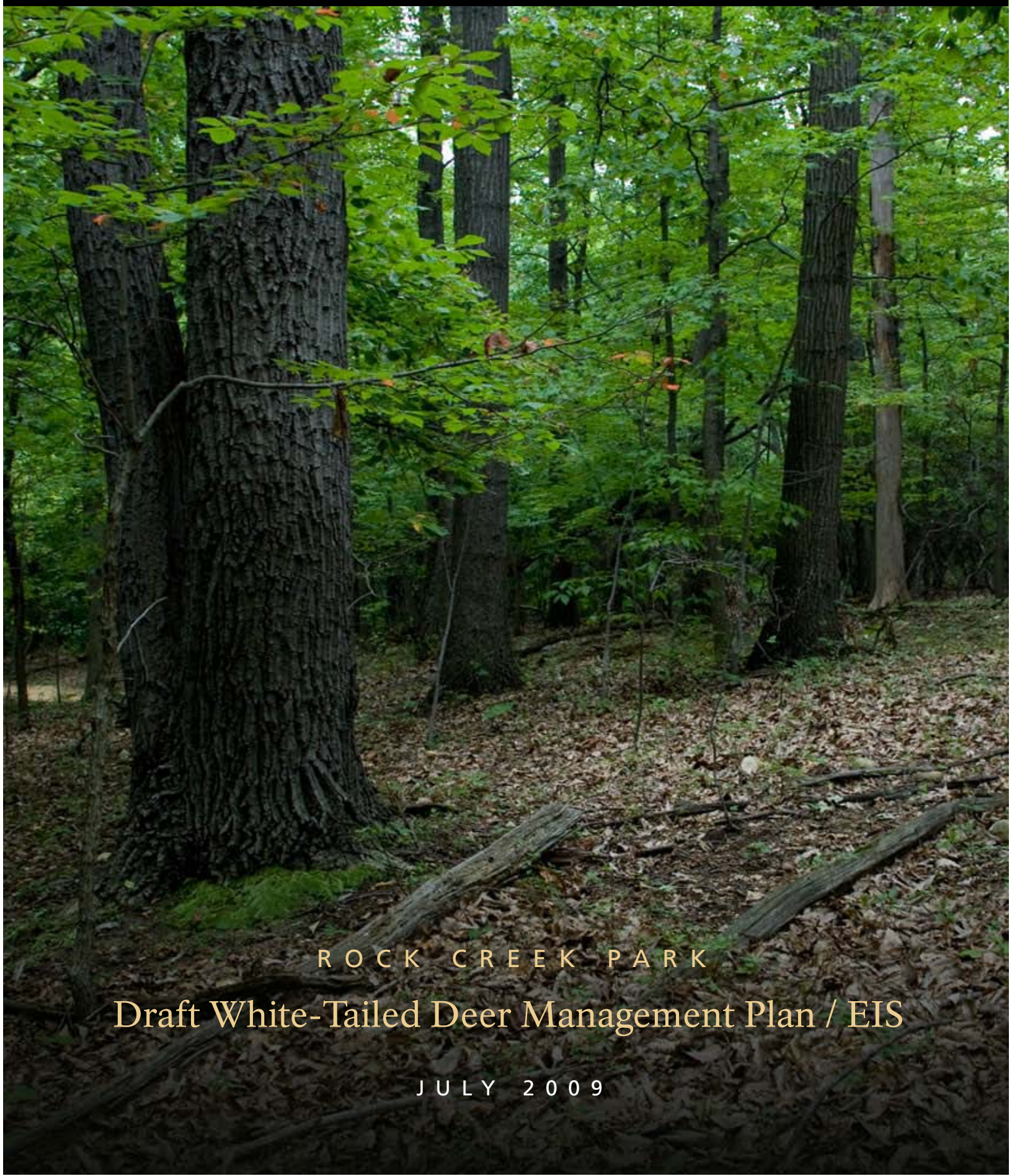
National Park Service
U.S. Department of the Interior



ROCK CREEK PARK

Draft White-Tailed Deer Management Plan / EIS

JULY 2009

UNITED STATES DEPARTMENT OF THE INTERIOR – NATIONAL PARK SERVICE

DRAFT WHITE-TAILED DEER MANAGEMENT PLAN ENVIRONMENTAL IMPACT STATEMENT
ROCK CREEK PARK, WASHINGTON, DC

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

This *Draft White-tailed Deer Management Plan/Environmental Impact Statement* describes four alternatives for the management of deer at Rock Creek 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 white-tailed deer management strategy that supports long-term protection, preservation, and restoration of native vegetation and other natural and cultural resources in Rock Creek Park. Action is needed at this time to address the potential of deer becoming the dominant force in the park's ecosystem, and adversely impacting native vegetation and other wildlife; a decline in tree seedlings caused by excessive deer browsing and the ability of the forest to regenerate in Rock Creek Park; excessive deer browsing impacts on the existing shrubs and herbaceous species; and deer impacts on the character of the park's cultural landscapes. White-tailed deer herds have increased substantially within and around Rock Creek Park in recent years, and results of vegetation monitoring have documented the adverse effects of the growing herd size on forest regeneration.

Under alternative A (no action), 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. Under alternative B, several non-lethal actions, such as large-scale exclosures (large fenced areas), and reproductive control of does via sterilization and an acceptable reproductive control agent when feasible would be taken to protect forest seedlings, promote forest regeneration, and gradually reduce deer numbers in the park. Under alternative C, direct reduction of the deer herd would be achieved by sharpshooting and by capture and euthanasia of individual deer in certain circumstances where sharpshooting would not be appropriate. Alternative D (preferred alternative) would combine elements from alternatives B and C: sharpshooting and capture/euthanasia would be used initially to quickly reduce the 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.

The potential environmental consequences of the alternatives are addressed for vegetation; soils and water quality; wetlands and floodplains; wildlife and wildlife habitat (including deer); rare, unique, threatened or endangered species; cultural landscapes; soundscapes; visitor use and experience; visitor and employee safety; socioeconomics; 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 would likely continue. The analysis indicates that impairment to vegetation, wildlife habitat, and certain rare plant species could result in the long term if alternative A was implemented.

The *Draft White-tailed Deer Management Plan/ 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 name and address listed below or you may post them electronically at http://parkplanning.nps.gov/rocr. 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 then 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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National Park Service
U.S. Department of the Interior

Rock Creek Park
District of Columbia

ROCK CREEK PARK
DRAFT DEER MANAGEMENT PLAN AND ENVIRONMENTAL IMPACT STATEMENT

July 2009

SUMMARY

PURPOSE OF AND NEED FOR ACTION

The purpose of this action is to develop a white-tailed deer (*Odocoileus virginianus*) management strategy that supports long-term protection, preservation, and restoration of native vegetation and other natural and cultural resources in Rock Creek Park. White-tailed deer herds have increased substantially within and around Rock Creek Park in recent years. In 2007, sampling indicated 82 deer per square mile in the park, and results of vegetation monitoring in recent years have documented the adverse effects of the growing herd size on forest regeneration.

The deer population in Rock Creek Park has continued to grow and have adverse effects on the park's vegetation; therefore, action is needed at this time to address:

- The potential of deer becoming the dominant force in the park's ecosystem, and adversely impacting native vegetation and other wildlife.
- A decline in tree seedlings caused by excessive deer browsing and the ability of the forest to regenerate in Rock Creek Park.
- Excessive deer browsing impacts on the existing shrubs and herbaceous species.
- Deer impacts on the character of the park's cultural landscapes.
- Opportunities to coordinate with other jurisdictional entities currently implementing deer management actions beneficial to the protection of park resource and values.

OBJECTIVES IN TAKING ACTION

Objectives define what must be achieved for an action to be considered a success. The following objectives relative to deer management at Rock Creek Park were developed for this plan, based on the park's enabling legislation, mandates, and direction in other planning documents, as well as service-wide objectives, management policies, and the Organic Act.

VEGETATION

- Develop and implement informed, scientifically-based vegetation impact levels and corresponding measures of deer population density that would serve as a threshold for taking prescribed management actions within the park.
- Protect the natural abundance, distribution, and diversity of native plant species within the applicable park units by reducing excessive deer browsing, trampling, and nonnative seed dispersal.
- Maintain, restore, and promote a mix of native plant species and reduce the spread of nonnative plant species through effective deer management.

WILDLIFE AND WILDLIFE HABITAT

- Allow for a white-tailed deer population within the park while protecting other park resources.
- Protect the natural abundance, distribution, and diversity of native animal species within the park by reducing excessive deer browsing, trampling, and nonnative seed dispersal.
- Protect lower canopy, shrub, and ground nesting bird habitat from adverse effects of deer browsing.

THREATENED, ENDANGERED, AND SPECIES OF SPECIAL CONCERN

- Protect habitat of rare plant and animal species from adverse effects of deer, such as excessive deer browsing, trampling, and nonnative seed dispersal.

CULTURAL RESOURCES

- Protect the integrity, variety, and character of the cultural landscapes by reducing excessive deer browsing, trampling, and nonnative seed dispersal.

VISITOR USE AND EXPERIENCE

- Share information with the public regarding the deer population and the forest regeneration process and diversity, including the role of deer as part of a functioning park ecosystem, not the primary driving force within it.
- Initiate cooperative efforts to address deer effects on the park and surrounding communities.

PARK MANAGEMENT AND OPERATIONS

- Share information with park staff and other regional parks regarding the deer population and management strategies.

WHITE-TAILED DEER AT ROCK CREEK PARK

Although relatively rare at the turn of the twentieth century, white-tailed deer populations in the District of Columbia metropolitan area have rebounded 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, some of which are adjacent to the District of Columbia.

Although there are no historic records before 1960 of the deer population specific to Rock Creek Park, deer herds have increased substantially within and around Rock Creek Park in recent years. Park observation records show four sightings of deer in Reservation 339 of Rock Creek Park in the 1960s. Deer sightings increased to 19 by the 1970s, and in 1984, the first recorded deer sighting in Glover-Archbold Park occurred. In the late 1980s (1987–1989) there were 39 deer sightings. By the early 1990s, deer sightings were so prevalent that observation cards were no longer completed. In 2007, sampling indicated 82 deer per square mile in the park, and results of vegetation monitoring in recent years have documented the effects of the growing herd size.

