higher overall, but after the first capture for reproductive control, costs would go down, and some studies have shown that reproductive control costs can decrease over time, although there is uncertainty regarding that method.

Alternative B only partially meets many of the objectives, because of the lack of immediate reduction in deer numbers and the uncertainty that the deer density goal would be achieved even over an extended period of time. Many impacts on park resources, especially impacts on vegetation, wildlife habitat, and cultural landscapes, would be greater under alternative B because of the length of time required before deer numbers would be reduced, thus continuing the adverse impacts of deer browse on vegetation in the parks. Alternative A (no action) fails to meet or fully meet the objectives of the plan, since no action would be taken to reduce deer numbers or effect a change in conditions that are the basis for the purpose of and need for action.

The NPS will consider substantive comments on this plan/EIS and may modify or adjust the preferred alternative accordingly. Any modifications or adjustments will be disclosed in a final environmental impact statement (EIS). A record of decision will follow the final EIS and will be made publicly available.

ENVIRONMENTALLY PREFERRED ALTERNATIVE

The NPS is required to identify the environmentally preferred alternative in its NEPA documents for public review and comment. The NPS, in accordance with the Department of the Interior NEPA Regulations (43 CFR Part 46) and CEQ's Forty Questions, defines the environmentally preferable alternative (or alternatives) as the alternative that best promotes the national environmental policy expressed in NEPA (Section 101(b)) (516 DM 4.10). The CEQ's Forty Questions (CEQ 1981) further clarifies the identification of the environmentally preferable alternative stating:

> this means the alternative that causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves, and enhances historic, cultural, and natural resources. (CEQ 40 Questions, Question 6a)

Alternative C was selected as the environmentally preferred alternative, because it is the alternative that would best protect the biological and physical environment by ensuring an immediate reduction in deer population numbers that could be sustained with proven methods over the life of the plan. Alternative D would also protect, preserve, and enhance the cultural and natural processes that support the parks' forests and cultural landscapes by providing multiple management options to maintain low deer numbers. However, alternative D includes the introduction of a chemical agent within the white-tailed deer population to reduce population size. Although this would be beneficial to the vegetation and other resources currently impacted by the deer population, there is some uncertainty about its success, and the introduction of a chemical agent into the herd could have adverse impacts on the deer, such as behavioral effects as well as adverse effects of capture. Although any product that meets the NPS criteria would need to have minimal impacts to be selected for use, and alternatives C and D are very close in meeting the guidance for identification of the environmentally preferred alternative, alternative C was selected primarily because it provides the park with the ability to select the least environmentally damaging option.

Alternatives A and B were not considered environmentally preferred because of their lack of effect on the deer population numbers, which would result in potential or continued adverse impacts on the biological and cultural resources of the parks over the life of the plan.

Chapter 3: Affected Environment

CHAPTER 3: AFFECTED ENVIRONMENT

INTRODUCTION

The "Affected Environment" describes existing conditions for those elements of the natural and cultural environment that could be affected by implementation of the actions considered in this White-tailed Deer Management Plan / Environmental Impact Statement (plan/EIS). The natural environment components addressed include vegetation; white-tailed deer (*Odocoileus virginianus*); and other wildlife and wildlife habitat; and special status species. The cultural environment includes neighboring land use/socioeconomics; visitor use and experience; cultural landscapes; health and safety; and park management and operations. Relevant impact topics were selected based on agency and public concerns, regulatory and planning requirements, and known or expected resource issues. The information provided in this chapter will be used as context for comparing the potential impacts of each alternative, which are presented in "Chapter 4: Environmental Consequences."

VEGETATION

OVERVIEW

Antietam National Battlefield

A vascular plant survey was conducted at several National Capital area parks in 2003–2004 (Engelhardt 2005). The inventory documented 576 species at Antietam, including species of the highly diverse limestone woodlands (Snavely Ford woods) and relatively extensive riparian woodlands along Antietam Creek. The majority of the land within the battlefield is in agricultural production (crops, grass/hay, or pasture), with woodland stands scattered throughout (NPS 2009c). The main woodland areas within the park are North, East, and West Woods, and the land along Antietam Creek, near Burnside Bridge, and there are also several reforestation areas associated with these wooded areas (figure 9).

Herbaceous plants: non-woody plants; includes grasses, wildflowers, and sedges and rushes (grass-like plants).

Tree species such as oak (*Quercus* spp.) and hickory (*Carya* spp.) are the backbone of woodland areas and provide habitat suitable for other canopy and understory species. Canopy trees include northern red oak (*Quercus rubra*), American beech (*Fagus grandifolia*), bitternut hickory (*Carya cordiformis*), red maple (*Acer rubrum*), and tulip poplar (*Liriodendron tulipifera*) (NPS 2009c). The woodland areas have a well-developed understory comprised of shrubs such as flowering dogwood (*Cornus florida*), spicebush (*Lindera benzoin*), and witch hazel (*Hamamelis virginiana*), as well as an herbaceous layer including spring wildflowers such as toadshade (*Trillium sessile*), bloodroot (*Sanguinaria canadensis*), yellow trout lily (*Erythronium americanum*), Dutchman's britches (*Dicentra cucullaria*), toothwort (*Cardamine* spp.), spring beauty (*Claytonia virginica*), Virginia bluebells (*Mertensia virginica*), and hepatica (*Hepatica* spp.) (NPS 2009c).

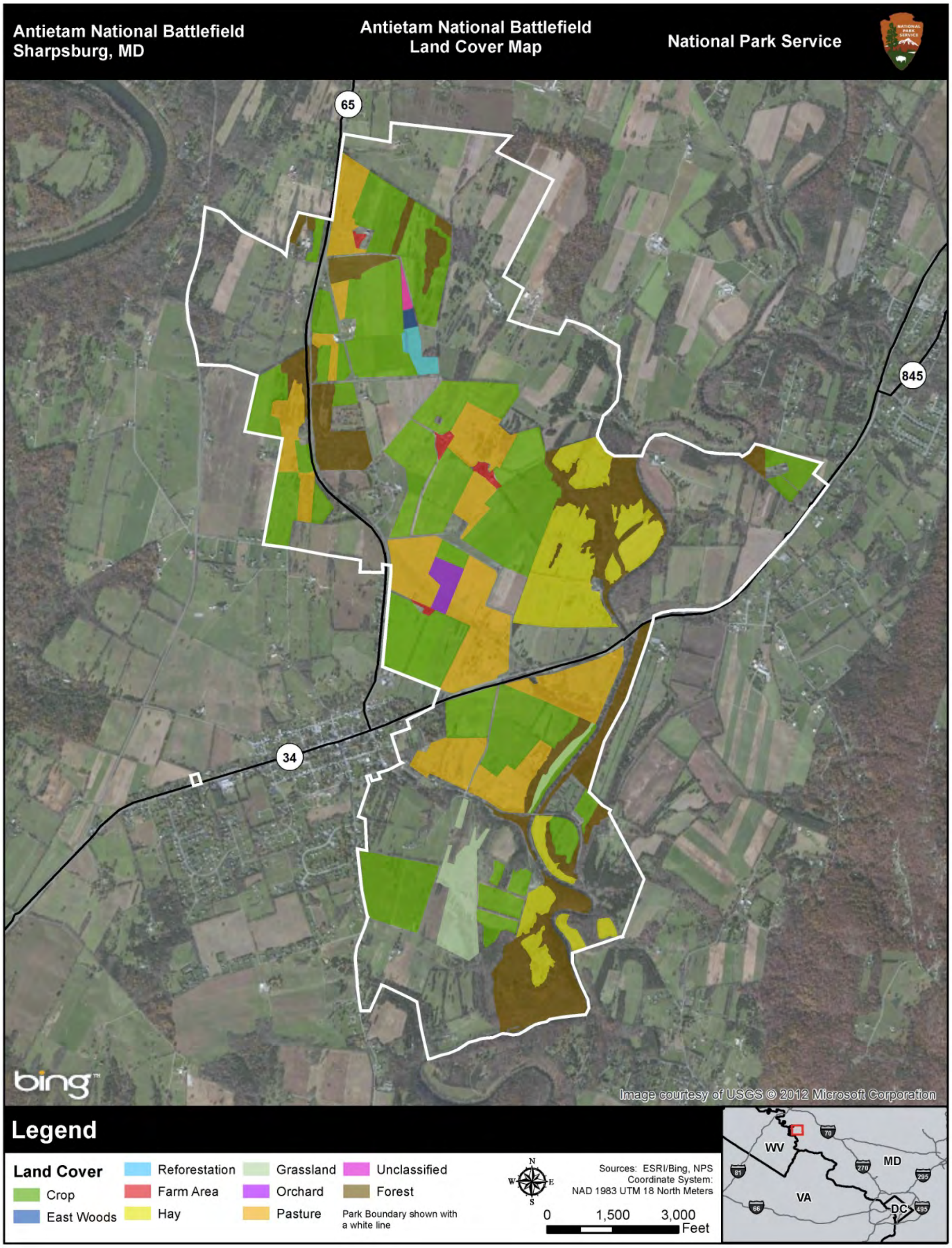


FIGURE 9: VEGETATION DISTRIBUTION AT ANTIETAM NATIONAL BATTLEFIELD

> *Exotic plant: any introduced plant species that is not native to the area and may be considered a nuisance; also called nonnative or alien species.*

Several invasive exotic species were identified throughout Antietam. Invasive exotic species are very common and in late summer they tend to dominate the ground layer of the woodlands and the agricultural lands. Common invasive exotic species of the woodlands include garlic mustard (*Alliaria petiolata*), Japanese stiltgrass (*Microstegium vimineum*), and Japanese honeysuckle (*Lonicera japonica*) (NPS 2009c). Other invasive species in the agricultural lands include autumn olive (*Elaeagnus umbellata*), tree-of-heaven (*Ailanthus altissima*), multiflora rose (*Rosa multiflora*), Johnson grass (*Sorghum halepense*), Canada thistle (*Cirsium arvense*), and bull thistle (*Cirsium vulgare*), and Japanese hops (*Humulus japonicus*) in the riparian areas (NPS 2009c).

Farmers use the fields at Antietam to grow a variety of grains, pasture and hay grasses under National Park Service (NPS) special use permits. Crops consist of corn, soybeans, and grains, including oats, wheat, barley, and rye. The farms also produce a mixed hay crop of clover, orchardgrass, timothy grass, and periodically alfalfa. Pastures contain primarily cool season fescues and bluegrass, although some orchardgrass and warm season grasses such as little bluestem (*Schizachyrium scoparium*) are present (NPS 2009c). In addition, several areas have been planted with trees, shrubs, or other vegetation to enhance the aesthetics of the park. Ornamental trees and shrubs were planted at the farmsteads and include walnut (*Juglans* sp.), silver maple (*Acer saccharinum*), eastern white pine (*Pinus strobus*), and lilac (*Syringa vulgaris*) (NPS 2004a, 2009g, 2011p). Landscaping around the visitor center includes species of dogwood, holly, oaks, juniper, rhododendron, ferns, and ivy (NPS 2009c).

Monocacy National Battlefield

The vegetation composition and patterns at Monocacy are indicative of the open natural and agricultural landscape in the Piedmont region of Maryland. The park is approximately 40% forested and 60% agricultural land and represents a patchwork of upland and riparian forested areas interspersed with agricultural lands and open fields (NPS 2009f). Portions of the park are undergoing old-field succession; whereas, other portions are second or third growth forests with mature hardwoods. The diverse nature of the landscape offers a number of vegetation and habitat types (figure 10).

Even though the elevation range at Monocacy is relatively insignificant, upland areas contain associated dry site species such as oak, hickory, and American beech. At Monocacy, the lowland riparian forests in the floodplain of the river and along streams are dominated by maple (*Acer* spp.), American sycamore (*Platanus occidentalis*), hackberry (*Celtis occidentalis*), and ash (*Fraxinus* spp.) (NPS 2009f). Recently disturbed areas are characterized by generalist tree species such as tulip poplar, black cherry (*Prunus serotina*), black locust (*Robinia pseudoacacia*), boxelder (*Acer negundo*), and the invasive and exotic tree-of-heaven.

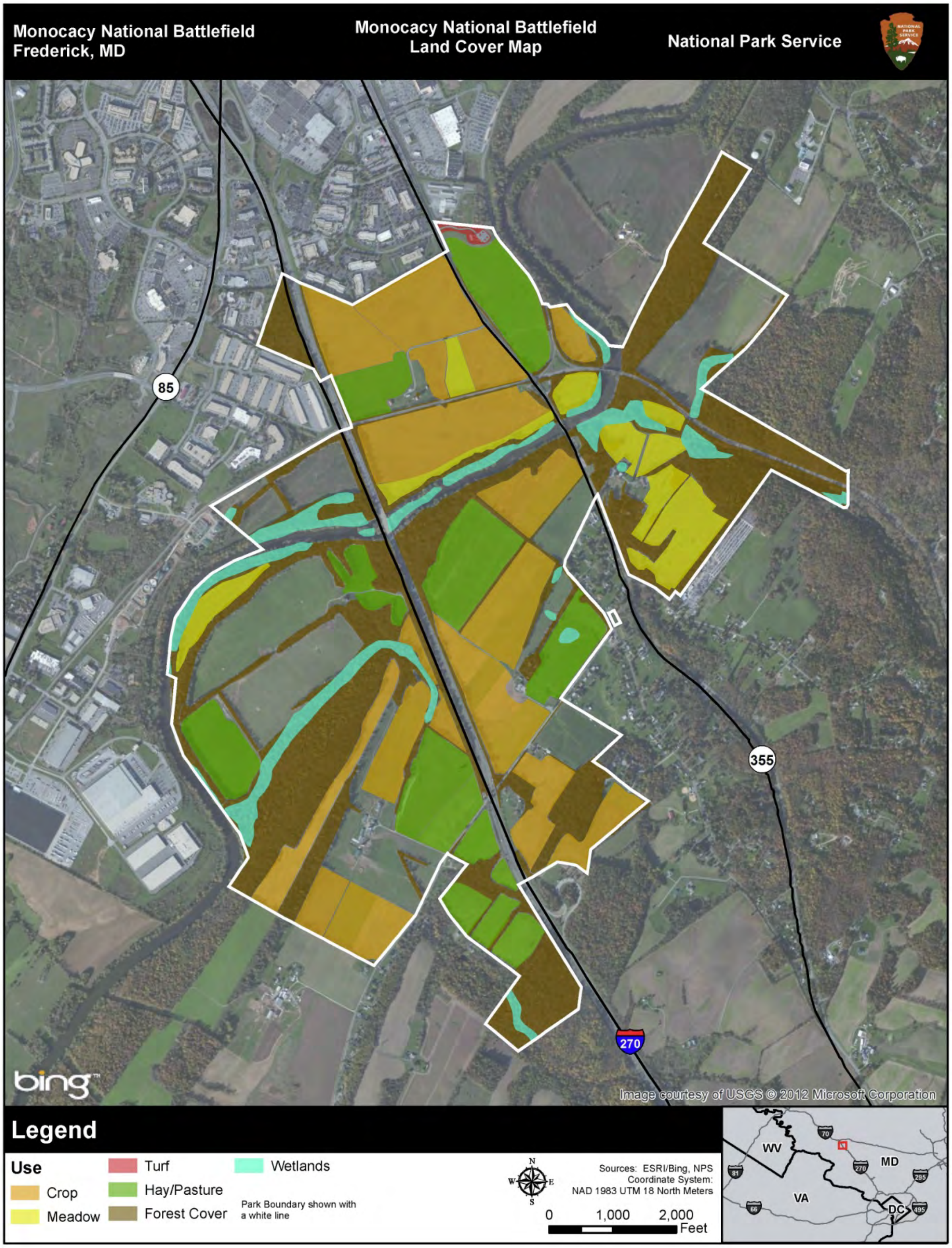


FIGURE 10: VEGETATION DISTRIBUTION AT MONOCACY NATIONAL BATTLEFIELD

Several vegetation studies have been or are being conducted at national battlefields throughout the country of which almost a third of all plants are exotic. The vegetation composition found at Monocacy is considered similar and consistent to these studies. Recent surveys have shown that exotic plants infest most of the nonagricultural land at the Monocacy (NPS 2009f). Some common invasive weeds at the park include multiflora rose, tree-of-heaven, Japanese honeysuckle, garlic mustard, and Japanese stiltgrass. There are several nonnative invasive weeds in the agricultural areas that are a high priority to address, including Johnson grass, Canada thistle, and bull thistle (NPS 2009f), due to incompatibility with agricultural uses. Johnson grass contains hydrogen cyanide, for example, and can kill livestock if eaten in quantity, and the thistles reduce forage potential in pastures. The battlefield has placed a high priority on removing Johnson grass, Canada thistle, and bull thistle from the agricultural areas (NPS 2009f).

Invasive Exotic Vegetation

Similar to Antietam, farmers use lands at the Monocacy to grow a variety of grains, corn, soybeans and pasture and hay grasses on the Thomas, Best, Worthington, Baker and Lewis farms (NPS 2009f). Common grains include winter wheat and barley; whereas, pasture and hay grasses include orchardgrass, timothy grass and alfalfa (NPS 2009f). Other plantings around the park include lines of Osage orange trees (*Maclura pomifera*) intended to act as "living fences," as well as stands of white pine trees. Ornamental plantings near Gambrill Mill include perennial and annual flower beds and plants such as crab apple (*Malus sp*.) and serviceberry (*Amelanchier arborea*) (NPS 2009f).

Manassas National Battlefield Park

The vegetation at Manassas is an assortment of open fields and forest in a range of successional stages, as well as some stream and wetland areas. Fields and grasslands are maintained by agricultural lease holders, and park personnel mow some of these areas. Many of the fields and grasslands contain native grass communities (Indian grass [*Sorghastrum nutans*] and little bluestem) and cover about 35% of the park or 1,500 acres. Approximately 50% of the park is deciduous forest and includes stands of oak/hickory, pine/cedar, mixed pine/hardwood, and bottomland hardwood (figure 11). Throughout the park, more than 700 taxa of vascular plants can be found, six of which are considered rare in Virginia, and 128 of which were classified as nonnative species (Fleming and Belden 2004).

Field at Manassas

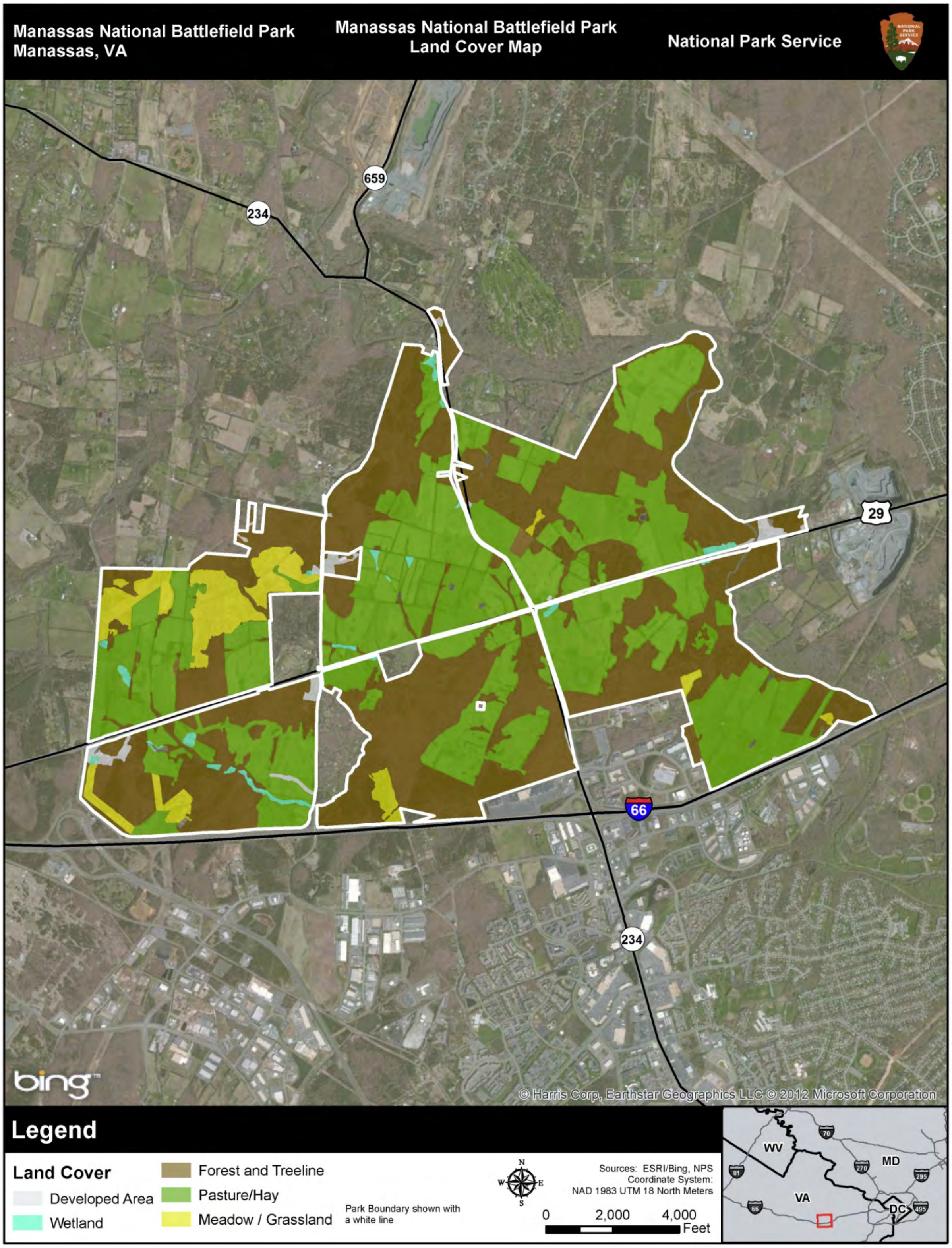


FIGURE 11: VEGETATION DISTRIBUTION AT MANASSAS NATIONAL BATTLEFIELD PARK

In March 2001, the Virginia DCR, Division of Natural Heritage completed a vascular plant inventory of Manassas. Stands of coniferous forest, developed from previously open fields, are characterized by Virginia pine (*Pinus virginiana*), eastern red cedar (*Juniperus virginiana*), and shortleaf pine (*Pinus echinata*) and are in the successional stage of growth. The mixed forest is in a transitional stage that occurs in comparatively small, scattered stands. Oak-hickory dominates the deciduous forest in upland areas and represents the climax growth stage in the park (NPS 2008a). Stands are often more than 100 years old and commonly consist of white oak (*Quercus alba*), northern red oak, black oak (*Quercus velutina*), white ash (*Fraxinus americana*), and hickory (NPS 2008a). Floodplain bottomland forests, found primarily along Bull Run, represent old, undisturbed forests with many mature floodplain trees. Tree species include pin oak (*Quercus palustris*), swamp white oak (*Quercus bicolor*), green ash (*Fraxinus pennsylvanica*), and American elm (*Ulnus americana*). Various bottomland hardwoods also occur along the riparian fringe of tributary streams. Small patches of loblolly pine (*Pinus taeda*) and eastern white pine occur on somewhat drier slopes and bluffs (NPS 2008a). Shrubs common in the park include flowering dogwood, blackhaw (*Viburnum prunifolium*), and deerberry (*Vaccinium stamineum*) and can be found along the forest floor.

In Virginia, grasslands have decreased by 55% since 1945; as such, an emphasis has been placed on restoring warm season grasses throughout the park. The park has restored over 1,000 acres of native warm season grasses that provide wildlife habitat, prevent erosion, help to filter nitrates through their roots, and serve as a riparian buffer along streams and wetlands (NPS 2011e; Gorsira, pers. comm. 2012c).

CURRENT VEGETATION STATUS AND THE ROLE OF DEER

Most national battlefields have clauses in their enabling legislation that require them to maintain the landscape as it was historically during the battle. In Virginia and Maryland, historic battlefields retain a rural, agricultural landscape with a mixture of agricultural or hay and grass fields, small woodlots, forest, and homesteads; historic battlefields also provide habitat for white-tailed deer. Present densities of deer in many national historical parks in the region make it difficult to meet park management objectives for woodlot retention, forest regeneration and establishment, and in some cases discourage production of agricultural crops. Historical parks in this region have focused on assessing the density of deer and their impact on the natural resources that are essential components of the cultural landscape (McShea et al. 2009; McShea and Bourg 2009; Gorsira, Rossell, and Patch 2006).

Antietam and Monocacy National Battlefields

A multi-park study was conducted to evaluate the impacts of deer browse on park cultural landscapes and natural resources in Antietam, Monocacy, and the Chesapeake and Ohio Canal National Historical Park. The three parks partnered with the Smithsonian Institution in 2002 to study deer impacts on crops and regeneration of wooded areas. The study was conducted during the 2003 and 2009 field seasons. The objective was to determine deer impacts on native woody vegetation in order to inform management decisions regarding deer densities and forest communities in the parks. The crop damage portion of

Deer with Browse Line at Forest Edge

the project was completed in 2004 (Stewart, McShea, and Piccolo 2007) and woodland deer exclosures continued to be monitored (recommendation by the Smithsonian). Impacts were assessed based on species richness, abundance comparisons, and seedling stocking rates. For the purposes of this planning document, only Antietam and Monocacy will be discussed.

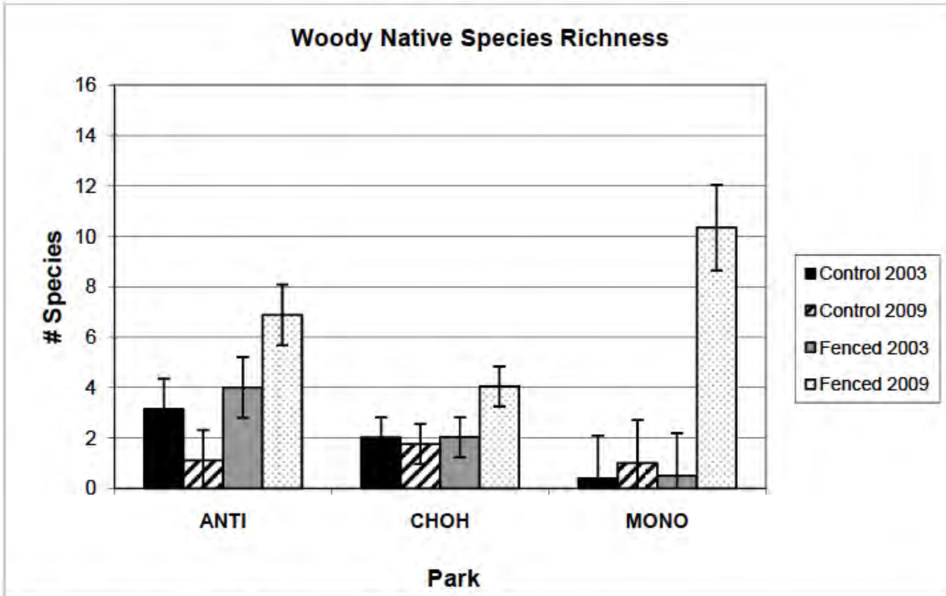
As part of the study, four sites at Antietam were located at least 100 meters (328 feet) from an agricultural field. The two sites at Monocacy were within 100 meters of the forest edge and an agricultural field. At each site, three pairs of 5 × 5 meter (16.4 × 16.4 feet) plots were installed. Each paired plot included a fenced plot (exclosure) and an open plot (control) located less than 5 meters (16.4 feet) from one another. Exclosure fences at the woodlot sites consisted of 2.4 meter (7.8 feet) high farm fencing with 10 × 10 cm (4 × 4 inch) mesh that permitted the passage of small mammals and was flush with the ground. All herbaceous and woody plants (≤ 30 cm [11.8 inches] in height) and woody saplings (> 30 cm to 2 m [6.5 feet] in height) within each 5 × 5 meter (16.4 × 16.4 feet) plot were identified and counted.

For each park, the study addressed individual abundances for the most common woody seedling species in the open and fenced plots. In general, there were fewer seedlings in 2009 than 2003, regardless of plot type (McShea and Bourg 2009). In contrast, the majority of the most common sapling species decreased significantly in open plots from 2003 to 2009; whereas, saplings in the fenced plots increased significantly. This was particularly true at Monocacy, where all but one of the most common species were absent prior to 2009. Overall, Monocacy had more native woody seedlings than Antietam in the control plots; however the fenced plots had greater numbers of individuals at Antietam.

Native saplings increased in abundance in fenced plots at both battlefields. In all cases, the number of saplings was not significantly different between control and fenced plots in 2003; however, by 2009 the fenced plots contained significantly more individuals (figure 12). Additionally, a number of species, including the American beech, red maple, tulip poplar, and sassafras (*Sassafras albidum*) were recorded for the first time in fenced plots at Monocacy in 2009 (McShea and Bourg 2009).

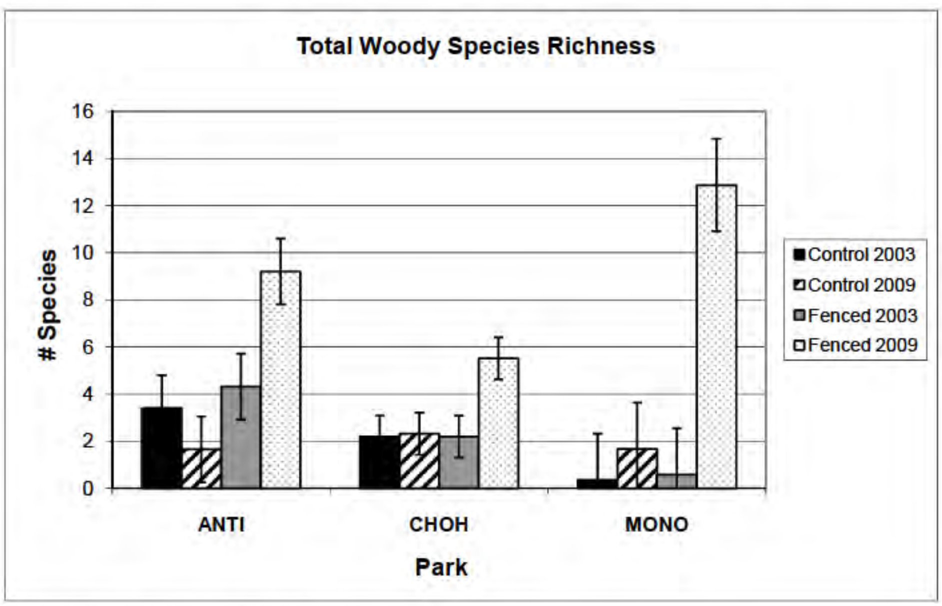
Similarly, invasive woody seedlings were assessed. The two most abundant invasive species included the Japanese honeysuckle and multiflora rose. Woody invasive seedlings were found at both parks at varying levels due to park treatment and maintenance. Overall, more invasive seedlings were found in the fenced plots at Antietam; whereas, Japanese honeysuckle was more abundant in fenced plots at the end of the study at Monocacy. Japanese honeysuckle decreased significantly in control plots from 2003 to 2009, but increased substantially (though not significantly) in fenced plots during the same time (McShea and Bourg 2009).

Although there was not a consistent pattern of seedling species richness between the two battlefields in the study, long-term deer exclusion had a significant positive effect on sapling species richness in both parks (figure 13), sapling species richness showed two- to ten-fold increases in all three parks studied from 2003 to 2009 (McShea and Bourg 2009). The increased richness and abundance was accompanied by a simultaneous increase in invasive species of saplings in all plots, with a greater magnitude of invasive species in fenced plots (McShea and Bourg 2009).



Source: McShea and Bourg 2009.

FIGURE 12: MEAN SPECIES RICHNESS PER PLOT OF NATIVE WOODY SAPLING SPECIES IN CONTROL AND FENCED PLOTS AT ANTIETAM (ANTI), AND MONOCACY (MONO) IN 2003 AND 2009



Source: McShea and Bourg 2009.

FIGURE 13: MEAN SPECIES RICHNESS PER PLOT OF ALL WOODY SAPLING SPECIES (NATIVE + INVASIVE) IN CONTROL AND FENCED PLOTS AT ANTIETAM (ANTI), AND MONOCACY (MONO) IN 2003 AND 2009

The study also examined if the plots met the desired seedling stocking rate, or the number of seedling stems per plot needed to ensure adequate tree regeneration. Stout recommended that 67% of the exclosure plots should be at or above a certain stocking threshold for successful regeneration (McShea and Bourg 2009). At the conclusion of the study, fenced (exclosure) plots were below the high deer density stocking threshold. None of the plots at Antietam reached the desired stocking threshold, and only one of the 12 control plots at Monocacy reached the threshold for high deer density conditions (McShea and Bourg 2009). However, 83% of fenced plots at Antietam and 100% of the fenced plots at Monocacy exceeded the desired stocking threshold needed under low deer density conditions (13–21 deer/mi^2 [5-8 deer/km^2]). The stocking rate results indicate that successful forest generation cannot occur in either battlefield under current deer densities. Under existing conditions at the parks, deer densities would have to be reduced by approximately 88% to attain the level required for the forest to reach the low density stocking threshold or successful regeneration (McShea and Bourg 2009). It should be noted, however, that vegetation conditions in the exclosures are not appropriate NPS goals because they exclude deer entirely, which is not a natural condition in the ecosystem.

Manassas National Battlefield Park

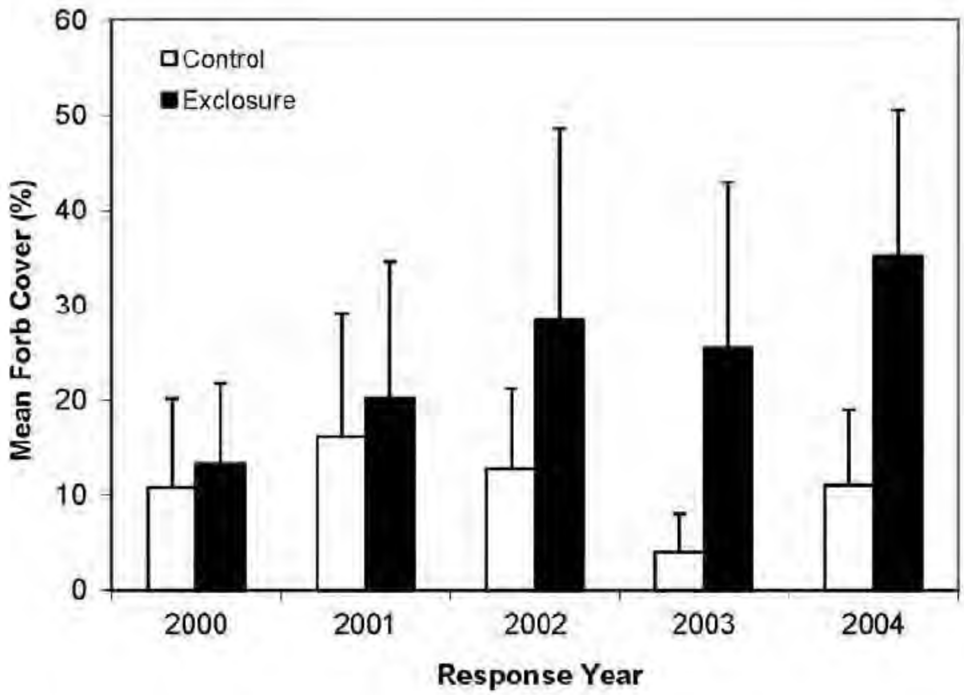
In 2006, park staff analyzed five years of data in an ongoing study (2000–2004) assessing the impacts of white tailed deer on vegetation structure and woody seedling compositions within Manassas (Gorsira, Rossell, and Patch 2006). The effects of deer browsing were monitored for three forest types: Oak - Hickory, Virginia Pine - Eastern Red Cedar (successional), and Piedmont - Mountain Bottomland, as described by Fleming and Weber (2003). The latter forest type is also referred to as Bottomland Hardwood below.

Deer Exclosures

Vegetation data were collected from exclosure and control plots (10 of each) in each forest type from June to August for each year of the study. The exclosures and controls plots were 2 m × 6 m (6.6 feet × 19.7 feet). Exclosures were constructed at the start of the study and consisted of welded wire fence. The fences were 2 meters (6.6 feet) tall and included mesh openings (5 × 10 cm; 2 × 4 inches) to facilitate the passage of small mammals (Gorsira, Rossell, and Patch 2006). A control or open plot was placed 1 meter from, and on the opposite side of, each exclosure entrance. Within the center of each exclosure, 1 × 4 meter (3.3 × 13.1 feet) vegetation plots were established using metal stakes at each corner. All exclosures were chosen at random among forest types using a random location generator in Geospatial Information Systems (GIS) software (Gorsira, Rossell, and Patch 2006). Groundcover was identified in each plot as the following categories: litter, forb (i.e., all broadleaf plants, including seedlings), grass, fern, moss, and soil. Other data collected included vertical plant cover and the survival rates of woody plant seedlings.

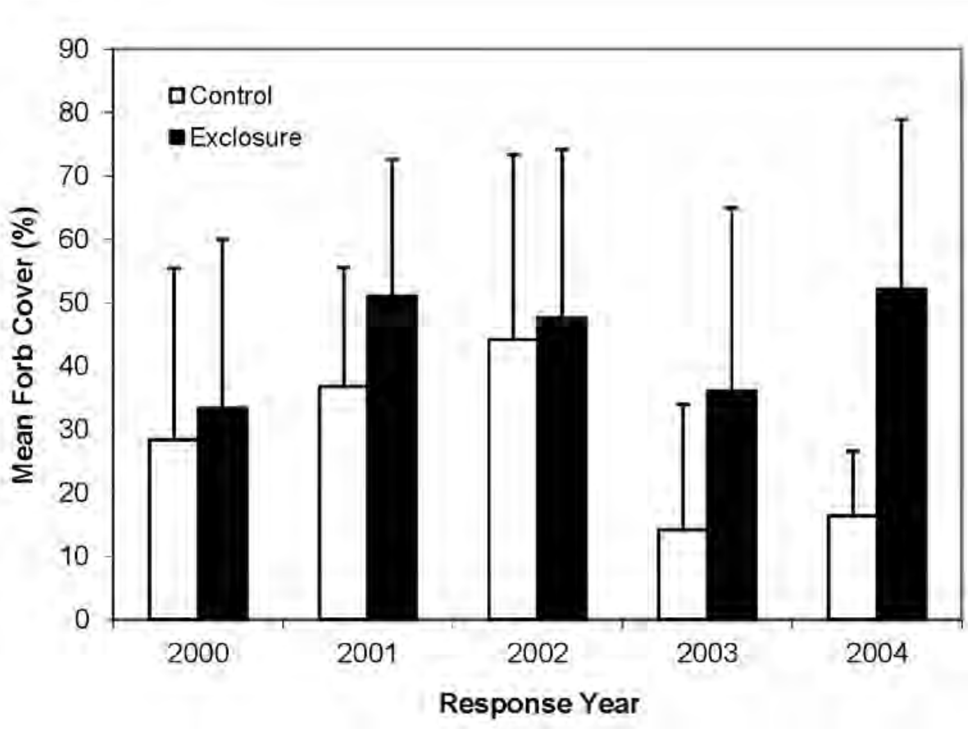
> *Herbivory: refers to animals that subsist primarily on plants.*

Data collected from these plots showed that herbivory by deer severely impacted forb cover in all three forest types. At the beginning of the study, forb cover was similar between control plots and exclosures in each of the forest types; however, differences were noted over time. Forb cover in the controls remained relatively stable; however, in the exclosures forb cover clearly increased (with the exception the bottomland forest) as displayed in figures 14 and 15. The bottomland hardwood forest flooded in the fall 2002 and spring 2003, resulting in declines in forb cover in 2003 sampling year (Gorsira, Rossell, and Patch 2006). Due to flooding, forb cover tended to decrease over time for the controls and the exclosures (figure 16). However, by the fifth year, forb cover in the exclosures was at least 30% greater than in the controls (Gorsira, Rossell, and Patch 2006).



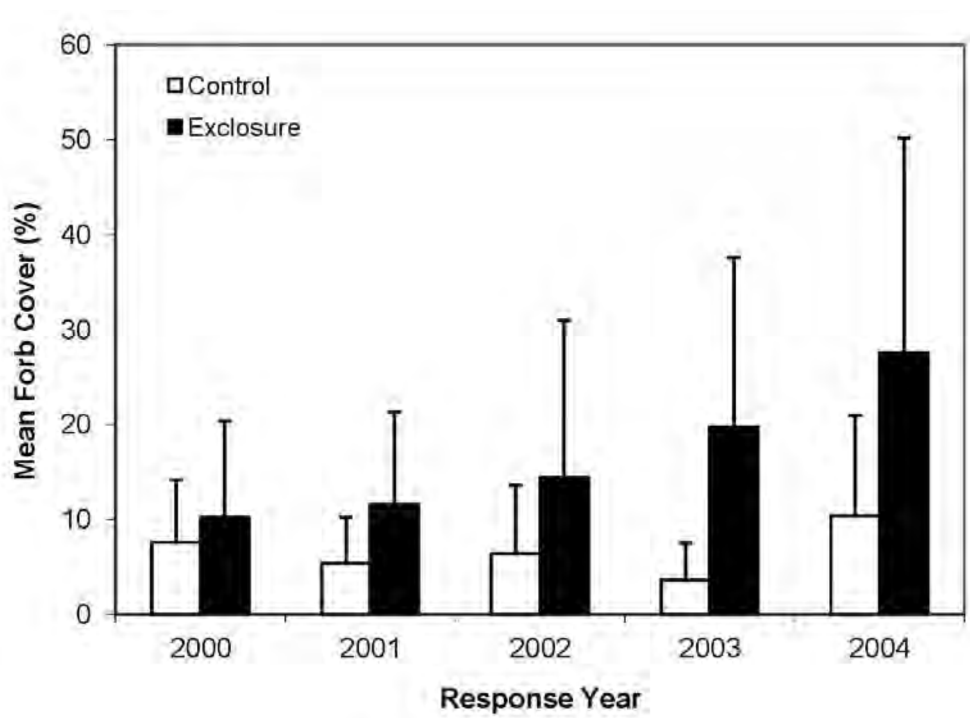
Source: Gorsira, Rossell, and Patch 2006.

FIGURE 14: OAK-HICKORY



Source: Gorsira, Rossell, and Patch 2006.

FIGURE 15: VIRGINIA PINE



Source: Gorsira, Rossell, and Patch 2006.

FIGURE 16: BOTTOMLAND FOREST

Vertical plant cover was analyzed at three height intervals: bottom (0–0.5 m [1.64 feet]), middle (0.6–1.0 m [1.97–3.28 feet]), and top (1.1–1.5 m [3.61–4.92 feet]). Trends in vertical cover at all heights were consistently less in the open plots (controls) than in exclosures and were particularly pronounced during the last two years of the study (table 16). Overall it was determined that vertical plant cover was suppressed by deer browsing in each of the forest types (Gorsira, Rossell, and Patch 2006).

With few exceptions, annual survival rates of tagged woody plant seedlings were consistently and significantly lower in the controls than in the exclosures (table 17). Canopy species, including ashes, hickories, red maple, and red and white oaks, displayed the greatest mortality from year 1 to year 5 in the control (open) plots. Shrub and subcanopy species, including boxelder, black hawthorn (*Crataegus* spp.), and spicebush, displayed the greatest mortality from year 1 to year 5 of the study in the control (open) plots. Mortality was not statistically significant for blueberry (*Vaccinium* spp.) or redbud (*Cercis canadensis*) in the controls or exclosures, suggesting these species are not palatable to deer. Due to high seedling mortality, seedling heights were not analyzed. Seedling survival rates varied among species, suggesting that deer selectively browse across forest types, thus altering the species composition of a forest or ecosystem. By the fourth year, boxelder, hickory, and red maple seedlings were completely eliminated from control (open) plots; whereas, red and white oak seedlings were severely reduced (table 17). Ash, black cherry, and hackberry were the most abundant species throughout the entire study; suggesting a preference in deer grazing (Gorsira, Rossell, and Patch 2006).

Results of this study indicate that browsing by white-tailed deer may be impacting the herb and shrub layers in the forest interior to levels that may be detrimental to wildlife species that are dependent on a thick understory to thrive. In addition, the future composition of forests in the park, particularly in the oak-hickory and bottomland hardwood types, will shift toward stands with fewer species and a greater dominance of ash, black cherry, and hackberry (Gorsira, Rossell, and Patch 2006).

A subsequent study of existing plots was completed in 2010 and included resurveying the exclosures from two separate studies. In one study, plots were established in 1990 as part of an NPS regional monitoring program. In the second study, plots were established in 2000 (described above). The subsequent study completed a survey of woody and herbaceous plants from the two previous studies between the years 2000 and 2009. By 2009, both plot types had increased in species richness, but the exclosures contained significantly more woody and herbaceous species than control (open) plots. There were significant differences in seedling survival rates in the exclosures and control plots. Of 244 individuals tagged in exclosures in the previous study, 56 individuals (23%) were present in 2009 (McShea et al. 2009). For control plots, 236 individuals were tagged in 2000, but no tagged individuals (0%) had survived by 2009. Of the eight most common sapling species, only paw-paw (*Asimina triloba*) showed no abundance differences in control versus fenced plots in any of the parks and is considered unpalatable to deer (McShea et al. 2009).

WHITE-TAILED DEER

GENERAL ECOLOGY

White-tailed deer are medium-sized ungulates, native to North America, and regarded as one of the most adaptable mammals in the world (Hesselton and Hesselton 1982). Among the reasons for this adaptability are the hardiness, reproductive capability, wide range of plant species accepted as food, and the tolerance deer express for close contact with humans.

> *Ungulate: A hoofed, typically herbivorous, animal; includes horses, cows, deer, elk, and bison.*

TABLE 16: VERTICAL PLANT COVER IN THREE FOREST TYPES AT MANASSAS NATIONAL BATTLEFIELD PARK

Height Interval	Forest Type	Treatment	Mean % Vertical Plant Cover (SD) Year 1: 2000	Year 2: 2001	Year 3: 2002	Year 4: 2003	Year 5: 2004	% Change
Bottom (0-0.5 m)	Oak-Hickory	Control	44.8 (21.5)	37.6 (20.9)	42.4 (19.9)	35.4 (23.5)	37.8 (13.6)	-7.0
		Exclosure	43.0 (17.5)	53.8 (17.5)	54.0 (19.8)	63.8 (19.1)	61.0 (23.4)	18.0
	Bottomland Hardwood	Control	79.3 (14.1)	65.4 (28.1)	82.9 (24.7)	43.4 (28.2)	58.0 (21.0)	-21.3
		Exclosure	83.0 (19.4)	82.6 (17.6)	71.6 (26.1)	65.6 (33.5)	82.9 (24.9)	-0.1
	Virginia Pine - Eastern Red Cedar Successional	Control	52.8 (24.9)	55.6 (17.6)	52.8 (26.8)	31.8 (21.7)	39.2 (24.2)	-13.6
		Exclosure	24.2 (19.1)	33.2 (23.3)	48.5 (20.7)	37.0 (23.4)	53.8 (18.7)	29.6
Middle (0.6-1.0 m)	Oak-Hickory	Control	12.0 (16.4)	15.0 (16.0)	14.2 (20.6)	7.6 (17.0)	7.6 (15.9)	-4.4
		Exclosure	13.4 (16.5)	17.4 (16.8)	12.7 (16.0)	21.2 (22.3)	17.6 (22.1)	4.2
	Bottomland Hardwood	Control	19.3 (23.9)	25.0 (31.4)	24.2 (38.2)	6.0 (8.0)	9.4 (14.9)	-9.9
		Exclosure	25.8 (29.8)	36.8 (38.2)	40.2 (39.9)	36.0 (35.2)	38.6 (29.0)	12.8
	Virginia Pine - Eastern Red Cedar Successional	Control	42.2 (31.0)	49.2 (27.2)	50.8 (29.5)	21.2 (26.7)	22.2 (25.0)	-20.0
		Exclosure	11.8 (16.1)	21.6 (23.8)	20.3 (28.1)	14.2 (25.4)	25.4 (23.9)	13.6
Top (1.1-1.5)	Oak-Hickory	Control	20.6 (25.6)	17.6 (18.6)	12.7 (13.6)	1.6 (3.9)	12.6 (20.0)	-8.0
		Exclosure	15.6 (16.9)	14.6 (20.9)	24.0 (23.7)	15.6 (18.1)	10.2 (12.1)	-5.4
	Bottomland Hardwood	Control	10.4 (20.4)	21.2 (23.6)	17.3 (32.3)	8.8 (15.4)	6.0 (9.0)	-4.4
		Exclosure	12.2 (23.7)	16.4 (17.1)	36.4 (34.2)	26.8 (40.1)	27.7 (32.9)	15.5
	Virginia Pine - Eastern Red Cedar Successional	Control	46.6 (29.6)	46.6 (35.7)	61.3 (35.3)	22.2 (26.8)	27.2 (31.2)	-19.4
		Exclosure	18.0 (32.9)	26.6 (32.7)	25.5 (34.0)	15.8 (27.6)	23.2 (25.3)	5.2

Source: Gorsira, Rossell, and Patch 2006.

Note: Percentage of vertical plant cover was estimated in 10 control plots and 10 exclosures for three forest types—oak-hickory, bottomland hardwood, and Virginia pine - eastern red cedar successional—at three height intervals. Control plots and exclosures measured 1 × 4 meters each.

TABLE 17: SURVIVAL OF TREE AND SHRUB SEEDLINGS AT MANASSAS NATIONAL BATTLEFIELD PARK

		Year 1 (2000)	Year 2 (2001)		Year 3 (2002)		Year 4 (2003)		Year 5 (2004)		
Species[1]	Treatment	Number Seedlings	Survival Rate	*P*-value	Survival Rate	*P*-value	Survival Rate	*P*-value	Survival Rate	*P*-value	Number Seedlings
Green and White Ash	Control	51	0.314	<0.001	0.216	<0.001	0.176	<0.001	0.118	<0.001	5
	Exclosure	54	0.889		0.833		0.630		0.574		32
Black Cherry	Control	23	0.696	0.934	0.261	0.026	0.217	0.026	0.130	0.001	3
	Exclosure	15	0.667		0.600		0.467		0.467		7
Boxelder	Control	15	0.467	0.751	0.067	0.006	0.000		0.000		0
	Exclosure	19	0.421		0.211		0.105		0.053		1
Black Hawthorn	Control	14	0.643		0.500	0.073	0.286	0.022	0.214	0.015	3
	Exclosure	11	1.000		0.909		0.909		0.818		9
Vaccinium Spp.	Control	7	0.429	0.066	0.429	0.117	0.429	0.213	0.429	0.213	4
	Exclosure	12	0.917		0.833		0.750		0.750		9
Hackberry	Control	22	0.545	0.021	0.409	0.601	0.182	0.322	0.091	0.081	2
	Exclosure	19	0.842		0.526		0.316		0.316		6
Hickory	Control	11	0.273	<0.001	0.091	0.020	0.000		0.000		0
	Exclosure	9	0.889		0.778		0.667		0.667		6
Red Maple	Control	16	0.125	0.021	0.000		0.000		0.000		0
	Exclosure	13	0.615		0.462		0.462		0.385		5
Redbud	Control	7	0.429	0.087	0.429	0.424	0.429	0.999	0.286	0.555	2
	Exclosure	15	0.800		0.600	0.529	0.400		0.400		6
Red Oak Group	Control	18	0.333	<0.001	0.333	0.018	0.167	0.023	0.111	0.023	2
	Exclosure	17	0.882		0.765		0.588		0.529		9
Spicebush	Control	12	0.583		0.500	0.006	0.083	0.005	0.083	0.086	1
	Exclosure	10	1.000		0.900		0.600		0.300		3
White Oak	Control	9	0.556	0.131	0.444	0.246	0.111	0.033	0.111	0.033	1
	Exclosure	11	0.909		0.727		0.727		0.727		8

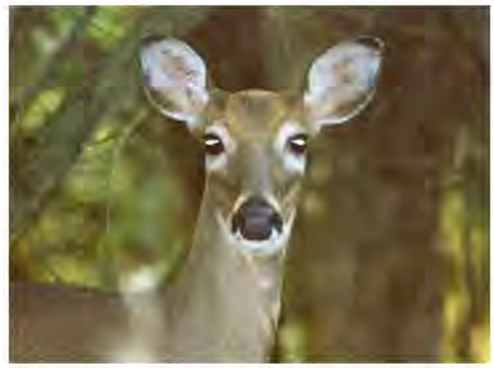
Source: Gorsira, Rossell, and Patch 2006.

Note: Seedlings were tagged in 2000, the first year of the study. Seedling survival was monitored 2000–2004 in 10 control plots and 10 exclosures in three forest types: oak-hickory, bottomland hardwood, and Virginia pine - eastern red cedar successional. Control Plots and exclosures measured 1 × 4 meters each. P-values could not be calculated for treatments having survival rates of 0 or 1.

[1]Green ash (*Fraxinus pennsylvanica*) and white ash (*Fraxinus americana*), black cherry (*Prunus serotina*), boxelder (*Acer negundo*), black hawthorn (*Crataegus* spp.), *Vaccinium* spp. (deerberry and lowbush blueberry), hackberry (*Celtis occidentalis*), spicebush (*Lindera benzoin*), and white oak group (*Quercus alba* and *Quercus* spp.).

Most abundant in the eastern woodlands, white-tailed deer are typically forest dwellers, but often frequent wetlands or woodland openings while feeding. Deer also forage along forest margins, in orchards, and on farmlands. When deer populations become excessive, damage to crops and forests may result. Excessive populations also may affect reproductive success and increase young animal mortality, depending on food availability and how harsh the winters are.

The diet of white-tailed deer consists of twigs from shrubs and trees, as well as herbaceous (non-woody) plants that are eaten frequently in spring and summer when they are abundant. Acorns, blackgum fruits, persimmons, and other kinds of fruits are consumed in late summer and fall. Some of the plants that deer browse heavily in the winter season are selected by necessity, rather than choice (Martin, Zim, and Nelson 1951).



White-tailed Deer

White-tailed deer are well known for their ability to rapidly increase reproductive productivity, given abundant food resources, and to limit productivity in the presence of less nutritious forage (Verme 1965, 1969; Hesselton and Hesselton 1982). On good range containing abundant food, deer tend to produce more than one young, usually twins and sometimes triplets. Where food is limited, the number of births is typically restricted to a single fawn, and sometimes the does do not ovulate (Morton and Cheatum 1946; Verme 1965; Hesselton and Hesselton 1982). Nutrition plays an important role in influencing the onset of puberty, with yearling (1.5 year) does on submarginal range possibly remaining sexually immature, while doe fawns on nutritious range possibly becoming reproductively active as early as six or seven months of age (Verme and Ullrey 1984). The potential for rapid expansion of deer populations, coupled with the wide variety of plant species deer consume, can result in substantial impacts on plant communities (Marquis 1981; Shafer 1965).

Deer Movement

Deer movement has only been studied specifically at Antietam (McShea and Stewart 2005), although deer movement has been studied in other places in Maryland and Virginia with environments similar to those found at the parks. Rhoads, Bowman, and Eyler (2010) studied home range and movement routes of female exurban deer at the Fair Hill Natural Resource Management area in Cecil County, Maryland. The researchers studied 60 deer, and found that seasonal home range generally increased from fawning (when home ranges are relatively small because fawns have limited mobility) through posthunting seasons. The deer population studied appeared to reside on similar and overlapping ranges throughout the year. Home ranges in urban and suburban areas tend to be smaller by less than 50 % than those in rural and agricultural areas. The extent and distribution of urban development and habitat fragmentation can affect the home range size for exurban deer, with higher levels of fragmentation restricting home ranges.

Antietam National Battlefield

Myopathy: a condition in which the muscle fibers do not function.

Between August 2004 and January 2005, 117 deer (7 of which died shortly after capture, likely as a result of capture myopathy) were captured and tagged for movement studies at Antietam (McShea and Stewart 2005). The results showed that 19 females, captured as fawns, traveled an average of 0.8 miles (1.29 km). Twenty males, captured as fawns, traveled an average of 2.4 miles (3.86 km), with one traveling as far as 5.0 miles (8.05 km) and one traveling 13 miles (20.92 km). Forty-two females, captured as adults, traveled an average of 0.9 miles (1.45 km), with one female traveling as far as 6.5 miles (10.5 km) before returning to the park. Five males, captured as adults, traveled an average of 1.3 miles (2.09 km). The study indicated that female deer likely will remain on or near Antietam, and that males may exhibit longer movements that could not be detected due to small sample size (only 35 fawn, yearling, and adult males were captured during this study, and 15 of those were seen/harvested off NPS property) (McShea and Stewart 2005).

Monocacy National Battlefield

Deer movement studies have not been conducted for Monocacy. Given the similar nature of the habitats available at Antietam and Monocacy (protected forest and agricultural fields), it could be assumed that deer movements might be similar to Antietam and Fair Hill. However, the area surrounding Monocacy is more developed, providing less area for dispersal, which could restrict some movements.

Manassas National Battlefield Park

Deer movement studies have not been conducted for Manassas. Although the battlefield is large and relatively open, the area surrounding the battlefield is even more developed than Monocacy. Therefore, while deer movements may be similar to Antietam and Fair Hill, there are more restrictions on some movements outside the park.

POPULATION SIZE AND DENSITY

In 2010, the NPS published the "National Capital Region Network 2009 Deer Monitoring Report" (Bates 2010) that documented annual findings of ongoing deer population surveys throughout the National Capital Region (NCR). Field methods for collecting and analyzing the data followed NCR Distance Protocols described in the monitoring plan for the region. All analyses were done at the Center for Urban Ecology. Spotlight data was entered into Distance software (Bates 2010; Thomas et al. 2006).

Information on deer density and sex ratios was collected during the survey. These data contribute information about the abundance and structure of the deer population, though density remains the single most important piece of information to indicate if the deer population may be impacting forest vegetation. The results of these efforts are summarized below for each of the three parks.

Antietam National Battlefield

Deer density surveys at Antietam have been conducted every April and November since 2001 to estimate the size of the herd within the battlefield. In 2010, the deer herd at Antietam was estimated at 130.71 deer per square mile (50.47 deer per square kilometer). This was the second highest population density recorded at the park in the last ten years, and was similar to the 2010 deer population density. Table 18 lists the population densities recorded at the park between 2001 and 2010.

Monocacy National Battlefield

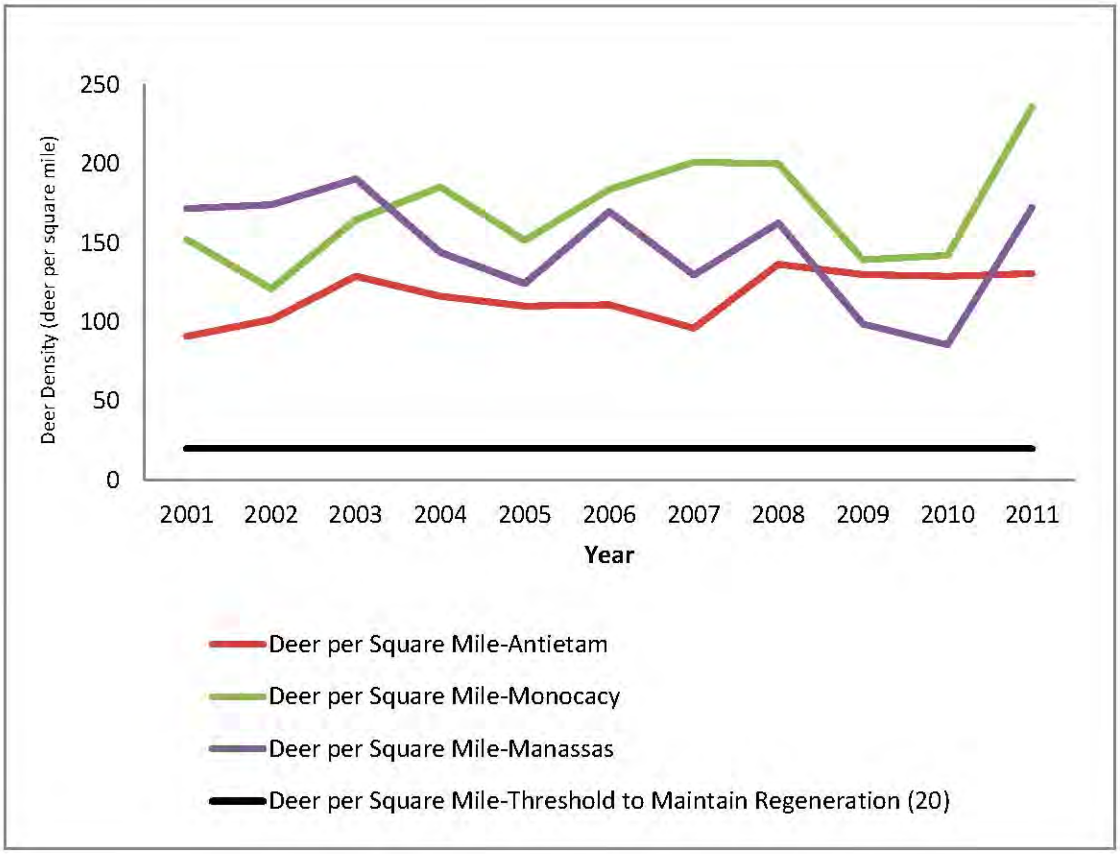
In 2011, the deer herd at Monocacy was estimated at 235.92 deer per square mile (91.09 deer per square kilometer). This population density represents a noticeable increase over 2010's relatively low number in the ongoing fluctuation of the park's deer population. Table 19 lists the population densities recorded at the park between 2001 and 2011. Figure 17 illustrates these figures in comparison to Antietam and Manassas.

TABLE 18: RECORDED DEER DENSITIES AT ANTIETAM NATIONAL BATTLEFIELD

Year	Deer per Square Mile	Standard Error	Deer per Square Kilometer	Standard Error
2001	90.9	20.04	35.1	7.74
2002	101.57	12.87	39.22	4.97
2003	128.98	26.72	49.8	10.32
2004	116.29	6.00	44.9	2.32
2005	110.17	9.27	42.54	3.58
2006	110.92	16.26	42.83	6.28
2007	96.19	16.29	37.14	6.29
2008	136.51	12.4	52.71	4.79
2009	130.01	13.02	50.2	5.03
2010	128.98	11.91	49.8	4.60
2011	130.71	10.85	50.47	4.19

TABLE 19: RECORDED DEER DENSITIES AT MONOCACY NATIONAL BATTLEFIELD

Year	Deer per Square Mile	Standard Error	Deer per Square Kilometer	Standard Error
2001	152.29	45.94	58.8	17.74
2002	121.1	27.66	46.76	10.68
2003	164.54	31.83	63.53	12.29
2004	185.36	9.68	71.57	3.74
2005	151.56	12.22	58.52	4.72
2006	183.86	12.32	70.99	4.76
2007	201.13	24.19	77.66	9.34
2008	200.1	25.01	77.26	9.66
2009	139.34	8.80	53.8	3.40
2010	142.19	17.61	54.9	6.8
2011	235.92	14.81	91.09	5.72



Note: Standard error is shown in tables 18–20.

FIGURE 17: DEER DENSITY AT ANTIETAM, MONOCACY, AND MANASSAS

Manassas National Battlefield Park

In 2011, the deer herd at Manassas was estimated at 172.4 deer per square mile (66.59 deer per square kilometer). This figure represents an increase after 2 years of lower, but still high densities. Table 20 lists the population densities recorded at the park between 2001 and 2011. Figure 17 illustrates these figures in comparison to Antietam and Monocacy.

As can be seen from figure 17, the deer populations at all three battlefields have varied and will continue to vary over time depending on factors such as winter temperature, snow depth and duration, disease, habitat conditions, deer movements, and acorn production. However, based on distance sampling observations for over 10 years, the deer population continues to exceed deer abundances that interfere with forest regeneration and associated wildlife habitat. In the absence of any population management measures, high population levels are expected to continue over time, with some fluctuations due to weather and other factors.

TABLE 20: RECORDED DEER DENSITIES AT MANASSAS NATIONAL BATTLEFIELD PARK

Year	Deer per Square Mile	Standard Error	Deer per Square Kilometer	Standard Error
2001	171.74	18.95	66.31	7.32
2002	174.08	12.38	67.2	4.78
2003	190.49	29.86	73.55	11.53
2004	144.08	22.45	55.63	8.67
2005	124.29	22.61	47.99	8.73
2006	169.87	18.2	65.59	7.03
2007	129.73	16.26	50.09	6.28
2008	162.67	24.65	62.81	9.52
2009	98.78	14.65	38.14	5.66
2010	85.67	12.04	33.08	4.65
2011	172.4	22.61	66.59	8.73

WHITE-TAILED DEER HERD HEALTH

Antietam National Battlefield

On August 26, 2002, the University of Georgia's College of Veterinary Medicine conducted a deer herd health check at Antietam. The check involved the evaluation of five adult deer. Overall, ratings were variable with one or more animals rated as fair, good, and excellent, based on kidney fat indices. The evaluation did not identify evidence of eminent health problems, overtly diseased animals, or obvious physiologic degradation (e.g., low weights, overall physical condition, etc.).

The deer population within the park was found to have little immunity to epizootic hemorrhagic disease, possibly with only the oldest animals having antibodies. This means that future episodes of epizootic hemorrhagic disease virus or bluetongue virus activity could infect a large proportion of the population and result in a mortality event. These diseases are discussed in greater detail in the section below (SCWDS 2002c).

The herd at Antietam was found to be in higher health status than other nearby national parks (SCWDS 2002a). Since the 2002 health check, no similar studies have been conducted at the park. Anecdotal evidence, however, suggests that herd health has not noticeably declined since 2002 (Wenschhof, pers. comm. 2011). The NPS relies on the deer density studies, discussed above, to monitor changes in herd health since the 2002 study. In 2010, NPS studies reported a buck/doe ratio of 1 per 8.53 does, which is considered to be low, and a fawn/doe ratio of 0.39 per doe, which is considered to be moderately low (Bates 2010). The buck/doe ratio is an indicator of potential population growth. Low buck/doe ratios usually indicate abundant deer populations. The fawn/doe ratio highlights the reproductive productivity of the herd. Low fawn/doe ratios may indicate a lack of resources to support reproduction (Bates 2010).

Monocacy National Battlefield

On August 27, 2002, the University of Georgia's College of Veterinary Medicine conducted a deer herd health check at Monocacy. The check involved the evaluation of five adult deer. Overall, the park's deer herd health was not quite as high as that of Antietam. Many of the other findings of the evaluation were similar to what is described above for Antietam (SCWDS 2002b).

One notable outcome of the health check was that three of the five animals had moderate to severe chronic pleuritis, including two with extensive adhesions of thoracic organs to the chest wall. Although such lesions are sometimes found in similar deer herds, it is unusual to find a sample in which more than one had such striking lesions. These lesions were coupled with a high prevalence of antibodies to parainfluenza virus. Parainfluenza virus is known to cause pleuritis in other ruminants; however, the animals identified in the health check with lesions did not align with those with positive results. The chronic nature of the lesions and the large number of potential causes precluded determination of their precise cause (SCWDS 2002b).

Since the 2002 health check, no similar studies have been conducted at the park. Anecdotal evidence, however, suggests that herd health has not noticeably declined since 2002 (Banasik, pers. comm. 2011). The 2010 NPS deer population survey found a buck/doe ratio of 1 per 5.9 does, which was considered moderately low, and a fawn/doe ratio of 0.52 per doe, which was considered normal (Bates 2010).

Manassas National Battlefield Park

Herd health checks have not been performed at Manassas. The NPS relies on its deer density calculations, discussed above, to assess the health of the herd. In 2010, NPS surveys reported a buck/doe ratio of 1 per 6.25 does, which was considered low, and a fawn/doe ratio of 0.17 per doe, which was considered very low.

DISEASES OF CONCERN

Deer with CWD

There are a number of diseases of concern in eastern deer populations. These include parasites, malnutrition, bluetoungue virus, and epizootic hemorrhagic disease. Chronic wasting disease (CWD) has recently been documented at Green Ridge State Forest in Allegany County, Maryland; in western Frederick County, Virginia; and in Old Oxford, Pennsylvania near Gettysburg National Military Park (MD DNR 2011c; VDGIF 2011; PAGC 2012), between 36 and 51 miles from the three NPS units. CWD is being watched closely by the NPS, as it is thought to be spread easily in areas with high concentrations of deer. These diseases are briefly described below:

Bluetongue Virus

Bluetongue virus is an insect-transmitted, viral disease of ruminant mammals, including white-tailed deer. A bluetongue virus infection causes inflammation, swelling, and hemorrhage of the mucous membranes of the mouth, nose, and tongue. Inflammation and soreness of the feet also are associated with bluetongue virus. Bluetongue virus is considered to be a disease that has the potential to spread rapidly. White-tailed deer can be severely affected by bluetongue virus because virus infections cause hemorrhaging and sudden death, and the mortality rate can be extremely high (CFSPH 2006).

A ruminant animal is an even-toed, hoofed mammal (such as sheep, oxen, and deer) that chew the cud and have a complex three- or four-chambered stomach.

The disease is most prevalent in the United States in the southern and southwestern states. It is currently almost non-existing in the upper north central and northeastern states, where biting flies do not appear to transmit the viruses (CFSPH 2006).

Epizootic Hemorrhagic Disease

Epizootic hemorrhagic disease is an insect-borne viral disease of ruminants. The disease causes widespread hemorrhages in mucous membranes, skin, and viscera, the result of disseminated intravascular clotting. Strains of epizootic hemorrhagic disease can cause widespread vascular lesions similar to those described for bluetongue virus. Degenerative changes (focal hemorrhage or dry and gray-white appearance, or both) in striated musculature are prominent in the esophagus, larynx, tongue, and skeletal muscles. Epizootic hemorrhagic disease in white-tailed deer can lead to death. Often, deer are found dead around waterholes, suggesting that they had a high fever and were dehydrated (Stott 1998).

Not all deer infected with epizootic hemorrhagic disease or bluetongue virus will die; this is known because many normal deer have antibodies that indicate prior exposure to various viruses. Deer that recover develop immunity to the specific virus, which protects against reinfection by the same virus. However, it is not known how well this immunity cross-protects deer against other hemorrhagic viruses. When deer survive infection with a virus from one virus type (epizootic hemorrhagic disease or bluetongue virus), there is good evidence to indicate they are not protected from disease caused by subsequent infection with a different virus strain (SCWDS 2000). There was an outbreak of epizootic hemorrhagic disease among the deer herd at Monocacy in 2002, during which time the deer population dropped by 40% (Bates, pers. comm. 2012).

Chronic Wasting Disease

CWD belongs to a group of diseases known as transmissible spongiform encephalopathies, which include scrapie, bovine spongiform encephalopathy, and Creutzfeldt-Jakob disease. The diseases are grouped because of similarity in clinical features, pathology, and presumed etiology: the infectious agents are hypothesized to be prions (infectious proteins without associated nucleic acids). Transmissible spongiform encephalopathies cause distinctive lesions in the brain and consistently result in death.

> *Prion: proteinaceous infectious particle; a microscopic particle similar to a virus but lacking nucleic acid, thought to be the infectious agent for certain degenerative diseases of the nervous system such as CWD.*
>
> *Etiology: the cause, set of causes, or manner of causation of a disease or condition.*

Deer and elk affected by CWD show loss of body condition and changes in behavior. Affected animals may demonstrate a variety of behavioral signs, including decreased fear of humans and isolation from the remainder of the herd. Animals in the later stages of the disease become emaciated. Excessive drinking and urination are common in the terminal stages because of specific lesions in the brain. Many animals in terminal stages have excessive salivation and drooling. Death is inevitable once clinical signs are visible.

The clinical course of CWD varies from a few days to several months. While a protracted clinical course is typical, occasionally death may occur suddenly; this may be more common in the wild than in the relative security of captivity.

The health risk for humans consuming elk or deer infected with CWD is unknown; however, the risk is likely extremely low. The risk is based on an analysis of existing research studies that indicate no established link between the disease and similar human transmissible encephalopathy diseases. Current literature reviews and experts agree that more information is needed and that many questions remain unanswered about the transmissibility of CWD. Antietam and Monocacy published the Chronic Wasting Disease Detection and Initial Response Plan and Environmental Assessment in 2009. Additional information on CWD diagnosis and management is included in appendix C.

Transmissible spongiform encephalopathies: a group of diseases characterized by accumulations of abnormal prion proteins in neural and lymphoid tissues, which cause distinctive lesions in the brain and result in death.

OTHER WILDLIFE AND WILDLIFE HABITAT

OVERVIEW

The mix of fields and wooded areas at the battlefields provide habitat for a variety of mammals, birds, reptiles, and amphibians that could be affected by actions taken for deer management. Fish are not discussed in this section because impacts on fish and fish habitat would not occur, as described in the "Issues Considered but Dismissed from Further Analysis" section of the "Purpose of and Need for Action" chapter.

Antietam National Battlefield

Mammals

In addition to the white-tailed deer, 33 other mammals are known to occur at the battlefield (NPS 2005b). Common small mammals include the eastern cottontail (*Sylvilagus floridanus*), white-footed mouse (*Peromyscus leucopus*), deer mouse (*Peromyscus maniculatus*), gray squirrel (*Sciurus carolinensis*), chipmunk (*Tamias striatis*), short-tailed shrew (*Blarina brevicauda*), and little brown bat (*Myotis lucifugus*) (NPS 2006g). Medium-sized mammals common at the battlefield include red fox (*Vulpes vulpes*), raccoon (*Procyon lotor*), and woodchuck (*Marmota monax*) (NPS 2006g). The coyote (*Canis latrans*) is known to occur at Antietam, and black bear (*Ursus americanus*) have been reported in the vicinity, but not in the park (NPS 2009c).

Birds

Surveys throughout Antietam have identified more than 77 bird species (NPS 2008c). Many of the bird species found at Antietam nest on or near the ground, using grasses and other low-growing vegetation for building nests and concealment. These include the wild turkey (*Meleagris gallopavo*), grasshopper sparrow (*Ammodramus savannarum*), and eastern towhee (*Pipilo erythrophthalmus*). Birds that nest in the upper understory or canopy include indigo bunting (*Passerina cyanea*) and northern cardinal (*Cardinalis cardinalis*) (NPS 2008c). The upper canopy also supports cavity-nesting birds such as the red-headed woodpecker (*Melanerpes erythrocephalus*) and Carolina chickadee (*Poecile*

Northern Cardinal

carolinensis) (NPS 2008c). Many of these birds depend on older trees that have natural cavities or weakened sections that can be hollowed out for nesting.

Raptors commonly seen at the battlefield include red-tailed hawk (*Buteo jamaicensis*), sharp-shinned hawk (*Accipiter striatus*), Cooper's hawk (*Accipiter cooperii*), and American kestrel (*Falco sparverius*). Barred owl (*Strix varia*) and great horned owl (*Bubo virginianus*) are also common at the battlefield. Raptors and these owls prey on other birds and mammals. Scavengers like the crow (*Corvus brachyrhynchos*) and turkey vulture (*Carthartes aura*) rely on the remains of other animals, including deer, for food at the battlefield.

Antietam hosts an eastern bluebird (*Sialia sialis*) trail. The trail has 70 nest boxes which have fledged over 6,000 eastern bluebirds since 1979 (NPS 2008c).

Reptiles and Amphibians

Snakes and turtles are abundant in the habitats of Antietam, inhabiting wet or wooded areas as well as open grassy fields (NPS 2006h). These habitats provide important sun and shade for regulating body temperatures in reptiles. Some species that occur at the battlefield include the eastern garter snake (*Thamnophis sirtalis sirtalis*), northern ringneck snake (*Diadophis punctatus edwardsii*), common snapping turtle (*Chelydra serpentina serpentina*), and eastern painted turtle (*Chrysemys picta picta*) (NPS 2006h).