- The increasing numbers of white-tailed deer within the park are resulting in a substantial effect on the park ecosystem due to the deer's heavy browsing of vegetation. Studies being conducted by the park indicate that deer are having adverse effects on shrub cover, tree seedling regeneration, and herbaceous cover, which affect habitat quality for other wildlife within the park 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*** — Current deer management actions and policies would continue under alternative A, including monitoring deer density and relative numbers, monitoring

vegetation, data management, and opportunity for research. Protective caging and limited use of deer repellents may also be used to protect rare plants in natural areas and small areas in landscaped and cultural areas. Current educational and interpretive measures, as well as inter-jurisdictional communication, would continue. No new actions would occur to reduce the effects of deer overbrowsing.

- ***Alternative B: Combined Non-Lethal Actions*** — Alternative B would include all actions described under alternative A, but would also incorporate several non-lethal actions to protect forest seedlings, promote forest regeneration, and gradually reduce deer numbers in the park. The additional actions would include the construction of large-scale deer exclosures (large fenced areas) and reproductive control of does via sterilization and an acceptable reproductive control agent when feasible. Reproductive control implementation may require construction of temporary holding areas to house captured deer prior to treatment.
- ***Alternative C: Combined Lethal Actions*** — Alternative C would include all actions described under alternative A, but would also incorporate two lethal deer management actions to reduce the herd size. The additional actions would include reduction of the deer herd by either sharpshooting or by implementing capture and euthanasia of individual deer, to be used in limited circumstances where sharpshooting may not be appropriate.
- ***Alternative D: Combined Lethal and Non-Lethal Actions*** — Alternative D would include all actions described under alternative A, but would also include a combination of certain additional lethal and non-lethal actions from alternatives B and C to reduce deer herd numbers. The lethal actions would include both sharpshooting and capture/euthanasia and would be taken initially to quickly reduce the deer herd numbers. Population maintenance would be conducted via reproductive control methods if these are available and feasible; if not, sharpshooting would be used as a default option for maintenance.

ENVIRONMENTAL CONSEQUENCES

The summary of environmental consequences considers the actions being proposed and the cumulative impacts to resources from occurrences inside and outside the park. The potential environmental consequences of the actions are addressed for vegetation; soils and water quality; wetlands and floodplains; wildlife and wildlife habitat (including deer); rare, unique, threatened or endangered species; cultural landscapes; soundscapes; visitor use and experience; visitor and employee safety; socioeconomics; and park management and operations.

SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
Vegetation	*Direct/Indirect Impact*: The impacts of large numbers of deer browsing on a very large percentage of the park's woody and herbaceous vegetation and consequently limiting natural regeneration would be adverse, long term, and major.	*Direct/Indirect Impact*: Since the benefits of reproductive control would not be fully realized within the life of this plan, overall impacts to woody and herbaceous vegetation would be adverse, long term, and major.	*Direct/Indirect Impact*: Enhancing natural forest regeneration by quickly reducing deer browsing pressure and maintaining a smaller deer population through direct reduction would result in beneficial, long-term impacts. Over time as natural forest regeneration occurred, adverse, long-term, major impacts that could be expected if the deer herd continued unchecked would be reduced to minor levels.	*Direct/Indirect Impact*: Enhancing natural forest regeneration by quickly reducing deer browsing pressure and maintaining a smaller deer population through the use of reproductive control (and direct reduction if needed) would result in beneficial, long-term impacts. Over time as natural forest regeneration occurred, adverse, long-term, major impacts would be reduced to minor levels.
	Cumulative Impact: Would result in adverse, long-term, major cumulative impacts.	*Cumulative Impact*: Would result in long-term, moderate to major adverse cumulative impacts.	*Cumulative Impact*: Would result in beneficial, long-term cumulative impacts.	*Cumulative Impact*: Would result in beneficial, long-term cumulative impacts.
	Potential for Impairment: Current conditions in the park indicate severe adverse impacts on vegetation resources. Under alternative A it is expected that impairment of vegetation resources would occur over the long term.	*Potential for Impairment*: It is not expected that impairment of vegetation resources would occur under this alternative.	*Potential for Impairment*: No impairment of vegetation resources would occur under this alternative.	*Potential for Impairment*: No impairment of vegetation resources would occur under this alternative.
Soils and Water Quality	*Direct/Indirect Impact*: Soil erosion and sedimentation due to loss of vegetation from increased deer browsing could result in adverse long-term, negligible to minor impacts on soils and water quality.	*Direct/Indirect Impact*: If deer displaced by the fenced exclosures concentrated in other areas of the park, resulting in increased loss of vegetation in those areas and a potential increase in soil erosion, adverse, long-term, minor impacts to soils and water quality could occur. Impacts would gradually shift to beneficial in the long term.	*Direct/Indirect Impact*: Immediately reducing the number of deer in the park and maintaining a sustainable population would result in beneficial, long-term impacts on soils and water quality.	*Direct/Indirect Impact*: Immediately reducing the number of deer in the park and maintaining a sustainable population would result in beneficial, long-term impacts on soils and water quality.

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
	Cumulative Impact: Would result in adverse, long-term, minor cumulative impacts on soil and water quality.	*Cumulative Impact*: Would result in adverse, long term, and minor cumulative impacts.	*Cumulative Impact*: Would result in adverse, long term, and minor cumulative impacts.	*Cumulative Impact*: Would result in adverse, long term, and minor cumulative impacts.
	Potential for Impairment: No impairment of soil or water resources would occur under this alternative.	*Potential for Impairment*: No impairment of soil or water resources would occur under this alternative.	*Potential for Impairment*. No impairment of soil or water resources would occur under this alternative.	*Potential for Impairment*: No impairment of soil or water resources would occur under this alternative.
Wetlands and Floodplains	*Direct/Indirect Impact*: Loss of vegetation from increased deer browsing, disturbance to small wetland areas and vernal pools and changes in species composition would result in adverse, long-term, moderate impacts on wetlands and floodplains.	*Direct/Indirect Impact*: Use of exclosures to protect many of the park's forested wetlands would gradually result in beneficial long-term impacts to wetlands, although continued long-term minor to moderate adverse impacts would be expected in areas that are not fenced and in smaller wetland areas and seeps. Beneficial long-term impacts would also result from decreased vegetation loss. Construction of exclosures within the 100-year floodplain could result in short-term, minor adverse impacts on the floodplain.	*Direct/Indirect Impact*: Immediately reducing the number of deer in the park and maintaining a sustainable population would result in beneficial, long-term impacts on wetlands and floodplains.	*Direct/Indirect Impact*: Immediately reducing the number of deer in the park and maintaining a sustainable population would result in beneficial, long-term impacts on wetlands and floodplains.
	Cumulative Impact: Would result in adverse, long-term, moderate impacts on wetlands and floodplains.	*Cumulative Impact*: Would result in adverse, long-term, moderate impacts on wetlands and floodplains.	*Cumulative Impact*: Would result in adverse, long term, minor to moderate cumulative impacts due mainly to past actions.	*Cumulative Impact*: Would result in adverse, long term, minor to moderate cumulative impacts due mainly to past actions.
	Potential for Impairment: No impairment of wetlands of floodplains would occur under this alternative.	*Potential for Impairment*: No impairment of wetlands or floodplains would occur under this alternative.	*Potential for Impairment*: No impairment of wetlands or floodplains would occur under this alternative.	*Potential for Impairment*: No impairment of wetlands or floodplains would occur under this alternative.

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
White-tailed Deer	*Direct/Indirect Impact*: Excessive deer browsing that would degrade habitat and limit food sources would result in long-term, moderate adverse impacts.	*Direct/Indirect Impact*. Because the benefits of reproductive control would not be fully realized within the life of this plan, overall impacts to deer habitat, and in turn deer, would be adverse, long term, and moderate as a result of habitat degradation and loss of food sources. There could also be long-term, major adverse impacts to individual deer from the physiological, biological, and behavioral effects associated with the use of reproductive control; however, long-term impacts to the population would be minor to moderate because the adverse effects would be offset over time by the benefits of population reduction.	*Direct/Indirect Impact*: The relatively rapid reduction of the deer herd and the resultant regeneration of forage would result in beneficial effects on deer herd health and would reduce adverse impacts to negligible or minor levels over the long term.	*Direct/Indirect Impact*: Enhancing natural forest regeneration by quickly reducing deer browsing pressure would result in beneficial, long-term impacts to deer and deer habitat. Over time as natural forest regeneration occurred, adverse, long-term, major impacts would be reduced to negligible to minor levels. If reproductive controls are used, there could also be long-term, major adverse impacts to individual deer from the physiological, biological, and behavioral effects associated with the use of reproductive control; however, long-term impacts to the population would be minor to moderate because the adverse effects would be offset over time by the benefits of population reduction.
	Cumulative Impact: Would result in adverse, long-term, moderate cumulative impacts.	*Cumulative Impact*: Would result in long-term, moderate adverse cumulative impacts.	*Cumulative Impact*: Would result in long-term, beneficial, cumulative impacts on deer herd health.	*Cumulative Impact*: Would result in beneficial, long-term cumulative impacts.
	Potential for Impairment: Although impacts to deer under alternative A could be severe, they would not approach the level of impairment over the long term.	*Potential for Impairment*: It is not expected that impairment of the white-tailed deer herd in Rock Creek Park would occur under this alternative.	*Potential for Impairment*: No impairment of the white-tailed deer population would occur under this alternative.	*Potential for Impairment*: No impairment of the white-tailed deer population would occur under this alternative.
Other Wildlife and Wildlife Habitat	*Direct/Indirect Impact*: A continued a large deer population and related browsing, resulting in decreased plant diversity, increased invasive exotic plants, and reduced forest regeneration would result in adverse effects on other wildlife. A	*Direct/Indirect Impact*: Construction of large, fenced exclosures over the life of the plan would protect some habitat; however, the remaining habitat would continue to be subject to a high degree of deer browsing,	*Direct/Indirect Impact*: Rapid reductions in deer numbers in the park, thereby reducing deer browsing pressure on woody and herbaceous vegetation and allowing increased abundance and diversity of other wildlife that	*Direct/Indirect Impact*: Rapid reductions in deer numbers in the park, thereby reducing deer browsing pressure on woody and herbaceous vegetation and allowing increased abundance and diversity of other wildlife that