Many amphibians live the first part of their lives in water and the second part on land. Those that occur in Antietam include frogs, toads, and salamanders. Species observed at the battlefield in a 2000 to 2001 survey included long-tailed salamander (*Eurycea longicauda*), northern dusky salamander (*Desmognathus fuscus*), bullfrog (*Lithobates catesbeianus*), Eastern American toad (*Anaxyrus americanus americanus*), northern spring peeper (*Pseudacris crucifer*), and wood frog (*Lithobates sylvaticus*) (NPS 2006i).

Monocacy National Battlefield

Mammals

A total of 34 different species of mammals have been known to occur at Monocacy. Most of these are small mammals, including northern short-tailed shrew, the woodland vole (*Microtus pinetorum*), the muskrat (*Ondatra zibethicus*), the meadow jumping mouse (*Zapus hudsonius*), and the hairy-tailed mole (*Parascalops breweri*). Other small mammals commonly observed include the gray squirrel and chipmunk (NPS 2006c, 2006e). Medium-sized mammals commonly observed at the battlefield include red fox, woodchuck, and raccoon. In addition to white-tailed deer, other large mammals that have been observed include coyote and transient black bear (NPS 2006c, 2006e).

Red Fox

Birds

Approximately 80 species of birds are known to occur in the habitat provided at the battlefield (NPS 2006c). Many of the bird species found at Monocacy nest on or near the ground. These include the northern harrier (*Circus cyaneus*), mallard (*Anas platyrhynchos*), killdeer (*Charadrius vociferous*), spotted sandpiper (*Actitis macularius*), vesper sparrow (*Pooecetes gramineus*), field sparrow (*Spizella pusilla*), eastern meadowlark (*Sturnella magna*), and wild turkey (NPS 2006c).

Birds that nest in the upper understory or canopy include the red-eyed vireo (*Vireo olivaceus*), wood thrush (*Hylocichla mustelina*), acadian flycatcher (*Empidonax virescens*), northern cardinal, and yellow-throated vireo (*Vireo flavifrons*) (NPS 2006c).

The upper canopy also supports cavity-nesting birds such as various woodpeckers, Carolina chickadee, and tufted titmouse (*Parus bicolor*) (NPS 2006c). Many of these birds depend on older trees that have natural cavities or weakened sections that can be hollowed out for nesting.

The barred owl and great horned owl, and raptors such as red-tailed hawk and red-shouldered hawk (*Buteo lineatus*), depend on other birds and mammals for food. Scavengers like the crow and turkey vulture rely on the remains of other animals, including deer, for food.

Reptiles and Amphibians

The battlefield provides diverse habitat for reptiles and amphibians. Reptiles, which include snakes, turtles, lizards, and skinks, can be found in moist floodplains or shaded woodlands, as well as within open grassland and agricultural fields. The variety of habitats available is important for reptiles because they move between shady and sunny spots to regulate body temperatures (NPS 2006d).

Habitats for amphibians are typically associated with aquatic environments and nearby upland areas. Frogs and toads at the battlefield include the American toad and the northern spring peeper. The red-backed salamander (*Plethodon cinereus*) is also found at Monocacy. (NPS 2006c).

Manassas National Battlefield Park

Mammals

A total of 25 different species of mammals have been known to occur at Manassas. Most of these are small mammals including northern short-tailed shrew, the meadow vole (*Microtus pennsylvanicus*), eastern mole (*Scalopus aquaticus*), and white-footed mouse (NPS 2011f). Other small mammals commonly observed include the eastern cottontail, gray squirrel, and red fox (NPS 2011f). Medium-sized mammals commonly observed at the battlefield include red fox, woodchuck, and raccoon.

Birds

A total of 168 species of birds have been documented to occur at Manassas (NPS 2008d). Many of the bird species found at Manassas nest on or near the ground, using grasses and other low-growing vegetation for building nests and concealment. These include the brown thrasher (*Toxostoma rufum*), savannah sparrow (*Passerculus sandwichensis*), mallard, killdeer, spotted sandpiper, vesper sparrow, field sparrow, eastern meadowlark, and wild turkey (NPS 2008d).

Birds that nest in the upper understory or canopy include the red-eyed vireo, wood thrush, acadian flycatcher, northern cardinal, and yellow-throated vireo (NPS 2008d). The upper canopy also supports cavity-nesting birds such as various woodpeckers, brown creeper (*Certhia americana*), Carolina chickadee, and tufted titmouse (NPS 2008d). Many of these birds depend on older trees that have natural cavities or weakened sections that can be hollowed out for nesting.

The barred owl and barn owl, and raptors such as red-tailed hawk, red-shouldered hawk, Cooper's hawk, and American kestrel, depend on other birds and mammals for food. Scavengers like the crow and turkey vulture rely on the remains of other animals, including deer, for food. The park has installed nest boxes for barn owl, American kestrel, and eastern bluebird (NPS 2008d).

Reptiles and Amphibians

As with the other battlefields, Manassas also provides diverse habitat for reptiles and amphibians. Reptiles can be found in moist floodplains or shaded woodlands, as well as within open grassland and agricultural fields. Twenty three species of reptiles have been documented at the battlefield including broad-headed skink (*Eumeces laticeps*), eastern garter snake, eastern box turtle (*Terrapene carolina carolina*), eastern snapping turtle (*Chelydra serpentina serpentina*), northern copperhead (*Agkistrodon contortrix mokasen*), and redbellied snake (*Storeria occipitomaculata*) (NPS 2011g).

Eastern Box Turtle

Habitats for amphibians are typically associated with aquatic environments and nearby upland areas. Important amphibian habitat at Manassas includes ephemeral pools that provide breeding habitat for spring peepers and wood frogs, as well as spotted and marbled salamanders (NPS 2008e).

CURRENT STATUS OF WILDLIFE AND THE ROLE OF DEER

There is more research on the effects of deer density on vegetation than on wildlife populations. However, the changes in vegetation represent a change in forest ecology and wildlife habitat, and can affect other species of wildlife. A number of studies have shown distinct changes in bird abundance as a result of reducing deer density by exclosures (McShea and Rappole 2000). One researcher found that seedling richness began to decline with just 10 deer per square mile and that songbird habitat was negatively impacted with 20 to 39 deer per square mile within a cherry/maple forest (deCalesta 1997b). Similarly, a nine-year study in the mid-Atlantic region found that a reduction in deer density changed the composition of forest bird populations (McShea and Rappole 2000). Three patterns of change were observed in bird populations within exclosures (where there were no deer): (1) species that preferred open understory (e.g., wood thrush) declined; (2) species that preferred a dense herbaceous ground cover (e.g., Carolina wren) immediately increased, but then decreased as herbaceous species were replaced by woody species; and (3) species that preferred a dense, woody understory (e.g., ovenbird) gradually increased.

The habitat most affected by heavy deer browsing is the herbaceous and woody vegetation in the forest understory. Deer can browse vegetation from ground level to an average of 60 inches (150 centimeters) above the ground, and this is the habitat that is primarily affected. Other wildlife also use this understory habitat. Other species that compete with deer for available food include squirrels and mice (which feed on acorns and other food from trees) and rabbits (which feed on young woody stems and green vegetation) (McShea and Rappole 2000). Heavy deer browsing also results in lack of cover for small mammals.

Flowerdew and Ellwood (2001) suggested that if rodent densities are lowered, avian and terrestrial predators are likely to suffer reduced breeding success, and tawny owls (*Strix aluco*) may prey more heavily on bank voles (*Myodes glareolus*) if their favored ground cover is reduced. Gorsira, Rossell, and Patch (2006) found that deer browsing had suppressed forb and vertical plant cover across all forest types at Manassas. Vertical plant cover is an important habitat attribute to understory bird species. It has been positively correlated with the abundance and species richness of breeding birds (McShea and Rappole 1992) and the abundance and species diversity of wintering birds (Zebehazy and Rossell 1996). Species that primarily depend on other habitats would be less affected by high deer numbers. Some frogs, snakes, salamanders, and turtles live close to water during much of their lives and are therefore less affected by deer. Similarly, heavy deer browsing would not directly change fish habitat. However, other species (e.g., box turtle) are dependent on vegetation, fruits, and insects found within the understory of the forest, and their habitat is affected by high deer numbers. Species that would benefit from high deer numbers and resulting habitat changes are those that prey on deer (e.g., coyotes) or that feed on carrion (e.g., vultures and box turtles). Predators would also benefit from hunting other prey, such as mice and squirrels, in areas with less dense cover at ground level, thus allowing better views through the forest and less cover for prey to hide. However, as prey declines due to reduced cover, predators also decline.

Species that depend on the upper canopy of the forest, such as woodpeckers and other birds that nest high in the trees, experience changes in their habitat related to deer densities over a longer period. As the forest ages, improved habitat may become available for cavity-nesting birds and birds that feed on insects as older trees die or become stressed from disease or infestations. However, in the long term with little to no regeneration, the dead trees will not be replaced by new trees, resulting in fewer trees that upper canopy species can use as habitat. A study of forest sapling stocking rates at Antietam and Monocacy indicated that successful forest regeneration will not occur under current deer densities (McShea and Bourg 2009). A similar study of sapling survival rates at Manassas indicated that forest succession was also not possible under current deer densities (McShea et al. 2009).

SPECIAL STATUS SPECIES

The NPS is required under the Endangered Species Act to ensure that federally listed species and their designated critical habitats are protected on lands within the agency's jurisdiction. In addition, the NPS considers state-listed or other rare species similarly in taking actions that may affect these species. An overabundance of deer and deer management actions have the potential to affect listed species as well as other wildlife. No federally listed or candidate species are known to occur within the three battlefields; therefore, this section only addresses state special status species. Aquatic special status species are not included here as they would not be affected by a deer management plan, but migratory bird species listed by the U.S. Fish and Wildlife Service (USFWS) as birds of conservation concern are considered because deer browsing affects many of their habitats. Table 21 shows the rare and state-listed threatened or endangered plant species and table 22 shows the state listed animal species documented to occur at all three battlefields, as there is significant overlap. The table for the plants also addresses palatability of these plants to deer. Palatability to deer represents a measurable threat to these plants, as deer tend to browse more heavily on plants they enjoy, and deer browse is a problem in the habitats in the parks more generally.

TABLE 21: RARE, THREATENED, AND ENDANGERED PLANTS OF ANTIETAM AND MONOCACY NATIONAL BATTLEFIELDS, AND MANASSAS NATIONAL BATTLEFIELD PARK

	Common Name	Global Rank[1]	State Rank[2]	ANTI	MONO	MANA	Habitat	Palatable to Deer?
Abies balsamea	Balsam fir	G5	S1	X			Mixed forest	Yes, but not preferred (Uchytil 1991)
Agalinis auriculata	Earleaf foxglove	G3	S1			X	Dry prairies, fallow fields, thickets and the borders of upland forests	Unknown
Asclepias purpurascens	Purple milkweed	G5?	S2			X	Moist meadows in woodlands or near rivers, thickets and woodland borders, bluffs and open woodlands, oak savannas, glades, and roadsides	No (Hilty 2012)
Arabis shortii	Short's rockcress	G5	S3		X		Moist to mesic deciduous woodlands, wooded floodplain areas along rivers, banks of small streams, rocky bluffs, and shaded limestone cliffs	Unknown
Bidens coronata	crowned beggarticks	G5	S2S3		X		Wet meadows, swamps	Unknown
Botrychium multifidum	Leathery grape-fern	G5	SH; X	X	X		Fields	Unknown
Bromus ciliatus	Fringed brome	G5	S1	X	X		Coniferous and mixed forest, grassland, riparian areas	Yes (Esser 1994)
Buchnera americana	Blue-hearts	G5?	S1S2			X	Sandy or gravelly soil of upland woods or prairies	Unknown
Cardamine pratensis	Cuckooflower	G5	S1	X			Woodland and meadow	Unknown
Carex argyrantha	hay sedge	G5	S3		X		Dry clearings, open woods, on acidic, rocky, or sandy substrates, rock outcrops	Unknown
Carex hitchcockiana	Hitchcock's sedge	G5	S1; E	X			Mesic woodland often with no shrub layer	Yes (Hilty 2012)
Carex molesta	Troublesome sedge	G4	S1	X	X		Prairies woodlands abandoned fields	No (non-toxic but not preferred) (Hilty 2012)

	Common Name	Global Rank[1]	State Rank[2]	ANTI	MONO	MANA	Habitat	Palatable to Deer?
Carex sparganioides	Burr-reed sedge	G5	S1S2	X			Deciduous and mixed forest and forest edge	Possibly (Garden Guides 2012)
Clematis viorna	Vasevine; leatherflower	G5	S3	X			Wooded cliffs and streambanks	Unknown
Cystopteris bulbifera	Bulb bladderfern; bulblet fern	G5	S3	X			Shaded limestone rich cliffs and outcroppings	Unknown
Delphinium tricorne	Dwarf larkspur	G5	S3	X	X		Woodlands, in particular hilly woodlands	No (Hilty 2012)
Dodecatheon meadia	Shooting star	G5	S3	X			Open woods and glades, rocky wooded slopes, bluff ledges, meadows and prairies	Possibly (Hilty 2012)
Erigenia bulbosa	harbinger of spring	G5	S3		X		High quality deciduous woodlands	Unknown
Galactia volubilis	Downy milk pea	G5	S3	X	X		Dry, open woodlands and old fields	Unknown
Galium concinnum	Shining bedstraw	G5	S3	X			Woodlands and woodland edges	Unknown
Gymnocladus dioicus	Kentucky coffee-tree	G5	S1	X	X		Bottomlands, rich soil along streams/rivers	No (California Dept. of Fish and Game 2008; Jull 2001)
Heracleum lanatum (Heracleum maximum)	Cow parsnip	G5	S3	X			Forest, grassland, shrubland, meadow	Yes (Esser 1995)
Hybanthus concolor	Green violet	G5	S3	X			Moist to mesic deciduous woodlands, wooded slopes, shaded terraces along streams, and damp ravines	Yes (Hilty 2012)
Hydrastis canadensis	Goldenseal	G4	S2; T	X			Rich, mesic hardwood forest, especially those underlain by limestone or alkaline soils	Unknown
Juglans cinerea	Butternut	G4	S2S3	X		X	Fertile woods	Yes (Coladonato 1991)
Liparis liliifolia	Large twayblade; brown widelip orchid	G5	S2S3	X			Open upland woodlands; savannahs	Yes (Hilty 2012; Rolfsmeier 2007)

	Common Name	Global Rank[1]	State Rank[2]	ANTI	MONO	MANA	Habitat	Palatable to Deer?
Liparis loeselii	Loesel's twayblade; yellow widelip orchid	G5	S1S2	X			Wetland habitats but occasionally drier upland areas	Possibly (Rolfsmeier 2007)
Monarda clinopodia	White bergamot; basal bee-balm	G5	S3	X			Moist floodplain forest	Unknown
Oligoneuron rigidum	Stiff goldenrod	G5	S2			X	Prairies, savannas, thickets, limestone glades, abandoned fields, roadsides, and open areas along railroads	Yes (Hilty 2012)
Panax quinquefolius	American ginseng	G3G4	S3	X			Mixed hardwood-dominated woodlands and forest with closed canopy	Yes (Vaughan, Chamberlain, and Munsell 2011)
Paspalum dissectum	Mudbank crowngrass; Walter's paspalum	G4	S2; T	X			Delmarva bays (uncommon seasonal pond habitat)	Unknown
Phlox pilosa	Downy phlox	G5	S2			X	Open woods, thickets, meadows, glades and prairies	Yes (Hilty 2012)
Physalis virginiana	Virginia ground-cherry	G5	S3	X			Dry, upland woods, fields	No (iVillage Garden Web 2006)
Quercus shumardii	Shumard's oak	G5	S2		X	X	Oak-hickory forest	Yes (Sullivan 1993)
Ribes cynosbati	Eastern prickly gooseberry	G5	S3	X			Rocky woodlands, wooded slopes, woodland borders, limestone bluffs	Yes (Hilty 2012)
Rumex hastatulus	Heartwing dock; Engelmann's dock	G5	SU	X	X		Dry to moist alluvial habitats, river valleys, sandy plains, meadows, waste places	Unknown
Salix exigua	Sandbar willow	G5	S1	X			Along riverbanks in riparian area	Possibly (Anderson 2006)
Scutellaria incana	Hoary skullcap; downy skullcap	G5	S3	X			Upland forests, woodlands, and meadows	No (Hilty 2012)
Scutellaria nervosa	Veined skullcap	G5	S1; E	X	X	X	Floodplain forest	Unknown

	Common Name	Global Rank[1]	State Rank[2]	ANTI	MONO	MANA	Habitat	Palatable to Deer?
Sorbus americana	American mountain ash	G5	S3	X			Forest	Yes – preferred (Sullivan 1992)
Stachys pilosa var. arenicola	Marsh hedgenettle	G5	S1			X	Wet meadows and thickets, lake and pond shores, openings in swamps, river and stream borders, ditches	Unknown
Symphyotrichum shortii	Short's aster	G5	S3	X	X		Open, often thin, rocky, well-drained soils, oak-hickory woods, edges of woods, thickets, calcareous hammocks, wooded stream banks or cliffs, roadsides	Unknown
Thuja occidentalis	Arborvitae	G5	S1; T	X			Woodlands, swamps	Yes (Carey 1993)
Zizia aurea	Golden Zizia; Golden Alexanders	G5	S3	X		X	Ditch margins, moist meadows, woods	No (McGregor 2008)

Source: Wenschhof, pers. comm. 2012c; Banasik, pers. comm. 2012c; NPS 2008a.

[1]Global Ranks: G5 = Demonstrably secure globally; G4: Apparently secure globally; G3: Either very rare and local throughout its range or distributed locally in restricted range; G2: Globally rare; G1: Highly globally rare; Q: Taxon under question.

[2] **Maryland State Ranks**: S5 = Demonstrably secure in MD; S4 = Apparently secure in MD, >100 occurrences; S3 = Watch list, rare to uncommon, 21-100 occurrences; S2 = State rare, rare, 6-20 occurrences; S1 = Highly state rare, extremely rare, <5 occurrences; SH = Historically known but not verified within several years; SU = Possibly rare in MD but historical records vague; B = Species is a migrant, species status refers to breeding populations; N = Species is a migrant, species status (shown after rank) refers to non-breeding populations; E = State endangered; T = State threatened; X = Believed to be extirpated with virtually no chance of species recovery; I = In need of conservation; population limited or declining towards threatened status. There was no state status given to any of the species on the Virginia list; status of all items shown after semicolon is for Maryland. **Virginia State Ranks**: S1=Extremely rare and critically imperiled with 5 or fewer occurrences or very few remaining individuals in Virginia; or because of some factor(s) making it especially vulnerable to extirpation in Virginia; S2=Very rare and imperiled with 6 to 20 occurrences or few remaining individuals in Virginia; or because of some factor(s) making it vulnerable to extirpation in Virginia. S3=Rare to uncommon in Virginia with between 20 and 100 occurrences; may have fewer occurrences if found to be common or abundant at some of these locations; may be somewhat vulnerable to extirpation in Virginia; S4=Common and apparently secure in Virginia, although it may be rare in parts of its range; SH=Formerly part of Virginia's fauna with some expectation that it may be rediscovered; generally applies to species that have not been verified in the state for an extended period (usually >15 years) and for which some inventory has been attempted recently; SX=Believed to be extirpated from Virginia with virtually no likelihood of rediscovery; S_S_=Rank is uncertain, but considered to be within the indicated range of ranks (e.g., S2S4); S_B=Breeding status of an animal (primarily used for birds) in Virginia; these species typically inhabit Virginia only during the breeding season; S_B/S_N= Breeding and non-breeding status of an animal (primarily used for birds) in Virginia, when they differ.

TABLE 22: RARE, THREATENED, AND ENDANGERED ANIMALS OF ANTIETAM AND MONOCACY NATIONAL BATTLEFIELDS, AND MANASSAS NATIONAL BATTLEFIELD PARK

Species	Common Name	Global Rank[1]	MD Rank[2]	VA Rank[3]	ANTI	MONO	MANA
Mammals							
Reithrodontomys humulis	Eastern harvest mouse	G5	SH; X		X		
Birds							
Accipiter striatus	Sharp-shinned hawk	G5	S1S2B		X	X	
Actitis macularius	spotted sandpiper	G5	S3S4B			X	X
Bartramia longicauda	Upland sandpiper	G5	S1B; E		X		
Carpodacus purpureus	Purple finch	G5	S3B		X		X
Catharus guttatus	Hermit thrush	G5		S1B/S5N	X		X
Certhia americana	Brown creeper	G5		S3B/S5N			X
Chordeiles minor	Common nighthawk	G5	S3S4B		X		
Circus cyaneus	Northern harrier	G5	S2B		X	X	X
Corvus corax	Common raven	G5	S2		X		X
Dendroica caerulescens	Black-throated blue warbler	G5	S3S4B		X		
Dendroica cerulea	Cerulean warbler	G4	S3S4B				X
Dendroica fusca	Blackburnian warbler	G5	S1S2B; T		X		X
Dendroica magnolia	Magnolia warbler	G5	S3S4B		X		X
Empidonax alnorum	alder flycatcher	G5		S1S2B			X
Haliaeetus leucocephalus	bald eagle	G5	S3B		X	X	X
Junco hyemalis	Dark eyed junco	G5	S2B		X	X	X
Lanius ludovicianus	Loggerhead shrike	G4	S1B; E		X		
Lophodytes cucullatus	hooded merganser	G5	S1B			X	X
Passerculus sandwichensis	Savannah sparrow	G5	S3S4B		X		X
Pooecetes gramineus	Vesper sparrow	G5	S3S4B		X	X	X
Regulus satrapa	Golden-crowned kinglet	G5	S2B		X		X
Sphyrapicus varius	Yellow-bellied sapsucker	G5	SHB		X		X
Troglodytes troglodytes	Winter wren	G5	S2B		X		X
Tyto alba pratincola	Barn owl	G5		S3B/S3N			X
Vermivora ruficapilla	Nashville warbler	G5	S1S2B			X	X

Species	Common Name	Global Rank[1]	MD Rank[2]	VA Rank[3]	ANTI	MONO	MANA
Insects							
Papilio cresphontes	Giant swallowtail	G5	S2; I		X		

Source: Wenschhof, pers. comm. 2012c; Banasik, pers. comm. 2012c; NPS 2008a

[1]Global Ranks: G5 = Demonstrably secure globally; G4: Apparently secure globally; G3: Either very rare and local throughout its range or distributed locally in restricted range; G2: Globally rare; G1: Highly globally rare; Q: Taxon under question.

[2] **Maryland State Ranks**: S5 = Demonstrably secure in MD; S4 = Apparently secure in MD, >100 occurrences; S3 = Watch list, rare to uncommon, 21-100 occurrences; S2 = State rare, rare, 6-20 occurrences; S1 = Highly state rare, extremely rare, <5 occurrences; SH = Historically known but not verified within several years; SU = Possibly rare in MD but historical records vague; B = Species is a migrant, species status refers to breeding populations; N = Species is a migrant, species status refers to non-breeding populations; E = State endangered; T = State threatened; X = Believed to be extirpated with virtually no chance of species recovery; I = In need of conservation; population limited or declining towards threatened status.

[3] **Virginia State Ranks**: S1=Extremely rare and critically imperiled with 5 or fewer occurrences or very few remaining individuals in Virginia; or because of some factor(s) making it especially vulnerable to extirpation in Virginia; S2=Very rare and imperiled with 6 to 20 occurrences or few remaining individuals in Virginia; or because of some factor(s) making it vulnerable to extirpation in Virginia. S3=Rare to uncommon in Virginia with between 20 and 100 occurrences; may have fewer occurrences if found to be common or abundant at some of these locations; may be somewhat vulnerable to extirpation in Virginia; S4=Common and apparently secure in Virginia, although it may be rare in parts of its range; SH=Formerly part of Virginia's fauna with some expectation that it may be rediscovered; generally applies to species that have not been verified in the state for an extended period (usually >15 years) and for which some inventory has been attempted recently; SX=Believed to be extirpated from Virginia with virtually no likelihood of rediscovery; S_S_=Rank is uncertain, but considered to be within the indicated range of ranks (e.g., S2S4); S_B=Breeding status of an animal (primarily used for birds) in Virginia; these species typically inhabit Virginia only during the breeding season; S_B/S_N= Breeding and non-breeding status of an animal (primarily used for birds) in Virginia, when they differ.

Antietam National Battlefield

The Maryland Wildlife and Heritage Service Natural Heritage Program tracks the status of over 1,100 native plants and animals that are among the rarest in Maryland and most in need of conservation efforts as elements of the state's natural diversity. Of these species, the Maryland Department of Natural Resources (MD DNR) officially recognizes 607 species and subspecies as endangered, threatened, in need of conservation, or endangered extirpated. The primary state law that allows and governs the listing of endangered species is the Nongame and Endangered Species Conservation Act (Annotated Code of Maryland 10-2A-01). This act is supported by regulations (Code of Maryland Regulations 08.03.08) which contain the official State Threatened and Endangered Species list.

The list for Antietam includes 33 plants, one mammal, 17 birds, and one insect (Wenschhof, pers. comm. 2012c). In addition, at least two species on the USFWS list of birds of conservation concern, the bald eagle (*Haliaeetus leucocephalus*) and cerulean warbler (*Dendroica cerulean*), can be found at Antietam.

Monocacy National Battlefield

The Maryland Nongame and Endangered Species Conservation Act (Annotated Code of Maryland 10-2A-01) is also applicable to Monocacy. Tables 21 and 22 include the Maryland rare and state-listed threatened or endangered species documented to occur at the battlefield (Banasik, pers. comm. 2012a). The list includes 15 plants and 8 birds. In addition to the bald eagle and cerulean warbler listed in table 22, the wood thrush and Kentucky warbler (*Oporornis formosus*) are birds that can be found at Monocacy that are on the USFWS list of birds species of conservation concern for the Piedmont (NPS n.d.b; USFWS 2008).

MANASSAS NATIONAL BATTLEFIELD PARK

Two state agencies, the Virginia Department of Game and Inland Fisheries (VDGIF) and the Department of Agriculture and Consumer Services have legal authority for endangered and threatened species and are responsible for their conservation in Virginia. VDGIF has statutory responsibility to manage the Commonwealth's wildlife and inland fisheries, and to protect state and federally threatened or endangered species (excluding plants and insects). In 1979, the Endangered Plant and Insect Species Act, Chapter 10 §3.2-1000 through 1011 of the Code of Virginia, as amended, mandated that the Virginia Department of Agriculture and Consumer Services conserve, protect, and manage endangered and threatened species of plants and insects.

Bald Eagle

The Virginia Department of Conservation and Recreation Heritage Program has designated a number of diabase conservation areas throughout Manassas, Virginia, including one within the park. Diabase soils are volcanic soils found throughout the park that have diabase, a hard igneous rock as a parent material, and the surrounding soils are rich in calcium and magnesium that weather easily. When exposed by erosion, diabase and metasiltstone form soils that can create the habitat for rare, drought-tolerant plant communities called diabase glades. The conservation areas are not afforded special protection, however. The Manassas Diabase Conservation Area within the park is known to support two state listed rare species: the marsh hedgenettle (*Stachys pilosa* var. *arenicola*), and purple milkweed (*Asclepias purpurascens*). According to the Virginia Department of Conservation and Recreation, there is potential for a number of additional rare plant species that may occur in diabase conservation areas including earleaf foxglove (*Agalinis auriculata*), blue-hearts (*Buchnera americana*), downy phlox (*Phlox pilosa*), and stiff goldenrod (*Oligoneuron rigidum*) (NPS 2008a). Six state-listed plants and nine state-listed birds could occur at Manassas. In addition, seven migratory bird species at Manassas are on the USFWS 2008 list of Birds of Conservation Concern for the Piedmont. In addition to the bald eagle and cerulean warbler, the remaining five species are Henslow's sparrow (*Ammodramus henslowii*), wood thrush, blue-winged warbler (*Vermivora cyanoptera*), Kentucky warbler, and prairie warbler (*Dendroica discolor*) (NPS n.d.c; USFWS 2008).

NEIGHBORING LAND USE / SOCIOECONOMICS

The following discussion of neighboring land use and socioeconomic resources focuses on the potential for deer-related landscape plant damage or crop damage to neighboring properties. No other actions under the alternatives considered would have more than a negligible effect on local or regional socioeconomic conditions. Therefore, the analysis for socioeconomic resources was limited to deer damage on crops and neighbors' landscape plants.

REGIONAL AND SOCIOECONOMIC OVERVIEW

Antietam National Battlefield

Population and Economy

Antietam is located in Washington County, in the Maryland panhandle. The town of Sharpsburg is located along the southwestern boundary of the battlefield and the city of Frederick, Maryland, is located approximately 20 miles east of the battlefield.

Over the last ten years the county has surpassed the state's rate of growth (9.0%), increasing in population from 131,293 in 2000 to 147,430 in 2010 (11.8%). During this period, the population of Sharpsburg increased from 691 people in 2000 to 705 people in 2010 (2.0%) and the city of Frederick grew from 52,767 to 65,239 (nearly 24%) (U.S. Census 2010a; State of Maryland 2012).

Based on the 2010 census, the median household income in the county was $48,883, below the state average of $69,193. Approximately 12.4% of the county's population lived below the poverty level, more than the 9.2% state average. Sharpsburg had similar conditions to the county, with the median household income reported to be $43,663; however, only 1.1% of the population lived below the poverty level (City Data 2012; American Towns 2012). By comparison, the city of Frederick, adjacent to Monocacy, had higher statistics, with a median household income of $64,833 and an estimated 7.7% of the population living below the poverty level (U.S. Census 2010b).

The battlefield contributes to economic growth in the county and surrounding communities through spending by park visitors and park employees, as well as creating or supporting jobs at the battlefield and in the surrounding community. In 2009, it was estimated that the economic benefit contributed by Antietam to the local area was approximately $14.5 million. This includes an estimated 229 jobs in the local area (Stynes 2011).

Land Use

The predominant land use in the county is agriculture. The 2002 Washington County Comprehensive Plan identifies preservation of agriculture as a top priority for the county. The plan identifies the area around Antietam as either a Preservation District or as the Antietam Overlay District. The goal of both areas is to limit development in support of preserving the resources in the area. More specifically to the Antietam Overlay District, the goal is to provide special protection to the environment around the battlefield and to ensure that development of the land adjacent to the major roads providing access to the battlefield is compatible with the agricultural and historic character of the area (Washington County 2002).

The lands surrounding Antietam include agricultural land, with forested areas along the east bank of the Potomac River and in pockets among the various agricultural parcels that surround the battlefield. Limited residential development occurs in the land surrounding the battlefield, and is primarily associated with farms. More concentrated development is located south of the battlefield in Sharpsburg. Through state conservation easements and the Washington County Rural Legacy program, however, nearly 5,000 acres of land around the battlefield have been preserved.

Monocacy National Battlefield

Population and Economy

Monocacy is located in Frederick County, in central Maryland, to the northwest of Washington, D.C. The battlefield is located approximately three miles south of the city of Frederick. Antietam is located approximately 20 miles northwest of the battlefield.

Fredrick County's population grew nearly 20% between 2000 and 2010, from 195,277 to 233,285. This is a much greater rate of growth than the state average of 9%. As noted above, the city of Frederick grew by nearly 24% during this period of time (U.S. Census 2010b).

Based on the 2010 census, the county had a median household income of $82,598, with an estimated 5.7% of the population living below the poverty level. As stated above, the state average median household income was $69,193, with 9.2% of the population living below the poverty level. The city of Frederick had a median household income of $64,833 and an estimated 7.7% of the population living below the poverty level (U.S. Census 2010b).

The battlefield contributes to economic growth in the county and surrounding communities through spending by park visitors and park employees, as well as creating or supporting jobs at the battlefield and in the surrounding community. In 2009, it was estimated that the economic benefit contributed by Monocacy to the local area was approximately $1.8 million. This includes 27 jobs in the local area (Stynes 2011).

Land Use

As is the case in Washington County, agriculture is the predominant land use in Frederick County. The county's 2010 comprehensive plan identifies the need to preserve at least 200,000 acres of land as permanent agricultural land. The plan identifies much of the area in and around the battlefield as agricultural land. A resource conservation designation is applied to steep slopes, forested lands, wetlands, and habitats of threatened and endangered species along the Monocacy River and its tributaries, including those lands within the battlefield. In addition, a Low Density Residential (R1) zoning district is located east of the battlefield and Limited Industrial (LI) is situated on the western side of the Monocacy River. The R1 zone is the least dense residential land use pattern applied to growth areas in the county. The LI zone provides opportunities for warehousing, wholesaling, and limited manufacturing uses in addition to corporate office and research/development uses (Frederick County 2010).

The battlefield is located at the southern edge of a heavily developed commercial area south of the city of Frederick. An office complex and a lumber yard are located along the northern boundary of the battlefield, with a mall and additional large stores further to the north, around the interchange for I-270. Several industrial developments and warehouses are located on the western boundary, across the Monocacy River. The land along the eastern boundary is a mix of heavily forested land, agricultural fields, and single-family homes. Land along the southern boundary is mostly agricultural, with some residential development, mainly along MD-355 in the Araby Church rural village. Residential development is encroaching from the south as the planned community of Urbana expands north (NPS 2009c).

Manassas National Battlefield Park

Population and Economy

Manassas is located in northern Virginia, straddling the border between Prince William County and Fairfax County. The city of Manassas and Bull Run Regional Park are located to the south, and on the opposite side of I-66 from the park.

Prince William County's population grew more than 43% between 2000 and 2010, from 280,813 to 402,002 (43%). This is a much greater rate of growth than the state average of 13.0%. Fairfax County was more in line with the state average, increasing from a 2000 population of 969,749 to a 2010 population of 1,081,726 (11.5%). The nearby city of Manassas, in Prince William County, grew from 35,135 to 37,821 (7.0%) during the same decade (U.S. Census 2010d).

Based on the 2010 census, the median household income in Prince William County was $88,823 with 6.0% of the population living below the poverty level. The state average median household income was $59,372, with 10.6% of the population living below the poverty level. Fairfax County had a median household income of $102,325, with 5.6% of the population living below the poverty level. The nearby city of Manassas had a median household income of $72,150 with 11.7% of the population living below the poverty level (U.S. Census 2010d).

The park contributes to economic growth in the county and surrounding communities through spending by park visitors and park employees, as well as creating or supporting jobs at the park and in the surrounding community. For 2009, it was estimated that the economic benefit contributed by Manassas to the local area was over $4.6 million. In addition, the park supported 82 jobs in the local area (Stynes 2011).

Land Use

Unlike the other two units discussed above, Manassas is located in a more urbanized area. There are a wide range of land use designations identified by Prince William County and Fairfax County around the park. In Prince William County, the designations identify areas for future development to support employment centers, as well as lands that should be protected as environmental resources, public land, and parks and open space. In Fairfax County, the land surrounding the park falls within the county's Residential-Conservation District, which is designed to protect sensitive resources by prohibiting high-density residential development. Both counties have historic overlay districts surrounding the park, as well. These classifications are designed to identify and protect important architectural, archaeological, and historical resources (Prince William County 2010; Fairfax County 2010b).

The park is surrounded by limited amounts of residential and commercial development. Several residences border the park to the north, with the Fairfax County Country Club located north of the Bull Run stream. The eastern boundary consists of limited residential development and an active quarry, which separates the park from more intense residential development to the east. A small commercial district and the Northern Virginia Community College Manassas Campus sit along the southern border of the park, separating it from the Interstate 66 interchange. The western boundary also consists of limited residential development, with the Conway Robinson Memorial State Forest located in proximity to the park boundary.

ECONOMIC IMPACTS ON LANDSCAPING / PROPERTY VALUES FROM DEER DAMAGE

The median property value of owner-occupied units in the counties and cities surrounding the three units ranged from $233,200 to $520,500, as of the 2010 census (U.S. Census 2010a, 2010b, 2010c). Table 23 lists these figures for each county and or city that surround the given NPS unit.

TABLE 23: SURROUNDING PROPERTY VALUES

<table>
<tr><th>NPS Unit</th><th>County/City</th><th>Median Property Value in 2005-2009</th><th>State Average Median Property Value in 2005-2009</th></tr>
<tr><td rowspan="2">Antietam National Battlefield</td><td>Washington County</td><td>$233,200</td><td>$326,400</td></tr>
<tr><td rowspan="2">City of Frederick</td><td rowspan="2">$303,900</td><td rowspan="2">$326,400</td></tr>
<tr><td rowspan="2">Monocacy National Battlefield</td></tr>
<tr><td>Frederick County</td><td>$355,600</td><td>$326,400</td></tr>
<tr><td rowspan="3">Manassas National Battlefield Park</td><td>Fairfax County</td><td>$520,500</td><td>$247,100</td></tr>
<tr><td>Prince William County</td><td>$393,300</td><td>$247,100</td></tr>
<tr><td>City of Manassas</td><td>$344,400</td><td>$247,100</td></tr>
</table>

Source: U.S. Census 2010a-f.

While home values across much of the country fell as a result of the relatively recent downturn in the economy and housing market, values in the Washington, D.C. metropolitan area, which includes all of the areas listed above except Washington County, have remained fairly consistent. This is due, in part, to the high demand for housing for the large workforce in the region. As a result, the availability of affordable housing in the region has decreased dramatically in the last ten years (ULI 2009). The continued demand for housing in the region places even greater value on the effort and financial investment homeowners put in to landscaping.

Landscaping can have a significant impact on property values, enhancing the resale value of a property by up to 15%, with a treed lot selling for 7% to 14% more than a lot without trees (Nuss 2000). Furthermore, landscaping expenditures are often easily recovered when selling, with 100% to 200% of landscaping costs typically recovered (Taylor 2003). Therefore, improvements to landscaping may be seen as a successful way to improve property values.

Deer can often have a highly destructive effect on landscaping. Their diet experiences seasonal variation, which is typically a function of what is available. Browse of shrubs and vines makes up a substantial part of the diet of the average deer. As habitat dwindles due to development pressure and as deer populations grow, deer may turn to surrounding residential areas for food. This is particularly true in late fall, winter, and early spring, when other food sources may be scarce. An average adult deer consumes approximately 6 to 10 pounds of food per day during late spring, summer, and fall (McDonald and Hollingsworth 2007), which may result in increased pressure on surrounding landscaped areas from deer browsing, if available natural habitat cannot support the population. In many residential areas surrounding protected areas, such as three NPS units discussed above, deer cause virtually year-round damage to landscaping, which can be costly to replace. In the District of Columbia, for example, the District Department of the Environment considers overbrowsing to be a serious conservation threat (DDOE 2006).

Deer damage shrubs and landscape vegetation by eating the buds, leaves, flowers, and twigs, and by rubbing on the bark. In home gardens, deer often eat leaves, flowers, stems, or other edible parts. Other less frequent damage includes trampling of plants and damage to trees and shrubs caused by antler rubbing (West Virginia University 1985). Damage typically extends to an average of 6 feet, which is as high as deer can reach. Nearby Fairfax County, Virginia, estimates annual damage to landscaping resulting from deer at approximately $1 million (NPS 2011b). There is no data maintained on deer damage occurring on private lands outside Antietam and Manassas boundaries; however, the NPS works closely with its neighbors and regional management agencies about the issue. Conversations with property owners adjacent to Monocacy suggest that the landowners regularly obtain crop damage permits to exceed bag limits for deer (Banasik, pers. comm. 2012a).

ECONOMIC IMPACTS ON CROPS FROM DEER DAMAGE

This section describes existing agricultural activities in and around the three NPS units, the affect deer browse may be having on these resources, and actions that are being taken to mitigate this impact. The presentation of this information is divided between the two units in Maryland and the unit in Virginia, due to the similarities in the conditions surrounding the sites and the responses the two states have taken to deer impacts. Despite the different sections, it can be assumed that the conditions documented in one state or county would be expected throughout much of the surrounding region.

Antietam National Battlefield and Monocacy National Battlefield

Hive in Orchard at Antietam

Antietam and Monocacy both contain actively used agricultural lands. Of the approximately 3,263 acres within Antietam's legislative boundary, an estimated 1,270 acres are managed for agricultural activities (57% crop, 27% pasture, and 16% hay). Farmers currently cultivating land at Antietam under a Special Use Permit grow a variety of grains, as well as pasture and hay grasses. Primary crops are corn and soybeans; other grains grown include oats, wheat, barley, and rye. Farmers also produce a mixed hay crop of clover, orchard grass, timothy, and periodically alfalfa. Pastures contain primarily cool season fescues and bluegrass, although some orchardgrass and warm season grasses, including little bluestem, are present. In addition, several areas have been planted with trees, shrubs, or other vegetation. Ornamental trees and shrubs planted at the farmsteads include walnut, silver maple, eastern white pine, and lilac (NPS 2009c).

Deer damage to these crops is well documented. When compared with the average crop yields for farms in Washington County, Antietam agricultural cooperators experienced reductions in corn for grain and silage, soybean, and winter wheat (results highly significant at $p<0.0005$). Harvest reductions also were marginally significant with barley ($0.05<p<0.10$), while sample size remained too small to analyze alfalfa hay ($n=2$). When compared with expected crop yields for soil types, Antietam agricultural cooperators also experienced highly significant crop yield reductions in corn for grain and silage and soybeans (results highly significant at $p<0.0005$). Yield reductions of winter wheat ($0.01<p<0.025$) and alfalfa hay ($0.025<p<0.05$) also were considered significant when compared with NRCS expected yields for these crops. Overall, harvests for all crops at Antietam were significantly lower than county averages and the expected yields based on soil type and crop (NPS 2011b).

Monocacy consists of 1,647 acres, of which an estimated 765 acres are managed for agricultural activities (46% crop, 28% hay, and 25% pasture). Farmers at the battlefield currently cultivate farmland under a special use permit from the NPS and grow a variety of grains, corn, soybeans, and pasture and hay grasses on the Thomas, Best, Worthington, Baker and Lewis farms. Grains include winter wheat and winter barley. Pasture and hay grasses include orchardgrass, timothy, and alfalfa. In addition, several areas have been planted with trees, shrubs, or other vegetation. There are lines of Osage orange trees, originally planted to act as “living fences,” and stands of white pine trees around the battlefield. Ornamental plantings have recently been added near Gambrill Mill and include perennial and annual flower beds consisting of plants such as crab apple and serviceberry (NPS 2009c). Deer damage to crops at the battlefield is not as well-documented as at Antietam, but is clearly evident. A study of crop yields at the park from 2000 to 2012 showed that corn production at Monocacy was noticeably lower than the county average, with an average of 96.4 bushels per acre at the park, compared with an average of 106.4 bushels per acre in the county. However, soybean yields were slightly higher than the county average, and statistically equivalent, with an average of 36.4 bushels per acre in the park and only 32.6 bushels per acre in the county.

Agricultural lands in the region are predominantly barley, corn, soybeans, and winter wheat. The total market value of agricultural products sold in Washington County was over $83 million in 2007. Approximately 72% of the agricultural value for the county comes from animal agriculture, with 54% from dairy farming (USDA-NASS 2010a). The total market value of agricultural products sold in Frederick County was over $127 million in 2007. The composition of this production is similar to Washington County, though less of the market is based around dairy (USDA-NASS 2010b).

The agricultural areas surrounding Antietam and Monocacy are experiencing crop loss due to deer. Common damage to row and forage crops includes deer eating and trampling the crops (NPS 2009c). According to the U.S. Department of Agriculture’s National Agricultural Statistics Service (USDA - NASS), Maryland farms lost $9.3 million in potential crop production due to wildlife damage in 2010. The greatest loss was seen in North Central Maryland, which includes Washington and Frederick counties, with losses of $3 million (approximately 32% of the total estimated state losses). Deer accounted for 78% of the damage in the region. Across the state, farmers spent $560,000 on preventative measures. Of this total, $230,000 was spent in the North Central Maryland (USDA - NASS 2011).

To determine the extent of crop damage from deer occurring statewide, 1,000 Maryland grain farmers were randomly selected to receive mail surveys in March 1997 (Drake et al. 2005). All counties of the state were represented, including Washington and Frederick. Nearly 92% of farmers surveyed indicated that they suffered deer damage in 1996, with the greatest damage reported by farmers in western Maryland and on the lower eastern shore. Table 24 indicates the average harvested yield for 1996 for those farmers surveyed in central Maryland, along with the average yield loss caused by deer (both in bushels per acre and as a percentage of harvested yield).

In central Maryland, corn yield losses from deer damage averaged 9.2 bushels per acre or approximately 7.4% of the expected 124.5 bushels per-acre yield. Soybean losses were 4.8 bushels per acre, or 11.8% of the expected per acre yield, and wheat losses were the lowest at 1.1 bushels per acre or 2.0% (McNew and Curtis 1997).

Losses per acre increased for some crops between 1996 and 2001. According to data from the Maryland Agriculture Statistics Service presented in table 25 yield loss increased from 7.4% to 9.8% for corn and from 2.0% to 5.2% for wheat in central Maryland. Per bushel crop prices in 2001 were $2.18 for corn, $4.20 for soybeans, and $2.45 for wheat (MASS 2004). Therefore, per acre losses to deer averaged $20.93 in 2001.

TABLE 24: 1996 CROP LOSS DUE TO DEER DAMAGE – CENTRAL MARYLAND

Crop	Harvested Yield (bushels/acre)	Yield Loss (bushels/acre)	Yield Loss (percentage of harvested yield)	Losses (× $1,000) [a]
Corn	124.5	9.2	7.4%	3,521
Soybeans	40.6	4.8	11.8%	2,758
Wheat	56	1.1	2.0%	248

Source: Drake et al. 2005

Note: Central Maryland includes Frederick, Washington, Carroll, Howard, Montgomery, Baltimore, and Harford Counties.

[a] Dollar losses resulting from deer were determined using figures from the Maryland Department of Agriculture for total grain acreage for each county and region in 1995. Based on the acreages and damage levels suffered by sample farmers, total crop loss was estimated for each region. Regional grain prices at harvest time in 1996 were used to value the losses for each crop.

TABLE 25: 2001 CROP LOSS DUE TO DEER DAMAGE – CENTRAL MARYLAND

Crop	Harvested Yield (bushels/acre)	Yield Loss (bushels/acre)	Yield Loss (percentage of harvested yield)	Losses (× $1,000) [a]
Corn	98.2	9.6	9.8%	2,464
Soybeans	34.0	3.9	9.8%	1,479
Wheat	63.3	3.3	5.2%	310

Source: MASS 2004.

[a] Central Maryland includes Frederick, Washington, Carroll, Howard, Montgomery, Baltimore, and Hartford counties.

Deer damage to crops also occurred on fruit and berry farms. A study conducted in 1982 by Decker and Brown indicated that fruit and berry growers experienced more severe damage than did grain and crop farmers, experiencing losses that were three times greater. Despite the greater absolute monetary losses, however, slightly fewer fruit growers than other farmers reported losses greater than 10% of the crop value. Fruit growers were twice as likely as other farmers to describe their damage as “substantial” or “severe” and to consider it unreasonable (Lynch 1997).

To assist landowners in controlling deer damage, the MD DNR oversees a program to issue Deer Management Permits. This program allows landowners to harvest antlerless deer on their property outside deer hunting season. An investigator from the MD DNR is assigned to review a request for eligibility and will consider the type, extent, and severity of damage, time of year, and deer population estimates for the specific locale (MD DNR 2012). The 1996 crop damage survey, referenced above, found only 18% of the farmers had received MD DNR permits to harvest deer. For those farmers statewide who used the program, 18.8 deer were allowed to be harvested, and an average of 13.4 deer were actually harvested. In central Maryland 15% of the farmers received an average of 23 permits per farm. However, on average, only 14.3 permits per farm were used (McNew and Curtis 1997).

In 2010, a total of 8,245 deer were taken statewide on deer management permits compared to 7,858 in 2009, and 6,722 in 2008. In 2010, harvests on Deer Management Permits in Washington and Frederick counties were 346 and 464 deer respectively. These county-wide statistics were lower by 12% and 14%, respectively, from the previous year (MD DNR 2011b).

Manassas National Battlefield Park

Manassas maintains fields for cutting hay, but does not lease or maintain any other agricultural lands. Because hay is not a regular part of a deer's diet, there is not a measurable impact on these fields.

Although the area surrounding Manassas is more developed than the other two units discussed above, the region still supports agriculture. Much of this agriculture is confined to smaller clusters than in the more rural counties discussed above. In 2007, Fairfax County and Prince William County contained 7,031 acres and 32,816 acres of farmland, respectively. These figures represent a decline in farmland in Fairfax County and virtually no change in Prince William County between the 2002 and 2007 census of agriculture. These acreages translated to less farming production than the areas discussed above, with an estimated total market value of $11,000,000 for products sold in the two counties in 2007 (USDA-NASS 2010c, 2010d).

The agricultural areas surrounding the park are experiencing crop loss due to deer. Common damage to row and forage crops includes deer eating and trampling the crops (NPS 2009c). The NASS does not provide statistics on the loss of potential crop production in Virginia, as was reported above for the counties in Maryland. Data are available from a study conducted by the VDGIF, which estimated the amount of agricultural crop damage caused by deer in Virginia in 1992 at approximately $11.4 million. The majority of this damage was to soybeans ($6.3 million), peanuts ($2.0 million), and orchards ($1.9 million) (VDGIF 2007).

Additional information was obtained through a study conducted by Virginia Polytechnic Institute and State University (Virginia Tech) in 1996. The study surveyed 1,506 agricultural producers and homeowners throughout Virginia to evaluate their beliefs and opinions about deer and deer damage. Among all respondents, 58% reported experiencing deer damage during 1995. The responses received from agricultural producers highlighted the variations in occurrence and severity of damage among commodity groups, where producers of soybeans, peanuts, and tree fruits reported greater damage severity and producers of forage crops typically reported less severe damage. Among all respondents, 70% indicated a desire to reduce Virginia's deer population. As expected, the occurrence and severity of damage greatly affected respondents' desire for future population management (VDGIF 2007).

Along with general hunting, VDGIF offers several programs to assist landowners with deer damage:

- The Deer Management Assistance Program is a site-specific deer management program that increases a landowner's management options by allowing a more liberal kill of antlerless deer than could be obtained under the current system of county either-sex deer hunting day regulations. It is a cooperative effort. Landowners and hunt clubs set their own deer management goals and collect biological data on the deer they kill. In turn, a wildlife biologist from VDGIF will analyze the data and provide the cooperator with the information necessary to make informed decisions about deer management issues (VDGIF 2012a). Table 26 lists present the status of Deer Management Assistance Program throughout Virginia from 1988 to 2010.

TABLE 26: STATUS OF DEER MANAGEMENT ASSISTANCE PROGRAM, 1988–2010

Year	Number of Cooperators	Acres in Program	No. of Tags Issued	Deer Killed
1988	56	253,596	960	
1989	97	451,790	3,324	3,930
1990	156	620,092	5,039	4,584
1991	209	752,978	8,957	5,905
1992	254	845,283	10,319	11,802
1993	323	1,016,968	13,160	13,393
1994	362	1,043,528	15,934	14,384
1995	394	1,091,385	15,467	15,127
1996	436	1,131,679	16,704	14,301
1997	499	1,203,016	19,288	17,111
1998	549	1,257,550	20,427	16,393
1999	587	1,222,448	19,265	16,182
2000	613	1,228,923	19,255	16,825
2001	654	1,276,946	20,701	18,778
2002	717	1,324,956	23,209	20,297
2003	756	1,376,148	25,459	22,391
2004	803	1,445,378	26,776	22,389
2005	837	1,508,351	28,303	23,517
2006	877	1,510,934	29,370	24,121
2007	911	1,562,016	31,650	26,555
2008	932	1,591,356	33,585	28,022
2009	920	1,564,816	34,812	25,906
2010	909	1,520,803	33,856	22,540

Source: Knox, pers. comm. 2012.

Note: Deer harvested data 1989-1991 is incomplete.

- Damage Control Assistance Program (DCAP) also is a site-specific deer damage management program designed to increase a landowner's management options by allowing a more liberal harvest of antlerless deer than offered under general hunting regulations. The primary objective of DCAP is to provide site-specific assistance to control crop depredation or other property damage by deer. A landowner who demonstrates damage from deer can use a kill permit at the time of damage or may defer removing deer until the hunting season using DCAP tags. DCAP is not available in counties east of the Blue Ridge Mountains, which includes Prince William and Fairfax counties, where the general firearms deer season is full season either-sex (except Fairfax County) (VDGIF 2012b). Table 27 lists the status of DCAP throughout Virginia from 1998 to 2010.

TABLE 27: STATUS OF DCAP, 1988–2011

Year	No. of Cooperators	Acres in Program	No. of Tags Issued	Deer Killed
1988	492	244,685	14,762	Unknown
1989	485	239,156	13,891	Unknown
1990	775	384,510	22,387	Unknown
1991	629	399,621	15,549	Unknown
1992	865	458,263	21,700	6,194(29)
1993	679	329,426	16,947	4,519(27)
1994	570	301,761	14,955	3,755(25)
1995	449	101,057	2,245	Unknown
1996	505	83,057	2,525	Unknown
1997	651	136,278	5,611	1,597(29)
1998	618	137,818	5,531	1,312(24)
1999	725	214,724	6,635	1,619(24)
2000	710	190,201	6,780	1,844(27)
2001	824	229,400	8,149	2,273(28)
2002	1,104	286,352	10,560	3,078(29)
2003	1,092	272,662	10,591	3,576(34)
2004	1,074	285,534	11,067	3,246(29)
2005	1,276	366,271	12,918	4,169(32)
2006	1.332	367,140	13,839	4,009(29)
2007	1,520	437,893	15,622	5,003(32)
2008	1,784	548,368	18,655	5,850(31)
2009	915	340,487	10,927	3,774(35)
2010	815	308,201	9,649	2,035(21)
2011	708	290,144	8,291	

Source: Knox, pers. comm. 2012.

Depredation: property damage caused by wildlife.

- Kill Permits, as provided by Virginia State Statute §29.1-529 (Killing of deer or bear damaging fruit trees, crops, livestock or personal property or creating a hazard to aircraft), are issued to permit owners or lessees of land to kill deer where deer cause commercial or personal property damage. Under the kill permit system, a landowner/lessee who sustains deer damage must report the damage to the local game warden for investigation. If, upon investigation, the game warden determines that deer are responsible for the reported damage, he/she may authorize in writing that the owner/lessee, or other person designated by the game warden, be allowed to kill deer when they are found upon the property where the damage occurred.

- To gauge the demands imposed by crop damage, the VDGIF uses the number of deer kill permits issued, by management unit, as an index. The number of kill permits issued statewide to manage deer damage has risen steadily, due largely to an increase in the use of kill permits in urban areas since 1999, as kill permits issued for agricultural damage has leveled off (VDGIF 2007). Table 28 presents the status of pill permits throughout Virginia from 1989 to 2010.
- The use of these permits in Fairfax County has followed a similar trend as the state, while Prince William County has not seen as great of use over the last twenty years. Table 29 illustrates this data for Fairfax County and table 30 provides similar information for Prince William County (Knox, pers. comm. 2012).

TABLE 28: STATUS OF KILL PERMITS IN VIRGINIA, 1989–2011

Year	No. of Permits	Agricultural	Urban	Antlered Males	Male Fawns	Females	Deer Killed
1989	515						1,510
1990	809			595	297	1,776	2,668
1991	887			280	314	2,130	2,724
1992	1,111			704	607	3,045	4,356
1993	1,127			511	585	3,444	4,540
1994	1,040			253	462	3,002	3,717
1995	1,211			282	574	3,251	4,107
1996	1,324			455	523	3,072	4,050
1997	1,561			453	658	4,554	5,665
1998	1,443			480	529	4,479	5,488
1999	1,668			313	632	4,613	5,558
2000	1,340	1,075	250	353	451	4,104	4,908
2001	1,570	1,317	219	380	636	5,260	6,271
2002	1,989	1,647	294	310	872	6,593	7,742
2003	1,894	1,475	382	473	730	6,018	7,221
2004	1,892	1,337	527	362	1,023	5,202	6,587
2005	2,104	1,603	478	484	500	5,758	6,742
2006	2,235	1,683	524	494	621	6,976	8,091
2007	2,567	2,068	454	234	658	9,009	9,901
2008	3,223	2,687	528	424	754	13,348	14,526
2009	3,222	2,496	712	493	873	13,777	15,143
2010	2,583	2,118	452	321	567	11,685	12,573
2011	2,131	1,807	306	358	362	9,976	10,696

Source: Knox, pers. comm. 2012.

TABLE 29: VDGIF KILL PERMITS ISSUED IN FAIRFAX COUNTY

Year	Number of Permits Issued	Antlered Males	Button Bucks	Females	Total
1989	5	0	0	25	25
1990	3	1	0	3	4
1991	19	4	2	35	41
1992	18	18	4	21	43
1993	42	23	59	140	222
1994	31	6	38	87	131
1995	65	15	48	130	193
1996	165	35	42	167	244
1997	147	1	68	241	310
1998	143	19	10	268	297
1999	203	12	68	364	444
2000	197	27	28	208	263
2001	148	51	61	286	398
2002	187	16	25	208	249
2003	173	59	28	224	311
2004	217	31	42	206	279
2005	191	26	35	166	227
2006	168	33	40	185	258
2007	152	30	27	188	245
2008	140	20	47	208	275
2009	182	15	7	189	211
2010	152	36	30	337	403

Source: Knox, pers. comm. 2012.

TABLE 30: VDGIF KILL PERMITS ISSUED IN PRINCE WILLIAM COUNTY

Year	Number of Permits Issued	Antlered Males	Button Bucks	Females	Total
1989	0	0	0	0	0
1990	4	0	0	3	3
1991	1	0	0	4	4
1992	0	0	0	0	0
1993	4	0	1	5	6
1994	5	0	1	6	7
1995	5	2	0	2	4
1996	20	21	18	58	97
1997	13	0	1	12	13
1998	11	1	7	42	50
1999	11	11	11	35	57
2000	9	0	3	22	25
2001	5	0	1	9	10
2002	14	16	16	41	73
2003	11	16	5	34	55
2004	24	21	5	79	105
2005	10	7	5	47	59
2006	21	3	7	57	67
2007	21	2	11	61	74
2008	19	1	4	64	69
2009	21	0	0	35	35
2010	9	0	1	19	20

Source: Knox, pers. comm. 2012.

VISITOR USE AND EXPERIENCE

Several of the potential deer management actions may require limiting public access within the battlefields, which could affect visitor experience of both the natural and cultural resources at the battlefields.

ANTIETAM NATIONAL BATTLEFIELD

Visitation

Visitor Distribution

Visitors to Antietam typically spend about a half day at the battlefield, and half the day participating in programs at the visitor center and driving the tour route (NPS 1992). Visitor surveys are completed annually by the battlefield and are a source of information on visitor satisfaction. Since 2004, on average, 98% of visitors to Antietam each year have indicated that they were satisfied with appropriate park facilities, services, and recreational opportunities (NPS 2009c).

Seasonal Use Patterns

Approximately 312,970 people visit Antietam annually, as shown in table 31.

TABLE 31: ANNUAL VISITATION AT ANTIETAM NATIONAL BATTLEFIELD

Year	Annual Visitors	Percent Change from Previous Year
1998	275,385	—
1999	268,897	-2.36%
2000	286,896	6.69%
2001	303,599	5.82%
2002	303,209	-0.13%
2003	279,694	-7.76%
2004	237,885	-14.95%
2005	295,309	24.14%
2006	282,676	-4.28%
2007	337,569	19.42%
2008	352,548	4.44%
2009	378,966	7.49%
2010	393,957	3.96%
2011	384,987	-2.28%
Average	**312,970**	**2.87%**

Visitation has fluctuated greatly over the past 14 years, with an average annual growth of 2.87%. Visitation is highest in July, with almost 81,000 visitors in 2011, and lowest in January, with just over 4,200 visitors in 2011, as shown in table 32 (NPS 2012c).

TABLE 32: ANTIETAM NATIONAL BATTLEFIELD 2011 MONTHLY VISITATION

Month	Visitation
January	4,285
February	7,436
March	15,207
April	24,457
May	37,267
June	48,045
July	80,987
August	44,339
September	38,971
October	40,095
November	21,531
December	22,367
2011 Total	**384,987**

Visitor Activities

Visitors come to the battlefield because it is one of the best-preserved Civil War battlefields in the country. A 9-mile tour road allows for a self-guided tour of the battlefield. Included along the tour route are several hundred War Department markers that provide detailed descriptions of the actions during the battle.

Other outdoor activities include the following:

- Hiking—Trails are located throughout the battlefield, including the Cornfield Trail, the Antietam Remembered Trail, the Union Advance Trail, the Final Attack Trail, the Snavely Ford Trail, and the Sherrick Farm Trail. These trails provide access to major sites at the battlefields.
- Bicycling—Bicycling is permitted on paved park tour roads, parking lots and select park trails.

Living History Demonstration at Antietam

- Horseback Riding—Horseback riding is permitted on all paved roads and the Snavely Ford and Final Attack trails. Groups of 11 or more riders need a permit.

Burnside Bridge at Antietam

- Fishing—Fishing is permitted on the Antietam Creek with a valid Maryland fishing license, except within 500 feet of the Burnside Bridge.
- Picnicking—Picnicking is allowed except in the Antietam National Cemetery, Mumma Cemetery, inside the Dunker Church, inside the Observation Tower, on the Burnside Bridge, or on any monument.
- Boating and Tubing—These activities are popular on Antietam Creek; however, docking, removing, or putting in a boat or tube, or loading a person within 500 feet of the Burnside Bridge are prohibited.
- Camping—Camping is only allowed by permit at the Rohrbach Group Campground; only organized groups (such as Boy Scouts, Church, and School Groups) are permitted to camp.

The visitor center has a theater, exhibits, observation room, and a museum store. The center shows various audiovisual programs, and interpretive talks are conducted daily. The new Pry House Field Hospital Museum served as Union Commander General George B. McClellan's headquarters during the battle and is open daily during the summer. Exhibits include a re-creation of an operating theater, interpretive panels and objects relating to the care of wounded and the effects on the civilian population in the area, and information on the Pry House.

MONOCACY NATIONAL BATTLEFIELD

Visitation

Visitor Distribution

A visitor use survey was conducted in the summer of 2006 (NPS 2006b). Data gathered from the survey showed that visitors to Monocacy come primarily from Maryland (43%), Pennsylvania (9%), and Virginia (7%), with the remainder from other states. International visitors comprised 1% of the total visitation. The majority of visitors (73%) spend one to two hours at the battlefield. The primary reason for visiting the battlefield was to learn about history (58%). The most common sites visited in the park included Gambrill Mill Visitor Center (85%) and Monocacy River (57%). The most common activities in the park were visiting the visitor center (91%) and learning history (81%). Wildlife viewing was mentioned by 19% of the respondents and was 7th in importance out of the 14 activities listed on the survey (NPS 2006b). The survey was conducted before the new visitor center opened in 2007 and prior to the substantial increase in visitation, so visitor patterns may have changed.

Seasonal Use Patterns

Prior to 2007 when the new visitor center opened at Monocacy, approximately 16,000 people visited the battlefield annually (table 33). However, since the visitor center opened in late June 2007 visitation has increased dramatically, with the number of visitors in 2008 (31,276) nearly doubling the annual average number of visitors prior to 2007 (NPS 2012c). Prior to 2008, visitation was highest in July; however, in 2008, July had the third lowest number of visitors for the year, with just fewer than 2,000 visitors. For 2008, visitation was highest in October, with almost 4,500 visitors, while January had the lowest visitation, with just under 1,000 visitors (NPS 2012c). In 2011, visitation was again highest in October with 4,123 visitors, and lowest in January with 2,261 visitors, as shown in table 34 (NPS 2012c).

TABLE 33: ANNUAL VISITATION AT MONOCACY NATIONAL BATTLEFIELD

Year	Annual Visitors	Percent Change from Previous Year
1998	15,563	—
1999	14,834	-4.68%
2000	18,198	22.68%
2001	18,095	-0.57%
2002	15,592	-13.83%
2003	14,566	-6.58%
2004	18,145	24.57%
2005	17,985	-0.88%
2006	18,579	3.30%
2007	22,125	19.09%
2008	31,276	41.36%
2009	34,553	10.48%
2010	33,313	-3.59%
2011	36,674	10.01%
Average	**22,107**	**7.24%**

TABLE 34: MONOCACY NATIONAL BATTLEFIELD 2011 MONTHLY VISITATION

Month	Visitation
January	2,261
February	2,408
March	3,565
April	2,955
May	3,103
June	4,107
July	2,645
August	2,624
September	2,791
October	4,123
November	3,151
December	2,941
2011 Total	**36,674**

Visitor Activities

Primary visitor activities at Monocacy include a 6-mile, self-guided auto tour of the battlefield and several hiking trails. The trails located at the Gambrill Mill and on the Worthington and Thomas farms provide interpretation of the Battle of Monocacy and access to scenic areas of the park. Fishing and canoeing on the Monocacy River, which runs through the national battlefield, are also popular pastimes.

Monocacy opened a visitor center on the north end of the Best Farm in June 2007. This visitor center includes interactive and multimedia exhibits related to the battle, historical artifacts interpretive displays, and a bookstore. Special interpretive events are offered, usually in summer, to attract more visitors to Monocacy and to reach out to new audiences. These events often focus on specific themes or activities and also incorporate events that help to explain the importance of the battle, and the park, in the larger context of the American Civil War.

MANASSAS NATIONAL BATTLEFIELD PARK

Visitation

Seasonal Use Patterns

The visitor use and patterns of use described in this section provide background for understanding levels of use and impacts of this use on the park's resources. Visitor use data have been collected for many years. Recreational visits for the last 14 years are depicted in table 35. Monthly visitation numbers are listed in table 36, and are indicative of the normal park visitation patterns at Manassas (NPS 2012c).

Annual visitor use figures are presented in table 35. Annual visitor use at the park fluctuates from year to year. While it has increased slightly, visitation has generally been stable, with an average of 3.10% decrease over those 13 years. A similar trend is expected in the future (NPS 2008a).

TABLE 35: ANNUAL VISITATION AT MANASSAS NATIONAL BATTLEFIELD PARK

Year	Annual Visitors	Percent Change from Previous Year
1998	972,709	—
1999	815,338	-16.18%
2000	692,006	-15.13%
2001	822,684	18.88%
2002	779,147	-5.29%
2003	759,953	-2.46%
2004	722,132	-4.98%
2005	715,622	-0.90%
2006	674,851	-5.70%
2007	584,926	-13.33%
2008	594,992	1.72%
2009	578,383	-2.79%
2010	612,490	5.90%
2011	659,740	7.71%
Average	**713,212**	**-2.32%**

TABLE 36: MANASSAS NATIONAL BATTLEFIELD PARK 2011 MONTHLY VISITATION

Month	Visitation
January	33,425
February	29,357
March	45,229
April	96,617
May	94,182
June	62,709
July	85,773
August	56,468
September	48,679
October	60,192
November	25,824
December	21,285
2011 Total	**659,740**

Summer visitation is considerably higher than winter visitation. However, pleasant weather, combined with spring blossoms or autumn foliage, create peak visitation during spring and fall weekends (NPS 2008a).

As described above, the heaviest use of the park occurs during fall and spring weekends. At these times, local use increases dramatically. Seasonal variations are as follows:

- Spring: heaviest use occurs on weekends and is usually concentrated around Stone Bridge, the visitor center, and the surrounding area. Increased use by seniors and school groups occurs, as well as more use by hikers, joggers, and picnickers.
- Summer: family groups on extended vacations dominate the park. Peak daily use occurs between the hours of 11:00 a.m. and 4:00 p.m. The heaviest use is on the weekends.
- Fall: senior citizen and organized tour use increases, especially in October. Use is concentrated on weekends. Area residents make increased use of the park for recreational activities.
- Winter: visitation is the lightest of any season. Area residents and business commuters predominate during this period. Heaviest use occurs during periods of snowfall, when cross-country skiing, sledding, and snow play are the main attractions (NPS 2008a).

Visitor Activities

Resources available for visitor use include one visitor center, one visitor contact station, a picnic area, 5,071 acres of battlefield park, 12 miles of tour road, 150 interpretive park signs, 21 miles of hiking trails, and 23 miles of bridle trails (NPS 2008a).

The battles, location, historic resources, and historic significance of Manassas make it unique among the many parks and recreational areas of the affected region. The Henry Hill walking tour is the primary way that visitors experience the Battle of First Manassas; whereas, the park's driving tour is the primary way for people to experience the Battle of Second Manassas. The park also features walking, hiking, and horseback riding facilities (NPS 2008a). There is also a picnic area and shelter at Brownsville, and fishing in the park ponds.

Picnicking and hiking are available at the 400-acre Conway Robinson Memorial State Forest, which is 1/4 mile west of the park. In addition, numerous other parks and recreation facilities within the local area provide a wide variety of public recreational opportunities (NPS 2008a).

Bull Run Regional Park, operated by the Northern Virginia Regional Park Authority, is approximately 4 miles east of the Henry Hill visitor center. This facility features a broad range of recreational activities, and accommodates large groups' special events (NPS 2008a).

A visitor survey from 1995 revealed that common visitor activities include visiting the visitor center museum (83% of total respondents), using the information desk (74%), viewing the battle map (74%) and watching the slide program (67%). The least common activity was using the horseback riding trails (1%). Other activities mentioned by visitors included walking for exercise, watching history presentation at Stone House, picnicking and taking photographs (NPS 1995). The same study found that the most commonly visited sites at Manassas were Henry Hill (82%), Stone House (69%) and Stone Bridge (64%). The least visited site was Hazel Plain (30%) (NPS 1995b).

CULTURAL LANDSCAPES

Cultural landscapes are an issue in deer management because an overabundance of deer and resultant deer browse could adversely affect the cultural landscapes within the battlefields, as could the erection of fences and large exclosures. Both deer browse and fencing could damage the integrity and character of the cultural landscapes, including the spatial patterns of open versus wooded land and the viability of the historic agricultural landscape, such as crops, orchards, and pasture lands. On the other hand, the presence of a certain population of deer could be appropriate to historic conditions at the battlefields.

A cultural landscape, as defined by The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for the Treatment of Cultural Landscapes, consists of "a geographic area (including both cultural and natural resources and *the wildlife or domestic animals therein*) [emphasis added] associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values" (NPS 1996). There are four general types of cultural landscapes: (a) historic sites, (b) historic designed landscapes, (c) historic vernacular landscapes, and (d) ethnographic landscapes. A historic site is a landscape significant for its association with a historic event, activity, or person (e.g., battlefields). A historic designed landscape, which includes parks and estates, is a landscape that was consciously designed or planned out by a landscape architect, master gardener, architect, or horticulturist. A historic vernacular landscape is a landscape that has evolved over time through use by the people whose activities and occupancy shaped it. An ethnographic landscape contains sites associated with traditional cultures which include both ancient Indian sites and places where cultural traditions continue today. The most common forms of cultural landscapes within the three battlefield parks are historic sites and historic vernacular landscapes.

American Civil War battlefields of the Mid Atlantic Piedmont, despite their individual characteristics, have acquired an enduring image in the public mind. They are rural landscapes of 150 years ago that were once ravaged by battles and later hallowed as a place for commemoration and reflection.

It is a characteristic of battlefields as cultural landscapes that they usually incorporate complex overlays of vernacular landscapes, features associated with the conflict, and later commemorative interventions such as statuary, memorials, visitor facilities, and cemeteries. Their periods of significance are necessarily quite long to accommodate these layers. Landscape features such as the amount and location of tree cover may have changed greatly in portions of the battlefield before and after the battle; trees were often cut for firewood or to create barriers. The resulting cultural landscape is not that solely of the land as it existed prior to battle nor as it was subsequently preserved and embellished as a park for reflection, commemoration, and repose. It is a landscape which derives its significance from the memory of the human sacrifice of the only fratricidal war in the United States.

The three battlefield parks covered in this environmental impact statement (EIS) each constitute cultural landscapes in their entirety; however, they may be subdivided into component landscapes. The systematic documentation and classification of cultural landscapes, their components, and their character defining features are fairly recent developments in cultural resources practice. The NPS has developed several techniques beyond the National Register historic district nomination to address the unique qualities of cultural landscapes. One is the Cultural Landscape Inventory (CLI) which identifies and documents the characteristics of a cultural landscape that make it significant and worthy of preservation. CLIs permit the NPS to collate and evaluate information on the location, historical development, and features of the cultural landscapes that will assist park managers in their planning, programming, recording treatment, and management decisions.

As of the writing of this EIS, the documentation of the three battlefield parks in CLIs (and in more detailed studies known as a Cultural Landscape Reports or CLRs) is not uniform so other more conventional forms of historic resource documentation, such as NRHP nominations, as well as park General Management Plans (GMPs) have been used. The NRHP recognizes the cultural landscape categories defined in NPS policy as descriptive terms; however, it officially lists the landscapes as either "districts" or "sites." The NPS's GMPs often establish a specific period that the management of the park landscape will be focused on preserving or recreating.

The existing status of documentation for the cultural landscapes of the three battlefield parks is as follows:

- Antietam National Battlefield
  - Antietam 2002 GMP (for the battlefield as a whole)
  - Mumma Farmstead CLI (NPS 2009g)
  - Roulette Farm CLI (NPS 2009h)
  - D.R. Miller Farm CLI (NPS 2011q)
  - Antietam National Cemetery CLI (NPS 2011p)
  - Joseph Poffenberger Farmstead (NPS 2008b)
  - Parks Farmstead CLI (NPS 2011q)
  - Newcomer Farmstead CLI (NPS 2012g)
- Monocacy National Battlefield
  - Best Farm CLR (NPS 2005d)
  - Thomas and Worthington Farmsteads Cultural Landscape Report (NPS 2012b)
  - Monocacy National Battlefield CLI (NPS 2000)
  - Thomas Farm Cultural Landscape Assessment (NPS 2009a)
- Manassas National Battlefield Park
  - Manassas National Battlefield Park 2002 NRHP Nomination and 2008 GMP (NPS 2008a)
  - Field, Fences and Forests Cultural Landscape Report (NPS 2012h)
  - Groveton Confederate Cemetery CLI (NPS 2011r)

ANTIETAM AND MONOCACY NATIONAL BATTLEFIELDS IN MARYLAND

Both Antietam and Monocacy were designated as national battlefields because of the important roles they played during the American Civil War. Antietam was listed in the NRHP for military, conservation, and politics/government significance and place in national events of the period 1850–1874 (36 CFR 60.4 – criterion [a]) (NPS 2009e). Monocacy was also listed in the NRHP for its military significance and place in national events of the period 1850–1874 (36 CFR 60.4 – criterion [a]) (NPS 2009e).

Antietam was designated as a historic battlefield in 1890. It was listed on the National Register of Historic Places on October 15, 1966. The entire battlefield, including the private properties within the boundary, is listed on the National Register of Historic Places as a historic district. Contributing features to the cultural landscape of the battlefield include farm fields, woods, orchards, and fence lines that were known to exist just before the battle. Also contributing are the commemorative period features, which include the observation tower, battle markers, and monuments (NPS n.d.a).

Antietam preserves an area that has deep national significance. The battlefield is considered one of the best-preserved Civil War areas in the national park system. The farms and farmlands in and near the national battlefield appear much as they did on the eve of the battle in 1862. In the 1890s, veteran organizations from the various states erected monuments commemorating the regiments that engaged in the battle as well as larger state monuments honoring all the military units from a particular state (NPS n.d.a).