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
	few predator species would benefit from a large deer population and an open understory; however, the impacts of large numbers of deer browsing on vegetation would adversely affect a large percentage of habitats for other wildlife (e.g., ground-nesting birds, frogs, snakes, and turtles), resulting in adverse, long-term, and negligible to potentially major impacts, depending on the species.	adversely impacting both ground and shrub layer habitat for many other species of wildlife until reproductive controls took effect and reduced the deer population. A few species would tend to benefit from a large deer population and an open understory but overall, impacts to other wildlife would be adverse, long term, and negligible to potentially major, depending on the species.	depend on understory vegetation would result in beneficial long term impacts. Adverse, long-term impacts would be reduced to negligible or minor levels over time.	depend on understory vegetation would result in beneficial long term impacts. Adverse, long-term impacts would be reduced to negligible or minor levels over time.
	Cumulative Impact: Would result in both adverse and beneficial impacts, with adverse, long-term, major cumulative impacts.	*Cumulative Impact*: Would result in both adverse and beneficial impacts, with overall adverse, long term, moderate to major cumulative impacts.	*Cumulative Impact*: Would result in long-term, beneficial, cumulative impacts.	*Cumulative Impact*: Would result in beneficial, long-term cumulative impacts.
	Potential for Impairment: As explained in "Vegetation" above, alternative A would not reverse the expected long-term continued growth in the deer population, and wildlife habitat would likely continue to be degraded. Although not all wildlife species would be affected to the same extent, impairment of those wildlife species that depend on the presence of ground cover and understory vegetation that are heavily browsed by deer could occur under this alternative over the long term.	*Potential for Impairment*: It is not expected that impairment of other wildlife species or habitat would occur under this alternative.	*Potential for Impairment*: No impairment of the white-tailed deer population would occur under this alternative.	*Potential for Impairment*: No impairment of the white-tailed deer population would occur under this alternative.
Rare, Unique, Threatened, or Endangered Species	*Direct/Indirect Impact*: Impacts to rare, unique, threatened, or endangered species under alternative A would be both beneficial and adverse. Adverse	*Direct/Indirect Impact*: Adverse impacts to the federally listed Hay's Spring amphipod could be long term and negligible to minor. Impacts to species listed or	*Direct/Indirect Impact*: The reduced deer density would minimize potential impacts on the habitat for the Hay's Spring amphipod, resulting in long-term,	*Direct/Indirect Impact*: The reduced deer density would minimize potential impacts on the habitat for the Hay's Spring amphipod, resulting in long-term, beneficial

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	impacts to the federally listed Hay's Spring amphipod (*Stygobromus hayi*) could be long term and negligible to minor. Beneficial impacts to state-listed plants would result from establishing caging around known individual plants and around newly discovered plants in the park. Overall, there would be adverse, long-term, negligible to major impacts to rare, unique, threatened, or endangered species, from excessive deer browsing and the associated habitat degradation that could result in lack of food or cover for such species.	considered special status species by Maryland and the District of Columbia would be adverse, long term, and moderate to major, until reproductive controls on the park deer herd were effective. The placement and maintenance of large exclosures would include many species listed or considered special status species by Maryland and the District of Columbia, resulting in beneficial, long-term impacts. However, adverse, long-term, negligible to moderate impacts due to deer browsing would continue outside the exclosures.	beneficial effects that would reduce adverse impacts to negligible. Impacts on species listed or considered special status species by Maryland and the District of Columbia, as well as their habitat, would be beneficial and long term as a result of rapid reductions in deer numbers in the park that would reduce deer browsing pressure on woody and herbaceous vegetation. A few predators that use deer as a food source could be adversely affected by a lower deer density, as could scavengers that feed on deer carcasses, but this alternative could also increase the availability of other prey. Adverse, long-term impacts would be reduced to negligible or minor levels over time.	effects that would reduce adverse impacts to negligible. Impacts on species listed or considered special status species by Maryland and the District of Columbia, as well as their habitat, would be beneficial and long term as a result of rapid reductions in deer numbers in the park that would reduce deer browsing pressure on woody and herbaceous vegetation. Adverse, long-term impacts would be reduced to negligible or minor levels over time. A few predators and scavengers that use deer and their carcasses as a food source could be adversely affected by a lower deer density or denser understory conditions, but this alternative could also increase the availability of other prey. Adverse, long-term impacts would be reduced to negligible or minor levels over time.
	Cumulative Impact: Would result in both adverse and beneficial impacts, with overall long-term, minor to major, adverse cumulative impacts.	*Cumulative Impact*: Would result in both beneficial and adverse impacts.	*Cumulative Impact*: Would result in long-term, beneficial, cumulative impacts.	*Cumulative Impact*: Would result in long-term, beneficial, cumulative impacts.
	Potential for Impairment: Impairment under alternative A would be possible for some of the state-listed plants that are palatable to deer, as well as habitat for rare, unique, threatened, or endangered species, because alternative A would not reverse the expected long-term continued growth in the deer population and	*Potential for Impairment*: It is not expected that impairment of state-listed plants, as well as habitat for rare, unique, threatened, or endangered species, would occur over the long term.	*Potential for Impairment*: No impairment of rare, unique, threatened, or endangered species would occur under this alternative.	*Potential for Impairment*: No impairment of rare, unique, threatened, or endangered species would occur under this alternative.

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
	damage to vegetation would likely continue, as described under "Vegetation" above. Therefore, it is expected that impairment of certain state-listed plants could occur over the long term.			
Cultural Landscapes	*Direct/Indirect Impact*: The use of small cages and repellents to protect landscape plantings, new restoration plantings, or rare plant species at specified areas could result in beneficial, long-term, minor impacts to these parts of the park's vegetation. However, continued growth of the deer population and the associated ongoing decline in the abundance and diversity of the native plant communities and cultural plantings would result in an adverse, long-term, minor to moderate impact to the park's cultural landscapes.	*Direct/Indirect Impact*: Constructing exclosures over the life of this plan would preserve some vegetation that is part of the cultural landscapes of the park. However, presence of the exclosures would result in long-term minor to moderate adverse impacts to the cultural landscapes in which they are located, and remaining vegetation within the park would continue to be adversely affected by deer browsing over the long term until reproductive controls became effective and the population decreased. Since the benefits of reproductive control would not be fully realized within the life of this plan, overall impacts to cultural landscapes would be adverse, long term, and minor to moderate.	*Direct/Indirect Impact*: Enhancing natural forest regeneration by quickly reducing deer browsing pressure and maintaining a smaller deer population through direct reduction would result in beneficial, long-term impacts.	*Direct/Indirect Impact*: Enhancing natural forest regeneration by quickly reducing deer browsing pressure and maintaining a smaller deer population through direct reduction would result in beneficial, long-term impacts.
	Cumulative Impact: Would result in adverse, long-term, minor to moderate cumulative impacts.	*Cumulative Impact*: Would result in long-term, moderate adverse cumulative impacts.	*Cumulative Impact*: Would result in beneficial, long-term cumulative impacts.	*Cumulative Impact*: Would result in beneficial, long-term cumulative impacts.
	Potential for Impairment: No impairment of cultural landscapes would occur under this alternative.	*Potential for Impairment*: No impairment of cultural landscapes would occur under this alternative.	*Potential for Impairment*: No impairment of cultural landscapes would occur under this alternative.	*Potential for Impairment*: No impairment of cultural landscapes would occur under this alternative.
Soundscapes	*Direct/Indirect Impact*: Actions taken to protect plants and monitor the deer population and park	*Direct/Indirect Impact*: Intermittent construction of exclosures and reproductive control activities	*Direct/Indirect Impact*: Sharpshooting would result in adverse impacts, primarily affecting	*Direct/Indirect Impact*: Sharpshooting would result in adverse impacts, primarily affecting

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
	vegetation would result in an adverse, short-term, negligible adverse impact on soundscapes.	would result in short term, negligible to minor, adverse. impacts Individual construction and reproductive control activities would be short term, but would continue indefinitely into the future, resulting in both short- and long-term, negligible to minor, adverse impacts.	nearby residents. Perception of the intensity of the impacts would vary depending on several factors, including timing, attenuation levels, and distance from the source, resulting in minor to moderate impacts to individuals experiencing the sound.	nearby residents. Perception of the intensity of the impacts would vary depending on several factors, including timing, attenuation levels, and distance from the source, resulting in minor to moderate impacts to individuals experiencing the sound.
	Cumulative Impact: Would result in cumulative impacts ranging from minor to moderate and adverse depending on the source, due to the variety and abundance of noise sources that already exist around and within the park.	*Cumulative Impact*: Would result in cumulative impacts ranging from minor to moderate and adverse depending on the source, due to the variety and abundance of noise sources that already exist around and within the park.	*Cumulative Impact*: Would result in adverse, short and long term, and minor to moderate cumulative impacts. However, these impacts would be expected to decrease in the long term, as deer populations in all affected areas decrease and the need for direct reduction decreases as well.	*Cumulative Impact*: Would result in adverse, short and long term, and minor to moderate cumulative impacts. However, these impacts would be expected to decrease in the long term, as deer populations in all affected areas decrease and the need for direct reduction decreases as well.
	Potential for Impairment: No impairment of the park's soundscapes would occur under this alternative.	*Potential for Impairment*: No impairment of the park's soundscapes would occur under this alternative.	*Potential for Impairment*: No impairment of the park's soundscapes would occur under this alternative.	*Potential for Impairment*: No impairment of the park's soundscapes would occur under this alternative.
Visitor Use and Experience	*Direct/Indirect Impact*: Impacts to visitor use and experience 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). However, overall impacts related to a decreased ability to view scenery and other wildlife would be long term, minor to moderate and adverse.	*Direct/Indirect Impact*: Visitors would experience adverse, short-term impacts primarily due to aesthetics and closures of certain areas of the park, as well as a slight increase in occasional noise levels. These impacts would be offset by the educational and interpretive information, which would reduce adverse impacts to minor. Short-term impacts would eventually give way to beneficial, long-term impacts as the need for exclosures diminished and the deer population declined, resulting in a restored forest ecosystem	*Direct/Indirect Impact*: Adverse, short-term impacts that could occur if visitors were exposed to management actions would be offset by educational and interpretive information, resulting in negligible adverse impacts. Beneficial impacts would occur in the long term, as the forest regenerated and visitors could see increased plant and animal diversity, and enjoy enhanced scenery. Visitors focused primarily on seeing deer could be adversely impacted by the reduction in the herd size, but such impact would	*Direct/Indirect Impact*: Adverse, short-term impacts that could occur if visitors were exposed to management actions would be offset by educational and interpretive information, resulting in negligible adverse impacts. Beneficial impacts would occur in the long term, as the forest regenerated and visitors could see increased plant and animal diversity, and enjoy enhanced scenery. Visitors focused primarily on seeing deer could be adversely impacted by the reduction in the herd size, but such impact would

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
		throughout the park. Visitors focused primarily on seeing deer could be adversely impacted by the reduction in the herd size, but such an impact would be negligible to minor, as opportunities to view deer would still exist.	be negligible to minor, as opportunities to view deer would still exist.	be negligible to minor, as opportunities to view deer would still exist.
	Cumulative Impact: Would result in both adverse and beneficial (depending on an individual visitor's goals) impacts. Overall cumulative impacts would be long term, minor to moderate and adverse.	*Cumulative Impact*: Would result in mostly beneficial and long term cumulative impacts due to the effects of combined forest regeneration activities.	*Cumulative Impact*: Would result in cumulative impacts that would be primarily beneficial and long term.	*Cumulative Impact*. Would result in cumulative impacts that would be primarily beneficial and long term.
Visitor Safety	*Direct/Indirect Impact*: Because it is expected that no discernible effects to visitor safety would result from deer management actions, but vehicle collisions would continue, adverse, long-term, negligible to moderate adverse impacts could occur.	*Direct/Indirect Impact*: Adverse impacts to visitors would be short and long term and negligible from deer management, although the continued presence of a large number of deer over the life of the plan would continue to contribute to vehicle deer collisions on park roads and result in minor to moderate adverse impacts.	*Direct/Indirect Impact*: The extent of safety measures would result in adverse, short- and long-term, negligible to minor impacts, as it is expected that no discernible effects to visitor safety would occur from deer management actions and the possibility of deer-vehicle collisions would be diminished.	*Direct/Indirect Impact*: The extent of safety measures that would be used and locating activities away from park boundaries would result in adverse, short- and long-term, negligible impacts. The possibility of deer-vehicle collisions would be greatly diminished.
	Cumulative Impact: Would result in adverse, long term, and minor cumulative impacts.	*Cumulative Impact*: Would result in adverse, long term, and minor cumulative impacts.	*Cumulative Impact*: Would result in adverse, long term, and negligible to minor cumulative impacts.	*Cumulative Impact*: Would result in adverse, long term, and negligible to minor cumulative impacts.
Employee Safety	*Direct/Indirect Impact*: Because it is expected that no discernible effects to employee safety would occur as a result of deer management actions, impacts would be adverse, long term, and negligible.	*Direct/Indirect Impact*: Adverse impacts to government employees would be short and long term and negligible to minor.	*Direct/Indirect Impact*: Adverse, short- and long-term, negligible to minor impacts would occur.	*Direct/Indirect Impact*: Adverse, short- and long-term, negligible to minor impacts would occur.

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
	Cumulative Impact: Would result in adverse, long term, and negligible cumulative impacts.	*Cumulative Impact*: Would result in adverse, long term, and negligible cumulative impacts.	*Cumulative Impact*: Would result in adverse, long term, and negligible cumulative impacts.	*Cumulative Impact*: Would result in adverse, long term, and negligible to minor cumulative impacts.
Socio-economic Resources	*Direct/Indirect Impact*: The continued high numbers of deer and likely long-term increase in the deer population in Rock Creek Park would result in additional damage to landscaping in the surrounding areas and could result in varying impacts, ranging from minor to moderate and adverse.	*Direct/Indirect Impact*: Reproductive controls (if successful) would allow for only a gradual reduction in the number of deer, and there could be some displacement of deer from the park due to exclosures. The net effect on surrounding property could result in slightly greater damage to landscaping, the impacts of which would be long term and moderate.	*Direct/Indirect Impact*: The reduction of the existing deer populations in both the short and long term could result in fewer deer leaving the park and browsing landscaping on adjacent lands, with long-term beneficial effects that would reduce adverse impacts to negligible or minor levels.	*Direct/Indirect Impact*: The reduction of the existing deer populations in both the short and long term could result in fewer deer leaving the park and browsing landscaping on adjacent lands, with long-term beneficial effects that would reduce adverse impacts to negligible or minor levels.
	Cumulative Impact: Would result in adverse, long term, and minor to moderate cumulative impacts.	*Cumulative Impact*: Would result in moderate adverse long-term cumulative impacts.	*Cumulative Impact*: Would result in long-term minor cumulative adverse impacts.	*Cumulative Impact*: Would result in long-term minor cumulative adverse impacts.
Park Management and Operations	*Direct/Indirect Impact*: Long-term demands on park staff and funding for managing the deer herd and protecting other park resources would result in adverse, long term, and minor to moderate impacts.	*Direct/Indirect Impact*: Installing and maintaining large exclosures and implementing and monitoring reproductive controls would result in long-term, moderate adverse impacts.	*Direct/Indirect Impact*: The need for additional staff time for monitoring and coordinating activities under alternative C would result in adverse, moderate impacts initially, reduced to minor over time.	*Direct/Indirect Impact*: The need for additional staff time for monitoring and coordinating activities under alternative C would result in adverse, moderate impacts initially, reduced to minor over time.
	Cumulative Impact: Would result in adverse, long-term, moderate cumulative impacts.	*Cumulative Impact*: Would result in adverse, long-term, moderate cumulative impacts.	*Cumulative Impact*: Would result in adverse, long-term, minor to moderate cumulative impacts.	*Cumulative Impact*: Would result in adverse, long-term, minor to moderate cumulative impacts.

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Appendices

PURPOSE OF AND NEED FOR ACTION

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 Draft White-Tailed Deer Management Plan and Environmental Impact Statement (plan/EIS) presents three action alternatives for managing white-tailed deer (*Odocoileus virginianus*), and assesses the impacts that could result from continuation of the current management framework (alternative A) 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 Rock Creek Park, which will guide future actions for a period of 15 years. Brief summaries of both purpose and need are presented here, but more information is available in the "Park Background" section of this chapter.

The purpose of this plan/EIS is to develop a white-tailed deer management strategy that supports long-term protection, preservation, and restoration of native vegetation and other natural and cultural resources in Rock Creek Park.

PURPOSE OF THE PLAN / ENVIRONMENTAL IMPACT STATEMENT

The purpose of this plan/EIS is to develop a white-tailed deer management strategy that supports long-term protection, preservation, and restoration of native vegetation and other natural and cultural resources in Rock Creek Park.

NEED FOR ACTION

Although relatively rare at the turn of the twentieth century, white-tailed deer populations in the District of Columbia metropolitan area have rebounded 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, some of which are adjacent to the District of Columbia (MD DNR 1998).

Although there are no historic records before 1960 of the deer population specific to Rock Creek Park, deer herds have increased substantially within and around Rock Creek Park in recent years. Park observation records show four sightings of deer in Reservation 339 of Rock Creek Park in the 1960s. Deer sightings increased to 19 by the 1970s, and in 1984, the first recorded deer sighting in Glover-Archbold Park occurred. In the late 1980s (1987–1989) there were 39 deer sightings. By the early 1990s, deer sightings were so prevalent that observation cards were no longer completed. In 2007, sampling indicated 82 deer per square mile in the park, and results of vegetation monitoring in recent years have documented the effects of the growing herd size.

The deer population in Rock Creek Park has continued to grow and have adverse effects on the park's vegetation; therefore, action is needed at this time to address:

- The potential of deer becoming the dominant force in the park's ecosystem, and adversely impacting native vegetation and other wildlife.
- A decline in tree seedlings caused by excessive deer browsing and the ability of the forest to regenerate in Rock Creek Park.
- Excessive deer browsing impacts on the existing shrubs and herbaceous species.

- Deer impacts on the character of the park's cultural landscapes.
- Opportunities to coordinate with other jurisdictional entities currently implementing deer management actions beneficial to the protection of park resource and values.

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 park's 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 Rock Creek Park:

VEGETATION

- Develop and implement informed, scientifically-based vegetation impact levels and corresponding measures of deer population density that would serve as a threshold for taking prescribed management actions within the park.
- Protect the natural abundance, distribution, and diversity of native plant species within the applicable park units by reducing excessive deer browsing, trampling, and nonnative seed dispersal.
- Maintain, restore, and promote a mix of native plant species and reduce the spread of nonnative plant species through effective deer management.

WILDLIFE AND WILDLIFE HABITAT

- Allow for a white-tailed deer population within the park while protecting other park resources.
- Protect the natural abundance, distribution, and diversity of native animal species within the park by reducing excessive deer browsing, trampling, and nonnative seed dispersal.
- Protect lower canopy, shrub, and ground nesting bird habitat from adverse effects of deer browsing.

THREATENED, ENDANGERED, AND SPECIES OF SPECIAL CONCERN

- Protect habitat of rare plant and animal species from adverse effects of deer, such as excessive deer browsing, trampling, and nonnative seed dispersal.

CULTURAL RESOURCES

- Protect the integrity, variety, and character of the cultural landscapes by reducing excessive deer browsing, trampling, and nonnative seed dispersal.

VISITOR USE AND EXPERIENCE

- Share information with the public regarding the deer population and the forest regeneration process and diversity, including the role of deer as part of a functioning park ecosystem, not the primary driving force within it.
- Initiate cooperative efforts to address deer effects on the park and surrounding communities.

PARK MANAGEMENT AND OPERATIONS

- Share information with park staff and other regional parks regarding the deer population and management strategies.

PROJECT SITE LOCATION

Part of the national park system, Rock Creek Park is composed of 99 separate units, known as reservations, located in the District of Columbia and bordered by Montgomery County, Maryland (see figure 1). The focus of the analysis is to develop management strategies for the white-tailed deer population in and around the 99 units administered by Rock Creek Park. Although all units were considered, those units that have the available land to support a deer population, provide travel corridors between viable habitats, and/or where deer are currently known to occur, are emphasized in this plan. Table 1 lists all administered units of Rock Creek Park, including the main unit, Reservation 339 (which is also called "Rock Creek Park," but as a separate unit) and its tributary extension units and other reservations that are part of the overall NPS-administered park. Reservations that are not specifically addressed in the plan are highlighted in gray. Triangle parks, traffic circles, and most parks less than one acre in size were removed from site specific evaluation. Park units less than one acre in size that are not highlighted in gray are included in the study area because of their proximity to Reservation 339 and their potential as a wildlife corridor to that reservation.