CLIs have been conducted for four major areas of this battlefield park. These inventories identify and document each landscape's location, size, physical development, condition, landscape characteristics, and character-defining features, as well as other valuable information useful to park management. These cultural landscapes and their areas of significance are described briefly in table 37 (NPS 2009c).

TABLE 37: FARMSTEADS AND DESIGNATED CULTURAL LANDSCAPES AT ANTIETAM NATIONAL BATTLEFIELD

Name	Description
Mumma Farmstead	Property associated with the Samuel Mumma Farmstead at the time of the Battle of Antietam on September 17, 1862; buildings include the main farm house and large bank barn, both constructed less than a year after they were burned by Confederates during the Battle of Antietam, as well as numerous smaller outbuildings (NPS 2003).
Roulette Farm Component Landscape	Consists of the entire 179.5-acre property constituting the William Roulette Farmstead as it existed at the time of the Battle of Antietam.
Miller Farm	Consists of 141.41 acres of the property constituting the D. R. Miller Farmstead as it existed at the time of the Battle of Antietam. The D. R. Miller Farmstead Component Landscape is significant in three distinct periods of history (NPS 2005f).
Antietam National Cemetery	Stands out for its concentration of large evergreen trees, predominantly Norway spruce (*Picea* spp.) and hemlock (*Tsuga* spp.), which are not native to the immediate area; an imposing limestone wall, dating from 1867, but rebuilt in 1939, encloses the 10-acre cemetery and its landscaped grounds on the east, south and west (NPS 2005g).

Monocacy was listed in the NRHP in 1966, and its nomination was updated recently to include new properties. Except for the Gambrill House, which was individually listed on the NRHP in 1984, the other historic structures in the national battlefield are listed as contributing resources to the battlefield's NRHP nomination.

In 1973, the Secretary of the Interior designated the national battlefield a National Historic Landmark, recognizing it as a site of exceptional importance possessing national significance. A cultural resource study for the national battlefield was undertaken in 1999 and has been updated several times to reflect new research and property acquisitions (NPS 2009f).

The NPS completed a CLI of the entire national battlefield in 2000 (NPS 2000) and a number of recent architectural, archeological, and historic research projects have contributed greatly to understanding the national battlefield's cultural landscape. Such studies also have helped to establish the historic context of the national battlefield's many cultural resources.

Before the Civil War, the area now occupied by the battlefield was a productive agricultural and milling community surrounding Monocacy Junction and other important transportation features in the vicinity. The rolling hills of the Monocacy River Valley were fertile lands on which a variety of crops were produced, ranging from corn, wheat, and other small grains to vegetables and dairy products.

The properties that make up Monocacy reflect nearly three centuries of historic occupation and development around the Monocacy River crossroads. The buildings, structures, circulation systems, materials, organization, and open space all contribute to the historic agricultural, milling, and early twentieth century commemorative landscape qualities of the battle site. Monocacy's many remaining historic structures combine with the railroad, highways, and farm fields to form a remarkably intact eighteenth and nineteenth century agrarian landscape.

The five component farmsteads that make up the cultural landscape for Monocacy include: the Hermitage, the Araby community, Baker Farm, Hill Farm, and Clifton (Worthington). A number of eighteenth and nineteenth century dwelling houses and agricultural outbuildings were clustered on the battlefield's five component farmsteads, along with mills, warehouses, and other structures associated with the Gambrill milling complex. Many of these structures are still extant on the battlefield landscape. The five farmsteads are described briefly in table 38 (NPS 2009f).

TABLE 38: FARMSTEADS AT MONOCACY NATIONAL BATTLEFIELD

Name	Description
Hermitage Farmstead	748 acres, located generally within the area shown as "Best Farm"; the number of slaves recorded to work the area suggests plantation type agriculture. The farm's intact spatial arrangements are important: edges of fields, dimensions of yards, and road traces. In addition to the Main House, other structures, and three Civil War monuments, the trees in the front yard and at drainage along the entrance road, the field and fence lines, yards, and vegetable garden site are defining features.
Araby Community	1,111-acre property; between 1812 and 1832, John McPherson and his son assembled various portions of adjacent tracts that became known as the Araby Community, which generally encompasses the properties known since the mid-19th century as the Gambrill and Thomas Farms, as well as part of the Worthington Farm.
Clifton Farmstead	Located in the general area shown as "Worthington Farm"; Clifton had a very productive agricultural enterprise during the period before the Battle of Antietam. After the battle the agricultural industry continued to prosper in this area. By 1860 the properties that would one day make up the Monocacy were in their present recognizable form (NPS 2000).
Thomas Farm	The Thomas Farm is a 299-acre property purchased by C.K. Thomas in 1862, and had been part of the Araby community until it and the Worthington Farms (Clifton) were sold in the early 1860s.
Baker Farm	Purchased in 1841 and is composed of 500-acres; Baker Farm shared the characteristics of neighboring farms: fertile soil, access to water, woodlands, and links to both the Georgetown and Buckeystown pikes via Baker Valley Road.
The Hill Farm	10 acres of land purchased in 1819; includes that area located south and east of the Baker Valley Road, the southernmost portion of the battlefield.
Best Farm	The Best Farm is a 274-acre southern portion of a much larger property called L'Hermitage, owned by the McElfresh and Trail families from 1835 to 1924. The Best family, for which the farm is named, farmed the south Hermitage land for 56 years during this time.

Layered upon this eighteenth and nineteenth century agrarian (agricultural or farming) landscape is an early twentieth century Civil War commemorative component, along with other features associated with NPS management functions. Monocacy preserves a unique "crossroads community" whose diverse history spans more than 250 years. These landscape layers combine to result in a high level of integrity, character, and feeling (NPS 2009f).

MANASSAS NATIONAL BATTLEFIELD PARK IN VIRGINIA

The following information is excerpted from the 2004 official nomination to the NRHP of the Manassas Battlefield Historic District (NPS 2004e). The historic district contains approximately 6,469.54 acres of Virginia landscape historically significant for its association with the First Battle of Manassas on July 21, 1861, and the Second Battle of Manassas on August 28–30, 1862. Prior to the military conflicts, the property was agricultural in nature with scattered eighteenth- and nineteenth-century plantations and rural farms. By the end of the war, however, nearly all of the eighteenth century houses had been destroyed by troops passing through the region; several of the nineteenth century dwellings were severely damaged or destroyed during the fighting; and the agricultural landscape was scarred. In the Reconstruction decades following the war, commemorative markers, cemeteries, and historical monuments began to grace the land that had only partially returned to its agricultural roots. Preservation and commemoration of this hallowed ground became a priority, ultimately the park was established by Congress in 1940. The land outside the boundaries of the NPS reserve, property that was historically associated with the battles, largely remained rural in nature, with a limited number of late-twentieth-century housing developments and commercial ventures. Today, the battleground is sufficiently intact to allow vistas not unlike those observed by the commanding generals and the thousands of soldiers who fought there. The battlefield retains integrity of location, setting, feeling, and association with the historic events that occurred on the property during the Civil War. With reference to the man-made resources, such as the dwellings, military embattlements, and the Unfinished Railroad, Manassas Battlefield has integrity of design, workmanship, and material. The Manassas Battlefield Historic District has 126 contributing buildings, sites, and objects dating from the period between 1820 and 1942, and 254 non-contributing buildings and sites. Of these 380 resources, 231 buildings, sites, and objects are located within the boundaries of the Manassas National Battlefield Park Historic District, originally designated in 1981. A cultural landscape report has been prepared for the park's fences, fields and forests, and for Brawner Farm, which was the site where the second battle of Manassas opened. A CLI was prepared for Groveton Confederate Cemetery (table 39).

TABLE 39: FARMSTEADS AND DESIGNATED CULTURAL LANDSCAPES AT MANASSAS NATIONAL BATTLEFIELD PARK

Name	Description
Brawner Farm	Brawner Farm is an approximately 319-acre property that was the site of the opening conflict of the Second Battle of Manassas.
Groveton Cemetery	Groveton Confederate Cemetery is a 300 x 130 foot cemetery in the vicinity of the Lucinda Dogan House, near the intersection of Lee Highway and Featherbed Lane. The cemetery allowed for the removal of the Confederate casualties from the battlefields, which allowed the land to be returned to cultivation in the late 1860s.

The undulating battlefield features natural elements including small streams and ridges that proved to be significant landscape components during the Civil War battles. Bull Run, beginning at Cool Springs Gap in the Bull Run Mountains, travels along the county border of Prince William and Loudoun Counties. A chief tributary, the stream defines the battlefield to the east as it moves southeast into the Occoquan River

With the growth of agriculture, well-established roads traversing the future battlefield afforded direct routes to neighboring mills, centers of commerce, and local ports.

By the middle part of the 19th century, transportation in the area had been further augmented by the laying of the Orange & Alexandria (1853) and the Manassas Gap (1854) railroad lines. The expansion of the Manassas Gap Railroad forever branded the rural landscape in 1854, when the company began constructing a 35-mile railroad embankment that was to continue the line from Gainesville to Bull Run at

Sudley Mill. An expansion route was ultimately abandoned by the railroad company with no ties set and no rails laid. This man-made feature, located about one-half mile north of the intersection of today's Route 234 and Interstate 66, proved to be one of most significant landscape features in the Second Battle of Manassas by providing ready-made fortifications. At the time of the battle, the grade was overgrown, with its straight-engineered lines largely obscured by grass, cedars, and brush. Furthermore, farm fences had encroached upon the right-of-way and ran along the top of the embankment.

A significant element during the Civil War battles, the first Stone Bridge was originally constructed in 1825 to allow access over Bull Run. The private turnpike company extending the Fauquier and Alexandria Turnpike westward provided funding for the construction of the bridge. Documentation records that the original bridge consisted of two arches, spanning about twenty feet each. In 1862, with the removal of Confederate troops from Manassas, the bridge was intentionally destroyed to prevent Federal forces from gaining easy access to the area. Reflecting traditional land use rather than later development trends, nearly half of the battlefield property is presently forested; the remainder is open land. The NPS uses a lease program for hay production in an effort to maintain these open areas. The many successions of forest growth include dogwood, red maple, sumac, woody vines, pine, cedar, oak, ash, and hickory. This growth has obstructed close to 45% of the historic vistas significant to the battles, occupying portions of the once open pastures and cultivated fields of Chinn Ridge, Bald Hill, Stuart's Hill, and Henry Hill. Henry Hill, however, does maintain most of its open character with views to the John Dogan House, Buck Hill, and Matthews Hill. A narrow corridor was cleared in the third quarter of the 20th century from Henry Hill at the Visitor Center to Chinn Ridge as an interpretive viewing corridor but that vista has not been maintained. Significant views to the Stone Bridge from the ridge east of Van Pelt are no longer evident due to the growth of riparian vegetation between the ridge and the bridge. Although the view southwest from Pittsylvania (the principal colonial residence that once stood on the battlefield) to Henry Hill is still clear, the vista to the west is blocked by mature trees. The scene from Stuart's Hill, a panoramic vantage afforded Robert E. Lee during the second battle, is overgrown. However, a narrow corridor has been cleared to provide the effect of the vista northward to Brawner Farm.

The 2008 General Management Plan for Manassas

The 2008 GMP and EIS for Manassas adopted as its preferred alternative "The Two Battles of Manassas: A Comprehensive Understanding of Each Battle" with implications for the ongoing management of cultural landscapes (NPS 2008a). The following information on the existing conditions and the intended treatment of the Manassas historic landscapes is excerpted from that document:

> Like many Civil War battlefields, Manassas National Battlefield Park is much more heavily wooded now than during the war. However, portions of the park still retain their wartime appearance. The continuity of agrarian patterns from the 19^{th} century period of the two battles of Manassas through the 20^{th} century establishment of the park, as well as the fact that major road alignments (such as U.S. Route 29 and VA Route 234) generally follow their wartime alignments, have helped the park keep its Civil War-era atmosphere. Unfortunately, the heavy traffic on these roads makes interpretation of some of the battle stories difficult and inhibits visitor appreciation of the historic battlefield landscape…
>
> The historic battlefield landscape constitutes the park's most important resource and provides the setting for understanding the events of the Civil War battles fought here. Although the ground cover has changed in some areas, the terrain remains largely unaltered, and key landscape features survive. Within the battlefield landscape are numerous resources that contribute to the park's significance, including historic buildings, archeological sites and ruins, remnants of historic fence lines, cemeteries and

> burial sites, traces of wartime roads and farm lanes, the reconstructed Stone Bridge, and the graded bed of the Unfinished Railroad…

Under the preferred alternative of the GMP:

> …preparation of a cultural landscape report would precede the rehabilitation of the battlefield landscape. Clearing trees in areas that were not forested during either battle and returning the landscape to grasslands and/or scrubland would convert the landscape to more of a semblance of its historic appearance. Vistas of the battlefield would again show the relationship of hills, ridges, and water features to the positions of the embattled Union and Confederate troops, and would contribute to a better understanding of both battles by the visitor…
>
> Removing the U.S. Route 29 bridge over Bull Run would eliminate a modern intrusion from the viewshed of the stone bridge and the battlefield landscape…
>
> Any new construction for a Second Manassas visitor contact station at the Brawner Farm and a new access road and bridge over Bull Run would be carefully sited to be as visually unobtrusive as possible and to minimally affect the scale and visual relationships among character-defining landscape features. Sensitive design of the new facilities, the use of appropriate materials and colors in construction, and select plantings of native vegetation as visual buffers, if necessary, would permit new facilities to be as compatible as possible with the historic landscape…
>
> Careful design would ensure that the rehabilitation of parking areas and the expansion or development of trails would minimally affect the scale and visual relationships among landscape features. In addition, the topography, vegetation, circulation features, and land use patterns of any historic district or cultural landscape would remain largely unaltered…
>
> Restricting access to U.S. Route 29 and VA Route 234 by commuter traffic and commercial trucks would reduce dissonant sights and sounds that currently intrude on the battlefield landscape.

The Brawner Farm CLR: A Representative Analysis of a Component of the Manassas Battlefield Park

Black Horse Calvary Demonstration at Manassas

A draft Cultural Resources Report was prepared by the NPS after the 1983 GMP for the park identified Brawner Farm as the primary interpretive site for the Second Battle of Manassas. The CLR attempted to determine what remained of the landscape conditions existing at the time of the war for seven subareas. It also analyzes the historic use of this site as a typical agricultural landscape of the Virginia Piedmont. It may be taken as a representative narrow gage focus on an important component of the overall

Manassas cultural landscape. The goals and some findings of the CLR which are relevant to the EIS are as follows:

> Because there are uncertainties about the historic appearance of Brawner Farm, restoration as an overall strategy is not viable. In addition, strict restoration would affect the decision to retain the farmhouse, since it is likely that none of the standing structure (except some of the foundation) existed on this site at the time of the Civil War. Therefore, the strategy proposed is rehabilitation. Rehabilitation focuses on site adaptation for new uses. Here the new use is the interpretative program for the landscape, which will allow greater understanding of the battle. It is also important that the uninterrupted continuum of agricultural use still visible on the landscape remain readable, which rehabilitation allows for. (NPS 2004f)
>
> With rehabilitation as the overarching strategy, the treatments of preservation and restoration can be applied to certain features or portions of the landscape. The preservation of conditions on Brawner Farm as they appear today, such as the majority of field and fence patterns, is termed “preservation.” The clearing of woodland to create patterns of open fields and woods that existed at the time of the Civil War can be termed “restoration.” Full restoration of the historic patterns of woods and open fields is not possible because of limited knowledge. Environmental considerations, such as the need to buffer all streams, also place limitations on vegetative changes. The re-establishment of fences in historic styles, reintroduction of the orchard, and re-establishment of the historic entrance road from Route 29 are other changes that come within the umbrella of “restoration.” (NPS 2004f)
>
> Rehabilitation, however, guides the changes in the yard, the work on the farmhouse, and the development of a new entrance road, parking lot, and pedestrian path to accommodate visitors. For areas of the farm beyond the Historic Core, preservation is the most appropriate strategy. (NPS 2004f)

The CLR contains much detail from the historic record about the exact location and species compositions of stands of trees, vistas, structures, fence lines, roads, and crops and orchards. It lays out a considered plan for reaching a goal of treatment.

Conclusion

The description of the Affected Environment of the three Civil War battlefield parks above presents necessarily limited information on the history, setting, significant contributing features, and feeling and association of these remarkable historic sites as cultural landscapes. However, only certain contributing features, such as tree lines, orchards, crops, and - by extension - views and vistas are vulnerable to the degradation by the deer browsing. Therefore the discussion of this topic in chapter 4, Environmental Effects, will focus on that narrower issue.

HEALTH AND SAFETY

Deer management actions and activities all have safety implications for employees and visitors, especially if firearm use is considered. Deer-vehicle collisions are of particular concern to residents and commuters. The NPS is committed to providing appropriate, high-quality opportunities for visitors and employees to enjoy parks in a safe and healthy environment. Further, the NPS will strive to protect human life and provide for injury-free visits.

The general management planning process identified the following optimum conditions related to visitor use and experience that influence health and safety:

- a safe healthful environment is provided for visitors and employees; management actions strive to protect human life and provide for injury-free visits
- park visitors assume a substantial degree of risk and responsibility for their own safety when visiting areas that are managed and maintained as natural, cultural, or recreational environments
- effective law enforcement occurs as part of a cooperative community effort; the park encourages and assists park neighbors in the development of cooperative crime prevention and detection programs

Health and safety applies to Antietam, Monocacy and Manassas visitors, local residents, and employees at all three battlefields.

ANTIETAM NATIONAL BATTLEFIELD

General Health and Safety Issues

General health and safety issues present at the park primarily deal with both visitor and employee safety and injuries. A visitor injury is described as physical harm or illness that is observed or reported to the NPS that requires the medical attention beyond the basic first aid level. Visitor injuries at the park have typically been as a result of falls, cuts, and bicycle accidents. Visitor injuries at Antietam from 2001 to 2011 are presented in table 40. Of these accidents none were reported to have been caused by deer.

TABLE 40: VISITOR INJURIES AT ANTIETAM NATIONAL BATTLEFIELD, 2001–2011

Year	Visitor Injuries
2001	4
2002	2
2003	1
2004	1
2005	2
2006	3
2007	2
2008	2
2009	3
2010	1
2011	1

Source: NPS 2009c; Wenschhof, pers. comm. 2012a.

To promote safety, inspections are conducted for all visitor use and public areas, both by the Risk Management Committee and staff during their daily duties. Protection rangers (law enforcement) are responsible for visitor safety monitoring on a daily basis and provide visibility and investigation for the protection of persons and property, traffic safety programs, and monitoring of visitor activity patterns.

Employee injuries mostly have been caused by insect bites, equipment handling, falls, and poison ivy. Reported employee injuries that resulted in lost time from 2001 to 2011 are listed in table 41. Of all employee injuries none have been reported to have been caused directly from a deer.

TABLE 41: EMPLOYEE INJURIES AT ANTIETAM NATIONAL BATTLEFIELD, 2001–2011

Year	Employee Injuries
2001	2
2002	2
2003	2
2004	4
2005	2
2006	2
2007	1
2008	2
2009	5
2010	4
2011	7

Source: NPS 2009c; OSHA 2012.

The NPS is committed to employee safety and the superintendent, division chiefs, and supervisors consider safe work practices a primary element of all park management activities. The park's safety committee is responsible for developing an annual work plan that includes training, facility inspections, and reviews of accident and injury reports and near miss situations. In addition, the safety committee, in conjunction with appropriate supervisors and park staff, track and report the progress of safety audits in the areas of risk management, structural fire, industrial hygiene, housekeeping, public health, and others (NPS 2009c).

Activities that have the potential to impact employee safety are listed below:

- Equipment Use – Chainsaws, lab equipment (scalpels, formalin, chemicals), immobilization equipment/drugs, firearms, knives;
- Vehicle Use – Trucks, off-road vehicles, etc.;
- Footing Hazards – Off-road pedestrian travel, woodchuck holes, rocks, uneven terrain; or
- Miscellaneous – Bees, poison ivy, stinging nettle, ticks, chiggers, and snakes (NPS 2009c).

Deer -Vehicle Collisions

Deer-vehicle collisions are a threat to human safety and are one of the predominant sources of deer mortality. At the park an extremely dense population of deer exists, with a 10-year average of over 115 deer per square mile, with each year since 2001 increasing. In addition, Antietam is bisected by two main state highways covering 4.6 linear miles, and when mixed with a dense population of deer there is a significant potential for vehicle collisions.

Accidents at the park have been monitored and documented since 2000, and NPS staff have discovered an average of 33 accidents per year from 2000 to 2011, with a high of 55 deer in 2004. Between 2000 and 2011, 70% of all deer fatalities within the park boundary were the result of a deer-vehicle collision. In 2002, 2008, and 2011, the highest majority of all deer fatalities within the park were caused by deer-vehicle collisions: 90% in 2002 and 83% in 2008 and 2011. See table 42 for detailed yearly data. When compared with similar data on deer-vehicle collisions from the Maryland State Highway Administration a plot of these accident locations illustrates the role that the battlefield seems to play in the collisions, as a refuge for the high, local deer population, with the majority of the accidents occurring within park boundaries (NPS 2011o). Using Sullivan and Messmer's (2003) estimated cost per vehicle accident, deer vehicle collisions, within the NPS legislative boundary of Antietam cost approximately $52,041 in property damages per year. With State Farm Insurance's more liberal estimate of $3,353 per accident (Sloan 2010), annual costs could exceed $110,000 within the boundaries of Antietam. Both numbers are higher than the nationwide average for vehicle repair cost per deer vehicle collision of $1,840, with the Sullivan and Messmer estimate being substantially higher (FHWA 2008). Assuming continued increases in deer density mixed with increasing traffic counts, the potential for future deer-vehicle collisions is present.

TABLE 42: WHITE-TAILED DEER VEHICLE FATALITIES WITHIN ANTIETAM BOUNDARY, 2000–2011

Year	Vehicle-Related Deer Fatalities	Total Deer Fatalities
2000	17	23
2001	34	46
2002	26	29
2003	23	39
2004	55	73
2005	29	52
2006	20	33
2007	38	63
2008	35	42
2009	21	36
2010	41	60
2011	49	59
Total	**388**	**555**

Source: NPS 2011h.

Lyme Disease

One visitor and employee health concern related to deer management is Lyme disease and other tickborne diseases. Lyme disease is an infection caused by *Borrelia burgdorferi*, a type of bacterium called a spirochete that is carried by deer ticks (*Ixodes scapularis*). This disease organism is transmitted primarily by these ticks, which commonly attack white-tailed deer. An infected tick can transmit the spirochete to the humans. Since it was first recognized and reported in Connecticut in 1975, three areas in the U.S. are now identified where this disease organism is known to be endemic, or occurring naturally. These are areas of the Northeast (in coastal areas from northern Virginia to southern Maine), the northern Midwest (Minnesota and Wisconsin) and the West (parts of California, Oregon, Utah, and Nevada). Although most cases occur in the northeastern U.S., cases of Lyme disease have been reported in at least 39 states, with the prevalence of the disease being more common in Maryland (ALDF n.d.). Borrelia is typically transmitted to the ticks by the rodents that are principal hosts for the ticks earlier in the life cycle. Deer cannot be infected with borrelia, and do not facilitate the transmission of the disease, other than providing a host for the ticks.

From 1990 to 1999, a total of 4,067 cases of Lyme disease were reported in Maryland. During this period, the number of reported cases of Lyme disease ranged from approximately 200 to approximately 900, peaking at 899 in 1999 and with an average of 407 cases per year. Annual reported cases of Lyme disease in Washington County ranged from 0 to 6, with the peak year occurring in 1995. From 2000 to 2010 Maryland had 14,532 confirmed and probable cases of Lyme disease, peaking at 2,576 cases in 2007. In, 2010 1,617 cases were reported in the state of Maryland, of which 99 cases were reported in Washington County, the highest amount of cases seen in Washington County during the reporting period. Lyme disease cases in Washington County ranged from 10 to 99. The prevalence of Lyme disease in the park is unknown (MDH 2012).

Conflicting evidence exists to support the link between deer and Lyme disease. A 2005 NPS study at Fire Island National Seashore found that "because deer are not competent reservoirs for the disease organism, they play no direct role in the transmission cycle. Deer are, however, the primary host for the adult black-legged tick and thus indirectly affect the distribution and abundance of immature ticks" (Ginsberg 2005).

MONOCACY NATIONAL BATTLEFIELD

General Health and Safety Issues

Similar to Antietam, general health and safety issues present at Monocacy are focused on visitors and employees. In general accidents and injuries at Monocacy are rare. From 2001 to 2010 visitor injuries have been routine in nature, such as cuts, scrapes, and other injuries requiring basic minor first aid. None of these visitor injuries were serious enough to be officially reported (NPS 2009f).

From 2001 to 2010 employee injuries have also been rare and minor in nature. The most serious injuries to Monocacy staff between 2004 and 2005. One of these injuries was a strained back and the other was a shoulder injury (NPS 2008f). Battlefield staff that are most at risk of injury from deer includes staff members from the Natural Resource division who are involved in field research and would be the most likely to be affected by deer management and monitoring activities (NPS 2009f). To ensure employee safety Monocacy has made safety considerations of utmost importance, and incorporates safe work practices into all facets of park management activities. The park's safety committee is also responsible for reviewing accident injury reports and near misses, developing training opportunities for all employees, and conducting facility inspections on a regular basis.

Deer - Vehicle Collisions

Deer-vehicle collisions do occur within the battlefield boundary and on nearby roads I-270 and MD335 within a quarter-mile of the park boundary, however, the magnitude of deer-vehicle collisions at Monocacy is significantly smaller than at Antietam. Vehicles collisions with deer have been monitored since 2001 and from 2001 to 2010, 45 deer fatalities have occurred within the park boundary as a result of a vehicle collision. On I-270 and MD355, during the same time period, there were 118 and 70 deer fatalities respectively due to vehicle collisions. During this period, 2009 had the most deer-vehicle collision fatalities, with 46, of which 21 occurred within the park boundary. October – December experienced the most deer-vehicle collisions with 114 deer fatalities from 2001 to 2010, equating to 49% of all deer fatalities from vehicle collisions. Although, there have been more deer-vehicle collisions outside the park boundary on I-270 and MD335, throughout the period, from 2009 to 2010, there were more deer-vehicle collision fatalities within the park than on nearby roads. Detailed deer-vehicle collision data for Monocacy is present in table 43 (NPS 2011d).

TABLE 43: WHITE-TAILED DEER FATALITIES, 2001–2010

Year	Within Park Boundary	I-270	MD335
2001	0	0	1
2002	1	11	4
2003	0	7	9
2004	1	18	7
2005	0	15	14
2006	0	10	8
2007	14	9	3
2008	9	17	9
2009	21	19	6
2010	10	7	3
Total	**45**	**118**	**70**

Source: NPS 2011d.

Lyme Disease

Similar to Antietam, a significant visitor and employee health concern related to deer management is Lyme disease and other tickborne diseases. It is of heightened concern, because of the location of both Antietam and Monocacy battlefields in Maryland, where the presence of the disease is more common than in the United States as a whole (ALDF n.d.).

Information regarding Lyme disease prevalence in Maryland from 1990 to 1999, and from 2000 to 2010 can be seen in the Human Health and Safety section for Antietam. Annual reported cases of Lyme disease in Frederick County ranged from 0 to 32, with the peak year occurring in 1999. From 2000 to 2010 Lyme disease cases reported in Frederick County ranged from 10 to 221, with the peak year in 2007. Based on Lyme disease statistics by county in Maryland, Frederick County is one of the hardest hit counties in the state. In 2010, cases of Lyme disease within the county equaled 7% of total cases in Maryland and in the peak year of Lyme disease in the county in 2007, Frederick County had approximately 9% of all cases. To provide perspective, there are 23 counties in Maryland, plus the city of Baltimore. The prevalence of Lyme disease in the park is unknown (MDH 2012).

MANASSAS NATIONAL BATTLEFIELD PARK

General Health and Safety Issues

Manassas is committed to providing appropriate, high-quality opportunities for visitors and employees to enjoy the park in a safe and healthful environment and strives to provide for injury-free visits and a safe work environment. Human health and safety concerns associated with the proposed project include the safety of park staff and visitors during deer management activities. Visitor injuries at Manassas from 2001 to 2011 are presented in table 44, with the majority of visitor injuries being attributable to horseback riding.

TABLE 44: VISITOR INJURIES AT MANASSAS NATIONAL BATTLEFIELD PARK, 2001–2011

Year	Visitor Injuries
2001	3
2002	1
2003	0
2004	2
2005	3
2006	2
2007	1
2008	4
2009	2
2010	3
2011	2

Source: Gorsira, pers. comm. 2012a.

Reported employee injuries that resulted in lost time from 2001 to 2010 are listed in table 45. Of all employee injuries none have been reported to have been caused directly from a deer.

TABLE 45: EMPLOYEE INJURIES AT MANASSAS NATIONAL BATTLEFIELD PARK, 2001–2011

Year	Employee Injuries
2001	9
2002	2
2003	0
2004	1
2005	1
2006	3
2007	1
2008	1
2009	2
2010	3
2011	8

Source: Gorsira, pers. comm. 2012a.

Deer -Vehicle Collisions

Manassas does not maintain records on deer-vehicle collisions within the park, since Virginia owns and maintains the roads through the park. In 2007–2008, Virginia had the eighth highest number of deer-vehicle collisions in the United States. Fairfax County, adjacent to the park and to Prince William County, recorded 120 deer-vehicle collisions in 2010, and estimated approximately 419 deer per square mile in Bull Run Regional Park, which is adjacent to the battlefield (Fairfax County 2011). That reported deer density is more than twice the density of other county parks and is also higher than the density calculated at the battlefield. A Metropolitan Washington Council of Governments deer-vehicle policy report (2006) mentioned 161 deer vehicle collisions reported to VDOT in Prince William County in 2003. The deer-vehicle collision avoidance policy and report from the council of governments (whose region includes both Prince William County in Virginia, and Frederick County in Maryland) indicates that the number of collisions in the area and the associated safety risks have been a concern in recent years (MWCOG 2006).

Lyme Disease and Other Tickborne Diseases

Similar to Maryland, Lyme disease is very common in the Commonwealth of Virginia. The disease is particularly common in the northeastern portion of Virginia, including Prince William County, where the park is located. From 1990 to 1999, a total of 1,003 cases of Lyme disease were reported in Virginia. During this period, the number of reported cases of Lyme disease ranged from 55 to 151, peaking in 1991, with an approximate average of 100 cases a year. From 2000 to 2010, Virginia had 5,508 reported cases of Lyme disease, ranging from 156 cases in 2001 to 1,245 in 2010, with an approximate average of 551 cases per year. Within Prince William County, from 2000 to 2010, a total of 395 cases were reported with, peaking in 2007 with 79 cases. Lyme disease cases ranged from 6 to 79. The prevalence of Lyme disease in the park is unknown (VDH 2012; Gaines, pers. comm. 2012).

PARK MANAGEMENT AND OPERATIONS

Deer management actions, even the dissemination of information about deer and their effects on the environment, require time and money, and all alternatives considered would have effects on staffing and operating budgets of the three national battlefields.

ANTIETAM NATIONAL BATTLEFIELD

The staff of Antietam is organized into five operating divisions: Administration and Management, Cultural Resource Management, Facility Management, Natural Resources Management and Visitor Protection, and Resource Education and Visitor Services. The fiscal year 2011 appropriation for the battlefield was $3,472,200 (Wenschhof, pers. comm. 2012b). A detailed description of the operating budget is given in table 46. Operation budgets may vary annually with nonrecurring base changes.

TABLE 46: ANTIETAM OPERATING BUDGET

Division	2011 Operating Budget
Administration and Management	$432,800
Cultural Resources	$333,700
Facility Management	$1,168,000
Natural Resources Management, Visitor Protection, and Resource Education	$906,600
Visitor Services	$631,100
Total	**$3,472,2000**

Source: Wenschhof, pers. comm. 2012b.

Currently there are 40 full-time positions and one shared employee from Catoctin Mountain Park. The permanent staff is augmented by a seasonal or temporary workforce, which change from year to year based on funding variations and need. Typically this seasonal workforce has varied between 30 and 40 employees. In addition, Antietam had 4,086 volunteers help out in park affairs in 2011 (Wenschhof pers. comm. 2012b).

Administration and Management

The Park Superintendent is responsible for overall park management and supervision of division chiefs. The Superintendent serves as the park's representative to external partners and is the park information officer. The Administration Division's responsibilities include human resource management, budget, procurement and contracting, property management, travel management, payroll and benefits programs, excess/surplus property program, and utility program management. Administration and Management includes six full-time permanent positions (Wenschhof, pers. comm. 2012b).

Cultural Resources Management

The Cultural Resources Management division's responsibilities include National Historic Preservation Act (NHPA) and NPS Cultural Resources compliance activities, historic structures management, preservation and restoration, contract management and oversight, national cemetery management, Mumma cemetery management, monument preservation and research. There are four full-time permanent positions (Wenschhof, pers. comm. 2012b).

Facility Management

The responsibilities of the Facility Management Division include general operational maintenance, preservation maintenance, contract management, fleet management and maintenance, turf management, landscape restoration, historic structure preservation and restoration, national cemetery maintenance and burials, fencing program oversight and operations, general and custodial services, and support for special events. There are fifteen full-time permanent positions (Wenschhof, pers. comm. 2012b).

Antietam National Cemetery

Natural Resources Management and Visitor Protection

The branch of Natural Resources Management employs four full-time employees whose responsibilities include vegetation management, wildlife management (including targeted and opportunistic surveillance activities for CWD detection and general deer surveys), agricultural lease program, trail management and construction, contract management, fencing program management, youth programs, native plant nursery, water quality program, soils program, research, and National Environmental Policy Act (NEPA) compliance. This division also coordinates with the MD DNR Wildlife Staff, Natural Resources Police, the NPS NCR Regional Wildlife Biologist, and other interested parties regarding deer and wildlife management issues. This coordination includes sharing information on deer density, spotlighting survey periods, and involving of MD DNR staff in the CWD planning process.

The branch of Visitor Protection employs five full-time employees whose responsibilities include law enforcement, resource protection, boundary management, fire and security alarm programs, special use management program, special events programs, wildfire and structural fire program, cooperative agreement program management, risk management and safety operations, and investigative services (Wenschhof, pers. comm. 2012b).

Resource Education and Visitor Services

The Resource Education and Visitor Services division's responsibilities include interpretive planning and operations, visitor services, education program operations, curatorial services research, library management, collections management, contract management, living history program coordination, volunteer program oversight, and the black powder safety program. The battlefield does not have regular interpretive programming related to deer habitat and management. However, battlefield staff have developed brochures, wildlife displays, news releases, and other information as public outreach for CWD. Natural resources programming is also incorporated into the school group program offerings. Battlefield staff have also produced educational materials about their deer movement study and general natural resources management programs. There are seven full-time permanent positions (Wenschhof, pers. comm. 2012b).

MONOCACY NATIONAL BATTLEFIELD

The staff at Monocacy is organized into six operational divisions: Management, Resource Education and Visitor Services, Law Enforcement, Natural Resources, Cultural Resources, and Maintenance. The fiscal year 2011 operating budget for the battlefield was $1,526,000. Budgets are broken down for fiscal year 2009-2011 in table 47. These budgets vary from year to year based on available funding, needs and base changes. In 2011, there were 16 full-time employees and 27 temporary/seasonal employees at the battlefield (Banasik, pers. comm. 2012b).

TABLE 47: MONOCACY OPERATING BUDGETS

	Fiscal Year 2009	Fiscal Year 2010	Fiscal Year 2011
Management	$276,600	$275,900	$305,000
Cultural Resources	$91,200	$102,000	$110,000
Natural Resources	$120,000	$126,000	$116,000
Resource Education and Visitor Services	$333,000	$356,000	$344,000
Law Enforcement	$321,500	$288,000	$296,000
Maintenance	$331,400	$404,100	$355,700
Total	**$1,473,700**	**$1,552,000**	**$1,526,000**

Source: Banasik, pers. comm. 2012b.

Management

The Management Division for Monocacy is comprised of the park superintendent and a historian who serves as the NPS liaison with the Catoctin Center for Regional Studies based at Frederick Community College. Administrative services are provided by Antietam and there are no administrative personnel assigned to Monocacy (Banasik, pers. comm. 2012b; NPS 2009c).

Resource Education and Visitor Services

The Resource Education and Visitor Services Division has four full-time employees and two temporary employees and is responsible for operation of the visitor center, interpretation and education operations, curatorial services and collections management, living history program coordination, black powder safety, and Volunteers-In-Parks program (Banasik, pers. comm. 2012b; NPS 2009f).

Law Enforcement

The responsibilities of the Law Enforcement Division include enforcing federal and state laws within park boundaries; responding to motor vehicle accidents (including assisting state and local authorities with traffic control and patient care); and investigating crimes that harm NPS resources in the national battlefield, such as vandalism to historic structures, illegal relic hunting, trash dumping, and wildlife poaching. The Law Enforcement Division also monitors the recreational use of the Monocacy River, which runs through the national battlefield. Rangers patrol the river on foot and by vehicle. In 2011, there were three full-time employees and one temporary employee within this division (Banasik, pers. comm. 2012b; NPS 2009f).

Natural Resource Management

The Natural Resources Management Division's responsibilities include vegetation and wildlife management (including all CWD surveillance activities), trail maintenance, landscape rehabilitation, water resources management, the agricultural permit program, contract management and oversight, youth programs, and NEPA compliance activities. The Division's Natural Resource Manager and Biological Science Technician are responsible for current deer management activities at the battlefield, including coordination with the State and other interested parties. The battlefield also engages in deer density surveys in the Spring and Fall and actively engages in opportunistic and targeted surveillance of deer for CWD. In 2011, there was one full-time employee and 11 temporary employees (Banasik, pers. comm. 2012b; NPS 2009f).

Cultural Resource Management

The Cultural Resources Management Division’s responsibilities include the NHPA Section 106 compliance activities; historic structures management, preservation, and restoration; archeology; contract management and oversight; and research. In 2011, there was one full-time employee and eight temporary employees (Banasik 2012b; NPS 2009f).

Facility Management

In 2011, there were five full- time employees and five temporary employees in the Facility Management Division who are responsible for operational maintenance activities, contract management and oversight, fleet management and vehicle maintenance, fencing, maintenance and operation of battlefield structures, grounds maintenance, and custodial services (Banasik, pers. comm. 2012b; NPS 2009f).

MANASSAS NATIONAL BATTLEFIELD PARK

Manassas had a base operating budget of approximately $3,157,000 in fiscal year 2010 and a work force of 27 permanent positions and 19 seasonal or temporary positions, for a full-time equivalent of 33.69 employees annually (NPS 2011i). Staff is organized into six operating divisions: Park Management and Administration, Natural Resource Management, Cultural Resources Management, Education and Interpretation, Law Enforcement, and Maintenance (Gorsira, pers. comm. 2012b). This staff is supplemented and/or supported using special project funds, contracts, and/or the assistance or expertise of various NPS entities and other organizations, as available.

Park Management and Administration

There are 6 full-time employees within this division and consists of the Park Superintendent, an administrative assistant as well as the Administrative Officer and other support staff. The primary responsibility of the superintendents is the day-to-day management of the overall park operations. The Administrative Officer oversees purchasing, budget, contract administration, and property management (Gorsira, pers. comm. 2012b).

Natural Resource Management

Manassas currently has one full-time employee and one 6-month subject to furlough full time biological technician with duties solely in natural resource management. The natural resource management staff devotes about 10% to 15% of their time to deer management activities, which include erecting and maintaining exclosures, conducting annual fall spotlight surveys to determine population trends and densities, and responding to questions from visitors and neighbors. The 2012 annual budget for this division was $167,679.

Other duties of the natural resource management staff include water quality monitoring and mitigation of problems affecting these resources; park wildlife management and population monitoring; vegetation management including control of invasive plants; integrated pest management; GIS and global positioning system (GPS) duties for the park, park coordination for NEPA compliance, agricultural leasing management, hazardous tree management.

Water Quality Monitoring

The NPS NCR Natural Resources Science group assists park resource management staff by providing services related to distance sampling and deer management statistics. The center staff also provides technical assistance on park programs including water quality monitoring, vegetation monitoring, air quality monitoring, invasive plant control, wildlife management, integrated pest management, cultural resource management, and education (Gorsira, pers. comm. 2012b).

Cultural Resources Management, Education and Interpretation

The park has five full-time employees with duties solely devoted to cultural resource management, education and interpretation. The park manages many properties that are listed on NRHP as well as several sites that are eligible for listing. This division is also responsible for managing the park’s collections.

Education and interpretation are a large part of the visitor services offered by this division. The staff provides many educational and interpretive programs focused on the park's cultural history. These programs are focused on school groups, families, and adults. At this time there are no programs that focus on natural resource topics.

The park manages three main visitor contact points: The Visitor Center, The Stone House, and the Brawner Farm Contact Station. The park is an integral part of the Bridging the Watershed Program which educates local school groups on the importance and function of the watersheds in the Washington, D.C. metro area (Gorsira, pers. comm. 2012b).

Law Enforcement

There are 4 full time employees in the law enforcement division. They provide law enforcement on all lands administered by Manassas. They also provide for visitor safety, respond to emergencies, enforce traffic laws, enforce the Code of Federal Regulations (CFR), and preserve the natural and cultural resources entrusted to the NPS (Gorsira, pers. comm. 2012b).

Maintenance

There are currently nine full-time maintenance positions. The primary responsibility of the Maintenance Division is to provide for the general upkeep and maintenance of all park buildings and infrastructure. Park maintenance is also responsible for maintaining all utilities that service park buildings and other park facilities.

The Maintenance Division is divided up into several areas of responsibility. The tree crew manages hazardous trees and trees that are storm damaged or have fallen across roads, trails, or waterways causing obstruction. The roads and trails crew perform maintenance on park roads and trails to include road surface repair, culvert cleaning and stabilization, construction/rehabilitation of all park trails, sign maintenance, and snow removal. The grounds crew is responsible for litter removal, landscaping bed maintenance, and general grounds maintenance. The building and utilities crew maintains buildings include plumbing, painting, electrical, and heating/air conditioner maintenance. The Maintenance Division also has a mechanic to service vehicles and equipment.

Of the nine full-time maintenance positions at Manassas, none perform general maintenance tasks specifically related to deer management, and no maintenance staff employees are currently assigned to perform deer management tasks, such as applying repellents or erecting small exclosures. As described previously, the natural resource management staff conducts these activities. Maintenance staff will occasionally remove a tree that has fallen onto a deer exclosure (Gorsira, pers. comm. 2012b).

Chapter 4: Environmental Consequences

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

INTRODUCTION

This chapter analyzes the potential consequences of both beneficial and adverse impacts that would result from implementing the deer management alternatives presented in this plan, and the consequences that could occur from the implementation of the long-term chronic wasting disease (CWD) management plan that is common to all action alternatives. These analyses are done separately to avoid confusion, but it is important to recognize that the CWD management plan is an integral part of each of the action alternatives. Therefore, a summary is provided at the end of this chapter that presents the impacts of deer management combined with the impacts of the long-term CWD management plan for each alternative.

The chapter also presents a summary of laws and policies relevant to each impact topic, definitions of impact intensities (for example, negligible, minor, moderate, and major), methods used to analyze impacts, and the analysis methods used for determining cumulative impacts. As required by the Council on Environmental Quality (CEQ) regulations implementing the National Environmental Policy Act (NEPA), a summary of the environmental consequences for each alternative is provided in table 15, which can be found in chapter 2. The resource topics presented in this chapter, and the organization of the topics, correspond to the resource discussions contained in chapter 3.

SUMMARY OF LAWS AND POLICIES

Three environmental protection laws and their implementing policies guide the actions of the National Park Service (NPS) in the management of the parks and their resources—the Organic Act of 1916, NEPA and its implementing regulations, and the Omnibus Management Act. For a complete discussion of these and other guiding authorities, refer to the "Related Laws, Policies, Plans, and Constraints" discussion in chapter 1. These guiding authorities are briefly described below.

The Organic Act of 1916 (16 USC 1), as amended or supplemented, commits the NPS to making informed decisions that perpetuate the conservation and protection of park resources unimpaired for the benefit and enjoyment of future generations. NEPA is implemented through regulations of the CEQ (40 CFR 1500–1508). The NPS has, in turn, adopted procedures to comply with these requirements, as found in Director's Order 12 (NPS 2011c) and its accompanying handbook (NPS 2001). The Omnibus Management Act (16 USC 5901 et seq.) underscores NEPA provisions in that both acts are fundamental to park management decisions. Both acts provide direction for connecting resource management decisions to the analysis of impacts and communicating the impacts of those decisions to the public, using appropriate technical and scientific information. Both acts also recognize that such data may not be readily available, and they provide options for resource impact analysis should this be the case. Section 4.5 of Director's Order 12 adds to this guidance by stating, "when it is not possible to modify alternatives to eliminate an activity with unknown or uncertain potential impacts, and such information is essential to making a well-reasoned decision, the National Park Service will follow the provisions of the CEQ regulations (40 CFR 1502.22)." In summary, the NPS must state in an environmental assessment (EA) or impact statement (1) whether such information is incomplete or unavailable; (2) the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment; (3) a summary of existing credible scientific adverse impacts that is relevant to evaluating the reasonably foreseeable significant adverse impacts; and (4) an evaluation of such impacts based on theoretical approaches or research methods generally accepted in the scientific community. Collectively, these guiding regulations provide a framework and process for evaluating the impacts of the alternatives considered in this environmental impact statement (EIS).

METHODOLOGY FOR ASSESSING IMPACTS

The following elements were used in establishing impact intensity definitions and analyzing the potential effects of the alternatives on each resource category:

- General analysis methods as described in guiding regulations, including the context and duration of environmental effects.
- Basic assumptions used to formulate the specific methods used in this analysis.
- Intensity definitions used to define the level of impact resulting from each alternative.
- Methods used to evaluate the cumulative impacts of each alternative in combination with unrelated factors or actions affecting park resources.

These elements are described in more detail below.

GENERAL ANALYSIS METHODS

The analysis of impacts follows CEQ guidelines and Director's Order 12 procedures and is based on the underlying purpose, as stated in "Chapter 1: Purpose of and Need for Action," of developing a deer management strategy that supports preservation of the cultural landscape through the protection and restoration of native vegetation and other natural and cultural resources. This analysis incorporates the best available scientific literature applicable to the region and setting, the species being evaluated, and the actions being considered in the alternatives. For each resource topic addressed in this chapter, the applicable analysis methods are discussed, including assumptions and impact intensity definitions.

Analysis Period

Goals, objectives, and specific implementation actions needed to manage deer at the parks are established for the next 15 years; therefore, the analysis period used for assessing impacts is up to 15 years. The impact analysis for each alternative is based on the principles of adaptive management, which would allow the NPS to change management actions as new information emerges from monitoring the results of management actions and ongoing research throughout the life of this plan.

Geographic Area Evaluated (Area of Analysis)

The geographic study area (or area of analysis) for assessment of indirect and direct impacts includes all lands within the boundaries of the three park units, except for socioeconomics and adjacent lands, which includes additional area around the parks. The area of analysis for socioeconomics/adjacent lands and for most cumulative impacts was extended to about 2.5 miles beyond the park boundaries to better capture typical deer and wildlife movement outside the park boundaries and on neighboring properties. According to the deer movement study done at Antietam, female fawns traveled an average of 0.8 miles (1.29 km) and male fawns traveled 2.4 miles (3.86 km), with extremes reaching 13 miles. Adult females traveled an average of 0.9 miles (1.45 km), with one traveling over 6 miles. A distance of 2.5 miles was selected to capture the typical range found for most male and female deer (excluding occasional extremes) and to include neighboring parks in Virginia where deer management programs are active (e.g., Bull Run Regional Park, Conway Robinson State Forest). The individual analysis for each resource topic begins with a description of the area of analysis.

Duration and Type of Impacts

Several basic assumptions are used for all impact topics (the terms “impact” and “effect” are used interchangeably throughout this document):

- *Short-term impacts*—Impacts that are temporary and would not have long–lasting effects, generally less than 3 years and usually associated with implementation of management actions. For CWD actions, this relates to the immediate effects of initially reducing the deer population.
- *Long-term impact*s—Impacts that would last beyond the time when management actions are taken, generally longer than three years and possibly lasting through the life of the plan, with potentially permanent effects, such as ongoing impacts on park operations or the beneficial effects on vegetation from reduced deer numbers.
- *Direct impacts*—Impacts that would occur as a direct result of NPS management actions (e.g., impacts on vegetation from building exclosures or impacts on visitor use during the selected management action).
- *Indirect impacts*—Impacts that would occur from NPS management actions and would occur later in time or farther in distance from the action.

Both direct and indirect impacts are addressed in the analysis, although they may not be specifically labeled as such.

Impact Intensity Definitions

Determining impact intensity is a key component in applying NPS *Management Policies 2006* and Director’s Order 12. Intensity definitions were developed to provide the reader with an idea of the intensity of a given impact on a specific topic. The impact intensity definition is determined primarily by comparing the effect to a relevant standard based on regulations, scientific literature and research, or best professional judgment. Because definitions of intensity vary by impact topic, intensity definitions are provided separately for each impact topic analyzed in this document. Intensity definitions are provided throughout the analysis for negligible, minor, moderate, and major impacts. In all cases, the impact intensity definitions are defined for adverse impacts. Beneficial impacts are addressed qualitatively.

CUMULATIVE IMPACTS ANALYSIS METHODS

The CEQ regulations to implement NEPA require the assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as “the impact on the environment which results from the incremental impact of the action when added to other past, current, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions” (40 CFR 1508.7). As stated in the CEQ handbook, “Considering Cumulative Effects” (CEQ 1997), cumulative impacts need to be analyzed in terms of the specific resource, ecosystem, and human community being affected and should focus on effects that are truly meaningful. Cumulative impacts are considered for all alternatives, including alternative A.

Cumulative impacts were determined by combining the impacts of the alternative being considered with other past, present, and reasonably foreseeable future actions. Therefore, it was necessary to identify those other actions at the parks and the surrounding areas (as appropriate) that could affect the various resources discussed in this plan and that are in addition to the actions already addressed within the alternatives analyzed.

The analysis of cumulative impacts was accomplished using four steps:

Step 1—Identify Resources Affected: fully identify resources affected by any of the alternatives.

Step 2—Set Boundaries: identify appropriate spatial and temporal boundaries for each resource.

Step 3—Identify Cumulative Action Scenario: determine which past, current, and reasonably foreseeable future actions to include for each resource. These actions are not only those within or undertaken by the park but also those actions by any entity that have had or will have an effect on the resources impacted by this plan.

Step 4—Cumulative Impact Analysis: determine the combined impact of the proposed alternative and the other identified actions of the cumulative scenario.

Table 48 summarizes the actions that were identified for the cumulative impact scenario for this plan, and additional information is provided in the following narrative.

Description of Actions Contributing to the Cumulative Impact Scenario

Land Development Outside the Park (Residential, Commercial, Transportation/Highways, and Utilities)

Past, present, and future development outside the parks is one of the most important factors that also affects the resources discussed in this White-tailed Deer Management Plan / Environmental Impact Statement (plan/EIS). All three parks, but especially Manassas and Monocacy, are located in areas that have undergone much suburban development and are still growing. Antietam is not experiencing as much development pressure, but expanding residential development is replacing some of the agricultural land use, particularly in the Keedysville and Boonsboro areas. Monocacy is at the southern edge of a heavily developed commercial area south of Frederick, Maryland, and residential development is extending toward the park from the south. The Manassas area continues to experience suburban growth all around the park, as it has become a prime commuter location for Washington, D.C. workers. There are estimates that approximately 9,000 acres have been developed within 3 miles of the boundary of Manassas National Battlefield Park in the past decade (Gorsira, pers. comm. 2010). Zoning and Comprehensive Plans for surrounding jurisdictions supports this development. Highway construction has affected mostly Manassas and Monocacy. This includes the construction along I-270 at Monocacy, and the construction of the Battlefield Bypass at Manassas. Manassas will be affected by any projects near the park under the Regional Transportation Expansion Plan. At Manassas, a utility transmission line crosses the park and was recently rebuilt. Land development is expected to continue, and this growth will likely be residential and some commercial development, and development of rights-of-way for associated utilities and highways. Land development generally involves removal of vegetation, which contributes to a reduction in natural habitat and fragmentation of forested habitat in the area surrounding the parks. Agricultural lands have been permanently lost and additional agricultural lands continue to be converted into other uses, especially around the Maryland parks. Forest fragmentation and abandonment of agricultural lands has led to increases in edge habitat, which are prime areas for deer to forage. Land disturbances and use of construction equipment in various locations can exacerbate the spread of invasive exotic species.

TABLE 48: CUMULATIVE IMPACT SCENARIO

Impact Topic	Area of Analysis	Past Actions (from 1950s to present)	Current Actions	Future Actions (15 years)
The temporal boundary for all resources is from the mid 1900s through the life of the plan (15 years out). White-tailed deer densities increased rapidly during this period (Bates 2010), and many eastern parks began experiencing the expansion of deer populations during the early 1960s (Porter and Underwood 1999). A spatial boundary is listed for each topic, but generally consists of the parks and (as appropriate) a 2.5 mile border surrounding the park boundaries that includes the typical movement outside the park boundaries for deer and other wildlife; this also includes the neighboring parks in Virginia that are currently managing deer.				
Vegetation	Up to 2.5 miles beyond park boundaries	• Land development outside the parks (residential, commercial, transportation/highways and utilities) - loss of forested habitat, loss of agricultural land, edge effects, invasive species spread • Ongoing operations, maintenance and development inside parks (including utility line at Manassas) • Deer management by surrounding entities (at Manassas: Bull Run, Fairfax County, Conway Robinson) • Public hunting outside the parks • Deer control on private property • Spread of invasive species and actions to control them • Fire management (suppression, plus prescribed burns at Antietam) • Increase in conservation easements (Antietam and Monocacy)	Same as past actions	Same as current actions, with expected decreasing agricultural land use over time and additional suburban development around the Maryland parks, increasing development close to Manassas
White-tailed Deer	Up to 2.5 miles beyond park boundaries	Same as Vegetation	Same as past actions	Same as past actions, plus: • Increasing development outside park, especially residential growth pressures
Other Wildlife and Wildlife Habitat	Up to 2.5 miles beyond park boundaries	Same as Vegetation / White-tailed Deer	Same as Vegetation / White-tailed Deer	Same as Vegetation / White-tailed Deer

Impact Topic	Area of Analysis	Past Actions (from 1950s to present)	Current Actions	Future Actions (15 years)
Special Status Species	Up to 2.5 miles beyond park boundaries	Same as Other Wildlife and Wildlife Habitat	Same as Other Wildlife and Wildlife Habitat	Same as Other Wildlife and Wildlife Habitat
Cultural Landscapes	Within park boundaries	• Park operations, maintenance and development inside parks (including utility line at Manassas) • Deer management by surrounding entities (at Manassas: Bull Run, Fairfax County, Conway Robinson) • Hunting outside the parks • Deer control on private property • Invasive species – spread and actions to control them • Increase in conservation easements (Antietam and Monocacy) • Fire management (suppression, plus prescribed burns at Antietam) • Increase in conservation easements (Antietam and Monocacy)	Same as past actions	Same as current actions
Socioeconomics/ Adjacent Lands	Up to 2.5 miles beyond park boundaries	• Deer management by surrounding entities (at Manassas: Bull Run, Fairfax County, Conway Robinson) • Hunting outside the parks • Deer control on private property • Land development outside the park (residential, commercial, and transportation/highways, utilities)	Same as past actions	Same as past actions
Visitor Use and Experience	Within the park boundaries	• Land acquisition • Highway development around the parks • Fire management (prescribed burns at Antietam)	Same as past actions, plus: • Additional development around the parks • New park facilities or programs	Same as current actions, plus: • Increased pressure for other recreational uses from neighboring populations

Impact Topic	Area of Analysis	Past Actions (from 1950s to present)	Current Actions	Future Actions (15 years)
Visitor and Employee Health and Safety	Up to 2.5 miles beyond park boundaries	• Hunting outside the parks • Tripping, falling, and slipping hazards associated with daily park employee and visitor activities • Fire management (prescribed burns at Antietam)	Same as past actions	Same as past actions
Park Management and Operations	Within park boundaries	• Land acquisition • Increased visitation (especially at Monocacy) • Fire management (prescribed burns at Antietam)	Same as past actions	Same as past actions

Ongoing Operations, Maintenance, and Development in the Parks

Past, present, and future actions in the parks involve new construction of facilities and trails; maintenance of existing buildings, roads, and trails; and day-to-day operations. This includes such actions as routine maintenance along roads, at picnic grounds, trail maintenance, and landscape maintenance (mowing and trimming). All of these actions, particularly any new construction, have the potential to affect vegetation and habitat through direct removal of vegetation where necessary, habitat fragmentation, and trampling, albeit on a relatively small scale. The recently completed transmission line upgrade project at Manassas includes disturbance of lands both inside and outside the park.

Deer Management/Removals by Surrounding Entities (Virginia)

As described in chapter 1, several public entities have taken steps to reduce deer populations in areas close to Manassas. These include Fairfax County, Bull Run Regional Park, and Conway Robinson State Forest. These actions have helped reduce local deer densities in certain areas. Actions of the local entities are expected to continue annually for the remainder of the life of this plan, and will aid in the regional reduction of the deer herds around the parks. There are no similar actions by public entities in Maryland, which relies on public hunting and deer depredation permits, discussed below.

Public Hunting/ State Deer Management Plans

In both Maryland and Virginia, hunters remove many deer from the lands surrounding Antietam and Monocacy, and to a lesser extent, lands near Manassas. Both states have deer management plans (described in chapter 1) that support regulated public hunting as a means of controlling the states' deer populations, which can include deer populations that also use the parks.

Deer Damage Control on Private Property

In addition to public hunting, deer damage control or kill permits are also issued to private landowners outside the park boundaries, under the Damage Control Assistance Program (DCAP) in Virginia and the Deer Management Permit program in Maryland. This results in the removal of additional deer in agricultural areas around the parks. More information on deer management or control permits can be found in chapter 3 under "White-tailed Deer."

Actions that Contribute to Invasive Species Increase, and Invasive Species Control

As noted in chapter 1, several actions in and around the parks have contributed to the problem of invasive nonnative or exotic species. This problem is particularly acute in urban parklands where extensive forest fragmentation and creation of "edge" environments, frequent human disturbance, and high deer densities enhance opportunities for invasive, nonnative plants to become established (NPS 2004a). All three battlefields are experiencing impacts from invasive nonnative species.

The parks and other neighboring agencies are also addressing control of invasive species. Actions taken by all three parks include assistance from the regional Exotic Plant Management Team and involve the use of various Integrated Pest Management techniques such as herbicides, mechanical means, and cultural controls.

Land Acquisitions by NPS

All three parks have undertaken land acquisitions that help preserve the parks' natural and cultural environments and can reduce issues with damage to neighboring property owners' plants and crops. However, any lands acquired require additional park oversight and management for these properties.

Increase in Conservation Easements—Both Maryland parks have added conservations easements associated with its agricultural preservation program in an effort to preserve rural lands and protect agricultural lands.

Fire and Fire Management

Antietam National Battlefield. The 2004 fire management plan for Antietam calls for a prescribed burn program, as well as a pre-suppression program to identify fire danger periods, plan accordingly, and protect park resources and minimize threat of harm to adjacent landowners and their properties. Prescribed burns have been incorporated into the resources management program, and have been carried out in 2005, 2008, 2009, and 2011. The fire plan is reviewed annually, and separate prescribed burn plans are developed for each project area (NPS 2004c).

Monocacy National Battlefield. Monocacy adopted a fire management or suppression plan in 2004 and is in the process of updating it. The plan includes wildfire suppression to protect park cultural and natural resources, and minimize threat of harm to adjacent landowners and their properties, but does not currently consider the use of prescribed burns as a management technique (NPS 2004d).

Manassas National Battlefield Park. The 2010 fire management plan for Manassas includes seven goals that relate to firefighter and public safety, protection of property, and reduction of hazard adjacent to cultural and historic sites. The primary goals of the fire management plan are to protect human health and safety, protect property, and diminish risk and consequences of severe wildland fires (NPS 2004b). Suppression of wildland fires has been the policy at Manassas. The plan does not allow for prescribed burns.

Actions that have Caused Changes in Visitation

All three parks are located in areas with high population growth (see the "Socioeconomics" section in chapter 3), and the parks take actions in their programs to provide more opportunities for visitors. For example, Monocacy has seen a large increase in visitation with the opening of its new visitor center in 2007.

IMPACTS ON VEGETATION

GUIDING REGULATIONS AND POLICIES

The NPS Organic Act of 1916 and the NPS *Management Policies 2006* (NPS 2006a) direct parks to provide for the protection of park resources. The *Management Policies 2006* state that "the Service will not attempt to solely preserve individual species (except threatened or endangered species) or individual natural processes; rather, it will try to maintain all the components and processes of naturally evolving park ecosystems, including the natural abundance, diversity, and genetic and ecological ecosystems" (NPS 2006a, Section 4.1). The policies further state, "The Service will not intervene in natural biological or physical processes, except … to restore natural ecosystem functioning that has been disrupted by past or ongoing human activities, or when a park plan has identified the intervention as necessary to protect other park resources, human health and safety, or facilities" (NPS 2006a, Section 4.1). With regard to the restoration of natural systems, the NPS “will reestablish natural functions and processes in parks” and it “will seek to return such disturbed areas to the natural conditions and processes characteristic of the ecological zone in which the damaged resources are situated” (NPS 2006a, Section 4.1.5).

Several of the general management plans (GMPs) for the parks include management policies that pertain to vegetation. These include the following:

- Antietam’s GMP calls for reestablishing vegetation patterns on the battlefield (farm fields, woods, and orchards) to resemble conditions just before the battle.

- Monocacy’s GMP identifies the effects of deer browsing on vegetation as an issue because it can force farmers to change agricultural practices and alter regrowth in forested areas, suppressing the regeneration of native trees.

- Manassas’ GMP notes the effects that deer are having on park vegetation, including historically wooded areas and streamside buffers, and the adverse effects on natural forest succession processes and newly installed landscape vegetation.

The parks’ resource management plans and natural resource condition assessments (see discussion in chapter 1) also mention the impacts on vegetation and crops from deer browse and propose that action be taken to reduce these impacts.

ASSUMPTIONS, METHODOLOGIES, AND INTENSITY DEFINITIONS

Information is presented in chapter 3 on the types and distribution of vegetation in the parks. This information, communications with NPS staff, and past monitoring data and reports were used to identify baseline conditions within the area of analysis. Action thresholds identified for taking management action were based on recent monitoring conducted at the park and research conducted in areas with similar habitat conditions. The following impact intensity definitions were developed to include an assessment of impact on the vegetation of the park, using professional judgment and observations of vegetation.

Negligible: A reduction in the abundance and diversity of native plants may occur, but any change would be so small that it would not be of any measurable or perceptible consequence. Suppression of seedlings would be light or would not occur. Cultural resource indicators for crops and orchards would indicate that browsing is very light or not occurring.

Minor: A reduction in the abundance and diversity of native plants would occur and would be measurable, but would be limited and of little consequence to the viability of native plant communities. Suppression of seedlings would be observable, but regeneration would still occur. Cultural resources indicators would indicate that some light browsing or damage is occurring.

Moderate: Some reduction in the abundance and diversity of native plants would occur, and it would be measurable, but would result in a medium-scale consequence to the viability of native plant communities. Suppression of seedlings would be noticeable and widespread, and regeneration would be limited in its success. Cultural resources indicators would indicate that medium browsing or damage is occurring to a medium amount of the affected resources.

Major: A noticeable reduction in the abundance and diversity of native plants would occur. Suppression of seedlings extremely noticeable to complete, severely limiting or preventing regeneration. Observed seedling numbers would represent that little to no regeneration was occurring, and cultural resources indicators would indicate that heavy browsing was occurring to the majority of the affected resources.

AREA OF ANALYSIS

The area of analysis for impact assessment includes all lands within the boundaries of all three parks. The area of analysis for cumulative impacts includes the parks and the area within 2.5 miles of the parks' boundaries, which encompasses typical deer movement outside the park boundaries.

IMPACTS OF DEER MANAGEMENT ACTIONS

Alternative A: No Action (Continuation of Current Management)

Under alternative A, park staff would continue to monitor the deer population and vegetation and continue to use tree tubes, repellents (mainly Antietam), or small-scale fencing to protect landscape plantings, orchards, and small areas containing tree plantings or rare species. As described in chapters 1 and 3, the parks have been conducting vegetation monitoring since 2000 (Manassas) and 2003 (Antietam and Monocacy). Each park has conducted various studies, including paired plots (exclosures and open control plots), to assess the impacts of deer on park vegetation. The studies at Antietam and Monocacy demonstrated no significant differences in seedling establishment between the fenced and open plots; however, native sapling species richness and abundance increased significantly in fenced plots, and all plots were below the threshold of seedling density that is required for forest regeneration. Similar studies at Manassas showed that deer have significant effects on forest structure and weedy seedling composition, species, richness, and seedling survival rates. These impacts can be directly attributed to deer browsing and indicate deer are affecting the integrity of the understory structure (see "Current Vegetation Status and the Role of Deer" in chapter 3). A distinct browse line is evident at Manassas and Monocacy, and to a lesser extent at Antietam, which is a visual indication of the effects deer have had on the understory at the parks.

Species composition was also found to be affected by deer browse and these effects would likely continue under the no action alternative. At Manassas, canopy species displayed the greatest mortality in the open plots, and seedling survival rates varied among species. By the fourth year of the study, species such as boxelder (*Acer negundo*), hickory (*Carya* sp.), and red maple (*Acer rubrum*) were eliminated in open plots, and red and white oak seedlings were severely reduced. The research suggests that deer selectively browse across forest types and can alter the species composition of a forest, causing oak-hickory and bottomland hardwood forests to shift toward stands with fewer species with a greater dominance of ash (*Fraxinus* spp.), black cherry (*Prunus serotina*), and hackberry (*Celtis occidentalis*), which were not as affected by deer browse.

In addition, deer activities, such as browsing, trampling, and seed dispersal through waste or attachment to hair, have the potential to increase the number and type of nonnative species within the battlefields (Myers et al. 2004; Vellend 2002; Williams and Ward 2006; Willson 1993; Duguay and Farfaras 2011). As the number of nonnative species increases, the native species within the parks encounter increased competition and can be adversely affected. Results from vegetation monitoring at the parks showed that nonnative species were more abundant in all plots (both fenced and open) over time, although there was a significant decrease in honeysuckle in the open plots. Deer may reduce the number of certain nonnative species that they browse on in open areas, but they can spread these plants throughout the parks through their movement and waste. Nonnative species likely thrived in the closed plots due to the protection provided from deer browse and the fences that support vertical growth of some of the nonnative species such as Japanese honeysuckle (*Lonicera japonica*).

Cultural resource indicators selected for the parks also show the effects of deer browse on crops and orchards that are essential components of the cultural landscapes of the parks. Stewart, McShea, and Piccolo (2007) showed that deer have a substantial effect on corn production and quality at the parks. In their study, which included Antietam and Monocacy in addition to the Chesapeake & Ohio Canal National Historical Park, fenced plots had higher weights of corn, more stalks with ears, and higher quality corn than open plots, and deer reduced crop yields by 5–43% over the course of the study. Crop yield reports from Antietam show the adverse impact that deer are having on crops at the battlefields. As noted in chapter 3, when compared with the average crop yields for farms in Washington County and compared with NRCS expected crop yields for soil types, Antietam agricultural cooperators experienced large reductions in corn for grain and silage, soybean, and winter wheat (NPS 2011b). Overall, harvests for all crops at Antietam were significantly lower than county averages and the expected yields based on soil type and crop, and this would be expected to continue under alternative A. Between 2000 and 2011, Monocacy crop yield data showed a statistically significant reduction in corn productivity compared to the county average, although no decrease in soybean productivity (NPS 2012d). Orchards and restoration plantings also continue to be susceptible to deer damage. Currently, about 50% of seedling trees in the east woods at Antietam are protected from deer by tree tubes, and apple trees at Piper Orchard are protected with cages to allow these trees to survive (Wenschhof, pers. comm. 2010). Under alternative A, it is expected that the deer population would continue at high densities within the parks, albeit with yearly fluctuations. As can be seen from 2011 deer density data, all of the parks exceed 20 deer per square mile (the high end of the desired deer density range) by a substantial margin (Antietam – 131 deer per square mile; Monocacy – 236 deer per square mile; Manassas – 172 deer per square mile). Deer densities exceed 100 deer per square mile in most years at all of the parks since monitoring began in 2001, and have exceeded 200 deer per square mile at Monocacy in three of those years. In all parks, it is expected that deer would continue to browse on plants to the extent that tree seedling densities would remain low, noticeable changes to the abundance and diversity of herbaceous vegetation throughout the area would occur, and crop/tree damage would continue to occur in cultural landscape plantings.

It is not expected that any periodic deer population fluctuations and temporary declines would be low enough or last long enough for forest regeneration to occur or vegetation of any kind to fully recover as long as deer densities remained above 20 per square mile. Based on these results and the expected high numbers of deer over the life of the plan, alternative A would have long-term major adverse impacts on vegetation due to the extensive amount of deer browse that would continue to occur at high deer densities. The protection offered by tree tubes and fencing, and limited use of repellents, at the parks would provide long-term benefits to vegetation in limited areas, but the majority of parks' vegetation would not be protected or not protected once the fencing is removed if deer can still reach the vegetation. Impacts on vegetation would continue to be adverse, long-term, and major because no measures would be taken to limit or control deer population size or growth under this alternative, and the relatively small amount of fencing or protection would not be sufficient to support forest regeneration in the parks.

Monitoring vegetation plots and maintaining fenced areas would result in very limited trampling of vegetation as staff traveled to and around any fenced areas that are not located along trails. However, such impacts would be temporary, as these activities typically take only a few days per year, and the amount of vegetation affected by these actions would be minimal, as they would occur in only a few areas. Therefore, the impact of these activities would be short-term negligible adverse.

Overall, alternative A would result in long-term moderate to major adverse impacts on vegetation because browsing pressure would be expected to remain high in either all or a large portion of the parks throughout the life of this plan (15 years) due to the lack of deer management actions.

Alternative B: Nonlethal Deer Management

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under alternative A would continue under alternative B. Alternative B would also include several techniques to prevent adverse deer impacts including fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning. However, the main focus of alternative B would be two nonlethal actions: the construction of large-scale deer exclosures (fencing) to promote forest regeneration and nonsurgical reproductive control of does to restrict population growth (when this technology meets certain criteria). Large fenced exclosures would be constructed under alternative B to allow forest regeneration to occur within enclosed areas of the parks that would not be accessible to deer. The 19 proposed exclosures would eliminate deer presence within a total of 184 acres or about 6% of the wooded area of the parks (23 acres at Antietam, 61 acres at Monocacy, and 100 acres at Manassas; see chapter 2 for details and locations). Protecting these areas from deer browsing would allow native woody species to grow higher than heights reached by deer (about 60 inches or 150 centimeters) after about 10 years, at which time the exclosures would be moved, and another 6% of the parks' vegetation would be enclosed. This action would have a long-term beneficial impact on up to about 12% of the woody vegetation in the park after 15 years (the life of the plan): 6% inside the existing exclosures at 15 years, and 6% in the original exclosures, which has grown above deer reach. However, the effect of having no browsing protection on woody species in the remaining unfenced areas of the park would be similar to alternative A. It is expected that monitoring over the life of the plan would continue to show that most of the long-term unfenced plots would have low seedling regeneration. Exclosures would provide a long-term beneficial, impact on herbaceous vegetation in about 6% of the park at any one time; however, these benefits would be limited to the location and time period of exclosure areas. The restoration planting protections described under alternative A would continue to be used under alternative B, providing limited benefits. Although this alternative may show some improvement over that seen under alternative A from the exclosures, it is expected to result in long-term moderate to major adverse impacts, when viewed over the life of the plan.

Constructing, maintaining, and monitoring the 19 large exclosures would have some impact on the vegetation within the park due to the trampling of small tree seedlings and herbaceous plants and the removal of existing woody vegetation. Even though fences would be located to avoid most trees, some trees would likely need to be removed during construction. Additionally, tree branches within 5 feet of either side of the fence would be removed to avoid branches hitting the fence in high winds or existing dead branches falling on the fence, thus minimizing future maintenance requirements. Given the relatively small size of the affected area of fence construction in relation to the size of the parks, and the limited nature of the action, the impact of exclosure construction and maintenance would be negligible. Trampling during fence construction and removal of deer from within fenced areas, as well as during monitoring, would have short-term negligible adverse impacts, because construction and monitoring would average only a few days per year and affect only a few areas, resulting in very small changes to the vegetation.

For the purposes of this analysis, it is assumed that an acceptable chemical reproductive control agent would be available and feasible during the life of this plan as described in chapter 2. Implementing reproductive controls would have short-term (a few hours to a few days in any location), localized, and negligible adverse impacts on vegetation. The effect of reproductive control on the deer population and thus deer browsing could be beneficial if the target deer density could be achieved within the life of this plan. However, the time required for the population to be reduced to the extent needed to allow for forest regeneration could be many years; researchers disagree on the amount of time needed to reduce a population size using reproductive controls (Hobbs, Bowden, and Baker 2000; Nielsen, Porter, and Underwood 1997; Rudolph, Porter, and Underwood 2000). The actual amount of time needed to observe a decrease would depend on a number of factors, such as the type of treatment, its effectiveness in stopping reproduction, the size of the population at the time of initial treatment, the actual mortality rate, and the percentage of the population that was treated. Other factors, such as untreated deer moving into the park and treated deer leaving the park, would also influence the time required to achieve reduced numbers.

Numerical reductions of white-tailed deer (*Odocoileus virginianus*) populations have been achieved with fertility control in at least two instances (Rutberg and Naugle 2008). However, these studies cannot be taken as evidence that fertility control can be used in the parks to reduce the deer population to the density that would allow the forest to regenerate. These studies focused on a fenced population and a relatively small segment of an intensively managed island population, and both study areas occupied less than one square mile. Also, the reductions achieved in these studies (27% over 5 years and 58% over 10 years) indicate that the amount of reduction in deer density needed to achieve the desired forest regeneration would take a long time to occur. Therefore, there is no empirical research that supports the conclusion that existing fertility control technology in a free-ranging population contiguous with other deer herds (such as what occurs in the parks) would have the desired outcome and meet plan objectives in support of forest regeneration. Although it is possible that the deer population goal could be met over a long period, the risk of not meeting the goal would be high.

Modeling efforts (Hobbs, Bowden, and Baker 2000; Rudolph, Porter, and Underwood 2000; Merrill, Cooch, and Stout 2006) and a comparison of field efforts that used lethal (Frost et al. 1997) and nonlethal methods (Rutberg and Naugle 2008) have also shown that fertility control is not as effective or efficient as culling when the goal is to reduce white-tailed deer populations. Hobbs, Bowden, and Baker described a model where if 90% of the breeding does in the park were effectively treated annually, mortality would need to exceed the number of surviving offspring from the 10% of untreated does to achieve a population reduction. An average mortality rate in urban/suburban deer populations is 10% (Hobbs, Bowden, and Baker 2000). Based on these factors, it is expected that reproductive control could stop population growth, but the park would not be able to reach its initial deer density goal within the life of this management plan using current technology. With the open nature of the deer populations in the parks and the uncertainty of success with this method, it is likely that this would not be sufficient to result in a recovery in vegetation within the life of this plan, and moderate to major adverse impacts would continue until the population densities decreased more throughout the parks.

Alternative B includes use of various techniques to prevent adverse deer impacts including fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning. All of these actions would provide beneficial impacts and serve to reduce deer damage, but in a limited, localized context. Fencing of crops and woodlots could supplement the proposed exclosure fencing and serve to protect smaller areas that are considered valuable, but there would be a limit on how much of the parks could be fenced without adverse visual effects on the cultural landscapes and adverse impacts in visitor access, use, or experience. Changing crops can prevent deer browse, but the substitute crop may not be one that is correct in the cultural context of the battlefields, which would cause adverse effects on cultural resource values. The ability to grow a crop would need to be balanced against the effect of the change in crop. Planting crops close together at the edge of fields to resist deer entry into the field is not a proven method, but could be initiated on a trial basis. Various aversive conditioning techniques (loud noises, scarecrow devices) would be useful in keeping deer away at certain times and in limited areas, but could detract from the cultural values of the parks and interfere with visitor experience. These would also need to be a used on a very selective basis and tested for effectiveness. These techniques would provide limited benefits that would not substantially reduce the overall moderate to major adverse effects expected under alternative B if the deer densities remain high.

Overall, alternative B would result in long-term moderate to major adverse impacts on vegetation due to continued high levels of deer browse at high deer densities.

Alternative C: Lethal Deer Management

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under alternative A would continue under alternative C. Alternative C would also include the additional techniques described under alternative B, but the primary focus of alternative C is using sharpshooting with firearms to reduce the herd size to the desired density level. A very limited use of capture and euthanasia of individual deer could be considered if needed due to safety concerns, but the parks do not expect that this will be necessary.

Under this alternative, it is estimated that the desired deer density goal could be reached at Antietam and Monocacy in 3–5 years and at Manassas in 4–6 years, based on 2011 deer density reports for the three parks and the experience with lethal removal at other NPS parks such as Valley Forge. The scenario described in chapter 2 to reach the desired deer density includes removal of a total of 550 deer at Antietam, 659 deer at Monocacy, and 1,635 deer at Manassas over 4–5 years to reach the desired goal at each park. It is expected that rapidly reducing the deer population and associated browsing pressure would allow the number of tree and shrub seedlings to increase and survive to saplings and into maturity in all areas of the parks, providing the necessary growth for natural forest regeneration, and would result in long-term beneficial impacts on herbaceous vegetation, which could regenerate over time with decreased deer browsing. It is expected that crop damage would decrease to a level similar to that found outside the parks, and damage to orchards or restoration tree plantings would similarly decrease.

The conclusion is supported by much of the long-term unfenced vegetation plot data from the park. As described in chapter 3, native saplings increased in abundance in fenced plots at both Antietam and Monocacy over the study period from 2003 to 2009. In all cases, the number of saplings was not significantly different between control and fenced plots in 2003; however, by 2009, the fenced plots contained significantly more individuals. Additionally, a number of species were recorded for the first time in fenced plots at Monocacy in 2009 (McShea and Bourg 2009). The study also examined if the plots met the desired seedling stocking rate. At the conclusion of the study, none of the plots at Antietam reached the desired stocking threshold, and only one of the 12 control plots at Monocacy reached the threshold for high deer density conditions (McShea and Bourg 2009). However, 83% of fenced plots at Antietam and 100% of the fenced plots at Monocacy exceeded the desired stocking threshold needed under low deer density conditions, indicating that the elimination of deer browse would have a positive impact on seedling success. At Manassas, studies showed that with few exceptions, annual seedling survival rates were consistently and significantly lower in the controls (open plots) than in the fenced plots. Studies focused on forbs showed that herbivory by deer severely impacted forb cover in all three forest types at the park, and a reduction to the desired density would have a long-term benefit on herbaceous cover as well as tree species.

Providing rapid deer herd reduction and control would result in beneficial long-term impacts on vegetation because deer browsing would be substantially reduced, which would allow the abundance and diversity of vegetation throughout the park to recover, as well as crops and trees planted in the parks. It is expected that after approximately 10 years, monitoring would show increased tree seedling regeneration, and herbaceous plants would recover over varying periods. Many plants would recover within a few years, resulting in a long-term beneficial impact on park vegetation.

Effects on invasive species are more difficult to predict. Studies from Antietam and Monocacy parks showed that more invasive seedlings were found in the fenced plots at Antietam, while Japanese honeysuckle was more abundant in fenced plots at the end of the study at Monocacy. Japanese honeysuckle decreased significantly in control (open) plots from 2003 to 2009, but increased substantially (though not significantly) in fenced plots during the same time (McShea and Bourg 2009). As previously noted, it is likely that deer herbivory resulted in the decrease noted in the open plots, and the invasive species already present in the fenced plots could increase when protected from deer browse, similar to native plants. However, if a reduction in deer is realized, any exotic plant management plan would have an increased chance of success, since one mode of dispersing seeds (through deer waste or attachment to hair) would be reduced, representing a long-term beneficial impact.

A number of other actions would occur as part of sharpshooting, as described in more detail in chapter 2, which would affect vegetation in limited areas. These actions include setting up bait stations, occupying shooting areas, and transporting deer to locations for processing and disposal. Sharpshooting might take place from elevated positions, which would require portable tree stands to be temporarily hung in trees. Such portable stands do not damage the tree (no nails or screws) and would not have an adverse impact on woody vegetation. Removing deer carcasses from the site could require dragging over vegetation, which would temporarily trample some vegetation. All of these actions (bait stations, shooting stations, and transporting deer) would result in some trampling of vegetation; however, the area of impact would be small, and because reduction actions would take place during late fall or winter months, these actions would not result in any measurable or perceptible change in herbaceous vegetation. The impact of trampling under this alternative would be short-term negligible adverse.

A few deer may be removed using capture and euthanasia, if needed due to safety concerns. Actions related to the capture and euthanasia of deer would be similar to those described for sharpshooting in that deer would be removed from the park through lethal means. The difference would be the way in which deer were captured and euthanized. This method would require physically capturing and handling deer before euthanizing them. Limited trampling would occur with the setting up of traps (rather than setting up bait stations), resulting in short-term negligible adverse impacts. Given that this method could be used at any time of the year, and the number of deer to be removed annually through this method would be very low, the waste or carcasses would likely be left on the surface to naturally decompose if the location were sufficiently remote, or would be disposed of in an approved landfill. This would have no noticeable impact on vegetation in the park.

Alternative C also includes the use of the techniques described in alternative B to prevent adverse deer impacts including fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning. Impacts would be as described under alternative B; these would provide beneficial impacts and serve to reduce deer damage, but in a limited, localized context. Assuming that the deer density is reduced to the desired goal in 4–5 years, it is likely that these techniques would be use more often in the first years of the program in cases where there is an immediate need to change crops, fence a vulnerable or sensitive area before more damage occurs, or scare deer from a important farm field, so impacts would also be short-term. Once the desired deer density is reached, it is expected that few of these techniques would be needed, but they could add to the beneficial impacts of alternative C in certain areas or situations.

Overall, the deer management actions of alternative C would result in long-term beneficial impacts on vegetation because the relatively rapid deer herd reduction would allow the abundance and diversity of vegetation throughout the park to recover.

Alternative D: Combined Lethal and Nonlethal Deer Management

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under alternative A would continue under alternative D, and the additional techniques described under alternative B could be used. However, the main emphasis of alternative D would be using a combination of sharpshooting and reproductive control of does from alternatives C and B to address high deer density. Sharpshooting (with very limited capture/euthanasia if necessary) would be taken initially to reduce the deer herd numbers quickly. Population maintenance would be conducted via nonsurgical reproductive control methods (if these are available and meet NPS criteria for use); if not, sharpshooting would be used for maintenance.

As described for alternative C, under this alternative, deer would be removed at all 3 parks over the course of 4–5 years to reach the initial density goal (15–20 deer per square mile). It is expected that reducing the deer browsing pressure (e.g., dropping from 131, 236, and 172 deer per square mile in Antietam, Monocacy, and Manassas, respectively, to about 20 deer per square mile would result in a noticeable increase in the number of tree and shrub seedlings, and an increase in the number of seedlings surviving to sapling stage, providing the necessary growth for natural forest regeneration. Herbaceous vegetation would also be able to recover, with many species expected to recover within a few years. Invasive species may increase if they had previously been browsed, but the spread of seeds by deer should decrease over time. Providing immediate reduction and control of the deer population would result in long-term beneficial impacts on vegetation, because deer browsing would be substantially reduced and the abundance and diversity of vegetation throughout the park could recover. Assuming reproductive controls could be used at a parkwide level to maintain the deer population size, impacts on vegetation would be beneficial and long-term because a substantial reduction in deer browsing would allow the abundance and diversity of vegetation throughout the park to recover.

As described for alternative C, it is not expected that capture and euthanasia would be required except when needed for safety reasons. Impacts would be as described in alternative C, with short-term negligible adverse impacts. Also as described for alternative C, a number of other actions would occur as part of implementing sharpshooting, such as setting up bait stations, occupying shooting areas, and transporting deer carcasses to locations for processing and transport, with short-term negligible impacts on vegetation given the small size of the affected area and the short duration of the impact. Some of the actions involved in implementing reproductive control (similar to implementing constructing fences and sharpshooting) could also result in trampling of vegetation; however, these actions would last only a few hours to a few days in any location, resulting in negligible adverse impacts on vegetation.

Alternative D also includes the use of the techniques described in alternative B to prevent adverse deer impacts including fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning. Impacts would be as described under alternative B; these would provide beneficial impacts and serve to reduce deer damage, but in a limited, localized context. Assuming that the deer density is reduced to the desired goal in 4–5 years, it is likely that these techniques would be use more often in the first years of the program in cases where there is an immediate need to change crops, fence an vulnerable or sensitive area before more damage occurs, or scare deer from a important farm field, so impacts would also be short-term. Once the desired deer density is reached, it is expected that few of these techniques would be needed, but they could add to the beneficial impacts of alternative D in certain areas or situations.

Overall, the deer management actions of alternative D would result in long-term beneficial impacts on vegetation because the relatively rapid deer herd reduction would allow the abundance and diversity of vegetation throughout the park to recover.

IMPACTS OF CHRONIC WASTING DISEASE MANAGEMENT ACTIONS, INCLUDING THE LONG-TERM CHRONIC WASTING DISEASE MANAGEMENT PLAN

Alternative A: No Action (Continuation of Current Management)

Under the no action alternative, the parks would continue with opportunistic and targeted CWD surveillance. Antietam and Monocacy would also respond to CWD presence in or near the parks in accordance with the CWD Detection and Initial Response Plan (NPS 2009c), and Manassas would create a similar plan. The Antietam and Monocacy CWD Detection and Initial Response Plan includes a range of actions including live testing and lethal removal of deer if CWD occurs within 5-20 miles of the park boundary. If CWD were to occur within 5 miles of the parks, initial response includes a one-time lethal removal of deer to reach a deer density of about 25-45 deer per square mile. Based on 2008 deer density data, this would involve removing about 250 deer at each park over 3 years (NPS 2009c). There would be no new longer term CWD monitoring or management activities.

Impacts on vegetation for the current CWD management actions and plan, including the initial response plan for Antietam and Monocacy, are described in the EA completed for these actions (NPS 2009c). Impacts of CWD surveillance and detection actions on vegetation would be short-term negligible to minor and adverse, mainly from inadvertent trampling and seed dispersal. If CWD were to occur within 5 miles of the parks, the initial response plan for Antietam and Monocacy calls for a substantial reduction in the deer population, which would have short-term beneficial effects on vegetation, as browse pressure would be reduced based on a one-time reduction in the deer population, and vegetation could regenerate during that time. These actions were analyzed through a separate NEPA process (NPS 2009c) and would be similar to the effects described for the deer removal actions under alternative C, above. Manassas would likely adopt a similar plan under no action, so impacts there would be the same.

Alternatives B, C, and D (All Action Alternatives)

Under any of the action alternatives, targeted and opportunistic surveillance, and actions under any current initial detection and response plans would continue with impacts similar to alternative A. However, under all alternatives, the parks would adopt a long-term CWD response plan that includes additional longer term response measures. Similar to the short-term plan, the plan provides for the lethal reduction of deer if CWD is confirmed in or within 5 miles of parks. This would include a rapid reduction to the target deer density and possibly reduction to as low as 10 deer per square mile, and deer would be removed for surveillance monitoring in subsequent years. Should it be necessary to prevent the parks from becoming problem areas for the disease, depending on the type of state management activities on adjacent and nearby land, sharpshooting could be used to maintain a deer population density as low as 10 deer per square mile for multiple years. Reductions would generally follow the same schedule as outlined in alternative C, above, but reductions would be coordinated with the state to address conditions at the time of the CWD detection and could be expedited if resources are available.

Impacts on vegetation from the deer reduction actions would be the same as described for alternative C under the analysis of deer management actions, above. Rapidly reducing the deer population and associated browsing pressure would allow the number of tree and shrub seedlings to increase and survive into maturity in all areas of the parks, and allow crops and orchard tress to survive without damage, resulting in long-term beneficial impacts on vegetation. The intensity of the impacts from CWD activities may vary, depending on when the CWD actions occur in relationship to the deer management actions. If CWD activities were to occur prior to deer management activities, the impacts would be more noticeable, while if they happened after the deer population had already been reduced as part of a deer management plan, less action would be needed for CWD and the impacts from CWD activities would be less intense and less noticeable.

CUMULATIVE IMPACTS

Alternative A: No Action (Continuation of Current Management)

Past, present, and reasonably foreseeable future actions that could impact vegetation in and around the park include actions with both adverse and beneficial impacts on vegetation. Adverse impacts on vegetation have occurred and will continue to occur from increasing urban and suburban development, including transportation projects and utility lines in the areas surrounding the parks, which has resulted in clearcutting, selective timbering, and removal of vegetation in specific areas, causing long-term minor to moderate localized adverse impacts. Past actions within the park, such as construction of facilities, roads, and trails, and the upgrade of a transmission line at Manassas, have adversely affected forest resources to a minor extent in limited areas due to cutting or removal of vegetation, trampling, or changes in species composition. Ongoing park maintenance and operations would have similar long-term minor adverse impacts on vegetation, limited to the areas affected. The parks' exotic plant management efforts and those of neighboring jurisdictions have had and will continue to have benefits to native vegetation by controlling and limiting the spread of invasive nonnative species. Beneficial impacts have resulted from past and current deer management efforts undertaken by neighboring agencies, landowners using deer depredation permits, which have resulted in reduced deer numbers in and around the park and reduced browsing pressure on vegetation. Public hunting has helped to reduce the deer population and provides a similar beneficial cumulative effect, particularly in the more rural areas surrounding Monocacy and Antietam.

The past, present, and reasonably foreseeable future actions described above would result in long-term minor to moderate adverse impacts as well as long-term beneficial impacts. These impacts, when combined with the long-term moderate to major impacts of deer management expected under alternative A because of continued deer browsing, would result in long-term moderate adverse cumulative impacts on vegetation. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative beneficial impacts on vegetation related to the associated reduced browse impacts, which would reduce long-term adverse cumulative impacts. In the absence of any CWD-triggered lethal response, the deer management actions that would continue under alternative A would contribute an appreciable adverse increment to the overall cumulative impact because of the expected continued deer browsing that would restrict forest regeneration and adversely affect the cultural landscapes of the parks.

Alternative B: Nonlethal Deer Management

The same past, current, and future actions described under alternative A would also occur under alternative B, including long-term minor to moderate adverse effects from increasing urban and suburban development in the areas surrounding the park, construction of facilities and roads, park maintenance, and other cumulative actions, and beneficial impacts from exotic species control and actions taken by neighboring jurisdictions to reduce deer numbers. These impacts, when combined with the mostly long-term moderate to major adverse impacts of alternative B, would result in long-term moderate adverse cumulative impacts on vegetation. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative beneficial impacts on vegetation related to the associated reduced browse impacts, which would reduce long-term adverse cumulative impacts. In the absence of any CWD triggered lethal response, the deer management actions under alternative B would add an appreciable adverse increment to the overall cumulative impact because of the lack of immediate reduction in the deer herd and the associated browsing impacts on vegetation and crops.

Alternative C: Lethal Deer Management

The same past, current, and reasonably foreseeable future actions described under alternative A would also occur under alternative C, with both minor to moderate adverse impacts and beneficial impacts, especially from neighboring deer management actions and invasive species control. These impacts, when combined with the mainly long-term beneficial impacts realized under alternative C from quickly reducing the parks’ deer population, would result in a long-term beneficial cumulative impact on vegetation. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative beneficial impacts on vegetation related to the associated reduced browse impacts, which could add to the long-term beneficial cumulative impacts. In the absence of any CWD triggered lethal response, the deer management actions under alternative C would contribute an appreciable beneficial increment to the overall cumulative impact because of the reduction in deer browse damage to vegetation.

Alternative D: Combined Lethal and Nonlethal Deer Management

Cumulative impacts would be essentially the same as described for alternative C. Past, current and reasonably foreseeable future actions that would contribute to cumulative impacts on vegetation would be the same as those described under alternative A, with minor to moderate adverse impacts and beneficial impacts. These impacts, when combined with the mainly long-term beneficial impacts of the reduced deer population under alternative D, would result in long-term beneficial cumulative impacts on vegetation. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative beneficial impacts on vegetation related to the associated reduced browse impacts, which could add to the long-term beneficial cumulative impacts. In the absence of any CWD triggered lethal response, the deer management actions under alternative D would contribute a substantial beneficial increment to the overall cumulative impact because of the reduction in deer browse damage to vegetation.

CONCLUSION

Alternative A: No Action (Continuation of Current Management)

Alternative A would result in long-term moderate to major adverse impacts because browsing pressure would be expected to remain high in either all or a large portion of the parks throughout the life of this plan (15 years) due to the lack of deer management actions. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would provide indirect beneficial impacts, but these would not outweigh the adverse effects of not taking deer management actions. The overall cumulative impact would be long-term, moderate, and adverse, with alternative A contributing appreciable adverse increments to the cumulative impact on vegetation

Alternative B: Nonlethal Deer Management

Similar results would occur under alternative B because reproductive control would result in only a gradual reduction in the deer population, and although the population goal could be met over the longer term, the risk of not meeting the goal would be high. Therefore, it is expected that the deer population would remain at relatively high density levels in the parks throughout the life of the plan. Also, the exclosures would protect only a small portion of the woody vegetation in the parks at any one time, requiring 10 years for regrowth above the browse line, and with no protection for herbaceous species once the exclosures are removed. Alternative B would therefore result in long-term moderate to major adverse impacts, with short-term negligible impacts from deer management implementation actions such as placement of bait piles and trampling and limited beneficial impacts from use of the techniques available to reduce deer access to crops, fields, and woodlots. Any CWD response that would be taken under the proposed long-term plan would provide indirect beneficial impacts, but these would not outweigh the adverse effects of not taking deer management actions. Similar to alternative A, the overall cumulative impact would be long-term, moderate, and adverse, with alternative B contributing appreciable adverse increments to the cumulative impact on vegetation.

Alternative C: Lethal Deer Management

The overall impact on vegetation under alternative C would be long-term and beneficial because the relatively rapid deer herd reduction would allow the abundance and diversity of vegetation throughout the park to recover. There would be short-term negligible impacts (mainly trampling) from deer management implementation actions, and benefits from the limited use of deer management techniques to reduce impacts in certain locations or circumstances. CWD actions would have similar impacts, with short-term negligible impacts (mainly trampling) from surveillance, and benefits from the reduction of deer and deer browse on vegetation. The overall cumulative impact would be long-term and beneficial, and alternative C would contribute appreciable beneficial increments to the cumulative impact on vegetation.

Alternative D: Combined Lethal and Nonlethal Deer Management

Alternative D would have essentially the same impacts as alternative C, with long-term beneficial effects due to the decrease in the deer herd, limited adverse impacts from the management actions themselves, and limited benefits from the use of the techniques described for all alternatives. CWD actions would have similar impacts, with short-term negligible impacts (mainly trampling) from surveillance, and benefits from the reduction of deer and deer browse on vegetation. The overall cumulative impact would be long-term and beneficial, and alternative D would contribute appreciable beneficial increments to the cumulative impact on vegetation.

IMPACTS ON WHITE-TAILED DEER

GUIDING REGULATIONS AND POLICIES

The NPS Organic Act of 1916, NPS *Management Policies 2006* (NPS 2006a), and NPS *Reference Manual 77: Natural Resource Management* (NPS 1991) direct NPS managers to provide for the protection of park resources. The Organic Act requires that wildlife be conserved unimpaired for future generations, which has been interpreted to mean that native animal life are to be protected and perpetuated as part of the park unit’s natural ecosystem. Parks rely on natural processes to control populations of native species to the greatest extent possible; otherwise they are protected from harvest, harassment, or harm by human activities. The NPS *Management Policies 2006* make restoration of native species a high priority. Management goals for wildlife include maintaining components and processes of naturally evolving park ecosystems, including natural abundance, diversity, and ecological integrity of plants and animals (NPS 2006a, Section 4.1).

Several of the GMPs for the parks include management policies that pertain to white-tailed deer and/or deer management. These include the following:

- Antietam’s GMP recognizes the impact deer are having on the orchards and notes the need for these resources to be fenced.

- Monocacy's GMP identifies the effects of deer browsing on vegetation and the cultural landscape as an issue because it can force farmers to change agricultural practices and alter field patterns, the composition of wooded and agricultural areas, and ornamental farmstead plantings.

- Manassas' GMP notes the effects that deer are having on park vegetation, including historically wooded areas and streamside buffers, and the adverse effects on natural forest succession processes and newly installed landscape vegetation.

The parks' resource management plans and natural resource condition assessments (see discussion in chapter 1) also mention the impacts on vegetation and crops from deer browse and propose that action be taken to reduce these impacts.

ASSUMPTIONS, METHODOLOGIES, AND INTENSITY DEFINITIONS

The evaluation of deer was based primarily on a qualitative assessment of how expected changes to vegetation within the three parks (as a result of increased or decreased browsing pressure) would affect the respective deer populations and their associated habitat. The evaluation also considered potential impacts on the deer populations directly associated with implementation of the alternatives (e.g., change in daily movements to avoid sharpshooting). Intensity definitions for white-tailed deer were developed based on available information and research on demographics, condition, population dynamics, behavior, and disease in white-tailed deer.

Data on demographic factors such as sex ratio, age structure, and abundance are collected by natural resource managers and are used in modeling wildlife population dynamics. The dynamics of a population are determined by demographic factors and factors such as productivity, survival, harvest rate/mortality rate, and rate of population growth. These, in turn, are directly influenced by deer condition and indirectly by habitat quality (e.g., quality and quantity of available forage). Lastly, deer behavior and risk of disease occurrence and amplification are influenced by all the above.

It is important to note that impacts on deer, as with other wildlife, are analyzed in terms of the desired conditions for the deer populations as a whole, including their overall health and ability to function in as natural a condition as possible. Thus, destruction of individual animals and reduction of the herd size alone are not necessarily adverse impacts, if their effect is to improve the overall condition of the deer populations as part of the natural ecosystem.

Available information on the deer populations (demographics, conditions, population dynamics, behavior, and disease) was compiled and analyzed in relation to the management actions. The definitions for the intensity of impact are defined as follows:

Negligible: There would be no observable or measurable impacts on the deer populations (e.g., demographics, population dynamics, condition, behavior, disease risk) as a result of changes in habitat or directly related to implementation of the management action. Impacts would be well within natural fluctuations, and the differences between natural fluctuations and effects resulting from the actions would not be discernible.

Minor: Impacts would be detectable but would not be outside the natural range of variability. Small changes to the deer populations (e.g., demographics, population dynamics, condition, behavior, disease risk) might occur. Occasional responses to disturbance by some individuals could be expected but without interference to factors affecting population levels. Sufficient habitat would remain functional to maintain viability of the deer population.

Moderate: Impacts on the deer populations (e.g., demographics, population dynamics, condition, behavior, disease risk) could be outside the natural range of variability. Changes in deer abundance, survival, productivity, movements and other factors would occur, but the deer populations would remain stable and viable. Frequent responses to disturbance by some individuals could be expected, with some adverse impacts on factors affecting population levels. Sufficient habitat would remain functional to maintain the viability of the deer population.

Major: Impacts on the deer populations (e.g., demographics, population dynamics, condition, behavior, disease risk) would be detectable, would be expected to be outside the natural range of variability, and would be extensive. Changes in deer abundance, survival, productivity, movements and other factors may be large, potentially resulting in decreased viability or stability. Frequent responses to disturbance by some individuals would be expected, with adverse impacts on factors negatively affecting population levels. Loss of habitat would affect the viability of the deer population.

AREA OF ANALYSIS

The area of analysis for impact assessment includes all lands within the boundaries of all three parks. The area of analysis for cumulative impacts includes the parks and the area within 2.5 miles of the parks' boundaries, which encompasses typical deer movement outside the parks' boundaries.

IMPACTS OF DEER MANAGEMENT ACTIONS

Alternative A: No Action (Continuation of Current Management)

Under alternative A, NPS staff would continue to monitor the deer population and vegetation and continue to use tree tubes, repellents (mainly at Antietam), or small-scale fencing to protect landscape plantings, orchards, and small areas containing tree plantings or rare species. As described in chapters 1 and 3, the parks or the National Capital Region (NCR) Natural Resources Science group performs distance sampling on an annual basis. Although a herd health check has never been conducted at Manassas, a herd health check was performed at Antietam and Monocacy in 2002 (SCWDS 2002a). The results of this analysis indicate that, though different, all three parks' deer herds have noticeably high population densities. Continued high deer densities could increase the risk for disease and substantial losses due to malnutrition and parasitism, contributing to the long-term adverse impacts on deer condition. High deer density populations also would increase the potential for the spread of CWD, if the disease should occur near the parks in the future (Joly et al. 2006; Samuel et al. 2003).Therefore, impacts of alternative A on deer population dynamics (deer density, productivity, mortality) would be long-term, moderate, and adverse.

Overall, alternative A would result in long-term minor to moderate adverse impacts on white-tailed deer because browsing pressure would likely remain high in the three parks throughout the life of this plan (15 years), reducing the amount and quality of habitat and browse.

Alternative B: Nonlethal Deer Management

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under alternative A would continue under alternative B. Alternative B would also include several techniques to prevent adverse deer impacts including fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning. However, the main focus of alternative B would be two nonlethal actions: the construction of large-scale deer exclosures (fencing) to promote forest regeneration and nonsurgical reproductive control of does to restrict population growth (when this technology meets certain criteria).

Use of large-scale exclosures would protect some deer habitat, but would eliminate deer presence within 5 to 20% of the forested areas of the parks (forest cover totals about 300 acres at Antietam, 500 acres at Monocacy, and 2,174 acres at Manassas). The construction of large-scale exclosures would prevent deer from accessing portions of their existing home ranges. This could result in deer expanding their home ranges further beyond the parks' boundaries and/or browsing more intensely in the areas that remain accessible within the existing home ranges. When the exclosures were rotated, there could be a short-term reduction in foraging outside of the parks, as the deer would seek to take advantage of the newly regenerated vegetation. This reduction, however, would be expected to be short-term and deer would then have to seek out additional forage to support the growing population. As a result, there would be long-term, moderate, adverse impacts on deer habitat and associated adverse impacts on the deer population in the parks.

If successfully implemented, the use of reproductive control when feasible (see chapter 2), would help reduce the impact on deer by gradually decreasing their numbers and allowing habitat to improve over time. As previously described in "Impacts on Vegetation" in this chapter, the use of reproductive control could reduce the deer populations in the parks to a limited extent if it was successfully implemented, but this would require many years to actually reduce the populations, based on modeling efforts (Hobbs, Bowden, and Baker 2000; Rudolph, Porter, and Underwood 2000; Merrill, Cooch, and Stout 2006) as well as a comparison of field efforts that used lethal (Frost et al. 1997) and nonlethal methods (Rutberg and Naugle 2008). A number of factors may influence the efficacy and reduction period of this method, including the amount of immigration/emigration of deer to/from the parks, mortality and recruitment rates, the size of the population at the time of initial treatment, and the percentage of each deer population that was treated. Other factors, such as untreated deer moving into the parks and treated deer leaving the parks, also would affect the time required to reduce herd numbers. The benefit of this action would be proportional to the amount of population reduction that it provided; therefore, a benefit could not actually be established until an improvement in vegetation and deer habitat was observed. Based on these factors, it is expected that reproductive controls could stop population growth, but would not reduce the numbers of deer to the desired deer density goal within the life of this management plan using current technology. Therefore, impacts on deer habitat and deer would only slightly be offset by this alternative, resulting in long-term, minor to moderate, adverse impacts. However, condition in female deer also may experience a long-term benefit through the elimination of physical stress and increased nutritional demands associated with pregnancy and lactation. Metabolic demands are greatest for females during summer while lactating (Moen 1976).

The intensity of long-term effects of implementing reproductive control on a free ranging deer herd is difficult to predict given the many variables. The actual administration of the reproductive control would result in disproportional impacts on does versus bucks. The effect on individual deer may be considered a substantial adverse impact (i.e., some mortality could occur), due to tranquilizer use and handling stress on the doe (DeNicola and Swihart 1997; Kilpatrick, Spohr, and DeNicola 1997); generally a two percent mortality rate or less would be expected (Peterson et al. 2003; Kreeger and Arnemo 2012), assuming that good capture techniques are used. Additionally, there may be potential physiological or behavioral changes associated with the application of a chemical reproductive control agent. However, any agent selected for use is required to have limited impacts on deer behavior or physiology. Beneficial impacts are not expected to be realized through the life of this plan, as population reduction would not be achieved. This would result in short- and long-term, minor to moderate, adverse impacts on the deer population at each park.

Until reproductive control could be effectively implemented, white-tailed deer densities would be expected to remain high in all three parks, potentially resulting in an increase in size of the deer home range and increased movements across the parks' boundaries into the surrounding communities. A shift in habitat use also may result as vegetative cover in the parks' forests continues to decrease. Therefore, impacts of alternative B on deer behavior (movements, habitat use) are expected to be similar to those described for alternative A, long-term minor to moderate adverse.

In addition, continued high deer densities also could increase the risk for disease and substantial losses due to malnutrition and parasitism, contributing to the long-term adverse impacts on deer condition. This would result in long-term, minor to moderate, adverse impacts on deer herd health.

Although this alternative would require additional vegetation monitoring plots, the impacts would be similar to those described under alternative A due the relatively small size of these plots. Increases in deer movements may result as NPS staff travel to and from monitoring plots, install and maintain rotational and small-scale fencing, conduct deer counts, and administer reproductive control agents. Installation of rotational fencing across 5 to 20% of the forested area of the parks may cause temporary displacement of deer from small areas of the parks for up to one month. As described for alternative A, deer population monitoring involves use of a spotlight from a vehicle along roadways and trails through the parks and occasionally getting out of vehicles to better observe deer. Administration of reproductive control agents will require capture, handling, and marking of deer. These activities may occasionally disturb deer and cause a temporary change in deer movements. However, these activities would be conducted during short periods over a relatively small area at any one time. Given the likely small size of the impacted area and the limited nature of the actions, the impacts of these activities on the deer population would be short-term, negligible to minor, adverse.

Alternative B includes use of various techniques to prevent deer from impacting resources in the parks, including fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning. All of these actions would provide negligible adverse impacts on the deer herds. Fencing of crops and woodlots would prevent deer from accessing portions of their current home range and could result in deer extending their home range outside of the parks' boundaries during short or long periods. This impact would be limited based on much of the parks could be fenced without adverse visual effects on the cultural landscapes and adverse impacts in visitor access/use. Changing crops can prevent deer browse, but also could result in an increase of deer browse in more palatable areas. Planting crops close together at the edge of fields to resist deer entry into the field is not a proven method, but could be initiated on a trial basis. Any success in this effort, however, would result in deer expanding their range to more accessible areas. Various aversive conditioning techniques (loud noises, scarecrow devices) could temporarily modify deer movement and behavior, resulting in expanded home ranges discussed above. Over time, however, it could be expected for deer to become conditioned to these disruptions and return to more normal home ranges. Overall, these techniques would provide limited impacts that would not substantially affect the minor to moderate effects expected under alternative B if the deer densities remain high.

Overall, alternative B would result in long-term minor to moderate adverse impacts on white-tailed deer because reproductive control would result in a gradual reduction in the deer population. Consequently, the deer population would remain at relatively high levels throughout the life of the plan, with associated adverse impacts due to a reduced quality of habitat and increased risk of disease.

Alternative C: Lethal Deer Management

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under alternative A would continue under alternative C. Alternative C would also include the additional techniques described under alternative B, but the primary focus of alternative C is using sharpshooting with firearms to reduce the herd size to the desired density level. A very limited use of capture and euthanasia of individual deer could be considered if needed due to safety concerns, but the parks do not expect that this would be necessary. Over the long-term, reducing and maintaining deer density levels at 15 to 20 deer per square mile would allow vegetation to recover, providing better foraging habitat for deer in all three parks. Based on previous NPS experience and current deer population data, it is estimated that Antietam and Monocacy would reach this goal in three to five years, with an additional one to three years at Manassas. Research indicates that when habitat is stressed, it cannot support healthy deer over the long term (Eve 1981). When deer density is high, there is increased mortality of younger animals and younger reproductive productivity, in addition to enhanced disease risk. In addition, fawn mortality could be expected during extreme winter stress if the habitat quality and deer populations remain at current levels. As described in “Chapter 2: Alternatives,” 15 to 20 deer per square mile is more closely aligned with levels that are in balance with other components of the ecosystem, namely a regenerating forest system. It is recognized that removing a large percentage of the deer populations in one year would have short-term moderate adverse impacts on the parks’ deer populations. The results would be outside the natural range of variability, and there would be a sizeable change in deer, but the deer populations would remain stable and viable). However, rapidly reducing the population to the desired range would have a beneficial effect on the long-term viability of the deer population within the parks by minimizing the potential for nutritional stress and disease, and improving habitat.

Sharpshooting and euthanasia activities may affect deer due to the disturbance and noise associated with the action. Noise impacts (as discussed in chapter 1) would be minimal due to use of noise suppressors, and impacts of sharpshooting on the remaining deer herd would be limited mainly to the temporary displacement/disturbance of deer during the nighttime hours of the fall and winter months. Increased shooting efforts, however, could result in temporary alterations to deer home ranges, as animals evacuated areas that were being targeted. Therefore, impacts of noise related to sharpshooting and euthanasia to the deer population would be short-term, minor, and adverse.

As described for alternative B, changes in deer movement may result as NPS staff travel to and from monitoring plots, install and maintain rotational and small-scale fencing, and conduct deer counts. Changes in deer movement also may result from the use of bait piles, which would attract the deer to specific locations; therefore, temporarily altering their normal movement patterns. However, these activities are conducted during short periods over a relatively small area at any one time, resulting in short-term negligible adverse impacts on deer behavior (e.g., movement).

Alternative C includes use of various techniques to prevent deer from impacting resources in the parks, including fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning. All of these actions would provide negligible adverse impacts on the deer herds. Fencing of crops and woodlots would prevent deer from accessing portions of their current home range and could result in deer altering their home range during short or long periods. This impact would be limited based on much of the parks could be fenced without adverse visual effects on the cultural landscapes and adverse impacts in visitor access/use. Changing crops can prevent deer browse, but also could result in an increase of deer browse in more palatable areas. Planting crops close together at the edge of fields to resist deer entry into the field is not a proven method, but could be initiated on a trial basis. Any success in this effort, however, would result in deer expanding their range to more accessible areas. Various aversive conditioning techniques (loud noises, scarecrow devices) could temporarily modify deer movement and behavior, resulting in expanded home ranges discussed above. Over time, however, it could be expected for deer to become conditioned to these disruptions and return to more normal home ranges. Overall, these techniques would provide limited impacts that would not substantially detract from the beneficial effects expected under alternative C if the deer densities are reduced.

Overall, alternative C would result in long-term beneficial impacts on white-tailed deer, because the relatively rapid deer herd reduction would allow the abundance and diversity of vegetation throughout the three parks to recover and better protect deer habitat.

Alternative D: Combined Lethal and Nonlethal Deer Management

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under alternative A would continue under alternative D, and the additional techniques described under alternative B could be used. However, the main emphasis of alternative D would be using a combination of sharpshooting and reproductive control of does from alternatives C and B to address high deer density. Sharpshooting (with very limited capture/euthanasia if necessary) would be taken initially to reduce the deer herd numbers quickly. Population maintenance would be conducted via nonsurgical reproductive control methods (if these are available and meet NPS criteria for use); if not, sharpshooting would be used for maintenance.

As with alternative C, the intent of this alternative would be to rapidly reduce the deer density within the three parks to allow for native vegetation to recover from deer browsing pressure. Based on previous NPS experience and current deer population data, it is estimated that Antietam and Monocacy would reach this goal in three to five years, with an additional one to three years at Manassas. Research indicates that when habitat is stressed it cannot support healthy deer over the long term (Eve 1981). As described for alternative C, reduction of the deer population size would minimize the potential for nutritional stress and result in a deer density more closely aligned with levels that are in balance with other components of the ecosystem, namely a regenerating forest system. The reduced population would be able to support itself on the existing forage, while the parks' vegetative communities regenerated. It is recognized that removing a large percentage of the deer populations over a few years would have short-term moderate adverse impacts on the parks' deer populations in that the results are outside the natural range of variability, and a sizeable change in deer would occur, but the deer populations would remain stable and viable, but rapidly reducing the population to the desired range would have a beneficial effect on the long-term viability of the deer population within the parks by minimizing the potential for nutritional stress and disease, and improving habitat. Impacts on the deer population would range from minor to moderate adverse while habitat recovered; however, as vegetation regenerates, better foraging habitat would be provided for the deer.

As described for alternative B, the intensity of long-term effects of implementing reproductive control on a free ranging deer herd is difficult to predict. The actual administration of the reproductive control would result in disproportional impacts on does versus bucks. The effect on individual deer may be considered a substantial adverse impact (i.e., some mortality could occur), due to tranquilizer use and handling stress on the doe (DeNicola and Swihart 1997; Kilpatrick, Spohr, and DeNicola 1997); generally a 2% mortality rate or less would be expected (Peterson et al. 2003; Kreeger and Arnemo 2012), assuming that good capture techniques are used. Additionally, there are potential physiological or behavioral changes associated with the application of a chemical reproductive control agent. It is expected, however, that the long-term adverse effect on the population would be minor to moderate, as the adverse impacts over time would be offset by the beneficial effect of population reduction.

As described for alternatives B and C, changes in deer movement may result as NPS staff travel to and from monitoring plots, install and maintain rotational and small-scale fencing, conduct deer counts, and administer reproductive control agents. Changes in deer movement also may result from the use of bait piles, which would attract the deer to specific locations; and shooting activities, which may push deer out of areas in each park. These activities, however, would be conducted during short periods of time over a relatively small area at any one time resulting in short-term, negligible to minor, adverse impacts on deer behavior (e.g., movement).

Alternative D includes use of various techniques to prevent deer from impacting resources in the parks, including fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning. All of these actions would provide negligible adverse impacts on the deer herds. Fencing of crops and woodlots would prevent deer from accessing portions of their current home range and could result in deer extending their home range outside of the parks' boundaries during short or long periods of time. This impact would be limited based on much of the parks could be fenced without adverse visual effects on the cultural landscapes and adverse impacts in visitor access/use. Changing crops can prevent deer browse, but also could result in an increase of deer browse in more palatable areas. Planting crops close together at the edge of fields to resist deer entry into the field is not a proven method, but could be initiated on a trial basis. Any success in this effort, however, would result in deer expanding their range to more accessible areas. Various aversive conditioning techniques (loud noises, scarecrow devices) could temporarily modify deer movement and behavior, resulting in expanded home ranges discussed above. Over time, however, it could be expected for deer to become conditioned to these disruptions and return to more normal home ranges. Overall, these techniques would provide limited impacts that would not substantially detract from the beneficial effects expected under alternative D if the deer densities are reduced.

Overall, alternative D would result in long-term beneficial impacts on white-tailed deer, because the relatively rapid deer herd reduction would allow the abundance and diversity of vegetation throughout the three parks to recover and better protect deer habitat.

IMPACTS OF CHRONIC WASTING DISEASE MANAGEMENT ACTIONS, INCLUDING THE LONG-TERM CHRONIC WASTING DISEASE MANAGEMENT PLAN

Alternative A: No Action (Continuation of Current Management)

Under the no action alternative, the parks would continue with opportunistic and targeted CWD surveillance. Antietam and Monocacy would also respond to CWD presence in or near the parks in accordance with the CWD Detection and Initial Response Plan (NPS 2009c), and Manassas would create a similar plan. The Antietam and Monocacy CWD Detection and Initial Response Plan includes a range of actions including live testing and lethal removal of deer if CWD occurs within 5-20 miles of the park boundary. If CWD were to occur within 5 miles of the parks, initial response include a one-time lethal removal of deer to reach a deer density of about 25–45 deer per square mile. Based on 2008 deer density data, this would involve removing about 250 deer at each park over 3 years (NPS 2009c). There would be no new longer term CWD monitoring or management activities.

Impacts on deer for the current CWD management actions and plan, including the initial response plan for Antietam and Monocacy, are described in the EA completed for these actions (NPS 2009c). Impacts of CWD surveillance and detection actions on deer would be short-term negligible to minor and adverse, mainly from temporary disturbances during implementation. If CWD were to occur within 5 miles of the parks, the initial response plan for Antietam and Monocacy calls for a substantial reduction in the deer population, which would have long-term beneficial effects on the viability of the deer population as a whole from increasing the potential for early detection of the disease and reducing the potential for amplification, spread, and establishment of the disease. These actions were analyzed through a separate NEPA process (NPS 2009c) and would be similar to the effects described for the deer removal actions under alternative C, above. Manassas would likely adopt a similar plan under no action, so impacts there would be the same.

Alternatives B, C, and D (All Action Alternatives)

Under any of the action alternatives, targeted and opportunistic surveillance, and actions under any current initial detection and response plans would continue with impacts similar to alternative A. However, under all alternatives, the parks would adopt a long-term CWD response plan that includes the lethal reduction of deer if CWD is confirmed in or within 5 miles of parks. This would include a rapid reduction to the target deer density and possibly reduction to as low as 10 deer per square mile, with an option to hold that density to 10 deer per square mile over time. In addition, deer would be removed for surveillance monitoring in subsequent years. Reductions would generally follow the same schedule as outlined in alternative C, above, but reductions would be coordinated with the state to address conditions at the time of the CWD detection and could be expedited if resources are available.

Impacts on deer from the deer reduction actions would be the same as described for alternative C under the analysis of deer management actions, above. Rapidly reducing the deer population would minimize the potential for nutritional stress and disease, including CWD, resulting in a beneficial effect on the long-term viability of the deer population within the parks. The intensity of the impacts from CWD activities may vary, depending on when the CWD actions occur in relationship to the deer management actions. If CWD activities were to occur prior to deer management activities, the impacts would be more noticeable, while if they happened after the deer population had already been reduced as part of a deer management plan, less action would be needed for CWD and the impacts from CWD activities would be less intense and less noticeable.

CUMULATIVE IMPACTS

Alternative A: No Action (Continuation of Current Management)

Past, present, and reasonably foreseeable future actions that could impact white-tailed deer in and around the three parks include actions with both adverse and beneficial impacts. Adverse impacts on white-tailed deer have occurred and would continue to occur from land development outside the parks; ongoing operations, maintenance, and development in the parks; changes in visitation/increase in local population; and, deer-vehicle collisions. Development outside of the parks' boundaries, ongoing operations and development inside the parks, and changes/increases in visitation could result in a loss of habitat and/or more regular disturbances to existing habitat. Deer vehicle collisions and deer damage control on private property provide obvious impacts on individuals within the population and can result in long-term impacts on each deer herd if deaths result in orphaned fawns or a reduction in members of the herd that are at the height of their reproductive efficiency. Beneficial impacts also have resulted from past and current deer management/removals by surrounding entities; public hunting/state deer management plans; land acquisition by the NPS; increase in conservation easements; invasive species management; and, fire management actions at the parks. Deer management removals by surrounding entities and public hunting/state deer management plans all are governed in a manner that reduce adverse effects on the overall herd while reducing population pressures. Land acquisition by the NPS and increased conservation easements have provided more undisturbed habitat for deer in areas that are not targeted by hunters. Invasive species management and fire management actions on these lands have resulted in improved habitat for these deer herds.

The past, present, and reasonably foreseeable future actions described above would result in both long-term minor to moderate adverse impacts and long-term beneficial impacts on white-tailed deer. These impacts, when combined with the long-term minor to moderate adverse impacts under alternative A from the continued growth in population and reduction of adequate forage, would result in long-term minor to moderate adverse cumulative impacts on the white-tailed deer population. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional long-term cumulative beneficial impacts on the deer population as a whole related to the associated reduced potential for disease amplification, spread, and establishment, which would reduce long-term adverse cumulative impacts. In the absence of any CWD-triggered lethal response, alternative A would contribute an appreciable adverse increment to the overall cumulative impact because of the lack of reduction in the deer herd and the associated impacts on the long-term herd viability.

Alternative B: Nonlethal Deer Management

The same past, present, and reasonably foreseeable future actions described under alternative A would also occur under alternative B, with long-term minor to moderate adverse and long-term beneficial impacts on white-tailed deer. These impacts, when combined with the long-term minor to moderate and short-term negligible to minor adverse impacts of alternative B from continued reduction of native habitat and deer management actions, would result in long-term minor to moderate adverse cumulative impacts on white-tailed deer. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative beneficial impacts on the deer populations in the parks related to the associated reduced potential for disease amplification, spread and establishment, which would reduce long-term adverse cumulative impacts. In the absence of any CWD triggered lethal response, alternative B would contribute an appreciable adverse increment to the overall cumulative impact because of the lack of reduction in the deer herd.

Alternative C: Lethal Deer Management

The same past, present, and reasonably foreseeable future actions described under alternative A would also occur under alternative C, with long-term minor to moderate adverse and long-term beneficial impacts on white-tailed deer due. These impacts, when combined with the primarily long-term beneficial impacts of alternative C and the long and short-term negligible adverse impacts of deer management actions, would result in long-term beneficial cumulative impacts on white-tailed deer. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative beneficial impacts on deer related to the associated reduced potential for disease amplification, spread and establishment, which could add to the long-term beneficial cumulative impacts. In the absence of any CWD triggered lethal response, alternative C would contribute an appreciable beneficial increment to the overall cumulative impact by achieving healthy deer densities.

Alternative D: Combined Lethal and Nonlethal Deer Management

The same past, present, and reasonably foreseeable future actions described under alternative A would also occur under alternative D, with long-term minor to moderate adverse and long-term beneficial impacts on white-tailed deer. These impacts, when combined with the primarily long-term beneficial impacts of alternative D and the long and short-term negligible adverse impacts of deer management actions, would result in long-term beneficial cumulative impacts on white-tailed deer. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative beneficial impacts on deer related to the associated reduced potential for disease amplification, spread and establishment, which could add to the long-term beneficial cumulative impacts. In the absence of any CWD triggered lethal response, alternative D would contribute an appreciable beneficial increment to the overall cumulative impact because of the reduction in browse damage to deer habitat.

CONCLUSION

Alternative A: No Action (Continuation of Current Management)

Under alternative A, deer would experience long-term, minor to moderate, adverse impacts because browsing pressure would likely remain high in the three parks throughout the life of this plan (15 years). There would be short-term negligible adverse impacts on deer from deer monitoring actions. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would provide indirect beneficial impacts on the overall deer population, but these would not outweigh the adverse effects of not taking deer management actions. The overall cumulative impact would be long-term, minor to moderate adverse, with alternative A contributing appreciable adverse increments to the cumulative impact on the white-tailed deer population.

Alternative B: Nonlethal Deer Management

Similar results would occur under alternative B, because reproductive control would result in a gradual reduction in the deer population, and consequently the deer population would remain at relatively high levels throughout the life of the plan. The exclosures would protect only a small portion of the forest at any one time, requiring 10 years for regrowth above the browse line. Alternative B would result in long-term minor to moderate adverse impacts. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would provide indirect beneficial impacts, but these would not outweigh the adverse effects of not taking deer management actions. Similar to alternative A, the overall cumulative impact would be long-term, minor to moderate adverse, with alternative B contributing appreciable adverse increments to the cumulative impact on the white-tailed deer population.

Alternative C: Lethal Deer Management

The overall impact on white-tailed deer under alternative C would be long-term and beneficial, because the relatively rapid deer herd reduction would allow the abundance and diversity of vegetation throughout the three parks to recover and better protect deer habitat. There would be short-term, negligible, adverse effects from implementing deer management actions (noise, disturbance), and short-term moderate adverse impacts on the parks’ deer populations from removing a relatively large percentage of the population over a short period of time to achieve the desired long-term benefit. CWD actions would have similar impacts, with short-term negligible impacts from surveillance, and long-term benefits from the reduction of the potential for disease amplification, spread and establishment. For both alternatives, the overall cumulative impact would be long-term and beneficial, and alternative C would contribute appreciable beneficial increments to the cumulative impact on the white-tailed deer population.

Alternative D: Combined Lethal and Nonlethal Deer Management

Alternative D would have essentially the same impacts as alternative C, with long-term beneficial effects due to the relatively rapid deer herd reduction that would allow the abundance and diversity of vegetation throughout the three parks to recover and better protect deer habitat. There would be short-term, negligible, adverse effects from implementing deer management actions (noise, disturbance), and short-term moderate adverse impacts on the parks’ deer populations from removing a relatively large percentage of the population over a short period of time to achieve the desired long-term benefit. CWD actions would have similar impacts, with short-term negligible impacts from surveillance, and long-term benefits from the reduction of the potential for disease amplification, spread and establishment. The overall cumulative impact would be long-term and beneficial, and alternative D would contribute appreciable beneficial increments to the cumulative impact on the white-tailed deer population.

IMPACTS ON OTHER WILDLIFE AND WILDLIFE HABITAT

GUIDING REGULATIONS AND POLICIES

The NPS Organic Act of 1916, NPS *Management Policies 2006* (NPS 2006a), and NPS *Reference Manual 77: Natural Resource Management* (NPS 1991) direct NPS managers to provide for the protection of park resources. The Organic Act requires that wildlife be conserved unimpaired for future generations, which has been interpreted to mean that native animal life are to be protected and perpetuated as part of a park unit's natural ecosystem. Parks rely on natural processes to control populations of native species to the greatest extent possible; otherwise, they are protected from harvest, harassment, or harm by human activities. The NPS *Management Policies 2006* make restoration of native species a high priority. Management goals for wildlife include maintaining components and processes of naturally evolving park ecosystems, including natural abundance, diversity, and ecological integrity of plants and animals (NPS 2006a, Section 4.1). Policies in the NPS Natural Resource Management Guideline state, "the National Park Service will seek to perpetuate the native animal life as part of the natural ecosystem of parks" and that "native animal populations will be protected against…destruction…or harm through human actions."

All three of the GMPs for the parks include management policies that pertain to wildlife and wildlife habitat; many of these address the vegetation communities that support wildlife:

- Antietam's GMP calls for reestablishing vegetation patterns on the battlefield (farm fields, woods, and orchards) to resemble conditions just before the battle.

- Monocacy's GMP identifies the effects of deer browse on vegetation as an issue because it can force farmers to change agricultural practices and alter regrowth in forested areas, suppressing the regeneration of native trees.

- Manassas' GMP notes the effects that deer are having on park vegetation, including historically wooded areas and streamside buffers, and the adverse effects on natural forest succession processes and newly installed landscape vegetation.

The parks' Resource Management Plans and Natural Resource Condition Assessments (see discussion in chapter 1) also mention the impacts on vegetation and crops from deer browse and propose that action be taken to reduce these impacts.

ASSUMPTIONS, METHODOLOGIES, AND INTENSITY DEFINITIONS

The evaluation of other wildlife was based on a qualitative assessment of how expected changes to each parks' vegetation (as a result of increased or decreased deer browsing pressure) would affect the habitat of other wildlife. The parks' wildlife species are directly affected by the natural abundance, biodiversity, and the ecological integrity of the vegetation that comprises their habitat.

Available information on known wildlife species was compiled and analyzed in relation to the management actions. The definitions for the intensity of adverse impacts on wildlife are defined as follows:

Negligible: There would be no observable or measurable impacts on the abundance and diversity of native species and/or the quality of their habitat.

Minor: Impacts would be detectable, but would not be outside the natural range of variability. Small changes to population numbers, number of species present, habitat quality, and other factors might occur. Occasional responses to disturbance by some individuals could be expected, but without interference to factors affecting population levels.

Moderate: Impacts on the abundance and diversity of native species and/or the quality of their habitat would be detectable and could be outside the natural range of variability. Changes to population numbers, number of species present, habitat quality, and other factors would occur, but species would remain stable and viable. Frequent responses to disturbance by some individuals could be expected, with some negative impacts on factors affecting population levels. Sufficient habitat would remain functional to maintain the viability of all native species.

Major: Impacts on the abundance and diversity of native species and/or the quality of their habitat would be detectable, would be expected to be outside the natural range of variability, and would be extensive. For example, population numbers, number of species present, habitat quality, genetic variation, and other metrics might experience large declines. Frequent responses to disturbance by some individuals would be expected, with negative impacts on factors resulting in a decrease in population levels. Loss of habitat might affect the viability of at least some native species.

AREA OF ANALYSIS

The area of analysis for impact assessment includes all lands within the boundaries of all three parks. The area of analysis for cumulative impacts includes the parks and the area within 2.5 miles of the parks' boundaries, which encompasses typical deer movement outside the park boundaries.

IMPACTS OF DEER MANAGEMENT ACTIONS

Alternative A: No Action (Continuation of Current Management)

Under alternative A, park staff would continue to monitor the deer population and vegetation and continue to use tree tubes, repellents (mainly Antietam), or small-scale fencing to protect landscape plantings, orchards, and small areas containing tree plantings or rare species. The vegetation/habitat conditions described in "Chapter 3: Affected Environment," for both vegetation and other wildlife and wildlife habitat indicates that deer have already affected the vegetation, and thus habitat, for other wildlife species within the parks. The herbaceous and woody seedling layers of the forest have been heavily browsed by deer, adversely affecting forest health and suggesting that the abundance and diversity of other wildlife using this understory habitat today is less than what it would be if deer browsing pressure was lower. Petit (1998) found that high amounts of deer browse of understory vegetation led to a reduction in abundance of understory bird species at Cuyahoga Valley National Park. McShea and Rappole (2000) found that avian species composition changes as the understory recovers from a period of extended deer browsing. This study is applicable to the three parks because it was conducted at Shenandoah National Park, another NPS unit that does not manage deer populations. The study documented the statistically significant increase of low forest guild birds as the understory recovered from excessive deer browsing. This included several species that nest at the parks (red-eyed vireo [*Vireo olivaceus*], eastern towhee [*Pipilo erythrothalmus*], and wood thrush [*Hylocichla mustelina*]). Gorsira, Rossell, and Patch (2006) found that deer browsing had suppressed forb and vertical plant cover across all forest types at Manassas National Battlefield. Vertical plant cover is an important habitat attribute to understory bird species. It has been positively correlated with the abundance and species richness of breeding birds (McShea and Rappole 1992) and the abundance and species diversity of wintering birds (Zebehazy and Rossell 1996). Heavy deer browsing also degrades habitat and results in a lack of cover for small mammals, making them vulnerable to predation from hawks, owls, foxes, skunks, raccoons, and coyotes. Flowerdew and Ellwood (2001) suggested that deer have indirectly decreased bank vole (*Myodes glareolus*) populations by removing the bramble blackberry (*Rubus fruticosus*). As discussed in this chapter in “Impacts on Vegetation,” deer activities, such as browsing, trampling, and seed dispersal through waste or attachment to hair, have the potential to increase the number and type of nonnative species within the battlefields. Continued spread and increase of nonnative species has the potential to alter native habitats over the long-term resulting in modifications to wildlife habitat.

At continued high densities, deer would also compete directly with other wildlife species for available resources. The production of acorns and other tree nuts, also known as mast, is a critical food source for many small mammals, birds, and deer preparing for the winter season. Particularly during low mast production years, abundant deer populations may directly compete with other wildlife for this important resource. Reduction in the availability of this critical food source negatively impacts reproduction and over-winter survival of species such as the eastern chipmunk (*Tamias striatus*), gray squirrel (*Sciurus carolinensis*), and white-footed mouse (*Peromyscus leucopus*) (Martin, Zim, and Nelson 1951; Miller and Getz 1977; Gashwiler 1979; Ostfeld, Jones, and Wolff 1996; Brooks and Healy 1988; McShea and Rappole 1992; McShea and Schwede 1993; McShea and Rappole 1997; McShea 2000). These impacts may be particularly important to insects such as butterflies, which are often dependent on a very narrow range of host plants (Strong, Lawton, and, Southwood 1984; Stewart 2001) that are also preferred deer browse species. Removal of nectar plants and other host species from fields and forests may result in adverse effects on species from the parks which are dependent on them. Other species that have a more diverse diet or that spend more time in the upper forest canopy (versus the shrub/ground layer) or leaf litter (e.g., salamanders) would be less affected by continued high deer density in unfenced areas of the parks.

Species that use deer as a food source, however rarely, such as coyotes could benefit from high deer density or open understory conditions. Other animals may also feed on deer carcasses, like crows (*Corvus* spp.) and raccoons, and these could benefit from higher deer densities. Small predators, such as foxes and hawks, could also benefit from a more open understory because prey might be easier to find. However, if the habitat of the prey species deteriorated to the point where prey (mice, rabbits, ground-nesting birds) could no longer maintain viable populations within the parks, then predator species would also decline. Grassland nesting birds would also benefit from deer browsing that keeps woody plants from taking over grasslands.

Deer impacts on herpetofauna (reptiles and amphibians) have not been well studied. In a study at Cuyahoga Valley National Park, Greenwald, Petit, and Waite (2008) placed coverboards within and outside of deer exclosures and found higher numbers of redback salamanders (*Plethodon cinereus*), and slugs outside of the exclosures. Given the small sample size (12 paired plots) and different theories for the results, results were inconclusive, and more research is needed. The authors noted that redback salamanders and garter snakes (*Thamnophis sirtalis sirtalis*) are species that do well in disturbed habitats, and the coverboards might have provided refuge from the lesser vegetated areas for the salamanders. Species that favor undisturbed habitats were not found outside of the exclosures.

Species that depend primarily on other habitats would be less affected by high deer numbers. Some frogs, snakes, salamanders, and turtles (e.g., bullfrogs (*Lithobates catesbeianus*), northern water snakes, snapping turtles [*Chelydra serpentina serpentine*]) live in or near water during much of their lives and are therefore less affected by deer, although they may also rely on forest cover. Similarly, heavy deer browsing would not directly change fish habitat, as noted in chapter 1.

Increases in wildlife movements may result as park staff travel to and from monitoring plots, install and maintain fencing and conduct deer counts. Deer population monitoring involves use of a spotlight from a vehicle along roadways and trails through the parks. This activity would be conducted at night and in the fall. No disturbance to breeding or diurnal animals would occur under this alternative. However, these activities may occasionally disturb common species of nocturnal wildlife such as raccoons and owls. Additionally, these activities would be expected to occur only periodically (annually to every five years) and for short duration (hours to days). Therefore, it is expected the impacts of these actions on wildlife species would be adverse, long-term, and negligible.

Overall, impacts of alternative A on other wildlife would vary considerably depending on the species, ranging from negligible to potentially major and long-term. Species that depend on ground cover and young tree seedlings or understory shrubs for food or cover could be severely reduced or eliminated from the parks; whereas, there would be negligible impacts on species that depend primarily on other habitats (not woodlands) or on the upper canopy for food and cover.

Alternative B: Nonlethal Deer Management

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under alternative A would continue under alternative B. Alternative B would also include several techniques to prevent adverse deer impacts including fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning. However, the main focus of alternative B would be two nonlethal actions: the construction of large-scale deer exclosures (fencing) to promote forest regeneration and nonsurgical reproductive control of does to restrict population growth (when this technology meets certain criteria). Large, fenced exclosures would be constructed to allow forest regeneration within localized areas of the parks. As explained previously in this chapter in “Impacts on Vegetation,” approximately 6% of the parks would be protected from deer browsing in this manner at a given time. The size of the openings in the fence (3 to 4 inches square) would allow small birds, mammals, and reptiles and amphibians (e.g., songbirds, squirrels, raccoons, snakes, salamanders) to pass in and out of these exclosures; other small to medium animals would be expected to be able to climb over (e.g., raccoon, opossum) or burrow under (e.g., fox, groundhog) the fencing. The added fence posts and fence would also provide perches for some birds, including hawks and owls. The fence could be an obstacle to others (e.g., birds hitting the fence). This action would make more ground/shrub layer habitat available to other wildlife than alternative A. However, because only 6% of the parks would be fenced off from browsing deer at any one time, and because deer density outside the protected areas would be expected to remain high for many years (see following discussion), the beneficial impact on other wildlife would be limited.

The use of reproductive controls could help reduce the impact on other wildlife by reducing the effects of deer browsing on wildlife habitat. However, as previously described in the chapter 4 section “Impacts on Vegetation,” the use of reproductive control could reduce the deer population to a limited extent if it was successfully implemented, but this would require many years to actually reduce the population, based on modeling efforts (Hobbs, Bowden, and Baker 2000; Merrill, Cooch, and Stout 2006) as well as a comparison of field efforts that used lethal (Frost et al. 1997) and nonlethal methods (Rutberg and Naugle 2008). The actual amount of time needed to observe a decrease would depend on a number of factors, such as the type of treatment used, its effectiveness in stopping reproduction, the size of the population at the time of initial treatment, the actual mortality rate, and the percentage of the population treated. Other factors, such as untreated deer moving into the parks and treated deer leaving the parks, would also affect the time required to reduce herd numbers. The benefit of this action would be proportional to the amount of population reduction that it achieved, and a corresponding improvement to understory habitat. Based on these factors, it is expected that reproductive controls could stop population growth, but it would not be possible to achieve the desired deer density goals for the parks during the life of this management plan.

Similar to alternative A, a continued high deer density and the associated browsing throughout a large portion of the parks would affect the overall forest health by reducing nesting and cover habitat as well as the availability of food for species that depend on ground/shrub layer vegetation for survival. These species, including ground and/or shrub-nesting birds (e.g., ovenbirds, eastern meadowlark (*Sturnella magna*), and white-crowned sparrow), would decline over time, with adverse, long-term, moderate to potentially major impacts. Other species that have a more diverse diet (e.g., raccoons) or that spend more time in other habitat (e.g., salamanders and snakes) or the upper canopy (e.g., owls and raptors) versus the ground/shrub layer, would be less affected by high or increased deer density. As with alternative A, species that use deer or their carcasses as a food source, such as coyotes and crows, grassland nesting birds, and small predators, such as foxes and hawks, could also benefit from the high deer densities that result in a more open understory. As a result, the overall impact on wildlife throughout the parks would continue to be long-term negligible to potentially major adverse, depending on the species.

Human presence associated with the installation of fenced exclosures or the reproductive control techniques could adversely affect wildlife while the actions are being carried out. However, such small areas of the parks would be affected for a short period that the adverse impact would be short-term and negligible. Bait could provide a beneficial food source to other wildlife during the time that reduction activities were conducted; however, the small quantity and short time periods that bait would be available would have a negligible impact on any species.

Alternative B includes use of various techniques to prevent adverse deer impacts including fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning. All of these actions would provide beneficial impacts and serve to reduce deer damage, but in a limited, localized context. Impacts of the fencing of crops and woodlots on wildlife would be the same as that discussed previously for the forest regeneration exclosures. Changing crops can prevent deer browse, but would likely have a negligible adverse impact on other wildlife. Wildlife that take advantage of crops for food or cover would likely adapt to the new crop variety and this would not affect any existing native wildlife habitats. Various aversive conditioning techniques (loud noises, scarecrow devices) would be useful in keeping deer away at certain times and in limited areas. These would also be used on a very selective basis and tested for effectiveness. Such aversive conditioning techniques may result in temporary disturbance to other wildlife in the area; however, given that these techniques would be used over limited areas they would have short-term negligible adverse impacts on wildlife populations in the parks.

Overall, alternative B would result in a range of long-term negligible to potentially major impacts, depending on the species, similar to alternative A, since it is expected that the deer population would remain at relatively high density levels in the parks throughout the life of the plan.

Alternative C: Lethal Deer Management

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under alternative A would continue under alternative C. Alternative C would also include the additional techniques described under alternative B, but the primary focus of alternative C is using sharpshooting with firearms to reduce the herd size to the desired density level. A very limited use of capture and euthanasia of individual deer could be considered if needed due to safety concerns, but the parks do not expect that this would be necessary. Unlike alternative A, a reduced degree of deer browsing throughout the majority of the parks would benefit species that use the same food sources (e.g., acorns), or otherwise depend on ground/shrub layer vegetation for their food and cover. Reduction of deer density would release plant communities from heavy browse pressure and substantially improve the quality and quantity of wildlife habitat throughout the parks, a benefit for overall forest health. As the forest herbaceous and shrub layers return and forests experience successful regeneration, wildlife communities would be provided with more high quality forage and nesting sites for ground and shrub nesting bird species and increased wildlife cover. This would lead to increased reproductive success and higher survival for many wildlife species. Under alternative C, wildlife would be expected to improve in both diversity and abundance, a long-term beneficial impact. Other species that have a more diverse diet (e.g., raccoons) or that spend more time in other habitat (e.g., frogs and salamanders) or the upper canopy (e.g., barred owls [*Strix varia*] and woodpeckers) would be less affected by a reduced deer density, although a long-term benefit to upper canopy species would be gained in the future as forest regeneration maintained the upper canopy.

Predators that use deer as a food source and grassland nesting birds could be somewhat adversely affected by a lower deer density or denser understory conditions. Other animals that feed on deer carcasses, such as crows and raccoons, could also be adversely affected. However, none of these species solely depend on deer as a food source, so the adverse impacts on these species would be long-term and minor at most. Predators could find a denser understory more difficult for hunting small prey than the current open condition, but better habitat conditions and an increase in the abundance of prey species could also benefit these predators.

Wildlife, other than deer, would be temporarily disturbed by the presence of humans placing bait stations, shooting deer, setting traps, and observing deer behavior. Bait could provide a beneficial food source to other wildlife during the time that reduction activities were conducted; however, the small quantity and short time periods that bait would be available would have a negligible impact on any species. The surface disposal of deer waste and/or carcasses would provide a beneficial food source to scavengers like the coyotes, crows, and raccoons; however, under this alternative, it is expected that meat would be donated to the maximum extent possible or would be disposed of through an approved landfill. The small number of carcasses left for natural decomposition would not be substantially different than what occurs through natural mortality (e.g., disease, old age, car collisions). These human disturbances in each instance would result in long-term negligible adverse impacts as they would not cause any measurable change to the habitat or responses by other wildlife species.

Alternative C includes use of various techniques to prevent adverse deer impacts including fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning. All of these actions would provide beneficial impacts and serve to reduce deer damage, but in a limited, localized context. Impacts of the fencing of crops and woodlots on wildlife would be the same as that discussed previously for the forest regeneration exclosures. Changing crops can prevent deer browse, but would likely have a negligible adverse impact on other wildlife. Wildlife that take advantage of crops for food or cover would likely adapt to the new crop variety and this would not affect any existing native wildlife habitats. Various aversive conditioning techniques (loud noises, scarecrow devices) would be useful in keeping deer away at certain times and in limited areas. These would also be used on a very selective basis and tested for effectiveness. Such aversive conditioning techniques may result in temporary disturbance to other wildlife in the area; however, given that these techniques would be used only occasionally over limited areas and for short time periods they would have short-term negligible adverse impacts on wildlife populations in the parks.

Overall, impacts of alternative C on other wildlife would be long-term and beneficial because the relatively rapid deer herd reduction would allow vegetation used as food and cover for many wildlife species to become more abundant.

Alternative D: Combined Lethal and Nonlethal Deer Management

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under alternative A would continue under alternative D, and the additional techniques described under alternative B could be used. However, the main emphasis of alternative D would be using a combination of sharpshooting and reproductive control of does from alternatives C and B to address high deer density. Sharpshooting (with very limited capture/euthanasia if necessary) would be taken initially to reduce the deer herd numbers quickly. Population maintenance would be conducted via nonsurgical reproductive control methods (if these are available and meet NPS criteria for use); if not, sharpshooting would be used for maintenance. Similar to alternative C, a reduced degree of deer browsing throughout the majority of the parks would benefit species that use the same food sources (e.g., acorns), or otherwise depend on ground/shrub layer vegetation for their food and cover. Reduction of deer density would release plant communities from heavy browse pressure and substantially improve the quality and quantity of wildlife habitat, and the forest ecology generally, throughout the parks. As the forest herbaceous and shrub layers return and forests experience successful regeneration, wildlife communities would be provided with more high quality forage and nesting sites for ground and shrub nesting bird species and increased wildlife cover. This would lead to increased reproductive success and higher survival for many wildlife species. Under alternative D, wildlife would be expected to improve in both diversity and abundance, a long-term beneficial impact. Other species that have a more diverse diet (e.g., raccoons) or that spend more time in other habitat (e.g., frogs and salamanders) or the upper canopy (e.g., barred owls and woodpeckers) would be less affected by a reduced deer density, although a long-term benefit to upper canopy species would be gained in the future as forest regeneration maintained the upper canopy.

Also similar to alternative C, predators that use deer as a food source, could be somewhat adversely affected by a lower deer density or denser understory conditions. Other animals that feed on deer carcasses, such as crows and raccoons, could also be adversely affected. However, none of these species solely depend on deer as a food source, so the adverse impacts on these species would be long-term and minor at most. Predators could find a denser understory more difficult for hunting small prey than the current open condition, but better habitat conditions and an increase in the abundance of prey species could also benefit these predators.

Wildlife other than deer would be temporarily disturbed by the presence of humans placing bait stations, shooting deer, setting traps, implementing reproductive control techniques, and observing deer behavior, similar to alternative C. Bait could provide a beneficial food source to other wildlife during the time that reduction activities were conducted; however, the small quantity and short time periods that bait would be available would have a negligible impact on any species. Surface disposal of deer waste and/or carcasses would provide a beneficial food source to scavengers; however, under this alternative, it is expected that meat would be donated to the maximum extent possible or would be disposed of through an approved landfill. The small number of carcasses left for natural decomposition would not be substantially different than what occurs today through natural mortality (e.g., disease, old age, car collisions). These human disturbances in each instance would be adverse, temporary, and negligible, as they would not cause any measurable change to the habitat or responses by other wildlife species.

Long-term reduction and controls on deer population growth would allow vegetation used as food and cover by other wildlife to become more abundant. Therefore, the impact of alternative D to other wildlife would be mostly beneficial and long-term, depending on the species, and existing adverse impacts would be reduced to negligible or minor levels. The impacts of each method (sharpshooting, euthanasia, or reproductive control) on other wildlife would be essentially the same, as long as habitat was improved by reducing deer browsing pressure. Potential differences in impacts would relate to the time required for implementation and the resulting deer population size.

Alternative D includes use of various techniques to prevent adverse deer impacts including fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning. All of these actions would provide beneficial impacts and serve to reduce deer damage, but in a limited, localized context. Impacts of the fencing of crops and woodlots on wildlife would be the same as that discussed previously for the forest regeneration exclosures. Changing crops can prevent deer browse, but would likely have a negligible adverse impact on other wildlife. Wildlife that take advantage of crops for food or cover would likely adapt to the new crop variety and this would not affect any existing native wildlife habitats. Various aversive conditioning techniques (loud noises, scarecrow devices) would be useful in keeping deer away at certain times and in limited areas. These would also be used on a very selective basis and tested for effectiveness. Such aversive conditioning techniques may result in temporary disturbance to other wildlife in the area; however, given that these techniques would be used over limited areas they would have short-term negligible adverse impacts on wildlife populations in the parks.

Overall, impacts of alternative D on other wildlife would be long-term and beneficial because the relatively rapid deer herd reduction would allow vegetation used as food and cover for many wildlife species to become more abundant, with limited adverse impacts from the management actions themselves.

IMPACTS OF CHRONIC WASTING DISEASE MANAGEMENT ACTIONS, INCLUDING THE LONG-TERM CHRONIC WASTING DISEASE MANAGEMENT PLAN

Alternative A: No Action (Continuation of Current Management)

Under the no action alternative, the parks would continue with opportunistic and targeted CWD surveillance. Antietam and Monocacy would also respond to CWD presence in or near the parks in accordance with the CWD Detection and Initial Response Plan (NPS 2009c), and Manassas would create a similar plan. The Antietam and Monocacy CWD Detection and Initial Response Plan includes a range of actions including live testing and lethal removal of deer if CWD occurs within 5-20 miles of the park boundary. If CWD were to occur within 5 miles of the parks, initial response include a one-time lethal removal of deer to reach a deer density of about 25–45 deer per square mile. Based on 2008 deer density data, this would involve removing about 250 deer at each park over 3 years (NPS 2009c). There would be no new longer term CWD monitoring or management activities.

Impacts on wildlife for the current CWD management actions and plan, including the initial response plan for Antietam and Monocacy, are described in the EA completed for these actions (NPS 2009c). Impacts of CWD surveillance and detection actions on wildlife would be short-term negligible to minor and adverse, mainly from temporary disturbances during implementation. If CWD were to occur within 5 miles of the parks, the initial response plan for Antietam and Monocacy calls for a substantial reduction in the deer population, which would have short-term beneficial effects on wildlife as a result of reduced browsing and grazing pressure associated with the lower deer densities achieved from the one-time reduction. This would decrease impacts on understory plants that provide wildlife habitat in woodlands, as well as vegetation in agricultural fields and ornamental vegetation, increasing the food and cover for species that depend on the ground/shrub layer for survival, at least until the deer herd increased again. These actions were analyzed through a separate NEPA process (NPS 2009c) and would be similar to the effects described for the deer removal actions under alternative C, above. Manassas would likely adopt a similar plan under no action, so impacts there would be the same.

Alternatives B, C, and D (All Action Alternatives)

Under any of the action alternatives, targeted and opportunistic surveillance, and actions under any current initial detection and response plans would continue with impacts similar to alternative A. However, under all alternatives, the parks would adopt a long-term CWD response plan that includes the lethal reduction of deer if CWD is confirmed in or within 5 miles of parks. This would include a rapid reduction to the target deer density and possibly reduction to as low as 10 deer per square mile, and deer would be removed for surveillance monitoring in subsequent years. Reductions would generally follow the same schedule as outlined in alternative C, above, but reductions would be coordinated with the state to address conditions at the time of the CWD detection and could be expedited if resources are available.

Impacts on wildlife from the deer reduction actions would be the same as described for alternative C under the analysis of deer management actions, above. Rapidly reducing the deer population would allow the number of tree and shrub seedlings to increase and survive into maturity and allow crops and trees to survive without damage, which would provide habitat for species that depend on the ground/shrub layer for survival and food sources, resulting in a beneficial effect. Predators that use deer as a food source (such as coyotes) and grassland nesting birds could be somewhat adversely affected by a lower deer density or denser understory conditions. Other animals that feed on deer carcasses, such as crows and raccoons, could also be adversely affected. However, none of these species solely depend on deer as a food source, so the adverse impacts on these species would be long-term and minor at most. The intensity of the impacts from CWD activities may vary, depending on when the CWD actions occur in relationship to the deer management actions. If CWD activities were to occur prior to deer management activities, the impacts would be more noticeable, while if they happened after the deer population had already been reduced as part of a deer management plan, less action would be needed for CWD and the impacts from CWD activities would be less intense and less noticeable.