1 **TABLE 1. ROCK CREEK PARK NAMED ADMINISTERED UNITS**

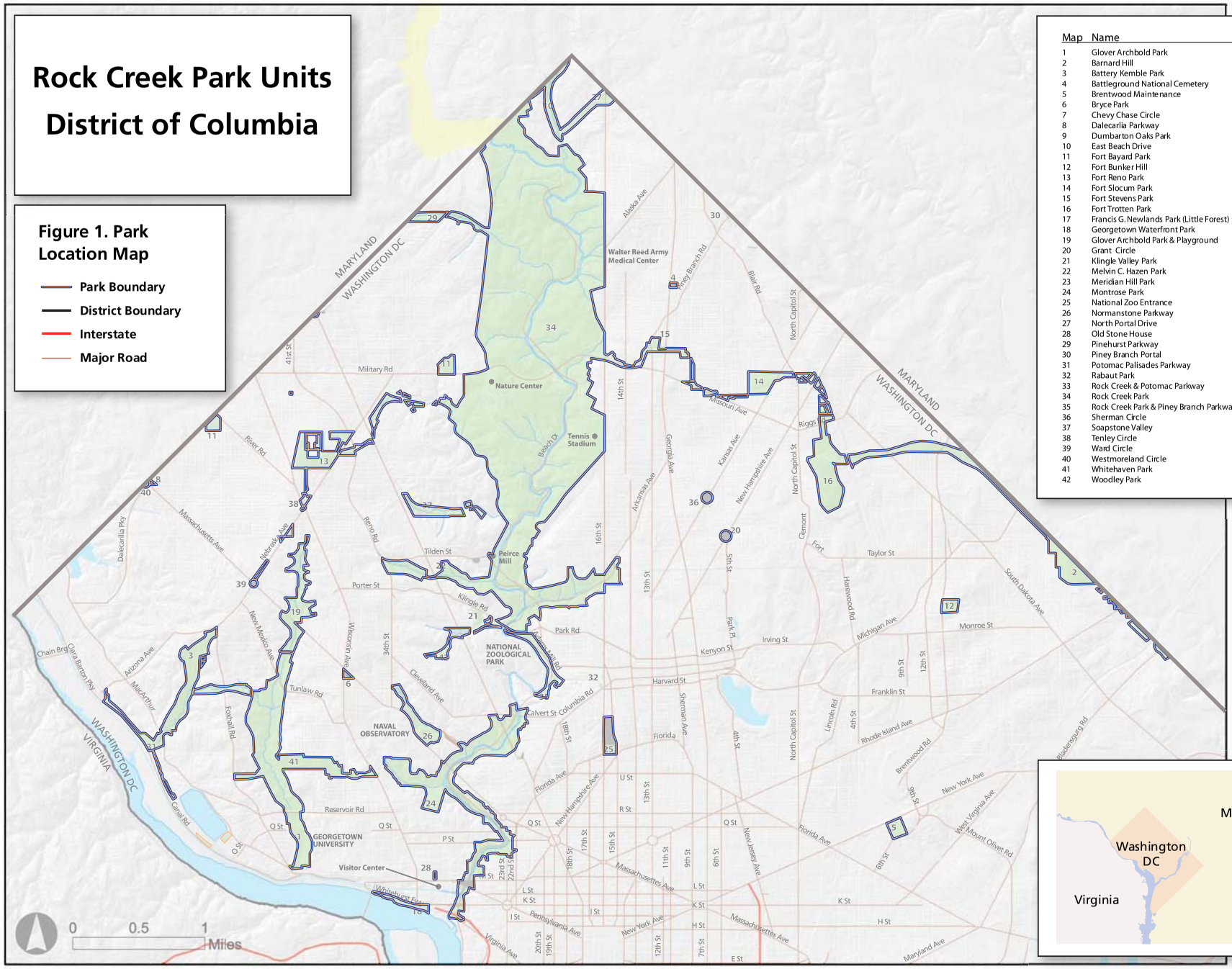
Unit Name	Reservation Number	Approx. Acreage	Enabling Legislation
Rock Creek Park and tributary park extensions Pinehurst Parkway Klingle Valley Soapstone Valley Park Normanstone Parkway North Portal Parkway Beach Parkway	339 545 356, 635, 563 402 514 433 432	1,822	26 Stat 492 September 27, 1890 Purchased by National Capital Planning Commission April 30, 1926 and Capper-Cramton Act, transfer from District of Columbia
Rock Creek and Potomac Parkway	360	171	Public Buildings Act of March 4, 1913
Fort Circle Parks Fort Reno Fort Stevens Battery Kemble Fort Bayard Fort Slocum Fort Totten Fort Bunker Hill	 470, 515, 542 358, 494, 499 521, 530 359 435 497, 544, 451 443	 62 24 57 4 18 129 6	Capper-Cramton Act, May 29, 1930
Potomac Palisades Parkway – Key Bridge to Chain Bridge, NW	404 Section 3	232	Capper-Cramton Act, May 29, 1930 Transfer of jurisdiction from District of Columbia
Barnard Hill	520, 528	29	Capper-Cramton Act, May 29, 1930
Dumbarton Oaks Park	637	27	Deeded to government from private donors
Meridian Hill Park	327	12	36 Stat 1310 March 4, 1911
Montrose Park	324	16	1911 District appropriations act provision (36 Stat 1005), transfer of jurisdiction from District of Columbia or other
Glover-Archbold Park, Glover Parkway & Children's Playground	351 (A–K), 450 (A–B), 451, 641	287	Land donations, authorized June 6, 1924 (43 Stat 464) and February 25, 1925 (43 Stat 978)

Unit Name	Reservation Number	Approx. Acreage	Enabling Legislation
Triangle Parks (irregular parcels) [note: Triangle Parks, located throughout the city, are not shown on figures 1 or 2]	302-303, 303B, 309 (A–B, G), 312 (A, I), 313B, 330 (B–C), 345–346, 397, 436, 438, 447–448, 468, 565, 573, 587, 614, 643, 667, 686	5.07	Transfer of jurisdiction from District of Columbia or other
Traffic Circles Grant Circle Chevy Chase Circle Sherman Circle Tenley Circle Westmoreland Circle Ward Circle	303A 312 335A 369 398, 399 559 572	0.16 1.84 0.71 2.32 0.16 0.76 0.69	Transfer of jurisdiction from District of Columbia or other
Curb Parking – Ashmeade Pl between Connecticut Ave & Kalorama Rd NW, Jenifer & 41st Sts at Belt Rd NW, Western Ave & Patterson St NW	303D, 326C, 335, 361	0.44	Transfer of jurisdiction from District of Columbia or other
Center Parking – Tilden St & Linnean Ave NW, Rock Creek Dr between Edgevale Terr & Normanstone Dr NW	308A, 338	1.20	Transfer of jurisdiction from District of Columbia or other
Rabaut Park	309C	0.57	Transfer of jurisdiction from District of Columbia or other
Whitehaven Parkway	357	51.25	--
National Zoological Park Entrance – Harvard St NW	516	1.0	Capper-Cramton Act, May 29, 1930
Park – Garfield St, between Fulton St & Foxhall Rd NW	529	14.0	Capper-Cramton Act, May 29, 1930
Piney Branch Portal	531	0.77	Transfer of jurisdiction from District of Columbia or other
Park – north side of National Zoological Park & Adams Mill Rd NW	563	1.77	Transfer of jurisdiction from District of Columbia or other U.S. agency
Battleground National Cemetery	568	1	Transfer from U.S. agencies
Melvin C. Hazen Park	630	43	Capper-Cramton Act, May 29, 1930
Woodley Park	635	3	Capper-Cramton Act, May 29, 1930 and transfer from District of Columbia or other
Francis G. Newlands Park (Little Forest)	668	9	Dedication/donation from private party
Park – Pennsylvania Ave btw 28th & M Sts NW	691	0.07	Transfer of jurisdiction from District of Columbia or other
Old Stone House	693	0.42	Purchased by USDI, NPS, or NCR, legislation approved September 25, 1950
Bryce Park	700	0.58	Capper-Cramton Act, May 29, 1930

Rock Creek Park Units
District of Columbia

Figure 1. Park Location Map

- Park Boundary
- District Boundary
- Interstate
- Major Road



Map	Name	Reservation #
1	Glover Archbold Park	351,450
2	Barnard Hill	520,528
3	Battery Kemble Park	521,530
4	Battleground National Cemetery	568
5	Brentwood Maintenance	
6	Bryce Park	700
7	Chevy Chase Circle	335A
8	Dalecarlia Parkway	478
9	Dumbarton Oaks Park	637
10	East Beach Drive	432
11	Fort Bayard Park	359
12	Fort Bunker Hill	443
13	Fort Reno Park	470,515,542
14	Fort Slocum Park	435
15	Fort Stevens Park	358,494,499
16	Fort Trotten Park	497,544,451
17	Francis G. Newlands Park (Little Forest)	668
18	Georgetown Waterfront Park	
19	Glover Archbold Park & Playground	451,641
20	Grant Circle	312
21	Klingle Valley Park	356,635,563
22	Melvin C. Hazen Park	630
23	Meridian Hill Park	327
24	Montrose Park	324
25	National Zoo Entrance	516
26	Normanstone Parkway	514
27	North Portal Drive	433
28	Old Stone House	693
29	Pinehurst Parkway	545
30	Piney Branch Portal	531
31	Potomac Palisades Parkway	404
32	Rabaut Park	309C
33	Rock Creek & Potomac Parkway	360
34	Rock Creek Park	339
35	Rock Creek Park & Piney Branch Parkway	339,531
36	Sherman Circle	369
37	Soapstone Valley	402
38	Tenley Circle	398,399
39	Ward Circle	572
40	Westmoreland Circle	559
41	Whitehaven Park	357
42	Woodley Park	635

PARK BACKGROUND

HISTORY OF ROCK CREEK PARK

The 1890 legislation establishing Rock Creek Park reserved land in the District of Columbia for the purpose of creating a "public park and pleasure ground for the benefit and enjoyment of the people of the United States." These urban allocations of land provided to the local residents and visitors fresh air, waterways, meadows, and serenity that were considered the antidote to the stress of daily work and the congestion of the city. However, Rock Creek Park was also linked to the burgeoning conservation movement within the United States. Congress emphasized the preservation of the park's natural resources and landscape scenery in the enabling legislation, stating "regulations shall provide for the preservation from injury or spoliation of all timber, animals or curiosities within said park, and their retention in their natural condition, as nearly as possible" (Bushong 1990).

The 1890 legislation establishing Rock Creek Park reserved land in the District of Columbia for the purpose of creating a "public park and pleasure ground for the benefit and enjoyment of the people of the United States."