CUMULATIVE IMPACTS

Alternative A: No Action (Continuation of Current Management)

Past, present, and reasonably foreseeable future actions that could impact wildlife and wildlife habitat would be similar to those described for vegetation, since vegetation comprises the habitat that affects wildlife species to a great extent. Minor to moderate short- and long-term adverse impacts on wildlife are expected from development within the vicinity of the parks, including transportation, utility lines, and construction projects, which can involve removal or disturbance to habitat and noise. Past actions within and around the parks, such as residential development, agriculture, and the spread of invasive exotic species, have adversely affected wildlife and their habitat, with short- and long-term minor to moderate adverse impacts from disturbance, noise, habitat removal and fragmentation, and demise of preferred native plant species. Exotic plant management efforts would also benefit wildlife habitat in the long term by removing plants that compete with native species. Beneficial impacts have resulted from past and current deer management efforts undertaken by neighboring agencies and landowners, which have reduced deer numbers in and around the parks and helped to limit browsing impacts on understory and herbaceous plants that are important habitat for many species.

The past, present, and reasonably foreseeable future actions described above would result in short- and long-term negligible to moderate adverse impacts as well as long-term beneficial impacts. These impacts, when combined with the negligible to potentially major impacts of deer management under alternative A with continued pressure on woody and herbaceous vegetation that makes up the wildlife habitat and the limited natural regeneration expected, would result in cumulative impacts that would be adverse, long-term, and minor to potentially major depending on the species. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative beneficial impacts on most wildlife species related to the associated reduced browse impacts, which would reduce long-term adverse cumulative impacts. In the absence of any CWD-triggered lethal response, the deer management actions that would continue under alternative A would contribute an appreciable adverse increment to the overall cumulative impact because of the expected continued deer browsing that would adversely affect wildlife food and cover.

Alternative B: Nonlethal Deer Management

The same past, current, and future actions described under alternative A would also occur under alternative B, with long-term minor to moderate adverse impacts from development and other actions and beneficial impacts mainly from control of invasive species and deer management by neighboring jurisdictions that have helped reduce loss of habitat in the area of analysis. These impacts, when combined with the long-term negligible to potentially major adverse impacts of alternative B, would result in cumulative impacts that would be adverse, long-term, and minor to potentially major depending on the species. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative beneficial impacts on vegetation related to the associated reduced browse impacts, which would reduce long-term adverse cumulative impacts. In the absence of any CWD triggered lethal response, the deer management actions under alternative B would contribute a substantial adverse increment to the overall cumulative impacts, because the exclosures and reproductive control actions taken would not be expected to result in a population reduction to the desired deer density goal in the parks within the life of this management plan, and would not protect wildlife species enough to offset the adverse effects of the continued high deer density expected.

Alternative C: Lethal Deer Management

The same past, current, and future actions described under alternative A would also occur under alternative C, with, with long-term minor to moderate adverse impacts from development and other actions and beneficial impacts mainly from control of invasive species and deer management by neighboring jurisdictions that have helped reduce loss of habitat in the area of analysis. These impacts, when combined with the long-term beneficial impacts and short-term negligible to long-term minor adverse impacts of alternative C, would provide long-term beneficial impacts on other wildlife. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative beneficial impacts on most wildlife related to the associated reduced browse impacts, which could add to the long-term beneficial cumulative impacts. In the absence of any CWD triggered lethal response, the deer management actions under alternative C would contribute a substantial beneficial increment amount to the overall cumulative impacts because deer browsing pressure would be reduced through a rapid reduction of the deer population and this would allow a greater proportion of the forest to regenerate within a few years for herbaceous species to 10 years for woody species, improving habitat for many other wildlife.

Alternative D: Combined Lethal and Nonlethal Deer Management

The same past, current, and future actions described under alternative A would also occur under alternative D, with, with long-term minor to moderate adverse impacts from development and other actions and beneficial impacts mainly from control of invasive species and deer management by neighboring jurisdictions that have helped reduce loss of habitat in the area of analysis. These impacts, when combined with the long-term beneficial impacts and short-term negligible to long-term minor adverse impacts of alternative D, would provide long-term beneficial impacts on other wildlife. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative beneficial impacts on most wildlife related to the associated reduced browse impacts, which could add to the long-term beneficial cumulative impacts. In the absence of any CWD triggered lethal response, the deer management actions under alternative D would contribute a substantial beneficial increment amount to the overall cumulative impacts because deer browsing pressure would be reduced through a rapid reduction of the deer population and this would allow a greater proportion of the forest to regenerate within a few years for herbaceous species to 10 years for woody species, improving habitat for many other wildlife.

CONCLUSION

Alternative A: No Action (Continuation of Current Management)

Under alternative A, other wildlife would experience primarily adverse, long-term, and negligible to potentially major impacts, depending on the species. Species that depend on ground cover and young tree seedlings or understory shrubs for food or cover could be severely reduced or eliminated from the parks, while impacts on species that depend primarily on other habitats (not woodlands) or on the upper canopy for food and cover would be negligible. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would provide indirect beneficial impacts, but these would not outweigh the adverse effects of not taking deer management actions. The overall cumulative impact would be long-term, moderate, and adverse, with alternatives A contributing appreciable adverse increments to the cumulative impact on wildlife.

Alternative B: Nonlethal Deer Management

Similar results would occur under alternative B, with primarily adverse, long-term, and negligible to potentially major impacts, depending on the species. Reproductive control would result in only a gradual reduction in the deer population, and although the population goal could be met over the longer term, the risk of not meeting the goal would be high. Therefore, it is expected that the deer population would remain at relatively high density levels in the parks throughout the life of the plan. Also, the exclosures would protect only a small portion of the forest in the parks at any one time, requiring 10 years for regrowth above the browse line. Species that depend on ground cover and young tree seedlings or understory shrubs for food or cover could be severely reduced or eliminated from the parks, while impacts on species that depend primarily on other habitats (not woodlands) or on the upper canopy for food and cover would be negligible. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would provide indirect beneficial impacts, but these would not outweigh the adverse effects of not taking deer management actions. Similar to alternative A, the overall cumulative impact would be long-term, moderate, and adverse, with alternative B contributing appreciable adverse increments to the cumulative impact on wildlife, the overall cumulative impact would be long-term, moderate, and adverse, with alternative B contributing appreciable adverse increments to the cumulative impact on wildlife and wildlife habitat.

Alternative C: Lethal Deer Management

The overall impact on other wildlife under alternative C would be long-term and beneficial because the relatively rapid deer herd reduction would allow vegetation used as food and cover for many wildlife species to become more abundant. There could be long-term minor adverse effects on some species that prefer open habitat and short-term negligible adverse impacts from disturbance and noise during the implementation of the action and use of deer management. However, the impacts of deer management actions under alternative C on other wildlife would be mostly beneficial and long-term, depending on the species. CWD actions would have similar impacts, with short-term negligible impacts (mainly trampling) from surveillance, and benefits from the reduction of deer and deer browse on vegetation. The overall cumulative impact would be long-term and beneficial, and alternative C would contribute appreciable beneficial increments to the cumulative impact on vegetation.

Alternative D: Combined Lethal and Nonlethal Deer Management

Alternative D would have essentially the same impacts as alternative C, with long-term beneficial effects due to the decrease in the deer herd, and limited adverse impacts from the management actions themselves. CWD actions would have similar impacts, with short-term negligible impacts (mainly trampling) from surveillance, and benefits from the reduction of deer and deer browse on vegetation/habitat. The overall cumulative impact would be long-term and beneficial, and alternative D would contribute appreciable beneficial increments to the cumulative impact on wildlife and wildlife habitats.

IMPACTS ON SPECIAL STATUS SPECIES

GUIDING REGULATIONS AND POLICIES

The Endangered Species Act (16 USC 1531 et seq.) and amendments (1973) mandate that all federal agencies consider the potential effects of their actions on species listed as threatened or endangered. If the NPS determines that an action may adversely affect a federally listed species, consultation with the U.S. Fish and Wildlife Service (USFWS) is required to ensure that the action will not jeopardize the species' continued existence or result in the destruction or adverse modification of critical habitat.

The NPS *Management Policies 2006* states that potential effects of agency actions will also be considered on state- or locally-listed species (NPS 2006a). The NPS is required to control access to important habitat for such species and to perpetuate the natural distribution and abundance of these species and the ecosystems upon which they depend. Although the NPS does not have a legal obligation to manage for state-listed species, it is required by the Organic Act to "conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such a manner and by such means as will leave them unimpaired for the enjoyment of future generations" (16 USC 1). In addition, NPS *Management Policies 2006*, Section 4.4.2.2 states, "the National Park Service will…manage state and locally listed species in a manner similar to its treatment of federally listed species to the greatest extent possible" (NPS 2006a).

There are no federally listed animal species that occur in the parks. The bald eagle (*Haliaeetus leucocephalus*) was formerly listed but was delisted in 2007. It retains protection against take (including disturbance) at the federal level under the Bald and Golden Eagle Protection Act. No federally listed plant species are known to occur in the parks. Numerous Maryland or Virginia state-listed or rare species have been documented in the park and include plants, birds, a mammal, and an insect.

ASSUMPTIONS, METHODOLOGIES, AND INTENSITY DEFINITIONS

To assess impacts on listed species, the following process was used:

- Identification of which species are in areas likely to be affected by management actions described in the alternatives
- Analysis of habitat loss or alteration caused by the alternatives
- Analysis of disturbance potential of the actions and the species' potential to be affected by the actions.

The information in this analysis was obtained through best professional judgment of park staff and experts in the field (as cited in the text) and from relevant literature. The following thresholds were used to determine impacts on special status species.

Negligible: Impacts on special status species would result in no measurable or perceptible changes to a population or individuals of such species or its habitat. Impacts would be well within natural fluctuations.

Minor: Impacts on special status species would result in measurable or perceptible changes to individuals of a species, a population, or its habitat, but would be localized within a relatively small area, and the overall viability of the species would not be affected.

Moderate: Impacts on special status species would result in measurable and/or consequential changes to individuals of a species, a population, or its habitat; however, the impact would remain relatively localized. The viability of the species could be affected, but the species populations in the park would not be permanently lost.

Major: Impacts on special status species would result in measurable and/or consequential changes to a large number of individuals of a species or a population or a large area of its habitat. These changes would be substantial, highly noticeable, and permanent, potentially resulting in a loss of species viability and possible extirpation from the park.

AREA OF ANALYSIS

The area of analysis for impact assessment includes all lands within the boundaries of all three parks. The area of analysis for cumulative impacts includes the parks and the area within 2.5 miles of the parks' boundaries, which encompasses typical deer movement outside the park boundaries.

IMPACTS OF DEER MANAGEMENT ACTIONS

Alternative A: No Action (Continuation of Current Management)

Under alternative A, park staff would continue to monitor the deer population and vegetation and continue to use tree tubes, repellents (mainly Antietam), or small-scale fencing to protect landscape plantings, orchards, and small areas containing tree plantings or rare species.

Special Status Plant Species

Of the more than 41 state-listed or rare plant species known to occur within the legislative boundaries of the parks, many are susceptible to deer damage because of their presence in habitat frequented by deer and/or their palatability to deer (table 21 in chapter 3). Antietam has extremely limited fencing around special status plant species. The parks currently do not selectively protect any populations of rare understory plant species that deer may browse, and this would not change under the no action alternative. Therefore, impacts on those state-listed or rare plant species that could be affected by deer or deer management would likely occur from the continued over browsing expected under alternative A, as described in the “Impacts on Vegetation” section in this chapter for non-listed woody and herbaceous vegetation. These state listed species include tree and shrub species such as arbor vitae (*Thuja occidentalis*), which is in the national cemetery and not subject to deer browse, eastern prickly gooseberry (*Ribes cynosbati*), and Shumard’s oak (*Quercus shumardii*), as well as many uncommon herbaceous plants such as downy phlox (*Phlox pilosa*), cow parsnip (*Heracleum maximum*), and fringed brome (*Bromus ciliatus*) found in the parks. Browsing impacts on these species could result in a reduction of the species in the plant community, either because of mortality resulting directly from browsing or due to impacts on overall plant health, and its ability to produce seed stock or otherwise spread. Continuous browsing of preferred plants over time could result in the loss of individual species from the community. Similar impacts on sensitive species considered to be less palatable to deer but found in forest/upland habitat frequented by deer would also be expected if food resources were limited due to deer population growth, seasonal or climate variations (e.g., drought), or reductions in plant abundance resulting from disease or insect impacts. As a result, continued browsing pressure of an uncontrolled deer population would lead to long-term moderate to potentially major adverse impacts on several state-listed or rare plant species not protected by fencing.

Conversely, there are several special status plants that would not be affected to more than a negligible degree, because they are found in habitat not used by deer or are known to be unpalatable to deer. These include purple milkweed (*Asclepias purpurascens*), troublesome sedge (*Carex molesta*), dwarf larkspur (*Delphinium tricorne*), Kentucky coffee-tree (*Gymnocladus dioicus*), Virginia ground-cherry (*Physalis virginiana*), hoary skullcap (*Scutellaria incana*), golden alexanders (*Zizia aurea*), and mudbank crowngrass (*Paspalum dissectum*) (table 21 in chapter 3).

Special Status Animal Species

The vegetation and habitat conditions described in chapter 3, for vegetation and other wildlife and wildlife habitat indicates that deer have already affected vegetation, and thus habitat, for other wildlife species within the parks, including those listed or considered special status species by Maryland and Virginia. The herbaceous and woody seedling layers of the forest have been browsed by deer, and monitoring results indicate a substantial decline in vegetation in paired unfenced plots compared to paired fenced plots, suggesting that the abundance and diversity of the animals using this understory habitat today could be affected.

As described in “Impacts on Other Wildlife and Wildlife Habitat,” the continued growth of the deer population and heavy deer browsing can degrade habitat and result in lack of food or cover for species that require ground vegetation to maintain viable populations within the parks. This includes several species listed or considered special status species by Maryland or Virginia (see tables 21 and 22 in chapter 3), such as ground-nesting or feeding birds (e.g., hermit thrush [*Catharus guttatus*] and vesper sparrow (*Pooecetes gramineus*)). Other birds (e.g., brown creeper [*Certhia americana*], and magnolia warbler [*Dendroica magnolia*]) that nest or forage in the understory shrub layer would also be affected if available food and cover would be greatly reduced by browsing. Many of these birds are migratory and are listed in the USFWS Birds of Conservation Concern (USFWS 2008). The three parks provide important habitat for these birds.

Many state-listed animal species would likely not be affected by deer or deer management actions to more than a negligible to minor degree, because they do not breed in the parks, or do not breed or otherwise depend on habitat affected by deer browsing, or are not expected in areas that would be used for deer management actions such as placement of bait piles, sharpshooting, or trapping for reproductive control activities. This includes species that are mainly aquatic or associated with open water/emergent marsh habitats, or that are mainly upper canopy nesters, whose habitat would not be subject to heavy deer browsing and would not be close to most deer management activities. It also includes migrant species that do not breed or nest in the parks; these species would be affected mainly by the noise or disturbance associated with deer management actions, and this would cause short-term negligible adverse impacts. In addition, birds such as loggerhead shrike (*Lanius ludovicianus*) that prefer open areas would benefit from deer browsing that keeps woody growth from taking over grassland habitat.

Those special status animal species that would experience no or negligible adverse effects from the actions in this plan include the following: hooded merganser (*Lophodytes cucullatus*), barn owl (*Tyto alba*), and eastern harvest mouse (*Reithrodontomys humulis*), northern harrier (*Circus cyaneus*), yellow-bellied sapsucker (*Sphyrapicus varius*), upland sandpiper (*Bartramia longicauda*), bald eagle, black-throated blue warbler (*Dendroica caerulescens*), and blackburnian warbler (*Dendroica fusca*).

Based on the above analysis, the impact of alternative A on special status species would be primarily adverse, long-term, and would range from negligible to potentially major, depending on the species and its dependence on habitat that is adversely impacted by deer browse. Species that depend on ground cover, young tree species, or understory shrubs for food, cover, or nesting habitat (such as hermit thrush and vesper sparrow) could be reduced or eliminated over time in at least some areas of the parks, resulting in moderate to potentially major adverse effects. Impacts on wetland-dwelling herpetofauna and species that depend on the middle to upper canopy, such as woodpeckers and owls, would be long-term, negligible adverse.

Overall, under alternative A, impacts on special status species would vary considerably depending on the species, ranging from negligible to potentially major and long-term. Species that depend on ground cover and young tree seedlings or understory shrubs for food or cover or native plants could be severely reduced or eliminated from the parks; whereas, there would be negligible impacts on species that depend primarily on other habitats (not woodlands) or on the upper canopy for food and cover.

Alternative B: Nonlethal Deer Management

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under alternative A would continue under alternative B. Alternative B would also include several techniques to prevent adverse deer impacts including fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning. However, the main focus of alternative B would be two nonlethal actions: the construction of large-scale deer exclosures (fencing) to promote forest regeneration and nonsurgical reproductive control of does to restrict population growth (when this technology meets certain criteria).

Special Status Plant Species

Impacts on state-listed species would be similar to those described for non-listed vegetation.

As described for alternative A, deer browsing has already caused noticeable changes to vegetation. Browsing impacts on sensitive species could result in a reduction of species in the plant community and its ability to produce seeds or otherwise spread. This species reduction would be caused by mortality resulting directly from browsing or impacts on overall plant health. Continuous browsing of sensitive plants over time could result in the loss of individual species from the community, especially those that are palatable to deer and those located in preferred deer habitats. As a result, alternative B would continue to have long-term moderate to major adverse impacts on the listed plant species that are susceptible to deer browse and those that are located primarily in deer habitat and are not protected by fencing.

Impacts from construction of the large scale exclosures and administration of reproductive control agents would result in ground disturbances, including trampling by workers, which could affect state-listed or rare plant species and their habitat, but these impacts would be limited both because of the relatively small extent of the areas affected and the steps that would be taken to avoid injury to these plants. Exclosure areas would be surveyed for state-listed or rare plants prior to construction and any plants identified would be avoided during fence installation. Personnel involved in these activities would be educated about the potential impacts of their actions on these plants. In addition, small areas of the parks would be affected for only a short period, resulting in short-term negligible adverse impacts. If any of the state-listed or rare plants were within an exclosure, there could be long-term beneficial effects by removing the impacts of deer over-browsing (i.e., trampling, browsing, seed dispersal, etc.) in these areas. However, because only 6% of the parks would be fenced off from browsing deer at any one time, and because deer density outside protected areas would continue to remain high for many years, the beneficial impacts would be limited.

Alternative B includes use of various techniques to prevent adverse deer impacts including fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning. None of these techniques would be expected to impact sensitive plant species. As stated previously, installation of fencing could potentially impact a sensitive plant species if they were harmed by trampling from workers. However, impacts would be short-term negligible adverse given the precautions described previously.

Special Status Animal Species

Impacts on state-listed animal species that could be affected by deer or deer management actions would be similar to those described in “Impacts on Other Wildlife and Wildlife Habitat” for non-listed wildlife species. As with alternative A, a continued high deer density and the associated browsing throughout the majority of the parks would reduce the availability of food for wildlife listed or considered special status species by Maryland or Virginia that depend on ground/shrub layer vegetation for survival. This includes ground and/or shrub-nesting or foraging birds (e.g., brown creeper and magnolia warbler). Conversely, many species that do not breed or otherwise depend on habitat affected by deer browsing, or species that are not expected in areas that would be used for deer management actions, would be minimally affected. This includes species that are mainly aquatic or associated with open water/emergent marsh habitats, species that are mainly upper canopy nesters, and migrant species that do not breed or nest in the parks. However, because of the potential of increased predation resulting from the lack of an understory due to continued over-browsing, the impacts on species that use the understory and ground layer (such as ground nesting birds) would be long-term minor to major adverse, depending on the species and the extent of deer impacts.

Alternative B includes use of various techniques to prevent adverse deer impacts including fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning. All of these actions would provide beneficial impacts and serve to reduce deer damage, but in a limited, localized context. Impacts of the fencing of crops and woodlots on sensitive animal species would be the same as that discussed for other wildlife for forest regeneration exclosures. Changing crops can prevent deer browse, but would likely have a negligible adverse impact on sensitive animal species. Species that take advantage of crops for food or cover would likely adapt to the new crop variety and this would not affect any existing native wildlife habitats. Various aversive conditioning techniques (loud noises, scarecrow devices) would be useful in keeping deer away at certain times and in limited areas. These would also be used on a very selective basis and tested for effectiveness. Such aversive conditioning techniques may result in temporary disturbance to sensitive animal species in the area; however, given that these techniques would be used over limited areas, they would have short-term negligible adverse impacts on sensitive animal species populations in the parks.

Overall, alternative B would have a range of long-term negligible to potentially major impacts, depending on the species, similar to alternative A, since it is expected that the deer population would remain at relatively high density levels in the parks throughout the life of the plan.

Alternative C: Lethal Deer Management

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under alternative A would continue under alternative C. Alternative C would also include the additional techniques described under alternative B, but the primary focus of alternative C is using sharpshooting with firearms to reduce the herd size to the desired density level. A very limited use of capture and euthanasia of individual deer could be considered if needed due to safety concerns, but the parks do not expect that this would be necessary.

Special Status Plant Species

A reduced deer density throughout the majority of the parks would promote the growth of sensitive species if suitable habitat characteristics and seed stock were present. A smaller deer herd density would reduce browsing pressure on native plant communities over time, resulting in reestablishment and an increase in the extent of natural communities in the parks. Increased areas of native vegetation would be expected to promote the reestablishment of special status plant species. Reducing deer herd density would decrease the potential for deer browsing impacts on sensitive species, resulting in long-term beneficial impacts. Some browsing of sensitive plant species (see alternatives A and B) would be expected, even when herd density is maintained at target density levels. However, potential impacts on sensitive plant species would be reduced under this alternative, resulting in long-term beneficial impacts.

The implementation of sharpshooting and capture and euthanasia (where appropriate) would result in ground disturbance, including trampling by workers, that could affect state-listed or rare plant species and their habitat. However, small areas of the parks would be affected for only a short period and by relatively few individuals, resulting in short-term negligible adverse impacts.

Alternative C includes use of various techniques to prevent adverse deer impacts including fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning. None of these techniques would be expected to impact sensitive plant species. As stated previously, installation of fencing could potentially impact a sensitive plant species if they were injured by trampling from workers. However, impacts would be short-term negligible adverse given the precautions described previously.

Special Status Animal Species

Impacts on state-listed and rare species would be similar to those described in "Impacts on Other Wildlife and Wildlife Habitat" for non-listed wildlife species. As a result of a reduction in browsing pressure, the forests within the parks would be expected to regenerate in areas where this is now lacking, and shrub and groundcover vegetation would propagate, providing cover and protection for species dependent on that habitat such as ground and shrub nesting birds (e.g., hermit thrush) with long-term beneficial impacts. As noted previously, special status animal species that depend primarily on other habitats such as wetlands and water bodies, tree canopies, and tree bark, or cavity nesters would be less affected by a reduced deer density, although a long-term benefit to upper canopy species could be gained in the future as forest regeneration maintained the upper canopy. Predatory wildlife listed or considered special status species by Maryland or Virginia, such as the sharp-shinned hawk (*Accipiter striatus*), would find a denser understory more difficult for hunting small prey than the current open condition. However, these predators would benefit from better habitat conditions and an increase in the abundance of prey species. Other wildlife listed or considered special status species that nest in grassland habitat could experience negligible to minor adverse impacts. Many special status species that do not depend on habitat affected by deer browsing, or those that are not expected in areas used for deer management actions, would experience no or negligible adverse impacts.

As described above, special status wildlife could be temporarily disturbed by the presence of humans placing bait stations, shooting deer, setting traps, and observing deer behavior. However, because these actions would take place mainly during the non-breeding season for most animals, results would be short-term and temporary, and the use of silencers would reduce noise impacts from shooting to a minimum. The small number of carcasses left for natural decomposition would not be substantially different than what occurs through mortality from disease, old age, and car collisions. Impacts from these actions would be negligible; they would not cause any measurable change to the habitat or responses by wildlife listed or considered special status species by Maryland or Virginia.

Alternative C includes use of various techniques to prevent adverse deer impacts including fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning. All of these actions would provide beneficial impacts and serve to reduce deer damage, but in a limited, localized context. Impacts of the fencing of crops and woodlots on sensitive animal species would be the same as that discussed for other wildlife for forest regeneration exclosures. Changing crops can prevent deer browse, but would likely have a negligible adverse impact on sensitive animal species. Species that take advantage of crops for food or cover would likely adapt to the new crop variety and this would not affect any existing native wildlife habitats. Various aversive conditioning techniques (loud noises, scarecrow devices) would be useful in keeping deer away at certain times and in limited areas. These would also be used on a very selective basis and tested for effectiveness. Such aversive conditioning techniques may result in temporary disturbance to sensitive animal species in the area; however, given that these techniques would be used over limited areas they would have short-term negligible adverse impacts on sensitive animal species populations in the parks.

Overall, the long-term reduction and controls on deer population growth under alternative C would allow vegetation used as food and cover for sensitive wildlife to become more abundant and would decrease browse on sensitive plants, and alternative C would result in mostly beneficial and long-term impacts on special status species, depending on the species.

Alternative D: Combined Lethal and Nonlethal Deer Management

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under alternative A would continue under alternative D, and the additional techniques described under alternative B could be used. However, the main emphasis of alternative D would be using a combination of sharpshooting and reproductive control of does from alternatives C and B to address high deer density. Sharpshooting (with very limited capture/euthanasia if necessary) would be taken initially to reduce the deer herd numbers quickly. Population maintenance would be conducted via nonsurgical reproductive control methods (if these are available and meet NPS criteria for use); if not, sharpshooting would be used for maintenance.

Special Status Plant Species

The implementation of alternative D would result in ground disturbance, including trampling by people implementing the alternative, which could affect state-listed or rare plant species and their habitat. However, small areas of the parks would be affected for only a short period, and personnel involved in these activities would be educated about the potential impacts of their actions on these plants, resulting in short-term negligible adverse impacts. Alternative D would result in reduced deer density throughout the majority of the parks. As described for alternative C, this would promote the growth of sensitive plant species, reduce browsing pressure on native plant communities over time, and result in the reestablishment of special status species. Reducing deer herd density would decrease the potential for deer browsing impacts on sensitive species, resulting in long-term beneficial impacts. Some browsing of sensitive plant species (see alternatives A and B) occurring outside small, fenced exclosures would be expected, even when herd density is maintained within the desired deer density target level of 15 to 30 deer per square mile. However, potential impacts on sensitive plant species outside exclosures would be reduced, resulting in long-term beneficial impacts.

Alternative D includes use of various techniques to prevent adverse deer impacts including fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning. None of these techniques would be expected to impact sensitive plant species. As stated previously, installation of fencing could potentially impact a sensitive plant species if they were injured by trampling from workers. However, impacts would be short-term negligible adverse given the precautions described previously.

Special Status Animal Species

Impacts on state-listed animal species would be essentially the same as described for alternative C. As a result of a reduction in browsing pressure, the forests within the parks would be allowed to regenerate and shrub and groundcover vegetation would propagate, providing cover and protection for species dependent on that habitat such as ground and shrub nesting birds (e.g., hermit thrush) with long-term beneficial impacts. Special status species that depend primarily on other habitats such as wetlands and water bodies, tree canopies, and tree bark, or cavity nesters, would be less affected by a reduced deer density, although a long-term benefit to upper canopy species could be gained in the future as forest regeneration maintained the upper canopy. Predatory wildlife listed or considered special status species by Maryland or Virginia, such as the sharp-shinned hawk, would find a denser understory more difficult for hunting small prey than the current open condition. However, these predators would benefit from better habitat conditions and an increase in the abundance of prey species. Other wildlife listed or considered special status species that nest in grassland could also be slightly adversely affected. Many special status species that do not depend on habitat affected by deer browsing, or those that are not expected in areas used for deer management actions, would experience no or negligible adverse impacts.

As described above, special status wildlife could be temporarily disturbed by the presence of humans placing bait stations, shooting deer, setting traps, and observing deer behavior. However, because these actions would take place mainly during the non-breeding season for most animals, results would be short-term and temporary, and the use of silencers would reduce noise impacts from shooting to a minimum. The small number of carcasses left for natural decomposition would not be substantially different than what occurs through mortality from disease, old age, and car collisions. Impacts from these actions would be negligible; they would not cause any measurable change to the habitat or responses by wildlife listed or considered special status species by Maryland or Virginia.

Alternative B includes use of various techniques to prevent adverse deer impacts including fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning. All of these actions would provide beneficial impacts and serve to reduce deer damage, but in a limited, localized context. Impacts of the fencing of crops and woodlots on sensitive animal species would be the same as that discussed for other wildlife for forest regeneration exclosures. Changing crops can prevent deer browse, but would likely have a negligible adverse impact on sensitive animal species. Species that take advantage of crops for food or cover would likely adapt to the new crop variety and this would not affect any existing native wildlife habitats. Various aversive conditioning techniques (loud noises, scarecrow devices) would be useful in keeping deer away at certain times and in limited areas. These would also be used on a very selective basis and tested for effectiveness. Such aversive conditioning techniques may result in temporary disturbance to sensitive animal species in the area; however, given that these techniques would be used over limited areas they would have short-term negligible adverse impacts on sensitive animal species populations in the parks.

Overall, the long-term reduction and controls on deer population growth under alternative D would allow vegetation used as food and cover for sensitive wildlife to become more abundant and would decrease browse on sensitive plants. Therefore, alternative D would result in mostly beneficial and long-term impacts on special status species, depending on the species.

IMPACTS OF CHRONIC WASTING DISEASE MANAGEMENT ACTIONS, INCLUDING THE LONG-TERM CHRONIC WASTING DISEASE MANAGEMENT PLAN

Alternative A: No Action (Continuation of Current Management)

Under the no action alternative, the parks would continue with opportunistic and targeted CWD surveillance. Antietam and Monocacy would also respond to CWD presence in or near the parks in accordance with the CWD Detection and Initial Response Plan (NPS 2009c), and Manassas would create a similar plan. The Antietam and Monocacy CWD Detection and Initial Response Plan includes a range of actions including live testing and lethal removal of deer if CWD occurs within 5-20 miles of the park boundary. If CWD were to occur within 5 miles of the parks, initial response include a one-time lethal removal of deer to reach a deer density of about 25-45 deer per square mile. Based on 2008 deer density data, this would involve removing about 250 deer at each park over 3 years (NPS 2009c). There would be no new longer term CWD monitoring or management activities.

Impacts on special status species for the current CWD management actions and plan, including the initial response plan for Antietam and Monocacy, are not specifically described in the EA completed for these actions (NPS 2009c), since impacts were considered to be minimal or beneficial. However, impacts on these species would be similar to those described for vegetation and wildlife in that document. Impacts of CWD surveillance and detection actions on special status plants or animals would be short-term negligible to minor and adverse, mainly from trampling or temporary disturbances during implementation. If CWD were to occur within 5 miles of the parks, the initial response plan for Antietam and Monocacy calls for a substantial reduction in the deer population, which would have short-term beneficial effects on special status plants or wildlife as a result of reduced browsing and grazing pressure associated with lower deer densities achieved from the one-time reduction. This would decrease impacts on understory plants, including those that provide wildlife habitat in woodlands, resulting in mostly beneficial impacts on special status species, depending on the species. There could be longer-term minor adverse effects on some species that prefer open habitat created by deer browse. These effects would be similar to the effects described for the deer removal actions under alternative C, above. Manassas would likely adopt a similar plan under no action, so impacts there would be the same.

Alternatives B, C, and D (All Action Alternatives)

Under any of the action alternatives, targeted and opportunistic surveillance, and actions under any current initial detection and response plans would continue with impacts similar to alternative A. However, under all alternatives, the parks would adopt a long-term CWD response plan that includes the lethal reduction of deer if CWD is confirmed in or within 5 miles of parks. This would include a rapid reduction to the target deer density and possibly reduction to as low as 10 deer per square mile, and deer would be removed for surveillance monitoring in subsequent years. Reductions would generally follow the same schedule as outlined in alternative C, above, but reductions would be coordinated with the state to address conditions at the time of the CWD detection and could be expedited if resources are available.

Impacts on special status species from the deer reduction actions would be the same as described for alternative C under the analysis of deer management actions, above. The long-term reduction and controls on deer population growth would allow vegetation used as food and cover for sensitive wildlife to become more abundant and would decrease browse on sensitive plants. Therefore, the action alternatives would result in mostly beneficial and long-term impacts on special status species, depending on the species. There could be long-term minor adverse effects on some species that prefer open habitat and short-term negligible adverse impacts from disturbance during the implementation of the action.

CUMULATIVE IMPACTS

Alternative A: No Action (Continuation of Current Management)

Past, present, and reasonably foreseeable future actions that could impact special status species in and around the parks include many of the same actions previously discussed under cumulative impacts on vegetation and other wildlife and wildlife habitat. Adverse impacts on special status species have occurred and will continue to occur from increasing urban and suburban development, agricultural use, and transportation and utility line projects in the areas surrounding the parks, which have resulted in removal of habitat in limited areas, disturbance, noise, habitat removal and fragmentation, and demise of preferred native plant species, causing short- and long-term minor to moderate localized adverse impacts. Ongoing park maintenance and operations would have long-term minor adverse impacts on special status species, mainly from temporary noise or disturbance, limited to the areas affected. The parks' exotic plant management efforts and those of neighboring jurisdictions have had and will continue to have sizeable benefits to native vegetation, including special status plant species, by controlling and limiting the spread of invasive and nonnative species. Beneficial impacts have resulted from past and current deer management efforts undertaken by neighboring agencies and landowners, which have reduced deer numbers in and around the parks and helped to limit browsing impacts on understory and herbaceous plants that are important habitat for many species.

The past, present, and reasonably foreseeable future actions described above would result in short- and long-term negligible to moderate adverse impacts as well as long-term beneficial impacts. These impacts, when combined with the negligible to potentially major impacts of continued pressure on woody and herbaceous vegetation that makes up the wildlife habitat and the limited natural regeneration expected under alternative A because of continued deer browsing, would result in cumulative impacts that would be adverse, long-term, and minor to potentially major, depending on the species. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative beneficial impacts on some species related to the associated reduced browse impacts, which would reduce long-term adverse cumulative impacts. In the absence of any CWD-triggered lethal response, the deer management actions that would continue under alternative A would contribute an appreciable adverse increment to the overall cumulative impact because of the expected continued deer browsing that would adversely affect native plants and wildlife food and cover.

Alternative B: Nonlethal Deer Management

The same past, current, and future actions described under alternative A would occur under alternative B., Long-term minor to moderate adverse impacts would result from development and other actions; beneficial impacts would result mainly from actions (such as control of invasive species and deer management by neighboring jurisdictions) that have helped reduce loss of habitat in the area of analysis. These impacts, when combined with the long-term negligible to potentially major adverse impacts of alternative B, would result in long-term minor to potentially major adverse impacts, depending on the species. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative beneficial impacts on some species related to the associated reduced deer browse impacts, which would reduce long-term adverse cumulative impacts. In the absence of any CWD triggered lethal response, the deer management actions under alternative B would contribute a substantial adverse increment to the overall cumulative impacts. This is because the exclosures and reproductive control actions taken would not be expected to result in a population reduction to the desired deer density goal in many areas of the parks within the life of this management plan, and would not protect special status plants and wildlife species enough to offset the adverse effects of the continued high deer density expected.

Alternative C: Lethal Deer Management

The same past, current, and future actions described under alternative A would occur under alternative C, with long-term minor to moderate adverse impacts from development and other actions and beneficial impacts mainly from control of invasive species and deer management by neighboring jurisdictions that have helped reduce loss of habitat in the area of analysis. These impacts, when combined with the long-term beneficial impacts and short-term negligible to long-term minor adverse impacts of alternative C, would provide long-term beneficial impacts on special status species. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative beneficial impacts on some species related to the associated reduced browse impacts, which could add to the long-term beneficial cumulative impacts. In the absence of any CWD triggered lethal response, the deer management actions under alternative C would contribute a substantial beneficial increment amount to the overall cumulative impacts.

Alternative D: Combined Lethal and Nonlethal Deer Management

The same past, current, and future actions described under alternative A would occur under alternative D, with long-term minor to moderate adverse impacts from development and other actions and beneficial impacts mainly from control of invasive species and deer management by neighboring jurisdictions that have helped reduce loss of habitat in the area of analysis. These impacts, when combined with the long-term beneficial impacts and short-term negligible to long-term minor adverse impacts of alternative D, would provide long-term beneficial impacts on special status species. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative beneficial impacts on vegetation related to the associated reduced browse impacts, which could add to the long-term beneficial cumulative impacts. In the absence of any CWD triggered lethal response, the deer management actions under alternative D would contribute a substantial beneficial increment amount to the overall cumulative impacts. The intensity of the impacts from CWD activities may vary, depending on when the CWD actions occur in relationship to the deer management actions. If CWD activities were to occur prior to deer management activities, the impacts would be more noticeable, while if they happened after the deer population had already been reduced as part of a deer management plan, less action would be needed for CWD and the impacts from CWD activities would be less intense and less noticeable.

CONCLUSION

Alternative A: No Action (Continuation of Current Management)

Under alternative A, special status species would experience primarily adverse, long-term, and negligible to potentially major impacts, depending on the species. Species that depend on ground cover and young tree seedlings or understory shrubs for food or cover or native plants could be severely reduced or eliminated from the parks; whereas, impacts on species that depend primarily on other habitats (not woodlands) or on the upper canopy for food and cover would be negligible. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would provide indirect beneficial impacts for many species, but these would not outweigh the adverse effects of not taking deer management actions. Alternative A is expected to result in adverse, long-term, and minor to potentially major cumulative impacts, depending on the species.

Alternative B: Nonlethal Deer Management

Similar results would occur under alternative B, with primarily adverse, long-term, and negligible to potentially major impacts, depending on the species. Reproductive control would result in only a gradual reduction in the deer population, and although the population goal could be met over the longer term, the risk of not meeting the goal would be high. Therefore, it is expected that the deer population would remain at relatively high density levels in the parks throughout the life of the plan. Also, the exclosures would protect only a small portion of the forest in the parks at any one time, requiring 10 years for regrowth above the browse line. Species that depend on ground cover and young tree seedlings or understory shrubs for food or cover could be severely reduced or eliminated from the parks, while impacts on species that depend primarily on other habitats (not woodlands) or on the upper canopy for food and cover would be negligible. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would provide indirect beneficial impacts, but these would not outweigh the adverse effects of not taking deer management actions. Similar to alternative A, alternative B would result in adverse, long-term, and minor to potentially major cumulative impacts, depending on the species.

Alternative C: Lethal Deer Management

Overall, the long-term reduction and controls on deer population growth under alternative C would allow vegetation used as food and cover for sensitive wildlife to become more abundant and would decrease browse on sensitive plants. Therefore, alternative C would result in mostly beneficial and long-term impacts on special status species, depending on the species. There could be long-term minor adverse effects on some species that prefer open habitat and short-term negligible adverse impacts from disturbance during the implementation of the action. CWD actions would have similar impacts, with short-term negligible impacts (mainly trampling) from surveillance, and benefits from the reduction of deer and deer browse on vegetation/habitat. The overall cumulative impact would be long-term and beneficial, and alternative C would contribute appreciable beneficial increments to the cumulative impact on special status species.

Alternative D: Combined Lethal and Nonlethal Deer Management

Alternative D would have essentially the same impacts as alternative C, with mostly beneficial and long-term impacts on special status species, depending on the species. There could be long-term minor adverse effects on some species that prefer open habitat and short-term negligible adverse impacts from disturbance during the implementation of the action. CWD actions would have similar impacts, with short-term negligible impacts (mainly trampling) from surveillance, and benefits from the reduction of deer and deer browse on vegetation/habitat. The overall cumulative impact would be long-term and beneficial, and alternative D would contribute appreciable beneficial increments to the cumulative impact on special status species.

IMPACTS ON LAND USE / SOCIOECONOMICS

GUIDING REGULATIONS AND POLICIES

NEPA requires that economic and social impacts be analyzed in an EIS, when they are interrelated with natural or physical impacts. Economic impacts would potentially result from deer browsing damage to crops and landscaping on private lands adjacent to the parks as a result of changes in the deer population in Antietam, Monocacy, and Manassas. The extent of such impacts would be in large part dependent on the size of the deer population, outside development pressures, and loss of deer habitat.

ASSUMPTIONS, METHODOLOGIES, AND INTENSITY DEFINITIONS

Because of the limited supply of deer forage within the three parks, as well as the observed and expected home ranges for similar herds, deer may browse on crops and landscape plantings on adjacent lands outside the parks' boundaries. Recent studies at Antietam indicate that the sex and age of the deer and quality of habitat will result in home ranges of varying sizes. Yearling males will typically move many miles; whereas, adult females usually have smaller, more consistent annual home ranges. Generally, it is understood that deer in high quality habitat will travel less than deer in poorer quality habitat (MD DNR 2009). The Iowa Department of Natural Resources reports that white-tailed deer home range may expand seasonally based on breeding activity and food availability (Iowa Department of Natural Resources 1997).

Damage to landscaping on private land from wildlife is a common problem in certain parts of the United States, resulting in economic losses in the form of decreased property values or the costs of protecting or replacing susceptible vegetation. Wildlife impacts on crops also are common throughout much of the country. Crop loss associated with deer damage to agricultural lands has a direct economic effect on the farmer. Therefore, impact intensity definitions for socioeconomic conditions focus on landscaping or crop damage on neighboring lands and were defined as follows:

Negligible: No effects would occur, or the effects on neighboring landowners or other socioeconomic conditions would be below or at the level of detection.

Minor: The effects on neighboring landowners or other socioeconomic conditions would be small but detectable. The impact would be slight, but would not be detectable outside the neighboring lands and would affect only a few adjacent landowners.

Moderate: The effects on neighboring landowners or other socioeconomic conditions would be readily apparent. Changes in economic or social conditions would be limited and confined locally, and they would affect more than a few landowners.

Major: The effects on neighboring landowners or other socioeconomic conditions would be readily apparent. Changes in social or economic conditions would be substantial, extend beyond the local area, and affect the majority of landowners.

AREA OF ANALYSIS

The area of analysis for impact assessment and for cumulative impacts includes the parks and the area within 2.5 miles of the parks' boundaries, which encompasses typical deer movement outside the parks' boundaries.

IMPACTS OF DEER MANAGEMENT ACTIONS

Alternative A: No Action (Continuation of Current Management)

Under alternative A, NPS staff would continue to monitor the deer population and vegetation and continue to use tree tubes, repellents (mainly Antietam), or small-scale fencing to protect landscape plantings, orchards, and small areas containing tree plantings or rare species. As described in chapters 1 and 3, the parks have been conducting vegetation monitoring since 2000 (Manassas) and 2003 (Antietam and Monocacy). Each park has conducted various studies, including paired plots (exclosures and open control plots), to assess the impacts of deer on vegetation within the respective park. The studies at Antietam and Monocacy demonstrated no significant differences in seedling establishment between the fenced and open plots; however, native sapling species richness and abundance increased significantly in fenced plots, and all plots were below the threshold of seedling density that is required for forest regeneration. Similar studies at Manassas showed that deer have significant effects on forest structure and weedy seedling composition, species, richness, and seedling survival rates. These impacts can be directly attributed to deer browsing and indicate deer are affecting the integrity of the understory structure (see "Current Vegetation Status and the Role of Deer" in chapter 3). A distinct browse line is evident at Manassas and Monocacy, and to a lesser extent at Antietam, which is a visual indication of the effects deer have had on the understory at the parks.

Deer would continue to use their existing home ranges, which are estimated to extend up to 2.5 miles beyond the parks' boundaries, and may travel further based on food availability. Private landowners within or adjacent to the parks could experience increased deer browsing on plants in landscaped areas over the short- and long-term, as food sources decreased or remained limited within the parks. Ornamental plantings grown on private lands adjacent to the parks could be browsed more heavily, resulting in adverse economic impacts on landowners. The degree of physical and economic damage on adjacent lands would depend on growth in deer populations, types of plantings, market value of current plantings, and actions landowners use to manage deer. Damage to landscaping also may result in a decline in property values for affected landowners, resulting in short- and possibly long-term minor to moderate adverse impacts.

Property owners also would most likely incur additional costs for fencing, repellents, and other forms of deer control to protect their landscaping as the deer population continued at high levels under this alternative. The time and monetary costs associated with acquiring additional protection measures would result in long-term, minor, adverse impacts on private landowners.

High deer populations also would have adverse effects on adjacent agricultural landowners. Growing deer populations would most likely resulting in proportionately greater increases in crop damage as deer populations increase (McNew and Curtis 1997). This increase would result in farmers incurring additional costs for fencing, repellents, and other forms of deer control to protect their crops. Increased deer browsing also could result in additional monetary and time costs associated with harvesting deer. Drake et al. (2005) found that the higher the loss due to deer damage, the more likely that a farmer would request a deer damage permit. Depending on the extent of crop damage and costs associated with property protection measures, these costs could result in short- and long-term, minor to moderate, adverse impacts on farmers in and around the parks.

Overall, deer management actions under alternative A would result in long-term minor to moderate adverse impacts on socioeconomics/adjacent lands because of the continued high density of deer expected over the life of this plan and the associated costs of landscape damage, crop loss, and additional costs for fencing, repellents, and other forms of deer control to protect landscaping.

Alternative B: Nonlethal Deer Management

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under alternative A would continue under alternative B. Alternative B would also include several techniques to prevent adverse deer impacts including fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning. However, the main focus of alternative B would be two nonlethal actions: the construction of large-scale deer exclosures (fencing) to promote forest regeneration and nonsurgical reproductive control of does to restrict population growth (when this technology meets certain criteria). Large fenced exclosures would be constructed under alternative B to allow forest regeneration to occur within enclosed areas of the parks that would not be accessible to deer. The 19 proposed exclosures would eliminate deer presence within a total of 184 acres or about 6% of the wooded area of the parks (23 acres at Antietam, 61 acres at Monocacy, and 100 acres at Manassas; see chapter 2 for details and locations). Protecting these areas from deer browsing would allow native woody species to grow higher than heights reached by deer (about 60 inches or 150 centimeters) after about 10 years, at which time the exclosures would be moved, and another 6% of the parks' vegetation would be enclosed. Although exclosures would be expected to have a beneficial impact on sensitive vegetation within the parks, they also would prevent deer from accessing portions of their existing ranges. As a result, it could be expected that the deer herds within each park would expand their ranges to account for the reduction in potential habitat and/or interference in current movement patterns. These changes could lead to increased browse pressure on adjacent lands, resulting in long-term, moderate, adverse impacts on socioeconomics/adjacent lands.

The construction of large-scale exclosures would prevent deer from accessing portions of their existing home ranges. This could result in deer expanding their home ranges further beyond the parks' boundaries and/or browsing more intensely in the areas that remain accessible within the existing home ranges. When the exclosures were rotated, there could be a short-term reduction in foraging outside of the parks, as the deer would seek to take advantage of the newly regenerated vegetation. This reduction, however, would be expected to be short-term and deer would then have to seek out additional forage to support the growing population. Therefore, the construction of the exclosures would have a short-term, minor, beneficial impact on adjacent lands, but overall there would be a long-term, moderate, adverse impact on adjacent lands.

Reproductive control, if successful, this would gradually reduce the deer population over the long-term; however, deer numbers would not be immediately reduced and numbers would fluctuate annually. The availability and effectiveness of reproductive controls in the future could reduce the intensity of property and crop damage impacts because the deer population would decrease gradually, minimizing landscaping and crop damage and reducing the need for protection mechanisms. Under alternative B, however, it is not expected that there would be a substantial decrease in deer density during the life of this plan. Although it is possible to meet the reduced population goal over time, the risk of not meeting that goal is high under this alternative. In the meantime, landowners adjacent to the parks would continue to incur additional costs for fencing, repellents, and other forms of deer control to protect their landscaping and crops. Because deer would be displaced from the parks due to the rotational fencing, these costs would most likely be greater than in alternative A, and residents may suffer losses in vegetation and incur costs for replacement of lost vegetation or deterrents such as fencing. Because population reduction would not be realized in the life of the plan, this would result in a long-term, moderate, adverse impact on socioeconomic resources and adjacent lands.

Alternative B includes use of various techniques to prevent deer from impacting resources in the parks, including fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning. All of these actions would provide negligible adverse impacts on the socioeconomics and adjacent lands. Fencing of crops and woodlots would prevent deer from accessing portions of their current home range and could result in deer extending their home range outside of the parks' boundaries during short or long periods. This impact would be limited based on much of the parks could be fenced without adverse visual effects on the cultural landscapes and adverse impacts in visitor access/use. Changing crops can prevent deer browse, but also could result in an increase of deer browse in more palatable areas. Planting crops close together at the edge of fields to resist deer entry into the field is not a proven method, but could be initiated on a trial basis. Any success in this effort, however, would result in deer expanding their range to more accessible areas. Various aversive conditioning techniques (loud noises, scarecrow devices) would be useful in keeping deer away at certain times and in limited areas, but could not be expected to be over the long-term without allowing the deer to grow accustomed to such intrusions or unintended adverse impacts on other resources. Any of these actions that would result in deer expanding their existing ranges would be expected to result in adverse impacts related to increased deer browse on adjacent lands. Overall, these techniques would provide limited impacts that would not substantially affect the overall moderate adverse effects expected under alternative B if the deer densities remain high.

Overall, deer management actions under alternative B would result in long-term moderate adverse impacts on socioeconomics/adjacent lands for the same reasons as discussed for alternative A, since it is expected that the deer population would remain at relatively high density levels in the parks throughout the life of the plan, and there would be the additional impact of precluding deer from the large exclosures, which could add to browsing pressure on surrounding lands.

Alternative C: Lethal Deer Management

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under alternative A would continue under alternative C. Alternative C would also include the additional techniques described under alternative B, but the primary focus of alternative C is using sharpshooting with firearms to reduce the herd size to the desired density level. A very limited use of capture and euthanasia of individual deer could be considered if needed due to safety concerns, but the parks do not expect that this would be necessary.

Actions taken under alternative C would quickly reduce the deer population density to within the desired range of approximately 15 to 20 deer per square mile, and additional deer would be removed in subsequent years to maintain the population. Initial sharpshooting activities may push deer from one area of a park to another, or out of the given park. During the reduction activities, deer movements could become erratic and unpredictable. This could result in temporarily expanded home ranges. However, once the lethal reduction activities were reduced, observations at similar locations indicate that the deer would return to their original home range. Over the long-term, the reduction in deer population density within the three parks would likely result in far fewer deer leaving to search for food because the habitat in the parks could better support the reduced population. A corresponding decline in costs for fencing, repellents, and other forms of deer control to protect landscaping and crops on adjacent lands also could occur. As a result, reduced time and monetary costs associated with protection measures would reduce long-term moderate, adverse impacts on private landowners to minor, because they might still incur protection costs, but the cost would likely decrease noticeably. The reduction in the damage to neighboring landscaping and crops and the reduced cost for protection measures would result in long-term beneficial impacts on socioeconomics/adjacent lands, assuming that parks' deer populations are currently foraging on private lands adjacent to the park.

Alternative C includes use of various techniques to prevent deer from impacting resources in the parks, including fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning. All of these actions would provide negligible adverse impacts on the socioeconomics and adjacent lands. Fencing of crops and woodlots would prevent deer from accessing portions of their current home range and could result in deer extending their home range outside of the parks' boundaries during short or long periods. This impact would be limited based on much of the parks could be fenced without adverse visual effects on the cultural landscapes and adverse impacts in visitor access/use. Changing crops can prevent deer browse, but also could result in an increase of deer browse in other areas with more palatable crops. Planting crops close together at the edge of fields to resist deer entry into the field is not a proven method, but could be initiated on a trial basis. Any success in this effort, however, would result in deer expanding their range to more accessible areas. Various aversive conditioning techniques (loud noises, scarecrow devices) would be useful in keeping deer away at certain times and in limited areas, but could not be expected to be effective over the long-term without allowing the deer to grow accustomed to such intrusions or unintended adverse impacts on other resources. Overall, these techniques would result in limited impacts on park neighbors that would not substantially detract from the overall beneficial effects expected under alternative C as deer densities were reduced.

Overall, deer management actions under alternative C would result in long-term beneficial impacts because the relatively rapid reduction in deer density would reduce adverse impacts on landowners, due to improved crop yields and preserved landscaping and reduce the need for landscape and crop protection.

Alternative D: Combined Lethal and Nonlethal Deer Management

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under alternative A would continue under alternative D, and the additional techniques described under alternative B could be used. However, the main emphasis of alternative D would be using a combination of sharpshooting and reproductive control of does from alternatives C and B to address high deer density. Sharpshooting (with very limited capture/euthanasia if necessary) would be taken initially to reduce the deer herd numbers quickly. Population maintenance would be conducted via nonsurgical reproductive control methods (if these are available and meet NPS criteria for use); if not, sharpshooting would be used for maintenance.

Under alternative D, once the goal of 15 to 20 deer per square mile was reached, reproductive control, as described in alternative B, and lethal reduction, as described in alternative C (if needed), would be used to maintain the deer population at the reduced level. The success of implementing reproductive controls on a deer population that has undergone several years of lethal reduction efforts would depend on technological advances, the sensitivity of deer to humans, methods used by the sharpshooters, changes in immigration with reduced deer density, and general deer movement behavior (Porter, Underwood, and Woodward 2004; Naugle et al. 2002). If reproductive controls were found to be unsuccessful, deer densities could be maintained by lethal reduction. A decreased population would reduce potential impacts on adjacent lands. Deer browsing impacts would continue at some level, but there would be a reduced need for fencing, repellents and other forms of deer control designed to prevent damage to landscaping and crops. This change would reduce current adverse impacts to short- and long-term negligible to minor adverse.

Alternative D includes use of various techniques to prevent deer from impacting resources in the parks, including fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning. All of these actions would provide negligible adverse impacts on socioeconomics and adjacent lands. Fencing of crops and woodlots would prevent deer from accessing portions of their current home range and could result in deer extending their home range outside of the parks' boundaries during short or long periods. This impact would be limited based on much of the parks could be fenced without adverse visual effects on the cultural landscapes and adverse impacts in visitor access/use. Changing crops can prevent deer browse, but also could result in an increase of deer browse in more palatable areas. Planting crops close together at the edge of fields to resist deer entry into the field is not a proven method, but could be initiated on a trial basis. Any success in this effort, however, would result in deer expanding their range to more accessible areas. Various aversive conditioning techniques (loud noises, scarecrow devices) would be useful in keeping deer away at certain times and in limited areas, but could not be expected to be over the long-term without allowing the deer to grow accustomed to such intrusions or unintended adverse impacts on other resources. Overall, these techniques would provide limited impacts that would not substantially detract from the overall beneficial effects expected under alternative D as deer densities were reduced.

Overall, deer management actions under alternative D would result in long-term beneficial impacts because the relatively rapid reduction in deer density would reduce adverse impacts on landowners, due to improved crop yields and preserved landscaping and reduce the need for landscape and crop protection.

IMPACTS OF CHRONIC WASTING DISEASE MANAGEMENT ACTIONS, INCLUDING THE LONG-TERM CHRONIC WASTING DISEASE MANAGEMENT PLAN

Alternative A: No Action (Continuation of Current Management)

Under the no action alternative, the parks would continue with opportunistic and targeted CWD surveillance. Antietam and Monocacy would also respond to CWD presence in or near the parks in accordance with the CWD Detection and Initial Response Plan (NPS 2009c), and Manassas would create a similar plan. The Antietam and Monocacy CWD Detection and Initial Response Plan includes a range of actions including live testing and lethal removal of deer if CWD occurs within 5-20 miles of the park boundary. If CWD were to occur within 5 miles of the parks, initial response include a one-time lethal removal of deer to reach a deer density of about 25–45 deer per square mile. Based on 2008 deer density data, this would involve removing about 250 deer at each park over 3 years (NPS 2009c). There would be no new longer term CWD monitoring or management activities.

Impacts on socioeconomics/adjacent lands (including impacts on crops and landscaping) for the current CWD management actions and plan, including the initial response plan for Antietam and Monocacy, are described in the EA completed for these actions (NPS 2009c). Impacts of CWD surveillance and detection actions on neighboring landscaping and crops would be short-term negligible to minor and adverse, with the level of impact dependent on numbers of deer affected and the actions taken in surrounding communities. If CWD were to occur within 5 miles of the parks, the initial response plan for Antietam and Monocacy calls for a substantial reduction in the deer population, which would have short-term adverse effects as well as beneficial impacts on local socioeconomics. Beneficial effects related to deer damage to crops and landscaping, which is the focus of this plan/EIS, would occur as a result of reduced browsing pressure on adjacent lands. These actions were analyzed through a separate NEPA process (NPS 2009c) and the benefits related to the reduced deer numbers would be similar to the effects described for the deer removal actions under alternative C, above. Manassas would likely adopt a similar plan under no action, so impacts there would be the same.

Alternatives B, C, and D (All Action Alternatives)

Under any of the action alternatives, targeted and opportunistic surveillance, and actions under any current initial detection and response plans would continue with impacts similar to alternative A. However, under all alternatives, the parks would adopt a long-term CWD response plan that includes the lethal reduction of deer if CWD is confirmed in or within 5 miles of parks. This would include a rapid reduction to the target deer density and possibly reduction to as low as 10 deer per square mile, and deer would be removed for surveillance monitoring in subsequent years. Reductions would generally follow the same schedule as outlined in alternative C, above, but reductions would be coordinated with the state to address conditions at the time of the CWD detection and could be expedited if resources are available.

Impacts on the crops and landscaping on adjacent lands from the deer reduction actions would be the same as described for alternative C under the analysis of deer management actions, above. Rapidly reducing the deer population would result in beneficial effects as a result of the reduction in deer browsing on adjacent landscaping and crops. Given that any long-term plan would be coordinated with the states and would also result in reduced deer densities outside the parks, the benefit from reductions in the parks would add to the effects outside the parks taken as part of the larger state response. The intensity of the impacts from CWD activities may vary, depending on when the CWD actions occur in relationship to the deer management actions. If CWD activities were to occur prior to deer management activities, the impacts would be more noticeable, while if they happened after the deer population had already been reduced as part of a deer management plan, less action would be needed for CWD and the impacts from CWD activities would be less intense and less noticeable.

CUMULATIVE IMPACTS

Alternative A: No Action (Continuation of Current Management)

Past, present, and reasonably foreseeable future actions that could impact socioeconomic resources/adjacent land use in and around the parks include actions with both adverse and beneficial impacts. Adverse impacts on socioeconomics and adjacent lands have occurred and will continue to occur as a result of the size and range of the deer population. Impacts from deer browse have led to a reduction in property values and investment in deer protection instead of other goods, which has resulted in long-term, minor to moderate, adverse impacts. Deer management by other entities also has resulted in investments in deer protection instead of other goods, resulting in long-term, minor to moderate, adverse impacts. These actions, however, also have resulted in long-term beneficial impacts by reducing impacts on private landowners. Land development outside the parks also has had beneficial and adverse impacts. Beneficial impacts come from the growth and development of the region surrounding the parks. Adverse impacts are associated with the reduction of suitable habitat for deer which has and would continue to result in the herds being forced to rely on the parks and neighboring properties for food. Additional beneficial impacts have and would continue to result from hunting outside the parks and land development outside the parks. Hunting results in investments in the local economy and assists local land owners in reducing deer populations and browse impacts.

These past, present, and reasonably foreseeable future actions would result in long-term minor to moderate adverse impacts as well as long-term beneficial impacts. These impacts, when combined with the long-term minor to moderate impacts of continued deer browsing impacts on socioeconomic resources/adjacent lands and the limited natural regeneration expected under alternative A because of continued deer browsing, would result in long-term moderate adverse cumulative impacts on socioeconomic resources/adjacent lands. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative beneficial impacts on socioeconomics/adjacent lands (crops and landscaping) related to the associated reduced browse impacts, which would reduce long-term adverse cumulative impacts. In the absence of any CWD-triggered lethal response, the deer management actions that would continue under alternative A would contribute an appreciable adverse increment to the overall cumulative impact because of the expected continued deer browsing that would impact private properties and crops and require investment in deer protection or new plantings.

Alternative B: Nonlethal Deer Management

The same past, present, and reasonably foreseeable future actions described under alternative A would also occur under alternative B. These impacts, when combined with the short- and long-term minor but mostly moderate adverse impacts of alternative B, would result in long-term, moderate, adverse cumulative impacts on socioeconomics/adjacent lands in and within close proximity to the park. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative beneficial impacts on vegetation related to the associated reduced browse impacts, which would reduce long-term adverse cumulative impacts. In the absence of any CWD triggered lethal response, the deer management actions under alternative B would contribute an appreciable adverse increment to the overall cumulative impact because of the lack of substantial reduction in the deer density over the life of this plan, which would result in little reduction in landscape and crop damage.

Alternative C: Lethal Deer Management

The same past, present, and reasonably foreseeable future actions described under alternative A would also occur under alternative C, with long-term minor to moderate adverse impacts and long-term beneficial impacts. These impacts, when combined with the long-term beneficial impacts of alternative C, would result in long-term, beneficial cumulative impacts on socioeconomics/adjacent lands in and within close proximity to the parks. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative beneficial impacts on vegetation related to the associated reduced browse impacts, which could add to the long-term beneficial cumulative impacts. In the absence of any CWD triggered lethal response, the deer management actions under alternative C would contribute an appreciable beneficial increment to the overall cumulative impact because of the relatively rapid reduction in the deer density and the associated reduction in landscaping or crop damage or need for protection.

Alternative D: Combined Lethal and Nonlethal Deer Management

Cumulative impacts would be similar to those described for alternative A. The same past, present, and reasonably foreseeable future actions described under alternative A would also occur under alternative D, with long-term minor to moderate adverse impacts and long-term beneficial impacts. These impacts, when combined with the long-term beneficial impacts of alternative D, would result in long-term, beneficial cumulative impacts on socioeconomics/adjacent lands in and within close proximity to the park. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative beneficial impacts on vegetation related to the associated reduced browse impacts, which could add to the long-term beneficial cumulative impacts. In the absence of any CWD triggered lethal response, the deer management actions under alternative D would contribute an appreciable beneficial increment to the overall cumulative impact because of the relatively rapid reduction in the deer density and the associated reduction in landscaping or crop damage or need for protection.

CONCLUSION

Alternative A: No Action (Continuation of Current Management)

Alternative A would result in long-term, minor to moderate, adverse impacts because of the continued high density of deer expected over the life of this plan and the associated costs of landscape damage, crop loss, and additional costs for fencing, repellents, and other forms of deer control to protect landscaping. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would provide indirect beneficial impacts on neighboring properties, but these would not outweigh the adverse effects of not taking deer management actions. The overall cumulative impact would be long-term, moderate, and adverse, with alternative A contributing appreciable adverse increments to the cumulative impact on socioeconomics/adjacent lands.

Alternative B: Nonlethal Deer Management

Similar results would occur under alternative B because reproductive control would result in only a gradual reduction in the deer population, and although the population goal could be met over the longer term, the risk of not meeting the goal would be high. Therefore, it is expected that the deer population would remain at relatively high density levels in the parks throughout the life of the plan. Alternative B would result in long-term moderate adverse impacts (direct and cumulative) for the same reasons, but with the additional impact of precluding deer from the large exclosures, which could add to browsing pressure on surrounding lands. Any CWD response that would be taken under the proposed long-term plan would provide indirect beneficial impacts, but these would not outweigh the adverse effects of not taking deer management actions. Similar to alternative A, the overall cumulative impact would be long-term, moderate, and adverse, with alternative B contributing appreciable adverse increments to the cumulative impact on socioeconomics/adjacent lands.

Alternative C: Lethal Deer Management

The overall impact on socioeconomics/adjacent lands under alternative C would be long-term and beneficial because the relatively rapid reduction in deer density would reduce adverse impacts on landowners, due to improved crop yields and preserved landscaping and reduce the need for landscape and crop protection. CWD actions would have similar impacts, with benefits from the reduction of deer and deer browse on adjacent lands. The overall cumulative impact would be long-term and beneficial and alternative C would contribute appreciable beneficial increments to the cumulative impact on socioeconomics/adjacent lands.

Alternative D: Combined Lethal and Nonlethal Deer Management

Alternative D would have essentially the same impacts as alternative C, with long-term beneficial effects due to the decrease in the deer herd, limited adverse impacts from the management actions themselves, and limited benefits from the use of the techniques described for all alternatives. CWD actions would have similar impacts, with benefits from the reduction of deer and deer browse on adjacent lands. The overall cumulative impact would be long-term and beneficial, and alternative D would contribute appreciable beneficial increments to the cumulative impact on socioeconomics/adjacent lands.

IMPACTS ON VISITOR USE AND EXPERIENCE

GUIDING REGULATIONS AND POLICIES

The NPS *Management Policies 2006* (NPS 2006a) state that the enjoyment of park resources and values by the people of the United States is part of the fundamental purpose of all parks and that the NPS is committed to providing appropriate, high-quality opportunities for visitors to enjoy the parks. Management goals include making available to the public traditional outdoor recreational opportunities that are not detrimental to the natural or cultural resources of the parks.

While preservation and conservation are key components of the NPS *Management Policies*, they also instruct park units to provide for recreational opportunities. The NPS achieves its preservation and conservation purposes by working to maintain all native plants and animals as parts of the natural ecosystem, emphasizing preservation and conservation over recreation. The NPS will achieve this by preserving and restoring the natural abundances, diversities, dynamics, distributions, habitats, and behaviors of native plant and animal populations and the communities and ecosystems in which they occur (NPS 2006a).

Several of the GMPs for the parks include management policies that pertain to visitor use and experience. These include the following:

- Antietam will strive to keep with the objective of preserving the 1862 setting, which is an attraction for visitors.
- Manassas will maintain its historic landscape in a way that gives visitors an understanding of the events of the two battles of Manassas.
- Monocacy would maintain the battlefield in a manner that is remarkably similar to the way it looked during the Civil War.

ASSUMPTIONS, METHODOLOGIES, AND INTENSITY DEFINITIONS

Past visitor use data were used to estimate the effects of the alternative actions on visitors. The impact on the ability of visitors to experience a full range of the parks' resources was analyzed. The definitions for the intensity of an impact are defined as follows:

Negligible: Visitors would not be affected or changes in visitor use and/or experience would be below or at the level of detection. The visitor likely would not be aware of the impacts associated with the alternative.

Minor: Changes in visitor use and/or experience would be detectable, although the changes would be slight. The visitor would be aware of the impacts associated with the alternative, but the impacts would be slight.

Moderate: Changes in visitor use and/or experience would be readily apparent. The visitor would be aware of the impacts associated with the alternative and would likely express an opinion about the changes.

Major: Changes in visitor use and/or experience would be readily apparent and severely adverse. The visitor would be aware of the impacts associated with the alternative and would likely express a strong opinion about the changes.

AREA OF ANALYSIS

The area of analysis, including the cumulative impacts analysis, includes all lands within the boundaries of all three parks.

IMPACTS OF DEER MANAGEMENT ACTIONS

Alternative A: No Action (Continuation of Current Management)

Under alternative A, park staff would continue to monitor the deer population and vegetation and continue to use tree tubes, repellents (mainly Antietam), or small-scale fencing to protect landscape plantings, orchards, and small areas containing tree plantings or rare species. As the deer population continues to remain high and the overbrowsing of native plants continues, the diversity and abundance of many species would be expected to diminish or remain low. A distinctive browse line would be evident in areas with excessive numbers of deer, and, in addition, overbrowsing by deer gives invasive exotic plant species an opportunity to become established, which may deter native species propagation. Visitors who value native scenery or viewing the parks' cultural landscapes would be most affected, and adverse impacts on visitor experience from heavily browsed vegetation would be long-term, localized, and range from minor to moderate. Those visitors that value nature viewing would also be affected by the impacts of deer browse on wildlife including deer themselves.

Under this alternative, it is expected that the deer population in the parks would grow and/or remain at high levels, adversely impacting native plants and, as a result, wildlife and wildlife habitat through overbrowsing by deer. Overbrowsing could adversely impact habitat that supports the parks' bird species, particularly birds that use the ground or low shrub layer for nesting and feeding. Therefore, the parks' visitors who value native plants and wildlife could experience long-term, adverse, minor to moderate impacts as the diversity and abundance of native vegetation and wildlife habitat in the parks remains low or decreases as a result of deer browsing. Although it is not known what percent of visitors place a high importance specifically on seeing deer, any visitors who do so would have a higher chance of viewing deer under this alternative than under other alternatives, a long-term benefit. However, an increase in deer numbers could also adversely affect the condition of the herds, and if the deer populations drastically declined due to disease or malnutrition, visitor experience could be adversely affected until the herd recovered. This would result in a long-term, minor to moderate, adverse impact.

Tree tubes and small fenced areas used to protect plants could occur in view of the hiking/walking trails, biking areas (Antietam), and/or roadways. These measures would indirectly adversely affect visitor experience to the parks that are utilizing these recreational resources as a result of their visibility, a negligible to minor adverse impact. However, they also serve to protect rare plants and vegetation that visitors would not otherwise see due to excessive deer browsing. Visitors who primarily experience the parks by scenic driving would be the least affected, as fenced areas would be difficult to detect while driving. Visitors who primarily experience the parks by walking would be affected to a greater degree, depending on the location of the trail and the number of fences encountered.

Educational efforts included under this alternative, such as communication with the public about deer management activities as described in "Chapter 2: Alternatives," would help offset adverse impacts on all visitors, who would be informed of the reasons for implementing the management activities. Monitoring efforts described under this alternative, such as deer population surveys and vegetation monitoring, would have little to no impact on visitors since surveys would be conducted at night when the parks are closed, and most visitors would likely interpret vegetation monitoring as consistent with scientific efforts expected at a unit of the national park system.

Overall, given the differences in desired visitor experience, impacts on visitor use and experience under alternative A would be both beneficial and adverse to those visitors who maybe primarily interested in viewing deer (beneficial in that there would be more deer to see, adverse in that the appearance of the herd could be poor if the herd experiences density-dependent health issues). However, overall impacts related to a decreased ability to view scenery (including native vegetation and the historic landscape) and other wildlife would be long-term, minor to moderate, adverse.

Alternative B: Nonlethal Deer Management

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under alternative A would continue under alternative B. Alternative B would also include several techniques to prevent adverse deer impacts including fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning. However, the main focus of alternative B would be two nonlethal actions: the construction of large-scale deer exclosures (fencing) to promote forest regeneration and nonsurgical reproductive control of does to restrict population growth (when this technology meets certain criteria). Tree tubes and small fenced areas described under alternative A would continue to be used under alternative B, but large fenced exclosures would be constructed to allow reforestation. The 19 proposed exclosures would eliminate deer presence within a total of 184 acres or about 6% of the wooded area of the parks (23 acres at Antietam, 61 acres at Monocacy, and 100 acres at Manassas; see chapter 2 for details and locations). Several of these exclosures would be near trails, and would be visible to visitors. The use of such large exclosures would adversely impact visitors that use the areas in or near the locations selected in that these fenced areas would be obvious and closed to visitation. Visitors would also be affected by fence construction activities, which would result in temporary visual and noise intrusions, such as the presence of work crews and employees in certain areas of the parks. Visitors hiking in or walking through the parks to view wildlife and scenery in low-use visitor areas would be most affected. Visitors may also be adversely affected by intrusions on the historic landscape and experience a hampered ability to interpret the battlefield. Those who primarily experience the parks by car might not be as affected by the sight of the exclosures, which would probably not be detectable from vehicles. The parks plan to implement deer management educational and interpretive efforts under all alternatives, and visitors would be made aware of the reasons for the exclosures and their benefit to forest regeneration, which would beneficially impact visitors with the knowledge that the natural environment would eventually improve. Such information could offset adverse impacts related to visual aesthetics caused by the exclosures. Adverse impacts within the life of this plan would be negligible to minor and short-term, and benefits would be realized in the longer term as the forest regenerates due to protection afforded by the exclosures.

The use of reproductive controls on does would be based on available technology. Unless it was found that the selected reproductive control agent had an extended efficacy exceeding two years, treatment would occur at approximately this level over the life of the plan. Deer would be treated with reproductive controls using traps to capture them prior to administering the injections by hand and marking them. These activities would be limited to primarily to the months between October and March. Although treatment areas, including bait piles, would be done during less busy visitation periods and avoid highly used visitor areas to the extent possible, it is possible that some visitors would be exposed to treatment activities or that visitor access would be restricted around areas where bait piles were placed to attract deer for treatment. To ensure that visitors would understand the nature of the treatment efforts, the parks would conduct educational programs to inform visitors about the procedures and explain why the treatments are necessary. However, visitors may see various aspects of the reproductive control operations, which could result in short term minor adverse impacts on their visitor experience.

With reproductive control, deer would be marked with ear tags or some equivalent marking in order to avoid multiple treatments of the same does in the same year or to facilitate tracking for future application in subsequent years. Visitors could be troubled by the sight of deer with artificial markings, particularly those who primarily come to the parks to see deer. Again, educational material would alert visitors to deer management activities and explain their purpose and expected outcomes.

As reproductive controls eventually take effect and the deer population begins to decrease over time, some visitors might notice reductions in the excessive browsing pressure that has been damaging forest resources. There would be an increased ability to view certain plants and animals that have been affected by deer overbrowsing, such as ground nesting birds and herbaceous species. However, as described in “Impacts on Vegetation,” many years would be required to achieve these beneficial impacts. Overall, short-term impacts would be adverse and minor, with gradual long-term benefits, likely occurring beyond the life of this plan.

Those visitors who are interested primarily in seeing deer could be adversely affected over the longer term. However, the herds’ size would not be reduced much within the life of this plan, so adverse impacts would be negligible. Also, even after reproductive control is successful, deer would not be rare, but they would be more in balance with other elements of the ecosystem as reproductive control limited herd size. Eventually the herds might be healthier under this alternative as compared to alternative A. Therefore, visitors who value seeing deer might also prefer seeing fewer deer if it means maintaining a healthy, viable herd, which could lessen the intensity of the adverse impact on these visitors to negligible or minor.

Alternative B includes use of various techniques to prevent adverse deer impacts including fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning. All of these actions would provide beneficial impacts on visitor experience and serve to reduce deer damage, but in a limited, localized context. Fencing of crops and woodlots could supplement the proposed exclosure fencing and serve to protect smaller areas that are considered valuable, but there would be a limit on how much of the parks could be fenced without adverse visual effects on the cultural landscapes and adverse impacts in visitor access/use. Changing crops can prevent deer browse, but the substitute crop may not be one that is correct in the cultural context of the battlefields, which would cause adverse effects on visitor experience. Various aversive conditioning techniques (loud noises, scarecrow devices) would be useful in keeping deer away at certain times and in limited areas, but could interfere with visitor experience. These would also need to be a used on a very selective basis and tested for effectiveness. Overall, these techniques would provide limited long-term benefits and short-term minor to moderate adverse impacts on visitor experience.

Overall, given the differences in desired visitor experience, impacts on visitor use and experience under alternative B would be both beneficial and adverse to those visitors desiring to see deer, similar to alternative A, since deer would still be present in relatively high numbers for a long time. Overall adverse impacts on visitor use and experience would be negligible to minor, and impacts would gradually become beneficial in the long term, beyond the life of this plan.

Alternative C: Lethal Deer Management

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under alternative A would continue under alternative C. Alternative C would also include the additional techniques described under alternative B, but the primary focus of alternative C is using sharpshooting with firearms to reduce the herd size to the desired density level. A very limited use of capture and euthanasia of individual deer could be considered if needed due to safety concerns, but the parks do not expect that this would be necessary. Under this alternative, it is estimated that the desired deer density goal could be reached at Antietam and Monocacy in 3–5 years and at Manassas in 4–6 years, based on 2011 deer density reports for the three parks and the experience with lethal removal at other NPS parks such as Valley Forge. The scenario described in chapter 2 to reach the desired deer density includes removal of a total of 550 deer at Antietam, 659 deer at Monocacy, and 1,635 deer at Manassas over 4–5 years to reach the desired goal at each park. Visitors would be affected adversely primarily by closures required to conduct the direct reduction activities. However, sharpshooting activities would occur when visitation is low (during winter months), and primarily at night and outside developed areas. The public would be notified of any park closures in advance, information regarding deer management would be displayed at visitor contact facilities, and information would be posted on the parks' websites to inform the public of deer management actions. Visitor access would be limited as necessary while reductions were taking place, and NPS personnel would patrol public areas to ensure compliance with park closures and public safety measures. Noise suppressors would be used to decrease impacts on the soundscape, and visitors would only be affected by noise if sharpshooting occurred during the day and in areas that were not restricted or closed to visitor use. Because sharpshooting activities would occur at times of low park usage (during fall and winter months, and primarily at night), adverse impacts on visitors related to closures or noise from high-power, small caliber rifles with noise suppressors would be negligible. Impacts would be both short- and long-term, as limited sharpshooting activities could continue beyond the initial 3-6 year reduction period to maintain the target population in the future.

In certain circumstances, deer being captured and euthanized could adversely affect visitors. If necessary, deer would be captured as humanely as possible using methods such as nets or box traps, which visitors might see if hiking or walking near trapping locations. However, capture and euthanasia would occur at dawn or dusk when visitation is low. Because this method would be used only in limited circumstances, the likelihood of visitors being exposed to deer being captured and euthanized would be low. Impacts on visitor use would be sporadic over the life of this plan, adverse, and negligible.

It is the parks' intention to donate as much of the meat as possible to local charitable organizations. If this is done, the animals would be field dressed in the parks. The entrails (internal parts) would be buried if there were an appropriate location; otherwise, entrails would be placed in barrels for disposal at a processing or other appropriate facility. If the location were particularly remote, entrails could be left on the surface to decay or be scavenged. In these circumstances, every effort would be made to reduce the visibility of carcasses to visitors or park neighbors, limiting adverse impacts to negligible levels.

The parks plan to implement deer management educational and interpretive efforts under all alternatives, and visitors would be made aware of the reasons for the direct reduction activities and their benefit to forest regeneration.

Long-term beneficial impacts would occur to most visitors because the forests would regenerate relatively quickly, creating increased ability to view a healthier understory and herbaceous plant such as spring wildflowers, and providing improved habitat for a variety of species. Forest regeneration would help ensure that visitors would be able to experience the parks as examples of the natural regeneration of disturbed lands, and to experience nature's ability to regenerate. Beneficial impacts and forest regeneration would be realized relatively rapidly in areas most affected by deer browse, as direct reduction would have an immediate impact on the size of the deer herd. Regeneration would begin to occur after the desired deer density was achieved and the forest would be expected to meet regeneration goals approximately 10 years after the desired deer density is met. Maintaining a viable herd size would help ensure a more balanced ecosystem into the future.

With the reduction in deer, the opportunity to see deer would decrease, and those visitors who are interested primarily in seeing deer would be adversely affected. However, the herd sizes would not be reduced to the extent that deer would become rare in the parks, rather they would still be visible, but they would be more in balance with other elements of the ecosystem. Visitors who value seeing deer might also prefer seeing fewer deer if it means maintaining a viable herd, which could lessen the intensity of the adverse impact on these visitors to negligible or minor. Visitors who value general wildlife viewing could experience beneficial impacts under this alternative as the increase in wildlife that had been affected by overbrowsing would occur as a result of the regenerated forest.

There are others who are opposed to lethal management of deer in the park and who may experience short-term, moderate to even major adverse impacts from the implementation of this alternative. A study that analyzed the beliefs and attitudes towards lethal reduction of deer at Cuyahoga Valley National Park (Fulton et al. 2004) indicates that a minority of residents (15–20%) surrounding that park can be expected to continue to find lethal control very unacceptable as a management strategy for addressing abundant the deer populations at that park, despite the reasons it would be implemented. Additionally, a lethal management program for deer in the parks is likely to have negative emotional impacts on a majority of those who feel lethal deer control is unacceptable and discourage a minority of those (approximately 30–40%) from visiting the park or participating in staff-led activities. If a lethal deer management alternative is implemented, educational and interpretive information would be provided to the public that addresses these issues in a respectful and honest fashion, but it is recognized that some visitors would have a negative reaction to this alternative.

Overall, given the differences in desired visitor experience, impacts on the visitor use and experience under alternative C would be varied, with some visitors experiencing up to moderate to major short- and long-term adverse impacts on their experience, but with long-term beneficial impacts on many other visitors who value viewing a variety of wildlife, plants, and the cultural landscape as the forests recover.

Alternative D: Combined Lethal and Nonlethal Deer Management

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under alternative A would continue under alternative D, and the additional techniques described under alternative B could be used. However, the main emphasis of alternative D would be using a combination of sharpshooting and reproductive control of does from alternatives C and B to address high deer density. Sharpshooting (with very limited capture/euthanasia if necessary) would be taken initially to reduce the deer herd numbers quickly. Population maintenance would be conducted via nonsurgical reproductive control methods (if these are available and meet NPS criteria for use); if not, sharpshooting would be used for maintenance. Adverse impacts related to sharpshooting activities would be long-term and negligible, since they would primarily occur during fall and winter and at night, but beneficial impacts would result from a relatively rapid reduction in deer herd size, which would result in enhanced forest regeneration. Disposal of deer carcasses and waste would occur as described under alternative C. Visitors would only be slightly affected by the continued use of small fenced areas and repellents, which would be a negligible impact. Reproductive control would be applied after sharpshooting efforts had reduced the deer population. Therefore, reproductive control activities would augment direct reduction to reduce deer browsing pressure and allow forest regeneration, increasing the quality of the parks' scenery and the diversity of their plants and animals. Resulting impacts on visitors would be beneficial and long-term. Adverse impacts could occur from visitors being exposed to reproductive control activities and associated area closures, including seeing deer that have been tagged, and up to major adverse impacts could occur to that subset of visitors who are opposed to lethal removals. Educational and interpretive activities would help explain why deer management is needed.

As under the other action alternatives, visitors interested primarily in seeing deer could be adversely affected by the long-term reduction in the deer population. However, adverse impacts on these visitors would be negligible for the reasons mentioned under alternatives B and C.

Overall, similar to alternative C, impacts on the visitor use and experience under alternative D would vary, with some visitors experiencing moderate to major short-term adverse impacts on their experience, but with long-term beneficial impacts on many other visitors as the forest recovers.

IMPACTS OF CHRONIC WASTING DISEASE MANAGEMENT ACTIONS, INCLUDING THE LONG-TERM CHRONIC WASTING DISEASE MANAGEMENT PLAN

Alternative A: No Action (Continuation of Current Management)

Under the no action alternative, the parks would continue with opportunistic and targeted CWD surveillance. Antietam and Monocacy would also respond to CWD presence in or near the parks in accordance with the CWD Detection and Initial Response Plan (NPS 2009c), and Manassas would create a similar plan. The Antietam and Monocacy CWD Detection and Initial Response Plan includes a range of actions including live testing and lethal removal of deer if CWD occurs within 5–20 miles of the park boundary. If CWD were to occur within 5 miles of the parks, initial response include a one-time lethal removal of deer to reach a deer density of about 25–45 deer per square mile. Based on 2008 deer density data, this would involve removing about 250 deer at each park over 3 years (NPS 2009c). There would be no new longer term CWD monitoring or management activities.

Impacts on visitor use and experience for the current CWD management actions and plan, including the initial response plan for Antietam and Monocacy, are described in the EA completed for these actions (NPS 2009c). Impacts of CWD surveillance and detection actions on visitor use would be short-term negligible to minor and adverse, and impacts from deer removals would be short-term, minor to moderate, depending on the need for trail or area closures. If CWD were to occur within 5 miles of the parks, the initial response plan for Antietam and Monocacy calls for a substantial one-time reduction in the deer population, which would have short-term beneficial effects on vegetation and deer, and indirectly on visitor experience until the deer population rises again. These actions were analyzed through a separate NEPA process (NPS 2009c) and would be similar to the effects described for the deer removal actions under alternative C, above. Manassas would likely adopt a similar plan under no action, so impacts there would be the same.

Alternatives B, C, and D (All Action Alternatives)

Under any of the action alternatives, targeted and opportunistic surveillance, and actions under any current initial detection and response plans would continue with impacts similar to alternative A. However, under all alternatives, the parks would adopt a long-term CWD response plan that includes the lethal reduction of deer if CWD is confirmed in or within 5 miles of parks. This would include a rapid reduction to the target deer density and possibly reduction to as low as 10 deer per square mile, and deer would be removed for surveillance monitoring in subsequent years. Reductions would generally follow the same schedule as outlined in alternative C, above, but reductions would be coordinated with the state to address conditions at the time of the CWD detection and could be expedited if resources are available.

Impacts on visitor use and experience from the deer reduction actions would be the same as described for alternative C under the analysis of deer management actions, above. Impacts on visitor use and experience under alternative C would be varied, with some visitors experiencing up to moderate to major short- and long-term adverse impacts on their experience due to the lethal aspects of removal and temporary park closures, but with long-term beneficial impacts on many other visitors who value viewing a variety of wildlife, plants, and the cultural landscape as the vegetation recovers or is protected from excessive browsing.

CUMULATIVE IMPACTS

Alternative A: No Action (Continuation of Current Management)

Past, present, and reasonably foreseeable future actions that could impact visitor use and experience include those actions that impact the forest and visual character of the parks that are enjoyed by visitors. Increased impacts on the forest are expected from increased development around the parks (especially Manassas and Monocacy) and within the parks, including highway development around the parks. Impacts resulting from activities such as construction of fences and development around the parks would result in adverse impacts which would be long-term and negligible, as these impacts would not occur in areas where visitors would be hiking/walking or bicycling. Land acquisition from the two Maryland parks has resulted in long-term beneficial impacts on visitor experience, as it has helped preserve the parks' natural and cultural environments, and increase the land area visitors can enjoy. Impacts from the fire management plans of all three parks, but especially Antietam's fire management plan which includes a prescribed burn program and a presuppression program to identify fire danger periods to protect the parks' resources and minimize threat of harm to adjacent landowners, would result in long-term beneficial impacts, as the parks' resources would be protected from fire, and visitors would be able to enjoy these resources. However, short-term, minor to moderate adverse impacts would result from the prescribed fires, as visitors would be restricted from accessing certain areas of the parks while the prescribed fires are being conducted. The potential addition of new park facilities would result in long-term beneficial impacts on visitors of the parks, as these facilities would enhance the visitor experience. The potential for increased pressure for other recreational uses inside the parks from neighboring populations would result in long-term beneficial impacts on visitors, as the acceptable forms of recreation inside the parks may increase to include forms of recreation that are not currently allowed inside the parks.

The past, present, and reasonably foreseeable future actions described above would result in mostly long-term beneficial impacts. These impacts, when combined with the long-term negligible to moderate adverse impacts and long-term beneficial impacts of alternative A, would result in long-term negligible adverse cumulative impacts on visitor use and experience. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative beneficial impacts on visitor use and experience that would range from adverse to long-term beneficial, which could reduce long-term adverse cumulative impacts. In the absence of any CWD-triggered lethal response, the deer management actions that would continue under alternative A would contribute an adverse increment to the overall cumulative impacts because of the effects of continued overbrowsing on the forest resources and historic landscape components of the parks that are used and valued by many visitors for a variety of reasons.

Alternative B: Nonlethal Deer Management

The same past, present, and future actions described under alternative A would also occur under alternative B, with mostly long-term beneficial impacts. These impacts, when combined with the long-term negligible to mostly minor adverse impacts and the gradual beneficial impacts of alternative B, would result in mostly long-term beneficial cumulative impacts on visitor use and experience. Alternative B would add a small benefit to the cumulative impacts due to the effects of combined forest regeneration activities, which would enhance the overall visitor experience. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative adverse and long-term beneficial impacts on visitor use and experience, which could reduce long-term adverse cumulative impacts. In the absence of any CWD triggered lethal response, the deer management actions under alternative B would add an appreciable adverse increment to the overall cumulative impact because of the lack of immediate reduction in the deer herd and the associated browsing impacts on vegetation.

Alternative C: Lethal Deer Management

The same past, present, and future actions described under alternative A would also occur under alternative C, with mostly long-term benefits. These impacts, when combined with the short-term, minor to possibly major adverse impacts on visitor use and experience, as well as the long-term beneficial impacts of the recovered forest, are expected to result in long-term negligible adverse impacts. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative adverse and long-term beneficial impacts on visitor use and experience, which could reduce long-term adverse cumulative impacts and add to beneficial effects. In the absence of any CWD triggered lethal response, the deer management actions under alternative C would result in long-term beneficial impacts as a result of forest regeneration due to the restoration of natural resources.

Alternative D: Combined Lethal and Nonlethal Deer Management

The same past, present, and future actions described under alternative A would also occur under alternative D, with mostly long-term beneficial impacts. These impacts, when combined with the short-term, minor to possibly major adverse impacts on visitor use and experience, as well as the long-term beneficial impacts of the recovered forest, are expected to result in long-term negligible adverse impacts. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative adverse and long-term beneficial impacts on visitor use and experience, which could reduce long-term adverse cumulative impacts and add to beneficial effects. In the absence of any CWD triggered lethal response, the deer management actions under alternative D would result in long-term beneficial impacts as a result of forest regeneration due to the restoration of natural resources.

CONCLUSION

Alternative A: No Action (Continuation of Current Management)

It is recognized that an overall conclusion for this topic is difficult, since impacts on visitor use and experience under all alternatives will vary depending on the desired use and perceptions of the visitors, many of which have strong opinions about deer and deer management. Under alternative A, visitors who may be primarily interested in viewing deer would experience beneficial and adverse impacts (beneficial because there would be more deer to see, adverse because the appearance of the herd could be poor). However, there would be long-term minor to moderate adverse overall impacts related to a decreased ability to view scenery (including native vegetation and the historic landscape) and other wildlife, which is important to some visitors using the parks. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would provide indirect beneficial impacts relating to the appearance of vegetation in the parks, but would have adverse effects on visitation; these effects would not outweigh the adverse effects of not taking deer management actions in the long-term. The overall cumulative impact would be long-term beneficial, with alternative A contributing appreciable adverse increments to the cumulative impact on visitor use and experience.

Alternative B: Nonlethal Deer Management

Under alternative B visitors would experience beneficial and adverse impacts, similar to alternative A, since deer would still be present in relatively high numbers for a long time. Adverse impacts on visitor use and experience from the presence of exclosures and the continued effects of deer overbrowsing would range from negligible to moderate, and impacts related to forest regeneration would gradually become beneficial in the long term, beyond the life of this plan. Visitors may see various aspects of the reproductive control operations, which could result in minor adverse impacts on their visitor experience. Any CWD response that would be taken under the proposed long-term plan would provide indirect beneficial impacts relating to the appearance of vegetation in the parks, but would have adverse effects on visitation; these would not outweigh the adverse effects of not taking deer management actions in the long-term. Similar to alternative A, the overall cumulative impact would be long-term beneficial, with alternative B contributing appreciable adverse increments to the cumulative impact on visitor use and experience.

Alternative C: Lethal Deer Management

Impacts on the visitor use and experience under alternative C would vary between users. Impacts would be short- and long-term, minor to major adverse to those opposed to lethal deer management within the parks and from disturbance during implementation of the action, but long-term and beneficial to those who value an increase in vegetative and wildlife (including a health deer herd) diversity and being able to view natural and historic landscapes unaffected by overbrowsing. CWD actions would have similar impacts, with short-term negligible impacts (mainly trampling) from surveillance, benefits from the reduction of deer and deer browse on vegetation, and adverse effects on those visitors who are opposed to lethal deer management. The overall cumulative impact would be long-term and beneficial, and alternative C would contribute appreciable beneficial increments to the cumulative impact on visitor use and experience.

Alternative D: Combined Lethal and Nonlethal Deer Management

Impacts on the visitor use and experience under alternative D would be similar to those described for alternative C and would vary between users. Impacts would be short- and long-term, minor to major adverse to those opposed to lethal deer management within the parks and from disturbance during implementation of the action, but long-term and beneficial to those who value an increase in vegetative and wildlife (including a health deer herd) diversity and being able to view natural and historic landscapes unaffected by overbrowsing. CWD actions would have similar impacts, with short-term negligible impacts (mainly trampling) from surveillance, benefits from the reduction of deer and deer browse on vegetation, and adverse effects on those visitors who are opposed to lethal deer management. The overall cumulative impact would be long-term and beneficial, and alternative D would contribute appreciable beneficial increments to the cumulative impact on visitor use and experience.

IMPACTS ON CULTURAL LANDSCAPES

GUIDING REGULATIONS AND POLICIES

Federal actions that have the potential to affect cultural resources are subject to a variety of laws. The National Historic Preservation Act (1966, as amended) (NHPA) is the principal legislative authority for managing cultural resources associated with NPS projects. Generally, Section 106 of the act requires all federal agencies to consider the effects of their actions on cultural resources listed on or determined eligible for listing in the National Register of Historic Places (NRHP). Such resources are termed historic properties. Agreement on how to mitigate effects on historic properties is reached through consultation with the State Historic Preservation Officer (SHPO); the Tribal Historic Preservation Officer, if applicable; and the Advisory Council on Historic Preservation, as necessary. In addition, federal agencies must minimize harm to historic properties that would be adversely affected by a federal undertaking. Section 110 of the act requires federal agencies to establish preservation programs for the identification, evaluation, and nomination of historic properties to the NRHP. Other important laws or executive orders designed to protect cultural landscapes include Executive Order 11593, “Protection and Enhancement of the Cultural Environment.”

Through legislation the NPS is charged with the protection and management of cultural resources in its custody. This is furthered implemented through Director’s Order 28: Cultural Resource Management (NPS 2002b), NPS *Management Policies 2006* (NPS 2006a), and the 2008 servicewide “Programmatic Agreement among the National Park Service, the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers for Compliance with Section 106 of the NHPA.” These documents charge NPS managers with avoiding or minimizing to the greatest degree practicable, adverse impacts on park resources and values. Although the NPS has the discretion to allow certain impacts in parks, that discretion is limited by the statutory requirement that park resources and values remain unimpaired, unless a specific law directly provides otherwise.

ASSUMPTIONS, METHODOLOGIES, AND INTENSITY DEFINITIONS

The NPS categorizes cultural resources as archeological resources, cultural landscapes, historic structures, museum objects, and ethnographic resources. As noted under “Issues and Impact Topics” in chapter 1, only impacts on cultural landscapes have been retained for detailed analysis in this plan/EIS.

The descriptions of effects on cultural resources that are presented in this section are intended to comply with the requirements of both NEPA and Section 106 of the NHPA. In accordance with the regulations of the Advisory Council on Historic Preservation on implementing Section 106 (36 CFR 800, Protection of Historic Properties), impacts on cultural resources are to be identified and evaluated by (1) determining the area of potential effects; (2) identifying cultural resources present in the area of potential effects that are either listed on or eligible to be listed in the NRHP; (3) applying the criteria of an adverse effect on affected cultural resources either listed on or eligible to be listed in the NRHP; and (4) considering ways to avoid, minimize, or mitigate adverse effects.

Under the Advisory Council’s regulations, a determination of either *adverse effect* or *no adverse effect* must also be made for affected cultural resources eligible for listing in the NRHP. An *adverse effect* occurs whenever an impact alters, directly or indirectly, any of the characteristic that qualifies the resource for inclusion in the National Register (for example, diminishing the integrity of the resource location, design, setting, materials, workmanship, feeling, or association). Adverse effects also include reasonably foreseeable effects caused by the proposal that would occur later in time, be farther removed in distance, or be cumulative (36 CFR 800.5, Assessment of Adverse Effects). A determination of *no adverse effect* means there would either be no effect or that the effect would not diminish in any way the characteristics that qualify the cultural resource for inclusion in the NRHP.

CEQ regulations and the NPS Director’s Order 12 also call for a discussion of the appropriateness of mitigation, as well as an analysis of how effective the mitigation would be in reducing the intensity of a potential impact (e.g., reducing the intensity of an impact from major to moderate or minor). Any resultant reduction in the intensity of an impact due to mitigation, however, is an estimate of the effectiveness of mitigation under NEPA only. Cultural resources are nonrenewable resources, and adverse effects generally consume, diminish, or destroy the original historic materials or form, resulting in a loss in the integrity of the resource that can never be recovered. Therefore, although actions determined to have an adverse effect under Section 106 of the NHPA may be mitigated, the effect remains adverse.

Cultural Landscapes and Deer Management

The Secretary of the Interior’s Standards for the Treatment of Historic Properties with Guidelines for the Treatment of Cultural Landscapes are the primary source of guidance for the definition of cultural landscapes, their possible character defining features, and their treatment based upon a selected goal that may range from preservation to rehabilitation or even restoration (NPS 1996). Cultural landscapes that are designated within national parks have been determined to have historic significance and integrity.

The subset of cultural landscapes which Antietam National Battlefield, Monocacy National Battlefield, and Manassas National Battlefield Park represent, in their entirety, is the "historic site," due to the significance of the battles which took place there and the later placement of commemorative works, such as sculpture, to mark and interpret the battlefields as hallowed ground. In addition, the rural farmsteads which are components of the larger battlefield landscapes typify the subset "historic vernacular landscape."

In analyzing how alternative approaches for deer management would affect the cultural landscape of Antietam, Monocacy, and Manassas, primary attention was paid to the program's effect on vegetation as a character-defining feature of the cultural landscape and on views and vistas. Structures, statues, objects, and hardscapes often constitute contributing features of cultural landscapes as well, but they are <u>not</u> inherently subject to alteration by the action of deer. For this reason, the analysis of this topic will be similar in many respects to that for vegetation.

For the assessment of potential impacts on cultural landscapes, the principal sources reviewed were Antietam Battlefield GMP (NPS 1992), Manassas Battlefield National Register Nomination (NPS 2002d), and Monocacy Battlefield Cultural Landscape Inventory (NPS 2000), as well as the various cultural landscape inventories (CLIs) and reports for the three parks. As indicated in Section 4.3.1 several of the GMPs for the parks include management policies that pertain to vegetation and cultural landscapes. These include the following:

- Antietam's GMP calls for reestablishing vegetation patterns on the battlefield (farm fields, woods, and orchards) to resemble conditions just before the battle.

- Monocacy's GMP identifies the effects of deer browsing on vegetation as an issue because it can force farmers to change agricultural practices and alter regrowth in forested areas, suppressing the regeneration of native trees.

- Manassas' GMP notes the effects that deer are having on park vegetation, including historically wooded areas and streamside buffers, and the adverse effects on natural forest succession processes and newly installed landscape vegetation.

The more recent cultural resources reports for the Thomas and Worthington Farms at Monocacy (NPS 2012b), and the fences, fields and forests at Manassas (NPS 2012e) discuss the effects deer are having on these cultural landscapes and also lay out management or treatment options. In general, the vegetation issues for deer management that most impact cultural landscape values in the battlefield parks are (a) tree cover, (b) the protection of orchards, and (c) the capacity to sustain adequate yields of traditional row crop growth. Appropriate tree cover is also critical to preserve vistas and mask intrusive views of off park development which diminish the feeling and association of the park with its period of significance. These issues are not, however, equally present in all three parks. All have tree cover which requires regeneration, but only Antietam has orchards. Antietam and Monocacy both have row crops, while Manassas currently has only hay and pastureland. Manassas in particular is more wooded than it was in Civil War times, and the newer stands of trees often obscure historic vistas; nonetheless, the park would prefer to selectively remove intruding tree stands rather than have deer accomplish this over time at random. Monocacy and Manassas are situated in proximity to suburban development. Antietam's surroundings, except for the historic towns which contribute to their historic setting, remain largely rural.

For purposes of analyzing potential impacts on cultural landscapes, the thresholds of change for the intensity of an adverse impact under NEPA are defined along their equivalents under Section 106, NHPA, as follows:

Negligible: The impact would be at the lowest level of detection, with neither adverse nor beneficial consequences. For purposes of Section 106 of the NHPA, the determination of effect would be *no adverse effect*.

Minor: Alteration of a pattern(s) or feature(s) of the cultural landscape listed on or eligible for listing in the NRHP would not diminish the overall integrity of the landscape. For purposes of Section 106 of the NHPA, the determination of effect would be *no adverse effect*.

Moderate: The action would result in the alteration of a pattern(s) or feature(s) that would diminish the overall integrity of the landscape to the extent that its National Register eligibility would be jeopardized. For purposes of Section 106, the determination of effect would be *adverse effect*.

Major: The action would result in the alteration of a pattern(s) or feature(s) that would diminish the overall integrity of the landscape to the extent that it would no longer be eligible to be listed on the National Register. For purposes of Section 106, the determination of effect would be *adverse effect*.

A Section 106 summary is included in the impact analysis sections of the action alternatives for cultural landscapes. The Section 106 summary is an assessment of the effect of the undertaking (implementation of the alternative) only on cultural resources listed on or eligible for the NRHP, based on the criteria of effect and criteria of adverse effect found in the regulations of the Advisory Council on Historic Preservation.

AREA OF ANALYSIS

The area of analysis for impact assessment includes all lands within the boundaries of all three parks. The area of analysis for cumulative impacts includes the parks and the area within 2.5 miles of the parks' boundaries, which encompasses typical deer movement outside the park boundaries.

IMPACTS OF DEER MANAGEMENT ACTIONS

Alternative A: No Action (Continuation of Current Management)

Under alternative A, park staff would continue to monitor the deer population and vegetation and continue to use tree tubes, repellents (mainly at Antietam), or small-scale fencing to protect landscape plantings, orchards, and small areas containing tree plantings. As described in chapters 1 and 3, the parks have been conducting vegetation monitoring since 2000 (Manassas) and 2003 (Antietam and Monocacy). Each park has conducted various studies, including paired plots (exclosures and open control plots), to assess the impacts of deer on park vegetation. The studies at Antietam and Monocacy demonstrated no significant differences in seedling establishment between the fenced and open plots; however, native sapling species richness and abundance increased significantly in fenced plots, and all plots were below the threshold of seedling density that is required for forest regeneration. Similar studies at Manassas showed that deer have significant effects on forest structure and weedy seedling composition, species, richness, and seedling survival rates. These impacts can be directly attributed to deer browsing and indicate deer are affecting the integrity of the understory structure (see chapter 3, "Current Vegetation

Status and the Role of Deer"). A distinct browse line is evident at Manassas and Monocacy, and to a lesser extent at Antietam, which is a visual indication of the effects deer have had on the understory at the parks and not in keeping with the Civil War era period of significance.

Cultural resource indicators selected for the parks also show the effects of deer browse on crops and orchards that are essential components of the cultural landscapes of the parks. Stewart, McShea, and Piccolo (2007) showed that deer have a significant effect on corn production and quality at the parks. In their study, which included Antietam, Monocacy, and the Chesapeake & Ohio Canal National Historical Park, fenced plots had higher weights of corn, more stalks with ears, and higher quality corn than open plots, and deer reduced crop yields by 5-43% in the open plots over the course of the study. Crop yield reports from Antietam and Monocacy show the adverse impact that deer are having on crops at the battlefields. Overall, harvests for all crops at Antietam were significantly lower than county averages and the expected yields based on soil type and crop, and this would be expected to continue under alternative A. Orchards and restoration plantings also continue to be susceptible to deer damage. Currently, about 50% of the trees in the east woods at Antietam are protected from deer by tree tubes, and apple trees at Piper Orchard are protected with cages to allow these trees to survive. Under alternative A, it is expected that the deer population would continue at high densities within the parks, albeit with yearly fluctuations. As can be seen from 2011 deer density data, all of the parks exceed 20 deer per square mile (the high end of the desired deer density range) by a substantial margin (Antietam – 131 deer per square mile; Monocacy – 236 deer per square mile; Manassas – 172 deer per square mile). Deer densities exceed 100 deer per square mile in most years at all of the parks since monitoring began in 2001, and have exceeded 200 deer per square mile at Monocacy in three of those years. In all parks, it is expected that deer would continue to browse on plants to the extent that tree seedling densities would remain low, noticeable changes to the abundance and diversity of herbaceous vegetation throughout the area would occur, and crop/tree damage would continue to occur in cultural landscape plantings. Deer populations would be expected to remain at high levels and it is not expected that any periodic deer population declines would be low enough or last long enough for forest regeneration to occur or vegetation of any kind to fully recover as long as deer densities remained above 20 per square mile. Based on these results and the expected high numbers of deer over the life of the plan, the character-defining feature of the contrasting patterns of farmsteads, hardwood forests, open meadows, row crops, and pastures of the cultural landscape would continue to deteriorate.

Overall, deer management actions under Alternative A would have long-term moderate adverse impacts on cultural landscapes due to the extensive amount of deer browsing that would continue to occur at high deer densities and the associated ongoing depredation of plantings and crops by deer in unfenced cultural landscape areas, which could jeopardize the integrity of the cultural landscape.

Alternative B: Nonlethal Deer management

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under alternative A would continue under alternative B. Alternative B would also include several techniques to prevent adverse deer impacts including fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning. However, the main focus of alternative B would be two nonlethal actions: (a) the construction of large-scale deer exclosures (fencing) to promote forest regeneration and (b) nonsurgical reproductive control of does to restrict population growth (when this technology meets certain criteria).

Large fenced exclosures would be constructed under alternative B to allow forest regeneration to occur within enclosed areas of the parks that would not be accessible to deer. The 19 proposed exclosures would eliminate deer presence within a total of 184 acres or about 6% of the wooded area of the parks (23 acres at Antietam, 61 acres at Monocacy, and 100 acres at Manassas; see chapter 2 for details and locations).

Protecting these areas from deer browse would allow native woody species to grow higher than heights reached by deer (about 60 inches or 150 centimeters) after about 10 years, at which time the exclosures would be moved, and another 6% of the parks' vegetation would be enclosed. This action would have a long-term beneficial impact on up to about 12% of the woody vegetation in the park after 15 years (the life of the plan): 6% inside the existing exclosures at 15 years, and 6% in the original exclosures, which has grown above deer reach. However, the effect of having no browsing protection on woody species in the remaining unfenced areas of the park would be similar to alternative A. It is expected that monitoring over the life of the plan would continue to show that most of the long-term unfenced plots would have low seedling regeneration. Exclosures would provide a long-term beneficial, impact on herbaceous vegetation in about 6% of the park at any one time. These benefits would be limited to the location and time period of exclosure areas, however. The restoration planting protections described under alternative A would continue to be used under alternative B, proving limited benefits. Although this alternative may show some improvement over that seen under alternative A from the exclosures, it is expected to result in long-term moderate adverse impacts, when viewed over the life of the plan.

Exclosures must also be analyzed from the standpoint of their visual impact on cultural landscapes, not only their efficacy in promoting tree regeneration. Fencing for large exclosures would be about 8 feet high and would consist of woven wire with openings that would allow most other wildlife to move freely through the fence. Metal and wood posts would be used as supports. It is expected that the technical details (e.g., type of footer, post type and spacing) related to fence installation would vary based on factors such as site topography, geologic substrate, access, potential visibility, and presence of archeological resources. The siting at the parks would also require various configurations to fit the landscape, with locations based on several criteria: they must be relatively easy to access, yet away from high use visitor areas or scenic views; they must fit into the parks' topography and current trails systems; and they must avoid steep slopes and existing vegetation monitoring plots. The woven-wire, 8-foot fenced exclosures would, nonetheless, introduce new structural elements into the parks' overall landscape that would be inconsistent with the parks' contributing buildings and farmsteads. To mitigate these potential impacts on the cultural landscape, the exclosures would be located some distance from common visitor use areas as much as possible so that they would not intrude on these landscapes. However, the exclosures might be visible during the winter and spring from locations within the park where the views contribute features to the cultural landscapes that are located throughout the parks. Due to their materials and construction, they would be difficult to see. Regardless, the presence and visibility of these exclosures may result in long-term minor to moderate adverse impacts on particular cultural landscapes due to their detraction from the scenic value of the landscape, depending on their location.

Potential deer exclosure locations for the three parks are shown in figures 5–7 and are listed in table 6 of chapter 2. The potential locations of certain exclosures at Monocacy and Manassas would preserve tree stands that mask suburban and light industrial development outside park boundaries. This would be a minor long-term beneficial impact.

Alternative B also includes the use of a reproductive control agent. For the purposes of this analysis, it is assumed that an acceptable chemical reproductive control agent would be available and feasible during the life of this plan as described in chapter 2. Implementing reproductive controls would have short-term (a few hours to a few days in any location), localized, and negligible adverse impacts on cultural landscapes. The effect of reproductive control on the deer population and thus deer browsing could be beneficial if the target deer density could be achieved within the life of this plan. However, the time required for the population to be reduced to the extent needed to allow for forest regeneration could be many years. (For a more detailed discussion of the efficacy of this approach, see the discussion of alternative A, above.) Deer numbers would be expected to remain at high levels over the life of the plan; browsing would continue throughout the park, especially in zones with the highest deer density, and cause a decline in the long-term abundance and diversity of native plant species, particularly to susceptible landscape plantings and crops that are integral to many of the parks' cultural landscapes. As a result, there would be long-term adverse moderate impacts on the parks' cultural landscapes (depending on the landscape and the plants importance to the landscape) over the life of the plan.

Alternative B includes use of various techniques to prevent adverse deer impacts including fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning. All of these actions would provide beneficial impacts and serve to reduce deer damage, but in a limited, localized context. Fencing of crops and woodlots could supplement the proposed exclosure fencing and serve to protect smaller areas that are considered valuable, but there would be a limit on how much of the parks could be fenced without adverse visual effects on the cultural landscapes and adverse impacts in visitor access/use. Changing crops can prevent deer browse, but the substitute crop may not be one that is correct in the cultural context of the battlefields, which would cause adverse effects on cultural resource values. The ability to grow a crop would need to be balanced against the effect of the change in crop. Planting crops close together at the edge of fields to resist deer entry into the field is not a proven method, but could be initiated on a trial basis. Various aversive conditioning techniques (loud noises, scarecrow devices) would be useful in keeping deer away at certain times and in limited areas, but could detract from the cultural values of the parks and interfere with visitor experience. These would also need to be a used on a very selective basis and tested for effectiveness. Overall, these techniques would provide limited benefits that would not substantially reduce the overall moderate adverse effects expected under alternative B if the deer densities remain high.

Overall, under alternative B, there would be long-term moderate adverse impacts on cultural landscapes because in the majority of the parks, agricultural crops and other vegetation would continue to be adversely affected by deer browsing until reproductive controls became effective and the population decreased, and fencing would not protect all vegetation and there would be a limit on how much of the parks could be fenced without adverse visual effects on the cultural landscapes.

Alternative C: Lethal Deer Management

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under alternative A would continue under alternative C. Alternative C would also include the additional techniques described under alternative B, but the primary focus of alternative C is using sharpshooting with firearms to reduce the herd size to the desired density level. A very limited use of capture and euthanasia of individual deer could be considered if needed due to safety concerns, but the parks do not expect that this would be necessary.

Under this alternative, it is estimated that the desired deer density goal could be reached at Antietam and Monocacy in 3–5 years and at Manassas in 4–6 years, based on 2011 deer density reports for the three parks and the experience with lethal removal at other NPS parks such as Valley Forge. The scenario described in chapter 2 to reach the desired deer density includes removal of a total of 550 deer at Antietam, 659 deer at Monocacy, and 1,635 deer at Manassas over 4–5 years to reach the desired goal at each park. It is expected that rapidly reducing the deer population and associated browsing pressure would allow the number of tree and shrub seedlings to increase and survive to saplings and into maturity in all areas of the parks, providing the necessary growth for natural forest regeneration, and would result in long-term beneficial impacts on vegetation that is an important element of the parks' cultural landscapes. It is expected that crop damage would decrease to a level similar to that found outside the parks, and damage to orchards or restoration tree plantings would similarly decrease.

Alternative C also includes the use of the techniques described in alternative B to prevent adverse deer impacts including fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning. Impacts would be expected to be similar—beneficial, but in a limited, localized context. Assuming that the deer density is reduced to the desired goal in 4–5 years, it is likely that these techniques would be use more often in the first years of the program in cases where there is an immediate need to change crops, fence a vulnerable or sensitive area before more damage occurs, or scare deer from a important farm field, so adverse impacts would also be short-term.

However, the NPS would also rely on monitoring protocols and specific thresholds for the three major vegetative components of the cultural landscapes to trigger and target implementation. These thresholds are:

- Wooded Areas – 67% of 2 x 2 meter plots have more than 38.1 seedlings/plot at high deer density
- Crops – Less than 75% of the relevant county's 3-year average yield for a crop (economic viability of continued farming)
- Orchards – 30% or more of annual growth of individual trees removed by deer browsing (survival of individual trees is threatened if more than this amount of live growth is removed in a given year).

In addition, monitoring periods would be tightened as needed from the previous every 6-year standard, and crops and orchards would be monitored to assess impacts of deer browse. Decreased browsing and thus decreased deer depredations of agricultural crops would lead to increased chances of viability for the parks' farm ventures and maintain the open and closed patterns of the cultural landscape

Overall, under alternative C there would be long-term beneficial effects on cultural landscapes due to decreased browsing and thus decreased deer depredations of agricultural crops, with increased chances of viability for the parks' farms and maintenance of the parks' cultural landscapes.

Alternative D: Combined Lethal and Nonlethal Deer Management

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under alternative A would continue under alternative D, and the additional techniques described under alternative B could be used. However, the main emphasis of alternative D would be using a combination of sharpshooting and reproductive control of does from alternatives C and B to address high deer density. Sharpshooting (with very limited capture/euthanasia if necessary) would be taken initially to reduce the deer herd numbers quickly. Population maintenance would be conducted via nonsurgical reproductive control methods (if these are available and meet NPS criteria for use); if not, sharpshooting would be used for maintenance.

As described for alternative C, under this alternative, deer would be removed at all three parks over the course of 4–5 years to reach the initial density goal (15–20 deer per square mile). It is expected that reducing the deer browsing pressure (e.g., dropping from 131, 236, and 172 deer per square mile in Antietam, Monocacy, and Manassas, respectively, to about 20 deer per square mile) would result in a noticeable increase in the number of tree and shrub seedlings, and an increase in the number of seedlings surviving to sapling stage, providing the necessary growth for natural forest regeneration. Herbaceous vegetation would also be able to recover, with many species expected to recover within a few years. Invasive species may increase if they had previously been browsed, but the spread of seeds by deer should decrease over time. Providing immediate reduction and control of the deer population would result in long-term beneficial impacts on cultural landscapes, because deer browsing would be substantially reduced and the abundance and diversity of vegetation throughout the park could recover. Assuming reproductive controls could be used at a parkwide level to maintain the deer population size, impacts on vegetation that is an important element of the parks' cultural landscapes would be beneficial and long-term because a substantial reduction in deer browsing would allow the abundance and diversity of vegetation throughout the park to recover.

Decreased browsing and thus decreased deer depredations of agricultural crops would lead to increased chances of viability for the parks' farm ventures and maintain the open and closed patterns of the rural cultural landscape.

Overall, under alternative D there would be long-term beneficial effects on cultural landscapes due to decreased browsing and thus decreased deer depredations of agricultural crops, similar to alternative C.

IMPACTS OF CHRONIC WASTING DISEASE MANAGEMENT ACTIONS, INCLUDING THE LONG-TERM CHRONIC WASTING DISEASE MANAGEMENT PLAN

Alternative A: No Action (Continuation of Current Management)

Under the no action alternative, the parks would continue with opportunistic and targeted CWD surveillance. Antietam and Monocacy would also respond to CWD presence in or near the parks in accordance with the CWD Detection and Initial Response Plan (NPS 2009c), and Manassas would create a similar plan. The Antietam and Monocacy CWD Detection and Initial Response Plan includes a range of actions including live testing and lethal removal of deer if CWD occurs within 5–20 miles of the park boundary. If CWD were to occur within 5 miles of the parks, initial response include a one-time lethal removal of deer to reach a deer density of about 25–45 deer per square mile. Based on 2008 deer density data, this would involve removing about 250 deer at each park over 3 years (NPS 2009c). There would be no new longer term CWD monitoring or management activities.

Impacts on cultural landscapes for the current CWD management actions and plan, including the initial response plan for Antietam and Monocacy, are described in the EA completed for these actions (NPS 2009c). Impacts of CWD surveillance and detection actions on cultural landscapes would be short-term negligible to minor and adverse, mainly from temporary disturbances during implementation. If CWD were to occur within 5 miles of the parks, the initial response plan for Antietam and Monocacy calls for a substantial reduction in the deer population, which would have short-term beneficial effects on cultural landscapes and the deer herds that are a part of the cultural landscape, based on the reduction in the deer herd that would be achieved from the one-time reduction. These actions were analyzed through a separate NEPA process (NPS 2009c) and would be similar to the effects described for the deer removal actions under alternative C, above. Manassas would likely adopt a similar plan under no action, so impacts there would be the same.

Alternatives B, C, and D (All Action Alternatives)

Under any of the action alternatives, targeted and opportunistic surveillance, and actions under any current initial detection and response plans would continue with impacts similar to alternative A. However, under all alternatives, the parks would adopt a long-term CWD response plan that includes the lethal reduction of deer if CWD is confirmed in or within five miles of parks. This would include a rapid reduction to the target deer density and possibly reduction to as low as 10 deer per square mile, and deer would be removed for surveillance monitoring in subsequent years. Reductions would generally follow the same schedule as outlined in alternative C, above, but reductions would be coordinated with the state to address conditions at the time of the CWD detection and could be expedited if resources are available. Impacts on cultural landscapes from the deer reduction actions would be the same as described for alternative C under the analysis of deer management actions, above. Decreased browsing and thus decreased deer depredations of agricultural crops would lead to increased chances of viability for the parks' farm ventures, maintaining the open and closed patterns of the cultural landscape, a long-term beneficial impact. Reduced browsing would also result in less damage to orchards and provide for regeneration of forest species, which are both important elements of the parks' cultural landscapes. The intensity of the impacts from CWD activities may vary, depending on when the CWD actions occur in relationship to the deer management actions. If CWD activities were to occur prior to deer management activities, the impacts would be more noticeable, while if they happened after the deer population had already been reduced as part of a deer management plan, less action would be needed for CWD and the impacts from CWD activities would be less intense and less noticeable.

CUMULATIVE IMPACTS

Alternative A: No Action (Continuation of Current Management)

Past, present, and reasonably foreseeable future actions that could impact cultural landscapes in and around the park include actions with both adverse and beneficial impacts on vegetation. Adverse impacts on vegetation have occurred and will continue to occur from increasing suburban development, including transportation projects and utility lines in the areas surrounding the parks, which has resulted in clearcutting, selective timbering, and removal of vegetation in specific areas, causing long-term minor to moderate localized adverse impacts. Past actions within the park, such as construction of facilities, roads, and trails, and the upgrade of a transmission line at Manassas, have resulted in removal of vegetation and have adversely affected forest resources to a minor extent in limited areas. However, maintenance of character defining structures, the perpetuation through park contractors of typical agricultural activities, and restoration of landscape patterns, have had moderate, long-term beneficial impacts.

Land development in areas adjacent to the park affect views and vistas, gradually eroding the sense of place that used to surround the park. Character-defining features of a rural, cultural landscape include changes, either individually or collectively, that have occurred over time. Particularly affected are vulnerable sites on the immediate adjacent properties. Development pressures are probably greatest around Manassas and Monocacy. Land development in these areas contributes to the reduction of rural landscapes in the general vicinity and can reduce continuity of the rural landscapes that transcend park boundaries, causing minor adverse impacts on the parks' cultural landscapes.

Beneficial impacts have resulted from past and current deer management efforts undertaken by neighboring agencies, landowners using deer depredation permits, which have resulted in reduced deer numbers in and around the park. Public hunting has helped to reduce the deer population and provides a beneficial cumulative effect, particularly in the more rural areas surrounding Monocacy and Antietam.

The past, present, and reasonably foreseeable future actions described above would result in long-term minor to moderate adverse impacts as well as long-term beneficial impacts. These impacts, when combined with the long-term moderate adverse impacts of deer management actions under alternative A, with continued pressure on vegetation and the limited natural regeneration, would result in long-term moderate adverse cumulative impacts on vegetation that is an important component of the parks' cultural landscapes. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative beneficial impacts on vegetation related to the associated reduced browse impacts, which would reduce long-term adverse cumulative impacts. In the absence of any CWD-triggered lethal response, the deer management actions that would continue under alternative A would contribute an appreciable adverse increment to the overall cumulative impact because of the expected continued deer browsing that would restrict forest regeneration, orchard sustainability, and row crop productivity, and adversely affect the cultural landscapes of the parks.

Alternative B: Nonlethal Deer Management

The same past, current, and future actions described under alternative A would also occur under alternative B, including long-term minor to moderate adverse effects from increasing suburban development in the areas surrounding the parks, construction of facilities and roads, park maintenance, and other cumulative actions, and beneficial impacts from park management and actions taken by neighboring jurisdictions to reduce deer numbers. These impacts, when combined with the mostly long-term moderate adverse impacts of alternative B, would result in long-term moderate adverse cumulative impacts on cultural landscapes. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative beneficial impacts on vegetation and cultural landscapes related to the associated reduced browse impacts, which would reduce long-term adverse cumulative impacts. In the absence of any CWD triggered lethal response, the deer management actions under alternative B would add an appreciable adverse increment to the overall cumulative impact because of the lack of immediate reduction in the deer herd and the associated browsing impacts on vegetation and crops.

Alternative C: Lethal Deer Management

The same past, current, and reasonably foreseeable future actions described under alternative A would also occur under alternative C, with both minor to moderate adverse impacts and beneficial impacts, especially from neighboring deer management actions and park management. These impacts, when combined with the mainly long-term beneficial impacts realized under alternative C from quickly reducing a park's deer population, would result in a long-term beneficial cumulative impact on cultural landscapes. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative beneficial impacts on vegetation and cultural landscapes related to the associated reduced browse impacts, which could add to the long-term beneficial cumulative impacts. In the absence of any CWD triggered lethal response, the deer management actions under alternative C would contribute an appreciable beneficial increment to the overall cumulative impact because of the reduction in deer browse damage to woody and herbaceous vegetation.

Alternative D: Combined Lethal and Nonlethal Deer Management

Cumulative impacts would be essentially the same as described for alternative C. Past, current and reasonably foreseeable future actions that would contribute to cumulative impacts on cultural landscapes would be the same as those described under alternative A, with minor to moderate adverse impacts and also beneficial impacts. These impacts, when combined with the mainly long-term beneficial impacts of the reduced deer population under alternative D, would result in long-term beneficial cumulative impacts on cultural landscapes. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative beneficial impacts on vegetation and cultural landscapes related to the associated reduced browse impacts, which could add to the long-term beneficial cumulative impacts. In the absence of any CWD triggered lethal response, the deer management actions under alternative D would contribute a substantial beneficial increment to the overall cumulative impact because of the reduction in deer browse damage to both woody and herbaceous vegetation.

CONCLUSION

Alternative A: No Action (Continuation of Current Management)

Under alternative A, the cultural landscapes would experience long-term, moderate, adverse impacts due to the continued high levels of the deer population and the associated ongoing depredation of plantings and crops by deer in unfenced cultural landscape areas. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would provide indirect beneficial impacts, but these would not outweigh the adverse effects of not taking deer management actions. The overall cumulative impact would be long-term, moderate, and adverse, with alternative A contributing appreciable adverse increments to the cumulative impact on cultural landscapes.

Alternative B: Nonlethal Deer Management

Similar results would occur under alternative B because reproductive control would result in only a gradual reduction in the deer population, and although the population goal could be met over the longer term, the risk of not meeting the goal would be high. Therefore, it is expected that the deer population would remain at relatively high density levels in the parks throughout the life of the plan. Also, the exclosures would protect only a small portion of the forest in the parks at any one time, requiring 10 years for regrowth above the browse line, and would have adverse visual impacts on the cultural landscapes if they are visible. Under alternative B, the cultural landscapes would experience long-term, moderate adverse impacts because in the majority of the parks, agricultural crops and other vegetation would continue to be adversely affected by deer browsing until reproductive controls became effective and the population decreased. Any CWD response that would be taken under the proposed long-term plan would provide indirect beneficial impacts, but these would not outweigh the adverse effects of not taking deer management actions. The overall cumulative impact would be long-term, moderate, and adverse, with alternative B contributing appreciable adverse increments to the cumulative impact on cultural landscapes.

Alternative C: Lethal Deer Management

The overall impact on cultural landscapes under alternative C would be long-term and beneficial due to decreased browsing and thus decreased deer depredations of agricultural crops. This would lead to increased chances of viability for the parks' farm ventures and maintain the open and closed patterns of the cultural landscape. There would be short-term negligible impacts (mainly trampling) from deer management implementation actions, and benefits from the limited use of deer management techniques to reduce impacts in certain locations or circumstances. CWD actions would have similar impacts, with short-term negligible impacts (mainly trampling) from surveillance, and benefits from the reduction of deer and deer browse on vegetation. The overall cumulative impact would be long-term and beneficial, and alternative C would contribute appreciable beneficial increments to the cumulative impact on cultural landscapes.

Alternative D: Combined Lethal and Nonlethal Deer Management

Alternative D would have essentially the same impacts as alternative C, with long-term beneficial effects due to the decreased browsing and thus decreased deer depredations of agricultural crops, which would lead to increased chances of viability for the parks' farm ventures and forest vegetation that maintain the open and closed patterns of the cultural landscape. There would be short-term negligible impacts (mainly trampling) from deer management implementation actions, and benefits from the limited use of deer management techniques to reduce impacts in certain locations or circumstances. CWD actions would have similar impacts, with short-term negligible impacts (mainly trampling) from surveillance, and benefits from the reduction of deer and deer browse on vegetation. The overall cumulative impact would be long-term and beneficial, and alternative D would contribute appreciable beneficial increments to the cumulative impact on cultural landscapes.

NATIONAL HISTORIC PRESERVATION ACT SECTION 106 SUMMARY

This plan/EIS analyzes the impacts of four alternatives on cultural landscapes in Antietam (Sharpsburg, Maryland); Monocacy (Frederick, Maryland); and Manassas (Manassas, Virginia). The alternatives include a no action alternative and three action alternatives. All three parks are eligible for listing in the NRHP as historic cultural landscapes. Individual farmsteads, cemeteries, and component landscapes have been documented in CLIs but not comprehensively. The following provides a Section 106 summary for the three action alternatives considered in this plan/EIS.

Under alternative B, 19 large fenced exclosures would be constructed to allow 184 acres or 6% of the three parks' woodlands, a character-defining vegetation feature in their cultural landscapes, to regenerate over the life of the plan, resulting in long-term beneficial impacts. The fences would be a new structural element within the landscape. They would be temporary and would be placed in areas not easily visible to visitors if possible, but could result in minor to moderate adverse impacts on the character of the cultural landscapes due to their visual presence and the potential for even more intense browsing outside the fenced areas. Reproductive control measures would also be implemented under alternative B, but would take many years to be effective, so there would be long-term moderate adverse impacts for the life of this plan, since the deer population would not be reduced enough to reduce impacts on crops and other plantings and native vegetation that contributes to cultural landscapes. If the long-term CWD management plan were initiated in the future, those actions would reduce deer density and reduce the adverse effects of deer browse on vegetation and crops. However, in the absence of CWD management actions, alternative B would result in a Section 106 *adverse effect* on the parks' cultural landscapes.

Under alternative C, the quick reduction of the deer population would cause a substantial decline in browsing of native plant populations and crops. Native plants would begin to regenerate, resulting in long-term benefits to native plants, a character-defining vegetation feature in the cultural landscapes of the parks. If the long-term CWD management plan were initiated in the future, those actions would reduce deer density and reduce the adverse effects of deer browse on vegetation and crops and add to benefits related to reduction in deer browse. Therefore, a Section 106 *no adverse effect* would result from actions taken under alternative C.

Alternative D would be a combination of reproductive controls described in alternative B and lethal controls described in alternative C. These combined actions would result in a direct reduction in the deer population and the protection of vegetation including crop that is an identifying characteristic of the rural cultural landscapes at these parks. If the long-term CWD management plan were initiated in the future, those actions would reduce deer density and reduce the adverse effects of deer browse on vegetation and crops and add to benefits related to reduction in deer browse. Therefore, a Section 106 *no adverse effect* would result from actions taken under alternative D.

The analysis addresses only those features of the parks as cultural landscapes that are susceptible to alteration by the action of deer, all of which relate to vegetation. The analysis excludes the structures, roadways, and objects that also form parts of the cultural landscapes. Based upon the judgment of NPS cultural resource management professionals, the forested areas, especially in their historic locations and if of native or traditional species, are of prime significance, along with traditional patterns of row crop farming, and orchard cultivation. The analysis is driven by research which suggests that a reduction of deer density to 20 per acre over 4–5 years (from the far higher densities existing at all of the parks) would achieve desired results in tree regeneration, orchard survival, and crop yield. Alternatives C and D would achieve those goals, essential to preservation of the cultural landscapes; alternatives A and B would not.

In accordance with Section 106 of the NHPA, potential adverse impacts (as defined in 36 CFR 800) on cultural landscapes listed on or eligible for listing in the NRHP would be coordinated between the NPS and the Maryland and Virginia State Historic Preservation Offices to determine the level of effect on the property and to determine any necessary mitigation measures. Continuing implementation of the *Cultural Resource Management Guideline* (NPS 2002b) and adherence to NPS *Management Policies 2006* (NPS 2006a) and the 2008 Programmatic Agreement with the Advisory Council on Historic Preservation and National Conference of State Historic Preservation Offices would all aid in reducing the potential to adversely impact these resources.

Copies of this plan/EIS will be distributed to the Maryland and Virginia State Historic Preservation Offices for review and comment related to compliance with Section 106 of the NHPA.

IMPACTS ON VISITOR AND EMPLOYEE HEALTH AND SAFETY

GUIDING REGULATIONS AND POLICIES

The NPS *Management Policies 2006* state that, "while recognizing that there are limitations on its capability to totally eliminate all hazards, the Service …will seek to provide a safe and healthful environment for visitors and employees." The policies also state that "the Service will reduce or remove known hazards and apply other appropriate measures, including closures, guarding, signing, or other forms of education" (NPS 2006a, Section 8.2.5.1).

ASSUMPTIONS, METHODOLOGIES, AND INTENSITY DEFINITIONS

The health and safety of both the visitors and NPS employees at the parks could be affected by implementation of the proposed deer management actions. Impacts on visitor and employee safety would be related to the probability of being involved in a deer-vehicle collision or encountering a deer tick (*Ixodes scapularis*) resulting in contracting Lyme disease under all alternatives, the use of firearms under alternatives C or D, and the potential for any accidents that could result from implementation of the other proposed actions.

The purpose of this impact analysis is to identify the level of impact that implementing each of the proposed alternatives would have on the health and safety of visitors and employees at the parks. Past accident data were used to assess the impacts of the alternative actions on the health and safety of visitors and employees. The impact definitions for visitor and employee health and safety are defined below.

Negligible: There would be no discernible effects on visitor or employee safety; slight injuries could occur, but none would be reportable.

Minor: Any reported visitor or employee injury would require first aid that could be provided by park staff; for employees, the injury would involve less than eight hours of lost work time.

Moderate: Any reported visitor or employee injury would require further medical attention beyond what was available at the park; for employees, the injury would result in eight or more hours of lost work time.

Major: A visitor or employee injury would result in permanent disability or death.

AREA OF ANALYSIS

The area of analysis for impact assessment includes all lands within the boundaries of all three parks. The area of analysis for cumulative impacts includes the parks and the surrounding area within 2.5 miles of the parks' boundaries, which encompasses typical deer movement outside the park boundaries

IMPACTS OF DEER MANAGEMENT ACTIONS

Alternative A: No Action (Continuation of Current Management)

Under alternative A, park staff would continue to monitor the deer population and vegetation and would continue to use tree tubes or small-scale protective fencing to protect small areas of landscape plantings, orchards, and restored tree plantings, with the possible use of small amounts of deer repellents at these sites. This alternative also includes continued educational and interpretive measures such as educational programs, exhibits and brochures and publications discussing deer management issues as well as continued agency and interjurisdictional cooperation for the implementation of deer management efforts.

Implementation of the Actions

Park staff would continue to erect small protective fencing and tree tubes around sensitive plants and orchards and apply repellents to landscaped areas under alternative A. They would also continue monitoring activities and deer population surveys. No accidents or injuries have occurred as a result of these activities, and no accidents are anticipated from their continuation. These activities would result in long-term, negligible, adverse impacts on visitor and employee safety.

Deer-Vehicle Collisions

Under alternative A, the high deer population would continue to contribute to vehicle accidents experienced by visitors and staff using park roads, resulting in up to possibly major adverse effects on visitors and employees if the accident were severe, resulting in permanent disability or death. Visitation at the parks is expected to result in continued pressure for various recreational uses, and the potential for accidents and vehicle collisions would remain. Chapter 3 notes that deer-vehicle collisions resulting in deer fatalities within the Battlefield boundary at Antietam increased from 17 in 2000 to 49 in 2011, with a high of 55 in 2004 (NPS 2011h). Deer-vehicle collisions resulting in deer fatalities within the Battlefield boundary at Monocacy ranged from 0 in 2001 to 10 in 2010, with a high of 21 in 2009 (Sprague 2011). In general there have been fewer deer fatalities as a result of vehicle collisions inside Monocacy from 2001 to 2010 when compared to adjacent I-270 and MD335, however in recent years fatalities within the boundary have exceeded adjacent areas. Deer-vehicle collision data is not available for Manassas; however, Fairfax County recorded 120 deer-vehicle collisions in 2010 and Prince William County recorded 161 collisions in 2003 (Fairfax County 2011; MWCOG 2006). These numbers are based on a slightly higher deer density than is experienced at Manassas, and, based on the smaller scale of the park to the counties, deer-vehicle collisions at Manassas would be lower than those presented in Fairfax and Prince William counties. For each of the parks, no injuries have been reported as a result of these deer-vehicle collisions. Therefore, although there have not been any reported injuries related to deer- vehicle collisions, the likelihood of being involved in a deer-vehicle collision would remain high, which could result in long-term minor to potentially major adverse impacts on visitor and employee safety.

Lyme Disease

A high deer population provides more host animals and may support higher than normal deer tick populations compared to environments with a lower deer density. Deer ticks are responsible for transmission of the spirochete that causes Lyme disease to humans, *Borrelia burgdorferi*. With no reduction in the deer population, there would be no likely anticipated changes in tick populations within the parks. Although the number of visitors and employees that have encountered a deer tick or acquired Lyme disease within the parks is unknown, the chance for such impacts would continue. However, current understanding of Lyme disease dynamics does not allow an accurate prediction about whether continued high deer density contributes to the occurrence of Lyme disease (see additional detail under alternative C). Therefore, the impacts on Lyme disease prevalence cannot be determined, and the long-term adverse impacts related to the potential for contracting Lyme disease are expected to range from negligible to moderate.

Overall, deer management under alternative A would result in long-term adverse impacts on visitor and employee health and safety that range from negligible to potentially major, depending on the source and outcome of any accident.

Alternative B: Nonlethal Deer Management

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under alternative A would continue under alternative B. Alternative B would also include several techniques to prevent adverse deer impacts including fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning. However, the main focus of alternative B would be two nonlethal actions: the construction of large-scale deer exclosures (fencing) to promote forest regeneration and nonsurgical reproductive control of does to restrict population growth (when this technology meets certain criteria).

Implementation of the Actions

Although the level of employee involvement in deer management activities at all three parks under this alternative would increase compared to alternative A, impacts would remain relatively low due to the safety precautions that would be taken and the use of properly trained employees or authorized agents. Large exclosures would be constructed throughout the parks and would cover a range of 5 to 20% of the forested area at each battlefield. Approximate size of exclosures is 23 acres at Antietam, 61 acres at Monocacy and 100 acres at Manassas. These exclosures would be relocated as vegetation regrowth exceeded deer browsing height (60 inches or 150 centimeters). Based on the experience of and discussions with park staff, it is estimated it would take about 10 years for regrowth to reach this height. At each battlefield employees could be injured while constructing the exclosures, with the likelihood of injury being dependent on the amount of exclosures constructed; however, park staff typically exercise caution and apply safety techniques in all construction projects, as defined by park training and awareness activities. Visitors would not be able to use the fenced areas during or after construction. Park staff would place exclosures in locations so as to minimize impacts on visitor use wherever possible, offsetting any related safety issues. No impacts on visitor safety from increased monitoring are expected, as such activities would apply primarily to monitoring exclosures, which would be closed to visitors, and open forested areas, where park staff would exercise safety precautions.

Under this alternative, qualified federal employees or authorized agents would treat does with a GonaCon™, a reproductive agent. It is expected that the administration of the reproductive control agent would occur in the months of October through March, when visitor attendance is reduced. The use of the reproductive agent would require the capture of does for and delivery of the vaccine and marking to avoid multiple treatments of the same does. Trapping methods could include drop nets, box traps and darting with a tranquilizer gun.

Approximately 90% of the does in each individual battlefield would need to be treated every 3 years annually from October through March. Safety precautions would be followed, and training in the use of treatment and deer restraint methods would help ensure employee safety. No injuries to employees are expected from this method since the capture and treatment of deer would be conducted by qualified federal employees or authorized agents who are professionally trained to perform these tasks. In addition, qualified federal employees or authorized agents would be trained in handling live deer in order to prevent disease transmission and prevent harm to employees. This would result in a short-term, negligible to minor, adverse impact.

Alternative B also includes the application of additional techniques including fencing, changing crop configuration and selection and use of aversive conditioning. While the application of these techniques would require staff time, all safety precautions would be taken and only trained staff would participate, in order to prevent harm resulting in short-term negligible adverse impacts.

Deer-Vehicle Collisions

With no substantial reduction in the deer population expected over the life of the plan, there would be no anticipated reductions in the existing number of deer-vehicle collisions. In fact, by preventing the deer population from accessing areas enclosed by the rotational fencing, more deer may be encouraged to move to other parts of the park or surrounding areas, thus increasing the possibility of deer-vehicle collisions. This would result in a long-term, minor to potentially major, adverse impact, similar to alternative A for all three parks.

Lyme Disease

With no substantial reduction in the deer population over the life of the plan, there would be no anticipated reductions in tick populations within the park. Although the number of visitors and employees who have encountered a deer tick or acquired Lyme disease within the parks is unknown, the likelihood of encountering a deer tick would remain high (CDC 2009). Current understanding of Lyme disease dynamics does not allow an accurate prediction of the impacts of deer reduction on Lyme disease (see additional detail under alternative C), but impacts would likely remain as characterized under the no action alternative: long-term negligible to moderate adverse.

Overall, deer management under alternative B would result in long-term adverse impacts that would range from negligible to potentially major, depending on the source and outcome of any accident, similar to alternative A, because reproductive control would result in only a gradual reduction in the deer population.

Alternative C: Lethal Deer Management

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under alternative A would continue under alternative C. Alternative C would also include the additional techniques described under alternative B, but the primary focus of alternative C is using sharpshooting with firearms to reduce the herd size to the desired density level. A very limited use of capture and euthanasia of individual deer could be considered if needed due to safety concerns, but the parks do not expect that this would be necessary.

Implementation of the Actions

The safety of park employees at each of the parks could be affected by sharpshooting and capture and euthanasia activities proposed under this alternative. Qualified federal employees or authorized agents would conduct the sharpshooting activities, and their experience in such efforts would help ensure the safety of visitors and park employees. Deer would be shot with high-power, small caliber rifles at close range. Measures taken to ensure the safety of park visitors would include shooting at night during late fall or winter months when visitation is low, closing areas to visitors if shooting is required, notifying the public in advance of any park closures, providing information regarding deer management actions in the visitor contact facilities, and posting information on the park's website. Law enforcement personnel would also patrol the perimeter areas where sharpshooting would occur, and a safe distance would be maintained from any occupied building. Bait stations would be used to attract deer to safe removal locations. Park staff would approve the location of bait stations before sharpshooting took place. Activities would be in compliance with all federal firearm laws administered by the Bureau of Alcohol, Tobacco, Firearms, and Explosives. The majority of deer reduction activities would occur during the first four years of this plan, decreasing in scope (and the potential for accidents) during ensuing years as the deer population declined. The highest estimated amount of deer removed in any given year is 393 at Antietam, 497 at Monocacy and 1,209 at Manassas.

Qualified federal employees or authorized agents may also capture and euthanize deer; as such actions would occur in limited situations when sharpshooting was not appropriate. Therefore, impacts on the safety of employees could increase from potential injuries (kicks, bites, stabbing with antlers) that could occur during deer handling. Every precaution would be taken to ensure the safety of employees, and employees would apply safety training and awareness activities designed to reduce safety risks. Although more risks would be involved under this alternative due to the use of firearms, adverse impacts on the safety of employees would be expected to be negligible to minor due to the expected limited use of this technique and the safety precautions park staff would follow.

Alternative C also includes the application of additional techniques as mentioned in alternative B. While the application of these techniques would require staff time, all safety precautions would be taken and only trained staff would participate, in order to prevent harm resulting in short-term, negligible adverse impacts.

Deer-Vehicle Collisions

Although the direct relationship is unknown, research suggests that a decrease in the local deer population could reduce the number of deer-vehicle collisions (Curtis et al. 2002). Another recent paper by DeNicola and Williams (2008) concluded that reducing suburban deer populations through sharpshooting reduces deer-vehicle collisions. They report that in three suburban communities, sharpshooting management projects reduced deer herds by 54%, 72%, and 76%, with resulting reductions in deer-vehicle collisions of 49%, 75%, and 78%, respectively. These communities were described as typical suburban developments with a matrix of suburban and commercial development and intermingled small agricultural plots and undeveloped open space, similar to the area in and surrounding each of the parks.

In the early years of the plan, deer population would remain at relatively high levels and changes in deer movements as a result of the sharpshooting or euthanasia activities may temporarily increase the probability of being involved in a deer-vehicle collision, especially in areas with higher deer densities. As the population was reduced and deer reduction activities became less prevalent, however, a reduction in deer-vehicle collisions could be expected. Deer have most likely become accustomed to foraging on ornamental plantings and crops grown outside the park and would not cease to do so. However, the number of deer crossing the roads to reach these plantings and to get from one area of the park to another would decrease. The likelihood of being involved in a deer-vehicle collision would be expected to decrease proportionately with the reduction of the deer population. This would result in a long-term beneficial impact on visitor health and safety related to deer-vehicle collisions at each of the parks.

Lyme Disease

With an expected reduction in the deer population during the first few years of the plan, there would be anticipated reductions in tick populations within the park. Although the number of visitors and employees who have encountered a deer tick or acquired Lyme disease within the parks is unknown, the likelihood of encountering a deer tick would be reduced, but not eliminated. While a reduction in deer density may contribute to a reduction in deer ticks carrying Lyme disease, it is uncertain exactly how much of an effect would occur. Mumford Cove, Connecticut, and Monhegan Island, Maine, are commonly cited as two places where the removal or drastic decrease in the deer population resulted in the near eradication of Lyme disease. It should be noted that Mumford Cove is located on a peninsula and is 132 acres in size, and the area of Monhegan Island is one square mile (640 acres); with each of the parks being substantially larger than these two areas. There is also research showing that localized absence of deer increases tick feeding on rodents, leading to the potential for tickborne hotspots (Perkins et al. 2006). This study indicated there was an increase in nymphs, which are the primary life form that do not rely on deer and that do transmit Lyme disease. Current understanding of Lyme disease dynamics does not allow an accurate prediction as to whether results obtained in one setting can be extrapolated to other areas with different ecological and geographical factors present. Therefore, the impacts of deer reduction on Lyme disease prevalence cannot be determined.

Overall, deer management under Alternative C would result in long-term negligible to minor adverse impacts on visitor and employee health and safety, with beneficial impacts related to a reduced risk of deer-vehicle collisions due to the reduction in deer density.

Alternative D: Combined Lethal and Nonlethal Deer Management

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under alternative A would continue under alternative D, and the additional techniques described under alternative B could be used. However, the main emphasis of alternative D would be using a combination of sharpshooting and reproductive control of does from alternatives C and B to address high deer density. Sharpshooting (with very limited capture/euthanasia if necessary) would be taken initially to reduce the deer herd numbers quickly. Population maintenance would be conducted via nonsurgical reproductive control methods (if these are available and meet NPS criteria for use); if not, sharpshooting would be used for maintenance.

Implementation of the Actions

Sharpshooting and capture and euthanasia would be implemented over the first four years of the plan to reduce the size of the deer herd. A reproductive agent would then be administered though hand-delivered injections. Several actions would be taken to ensure the safe conduct of operations. Sharpshooting would primarily occur at night (between dusk and dawn) during late fall and winter months when deer are more visible and few visitors are in the park. In some areas sharpshooting might be conducted during the day, or at other times of year if needed to maximize effectiveness and minimize overall time of visitor restrictions. The parks would comply with all federal firearm laws administered by the Bureau of Alcohol, Tobacco, Firearms, and Explosives. Areas could be temporarily closed to park visitors and NPS park rangers would patrol public areas to ensure compliance with park closures and public safety measures. The public would be notified of any park closures in advance. Information regarding deer management would be displayed at visitor contact facilities, and information would be posted on the park's website to inform the public of deer management actions. These actions would increase the potential risk of employee injury due to the use of firearms and the need to capture and euthanize some deer. However, safety precautions taken by park staff would offset these risks, as described under alternative C, resulting in negligible to minor adverse impacts.

Similar to alternative C, capturing and euthanizing deer could affect visitor safety, but given that this technique would not be used often, if at all, and the precautions taken, impacts on visitors and employees would be adverse, long-term, and negligible.

Alternative D also includes the application of additional techniques as mentioned in alternative B. While the application of these techniques would require staff time, all safety precautions would be taken and only trained staff would participate, in order to prevent harm resulting in short-term, negligible adverse impacts.

Deer-Vehicle Collisions

As noted under the discussion for alternative C, although the direct relationship is unknown, research suggests that a decrease in the local deer population could reduce the number of deer-vehicle collisions (Curtis et al. 2002), and other research supports this (DeNicola and Williams 2008). This decrease would not be realized in the early years of the plan, as the deer population would remain at high levels and changes in deer movements as a result of the sharpshooting activities may temporarily increase the probability of being involved in a deer-vehicle collision. As the population was reduced and deer reduction activities became less prevalent, however, a reduction in deer-vehicle collisions could be expected. The likelihood of being involved in a deer-vehicle collision would be expected to decrease proportionately with the reduction of the deer population. This would result in a long-term beneficial impact.

Lyme Disease

As described for alternative C, with an expected reduction in the deer population during the first few years of the plan, there would be anticipated reductions in tick populations within the parks. Although the number of visitors and employees who have encountered a deer tick or acquired Lyme disease within the parks is unknown, the likelihood of encountering a deer tick would be reduced but not eliminated. As previously discussed under alternative C, the effects of deer reduction on Lyme disease prevalence cannot be determined.

Overall, deer management under Alternative D would result in long-term negligible to minor adverse impacts on visitor and employee health and safety, with beneficial impacts related to a reduced risk of deer-vehicle collisions due to the reduction in deer density

IMPACTS OF CHRONIC WASTING DISEASE MANAGEMENT ACTIONS, INCLUDING THE LONG-TERM CHRONIC WASTING DISEASE MANAGEMENT PLAN

Alternative A: No Action (Continuation of Current Management)

Under the no action alternative, the parks would continue with opportunistic and targeted CWD surveillance. Antietam and Monocacy would also respond to CWD presence in or near the parks in accordance with the CWD Detection and Initial Response Plan (NPS 2009c), and Manassas would create a similar plan. The Antietam and Monocacy CWD Detection and Initial Response Plan includes a range of actions including live testing and lethal removal of deer if CWD occurs within 5-20 miles of the park boundary. If CWD were to occur within 5 miles of the parks, initial response include a one-time lethal removal of deer to reach a deer density of about 25-45 deer per square mile. Based on 2008 deer density data, this would involve removing about 250 deer at each park over 3 years (NPS 2009c). There would be no new longer term CWD monitoring or management activities.

Impacts on health and safety for the current CWD management actions and plan, including the initial response plan for Antietam and Monocacy, are described in the EA completed for these actions (NPS 2009c). Impacts of CWD surveillance and detection actions on health and safety would be long-term negligible and adverse, mainly from surveillance actions and live testing. If CWD were to occur within 5 miles of the parks, the initial response plan for Antietam and Monocacy calls for a substantial reduction in the deer population, which would have short-term negligible to minor adverse effects on health and safety related to the removal efforts and the potential for injury during those efforts. These actions were analyzed through a separate NEPA process (NPS 2009c). Also, similar to the effects described for the deer removal actions under alternative C, above, there could be long-term beneficial impacts related to the reduction of deer density and the reduction of the potential for deer-vehicle collisions. Manassas would likely adopt a similar plan under no action, so impacts there would be the same.

Alternatives B, C, and D (All Action Alternatives)

Under any of the action alternatives, targeted and opportunistic surveillance, and actions under any current initial detection and response plans would continue with impacts similar to alternative A. However, under all alternatives, the parks would adopt a long-term CWD response plan that includes the lethal reduction of deer if CWD is confirmed in or within 5 miles of parks. This would include a rapid reduction to the target deer density and possibly reduction to as low as 10 deer per square mile, and deer would be removed for surveillance monitoring in subsequent years. Reductions would generally follow the same schedule as outlined in alternative C, above, but reductions would be coordinated with the state to address conditions at the time of the CWD detection and could be expedited if resources are available.

Impacts on health and safety from the deer reduction actions would be the same as described for alternative C under the analysis of deer management actions, above. There would be short-term negligible to minor adverse effects related to the implementation of the actions themselves, related to the potential for injuries or accidents during deer removals or use of techniques to reduce deer damages. The reduction in deer density would be expected to reduce the likelihood of deer-vehicle collisions, with long-term beneficial impacts.

CUMULATIVE IMPACTS

Alternative A: No Action (Continuation of Current Management)

The past, present, and reasonably foreseeable future actions that could impact health and safety include typical tripping, falling, and slipping accidents sustained by both visitors and employees, since there is inherent danger in any park, with generally negligible to moderate adverse effects. Hunting that occurs outside the parks would also affect health and safety in several ways. Hunting would reduce the number of deer in the area and would likely result in fewer deer inside the parks, which would decrease the likelihood of deer-vehicle collisions. Hunting outside the parks could also decrease the prevalence of deer ticks and reduce necessary management actions by employees inside the parks. This would result in long-term beneficial impacts on visitor and employee health and safety. However, hunting near the park boundaries could result in injuries to visitors or employees nearby. No record of any hunting related incident has occurred, however the potential exists. Therefore, impacts from hunting outside the park could have long-term, negligible (no injuries) to moderate (more serious injury) adverse impacts on visitor and employee health and safety, as well as long-term benefits. Park specific actions with the potential to impact health and safety include fire management through prescribed burns and Antietam and increased crime at Monocacy. It is expected that all prescribed fires at Antietam will be conducted by trained federal, park or hired employees and that all safety precautions will be followed. In addition, in the event of prescribed fires park closures will be implemented and enforced to reduce the potential of visitor injury. This would result in long-term negligible to minor adverse impacts on health and safety at Antietam.