As previously noted, Rock Creek Park is an administrative unit of the national park system consisting of 99 separate units, known as reservations, located entirely within the northwest and northeast quadrants of the District of Columbia. Residential and commercial areas of Washington, D.C. and Maryland surround all of the park units. Over 1,100 homes and apartments abut the park units along 72 miles of the park boundary (NPS 2005a). The largest of the 99 reservations, Rock Creek Park (Reservation 339), was established by Congress on September 27, 1890, and consists of 1,754 acres of Rock Creek and the surrounding valley from the Maryland state line south to the National Zoological Park (see figure 2). Beyond Reservation 339, Rock Creek administers areas such as the Rock Creek and Potomac Parkway (Reservation 360), Glover-Archbold Park (Reservations 351 and 450), and the Fort Circle Parks to name a few. These units have different purposes, ranging from highly designed cultural landscapes to natural forested areas. Throughout this document, references to Rock Creek Park or the park include all administered units; descriptions of specific units are referenced as such.

OVERVIEW OF THE PARK'S ECOSYSTEM

Deciduous woods cover most of the park's total acreage. While there are six forest communities in the park, over half of the park is an American beech (*Fagus grandifolia*)/white oak (*Quercus alba*) forest (Nature Conservancy 1998). Several species of oak (*Quercus* spp.), hickory (*Carya* spp.), tulip poplar (*Liriodendron tulipifera*), and American beech predominate the slopes and ridges. Elm (*Ulmus* spp.), sycamore (*Platanus occidentalis*), ash (*Fraxinus* spp.), box elder (*Acer negundo*) and tulip poplar are common in the occasional floodplain areas along stream channels. Remnant coniferous trees are spread throughout the park as single trees or small groves. An inventory of the park's vegetation has documented approximately 700 species of vascular plants. Thirty-one rare or uncommon plants listed by Maryland and Virginia are found in the park. Approximately 15 meadow areas, measuring from 0.3 to 4 acres in size, are scattered among the park units (NPS 2005a).

Wildlife studies throughout the park have identified 36 species of mammals, 181 species of birds, and 19 species of reptiles and amphibians that are present or probably present in the park (NPS unpublished data-NPSpecies 2008b). Species in the park include white-tailed deer, red (*Vulpes vulpes*) and gray (*Urocyon cinereoargenteus*) fox, raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*), gray squirrel (*Sciurus carolinensis*), beaver (*Castor canadensis*), chipmunk (*Tamias striatus*), southern flying squirrel (*Glaucomys volans*), coyote (*Canis latrans*), great horned owl (*Bubo virginianus*), barred owl (*Strix varia*), red shouldered hawk (*Buteo lineatus*), eastern box turtle (*Terrepene carolina*), spotted salamander (*Ambystoma maculatum*), and black rat snake (*Elaphe obsoleta*) (NPS 2005a). One endangered species is found in freshwater springs within the park, the Hay's Spring amphipod (*Stygobromus hayi*).

The increasing numbers of white-tailed deer within the park are resulting in a substantial effect on the park ecosystem due to the deer's heavy browsing of vegetation. Studies being conducted by the park indicate that deer are having adverse effects on shrub cover, tree seedling regeneration, and herbaceous cover, which affect habitat quality for other wildlife within the park that are dependent on this vegetation for food, shelter, and cover (see "Vegetation Impacts section, below).

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

PURPOSE AND SIGNIFICANCE OF ROCK CREEK PARK UNITS

All units of the national park system are formed for a specific purpose and to preserve significant resources or values for the enjoyment of future generations. The purpose and significance identify uses and values that individual NPS plans should support.

The following provides background on the purpose and significance of three large units managed by Rock Creek Park: Rock Creek Park (Reservation 339), Rock Creek and Potomac Parkway, and the Fort Circle Parks. Information on purpose and significance were taken from the enabling legislation and general management plan (GMP) language.

Rock Creek Park and Associated Tributary Parks (Reservation 339) and the Rock Creek and Potomac Parkway (Reservation 360)

Establishment—Congress established Rock Creek Park, one of the first national park areas, on September 27, 1890 as a unique natural park containing significant historic and archeological resources, and providing a variety of recreational opportunities for visitors and residents of the District of Columbia metropolitan area (Pub. L. 51-297, 26 Stat. 482).

Rock Creek Park is linked to the Potomac River and the monuments in downtown Washington, D.C. by the Rock Creek and Potomac Parkway. Congress established the parkway through the Public Buildings Act of March 4, 1913. The parkway corridor is managed contiguously with Rock Creek Park.

Figure 2. Rock Creek Park Map (Reservation 339 and Adjacent Units)

Purpose—The 1890 enabling legislation for Rock Creek Park states:

- The area is to be "perpetually dedicated and set apart as a public park or pleasure ground for the benefit and enjoyment of the people of the United States."
- The park is to "provide for the preservation from injury or spoliation of all timber, animals, or curiosities within said park, and their retention in their natural condition, as nearly as possible."

Based on NPS's interpretation of this legislation, as presented in the Rock Creek Park and the Rock Creek and Potomac Parkway General Management Plan, Rock Creek Park exists to:

- Preserve and perpetuate for this and future generations the ecological resources of the Rock Creek valley within the park in as natural a condition as possible, the archeological and historic resources in the park, and the scenic beauty of the park.
- Provide opportunities for the public to experience, understand, and appreciate the park in a manner appropriate to the preservation of its natural and cultural resources.
- Provide opportunities for recreation appropriate to the park's natural and cultural resources. The purpose of the tributary parks adjacent to Rock Creek Park includes the preservation of forests and natural scenery in and around the District of Columbia (NPS 2005a).

Rock Creek and Potomac Parkway exists to connect Rock Creek Park and the National Zoological Park to Potomac Park with a scenic road; and prevent pollution and obstruction of Rock Creek.

Significance—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 following significance statements, as detailed in the Rock Creek Park and the Rock Creek and Potomac Parkway General Management Plan (NPS 2005a), recognize the important features of the park.

- Rock Creek Park is one of the oldest and largest naturally managed urban parks in the United States. The park and parkway contains approximately 2,100 acres of valuable plant and wildlife habitat, providing protection for a variety of native species within a heavily urbanized area.
- Rock Creek Park encompasses a rugged stream valley of exceptional scenic beauty with forested, natural landscapes and intimate natural details, in contrast to the surrounding cityscape of Washington, D.C.
- Rock Creek Park's forests and open spaces help define the character of the nation's capital.
- Rock Creek valley was important in the early history of the region and in the development of the nation's capital. The park's cultural resources are among the few tangible remains of the area's past.
- Rock Creek Park is an oasis for urban dwellers, offering respite from the bustle of the city.
- Rock Creek Park is a historic designed landscape incorporating early twentieth century picturesque and rustic features designed to enhance the visitors' experience of the naturalistic park scenery.
- Located in the heart of a densely populated cosmopolitan area, Rock Creek Park serves as an ambassador for the national park idea, providing outstanding opportunities for education, interpretation, and recreation to foster stewardship of natural and cultural resources.

The following significance statement recognizes the important features of the parkway: The Rock Creek and Potomac Parkway provides a scenic gateway to the city's downtown area, known as the monumental core.

Fort Circle Parks (Battery Kemble, Fort Bayard, Fort Reno, Fort DeRussy, Fort Stevens, Fort Slocum, Fort Totten, and Fort Bunker Hill)

Establishment—The monies used by the NPS to acquire the Fort Circle Parks were appropriated by the Capper-Cramton Act of 1930. This act appropriated funds for the further acquisition of "…such lands in the District of Columbia as are necessary and desirable for the suitable development of the National Capital Park, parkway, and playground system…"

Purpose—The Fort Circle Park Final Management Plan / Environmental Assessment (NPS 2004b) states that the purpose of the Fort Circle Parks is to:

- Preserve and interpret historical resources related to the Civil War defenses of Washington.
- Conserve this linkage or urban green space that contributes to the natural character and scenic values of the nation's capital.
- Provide recreational opportunities compatible with historic and natural resource values.
- Protect the forests and natural scenery and prevent the pollution of park waterways.

Significance—The *Fort Circle Parks Final Management Plan/Environmental Assessment* (NPS 2004b) states that the significance of the Fort Circle Parks is as follows:

- The park sites contain remains of the defense sites (e.g., forts, batteries, rifle trenches) that effectively deterred the invasion of the nation's capital during the Civil War.
- The Fort Circle Parks include the remains of forts that were engaged in the Battle of Fort Stevens in July 1864 – the only Civil War battle in the District of Columbia and the only time a sitting U.S. president has come under enemy fire in warfare.
- The pattern (greenbelt) of public space of Fort Circle Parks represents an element of one of the earliest urban planning efforts for public recreation in the United States. Today it enhances the aesthetics of the capital city and the quality of life for its citizens.
- The Fort Circle Parks preserve significant natural features, including substantial acreage of mature native hardwood forests, geologic and aquatic resources, and a diversity of important habitat for indigenous flora and fauna that are unusual in an urban setting and that contribute to the uniqueness of the nation's capital.

AUTHORITY TO MANAGE DEER

The NPS has broad authority to manage wildlife and other natural resources within the boundaries of units of the national park system. See, generally, 16 U.S.C. 1 (NPS "shall promote and regulate the use of Federal areas known as national parks…by such mean and measures as conform with the fundamental purpose of the parks…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"). In defining this discretion, the 10th Circuit Court of Appeals overturned a district court decision, holding in part that the NPS "need not wait until the damage through overbrowsing has taken its toll on park plant life … before taking preventative action" New Mexico State Game Commission v. Udall, 410 F.2d 1197, 1201 (10th Cir. 1969). This discretion has been reinforced over time. In United States v. Moore, 640 F.Supp. 164, 166 (S.D. W.VA. 1986) the court found that Congress had given the Secretary great discretion in regulating and controlling wildlife within the national park system. This discretion is further defined by NPS management policy.

NPS *Management Policies 2006*, section 4.4.2, states that "[w]henever possible, natural processes will be relied upon to maintain native plant and animal species and influence natural fluctuations in populations of these species. The Service may intervene to manage populations or individuals of native species only when such intervention will not cause unacceptable impacts to the populations of the species or to other

components and processes of the ecosystems that support them." In addition, the policy restricts management to times when certain conditions exist. One such condition is when "a population occurs in an 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."

However, as part of any animal population management action, the NPS is required to follow an established planning process, including provisions for public review and comment. NPS policies also require that parks "assess the results of managing plant and animal populations by conducting follow-up monitoring or other studies to determine the impacts of the management methods on nontargeted and targeted components of the ecosystem" section 4.4.2. This strategy is described in this plan including specific thresholds for taking action and end points on management actions.