The beneficial and negligible to moderate adverse impacts and potential impacts of the above actions, when combined with the long-term negligible to potentially major adverse impacts of alternative A, would result in long-term moderate adverse cumulative impacts on health and safety. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative adverse impacts on health and safety related to risks associated with the actions and long-term benefits related to the reduction of deer, which would not change the overall cumulative impact assessment. In the absence of any CWD-triggered lethal response, the deer management actions that would continue under alternative A would contribute an appreciable adverse amount to the overall cumulative impacts because of the higher potential for deer-vehicle collisions with no reduction in the deer population.

Alternative B: Nonlethal Deer Management

The same past, present, and reasonably foreseeable future actions described under alternative A would also occur under alternative B, with beneficial and negligible to moderate adverse impacts and potential impacts on the health and safety of NPS staff and visitors. These impacts, when combined with the long- and short-term negligible to potentially major adverse impacts of alternative B, would result in long-term moderate adverse cumulative impacts on health and safety at all three parks. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative adverse impacts on health and safety related to risks associated with the actions and long-term benefits related to the reduction of deer, which would not change the overall cumulative impact assessment. In the absence of any CWD triggered lethal response, the deer management actions under alternative B would contribute an appreciable adverse amount to the overall cumulative impacts because of the higher potential for deer- vehicle collisions with the expected very gradual reduction in the deer population.

Alternative C: Lethal Deer Management

The same past, present, and reasonably foreseeable future actions described under alternative A would also occur under alternative C, with beneficial and negligible to moderate adverse impacts and potential impacts on the health and safety of NPS staff and visitors. These impacts, when combined with the long-term negligible to minor adverse and long-term beneficial impacts of alternative C, would result in long-term negligible adverse cumulative impacts on health and safety at all three parks. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative adverse impacts on health and safety related to risks associated with the actions and long-term benefits related to the reduction of deer, which would not change the overall cumulative impact assessment. In the absence of any CWD triggered lethal response, the deer management actions under alternative C would contribute a minimal amount to the overall risks and would add several long-term benefits related to the reduction in deer numbers.

Alternative D: Combined Lethal and Nonlethal Deer Management

The same past, present, and reasonably foreseeable future actions described under alternative A would also occur under alternative D, with beneficial and negligible to moderate adverse impacts and potential impacts on the health and safety of NPS staff and visitors. These impacts, when combined with the long-term negligible to minor adverse and long-term beneficial impacts of alternative D, would result in long-term negligible adverse cumulative impacts on health and safety at all three parks. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative adverse impacts on health and safety related to risks associated with the actions and long-term benefits related to the reduction of deer, which would not change the overall cumulative impact assessment. In the absence of any CWD triggered lethal response, the deer management actions under alternative D would contribute a minimal amount to the overall risks and would add several long-term benefits related to the reduction in deer numbers.

CONCLUSION

Alternative A: No Action (Continuation of Current Management)

For all three parks alternative A would result in long-term, adverse impacts on visitor and employee health and safety that range from negligible to potentially major depending on the source and outcome of any accident. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would include additional adverse impacts but provide long-term beneficial impacts related to the risk of collisions, but these would not outweigh the adverse effects of not taking deer management actions. The overall cumulative impact would be long-term, moderate, and adverse, with alternative A contributing appreciable adverse increments to the cumulative impact because of the higher potential for deer-vehicle collisions.

Alternative B: Nonlethal Deer Management

Alternative B would have impacts similar to those described for alternative A because reproductive control would result in only a gradual reduction in the deer population, and although the population goal could be met over the longer term, the risk of not meeting the goal would be high. Impacts on visitor and employee health and safety would be long-term and adverse and range from negligible to potentially major, depending on the source and outcome of any accident. Any CWD response that would be taken under the proposed long-term plan would have some adverse impacts and also provide indirect beneficial impacts, but these would not outweigh the adverse effects of not taking deer management actions. Similar to alternative A, the overall cumulative impact would be long-term moderate adverse, and alternative B would contribute appreciable adverse increments to the overall cumulative impacts because of the continued higher potential for deer-vehicle collisions.

Alternative C: Lethal Deer Management

Alternative C would result in long-term negligible to minor adverse impacts on visitor and employee health and safety with beneficial impacts related to a reduced risk of deer-vehicle collisions due to the reduction in deer density. CWD actions under a long-term management plan would have similar impacts, with short-term negligible to minor impacts from the actions themselves, and benefits from the reduction of deer tick hosts and the reduced potential for deer-vehicle collisions. Cumulative impacts of alternative C on visitor and employee health and safety would be long-term negligible adverse. Alternative C would contribute a minimal amount to the overall risks and would add an appreciable beneficial increment to the overall cumulative impact.

Alternative D: Combined Lethal and Nonlethal Deer Management

Alternative D would have essentially the same impacts as alternative C, with long-term negligible to minor adverse impacts on visitor and employee health and safety with beneficial impacts related to a reduced risk of deer-vehicle collisions due to the reduction in deer density. CWD actions under a long-term management plan would have similar impacts, with short-term negligible to minor impacts from the actions themselves, and benefits from the reduction of deer tick hosts and the reduced potential for deer-vehicle collisions. Cumulative impacts of alternative D on visitor and employee health and safety would be long-term negligible adverse. Alternative D would contribute a minimal amount to the overall risks and would add an appreciable beneficial increment to the overall cumulative impact.

IMPACTS ON PARK MANAGEMENT AND OPERATIONS

GUIDING REGULATIONS AND POLICIES

Park management and operations refers to the current staff available to adequately protect and preserve park resources and provide for an effective visitor experience. This topic also includes the operating budget necessary to conduct park operations.

ASSUMPTIONS, METHODOLOGIES, AND INTENSITY DEFINITIONS

The discussion of impacts on park operations focuses on (1) the amount of staff available to ensure visitor and employee safety, and (2) the ability of park staff to protect and preserve resources given current funding and staffing levels. It was assumed under all alternatives that each park’s annual budget would be increased to implement a particular alternative. However, this funding is not guaranteed. Park staff knowledge was used to evaluate the impacts of each alternative, and the evaluation is based on the description of park management and operations presented in chapter 3. Definitions of impact levels are as follows:

Negligible: There would be no discernible effects on park management and operations.

Minor: There would be detectable effects on park management and operations but not of a magnitude that would have any appreciable effects on the ability of park staff to meet their operational goals. Current staffing and funding levels would not change, but priorities may need to be changed.

Moderate: There would be readily apparent effects on park management and operations, and park staff may have difficulty meeting their operational goals. Increases or decreases in staffing and funding would be needed and changes in work assignments or priorities would be required.

Major: There would be substantial changes to park management and operations, and the staff may not be able to meet all operational goals. Increases or decreases in staff and funding would be needed and/or other park programs would have to be substantially changed or eliminated.

AREA OF ANALYSIS

The area of analysis for impact assessment includes all lands within the boundaries of all three parks. The area of analysis for cumulative impacts includes the battlefield boundaries, where park management and operations seizes.

IMPACTS OF DEER MANAGEMENT ACTIONS

Alternative A: No Action (Continuation of Current Management)

Under alternative A, park staff would continue to monitor the deer population and vegetation and continue to use tree tubes or small-scale fencing to protect small areas of restored tree plantings and utilize educational and interpretive activities. It is expected that the parks' deer populations would continue at relatively high levels, although numbers would fluctuate annually due to winter temperatures, snow depths and duration, food availability, reproduction and mortality rates due to herd health, and other factors. Existing park staff would be sufficient to continue performing current deer management functions at the present population level. However, it is expected that additional efforts by park staff would be required for implementation of other resource activities, such as control of nonnative plants or reestablishment of native vegetation due to the continued high density. At Antietam there are currently four full-time employees in natural resource management. At Monocacy there is one full-time employee and 11 temporary employees and at Manassas there is one full-time employee and one part-time employee. At Manassas natural resource staff currently devotes about 10% to 15% of their time to deer management. Exact numbers for time spent on deer management at Antietam and Monocacy are unknown however, it is likely that they are similar and range from 10% to 15%. Under the no action alternative, additional management responsibilities, as well as any additional funding that might be needed to build and maintain additional fencing and install restoration planting protections would require more time spent resulting in long-term, minor adverse impacts.

Under this alternative, staff would also monitor the costs of the deer management program, including costs related to staff time, training, administrative, legal, public relations, and monitoring. If deer management costs increase substantially, funds and personnel from other park divisions might have to be reallocated (e.g., from administration and maintenance), resulting in adverse, long-term, minor impacts on other divisions. There would be negligible adverse impacts on individual park operations from educational and coordination activities, as there are sufficient funds and personnel to run these activities, incorporating deer management, and present funding and staffing are expected to continue.

Overall, deer management actions under Alternative A would result in long-term minor adverse impacts on park management and operations. Because present deer management actions would continue, each park's deer population is expected to continue to fluctuate and remain at high levels, resulting in long-term demands on park staff and funding for managing the deer herd and protecting other park resources.

Alternative B: Nonlethal Deer Management

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under alternative A would continue under alternative B. Alternative B would also include several techniques to prevent adverse deer impacts including fencing of crops and woodlots, changing crop configurations or selection, and using aversive conditioning. However, the main focus of alternative B would be two nonlethal actions: the construction of large-scale deer exclosures (fencing) to promote forest regeneration and nonsurgical reproductive control of does to restrict population growth (when this technology meets certain criteria).

Similar to alternative A, deer populations would continue to remain at high levels, pending the implementation of reproductive controls, and numbers would likely continue to fluctuate annually. The nonlethal management measures outlined under alternative B would require additional staff time and seasonal staff, for which additional funding would be needed. Additional temporary staff would likely be needed for the initial construction of the large enclosures and construction of additional monitoring sites. If staff from other park divisions were used, park operations in those divisions would be adversely affected during the construction period.

In addition to an increase in temporary staffing, additional funding would be required, as the initial cost of installing the exclosures would be approximately $86,514 for supplies and labor at Antietam, $103,566 at Monocacy and $105,156 at Manassas. After the initial construction, the exclosures would be relocated and inspected and maintained, at an estimated cost of $90,821 for supplies and labor at Antietam, $102,939 at Monocacy and $110,675 at Manassas during the year of relocation. Furthermore, to reduce impacts on visitors as much as possible, some exclosures would be located in more remote areas of the park, adding to maintenance costs. These costs would be in addition to each park's present budget and would result in increased funding needs, with adverse, long-term, moderate impacts. Staff would also need to be reassigned, and the monitoring and inspection would represent additional duties.

Alternative B would include reproductive control of does, with 90% of does treated every 3 years, at an estimated cost of $544,500–$727,500 over the life of the plan at Antietam, $628,500–$840,000 at Monocacy and $2,398,500–$2,895,000 at Manassas. Costs for continued reproductive control would depend on the number of deer treated and the current available technology. Assuming the use of an agent that meets all NPS criteria as described in chapter 2, costs would be approximately $750 per deer. The cost for each treatment would vary depending on the number of does treated (see tables 9A, 9B, and 9C in chapter 2), but a high-end estimate, based on a very limited reduction in the deer population, for the years when treatments would occur, is $145,500, $168,000, and $289,500 each year at Antietam, Monocacy, and Manassas, respectively. Annual monitoring would cost $1,400 at Antietam, $1,370 at Monocacy and $1,400 at Manassas.

The operating budgets of the Natural Resource Management Divisions are $906,600 (2010) at Antietam, $116,000 (2010) at Monocacy, and $167,679 (2012) at Manassas. These budgets are considerably lower than the costs of both the exclosures and reproductive control measures under alternative B at both Monocacy and Manassas, and would take up a considerable amount of the total budget at Antietam. For example, at Manassas, the initial year would cost $394,656 for the exclosures and the reproductive control application; other years that did not include relocation of the exclosures or application of the agent would be much less (e.g., $33,208 in year 5). However, over the life of the plan, an average annual cost would be about $200,000. Due to the additional funds that would be needed for implementing the fencing and reproductive control of does and the amount of time required by park staff to participate in these activities, which could reduce time available for other efforts, impacts of implementing alternative B deer management actions would be adverse and potentially major.

Additional techniques such as smaller fencing, changing crop configuration and selection and use of aversive conditioning could also be implemented under alternative B. While the application of these techniques would require additional staff and funding, it is expected that this requirement will be minimal and would have a long-term, negligible adverse impact on the budget.

This alternative would also involve increased educational and interpretive activities, and would therefore require additional funding and/or additional staff time to implement these activities. Increased responses to inquiries about the actions taken under this alternative would likely increase the workload of park biologists, rangers, and the Superintendent. This would result in moderate adverse impacts on resource education and resource protection staff, which would decline to minor levels over time.

Overall, deer management actions under Alternative B would result in long-term moderate to potentially major adverse impacts on park management and operations due to the demands of installing and maintaining large exclosures and implementing and monitoring reproductive controls.

Alternative C: Lethal Deer Management

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under alternative A would continue under alternative C. Alternative C would also include the additional techniques described under alternative B, but the primary focus of alternative C is using sharpshooting with firearms to reduce the herd size to the desired density level. A very limited use of capture and euthanasia of individual deer could be considered if needed due to safety concerns, but the parks do not expect that this would be necessary.

The existing deer population would be reduced, within the desired range of 15-20 deer per square mile over a period between 4 and 6 years dependent upon the individual park unit. Additional deer would be removed in subsequent years to maintain the population. The addition of these lethal management measures would require additional staff time to accompany the qualified federal employees or authorized agents conducting sharpshooting activities, as well as the cost of the agents themselves. Removal activities would require obtaining permits, setting up bait stations, locating deer, sharpshooting, and handling the disposition of meat. In addition to the actual reduction activity, time would be required to coordinate the details of the reduction activity internally and with outside organizations.

Costs to the park for direct reduction through sharpshooting would vary, depending on a number of factors, including the number of deer to be removed each year, access to deer, number and location of bait stations, training requirements, equipment availability, amount of data to be collected from the deer, and processing or disposal requirements. Based on removal efforts at other parks, the estimated cost for the to implement direct reduction through sharpshooting would be $200 per deer initially, increasing to $400 per deer as the population decreased and more effort was required to locate deer. These higher costs include actions to maintain the herd at the reduced level once the initial goal was achieved. Over the 15-year planning period for the deer management plan, sharpshooting efforts are estimated to cost approximately $206,800 at Antietam, $195,800 at Monocacy and $545,000 at Manassas. Annual costs are estimated at about $27,500 for the first four-years and $8,800 for years 5–15 at Antietam; approximately $26,360 for the first 5 years and $4,800 for years 6–15 at Monocacy; and approximately $65,800 for the first 5 years and $21,600 for years 6–15 at Manassas. Annual costs for the first four-years at Antietam are about 3% and about 1% for years 5–15 of the current annual operating budget for the Natural Resource Management Division of $906,600. At Monocacy annual costs for the first 5 years is approximately 39% and about 4% for years 6–15 of the current annual operating budget for the Natural Resource Management Division of $116,000. Annual costs at Manassas costs are approximately 39% for the first five years and less than 3% for years 6–15 of the park's $167,679 natural resources management budget. The majority of project funding, including all deer reduction activities and management of these, would be the responsibility of the parks. Any assistance offered by park staff would be considered part of regular duties, rather than project specific, and would not require additional project funding. Due to the amount of time required by staff to participate in these activities and the funding increase that would need to be applied for, impacts would be adverse and moderate during the period of the reduction efforts.

Where direct reduction by sharpshooting was not possible due to safety concerns (e.g., near adjacent properties), capture and euthanasia would be implemented by qualified federal employees or authorized agents. Because this method would only be used in very limited situations, the cost would be expected to be minimal, with long-term negligible adverse impacts.

As part of this alternative, both deer population studies and vegetation monitoring would be conducted to document any changes in deer browsing and forest regeneration that may result from reduced deer numbers. This monitoring program would continue after the density goals were reached to determine if vegetation was showing signs of recovery, and monitoring would also include review of crop yield reports and assessment of orchard conditions. This monitoring would be similar to current park efforts that are already scheduled to continue and would result in long-term minor impacts on park operations and maintenance. Additional techniques as mentioned in alternative B would be implemented under alternative C. While the application of these techniques would require additional staff and funding, it is expected that this requirement will be minimal and would have a long-term, negligible adverse impact on the budget.

This alternative would also involve increased educational and interpretive and management activities, and would therefore require additional funding and/or additional staff time to implement these activities. This would result in moderate adverse impacts on resource education and resource protection staff. Moderate adverse impacts could also be expected due to time needed to answer public inquiries about the actions taken, especially if visitors have conflicting opinions about using sharpshooting or any lethal means for reduction and require additional attention. This need would likely decline over the years, and adverse impacts would also be expected to decline to minor levels over time.

Overall, deer management actions under alternative C would result in moderate adverse impacts during the period of direct reduction efforts because of the need for additional staff time or costs for monitoring and coordinating activities. The greater reduction of deer over a shorter period of time would reduce adverse long-term impacts from moderate to minor over time.

Alternative D: Combined Lethal and Nonlethal Deer Management

The actions and associated impacts from limited protection of restoration plantings and deer and vegetation monitoring described under alternative A would continue under alternative D, and the additional techniques described under alternative B could be used. However, the main emphasis of alternative D would be using a combination of sharpshooting and reproductive control of does from alternatives C and B to address high deer density. Sharpshooting (with very limited capture/euthanasia if necessary) would be taken initially to reduce the deer herd numbers quickly. Population maintenance would be conducted via nonsurgical reproductive control methods (if these are available and meet NPS criteria for use); if not, sharpshooting would be used for maintenance.

Costs to the park for sharpshooting would vary from $200 to $400 per deer, as described under alternative C, and would occur in the first four years of the plan at Antietam and the first 5 years at Monocacy and Manassas, as a cost of $27,500 per year at Antietam, $26,360 at Monocacy and $65,800 at Manassas. The majority of project funding, including all deer reduction activities, and management of these, would be the responsibility of the park. Any assistance offered by park staff would be considered part of regular duties. Impacts are expected to be adverse, long-term, and moderate.

Where direct reduction by sharpshooting was not possible due to safety concerns, capture and euthanasia would be implemented by qualified federal employees or authorized agents. As described under alternative C, since the parks do not expect to use this technique much if at all. The costs would be expected to be minimal, with negligible adverse effects.

After the initial reduction in density, alternative D would use reproductive control of each park's deer population by the methods described under alternative B if feasible. Costs for reproductive control are estimated at $23,000 every 2 years, starting in year 5, at Antietam assuming treatment of 23 does plus an annual $1,400 cost for reproduction monitoring in years 6 through 15. At Monocacy estimated costs are $19,000 every 2 years starting in year 6 assuming treatments of 19 does plus an annual cost of $1,370 for reproduction monitoring in years 6–15 and estimated costs of $68,000 every 2 years at Manassas starting in year 6, assuming 68 does plus an annual cost of $1,700 for reproduction monitoring in years 6–15. This is about 2% of the current annual operating budget of the Natural Resource Management Division of $906,000 at Antietam, about 16% at Monocacy and about 2% of the total Park budget at Manassas. Park staff would need to spend additional time and labor to coordinate and monitor activities, resulting in adverse, long-term, moderate impacts.

Additional techniques as mentioned in alternative B will also be implemented under alternative D. While the application of these techniques would require additional staff and funding, it is expected that this requirement would be minimal and would have a long-term, negligible adverse impact on the budget.

This alternative would also involve increased educational and interpretive activities, and would therefore require additional funding and/or additional staff time to implement these activities. There would be moderate adverse impacts on resource education and visitor protection staff as a result, which would decline to minor adverse levels over time.

Overall, the combination of nonlethal and lethal management under alternative D would have adverse, long-term, moderate impacts on park management and operations during the period of direct reduction and reproductive control. Once the deer herd was reduced, more staff time would be available for other activities, resulting in adverse, long-term, minor impacts.

Impacts of Chronic Wasting Disease Management Actions, Including the Long-term Chronic Wasting Disease Management Plan

Alternative A: No Action (Continuation of Current Management)

Under the no action alternative, the parks would continue with opportunistic and targeted CWD surveillance. Antietam and Monocacy would also respond to CWD presence in or near the parks in accordance with the CWD Detection and Initial Response Plan (NPS 2009c), and Manassas would create a similar plan. The Antietam and Monocacy CWD Detection and Initial Response Plan includes a range of actions including live testing and lethal removal of deer if CWD occurs within 5-20 miles of the park boundary. If CWD were to occur within 5 miles of the parks, initial response include a one-time lethal removal of deer to reach a deer density of about 25–45 deer per square mile. Based on 2008 deer density data, this would involve removing about 250 deer at each park over 3 years (NPS 2009c). There would be no new longer term CWD monitoring or management activities.

Impacts on park management and operations for the current CWD management actions and plan, including the initial response plan for Antietam and Monocacy, are described in the EA completed for these actions (NPS 2009c). Impacts of CWD surveillance and detection actions on park management and operations would be long- and short-term negligible to moderate and adverse, mainly from the efforts needed to manage the deer removals and related public inquires and education. If CWD were to occur within 5 miles of the parks, the initial response plan for Antietam and Monocacy calls for a substantial reduction in the deer population, which would have short-term moderate adverse effects on park management and operations. These actions were analyzed through a separate NEPA process (NPS 2009c) and would be similar to the effects described for the deer removal actions under alternative C, above. Manassas would likely adopt a similar plan under no action, so impacts there would be the same.

Alternatives B, C, and D (All Action Alternatives)

Under any of the action alternatives, targeted and opportunistic surveillance, and actions under any current initial detection and response plans would continue with impacts similar to alternative A. However, under all alternatives, the parks would adopt a long-term CWD response plan that includes the lethal reduction of deer if CWD is confirmed in or within 5 miles of parks. This would include a rapid reduction to the target deer density and possibly reduction to as low as 10 deer per square mile, and deer would be removed for surveillance monitoring in subsequent years. Reductions would generally follow the same schedule as outlined in alternative C, above, but reductions would be coordinated with the state to address conditions at the time of the CWD detection and could be expedited if resources are available.

Impacts on park management and operations from the deer reduction actions would be the same as described for alternative C under the analysis of deer management actions, above. Rapidly reducing the deer population and performing maintenance surveillance and additional jurisdictional coordination associated with a CWD response would require additional resources and funding, with short- and long moderate adverse impacts on park management and operations.

CUMULATIVE IMPACTS

Alternative A: No Action (Continuation of Current Management)

Several past, present, and reasonably foreseeable future actions would contribute to the cumulative impact on park management and operations at the three parks, land acquisition and increased visitation, which is predominantly true at Monocacy. Land acquisition would add more areas requiring park oversight and maintenance, a long-term minor adverse effect. Increased visitation would result in increased traffic on park roadways and require staff time and resources to deal with road maintenance, accident response, and visitor needs and inquiries and results in long-term negligible to minor adverse impacts with the heightened impact occurring at Monocacy. Prescribed fires occur at Antietam and have the potential to impact park management and operations. The use of these fires would require time and resources by highly trained federal, park or contracted staff and results in long-term minor adverse impacts.

The mostly minor adverse impacts of the above actions, when combined with the long-term negligible to minor adverse impacts of alternative A related to the expected demands of deer management, would result in long-term minor adverse cumulative impacts on park management and operations. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative adverse impacts on park management and operations related to the additional workload and costs associated with the actions, which would add to the cumulative adverse impacts. In the absence of any CWD-triggered lethal response, the deer management actions that would continue under alternative A would contribute a small adverse increment to the overall cumulative impacts because of the continued demand for deer management activities and coordination.

Alternative B: Nonlethal Deer Management

The same past, present, and reasonably foreseeable future actions described under alternative A would also occur under alternative B, with minor adverse impacts on the park management and operations. These impacts, when combined with the long-term minor to major adverse impacts of alternative B, would result in long-term moderate to possibly major adverse cumulative impacts on park management and operations. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative adverse impacts on park management and operations related to the additional workload and costs associated with the actions, which add to the cumulative adverse impacts. In the absence of any CWD triggered lethal response, the deer management actions under alternative B would contribute an appreciable adverse amount to the overall cumulative impacts because of the higher demands for staff time and the high costs associated with reproductive control and exclosure construction and maintenance.

Alternative C: Lethal Deer Management

The same past, present, and reasonably foreseeable future actions described under alternative A would also occur under alternative C, with minor adverse impacts. These impacts, when combined with the long-term minor to moderate adverse impacts of alternative C, would result in long-term moderate adverse cumulative impacts on park management and operations. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative adverse impacts on park management and operations related to the additional workload and costs associated with the actions, which would add to the cumulative adverse impacts. In the absence of any CWD triggered lethal response, the deer management actions under alternative C would contribute a moderate amount to the overall adverse effects due to the costs and demands associated with lethal removal.

Alternative D: Combined Lethal and Nonlethal Deer Management

The same past, present, and reasonably foreseeable future actions described under alternative A would also occur under alternative D, with long-term minor adverse impacts. These impacts, when combined with the long-term minor to moderate adverse impacts of alternative D, would result in long-term moderate adverse cumulative impacts on park management and operations. If CWD were to occur within 5 miles of the parks and a CWD lethal removal response were triggered that substantially reduced the deer population, there would be additional cumulative adverse impacts on park management and operations related to the additional workload and costs associated with the actions, which would add to the cumulative adverse impacts. In the absence of any CWD triggered lethal response, the deer management actions under alternative D would contribute a moderate amount to the overall adverse effects due to the costs and demands associated with lethal removal and reproductive control after year 5.

CONCLUSION

Alternative A: No Action (Continuation of Current Management)

Alternative A would result in long-term minor adverse impacts. Because present deer management actions would continue, each park’s deer population is expected to continue to fluctuate and remain at high levels, resulting in long-term demands on park staff and funding for managing the deer herd and protecting other park resources. Any CWD response that would be taken under an existing initial response plan that involves the lethal removal of relatively large numbers of deer would add adverse impacts on park management and operations related to the additional workload and costs, depending on the actions taken. The overall cumulative impact would be long-term, minor, and adverse, with alternative A contributing appreciable adverse increments to the cumulative impact on park management and operations. Alternative A would contribute a small adverse increment to the overall cumulative impacts because of the continued demand for deer management activities and coordination cumulative impacts.

Alternative B: Nonlethal Deer Management

Alternative B would result in long-term moderate to potentially major adverse impacts on park management and operations. These impacts would be caused by installing and maintaining large exclosures and implementing and monitoring reproductive controls. Minor adverse impacts would result from increased educational/interpretive activities and CWD surveillance. Any CWD response that would be taken under the proposed long-term plan would provide short- and long moderate adverse impacts on park management and operations. Cumulative impacts would be long-term, moderate to possibly major adverse, and alternative B would contribute an appreciable adverse amount to the overall cumulative impacts because of the higher demands for staff time and the high costs associated with reproductive control and exclosure construction and maintenance.

Alternative C: Lethal Deer Management

Alternative C would result in moderate adverse impacts during the period of direct reduction efforts because of the need for additional staff time for monitoring and coordinating activities. The use of qualified federal employees or authorized agents would reduce the amount of park staff time needed for implementation, but would still result in increased costs. With the greater reduction of deer over a shorter period of time, park staff would have more time to apply their efforts to other areas of the park when compared to alternative A, which would reduce adverse, long-term impacts from moderate to minor over time. Any CWD response that would be taken under the proposed long-term plan would provide short- and long moderate adverse impacts on park management and operations. Cumulative impacts would be long-term, moderate, adverse, and alternative C would contribute a moderate amount to the overall adverse effects due to the costs and demands associated with lethal removal.

Alternative D: Combined Lethal and Nonlethal Deer Management

Similar to alternative, C, alternative D would result in moderate adverse impacts because park staff involvement would be required for coordination and monitoring of the reduction and reproductive control actions. Once the deer herd was reduced, more staff time would be available for other activities, resulting in adverse, long-term, minor impacts. Any CWD response that would be taken under the proposed long-term plan would provide short- and long moderate adverse impacts on park management and operations. Cumulative impacts would be long-term, moderate, adverse, and alternative D would contribute a moderate amount to the overall adverse effects due to the costs and demands associated with lethal removal in the early years and reproductive control after years 5 and 6.

UNAVOIDABLE ADVERSE IMPACTS

The NPS is required to consider if the alternative actions would result in impacts that could not be fully mitigated or avoided (NEPA Section 101[c][ii]).

ALTERNATIVE A: NO ACTION (CONTINUATION OF CURRENT MANAGEMENT)

Under alternative A, there would be long-term, unavoidable adverse impacts on vegetation, the white-tailed deer population, other wildlife and wildlife habitat, and certain special status species due to the continued high number of deer in the parks over time and the associated damage to vegetation. This includes unavoidable adverse impacts on those wildlife species that depend on ground cover and seedlings for their food and/or cover. There would also be long-term unavoidable adverse impacts on visitor use and experience, because of the lack of vegetation and the associated wildlife and scenery which many park visitors enjoy, as well as adverse effects on cultural landscapes because of the changes to vegetation, crops, and the patterns seen. There would also be unavoidable adverse impacts on visitor safety related to deer-vehicle collisions and to socioeconomics/neighboring land uses, as the deer populations continued at high densities, inflicting damage on local properties and crops. Unavoidable adverse impacts would continue on park management and operations, due to the demand on park staff related to continued deer monitoring and resource management. Any CWD management actions would have unavoidable adverse impacts on the deer removed or the deer affected by the disease if actions do not prevent the spread of the disease, and the lack of a long-term CWD management plan could result in unavoidable adverse impacts on the deer populations if steps cannot be taken to respond to an immediate threat of CWD in or near the parks.

ALTERNATIVE B: NONLETHAL DEER MANAGEMENT

Alternative B would include most of the unavoidable adverse impacts described for alternative A over the life of the plan, since the benefits of reproductive control would not be realized until much later, given the length of time needed to realize a reduction in deer herd numbers based solely on reproductive control. Unavoidable adverse effects may occur to other wildlife species affected by the exclosures. Unavoidable adverse impacts may occur to some sensitive plant species due to the continued high numbers of deer and their browsing; this would be mitigated somewhat by the use of the exclosures, however. Reproductive control may have some unavoidable adverse impacts if the actions taken were visible or disturbingly audible to park visitors. Providing interpretive materials may help mitigate some of this effect, and most of these actions would take place in lower use periods in later fall and winter months. Unavoidable adverse impacts on park operations and management would increase compared to alternative A, due to the demands on staff for implementation of the program. Any CWD management actions would have unavoidable adverse impacts on the deer removed or the deer affected by the disease if actions do not prevent the spread of the disease.

ALTERNATIVE C: LETHAL DEER MANAGEMENT

Unavoidable adverse impacts for this alternative would be greatly reduced compared to alternatives A and B, because the reduction in deer numbers would occur rapidly and the parks' vegetation would begin to recover over the life of the plan. This would mitigate adverse effects on vegetation, the white-tailed deer population and other wildlife, special status species, and cultural landscapes. Some wildlife that prefer more open habitat would be unavoidably impacted as the vegetation recovered. There may be some unavoidable adverse effects on visitors related to the implementation of the sharpshooting or capture and euthanasia, if the visitors happened to be near areas where this was occurring and were disturbed by these actions. Conducting sharpshooting at night and providing interpretive materials would help mitigate some adverse effects. Unavoidable adverse impacts on park operations and management would increase compared to alternative A, due to the demands on staff for implementation of the program. CWD management actions would have unavoidable adverse impacts on the deer removed or the deer affected by the disease if actions do not prevent the spread of the disease.

ALTERNATIVE D: COMBINED LETHAL AND NONLETHAL DEER MANAGEMENT

Unavoidable adverse impacts for this alternative would be essentially the same as those described for alternative C, although use of reproductive controls for long-term maintenance of the deer herd would involve a greater commitment of staff and resources and result in greater unavoidable adverse impacts on park management and operations. CWD management actions would have unavoidable adverse impacts on the deer removed or the deer affected by the disease if actions do not prevent the spread of the disease.

SUSTAINABILITY AND LONG-TERM MANAGEMENT

In accordance with NEPA, and as further explained in Director’s Order 12, consideration of long-term impacts and the effects of foreclosing future options should pervade any NEPA document. According to Director’s Order 12, and as defined by the World Commission on Environment and Development, “sustainable development is that which meets the needs of the present without compromising the ability of future generations to meet their needs.” For each alternative considered in a NEPA document, considerations of sustainability must demonstrate the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity. This is described below for each alternative.

The NPS must consider if the effects of the alternatives involve tradeoffs of the long-term productivity and sustainability of park resources for the immediate short-term use of those resources. It must also consider if the effects of the alternatives are sustainable over the long term without causing adverse environmental effects for future generations (NEPA Section 102(c)(iv)).

ALTERNATIVE A: NO ACTION (CONTINUATION OF CURRENT MANAGEMENT)

Alternative A would trade any long-term productivity for short-term use of park resources. The deer population would likely continue to grow over time or remain at high levels, and use the parks’ vegetation at the expense of the long-term productivity and sustainability of the vegetation and other affected wildlife in the parks, as well as the parks’ cultural landscapes. Any CWD management action requiring removal of a large number of deer would require short-term impacts on the parks’ deer populations in an attempt to have long-term sustainability and productivity of a deer herd in the parks.

ALTERNATIVE B: NONLETHAL DEER MANAGEMENT

Alternative B would involve a similar trade for short-term use of park resources at the expense of long-term productivity for the duration of the plan, since the reproductive controls would not reduce the numbers of deer in the parks over the life of the plan. The construction of the exclosures would involve short-term impacts related to their construction and visual impacts on visitors, but they would help preserve some of the parks’ long-term productivity. They would only protect a small portion of the parks’ woody vegetation over time, and only a small percentage of the parks’ herbaceous vegetation at any one time. For this alternative to be truly sustainable, the reproductive control aspect must be continually managed and successful, and exclosures would need to be relocated to many areas of the park over time. Any CWD management action requiring removal of a large number of deer would require short-term impacts on the parks' deer populations in an attempt to have long-term sustainability and productivity of a deer herd in the parks.

ALTERNATIVE C: LETHAL DEER MANAGEMENT

Under alternative C, there would be a short-term commitment of human resources and short-term impacts on the parks' deer populations, park visitors, and environment during deer removal actions, but with the result of long-term productivity of the parks' vegetation and habitat and a sustainable use of the resources in the parks. To be sustainable, this alternative will require long-term management, including monitoring and adaptive management to protect park productivity. Any CWD management action requiring removal of a large number of deer would require short-term impacts on the parks' deer populations in an attempt to have long-term sustainability and productivity of a deer herd in the parks.

ALTERNATIVE D: COMBINED LETHAL AND NONLETHAL DEER MANAGEMENT

Alternative D would have the same long-term sustainability characteristics as alternative C, except that it would require more resources focused on the reproductive control aspect, since it is not a proven method in a free-ranging population. Any CWD management action requiring removal of a large number of deer would require short-term impacts on the parks' deer populations in an attempt to have long-term sustainability and productivity of a deer herd in the parks.

IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS OF RESOURCES

The NPS must consider if the effects of the alternatives cannot be changed or are permanent (that is, the impacts are irreversible). The NPS must also consider if the impacts on park resources would mean that once gone, the resource could not be replaced; in other words, the resource could not be restored, replaced, or otherwise retrieved (NEPA Section 102[c][v]).

ALTERNATIVE A: NO ACTION (CONTINUATION OF CURRENT MANAGEMENT)

Under alternative A, impacts on vegetation (particularly the forest understory and herbaceous ground cover) from continued overbrowsing by deer could result in irreversible impacts on the parks' forests if no actions are ever taken to reduce deer numbers. Exotic plants that are not palatable to deer would continue to colonize openings in the understory, and animal species that rely on native ground vegetation might not remain in or return to the parks if the forest understory does not regenerate. Even if fencing were used to protect some of the sensitive species, it would be impossible to identify all individual plants, and overbrowsing of new plants located outside the protected areas could occur. In addition, the deer herd could suffer irretrievable adverse effects if no action is taken, especially if no long-term CWD management actions are available for use to fight the spread of CWD.

ALTERNATIVE B: NONLETHAL DEER MANAGEMENT

Alternative B has the potential for some irreversible impacts, if some areas of the parks' forests are adversely affected to the point of nonregeneration or if invasive exotic plants take over some grazed areas before reproductive controls have had time to stabilize the deer herd numbers. Exclosures will not cover the entire area of any park, and so some of the irreversible impacts described for alternative A would likely occur under alternative B as well.

ALTERNATIVE C: LETHAL DEER MANAGEMENT

This alternative presents the least potential for irreversible or irretrievable commitments of resources. Although deer would be removed, the deer population would continue at a sustainable level. Because the herds would be reduced rapidly, there would be little chance that park vegetation (including certain special status species) or other species that are dependent upon forest understory and native ground cover would be irretrievably lost, since forest regeneration would begin within the life of the plan.

ALTERNATIVE D: COMBINED LETHAL AND NONLETHAL DEER MANAGEMENT

This alternative is essentially the same as alternative C, with very little potential for irreversible or irretrievable commitments of resources. Because the herds would be reduced rapidly, there would be little chance that park vegetation (including certain special status species) or other species that are dependent upon forest understory and native ground cover would be irretrievably lost, since forest regeneration would begin within the life of the plan.

Chapter 5: Consultation and Coordination

CHAPTER 5: CONSULTATION AND COORDINATION

One intent of National Environmental Policy Act (NEPA) is to encourage the participation of federal and state-involved agencies and affected citizens in the assessment procedure, as appropriate. This section describes the consultation that occurred during development of this White-tailed Deer Management Plan / Environmental Impact Statement (plan/EIS), including consultation with scientific experts and other agencies. This chapter also includes a description of the public involvement process and a list of the recipients of the draft document.

HISTORY OF PUBLIC INVOLVEMENT

The public involvement activities for this plan/EIS fulfill the requirements of NEPA and National Park Service (NPS) Director's Order 12 (NPS 2011c).

THE SCOPING PROCESS

The NPS divides the scoping process into two parts: internal scoping and external or public scoping. Internal scoping involved discussions among NPS personnel regarding the purpose of and need for management actions, issues, management alternatives, mitigation measures, the analysis boundary, appropriate level of documentation, available references and guidance, and other related topics.

Public scoping is the early involvement of the interested and affected public in the environmental analysis process. The public scoping process helps ensure that people have an opportunity to comment and contribute early in the decision-making process. For this plan/EIS, project information was distributed to individuals, agencies, and organizations early in the scoping process, and people were given opportunities to express concerns or views and to identify important issues or even other alternatives.

Taken together, internal and public scoping are essential elements of the NEPA planning process. The following sections describe the various ways scoping was conducted for this plan/EIS.

INTERNAL SCOPING

The internal scoping process began on October 12, 2010, at the U.S. Fish and Wildlife Service (USFWS) National Conservation Training Center in Shepherdstown, West Virginia. During three days of meetings, NPS employees identified the initial purpose, need, and objectives for managing deer at the parks, and identified issues and concerns associated with the current deer populations, the impact of deer on the ecosystem of the parks, and other ungulate plans in NPS units. Preliminary alternatives were also discussed. Additionally, Antietam, Monocacy, and Manassas convened a science team consisting of scientists and other specialists from a variety of state and federal government organizations to help define components of the planning process (members of the science team are listed later in this chapter). As described in "Chapter 1: Purpose of and Need for Action," the team evaluated scientific literature and research on the topic of deer management, reviewed alternatives approaches, established a monitoring protocol for park deer populations and other park resources, and established a basis for the resource thresholds at which deer management strategies would be implemented. The science team has held a number of meetings over the phone, providing technical background information and research references for this plan. Additional calls were held with cultural resources specialists from the parks and elsewhere in NPS to discuss and develop thresholds for action or modification to actions related to the cultural landscapes that are integral to all three parks.

The internal scoping and all science team meetings are documented in reports that are available in the administrative record for this plan/EIS.

PUBLIC SCOPING

Public scoping efforts for this planning process focused on efforts to include the public, the major interest groups, and local public entities. NPS staff places a high priority on meeting the public involvement requirements of NEPA and giving the public an opportunity to comment on proposed actions.

Public Notification

A Notice of Intent to prepare an EIS was published in the Federal Register on July 19, 2011 (Volume 76, Number 138).

A brochure was mailed on March 25, 2011, to the project's preliminary mailing list of government agencies, tribes, organizations, businesses, and individuals. The brochure announced public scoping meetings to be held in May 2011, summarized the purpose of and need for the plan, listed preliminary alternatives, provided background information on deer monitoring and research and findings at the parks, and presented instructions on how to comment on the plan.

Public Meetings

On March 25, 2011, Antietam National Battlefield, Manassas National Battlefield Park, and Monocacy National Battlefield released the public scoping newsletter for the draft plan/EIS for public review and comment. The public was invited to submit comments on the scope of the planning process and potential alternatives through September 2, 2011. The official notice of intent was published in the Federal Register on July 19, 2011. During the scoping period, three public scoping meetings were held:

- Tuesday, May 24, 2011, from 6:00 p.m. to 8:00 p.m. at the Manassas National Battlefield Park Visitor Center, Manassas, Virginia
- Wednesday, May 25, 2011, from 6:00 p.m. to 8:00 p.m. at the Antietam National Battlefield Visitor Center, Sharpsburg, Maryland
- Thursday, May 26, 2011, from 6:00 p.m. to 8:00 p.m. at the Monocacy National Battlefield Visitor Center, Frederick, Maryland

The meetings were held in an open-house format and included handouts and display boards that illustrated the project background; draft purpose, need, and objectives; park research; and preliminary concepts for deer management at the parks.

The purpose of the scoping meetings was to solicit public involvement early in the planning process and to obtain community feedback on the initial concepts for deer management at the three parks.

At the meetings, NPS personnel or contractors were available to provide additional information about the plan, answer questions or concerns of community members, and to record comments. Comment sheets were also provided to meeting attendees as an additional method for providing comments. Additionally, meeting attendees were directed to the EIS brochure, which provided information on other opportunities to comment on the project, including submitting comments through the NPS Planning, Environment, and Public Comment (PEPC) website at either, http://parkplanning.nps.gov/anti, http://parkplanning.nps.gov/mono, or http://parkplanning.nps.gov/mana. During the three meetings, a total of 45 attendees signed in.

Public Comment

The 160-day public comment period began with publication of the Notice of Intent to prepare an environmental impact statement (EIS) in the Federal Register on July 19, 2011, and ended on September 2, 2011, although comments were also accepted prior to the publication of the Notice of Intent from the start of the public meetings in May. In total, the NPS received 199 pieces of correspondence, representing 340 comments. A piece of correspondence (“correspondence”) is used to describe the entire document submitted by the commenter. A “comment” is a portion of the text within a piece of correspondence that addresses a single subject. In addition to comments received at the public scoping meetings from attendees, the NPS received comments from individuals and organizations not present at the meetings by means of mail, email, and the PEPC websites. The NPS read all correspondence and specific comments within each piece of correspondence were identified and grouped by similar topic. Public comments were analyzed and a public scoping comment analysis report was created, which is now on file as part of the administrative record.

Commenters provided numerous suggestions for elements that could be incorporated into the preliminary alternatives. A large portion of such comments addressed reproductive control. Among such comments were proposals for conducting contraceptive research, suggestions for a variety of ways to administer reproductive control, and concerns over the effectiveness of contraception. A number of comments also requested that public safety be taken into consideration in the plan/EIS. Specific concerns were related to damage to property, the possibility of human injury if the alternative involves shooting, and the danger related to bucks during the rut.

The most frequently addressed topics in public comments were the opposition of lethal management and consideration of trapping as an alternative in addressing deer management.

AGENCY CONSULTATION

Letters initiating consultation under Section 7 of the Endangered Species Act and Section 106 of the National Historic Preservation Act (NHPA) and/or requesting information or comments were sent to the agencies as described below. Copies of these letters and any responses are provided in appendix D.

U.S. Fish and Wildlife Service

A letter dated March 15, 2011, from Antietam National Battlefield, a letter dated April 18, 2011, from Manassas National Battlefield Park, and a letter dated May 7, 2012, from Monocacy National Battlefield initiated informal consultation with the USFWS about the presence of federally listed rare, threatened, or endangered species in or near the parks.

Maryland Department of Natural Resources, and Virginia Departments of Conservation and Recreation, and Game and Inland Fisheries

A letter dated March 15, 2011, from Antietam National Battlefield and a letter dated May 7, 2012, from Monocacy National Battlefield to the Maryland Department of Natural Resources (MD DNR), and letters dated April 18, 2011, from Manassas National Battlefield Park to the Virginia Natural Heritage Division in the Department of Conservation and Recreation, and Department of Game and Inland Fisheries, initiated informal consultation with the state natural resource departments about the presence of state-listed rare, threatened, or endangered species in or near the parks.

MARYLAND AND VIRGINIA STATE HISTORIC PRESERVATION OFFICES

A letter dated March 19, 2011, from Antietam National Battlefield to the and a letter dated May 7, 2012, from Monocacy Maryland Historical Trust, and a letter date April 18, 2011, from Manassas National Battlefield Park to the Virginia State Historic Preservation Office were sent in accordance with Section 106 of the NHPA, and initiated consultation with the State Historic Preservation Officers (SHPOs). Virginia Department of Historic Resources responded concerning Manassas on May 2, 2012 (letter available in appendix D), and the Maryland Historical Trust responded regarding Monocacy on May 22, 2012. Neither response offered substantive comments.

LIST OF RECIPIENTS OF THE DRAFT PLAN/ENVIRONMENTAL IMPACT STATEMENT

This plan/EIS will be sent to the following agencies, organizations, and businesses, as well as to other entities and individuals who have requested a copy.

Maryland Congressional Delegation

- Senator Ben Cardin
- Senator Barbara A. Mikulski
- Representative Roscoe Bartlett (District 6)

Virginia Congressional Delegation

- Senator Mark Warner
- Senator Jim Webb
- Representative Gerry Connolly
- Representative Frank Wolf

Federal Agencies

- Advisory Council on Historic Preservation
- Federal Highway Administration
- Federal Transit Administration, Region 3
- National Park Service
  - National Capital Parks – East
  - Appalachian National Scenic Trail
  - Catoctin Mountain Park
  - Chesapeake and Ohio Canal National Historical Park
  - George Washington Memorial Parkway
  - Harpers Ferry National Historical Park
  - National Mall and Memorial Parks
  - Potomac Heritage National Scenic Trail
  - Presidents Park
  - Prince William Forest Park
  - Rock Creek Park
  - Wolf Trap National Park for the Performing Arts
- U.S. Environmental Protection Agency
- U.S. Department of Agriculture, National Resources Conservation Service
- U.S. Fish and Wildlife Service, Chesapeake Bay Field Office
- U.S. Fish and Wildlife Service, National Conservation Training Center
- U.S. Fish and Wildlife Service, Northeast Region
- U.S. Fish and Wildlife Service, Virginia Field Office

State Legislative Delegation (Maryland)

- State Senator Christopher B. Shank (District 2)
- State Senator Ronald N. Young (District 3)
- State Delegate Neil C. Parrott (District 2B)
- State Delegate Galen R. Clagett (District 3A)
- State Delegate Patrick N. Hogan (District 3A)

State Legislative Delegation (State Legislative Delegation (Virginia)

- State Delegate Robert G. Marshall (District 013)
- State Senator Richard H. Black (District 013)

State Agencies

- Maryland Division of Historical and Cultural Programs, Maryland Historical Trust
- Maryland Department of Natural Resources
- Wildlife and Heritage Service
- Cunningham Falls State Park (MD)
- South Mountain State Park (MD)
- Greenbrier State Park (MD)
- Maryland Wildlife Services
- Maryland Natural Resources Police
- West Virginia Department of Natural Resources
- Pennsylvania Game Commission
- Virginia Department of Conservation and Recreation
- Virginia Department of Forestry (Conway Robinson State Forest)
- Virginia Department of Game and Inland Fisheries
- Virginia Department of Historic Resources
- Virginia Department of Transportation
- Virginia General Assembly
- Virginia Outdoors Foundation
- Virginia Run Community Association

Local Governments and Regional Authorities

- Metropolitan Washington Council of Governments
- Northern Virginia Regional Commission
- Northern Virginia Regional Park Authority (Bull Run Regional Park)
- Northern Virginia Soil and Water Conservation District
- Boonsboro, MD Government
- Hagerstown, MD Government
- Frederick City, MD Government
- Frederick County, MD Government
- Keedysville, MD Government
- Sharpsburg, MD Government
- City of Manassas, VA Government
- City of Manassas Park, VA Government
- Town of Haymarket, VA Government
- Jefferson County, WV Government

- Washington County, MD Government
- Fairfax County, VA Government
- Fauquier County, VA Government
- Loudoun County, VA Government
- Prince William County, VA Government

Organizations and Agencies

- Audubon Naturalist Society
- Maryland Sportsmen's Association
- Urbana (MD) Civic Association
- Thurmont Conservation & Sportsman's Club
- Civil War Preservation Trust
- Civil War Traveler
- Frederick Community College
- Isaac Walton League of America, Inc.
- Frederick County Civil War Round Table
- Community Commons
- Piedmont Environmental Council
- Frederick County Sportsman's Council
- Catoctin Fish & Game Protective Association
- Appalachian Conservation League
- Air Photo, Inc.
- Alice Ferguson Foundation
- APVA – Preservation Virginia
- Battlefield Business Park
- Battlefield Equestrian Society
- Chantilly Battlefield Association
- Cold Deer Hunting & Fishing Club
- Frederick County Fish & Game Protective Association
- Institute for Environmental Studies, Shepherd University
- NZP Conservation and Research Center
- Baltimore Civil War Round Table
- Antietam Battlefield Advisory Committee
- Save Historic Antietam Foundation
- Hagerstown-Washington County Convention and Visitors Bureau
- Hagerstown-Washington County Chamber of Commerce
- The Conservation Fund
- Friends of Manassas National Battlefield
- Heritage Hunt Homeowners Association
- Lighthouse Assembly of God Church
- Living Faith Bible Church
- Conococheague Sportman's Club
- McClellan Gun Club
- Funkstown Rod and Gun Club
- North American Rod and Gun Club
- Potomac Fish and Game Club
- South Mountain Rod and Gun Club
- Sharpsburg Historical Society
- National Park Foundation
- Shepherdstown Battlefield Preservation Association
- National Museum of Civil War Medicine
- The Humane Society of the US
- Animal Welfare Institute
- Civil War Preservation Trust
- National Trust for Historic Preservation
- Defenders of Wildlife

- People for the Ethical Treatment of Animals
- Quality Deer Management Association
- Coalition for Smarter Growth
- Dominion Virginia Power
- Eastern National
- Friends of Animals
- Friends of Frederick County
- Historical Society of Frederick County
- Maryland Farm Bureau
- Manassas Museum
- McCormick Civil War Institute
- National Wildlife Federation
- National Audubon Society
- National Parks and Conservation Association
- Sierra Club
- Southern Environmental Law Center
- Stonewall Memory Gardens
- Sudley Mountain/Stony Ridge Civic Association
- The Nature Conservancy

SCIENCE TEAM MEMBERS

Name	Title	Organization
Andrew Banasik	Natural Resources Manager, Monocacy National Battlefield	NPS-Monocacy National Battlefield
Scott Bates	Regional Wildlife Biologist	NPS-National Capital Region (NCR)-Natural Resources and Science
Scott Barras	Wildlife Services State Director	USDA / Animal and Plant Health Inspection Service-Virginia
Joe Calzarette	Natural Resources Manager, Antietam National Battlefield	NPS-Antietam National Battlefield
Tom Flanagan	Technical Advisor	NPS-Environmental Quality Division
Howard Ginsberg	Field Station Leader, Coastal Field Station	USGS Patuxent Wildlife Research Center
Bryan Gorsira	Natural Resources Manager, Manassas National Battlefield Park	NPS-Manassas National Battlefield Park
Nelson Lafon	Deer Project Coordinator	Virginia Department of Game and Inland Fisheries (VDGIF)
Andrew Landsman	Biological Technician	NPS-Antietam National Battlefield
Kirsten Leong	Program Manager of Human Dimensions of Biological Resource Management	NPS-Biological Resource Management Division
William McShea	Ecologist; Research Scientist	Smithsonian National Zoo; Conservation and Research Center
Ryan Monello	Wildlife Biologist / Disease Ecologist	NPS-Biological Resource Management Division
Diane Pavek	Botanist; Research Coordinator	NPS-NCR- Natural Resources and Science

Name	Title	Organization
Jenny Powers	Wildlife Veterinarian	NPS-Biological Resource Management Division
John Paul Schmit	Quantitative Ecologist	NPS-NCR- Natural Resources and Science
Susan Stout, PhD	Research Forester	USDA-Forest Service
Kevin Sullivan	Wildlife Services State Director	U.S. Department of Agriculture (USDA) / Animal and Plant Health Inspection Service-Maryland, Delaware, and District of Columbia
George Timko	Assistant Project Leader – Maryland Deer Project	Maryland Department of Natural Resources
Brian Underwood	Research Wildlife Biologist	USGS Patuxent Wildlife Research Center

LIST OF PREPARERS

Name	Title	Education/Responsibility	Experience (years)
National Park Service			
Tracy Atkins, PE, PMP	Project Manager, Denver Service Center	MS Community & Regional Planning, MS Civil Engineering, BS Architectural Engineering Project lead, responsible for technical content and review	25 years, 4 years with NPS
Andrew Banasik	Natural Resources Manager, Monocacy National Battlefield	MS Environmental Science and Public Policy Park lead for project, responsible for data submission and technical review	10 years
Scott Bates	Regional Wildlife Biologist, NPS — NCRN	BS Biology; MS Wildlife Management Provided technical input and review, including calculation of rates of reduction of deer populations under the lethal alternative option	13 years with NPS NCR and 9 years with DoD as a wildlife biologist
Joy Beasley	Cultural Resources Specialist, and former Acting Superintendent, Monocacy National Battlefield	Technical review, assistance with scoping and alternatives development, and development of cultural landscape metrics	8 years with NPS
Joe Calzarette	Natural Resources Manager, Antietam National Battlefield	BS Recreation and Parks Management Provided technical input and data	20 years with NPS
Tom Flanagan	Environmental Protection Specialist, Environmental Quality Division	BA History; MA Geography NEPA technical review	7 years
Joel Gorder	Environmental Protection Specialist, National Capital Region	MURP; BS Biology Responsible for NEPA compliance and regional review of document	3 years with NPS

Name	Title	Education/Responsibility	Experience (years)
Bryan Gorsira	Natural Resources Manager and Wildlife Biologist, Manassas National Battlefield Park	BS Environmental Sciences, concentration in Wildlife Biology Park lead for project, responsible for data submission and technical review	25 years, 16 years with NPS
Andrew Landsman	Biological Technician, Antietam National Battlefield	BS Environmental Studies; MS Environmental Biology; PhD Wildlife Ecology and Entomology (in progress) Provided technical review and information for Antietam	4 years
Ryan Monello	Wildlife Biologist/Disease Ecologist	PhD Wildlife Science; MS Wildlife Resources; BA Biology Provided technical input and review, with emphasis on CWD, reproductive control, and deer health	16 years
Diane Pavek	Research Coordinator and Botanist, NPS — NCRN	BS in Botany and Zoology; MS and PhD Botany Provided technical input and review; drafted monitoring thresholds for each park	22 years in botany; 13 years with NPS
John Paul Schmit	Quantitative Ecologist, NPS — NCRN	BA Biology; MS Evolutionary Biology; PhD Evolutionary Biology Provided technical review	13 years; 6 years with NPS
Ed Wenschhof	Chief, Natural Resources, Antietam National Battlefield	BS Agricultural Education; MS Environmental Science Park lead for project, responsible for data submission and technical review	28 years with NPS
Debbie Cohen	Natural Resources/GIS Specialist, Antietam National Battlefield	MBA, BS Recreation Responsible for providing park-specific GIS data and technical review	22 years with NPS
Maureen Joseph	Regional Historical Landscape Architect, National Capital Region	BSLA Landscape Architecture; provided technical input for cultural landscape monitoring.	22 years with NPS
Louis Berger Group			
Larry Earle	Senior Planner	MP (Planning) Responsible for the cultural landscapes impact topic section	36 years
Jeff Gutierrez	Environmental Planner	BA Environmental Studies, MA (Candidate) Urban and Regional Planning (2013) Responsible for the visitor use and experience impact topic section	5 years
Lia Jenkins	Environmental Scientist	BS Biology Responsible for science team	3 years

Name	Title	Education/Responsibility	Experience (years)
Emily Larson	Environmental Scientist	BS Environmental Science with a concentration in Biology Responsible for the affected environment of the vegetation impact topic section	5 years
David Plakorus	Environmental Planner	BA History, MBA, MURP Urban and Regional Planning Responsible for the human health and safety and park management and operations impact topic sections	3 years
Michael Snyder	Environmental Scientist	BA Biology, MS Biological Sciences Responsible for the wildlife and wildlife habitat; and special status species impact topic sections	12 years
Margaret Stewart	Senior Planner	AB Growth and Structure of Cities Program; MRP Land Use and Environmental Planning Responsible for project management and science team lead	18 years
Nancy Van Dyke	Senior Consultant	BA Biology and Geography; MS Environmental Sciences Responsible for project management and the environmental consequences of the vegetation impact topic section	32 years
Julia Yuan	Senior Planner	BS Environmental and Forest Biology/Forest Resources Management MPS Forest and Natural Resources Management Responsible for public scoping	11 years
EEE Consulting			
Scott Smizik, AICP	Environmental Scientist	BA Environmental Studies; Masters in Energy and Environmental Policy Responsible for the white-tailed deer and socioeconomics section	10 years
The Final Word			
Juanita Barboa	Technical Editor	BS Technical Communication Responsible for editing document	23 years
Sherrie Bell	Technical Editor	Business Management Coursework Responsible for editing and formatting document	23 years

LIST OF CONSULTANTS

- Ed Clark, Superintendent, Manassas National Battlefield Park
- Rae Emerson, Acting Superintendent, Monocacy National Battlefield
- David Kreger, Branch Chief, Division of Planning, Denver Service Center
- Carol Pollio, Chief of Natural Resources and Science, National Capital Region
- Perry Wheelock, Associate Regional Director, Resource Stewardship and Science, National Capital Region
- Susan Dolan, Manager, NPS Cultural Landscapes Program (WASO)
- Susan Trail, Superintendent, Antietam National Battlefield, former Superintendent, Monocacy National Battlefield
- Ray Brown, Chief of Interpretation and Cultural Resources, Manassas National Battlefield Park

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GLOSSARY

action alternative—An alternative that proposes a different management action or actions to address the purpose, need, and objectives of the plan; one that proposes changes to the current management. Alternatives B, C, and D are the action alternatives in this planning process. See also: “No-Action Alternative.”

adaptive management—The rigorous application of management, research, and monitoring to gain information and experience necessary to assess and modify management activities. A process that uses feedback from research and the period evaluation of management actions and the conditions they produce to either reinforce the viability of objectives, strategies, and actions prescribed in a plan or to modify strategies and actions in order to more effectively accomplish management objectives.

amplification— Increased prevalence of disease through a target population or a region.

antibody—An immunoprotein that is produced by lymphoid cells in response to a foreign substance (antigen), with which it specifically reacts.

antigen—A foreign substance, usually a protein or polysaccharide, which stimulates an immune response upon introduction into a vertebrate animal.

affected environment—A description of the existing environment that may be affected by the proposed action (40 CFR 1502.15).

bluetongue virus—An insect-transmitted, viral disease of ruminant animals, including white-tailed deer, which causes inflammation, swelling, and hemorrhage of the mucous membranes of the mouth, nose, and tongue.

browse line—A visible delineation at approximately six feet below which most or all vegetation has been uniformly browsed.

carrying capacity—The maximum number of organisms that can be supported in a given area or habitat.

cervid—A member of the deer family, such as white-tailed deer, mule deer, elk, moose, and caribou.

chronic wasting disease (CWD)—A slowly progressive, infectious, self-propagating neurological disease of captive and free-ranging deer, elk, and moose. CWD belongs to the transmissible spongiform encephalopathy (TSE) group of diseases and is characterized by accumulations of abnormal prion proteins in neural and lymphoid tissue.

containment—To keep CWD from spreading outside of an area.

containment area or zone—A buffer area around confirmed positive CWD cases; terminology varies with the state involved. In Virginia, if additional CWD-infected free-ranging deer are found within or near the CWD surveillance area, a CWD Containment Area (CA) will be defined using county and/or state maintained roads or other geographic features. The primary objectives of establishing a CA will be to monitor the prevalence and geographic extent of the CWD infection and contain or slow the spread of the disease. In Maryland, if additional infected deer are detected in selected surveillance areas (SSAs), a new five-mile radius boundary will be extended and sampling will be conducted at newly identified SSAs within the expanded area(s). As sampling progresses, a CWD Infection Zone (CIZ) (containment area) will be identified using all available biological information and cultural/geographic features.

contragestive—A product that terminates pregnancy.

cultural landscape—A geographic area (including both cultural and natural resources and the wildlife or domestic animals therein) associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values.

cumulative impacts—Those impacts on the environment that result from the incremental effect of the action when added to the past, present, and reasonable foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).

deer herd—The group of deer that have common characteristics and interbreed among themselves. For the purposes of this plan, this term is synonymous with deer population.

deer population—See deer herd, above.

demographic—Referring to the intrinsic factors that contribute to a population's growth or decline: birth, death, immigration, and emigration. The sex ratio of the breeding population and the age structure (the proportion of the population found in each age class) are also considered demographic factors because they contribute to birth and death rates.

depredation—Damage or loss.

direct reduction—Lethal removal of deer; includes both sharpshooting and capture/euthanasia.

distance sampling—An analytical method to estimate population density that involves an observer traveling along a transect and recording how far away objects of interest are.

endemic—Native to or confined to a particular region.

ecosystem—An ecological system; the interaction of living organisms and the nonliving environment producing an exchange of materials and energy between the living and nonliving.

epizootic hemorrhagic disease (EHD)—An insect-borne viral disease of ruminants that causes widespread hemorrhages in mucous membranes, skin, and visceral organs.

environment—The sum total of all biological, chemical, and physical factors to which organisms are exposed; the surroundings of a plant or animal.

environmental assessment—A concise public document, prepared in compliance with NEPA, that briefly discusses the purposes and need for an action, and provides sufficient evidence and analysis of impacts to determine whether to prepare an environmental impact statement or finding of no significant impact (40 CFR 1508.9).

environmental consequences—Environmental effects of project alternatives, including the proposed action, any adverse environmental effects which cannot be avoided, the relationship between short-term uses of the human environment, and any irreversible or irretrievable commitments of resources which would be involved if the proposal should be implemented (40 CFR 1502.16).

environmental impact statement (EIS)—A detailed written statement required by Section 102(2)(C) of NEPA, analyzing the environmental impacts of a proposed action, adverse effects of the project that cannot be avoided, alternative courses of action, short term uses of the environment versus the maintenance and enhancement of long term productivity, and any irreversible and irretrievable commitment of resources (40 CFR 1508.11).

ethnographic resource—Any site, structure, object, landscape, or natural resource feature assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it.

euthanasia—Ending the life of an animal by humane means.

exclosure—A large area enclosed by fencing to keep out deer and allow vegetation to regenerate.

exotic species—Any introduced plant, animal or protist species that is not native to the area and may be considered a nuisance; also called non-native or alien species.

extirpated species—A species that is no longer present in an area where it once lived.

fenced plot—An area enclosed by a fence to keep deer out so vegetation can grow without the influence of deer browsing.

folliculogenesis—the maturation of the ovarian follicle (see below).

follicle—one of the small ovarian sacs containing an immature egg.

follicle stimulating hormone—a hormone synthesized and secreted by the pituitary gland that (in females) stimulates the growth of immature follicles to maturation.

forest regeneration—For the purposes of this plan, the regrowth of forest species and renewal of forest tree cover such that the natural forest sustains itself without human intervention.

fragmentation—The breaking up of large, contiguous blocks of habitat or landscape into small, discontinuous areas that are surrounded by altered or disturbed lands.

genetic variability—The amount of genetic difference among individuals in a population.

habitat—The environment in which a plant or animal lives (includes vegetation, soil, water, and other factors).

hectare—A metric unit of area equal to 2.471 acres.

herbaceous plants—Non-woody plants; includes grasses, wildflowers, and sedges and rushes (grass-like plants).

herbivore—An animal that eats a diet consisting primarily of plant material.

hypothesis—A tentative explanation for an observation or phenomenon that can be tested by further investigation.

immunocontraception—The induction of contraception by injecting an animal with a compound that produces an immune response that precludes pregnancy.

immunocontraceptive—A contraceptive agent that causes an animal to produce antibodies against some protein or peptide involved in reproduction. The antibodies hinder or prevent some aspect of the reproductive process.

irretrievable—A term that applies to the loss of production, harvest, and consumptive or nonconsumptive use of natural resources. For example, recreation experiences are lost irretrievably when an area is closed to human use. The loss is irretrievable, but the action is not irreversible. Reopening the area would allow a resumption of the experience.

irreversible—A term that describes the loss of future options. Applies primarily to the effects of use of nonrenewable resources, such as minerals or cultural resources, or to those factors, such as soil productivity that are renewable only over long periods of time.

leuprolide—A reproductive control agent that prevents secondary hormone secretion, which stops the formation of eggs and ovulation. Leuprolide is a GnRH agonist.

luteinizing hormone—a hormone which triggers ovulation in females.

monitoring—A process of collecting information to evaluate if an objective and/or anticipated or assumed results of a management plan are being realized (effectiveness monitoring) or if implementation is proceeding as planned (implementation monitoring).

National Environmental Policy Act of 1969—A law that requires all Federal agencies to examine the environmental impacts of their actions, incorporate environmental information, and utilize public participation in the planning and implementation of all actions. Federal agencies must integrate NEPA with other planning requirements and prepare appropriate NEPA documents to facilitate better environmental decision making. NEPA requires Federal agencies to review and comment on Federal agency environmental plans/documents when the agency has jurisdiction by law or special expertise with respect to any environmental impacts involved (42 USC 4321-4327) (40 CFR 1500-1508).

no-action alternative—The alternative in which baseline conditions and trends are projected into the future without any substantive changes in management (40 CFR 1502.14(d)). Alternative A is the no-action alternative in this planning process.

opportunistic surveillance—Taking diagnostic samples for CWD testing from deer found dead or harvested through a management activity within a national park unit.

P-value—The probability in statistical significance testing, with a value ranging from zero to one, of an observed (or more extreme) result arising by chance, assuming the null hypothesis is true.

paired plot—Two plots used for monitoring that include a fenced and an unfenced plot.

palatability—The property of being acceptable to the taste or sufficiently agreeable in flavor to be eaten.

parasitism—A symbiotic relationship in which one species, the parasite, benefits at the expense of the other, the host.

penetrating captive bolt gun—A gun with a steel bolt that is powered by either compressed air or a blank cartridge. When fired, the bolt is driven into the animal's brain and renders it instantly unconscious without causing pain.

population (or species population)—A group of individual plants or animals that have common characteristics and interbreed among themselves and not with other similar groups.

prevalence—The number of disease cases in a population at a designated time without distinction between old and new cases. It is represented by the number of diseased animals divided by the number of susceptible animals or the total number of cased of a disease in a given location at a specific time.

prion—Protinaceous infectious particle; a microscopic particle similar to a virus but lacking nucleic acid, thought to be the infectious agent for certain degenerative diseases of the nervous system such as CWD.

Record of Decision (ROD)—A concise public record of decision prepared by a federal agency, pursuant to NEPA, that contains a statement of the decision, identification of all alternatives, a statement as to whether all practical means to avoid or minimize environmental harm from the alternative selected have been adopted (and if not, why they were not), and a summary of monitoring and enforcement where applicable for any mitigation (40 CFR 1505.2).

recruitment—Number of organisms surviving and being added to a population at a certain point in time.

reproductive control—A method or methods used to limit the numbers of animals in a population by decreasing the reproductive success of the animals, such as contraception or sterilization.

rut—An annually recurring condition or period of sexual excitement and reproductive activity in deer; the breeding season.

sapling—A young tree, generally not over 4 inches in diameter at breast height.

scoping—An early and open process for determining the extent and variety of issues to be addressed and for identifying the significant issues related to a proposed action (40 CFR 1501.7).

seedling—A young plant grown from seed; a young tree before it becomes a sapling.

sex ratio—The proportion of males to females (or vice versa), in a population. A sex ratio of 50:50 would mean an equal number of does and bucks in a deer population.

sharpshooting—The authorized shooting of animals by specially trained professionals using appropriate weapons for means of effective and efficient lethal control.

species diversity—The variety of different species present in a given area; species diversity takes into account both species richness and the relative abundance of species.

species richness—The number of species present in a community.

spotlight survey—A method used to estimate deer numbers in an area by shining spotlights at night and counting the number of deer observed. This technique provides an estimate of deer numbers but not density.

surveillance area— A 5 mile –radius established around the first CWD-positive case.

sustainable forest—A mature eastern deciduous forest with adequate native regeneration and understory growth and minimal invasive species.

targeted surveillance—Lethal removal of deer that exhibit clinical signs of CWD, such as changes in behavior and body condition, and testing to determine if CWD is present.

transect— A line along which sampling is performed.

transmissible spongiform encephalopathies (TSEs)—A group of diseases characterized by accumulations of abnormal prion proteins in neural and lymphoid tissues, which cause distinctive lesions in the brain and result in death.

unfenced plot—A specific unfenced area that allows effects on deer browsing to be seen and to be measured.

ungulate— A hoofed, typically herbivorous, animal; includes horses, cows, deer, elk, and bison.

vaccine—A suspension of killed or attenuated microorganisms that, when introduced into the body, stimulates an immune response against that microorganism.

vascular plant—A plant that contains a specialized conducting system consisting of phloem (food-conducting tissue) and xylem (water-conducting tissue). Ferns, trees, and flowering plants are all vascular plants.

viable white-tailed deer population—A population of deer that allows the forest to naturally regenerate, while maintaining a healthy deer population in the park.

woody plants—Plants containing wood fibers, such as trees and shrubs (see "Herbaceous Plant").

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Appendices

APPENDIX A: MONITORING PLANS

There are two relevant monitoring strategies for this deer management plant, one related to forest regeneration, and the other to integrity of the cultural landscape, specifically the ability of farmers to continue to farm land on the battlefields at Antietam and Monocacy, and for Antietam to be able to keep orchard trees healthy so that the park can successfully restore and maintain orchards that were there at the time of the Battle of Antietam. Monitoring of forest regeneration is based on Stout's (1998) work at Cuyahoga Valley National Park. Monitoring for cultural landscapes is based on economic analysis of crop yields in comparison with average county crop yields, and on arboriculture standards related to the percentage of new growth browsed from the orchard trees in a season.

VEGETATION AND REGENERATION MONITORING METHODS

Deer populations, although monitored by density, will be managed according to response and success of native forest regeneration. Desired deer populations will allow for a sufficient level of regeneration of forest vegetation, and will be determined through long-term monitoring of native seedling species. Antietam, Manassas and Monocacy have previously utilized various methods of long-term vegetation monitoring, all of which have illustrated the damaging impacts of excessive deer browse on native seedlings.

PAIRED FENCED/OPEN PLOTS

Antietam and Monocacy National Battlefields have paired fenced/open vegetation plots in forested park areas, originally installed in 2003 in coordination with the Smithsonian Institution. Each forested site consists of three paired fenced/unfenced open plots. Each forested site is located over 100 m away from forest edges. Four sites (12 paired plots) were established at Antietam and two sites (6 paired plots) were established at Monocacy in 2003. Fenced plots consist of 5 m × 5 m square plots protected by 2.4 m tall wire fencing with 10 × 10 cm mesh size. Fencing extends to the ground and allows for entry into the plot by other herbivorous mammals. Open control plots (5 m × 5 m) were established within 5 m of each fenced plot. Each plot contains four 1 m × 1 m subplots located 1 m North, South, East, and West from the plot center.

Paired plots at both parks were thoroughly surveyed in 2003/2004 and 2009 by Smithsonian researchers. Monocacy plots were surveyed again by park staff in 2012. All woody and herbaceous species less than or equal to 30 cm in height were documented and measured in the 1 m × 1 m subplots, and all woody saplings between 30 cm and 2 m were documented and measured throughout the entire 5 m × 5 m plot. Changes in species richness and abundance were analyzed by using mixed model repeated measures ANOVA between 2003 and 2009. Non-parametric Kruskal-Wallis tests were used when necessary. Regeneration rate was calculated by using a weighted index for seedling size: a weighted value of 13 was given to seedlings between 30 cm and 2 m, while a value of 1 was assigned to seedlings 30 cm and smaller (modified from Stout [1998]). This rate was subsequently compared to threshold values of successful regeneration in the presence of high and low deer densities. Stout (1998) recommended that 67% of vegetation plots should be at or above the listed threshold values to maintain successful forest regeneration.

Deer Density	Threshold value per 0.000314 ha plot (Stout 1998)	Modified threshold value per 1 m × 1 m (or 0.0004 ha) plot
Low	10	12.7
High	30	38.1

Manassas National Battlefield Park also utilizes paired fenced/open plots to measure seedling regeneration and impacts from deer. Twenty paired plots were established in 2000. Fenced plots consist of 2 m tall wire fencing with 5 cm × 10 cm mesh. Fencing extends to the ground, and the mesh size provides entry into the plot by other herbivorous mammals. Open control plots are located within 1 m from each paired fenced plot. Each plot consists of a 2 m × 6 m rectangle with a centered 1 m × 4 m subplot. Paired plots are surveyed every year for woody seedlings, vegetative structure and herbaceous ground cover.

From a previous vegetation survey in 1991, Manassas also has twelve 20 m × 20 m open plots that each contain five 2 m × 2 m subplots. In 2009, Smithsonian Institution researchers surveyed 6 of these plots for tree species (greater than or equal to 4 cm diameter and 200 cm in height), saplings (less than 4 cm in diameter and 30 – 200 cm in height) and seedlings (less than 30 cm in height).

Herbaceous and Woody Vegetative Ground Cover

In addition to paired plots, Antietam maintains long-term vegetation plots to monitor changes in herbaceous and woody species by examining ground cover. Six plots, each containing two subplots, were established in the forested area known as Snavely woods in 1999. Each plot consists of a 20 m × 20 m square. Two line transects are established to run parallel to the plot sides, and the subplots are located at the center of each transect. Subplots are 2 m × 2 m squares.

Plots were first surveyed in 2000, and are measured annually in the spring in order to successfully identify and record spring ephemeral species. All woody and herbaceous species are identified, measured and recorded. Ground cover is estimated for all present herbaceous species and woody species less than or equal to 1 m in height. Estimates for ground cover are separated into 8 classes:

r	Solitary, with small cover
+	Few, with small cover
1	Numerous, but <5% cover
2	5-25% cover
3	26-50% cover
4	51-75% cover
5	76-95% cover
6	96-100% cover

Data is used to calculate temporal changes in ground cover, cover of exotic and native species, and native species richness and abundance.

FOREST MONITORING PLOTS

The National Capital Region Inventory and Monitoring Network established forest and vegetation monitoring plots throughout the National Capital Region (NCR), including Antietam, Manassas and Monocacy. To randomly select vegetation monitoring plots across forested lands in the parks, a generalized random-tessellation stratified survey was utilized across a 250 m square grid created through ArcGIS. Intersections of the grid were used as plot centroids, with established plots centered around those points. There are currently 4 monitoring plots at Antietam, 19 at Manassas and 3 at Monocacy.

Each plot consists of a 15 m radius circle, within which all tree species are identified and measured for diameter at breast height. Presence of vines, insect pests and signs of disease are also recorded. Tree saplings with diameter 1 – 10 cm and shrub species are identified, measured and recorded within three circular subplots with 3 m radius. Coarse woody debris greater than or equal to 7.5 cm in diameter and 1 m in length is measured and assessed for state of decay along three line transects representing radii of the circular plot. Seedlings greater than 15 cm in height and less than 1 cm in diameter are measured within twelve 0.5 m × 2 m rectangular subplots located within the circular subplots (n=3) and along the coarse woody debris line transects (n=9). Seedling height is measured in cm and subsequently placed in one of 10 size classes for analysis. Data collected is used to calculate tree, sapling and shrub density, basal area of trees and saplings, and seedling density and regeneration.

FUTURE VEGETATION MONITORING EFFORTS

Frequency with which the parks will survey long-term paired fenced/open plots will depend on the National Park Service preferred and chosen alternative. However, across all alternatives, monitoring efforts will be standardized to the extent possible in order to improve continuity among parks.

Paired fenced/open plots will be utilized to measure seedling regeneration and potential response before, during and after implementation of the Deer Management Plan. Subplots will comprise 0.0004 ha: four 1 m × 1 m square subplots per plot at Antietam and Monocacy, and one 1 m × 4 m subplot per plot at Manassas. All woody seedlings will be measured and recorded using an 8-class Hadidian system, with a weighted value for various height classes. The weighted index is that utilized by Hatfield and Krafft (2009) for vegetation analysis in Rock Creek Park, which was modified from Stout (1998).

Height Class	Weighted Value
0 – 10 cm	1
11 – 25 cm	
26 – 50 cm	2
51 – 75 cm	
76 – 100 cm	
101 – 125 cm	15
126 – 150 cm	
> 150 cm	30

Regeneration rate can be compared with the threshold values for adequate regeneration in the presence of varying densities of white-tailed deer populations modified from Stout (1998) and mentioned above. Antietam, Manassas and Monocacy are all considering the construction of additional paired fenced/open plots to coincide with the first year of implementation of the Deer Management Plan. Antietam also intends to continue the long-term monitoring of herbaceous and woody species ground cover.

The Inventory and Monitoring Program will also continue monitoring the vegetative and forest health parameters in their existing long-term plots. Additional monitoring plots (9 at Antietam; 12 at Monocacy) will be established between 2010 – 2013, with surveying of these plots to begin in 2014.

CULTURAL LANDSCAPES

CROP YIELD THRESHOLDS (ANTIETAM AND MONOCACY)

A crop field's cultural resource values include its spatial arrangement, healthy appearance, and type of crop (e.g., corn, hay, small grain). A crop field's economic value to the special use permittee/farmer is its yield either in bushels per acre or tons per acre. Crop yields are measured by machinery, by sampling, or by sale. There is an expected yield per acre based on soil type, soil fertility, and crop species and variety.

There are two ways to measure viability: to compare crop yields from the farms at the battlefields to projected county yields for the season and to average county yields overall. Although yields will vary according to soil, farming methods, and other variables, yields consistently below county averages hampers economic viability.

Most of the agricultural permittees at the two parks keep crop data with annual yield records or attainment and submit the same annual crop yield summaries to the NPS that they would also submit to the USDA for multiple purposes including the National Agricultural Statistical Survey (NASS). These annual crop yield summaries are used to calculate the average yield for that year, and are examined against the county average yield for that year, and sometimes against the projected yield by soil type and crop. Farmer reports are used for insurance purposes as well as federal and state agricultural program benefits. There is an economic threshold for acceptable yield loss. Farm returns are either profit from crop harvest and sale or crop harvest and use for feed for livestock.

An objective of achieving 75% of projected yields for crops is established based on an economic review, and interviews of the USDA Farm Service Agency, and of agricultural extension agents. This yield goal also meets goals for cultural landscape protection. According to the USDA Farm Services Agency and Washington County Cooperative Extension Service, yields below 80% of the projected yields begin to become economically unviable, depending on the crop and on input and costs. Corn requires more input, so if corn yields are 20% less than the average county yield, input can begin to outstrip yield. There is less input required for soybean and other crops, so they can remain viable until yield drops below 60% of the county average yield (Cashell, pers. comm. 2012; Semler, pers. comm. 2012). Based on the information above, the planning team agreed to use a threshold tied to crop yield at Antietam and Monocacy. Action would be taken when the 3-year average crop yield from farms within the park unit fell below 75% of the average yield reported by the county for similar agricultural production.

Methodology

The parks gather crop data from participating farmers and track average crop yield for each type of crop over time. Yield is expressed in bushels per acre for grain crops such as corn, wheat, soybeans and tons per acre for forage crops such as corn silage and hay. The NASS provides the annual state and county yields for individual crop species. It is assumed that producers are using adequate weed, insect and disease integrated pest management and proper nutrient management and soil fertility practices.

Crop yields for each season are compared to county average yields for the corresponding crop type and growing seasons. Average crop yields for corn and soybeans grown in Frederick and Washington Counties are available from the National Agricultural Statistics Service (NASS). Crop yields obtained within the park are then compared to county average yields for the corresponding crop and growing season. Variance should be analyzed using paired t-tests.

Visual surveys are also required to verify deer impacts, and not impacts due to other causes. Deer leave jagged edges on twigs or stems, compared with clean-cut surfaces left by rabbits or other rodents (Dolbeer, Holler, and Hawthorne 1994).

ORCHARD THRESHOLD (ANTIETAM ONLY)

At Antietam, key historic landscape features include woodlots and forested areas, agricultural fields, and orchards. Orchards have been particularly hard hit by deer, because deer browse on new growth on orchard trees. Damage to just the new growth (current growing season's tissue) is the most severe type of damage to trees (compared to damage to terminal leaders, older wood, or trunks), and this can drastically affect the ability of trees to survive (Dolan, pers. comm. 2012). Orchard trees are currently protected by fencing around each individual tree in highly visible areas.

Based on this assessment, the team decided to use a measure of damage to current growth as an indicator that action needed to be taken to protect orchard trees. Action would be taken when more than 25% of the current growth is removed by deer browse in one year. This is based on horticultural standards identifying the loss of more than 25% of live tissue (new growth) from any given tree in a single year having the likelihood that the tree would not be able to survive (ISA 2002). The park conducts deadwood/winter pruning annually, and monitoring and inspection for deer damage will be conducted in conjunction with the pruning cycle.

As with the inspections to the crops, deer related damage to fruit trees can be identified by the break. Deer do not have an upper set of incisors, so twigs will not be neatly broken, and will instead be ragged or shredded. White-tailed deer will tend to not browse on branches larger than an inch in diameter, and seldom browse on branches higher than six feet, although they can browse on branches up to eight feet if they stand on their hind legs (Dolbeer, Holler, and Hawthorne 1994). Male deer may also use trees to rub the velvet from their antlers (buck rub) and scarring from buck rub is generally found up to about three feet high on tree trunks (Dolbeer, Holler, and Hawthorne 1994).

Percentage of damage to the tree would be calculated visually by documenting obvious indications of damage during pruning, and documenting tree structure photographically before and after each pruning. The condition of the tree after pruning would be compared to the condition of the tree before pruning the next season. If it appears that more than 25% of fresh growth and live structure of the tree has been removed as a result of deer damage, deer management action should be taken.

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APPENDIX B: REVIEW OF WHITE-TAILED DEER FERTILITY CONTROL

INTRODUCTION

Managing the overabundance of certain wildlife species has become a topic of public concern (Rutberg et al. 2004). Species such as Canada geese (*Branta canadensis*), coyotes (*Canis latrans*), and white-tailed deer (*Odocoileus virginianus*) have become either locally or regionally overabundant in many areas in the United States (Fagerstone et al. 2002). Traditional wildlife management techniques such as hunting and trapping are often unfeasible, publicly unacceptable, or illegal in many parks, urban, and suburban areas, forcing wildlife managers to seek alternative management methods (Kilpatrick and Walter 1997; Muller, Warren, and Evans 1997). The use of reproductive control as a wildlife management tool has been studied for several decades.

For reproductive control agents to effectively reduce population size, treatment with an agent must decrease the reproductive rate to less than the mortality rate in a closed population with no immigration or emigration. In an open population, where there is much animal movement into and out of an area being considered for treatment, the use of fertility control agents is not likely to be successful in decreasing a population (Rudolph, Porter, and Underwood 2000). Good estimates of population emigration, immigration, and birth and survival rates are needed before predictive models can be used to approximate the effort required to successfully use contraception as a population management technique.

The purpose of this document is to provide NPS managers at Antietam National Battlefield, Monocacy National Battlefield, and Manassas National Battlefield Park with (1) a brief overview of contemporary reproductive control options as they pertain to white-tailed deer; (2) an outline of the primary advantages, disadvantages and challenges related to the application of wildlife fertility control agents including population management challenges, regulatory issues, potential logistical issues, and consumption issues; and (3) an evaluation of current fertility control agents against criteria established by the park for use of a reproductive control agent. This document is not intended to be exhaustive but to provide a scientifically sound basis for understanding and evaluating deer management alternatives that include reproductive control of female deer.

It is important to note that some of the most critical elements of a successful population level fertility control program focus on ecological and logistical questions rather than the efficacy of fertility control agents in individual animals. It should also be noted that technology and regulation is changing rapidly in this field and updated information should be reviewed prior to implementation of a deer management program that involves fertility control.

There is general agreement that because of the logistical difficulties of treating significant numbers of deer that controlling large, open, free-ranging populations of wild ungulates solely with a contraceptive vaccine is impractical and unlikely to succeed (Rutberg et al. 2004; Garrott et al. 1992; Garrott 1995; Warren 2000; Rudolph, Porter, and Underwood 2000; Cowan, Pech, and Curtis 2002; Merrill, Cooch, and Curtis 2003 and 2006). There is also agreement that fertility control as an exclusive means of managing populations cannot reduce wildlife population size rapidly (Rutberg and Naugle 2008a; Kirkpatrick and Turner 2008). The few long-term (> 10 year) research projects evaluating population level effects of PZP on long-lived species (horses and deer) support this statement. At Assateague Island National Seashore, PZP treatments were successful in reducing the wild horse population 16% (from 160 to 135 individuals) between 1994 and 2009 (15 years). The park expects to reach the target population size of 135 horses in another 8-9 years (C. Zimmerman, pers. comm. 2009). At Fire Island National Seashore, park managers report a 33% reduction in overall deer population size (from approximately 600 to 400 individuals) between 1994 and 2009 (M. Bilecki, pers. comm. 2009). In the most intensively treated areas of the park deer population size decreased up to 55% over 15 years (Rutberg and Naugle 2008a). All population level studies have been conducted in relatively closed populations. The appropriateness of fertility control as a deer management tool is heavily dependent on specific park objectives and the purpose and need for management.

CURRENT TECHNOLOGY

The area of wildlife contraception is constantly evolving as new technologies are developed and tested. For the sake of brevity, this appendix will only discuss reproductive control as it applies to female deer. There is a general understanding in white-tailed deer biology that managing the female component of the population is more important than managing the male component. Based on the polygamous breeding behavior of white-tailed deer, treating males with reproductive control would be ineffective when the goal is population management (Warren 2000; Garrett and Siniff 1992).

Regulation of wildlife fertility control agents can be confusing. If a product is intended for use in a food-producing animal, it must be deemed safe for human consumers. Regardless of its use in food animals, a fertility control agent must be considered safe for use in the target species and not present environmental health hazards to non-target species. Until 2006 the Food and Drug Administration (FDA), was the agency responsible for regulation of wildlife contraceptives and their potential for drug residues. Since this time the Environmental Protection Agency (EPA) has assumed responsibility for regulating contraceptives for use in free-ranging wildlife and feral animals (Fagerstone et al. 2010). The EPA, in consultation with the contraceptive manufacturer/sponsor, will determine the safety of the product and marking requirements for free-ranging animals treated with contraceptives. Prior to EPA registration, products can be studied in free-ranging populations to gather safety and efficacy data under an experimental use permit (EUP) which is obtained by the product's sponsor. Until products are registered by the EPA, and marking requirements made explicit, animals treated with any fertility control product should be permanently marked.

Marking is also needed for long-term monitoring of contraceptive efficacy in individual animals, determining which deer have been treated during implementation and for efficient re-treatment, and to monitor population vital rates. Finally, while NPS units have jurisdiction for wildlife management within their borders, parks are strongly encouraged to cooperate and coordinate with state agencies to manage cross boundary wildlife resources whenever possible (43 CFR 24). Therefore, parks should also communicate with appropriate state agencies regarding marking of treated animals in areas where deer may cross park boundaries. The disadvantages of permanent marking are primarily related to the substantial additional labor and costs of the first year's capture and marking of treated animals, sustainability of this effort over the long term, capture associated stress to individual deer (compared to remote delivery), and potential social acceptance concerns. Despite these drawbacks, marking is nearly always warranted when considering a fertility control program.

There are three basic categories of reproductive control technology: (1) immunocontraceptives (vaccines), (2) non-immunological methods (pharmaceuticals), and (3) physical sterilization.

IMMUNOCONTRACEPTIVES

It has been offered that immunocontraceptive vaccines offer significant promise for future wildlife management (Rutberg et al. 2004). Immunocontraception involves injecting an animal with a vaccine that stimulates its immune system to produce antibodies against a protein (antigen) involved in reproduction (Warren 2000). In order to induce sufficient antibody production, an adjuvant is combined with the antigen. An adjuvant is a product that increases the intensity and duration of the immune system's reaction to the vaccine. There are two primary types of antigens used in reproductive control vaccines in deer: porcine zona pellucida (PZP) and gonadotropin releasing hormone (GnRH).

Neither PZP nor GnRH vaccines are 100% effective in preventing pregnancy. Using a two-dose vaccination protocol Curtis et al. (2002) demonstrated approximately 85-90% decrease in the number of fawns born per female after vaccination with either GnRH or PZP immunocontraceptive vaccines in white-tailed deer. Likewise, Rutberg and Naugle (2008a) showed a 75% decrease in annual fawn production using PZP vaccination in two relatively closed white-tailed deer populations. In a more contemporary version of the GnRH vaccine, Gionfriddo et al. (2009) found 88% efficacy the first year and 47% efficacy the second year at preventing pregnancy in white-tailed deer after a single vaccination. The GnRH vaccine has not been evaluated at the population level. Efficacy generally decreases as antibody production wanes. Reduced pregnancy rates can usually be expected for 1 to 2 years post-treatment with immunocontraceptive vaccines although there is the potential for longer-term or even permanent sterility (Fraker et al. 2002; Miller et al. 2008; Miller et al. 2009). Duration of infertility is strongly related to the conjugate-antigen design, the adjuvant used, how the vaccine is delivered, and the host's immune system (Miller et al. 2008; Kirkpatrick et al. 2009).

Porcine Zona Pellucida (PZP)

The majority of immunocontraceptive research in wildlife has been conducted using PZP vaccines. PZP vaccines stimulate production of antibodies directed towards specific outer surface proteins of domestic pig ova (eggs). Pig ova are sufficiently similar to many other mammals' ova that antibodies produced will cross-react with the vaccinated animal's own ovum. PZP antibodies prevent fertilization, presumably by blocking the sperm attachment sites on the zona which surrounds the ovum. There are currently two PZP vaccine products being developed, one is simply called PZP and the other SpayVac®.

SpayVac® (ImmunoVaccine Technologies, Halifax) uses a liposome preparation of PZP mixed with an adjuvant to induce antibody production. This vaccine has been evaluated in a variety of species, including captive and to a lesser extent free-ranging white-tailed deer (Brown et al. 1997; Fraker et al. 2002; Locke et al. 2007; Rutberg and Naugle 2009). The other PZP vaccine, often referred to as "native" PZP, does not use liposome technology but does require a potent adjuvant. Native PZP vaccines have been used extensively in captive wildlife species in the course of investigating its effectiveness (Rutberg and Naugle 2008a; Kirkpatrick et al. 1997; Turner, Kirkpatrick, and Liu 1996; Walter et al. 2002a, 2002b).

The native PZP vaccine has also been tested at length in free-ranging white-tailed deer (Rutberg and Naugle 2008a; Naugle et al. 2002; Rudolph, Porter, and Underwood 2000; Rutberg et al. 2004; Walter et al. 2002a, 2002b; Walter, Kilpatrick, and Gregonis 2003). Potential benefits of the native vaccine include the ability to deliver the vaccine remotely, its safety in pregnant deer and non-target species (Barber and Fayrer-Hosken 2000), and the availability of at least some long-term data on population level effects. The currently available PZP vaccine formulation is effective for two years (Turner et al. 2007; Turner et al. 2008; Rutberg and Naugle 2009), though longer multiyear applications are also being studied. The two-year formulation has received only limited testing in free-ranging white-tailed deer.

SpayVac® provides the same advantages as native PZP but may result in infertility for up to seven years (Miller et al. 2009). Potential advantages of SpayVac® compared to the native PZP vaccine are (1) a more rapid immune response, (2) higher antibody titers, (3) a higher proportion of antibodies that bind to target sites, and (4) longer duration of efficacy (Fraker and Bechert 2007). Although little long-term data on population level effects exists for SpayVac®, it is assumed they are similar to those for the native PZP formulation.

Challenges to the use of both PZP vaccines include lack of regulatory approval for use in free-ranging wildlife populations, behavioral impacts (continued estrous cycling), frequency of treatment (need for booster shots), out of season fawning, and possibly changes in body condition. PZP vaccines are not currently registered for use in free-ranging wildlife but may be in the future (see above for regulatory issues).

PZP based vaccines often cause out of season breeding behavior in treated deer because reproductive hormones which are responsible for estrous cycling are not suppressed (Miller et al. 2009; McShea et al. 1997; Fraker et al. 2002; McShea and Rappole 1997). Repeated estrous cycling has the potential to extend the population breeding season and male/female rutting behaviors. Additionally, extended estrous seasons may result in late pregnancies if the vaccine fails (Fraker et al. 2002; McShea et al. 1997). Fawning later in the summer/fall may lead to higher fawn mortality as winter ensues. Any effect that extends the rut also has the potential for secondary effects to both male and female deer. Increased attempts to breed may result in increased deer movements. It has been suggested that this may encourage deer-vehicle collisions. However, the only known research evaluating this specific issue reported that deer treated with PZP were at no greater risk of being involved in a deer-vehicle collision than untreated deer (Rutberg and Naugle 2008b).

Increased activity during rut can be energetically costly for both sexes. While this is likely offset by the lack of pregnancy demands in female deer it may have cumulative effects on energy expenditures in male deer (Walter, Kilpatrick, and Gregonis 2003; McShea et al. 1997). Alternatively, PZP-treated females may experience increased body condition and a longer life span compared to untreated individuals as a result of reduced energetic costs of pregnancy and lactation (Warren 2000; Hone 1992). For example, at Assateague Island National Seashore, the life span of horses treated with PZP has been extended from an average age at death of 20 years to 26-30 years (Kirkpatrick and Turner 2008; C. Zimmerman, pers. comm. 2009). Longer life span may extend the time needed to observe a decline in population size (Kirkpatrick and Turner 2008). Studies in white-tailed deer investigating effects on body condition are equivocal (Walter, Kilpatrick, and Gregonis 2003; McShea et al. 1997). There are no long-term studies investigating potential extended survival in free-ranging wild deer.

Successful field application of a fertility control program requires both an effective agent and a practical delivery system (Cowan, Pech, and Curtis 2002). Although PZP vaccines may be successfully delivered remotely through darting, the native PZP vaccine that has been tested most extensively requires a series of two initial doses followed by periodic boosters in order to maintain infertility. The need for multiple doses leads to significant logistical issues when working with free-ranging white-tailed deer, particularly when the number of deer to be treated is high. New research involving controlled-release native PZP formulations incorporates primer and booster immunizations into one injection and may extend the period of infertility (Turner et al. 2008). Turner et al. (2008) provides an overview of the current status of research related to controlled-release components of native PZP contraceptive vaccines. The new native PZP formulations have not yet been delivered through a dart. SpayVac® does not require a first year booster and may prove to be easier to implement because follow-up doses would only be required every 3-7 years (Fraker 2009), however, to our knowledge SpayVac® has not been delivered remotely.

Many studies have modeled and a few field studies have field tested population-level effects of PZP vaccination (Rutberg et al. 2004; Nielsen, Porter, and Underwood 1997; Rudolph, Porter, and Underwood 2000; Rutberg and Naugle 2008a). Research evaluating the effectiveness of PZP in reducing the size of deer populations has focused on moderate to high density deer populations of relatively small size (< 300-500 individuals). Within these populations, long-term (> 10 year) data indicates that population size of may be gradually reduced using PZP treatments (Kirkpatrick and Turner 2008; Rutberg and Naugle 2008a). Rutberg and Naugle (2008a) reported a 27% decline in the size of a small, relatively closed, suburban deer population (approximately 250 deer) between 1997 and 2002, as a result of PZP treatments and potentially other stochastic events. However, level of success in reducing population size varies widely. For example, deer density on Fire Island National Seashore was significantly reduced in some areas but reduced very little in other areas likely due to inability to treat significant numbers of does in certain areas (Rutberg and Naugle 2008a; Underwood 2005). Site specific modeling using accurate population demographic and vital rate data as well as knowledge of local deer behavior, land access availability and likelihood of achieving treatment application goals is needed to determine how fast a population can be reduced and how deep a reduction can be achieved.

Additional information on PZP may be obtained at

http://www.aphis.usda.gov/wildlife_damage/nwrc/research/reproductive_control/index.shtml OR http://www.pzpinfo.org.

Gonadotropin Releasing Hormone (GnRH) Vaccines

GnRH is a small neuropeptide (a protein-like molecule made in the brain) that plays a necessary role in reproduction. It is naturally secreted by the hypothalamus (a region of the brain that regulates hormone production), which directs the pituitary gland to release hormones (luteinizing hormone and follicle stimulating hormone) that control the function of reproductive organs (Hazum and Conn 1988). In an attempt to interrupt this process, research has focused on eliminating the ability of GnRH to trigger the release of reproductive hormones. One option is vaccination against GnRH. Antibodies produced in response to vaccination likely attach to GnRH in the hypothalamic region and prevent the hormone from binding to receptors in the pituitary gland, thus suppressing the secretion of reproductive hormones and preventing ovulation.

GnRH vaccines have been investigated in a variety of wild and domestic ungulates (hoofed mammals) (Adams and Adams 1990; Curtis et al. 2002; Miller et al. 2000; Miller, Rhyan, and Drew 2004). One GnRH vaccine that has been developed specifically for wildlife contraception is GonaCon™. GonaCon™ is registered with the EPA as a restricted use pesticide to control white-tailed deer fertility. The label requires marking the treated animal and giving the vaccine by hand-injection to limit the potential for non-target animal and environmental exposure to the vaccine.

Potential benefits of this vaccine include a relatively long-lasting contraceptive effect (1-2 years and potentially longer) and possibly the lack of repeated estrous cycles (Curtis et al. 2002). In free-ranging white-tailed deer, GonaCon™ is estimated to be 88% effective in preventing pregnancy during the first year post-treatment, and approximately 47% effective in the second year (Gionfriddo et al. 2009), however long-term field efficacy data currently does not exist. Although the label indicates a minimum of 1 year efficacy, the contraceptive effect typically lasts two years and possibly longer in some individuals (Fagerstone et al. 2008). Repeated estrous cycling and other behavioral changes in white-tailed deer have not been consistently documented in association with GnRH vaccines (Curtis et al. 2008). However, Killian et al. (2008) reported that behavioral expressions of estrus were only decreased for 1-2 years post-treatment and increased in subsequent years despite does remaining infertile and Curtis et al. (2002) reported sporadic and delayed estrous cycling with prolonged fawning season in GnRH vaccinated deer as contraceptive effects waned.

GnRH vaccines have many of the same challenges associated with PZP including the need for repeated treatment to maintain infertility, and the need to mark treated animals. Additionally, as with any vaccine which uses the adjuvant AdjuVac™, immune response to the adjuvant may interfere with determination of the animal's Johne's disease status (a gastrointestinal disease of potential regulatory importance for domestic livestock) (Miller et al. 2008). Managers should be aware of this prior to vaccination if neighboring lands have domestic livestock grazing.

Other challenges to use of GonaCon™ include potential health effects on treated deer, lack of information related to effectiveness at the population level in free-ranging deer, and requirement for hand-injection. Killian et al. 2006 concluded that GonaCon™ was safe for deer and that there were no adverse health impacts associated with unintentional repeated vaccination. However, granulomas and injection site abscesses have been consistently associated with vaccination (Curtis et al. 2008, Gionfriddo et al. 2009). A granuloma is a localized inflammatory response to the vaccine that occurs at the site of injection and can persist for many years post-treatment. Overall, no debilitating, long-term impacts to health or changes in behavior have been consistently associated with GnRH vaccination in female deer.

Similar site specific modeling and population data are required for evaluating the potential for success in managing a free-ranging deer population with GonaCon™ as was described for PZP immunocontraception.

Additional information may be obtained at: http://www.aphis.usda.gov/wildlife_damage/nwrc/research/reproductive_control/index.shtml.

NON-IMMUNOLOGICAL REPRODUCTIVE CONTROL METHODS

This group of reproductive control agents includes GnRH agonists, GnRH toxins, steroid hormones, and contragestives.

GnRH Agonists

GnRH agonists are highly active analogs of GnRH which are similar in structure and action to the endogenous hormone. These agonists attach to receptors in the pituitary gland. By attaching to the receptors, these agonists reduce the number of binding sites available and thereby temporarily suppress the effect of the GnRH. As a result of this suppression, reproductive hormones are not released (Aspden et al. 1996; D'Occhio, Aspden, and Whyte 1996). Continuous administration of the agonist is necessary to maintain infertility. This can be accomplished with controlled-release formulations or surgically implanted pumps in addition to daily administration.

Not all agonists have the same effects in all species. In fact, some can have an effect that is the opposite of what is intended. The wide variation in response is likely due to a combination of type of agonist, dose, treatment regime, reproductive status, sex, and species (Becker and Katz 1997). Therefore, it is important to fully understand the effects of a product on a given species. Although many GnRH agonists are used in human as well as veterinary medicine only a few have been investigated in wildlife species (Becker and Katz 1997; Vickery 1986). GnRH agonists have been tested primarily in mule deer and elk and been shown to both suppress reproductive hormones and prevent pregnancy (Baker et al. 2005; Baker et al. 2004; Baker et al. 2002; Conner et al. 2007).

- **Leuprolide acetate**. Leuprolide is a GnRH agonist that when administered as a controlled-release formulation, results in 100% pregnancy prevention in treated female elk and mule deer (Baker et al. 2002 and 2004; Conner et al. 2007). In addition, the treatment is reversible, and the effects last only for a single breeding season (Baker et al. 2004; Trigg et al. 2001). Advantages of leuprolide acetate are that it is 100% effective in preventing pregnancy, is safe for human consumption (Baker et al. 2004), can be delivered remotely (Baker et al. 2005), does not result in physiological side effects, and there are few behavioral effects (Baker et al. 2004). Treatment did not suppress reproductive behavior during the breeding season but also did not prolong behaviors into the non-breeding season.

Leuprolide is FDA-approved for use in humans and has been used experimentally in cervids. It is not currently approved for use as a free-ranging wildlife as a fertility control drug. It is not known if this application will be pursued in the future. The need to deliver leuprolide subcutaneously via hand injection has traditionally been considered a significant barrier to the long-term application of this drug as a wildlife management tool. However, Baker et al. (2005) successfully applied the treatment through dart delivery which may extend the practical application of this contraceptive.

Treatment using leuprolide differs from GnRH vaccines in that it does not require an adjuvant and does not induce an antibody reaction. Therefore, inflammatory responses to adjuvant components and other physiological effects, often observed with immunocontraceptives, have not been observed in association with leuprolide. It does, however, require a slow release implant that remains under the skin or in the muscle. Additionally, leuprolide does not likely pose a threat to the environment or nontarget species because the drug is not absorbed through the oral route of administration (Baker et al. 2004). Marking requirements for animals treated with leuprolide implants are currently unknown because it is not a registered wildlife contraceptive.

One drawback to the use of leuprolide is the need to treat animals within a short timeframe prior to the breeding season (Conner et al. 2007). If a female is not retreated each year, she has the same chances of becoming pregnant as an animal that was never treated. The need to treat a potentially large number of individuals within a short period of time on an annual basis reduces the feasibility of leuprolide as a wildlife management tool, particularly for large, free-ranging, open deer populations.

- **Histrelin acetate**. Histrelin acetate is effective in suppressing a key reproductive hormone in white-tailed deer (Becker and Katz 1995). However, testing was administered using a mini-pump that was surgically implanted under the animal’s skin. This is an infeasible route of administration in free-ranging animals. In the future, a delivery system with slow release characteristics may help to make this a more feasible option for free-ranging wildlife. It is likely that histrelin acetate will also suppress ovulation and pregnancy in white-tailed deer, although this remains to be tested.

GnRH Toxins

GnRH toxins consist of a cellular toxin that is combined with a GnRH analog (either agonist or antagoinst). A GnRH analog is a synthetic peptide similar to the body’s own gonadotropin-releasing hormone. Using the analog as a carrier, a cellular toxin can be delivered to specific cells in the pituitary which produce reproductive hormones. Internalization of the toxin leads to cell death. When this occurs, the production of reproductive hormones (leuteinizing hormone and follicle stimulating hormone) is affected. This process has been studied in male dogs (Sabeur et al. 2003), domestic sheep (Nett et al. 1999), rats (Kovacs et al. 1997), and female mule deer (Baker et al. 1999) but the technology is still in the developmental stages and not ready for use in free-ranging wildlife.

Steroid Hormones

The field of wildlife contraception began with research examining the manipulation of reproductive steroid hormones (Matschke 1980, 1977a, 1977b). Treatment usually entails the application of synthetic hormones, such as norgestomet, and melangestrol acetate (Jacobsen, Jessup, and Kesler 1995; DeNicola, Kesler, and Swihart 1997a; Fagerstone et al. 2010). Available products are administered via slow release implants or repeated feeding and have demonstrated variable efficacy and duration of infertility. Most products that are available are used in domestic animal or zoological veterinary medicine and have not been used widely in free-ranging wildlife. Issues related to using steroids include difficulties in treating large numbers of animals for extended periods of time, potential reproductive tract pathological side effects experienced by the treated animals, and concerns over the consumption of treated animals by nontarget species and humans. Although many of these hormones are used as growth promotants in domestic food animal production, they are not labeled for use in free-ranging wildlife. Currently, this method of contraception is not being pursued by the wildlife management community.

Contragestives

Contragestives are products that terminate pregnancy. Progesterone is the primary gestational hormone for maintaining pregnancy in mammals. Many contragestives act by preventing progesterone production or blocking its effect, thereby affecting pregnancy. The primary contragestive that has been researched for use in domestic animals and white-tailed deer is an analog of Prostaglandin F2α (PGF2α) (Becker and Katz 1994; DeNicola, Kesler, and Swihart 1997b; Waddell et al. 2001). Lutalyse® is a commercially available form of PGF2α. Unlike many of the other alternatives, there are no issues related to consumption of the meat when the animal has been treated with this product. Challenges with contragestives include timing of administration, efficacy, potential to rebreed if breeding season is not finished, and the potential for aborted fetuses on the landscape. These limitations make their use in free-ranging populations for fertility control purposes infeasible.

Sterilization

Surgical sterilization of females is an effective method of controlling reproduction and has been used extensively in domestic animal medicine. However, implementation requires capture, general anesthesia, and surgery conducted by a veterinarian which is generally considered labor intensive and costly and calls into question the long-term sustainability of sterilization as a wildlife management tool, except under very limited circumstances. Only in rare circumstances is physical sterilization reversible.

Depending on the method of sterilization, this procedure may have behavior effects on both male and female deer. If gonads are removed, then the source of important reproductive hormones will be removed. This is likely to change deer social interactions. If gonads are not removed, females will continue to ovulate and show behavioral signs of estrus and consequently may extend the breeding season.

EVALUATION OF REPRODUCTIVE CONTROL AGENTS BASED ON SELECTION CRITERIA ESTABLISHED BY THE NPS

Five criteria were established by the NPS that reflect minimum desired conditions for using a reproductive control agent. Only when these criteria are met would reproductive control be implemented.

1.	There is a federally approved fertility control agent for application to free-ranging populations.
2.	The agent provides multiyear (3–5 years) efficacy.
3.	The agent can be administered through remote injection.
4.	The agent would leave no hormonal residue in the meat (i.e., meat derived from treated animals should be safe for human consumption according to applicable regulatory agencies, and safe for consumption by other animals).
5.	Overall, there is substantial proof of success with limited behavioral impacts in a free-ranging population, based on scientific review and NPS policy.

Table B-1 provides a summary of how current reproductive control agents meet the criteria.

TABLE B-1: EVALUATION OF FERTILITY CONTROL AGENTS BASED ON NPS SELECTION CRITERIA

Agent	Criterion 1 Federally Approved	Criterion 2 Multiyear Efficacy (3+)	Criterion 3 Capable of Remote Administration	Criterion 4 Meat Safe for Humans	Criterion 5 Success in Free-ranging Populations
Immunocontraceptives					
"Native" PZP	No	No [a]	Yes	Likely, but need EPA approval	Yes, but only in fenced populations or on a very small scale
SpayVac™	No	Possibly [b]	Unknown		
GnRH (GonaCon™)	Yes	Variable [c]	Possibly [d]	Yes	Untested
GnRH Agonists					
Leuprolide acetate	No	No	Yes	Likely, but need EPA approval	Untested
Histrelin acetate	No	No	No	Likely, but need EPA approval	Untested
Other					
GnRH toxins	No	Unknown	Unknown	Likely but unknown	Untested
Steroid hormones	No	No	Unknown	Unlikely, but need regulatory guidance	Untested
Contragestives	No	No	Yes	Yes	Not likely but untested

[a] Initial research on one-shot, multiyear PZP vaccine has demonstrated 88.3% efficacy in year 1 and 75% efficacy in the second year after treatment (Turner et al. 2008). Research is currently ongoing to evaluate effectiveness in year 3 and beyond. Rutberg has indicated that "based on the design of the vaccine and our experience with horses, it's unlikely that the vaccine would have much effect past the third year" (Rutberg, pers. comm. 2009). However, research on this vaccine is ongoing and is expected to continue into the future.

[b] SpayVac™ has demonstrated 80%–100% efficacy for up to 5–7 years in horses and deer (Fraker, pers. comm. 2009; Miller, Fagertone et al. 2009; Killian et al. 2008). The term "possibly" is used because long-term studies (>5 years) have been conducted only in captive deer and had a small sample size in each treatment group (N = 5) (Miller, Fagertone et al. 2009).

[c] Recently published research on one-shot, multiyear GnRH vaccine in penned/captive deer indicates GonaCon™ is 88%–100% effective in year 1, 47%–100% effective in year 2, and 25%–80% effective up to 5 years after treatment (Miller, Gionfriddo et al. 2008; Gionfriddo et al. 2009). The term "variable" is used because the multi-year formulation has been used only in captive deer, had a small sample size, and lacks confidence intervals on the data. GonaCon™ has been found to be less effective in free-ranging ungulates than captive ungulates (Gionfriddo et al. 2009).

[d] Recent work published used dart delivery to administer the GnRH vaccine to elk (Killian et al. 2009).

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APPENDIX C: CHRONIC WASTING DISEASE

This appendix summarizes guidance provided by the National Park Service (NPS) in response to chronic wasting disease (CWD), and it outlines management options available to parks for implementation in the absence of a specific CWD plan.

As of March 2011, CWD has been diagnosed in only two national parks — Rocky Mountain and Wind Cave national parks. However, several national park system units are at high risk because of their proximity to known CWD cases in many areas of the United States. As of December 2012, the closest known cases of CWD to the three parks are in white-tailed deer in Slanesville, West Virginia, in Maryland in Green Ridge State Forest, and a recent case of CWD found in a captive deer in New Oxford, Pennsylvania, near Gettysburg National Military Park. Green Ridge State Forest is approximately 10-20 miles north of Slanesville and across the Potomac River. These occurrences place CWD within 36 miles of Antietam, 39 miles of Monocacy, and 51 miles of Manassas. While much is still unknown about the spread of the disease and the long-term effects, there is currently no evidence that the disease can be transmitted to humans or domestic livestock.

There is a high likelihood that the disease will be detected in other areas of the country following increases in disease surveillance as well as disease spread. CWD presents population decline risks to wild cervids and although there is no evidence to suggest that CWD is transferred to domestic animals or humans these risks are not completely understood. Therefore, CWD has become an issue of national importance to wildlife managers and other interested publics, as well as NPS managers.

NPS POLICY AND GUIDANCE

DIRECTOR'S CWD GUIDANCE MEMORANDUM (JULY 26, 2002)

The NPS director provided guidance to regions and parks on NPS response to CWD in a memorandum dated July 26, 2002. Even though the memo pre-dates current CWD distribution in the national park system, the guidance remains pertinent. The guidance addresses surveillance, management, and communication regarding the disease. It also strictly limits human assisted translocation of deer and elk into or out of national park system units. Deviation from the guidance memo requires a waiver approved by the director.

A NATIONAL PARK SERVICE MANAGER'S REFERENCE NOTEBOOK TO UNDERSTANDING CHRONIC WASTING DISEASE (VERSION 4: JULY 2007)

This notebook serves as an informational reference that summarizes some of the most pertinent CWD literature, management options, and policies as they pertain to units of the national park system. It is not meant to be an all-inclusive review of current literature or management options. CWD is an emerging disease, and the knowledge base is continuing to expand. This document will be updated as necessary to include information pertinent to the NPS.

ELK AND DEER MEAT FROM AREAS AFFECTED BY CHRONIC WASTING DISEASE: A GUIDE TO DONATION FOR HUMAN CONSUMPTION (MAY 2006)

This document provides an overview of the issues surrounding CWD as it relates to public health, and includes NPS recommendations for the use of cervid meat for human consumption from parks affected by CWD surveillance and management actions within or near areas where CWD has been identified or where CWD testing is being conducted.

DESCRIPTION AND DISTRIBUTION

CWD is a slowly progressive, infectious, self propagating, neurological disease of captive and free-ranging mule deer (*Odocoileus hemionus*), white-tailed deer (*O. virginianus*), Rocky Mountain elk (*Cervus elaphus nelsoni*), and moose (*Alces alces*). The disease belongs to the transmissible spongiform encephalopathy (TSE) group of diseases (similar to scrapie and bovine spongiform encephalopathy). CWD is the only TSE currently found in free-ranging animals. TSEs are characterized by accumulations of abnormal prion (proteinaceous infectious particle) proteins in neural and lymphoid tissues (Prusiner 1982, 1991, 1997).

There is evidence that human-associated movement of cervids has aided in the spread of the disease in captive, and likely free-ranging, deer and elk (Miller and Williams 2003; Salman 2003; Williams and Miller 2003). Localized artificial concentration of cervids in areas with few natural predators likely aids in disease transmission (Spraker et al. 1997; Samuel et al. 2003; Farnsworth et al. 2005, Wild et al. 2011). There is strong evidence to suggest that anthropogenic factors, such as land use, influence CWD prevalence (Farnsworth et al. 2005). Therefore, human influences are likely a significant component of observed CWD distribution and prevalence. CWD is considered a non-native disease process (Wild et al. 2011).

As of March 2011, CWD had been found in captive/farmed cervids in 12 states and 2 Canadian provinces and in free-ranging cervids in 15 states and 2 provinces. The historic area of CWD infection encompasses northeastern Colorado, southeastern Wyoming, and the southwest corner of the Nebraska panhandle (Williams and Miller 2002; Williams et al. 2002b). However, with increased surveillance that has occurred since 2001, the disease has been found with increasing frequency in other geographically distinct areas (Joly et al. 2003).

CLINICAL SIGNS

The primary clinical signs of CWD in deer and elk are changes in behavior and body condition (Williams et al. 2002b). Signs of the disease are progressive. Initially only someone who is quite familiar with a particular animal or group of animals would notice a change in behavior. As the clinical disease progresses over the course of weeks to months, animals demonstrate increasingly abnormal behavior and additional clinical signs (Williams and Young 1992). Affected animals can lose their fear of humans, show repetitive movements, and/or appear depressed but quickly become alert if startled. Affected animals rapidly lose body condition, despite having an appetite (Williams et al. 2002b). In the end stages of the disease they become emaciated. Once an animal demonstrates clinical signs, the disease is invariably fatal. There is no treatment or preventative vaccine for the disease.

DIAGNOSIS AND TESTING

CWD was initially diagnosed in deer and elk by testing a portion of the brain (histopathology techniques) (Williams and Young 1993). While this method is effective at diagnosing relatively advanced cases, it is not sensitive enough to detect early disease stages (Spraker et al. 1997; Peters et al. 2000).

In contrast, immunohistochemistry (IHC) is a sensitive, specific, and reliable test that can be used to identify relatively early stages of chronic wasting disease. This technique can detect CWD prions in many tissues (brain, retropharyngeal lymph nodes, and tonsils) (O'Rourke et al. 1998).

In addition to immunohistochemistry, which takes several days to complete, new rapid tests also employ antibody technology to diagnose CWD. Each has various advantages and disadvantages. Only certified laboratories can perform immunohistochemistry or the rapid CWD tests.

No test available is 100% sensitive for CWD, which means that a negative test result is not a guarantee of a disease-free animal.

TRANSMISSION

There is strong evidence that CWD is infectious and is spread by direct (animal to animal) or indirect (environment to animal) lateral transmission (Miller et al. 2000; Miller and Williams 2003). Bodily secretions such as feces, urine, and saliva have all been suggested as possible means of transmitting the disease between animals and disseminating infectious prions into the environment (Miller et al. 2000; Williams et al. 2002b; Williams and Miller 2003). Maternal transmission cannot be ruled out, but it does not play a large role in continuing the disease cycle in either deer or elk (Miller et al. 1998; Miller et al. 2000; Miller and Williams 2003; Miller and Wild 2004).

Like other contagious diseases, CWD transmission increases when animals are highly concentrated. High animal densities and environmental contamination are important factors in transmission among captive cervids. These factors may also play a role in transmission in free-ranging animals (Miller et al. 2004).

Management actions that increase mortality rates in diseased populations can retard disease transmission by

1. Reducing the average lifetime of infected individuals. Reduced lifespan, in turn, can compress the period of time when animals are infectious, thereby reducing the number of infections produced per infected individual.

2. Reducing population density. The effect of reduced intervals of infectivity is amplified by reductions in population density because there are potentially fewer infectious contacts made. Both of these mechanisms may retard the transmission of disease. If these mechanisms cause the number of new infections produced per infected individual to fall below one, then the disease will be eliminated from the population (Tompkins et al. 2001). The likelihood of this occurring is unknown at this time.

DISPOSAL OF CWD INFECTED ORGANIC MATERIAL

Discarding known or suspect CWD-contaminated organic material, such as whole or partial carcasses, is likely to become an important issue for national park system units in the future. Each state, Environmental Protection Agency region, and refuse disposal area is likely to have different regulations and restrictions for disposal of potentially infected tissues. Currently there is no national standard for disposal. Because infected carcasses serve as a source of environmental contamination (Miller et al. 2004), it is recommended that known and suspect CWD-positive animals be removed from the environment.

Given the type of infectious agent (prions), there are limited means of effective disposal. In most cases, however, off-site disposal of infected material is recommended in approved locations. The available options for each park will vary and will depend on the facilities present within a reasonable distance from the park. Disposal of animals that are confirmed to be infected should be disposed of in one of the following ways:

- Alkaline Digestion—Alkaline digestion is a common disposal method used by veterinary diagnostic laboratories. This method uses sodium hydroxide or potassium hydroxide to catalyze the hydrolysis of biological material (protein, nucleic acids, carbohydrates, lipids, etc.) into an aqueous solution consisting of small peptides, amino acids, sugars, and soaps. During this process the prion proteins are destroyed.

- Incineration—Incineration is another disposal method commonly used by veterinary diagnostic laboratories. This method burns the carcass at intense temperatures (600 – 1000 degrees centigrade).
- Landfill—The availability of this option varies by region, state, and local regulations. Therefore, local landfills must be contacted for more information regarding carcass disposal, to determine if they can and will accept CWD positive carcasses or carcass parts.

MANAGEMENT

Chronic wasting disease has occurred in a limited geographic area of northeastern Colorado and southeastern Wyoming for over 30 years. Relatively recently, it has been detected in captive and free-ranging deer and elk in several new locations, including Nebraska, South Dakota, New Mexico, Utah, new areas of Wyoming and Colorado, and east of the Mississippi River in Wisconsin, Illinois, West Virginia, New York, Michigan and most recently in North Dakota, Minnesota, Virginia, and Maryland.

The NPS does not have a single overarching plan to manage chronic wasting disease in all parks. However, it has provided guidance to parks in how to monitor for and minimize the potential spread of the disease, as well as remove infected animals from specific areas. Generally, two levels of action have been identified, based on risk of transmission: (1) when CWD is not known to occur within a 60-mile radius from the park, and (2) when the disease is known to occur within the park or within a 60-mile radius.

The chance of finding CWD in a park is related to two factors: the risk of being exposed to the disease (the likelihood that the disease will be introduced into a given population), and the risk of the disease being amplified once a population of animals has been exposed. The first risk is important for national park system units where no CWD cases have been identified within 60 miles of their border. The second risk applies to units where chronic wasting disease is close to or within their borders, as well as in proactive planning efforts. By evaluating the risk of CWD exposure and amplification, managers can make better decisions regarding how to use their resources to identify the disease.

Actions available to identify CWD are linked to the risk factors present in and around the park. When risk factors are moderate, surveillance for chronic wasting disease can be less intense (e.g., opportunistic) than when risk is high (NPS 2005e). When the risk is higher, surveillance of all types should be increased. Other management actions that are in place for the host species may limit risk of exposure or transmission by maintaining biologically appropriate population densities. Whether CWD is within 60 miles of a unit or not, coordination with state wildlife and agriculture agencies when conducting CWD surveillance is strongly encouraged.

OPPORTUNISTIC SURVEILLANCE

Opportunistic surveillance involves taking diagnostic samples for testing from deer found dead or harvested through a management activity within a unit of the national park system. Cause of death may be culling, predation, disease, trauma (hit by car), or undetermined. Opportunistic surveillance has little, if any, negative impact on current populations. Unless deer are culled, for either population management or research goals, relatively small sample sizes may be available for opportunistic testing. Animals killed in collisions with vehicles may be a biased sample that could help detect CWD. Research has indicated that CWD-infected mule deer may be more likely to be hit by vehicles than non-CWD infected deer (Krumm et al. 2005).

Opportunistic surveillance is an excellent way to begin surveying for presence of CWD without changing management of the deer population. This is a good option for park units where CWD is a moderate risk but where it has not yet been encountered within 60 miles of the park. Opportunistic surveillance should also be used in parks in close proximity to the disease.

TARGETED SURVEILLANCE

Targeted surveillance entails lethal removal of deer that exhibit clinical signs consistent with CWD. Targeted surveillance has negligible negative effects on the entire population, removes a potential source of CWD infection, and is an efficient means of detecting new centers of infection (Miller et al. 2000). One limitation to targeted surveillance is that environmental contamination and direct transmission may occur before removal. Targeted surveillance is moderately labor intensive and requires educating park staff in recognition of clinical signs, as well as vigilance for continued observation and identification of potential CWD suspect animals. Training is available through the NPS Biological Research Management Division. Targeted surveillance is recommended in areas with moderate to high CWD risk (within 60 miles of known CWD occurrence) or in park units where CWD has already been identified.

POPULATION REDUCTION

Population reduction involves randomly culling animals within a population in an attempt to reduce animal density, and thus decrease transmission rates. In captive situations, where animal density is high, the prevalence of CWD can be substantially elevated compared to that seen in free-ranging situations. Thus, it is hypothesized that increased animal density and increased animal-to-animal contact, as well as increased environmental contamination, enhance the spread of CWD. Therefore, decreasing animal densities may decrease the transmission and incidence of the disease. However, migration patterns and social behaviors may make this an ineffective management strategy if instead of dispersing across the landscape, deer and elk stay in high-density herds in small home ranges throughout much of the year (Williams et al. 2002b). Population reduction is an aggressive and invasive approach to mitigating the CWD threat. It has immediate and potentially long-term effects on local and regional populations of deer and the associated ecosystem. This may be an appropriate response if animals are above population objectives and/or the need to know CWD prevalence with a high degree of accuracy is vital.

COORDINATION

Regardless of which surveillance method is used, each park should cooperate with state wildlife and agriculture agencies in monitoring CWD in park units, working within the park's management policies. CWD is not contained by political boundaries, thus coordination with other management agencies is important.

Additionally, as stated above, the NPS Biological Resource Management Division provides assistance to parks for staff training (e.g., sample collection, recognizing clinical signs of CWD) and testing (e.g., identifying qualified/approved labs or processing samples).

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APPENDIX D: AGENCY CONSULTATION

United States Department of the Interior

NATIONAL PARK SERVICE
Antietam National Battlefield
P.O. Box 158
Sharpsburg, MD 21782-0158

IN REPLY REFER TO:

March 15, 2012

Genevieve LaRouche, Field Supervisor
U.S. Fish and Wildlife Service
Chesapeake Bay Field Office
177 Admiral Cochran Drive
Annapolis, Maryland 21401

Dear Ms. LaRouche:

The National Park Service (NPS), in accordance with the National Environmental Policy Act, is currently preparing a white-tailed deer management plan and environmental impact statement (plan/EIS) for three battlefields: Antietam National Battlefield, Monocacy National Battlefield and Manassas National Battlefield Park. The purpose of the plan/EIS is to develop a deer management strategy that supports preservation of the cultural landscape through the protection and restoration of native vegetation and other natural and cultural resources. The plan will also include longer-term strategies for detection, monitoring and addressing Chronic Wasting Disease in white-tailed deer at the battlefields (in addition to the short term detection and initial response plan already in place at the two Maryland battlefields).

The plan will address a number of issues related to deer management in the battlefields, such as impacts to vegetation and wildlife, deer population health, and effects on visitor experience, among others. A primary focus of the plan/EIS will be the effects of high deer densities on forest regeneration and important park cultural landscapes. We welcome your input on any aspect of this project. We specifically seek information on the presence of listed threatened or endangered species in the vicinity of Antietam National Battlefield. Please note that although we are doing a combined EIS, a separate letter will be sent to solicit your input for Monocacy National Battlefield. To the knowledge of the NPS, no listed threatened or endangered species occur in the vicinity of either Antietam or Monocacy National Battlefields.

We specifically seek information on the presence of any known state-listed rare, threatened, or endangered species that are known to exist in the vicinity of Antietam National Battlefield. Please note that although we are doing a combined EIS, a separate letter will be sent to solicit your input for Monocacy National Battlefield.

Additional information on the plan/EIS may be found on the NPS's website at http://parkplanning.nps.gov/projectHome.cfm?projectID=35457. The NPS is now working on the draft plan/EIS which is anticipated for release in late 2012.
Your input will help ensure that the environmental impacts of the proposal are properly considered in the planning process. If you have any questions or require any further information please contact me at 301-432-7648 or by email at susan_trail@nps.gov. Thank you for your assistance.

Sincerely,

Susan Trail

Susan Trail
Superintendent
Antietam National Battlefield

Copy to:
Nancy Van Dyke, Louis Berger Group
Tracy Atkins, NPS, Denver Service Center

TAKE PRIDE IN AMERICA

United States Department of the Interior

NATIONAL PARK SERVICE
Antietam National Battlefield
P.O. Box 158
Sharpsburg, MD 21782-0158

IN REPLY REFER TO:

March 19, 2012

Mr. J. Rodney Little
State Historic Preservation Officer
Maryland Historical Trust
100 Community Place
Crownsville, MD 21032

Dear Mr. Little:

The National Park Service (NPS) is currently preparing a White-tailed Deer Management Plan/ Environmental Impact Statement for Antietam National Battlefield and Monocacy National Battlefield in Maryland and Manassas National Battlefield Park in Virginia, in accordance with the National Environmental Policy Act (NEPA). Louis Berger Group, Inc. (LBG) is the NPS's consultant for this effort.

The Plan/EIS will address a number of issues connected with deer management in the parks, such as impacts to vegetation and wildlife, deer population health, and effects on visitor experience, among others. A primary focus of the plan/EIS will be the effects of high deer densities on forest regeneration and important park cultural landscapes. Therefore, in accordance with the National Historic Preservation Act of 1966 (NHPA), as amended, and the regulations of the Advisory Council on Historic Preservation, the NPS wishes to formally begin consultation with your office with regard to the Plan's potential to affect historic properties at the Antietam National Battlefield. The NPS intends to coordinate the Section 106 review with its responsibilities under NEPA as identified in 36 CFR 800.3(a)(2)(b) and will be submitting the Draft EIS to your office for your review. In accordance with 36 CFR 800.8(c)(2)(i), the Draft EIS will serve as the Determination of Effect for cultural resources under Section 106 of the NHPA.

Information on the Plan/EIS may be found on the NPS's website at http://parkplanning.nps.gov/projectHome.cfm?projectID=35457. The NPS is now working on the Draft Plan/EIS which is anticipated for release in late 2012.

If you have any questions or concerns on the cultural resource or Section 106 aspects of the White-tailed Deer Management Plan/EIS development, or require any further information please contact me at 301-432-7648 or by email at susan_trail@nps.gov. Please note that although we are doing a combined EIS, a separate letter will be sent to solicit your input for Monocacy National Battlefield.

Sincerely,

Susan Trail

Susan Trail
Superintendent
Antietam National Battlefield

Copy to: Nancy Van Dyke, Louis Berger Group

United States Department of the Interior

NATIONAL PARK SERVICE
Antietam National Battlefield
P.O. Box 158
Sharpsburg, MD 21782-0158

IN REPLY REFER TO:

March 15, 2012

Paul A. Peditto, Director
Wildlife and Heritage Service
Maryland Department of Natural Resources
Tawes State Office Building
580 Taylor Avenue
Annapolis, Maryland 21401

Dear Mr. Peditto:

The National Park Service (NPS), in accordance with the National Environmental Policy Act, is currently preparing a white-tailed deer management plan and environmental impact statement (plan/EIS) for three battlefields: Antietam National Battlefield, Monocacy National Battlefields, and Manassas National Battlefield Park. The purpose of the plan/EIS is to develop a deer management strategy that supports preservation of the cultural landscape through the protection and restoration of native vegetation and other natural and cultural resources. The plan will also include longer-term strategies for detection, monitoring and addressing Chronic Wasting Disease in white-tailed deer at the battlefields (in addition to the short term detection and initial response plan already in place at the two Maryland battlefields).

The plan will address a number of issues related to deer management in the battlefields, such as impacts to vegetation and wildlife, deer population health, and effects on visitor experience, among others. A primary focus of the plan/EIS will be the effects of high deer densities on forest regeneration and important park cultural landscapes. We welcome your input on any aspect of this project. We specifically seek information on the presence of any known state-listed rare, threatened, or endangered species that are known to exist in the vicinity of Antietam National Battlefield. Please note that although we are doing a combined EIS, a separate letter will be sent to solicit your input for Monocacy National Battlefield.

Additional information on the plan/EIS may be found on the NPS's website at http://parkplanning.nps.gov/projectHome.cfm?projectID=35457. The NPS is now working on the draft plan/EIS which is anticipated for release in late 2012.
Your input will help ensure that the environmental impacts of the proposal are properly considered in the planning process. If you have any questions or require any further information please contact me at 301-432-7648 or by email at susan_trail@nps.gov. Thank you for your assistance.

Sincerely,

Susan Trail

Susan Trail
Superintendent
Antietam National Battlefield

Copy to:
Nancy Van Dyke, The Louis Berger Group, Inc.
Tracy Atkins, NPS, Denver Service Center

TAKE PRIDE IN AMERICA

United States Department of the Interior

NATIONAL PARK SERVICE
Monocacy National Battlefield
4632 Araby Church Road
Frederick, MD 21704

IN REPLY REFER TO:

May 7, 2012

Paul A. Peditto, Director
Wildlife and Heritage Service
Maryland Department of Natural Resources
Tawes State Office Building
580 Taylor Avenue
Annapolis, Maryland 21401

Dear Mr. Peditto:

The National Park Service (NPS), in accordance with the National Environmental Policy Act, is currently preparing a white-tailed deer management plan and environmental impact statement (plan/EIS) for three battlefields: Antietam and Monocacy National Battlefields, and Manassas National Battlefield Park. The purpose of the plan/EIS is to develop a deer management strategy that supports preservation of the cultural landscape through the protection and restoration of native vegetation and other natural and cultural resources. The plan will also include longer-term strategies for detection, monitoring and addressing Chronic Wasting Disease in white-tailed deer at the battlefields (in addition to the short term detection and initial response plan already in place at the two Maryland battlefields).

The plan will address a number of issues related to deer management in the battlefields, such as impacts to vegetation and wildlife, deer population health, and effects on visitor experience, among others. A primary focus of the plan/EIS will be the effects of high deer densities on forest regeneration and important park cultural landscapes. We welcome your input on any aspect of this project. We specifically seek information on the presence of any state-listed rare, threatened, or endangered species that are known to exist in the vicinity of Monocacy National Battlefield. Please note that although we are doing a combined EIS, a separate letter will be sent to solicit your input for Antietam National Battlefield.

Additional information on the plan/EIS may be found on the NPS's website at http://parkplanning.nps.gov/projectHome.cfm?projectID=35457. The NPS is now working on the draft plan/EIS which is anticipated for release in autumn 2012. Your input will help ensure that the environmental impacts of the proposal are properly considered in the planning process. If you have any questions or require any further information please contact me at 301-694-6147 or by email at rae_emerson@nps.gov. Thank you for your assistance.

Sincerely,

Rae Emerson

Rae Emerson
Acting Superintendent
Monocacy National Battlefield

Copy to:
Nancy Van Dyke, The Louis Berger Group, Inc.
Tracy Atkins, NPS, Denver Service Center

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JES

United States Department of the Interior

NATIONAL PARK SERVICE
Monocacy National Battlefield
4632 Araby Church Road
Frederick, MD 21704

IN REPLY REFER TO:

MAY 1 2012

May 7, 2012

The Maryland Historical Trust has determined that there are no historic properties affected by this undertaking.

Jonathan Sager Date 5/22/12

Mr. J. Rodney Little
State Historic Preservation Officer
Maryland Historical Trust
100 Community Place
Crownsville, MD 21032

FR

Dear Mr. Little:

The National Park Service (NPS) is currently preparing a White-tailed Deer Management Plan/ Environmental Impact Statement for Antietam and Monocacy National Battlefields in Maryland and Manassas National Battlefield Park in Virginia in accordance with the National Environmental Policy Act (NEPA). Louis Berger Group, Inc. (LBG) is the NPS's consultant for this effort.

The Plan/EIS will address a number of issues connected with deer management in the parks, such as impacts to vegetation and wildlife, deer population health, and effects on visitor experience, among others. A primary focus of the plan/EIS will be the effects of high deer densities on forest regeneration and important park cultural landscapes. Therefore, in accordance with the National Historic Preservation Act of 1966 (NHPA), as amended, and the regulations of the Advisory Council on Historic Preservation, the NPS wishes to formally begin consultation with your office with regard to the Plan's potential to affect historic properties at the Monocacy National Battlefield. The NPS intends to coordinate the Section 106 review with its responsibilities under NEPA as identified in 36 CFR 800.3(a)(2)(b) and will be submitting the Draft EIS to your office for your review. In accordance with 36 CFR 800.8(c)(2)(i), the Draft EIS will serve as the Determination of Effect for cultural resources under Section 106 of the NHPA.

Information on the Plan/EIS may be found on the NPS's website at http://parkplanning.nps.gov/projectHome.cfm?projectID=35457. The NPS is now working on the Draft Plan/EIS which is anticipated for release in autumn 2012.

If you have any questions or concerns on the cultural resource or Section 106 aspects of the White-tailed Deer Management Plan/EIS development at this time, please feel free to contact me at 301-694-3147, or by email at rae_emerson@nps.gov. Please note that although we are doing a combined EIS, a separate letter will be sent to solicit your input for Antietam National Battlefield.

Sincerely,

Rae Emerson
Acting Superintendent
Monocacy National Battlefield

Copy to:
Nancy Van Dyke, Louis Berger Group
Tracy Atkins, NPS, Denver Service Center

United States Department of the Interior

NATIONAL PARK SERVICE
Monocacy National Battlefield
4632 Araby Church Road
Frederick, MD 21704

IN REPLY REFER TO:

May 7, 2012

Mr. J. Rodney Little
State Historic Preservation Officer
Maryland Historical Trust
100 Community Place
Crownsville, MD 21032

Dear Mr. Little:

The National Park Service (NPS) is currently preparing a White-tailed Deer Management Plan/ Environmental Impact Statement for Antietam and Monocacy National Battlefields in Maryland and Manassas National Battlefield Park in Virginia in accordance with the National Environmental Policy Act (NEPA). Louis Berger Group, Inc. (LBG) is the NPS's consultant for this effort.

The Plan/EIS will address a number of issues connected with deer management in the parks, such as impacts to vegetation and wildlife, deer population health, and effects on visitor experience, among others. A primary focus of the plan/EIS will be the effects of high deer densities on forest regeneration and important park cultural landscapes. Therefore, in accordance with the National Historic Preservation Act of 1966 (NHPA), as amended, and the regulations of the Advisory Council on Historic Preservation, the NPS wishes to formally begin consultation with your office with regard to the Plan's potential to affect historic properties at the Monocacy National Battlefield. The NPS intends to coordinate the Section 106 review with its responsibilities under NEPA as identified in 36 CFR 800.3(a)(2)(b) and will be submitting the Draft EIS to your office for your review. In accordance with 36 CFR 800.8(c)(2)(i), the Draft EIS will serve as the Determination of Effect for cultural resources under Section 106 of the NHPA.

Information on the Plan/EIS may be found on the NPS's website at http://parkplanning.nps.gov/projectHome.cfm?projectID=35457. The NPS is now working on the Draft Plan/EIS which is anticipated for release in autumn 2012.

If you have any questions or concerns on the cultural resource or Section 106 aspects of the White-tailed Deer Management Plan/EIS development at this time, please feel free to contact me at 301-694-3147, or by email at rae_emerson@nps.gov. Please note that although we are doing a combined EIS, a separate letter will be sent to solicit your input for Antietam National Battlefield.

Sincerely,

Rae Emerson
Acting Superintendent
Monocacy National Battlefield

Copy to:
Nancy Van Dyke, Louis Berger Group
Tracy Atkins, NPS, Denver Service Center

United States Department of the Interior

NATIONAL PARK SERVICE
Monocacy National Battlefield
4632 Araby Church Road
Frederick, MD 21704

IN REPLY REFER TO:

May 7, 2012

Genevieve LaRouche, Field Supervisor
U.S. Fish and Wildlife Service
Chesapeake Bay Field Office
177 Admiral Cochran Drive
Annapolis, Maryland 21401

Dear Ms. LaRouche:

The National Park Service (NPS), in accordance with the National Environmental Policy Act, is currently preparing a white-tailed deer management plan and environmental impact statement (plan/EIS) for three battlefields: Antietam and Monocacy National Battlefields, and Manassas National Battlefield Park. The purpose of the plan/EIS is to develop a deer management strategy that supports preservation of the cultural landscape through the protection and restoration of native vegetation and other natural and cultural resources. The plan will also include longer-term strategies for detection, monitoring and addressing Chronic Wasting Disease in white-tailed deer at the battlefields (in addition to the short term detection and initial response plan already in place at the two Maryland battlefields).

The plan will address a number of issues related to deer management in the battlefields, such as impacts to vegetation and wildlife, deer population health, and effects on visitor experience, among others. A primary focus of the plan/EIS will be the effects of high deer densities on forest regeneration and important park cultural landscapes. We welcome your input on any aspect of this project. We specifically seek information on the presence of listed threatened or endangered species in the vicinity of Monocacy National Battlefield. Please note that although we are doing a combined EIS, a separate letter will be sent to solicit your input for Antietam National Battlefield. To the knowledge of the NPS, no listed threatened or endangered species occur in the vicinity of either Antietam or Monocacy National Battlefields.

Additional information on the plan/EIS may be found on the NPS's website at http://parkplanning.nps.gov/projectHome.cfm?projectID=35457. The NPS is now working on the draft plan/EIS which is anticipated for release in late 2012.
Your input will help ensure that the environmental impacts of the proposal are properly considered in the planning process. If you have any questions or require any further

information please contact me at 301-694-3147 or by email at rae_emerson@nps.gov. Thank you for your assistance.

Sincerely,

Rae Emerson

Rae Emerson
Acting Superintendent
Monocacy National Battlefield

Copy to:
Nancy Van Dyke, Louis Berger Group
Tracy Atkins, NPS, Denver Service Center

United States Department of the Interior

NATIONAL PARK SERVICE
Manassas National Battlefield Park
12521 Lee Highway
Manassas, Virginia 20109-2005

IN REPLY REFER TO:
N14 (NCR-MANA)

April 18, 2012

Ms. Rene Hypes
Environmental Review Coordinator
Virginia Department of Conservation and Recreation
Division of Natural Heritage
217 Governor Street, 2nd Floor
Richmond, Virginia 23219

Dear Ms. Hypes:

The National Park Service (NPS), in accordance with the National Environmental Policy Act, is currently preparing a White-tailed Deer Management plan and Environmental Impact Statement (plan/EIS) for three battlefields: Antietam National Battlefield and Monocacy National Battlefield, and Manassas National Battlefield Park. The purpose of the plan/EIS is to develop a deer management strategy that supports preservation of the cultural landscape through the protection and restoration of native vegetation and other natural and cultural resources. The plan will also include strategies for detection, monitoring, and initial and long-term response to Chronic Wasting Disease in white-tailed deer should it be found in the vicinity of the battlefields.

The plan will address a number of issues related to deer management in the battlefields, such as impacts to vegetation and wildlife, deer population health, and effects on visitor experience, among others. A primary focus of the plan/EIS will be the effects of high deer densities on forest regeneration and important park cultural landscapes. We welcome your input on any aspect of this project. We specifically seek information on the presence of any known state-listed rare, threatened, or endangered species that are known to exist in the vicinity of Manassas National Battlefield Park.

Additional information on the plan/EIS may be found on the NPS's website at http://parkplanning.nps.gov/projectHome.cfm?projectID=35457. The NPS is now working on the draft plan/EIS which is anticipated for release in late 2012.

Your input will help ensure that the environmental impacts of the proposal are properly considered in the planning process. If you have any questions or require any further information please contact me at 703-754-1861 or by email at ed_w_clark@nps.gov. Thank you for your assistance.

Sincerely,

Edward W. Clark, III
Superintendent
Manassas National Battlefield Park

Copy to:
Nancy Van Dyke, Louis Berger Group
Tracy Atkins, NPS, Denver Service Center

United States Department of the Interior

NATIONAL PARK SERVICE
Manassas National Battlefield Park
12521 Lee Highway
Manassas, Virginia 20109-2005

IN REPLY REFER TO:
N14 (NCR-MANA)

April 18, 2012

Ms. Kathleen Kilpatrick
State Historic Preservation Officer
Commonwealth of Virginia
2801 Kensington Avenue
Richmond, VA 23221

Dear Ms. Kilpatrick:

The National Park Service (NPS) is currently preparing a White-tailed Deer Management plan/ Environmental Impact Statement (Plan/EIS) for three battlefields: Antietam National Battlefield and Monocacy National Battlefield in Maryland, and Manassas National Battlefield Park in Virginia in accordance with the National Environmental Policy Act (NEPA). Louis Berger Group, Inc. (LBG) is the NPS's consultant for this effort.

The plan/EIS will address a number of issues connected with deer management in the parks, such as impacts to vegetation and wildlife, deer population health, and effects on visitor experience, among others. A primary focus of the plan/EIS will be the effects of high deer densities on forest regeneration and important park cultural landscapes. Therefore, in accordance with the National Historic Preservation Act of 1966 (NHPA), as amended, and the regulations of the Advisory Council on Historic Preservation, the NPS wishes to formally begin consultation with your office with regard to the Plan's potential to affect historic properties at Manassas National Battlefield Park. The NPS intends to coordinate the Section 106 review with its responsibilities under NEPA as identified in 36 CFR 800.3(a)(2)(b) and will be submitting the Draft EIS to your office for your review. In accordance with 36 CFR 800.8(c)(2)(i), the Draft EIS will serve as the Determination of Effect for cultural resources under Section 106 of the NHPA.

Information on the Plan/ EIS may be found on the NPS's website at http://parkplanning.nps.gov/projectHome.cfm?projectID=35457. The NPS is now working on the Draft Plan/EIS which is anticipated for release in late 2012.

If you have any questions or concerns on the cultural resource or Section 106 aspects of the White-tailed Deer Management Plan/EIS development at this time, please feel free to contact me at the park, at 703-754-1861, or by email at ed_w_clark@nps.gov.

Sincerely,

Edward W. Clark, III
Superintendent
Manassas National Battlefield Park

Copy to:
Nancy Van Dyke, Louis Berger Group
Tracy Atkins, NPS, Denver Service Center

United States Department of the Interior

NATIONAL PARK SERVICE
Manassas National Battlefield Park
12521 Lee Highway
Manassas, Virginia 20109-2005

IN REPLY REFER TO:

N14 (NCR-MANA)

April 18, 2012

Ms. Cindy Schulz
Field Office Supervisor
U.S. Fish and Wildlife Service
Virginia Field Office
6669 Short Lane
Gloucester, Virginia 23061

Dear Ms. Schulz:

The National Park Service (NPS), in accordance with the National Environmental Policy Act, is currently preparing a White-tailed Deer Management plan and Environmental Impact Statement (plan/EIS) for three battlefields: Antietam National Battlefield and Monocacy National Battlefield, and Manassas National Battlefield Park. The purpose of the plan/EIS is to develop a deer management strategy that supports preservation of the cultural landscape through the protection and restoration of native vegetation and other natural and cultural resources. The plan will also include strategies for detection, monitoring, and initial and long-term response to Chronic Wasting Disease in white-tailed deer should it be found in the vicinity of the battlefields.

The plan will address a number of issues related to deer management in the battlefields, such as impacts to vegetation and wildlife, deer population health, and effects on visitor experience, among others. A primary focus of the plan/EIS will be the effects of high deer densities on forest regeneration and important park cultural landscapes. We welcome your input on any aspect of this project. We specifically seek information on the presence of listed threatened or endangered species in the vicinity of Manassas National Battlefield Park. Please note that although we are doing a combined EIS for several battlefields, separate letters will be sent to the Chesapeake Bay Field Office for the other two battlefields. To the knowledge of the NPS, no federally listed threatened or endangered species occur in the vicinity of Manassas National Battlefield Park.

Additional information on the plan/EIS may be found on the NPS's website at http://parkplanning.nps.gov/projectHome.cfm?projectID=35457. The NPS is now working on the draft plan/EIS which is anticipated for release in late 2012.

Your input will help ensure that the environmental impacts of the proposal are properly considered in the planning process. If you have any questions or require any further information please contact me at 703-754-1861 or by email at ed_w_clark@nps.gov. Thank you for your assistance.

Sincerely,

Edward W. Clark, III
Superintendent
Manassas National Battlefield Park

Copy to:
Nancy Van Dyke, Louis Berger Group
Tracy Atkins, NPS, Denver Service Center

United States Department of the Interior

NATIONAL PARK SERVICE
Manassas National Battlefield Park
12521 Lee Highway
Manassas, Virginia 20109-2005

IN REPLY REFER TO:
N14 (NCR-MANA)

April 18, 2012

Mr. Ray Fernald
Manager
Virginia Department of Game and Inland Fisheries
Environmental Services Section
P.O. Box 11104
Richmond, Virginia 23230

Dear Mr. Fernald:

The National Park Service (NPS), in accordance with the National Environmental Policy Act, is currently preparing a White-tailed Deer Management plan and Environmental Impact Statement (plan/EIS) for three battlefields: Antietam National Battlefield and Monocacy National Battlefield, and Manassas National Battlefield Park. The purpose of the plan/EIS is to develop a deer management strategy that supports preservation of the cultural landscape through the protection and restoration of native vegetation and other natural and cultural resources. The plan will also include strategies for detection, monitoring, and initial and long-term response to Chronic Wasting Disease in white-tailed deer should it be found in the vicinity of the battlefields.

The plan will address a number of issues related to deer management in the battlefields, such as impacts to vegetation and wildlife, deer population health, and effects on visitor experience, among others. A primary focus of the plan/EIS will be the effects of high deer densities on forest regeneration and important park cultural landscapes. We welcome your input on any aspect of this project. We specifically seek information on the presence of any known state-listed rare, threatened, or endangered species that are known to exist in the vicinity of Manassas National Battlefield Park.

Additional information on the plan/EIS may be found on the NPS's website at http://parkplanning.nps.gov/projectHome.cfm?projectID=35457. The NPS is now working on the draft plan/EIS which is anticipated for release in late 2012.

Your input will help ensure that the environmental impacts of the proposal are properly considered in the planning process. If you have any questions or require any further information please contact me at 703-754-1861 or by email at ed_w_clark@nps.gov. Thank you for your assistance.

Sincerely,

Edward W. Clark, III
Superintendent
Manassas National Battlefield Park

Copy to:
Nancy Van Dyke, Louis Berger Group
Tracy Atkins, NPS, Denver Service Center

COMMONWEALTH of VIRGINIA

Department of Historic Resources

Douglas W. Domenech
Secretary of Natural Resources

2801 Kensington Avenue, Richmond, Virginia 23221

Kathleen S. Kilpatrick
Director

Tel: (804) 367-2323
Fax: (804) 367-2391
TDD: (804) 367-2386
www.dhr.virginia.gov

May 2, 2012

Edward W. Clark, III
United States Department of the Interior
National Park Service
Manassas National Battlefield Park
12521 Lee Highway
Manassas, Virginia 20109

Re: White-tailed Deer Management Plan/Environmental Impact Statement
Manassas National Battlefield Park
Fairfax and Prince William Counties, Virginia
DHR File No. 2012-0662
Received April 24. 2012

Dear Mr. Clark:

Thank you for your letter of April 18, 2012 informing us that the National Park Service is currently preparing a White-tailed Deer Management Plan/Environmental Impact Statement and intends to coordinate consultation pursuant to Section 106 of the National Historic Preservation Act of 1966, as amended, with its responsibilities under the National Environmental Policy Act. We understand that a primary focus of the plan/EIS will be the effects of high deer densities on cultural landscapes within the Park. We have no comments/suggestions at this time.

We look forward to receiving the draft EIS for review once it is available. If you have any questions, or if we may provide any further assistance, please do not hesitate to contact me at (804)482-6088; fax (804) 367-2391; e-mail ethel.eaton@dhr.virginia.gov

Sincerely,

Ethel R Eaton

Ethel R. Eaton, Ph.D., Senior Policy Analyst
Division of Resource Services and Review

As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering wise use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historic places, and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people. The department also promotes the goals of the Take Pride in America campaign by encouraging stewardship and citizen responsibility for the public lands and promoting citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

302/119641 (Spring 2013)

United States Department of the Interior · National Park Service