SCIENTIFIC BACKGROUND: DEER AND VEGETATION MANAGEMENT

DEER MANAGEMENT ISSUES AND RESEARCH OVERVIEW

The focus of the analysis is to develop deer management methods and strategies for Rock Creek Park in cooperation with local, state, and regional entities, as well as other federal agencies. 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. The team evaluated scientific literature and research on the topic of deer management; established a monitoring protocol for park deer populations and other park resources; and recommended resource thresholds at which deer management strategies would be implemented. Monitoring protocols and impact thresholds are a component of all action alternatives evaluated in analysis, helping to ensure that the deer population at the park does not jeopardize the ecological integrity of the park.

Regional Landscape-level Changes

Before European settlement of North America, white-tailed deer populations are estimated to have been between 23 and 24 million, or about 8 to 11 deer per square mile (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 continued to increase. 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).

White-tailed deer in Rock Creek Park

Improved habitat conditions resulting in increased reproduction, coupled with low mortality rates, have resulted in deer numbers that have grown to an estimated current population in excess of 234,000 animals in Maryland (MD DNR 2006–2007). 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. Fragmentation of the landscape and the increase in residential development have also reduced suitable hunting opportunities, particularly in

Maryland's growing suburban areas, some of which are adjacent to the District of Columbia and Rock Creek Park (MD DNR 1998). Although data exist for the District of Columbia near Rock Creek Park, the observations are too general and inconclusive (S. Bates, pers. comm. 2008d). However, because deer populations can and do cross these political boundaries, and because there are many similarities in regional landscape level changes and conditions, it is reasonable to assume that the District of Columbia and Rock Creek Park face the same issues as the neighboring Maryland suburbs.

Documentation of Deer Damage at Rock Creek Park

As in other eastern national parks, today the white-tailed deer at Rock Creek Park have no significant natural predators and virtually no hunting. The park provides an island of habitat in an urban environment, where there is no hunting per 36 Code of Federal Regulations (CFR) 2.2. Coupled with the lack of natural predation within the park, the combination of these factors has facilitated the growth of the deer population at Rock Creek Park.

Occasional sightings of deer in Rock Creek Park emerged in the 1960s, and continued sporadically throughout the 1970s. The deer population continued to increase, and in 1984, the first deer sighting in Glover-Archbold Park was recorded. By 1990, deer sightings were common throughout Rock Creek Park (K. Ferebee, pers. comm. 2005).

Deer have browsed a considerable amount of the understory at Rock Creek Park.

In an effort to determine the extent of deer-related impacts at Rock Creek Park, park staff have conducted a number of monitoring studies to document the size of the park's deer population, as well as plant growth in the understory of the forest. Generally, the data collected indicate that deer are having adverse effects on shrub cover, tree seedling regeneration, and understory plant densities. The following summarizes the surveys performed at the park to date and their results.

Population and Ecological Characteristics of White-tailed Deer at Rock Creek Park

Observed deer trends and density at Rock Creek Park has been estimated through roadside spotlight surveys, Distance Sampling, limited Forward Looking Infrared Surveys (FLIR), and roadkill reports. Deer monitoring and research started in Rock Creek Park when deer were first spotted in the 1960s. From the 1960s to the early 1990s, deer observation cards were collected to document sightings. By the early 1990s, deer sightings were so prevalent that observation cards were no longer completed. Until the early 1990s, observation cards served as the only method for tracking deer in Rock Creek Park.

Roadkill Reports (1989–present)

Rock Creek Park staff have been recording dead animals found in the park since the early 1980s. In 1989, the first deer struck and killed by a vehicle in the park was recorded. Data collected included sex, age, and the presence or absence of parasites. The park now records road-killed deer in a Geographic Information

System (GIS) layer. Areas of high numbers of road-killed deer include Military Road, Oregon Avenue, Beach Drive and Rock Creek and Potomac Parkway.

Radio Telemetry Surveys (2001–present)

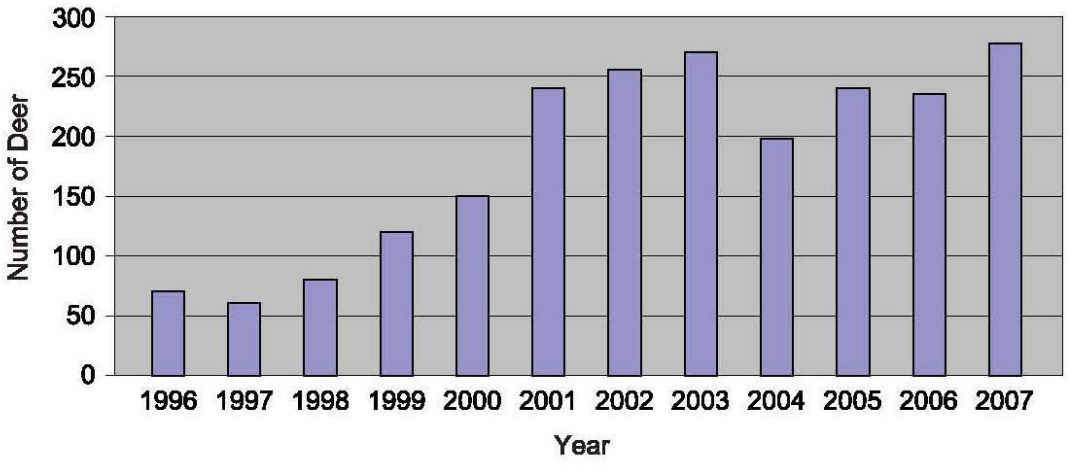
The park performs limited radio telemetry studies. Beginning in 2002, park staff have collared five deer (does) with a radio transmitter, recording their movements. Data collected from the telemetry surveys are used to estimate the area used by each deer and the percentage of time that each deer is inside or outside of the park. The survey data show that the area used by each deer ranges from about 31 to 260 acres, and that the percentage of time spent outside the park is quite variable, ranging from about 5 to 42% (K. Ferebee, pers. comm. 2008d). Results of this limited research indicate that deer typically move about 0.25 miles outside the park boundary (K. Ferebee, pers. comm. 2008i).

Spotlight Surveys (1996–present)

Conducting spotlight surveys at Rock Creek Park

Since 1996, park staff have conducted annual spotlight surveys to monitor trends in the deer population at Rock Creek Park. The surveys are conducted the same time each year over a four-night period, following the same 22-mile route covering the majority of Rock Creek Park (Reservation 339). The deer counts are based on visual sightings and eye shine from a spotlight. Where possible, sex and age determinations are recorded. The spotlight surveys are not based on any specific scientific protocols and provide population trends only, suggesting abundance levels in the area immediately adjacent to the vehicle route. Their usefulness is limited, since population densities cannot be calculated using this method (K. Ferebee, pers. comm. 2008c). As shown in figure 3, spotlight surveys indicate that the number of deer observed cumulatively over all four nights along the route increased steadily from 1997 to 2003, with a decrease in 2004, followed by some rebound in 2005–2007 (NPS 2005c; K. Ferebee, pers. comm. 2006, 2007a, b).

FIGURE 3. SPOTLIGHT COUNTS, 1996–2007



Forward Looking Infrared Surveys (1997–1999)

In March 1997, the park used FLIR, a nighttime survey conducted from a helicopter to estimate the total number of deer in the park. In the first two years of the survey, the main reservation of Rock Creek Park (Reservation 339), Glover-Archbold Park, and Battery Kemble Park were surveyed. In 1999 (year 3 of the survey), only Rock Creek Park was surveyed, to allow a more intensive survey in one location to attempt to obtain more accurate results. In Rock Creek Park the survey results were as follows: 1997, 87 deer; 1998, 80 deer; and 1999, 90 deer in the park. The company conducting the survey stated the results were 75% accurate or better; however, due to unacceptable error rate, the park did not use FLIR after 1999.

Distance Sampling (2000–present)

In 2000, Dr. Brian Underwood of the U.S. Geological Survey taught Distance Sampling, which accurately estimates animal population density, to the National Capital Region natural resource personnel. Trained Rock Creek Park staff conducted the first Distance Sampling in November 2000, estimating 62 deer per square mile within the park. Since 2000, Distance Sampling is repeated annually over three to four consecutive nights (table 2). In 2004, 75 deer per square mile were surveyed, a decrease from 98 deer per square mile in 2003 (NPS 2005d). The densities surveyed in 2005 and 2006, respectively, were 52 and 58 deer per square mile (K. Ferebee, pers. comm. 2007b). Current (2007) density is estimated at 82 deer per square mile (K. Ferebee, pers. comm. 2008a).

TABLE 2. DISTANCE SAMPLING RESULTS IN ROCK CREEK PARK

Year	Deer per Square Mile (density)	Standard Error of the Mean (±)
2000	62	11.6
2001	63	6.9
2002	60	8.0
2003	98	17.3
2004	75	7.8
2005	52	6.9
2006	58	8.9
2007	82	10.21

Source: K. Ferebee pers comm. 2007b, 2008f

Effects of White-tailed Deer on Vegetation Structure and Diversity at Rock Creek Park

In addition to determining abundance and distribution of deer at Rock Creek Park, the park is also conducting studies to determine the impacts of deer on other natural resources. Studies conducted to date include long-term monitoring of unfenced vegetation plots and studies of paired plots (fenced and unfenced) to assess the effects of deer browsing on forest vegetation.

Vegetation Impacts

Long-term Vegetation Plots

In 1990, 27 long-term vegetation monitoring plots (20 meters × 20 meters [66 feet × 66 feet], unfenced plots) were placed in three geographic regions in the park—north, central, and south—to ensure that all areas would be adequately sampled. Plots were placed randomly within each region to capture general changes in vegetation over time. There were not many deer documented in the park in 1990, providing a good baseline of vegetation characteristics. Data from these long-term unfenced plots, read every four years (1991, 1995, 1999, 2003, 2007), indicate that in 1991, 3.1 $\pm$ 0.9% of the stems were browsed compared to 31.1 $\pm$ 2.9% in 2003. During this time, the shrub cover decreased from 54.63 $\pm$ 5.9% in 1991 to 14.92 $\pm$ 2.2% in 2003. Tree seedlings decreased significantly from 1991 across all other years measured (Hatfield 2005). Preliminary 2007 data analysis (Hatfield 2008) show that all tree seedling counts generally declined since 1991 and that counts for all height classes were near zero in 2007. The data collected from these monitoring plots indicate that the mean seedling stocking rates (or tree seedling weighted measure, see appendix A) declined significantly from 1991 to 2007, with a stocking rate of 2.26 $\pm$ 0.32% in 2007, significantly below the 67% stocking rate recommended for regeneration (Hatfield 2008; Stout 1999 appendix A). Additional information including the most recent results of long-term monitoring can be found in the "Vegetation" section of the "Affected Environment" chapter.

Paired Plots

In 2000, 20 paired plots (one plot fenced, one plot unfenced, located next to each other in similar vegetation conditions) were established in Rock Creek Park proper and Glover-Archbold Park. From 2001 to 2004, the paired plots showed that plant cover outside the fenced plots was substantially less when compared to plant cover inside the fenced plots over the study period. Specifically, the mean percentages of plant cover for nonnative, native, herbaceous, and woody plants were 2 to 3 times less in the paired unfenced plots than in the paired fenced plots (Rossell et al. 2007). 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 there is some understory vegetation and the browse line is not prominent at Rock Creek Park, trends indicate that an unmanaged deer population could lead to these problems, which are currently being faced by similar eastern national parks such as Catoctin Mountain Park, Maryland.

Understory growth in a fenced plot

Current Deer Management at Rock Creek Park and in Surrounding Jurisdictions

Rock Creek Park currently has no formal deer management plan, but does undertake numerous deer management activities. In addition to the deer population and vegetation monitoring described in previous sections, other deer management activities currently undertaken by Rock Creek Park include assisting D.C. Animal Control with injured animals (e.g., darting animals, euthanizing injured animals), responding to neighbors' questions about the deer population (e.g., how to keep deer out of yards, preventing browsing of landscaping vegetation), and disseminating information about the deer population. These

actions constitute this plan's "no action" alternative, and details about current management actions are described in this document in "Chapter 2: Alternatives" under alternative A.

District of Columbia – Fisheries and Wildlife

Although there is not a formal deer management plan in the District of Columbia, issues associated with an overabundance of deer still exist. As issues arise, they are addressed mainly by two District government agencies: the Department of Health and the Department of the Environment. The Department of Environment's Fisheries and Wildlife Division has four major components: the Aquatic and Wildlife Education Branch, the Fisheries Research and Management Branch, the Grant Coordination and Licensure Branch, and the Wildlife Management and Research Branch. Collectively these branches monitor the District's aquatic and wildlife resources. Although not currently engaged in deer management activities, the Fisheries and Wildlife Division has recently hired several wildlife biologists and is beginning to establish an inventory and monitoring program.

The majority of deer related actions in the city are undertaken by the District of Columbia Department of Health (DCDOH). The DCDOH, through a contract with the Washington Humane Society, provides animal control and animal disease prevention services and assists the public with animal-related problems. Services offered by this agency include, but are not limited to, animal disease control, rabies suspect control, stray animal control, dangerous dog control, licensing, enforcement, sterilization, and adoption. Specific activities that may relate to this deer management effort include conducting disease surveillance, enforcement of animal control laws, and disposal of animals by redemption to owner, release to the wild, humane intravenous euthanasia; providing education via pamphlets and classroom visits, and assisting District of Columbia agencies, such as the Metropolitan Police Department, as requested (DCDOH n.d.).

Maryland National Capital Park and Planning Commission – Montgomery County Division

In addition to the District of Columbia, Rock Creek Park shares a border with Montgomery County, Maryland. Along this border, the NPS Rock Creek Park transitions into the Maryland National Capital Park and Planning Commission (M-NCPPC)–managed Rock Creek Park, a portion of the 33,000-acre county park system. Montgomery County and the NPS have concurrent jurisdiction over Rock Creek (the waterway). Montgomery County has been actively addressing deer overabundance since 1995.

Citizen complaints about the effects of deer, including deer/vehicle collisions and damage to landscape vegetation, began to increase in the county around 1992. At that time, the county established a task force to determine if deer overabundance was a problem and, if so, to discuss solutions for addressing it. The efforts of the task force focused on information relative to conflicts between deer and people in the county and resulted in the April 1994 *Report of the Task Force to Study White-Tailed Deer Management*. The report included a recommendation to the county council to establish a working group to prepare a comprehensive deer management plan. This working group is still active today.

White-tailed deer near the road at Rock Creek Park

As a result of the working group efforts, in 1995 the *Comprehensive Management Plan for White-tailed Deer in Montgomery County, Maryland* was published. This plan recognized that the type and extent of deer-human conflicts varies throughout the county and addresses

deer from a variety of standpoints including public safety issues (collisions), economic issues (agricultural interests, agricultural preserves), and the maintenance and protection of natural areas. The goal of the deer management plan in Montgomery County is to address the effects of deer. The plan does not provide a density goal to be reached (Montgomery County 1995a).

To develop the plan, the county collected and centralized data on the deer and their impacts so that these data could be used as a foundation for management decisions. Data collected during the initial stages included information on deer/vehicle collisions that was later incorporated into a geographic information system to identify hot spots and target areas, effects on agricultural lands and residential properties, and effects on natural areas. Part of the data collection involved vegetation monitoring where a number of plots were established throughout the county in upland and stream valley parks. The study, concluded in 1999, indicated that county forests experienced degradation, but it did not show to what extent increasing deer densities were responsible.

In 1990, the county placed one set of paired unfenced and fenced plots (20 meters × 20 meters [66 feet × 66 feet]) in each of nine parks (Storm and Ross 1992). The plots were arbitrarily placed in the county parks and there was no replication. Data from the paired plots showed an average loss of 65% of species to deer browsing. A qualitative assessment of 1995–2001 paired plot data concluded that (1) deer impacts are reducing height, number, and species diversity of seedlings within county parks, (2) understory density has been dramatically reduced, and (3) the effects appear greatest in parks with higher densities of deer (Montgomery County 2002). In 1995, the *Inventory of Rare, Threatened, and Endangered Plant Populations and Significant Habitats on Selected Park Lands of M-NCPPC in Montgomery County, Maryland*) stated:

> Every park surveyed during this project had an overpopulation of deer. The severity of this problem varies from one park to another, but it represents a considerable threat to the native vegetation in every park (Montgomery County 1995b).

The county studied a variety of deer management methods, and in 1996 in areas where immediate attention was required, managed deer hunts were implemented. The first managed hunt occurred in northern Montgomery County on a 400-acre agricultural history farm park. The hunt was considered a success based on several factors: it was completed safely with no injuries or accidents; the deer population was reduced to the desired goal; and impacts to the surrounding communities (landscape and crop damages) were reduced. Managed hunts have continued throughout the county and the program has been expanded since its implementation (W. Hamilton pers. comm. 2008).

Depredation means damage or loss.

The county also considered the use of repellents/scare devices, fencing/physical exclusion, habitat management, supplemental feeding, restoration of predators, modifying legal harvest, agricultural depredation permits, direct reduction through sharpshooting or special or managed hunts, contraception, and trapping and removal/relocation. Although all were considered, not all of these methods have been or will be implemented.

One method implemented throughout the county is sharpshooting. When sharpshooting activities occur, a notification is posted at the entrance of the park stating that the park is closed to the public from sunset to sunrise. M-NCPPC Park Police officers perform the sharpshooting, removing deer for approximately five hours per night. Deer are processed and donated to the Capital Area Food Bank. The county notes that, while this method is effective, the administration and logistics are difficult. The county estimates the cost of sharpshooting at $150 per animal, which includes approximately $50 for deer processing for donation and the rest for ammunition, staffing, and other needs. The other form of direct reduction, special or managed hunts, involves taking land previously closed to hunting and holding a managed hunt under

strict guidelines for limited duration. To participate in the hunts, hunters must pass special training and marksmanship tests.

The county has considered contraception and has worked with the Humane Society of the United States and the National Institute of Standards and Technology (NIST) to implement a study in Wheaton Regional Park. However, the Wheaton Regional Park site was determined inappropriate for such an effort as policy in the State of Maryland prefers an enclosed population for research studies.

As part of the Comprehensive Management Plan (1995), the Montgomery County Deer Management Work Group annually reviews deer impact data and creates a list of recommendations for the upcoming year. In fiscal year 2003, this report stated that the management options implemented over the previous six years appeared to be having an effect. The report also stated that, in areas where managed hunts had been held (Little Bennett Regional Park, the Agricultural History Farm Park, and Seneca Creek State Park), the number of deer/vehicle collisions had been reduced and remained at lower levels. The fiscal year 2003 study also identified 19 "hot spots" for deer impacts and listed a combination of lethal and non-lethal methods at each site to manage the deer population (Montgomery County 2002).

Deer removals are not currently taking place in Maryland's lower Rock Creek Park. The M-NCPPC has been addressing other areas within the county that have higher concentrations of deer. The park is currently on a list of areas to be managed for deer, but specific management actions have not yet been implemented. The M-NCPPC continues to express interest in working together with Rock Creek Park to coordinate management efforts (K. Ferebee, pers. comm. 2008h).

Comprehensive Management Plan for White-tailed Deer in Montgomery County (1995, updated 2004)

The M-NCPPC, which oversees the Montgomery County Department of Park and Planning, created a comprehensive management plan for white-tailed deer on the premise that deer are an important and valued part of the county's natural heritage; however, deer are an opportunistic species that can, in the absence of checks and balances, become abundant enough to conflict with human interests. The plan, developed to be open-ended and adaptable, acknowledges that deer-human conflicts vary and one single management prescription may not be appropriate. The *Comprehensive Management Plan for White-tailed Deer in Montgomery County* establishes goals and objectives for managing deer in the county, develops a plan of action for each of the problem issues identified, and sets a timetable for implementation of these actions. The management plan is composed of four components:

Part I addresses the collection, centralization, and use of accurate data on white-tailed deer and their effects on Montgomery County, and forms the foundation on which sound management decisions must be based.

Part II outlines the implementation of a comprehensive public awareness and public education program to better inform citizens about deer-human conflicts and how to prevent them.

Part III describes the various management alternatives that are available to reduce the deer effects and outlines the implementation of population management alternatives to reduce deer populations in areas where this is deemed necessary.

Part IV outlines the current status of the plan's implementation and the work program for the current fiscal year—this component of the plan is updated annually.

Other Deer Management Efforts

Deer Management Efforts within the National Park Service

Other national park units have been involved in deer management planning efforts. Gettysburg National Military Park and Eisenhower National Historic Site completed a *White-tailed Deer Management Plan and Environmental Impact Statement* in 1995, and approved management strategies are now being implemented. Deer management planning and environmental review efforts are also being undertaken at Indiana Dunes National Lakeshore, Catoctin Mountain Park in Maryland, Cuyahoga Valley National Park in Ohio, and Valley Forge National Historical Park in Pennsylvania and are in various stages of completion.

Deer Management by State and Other Federal Agencies

The Wildlife Services program of the Animal and Plant Health Inspection Service (APHIS), 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. USDA-ARS Beltsville Agricultural Research Center has been conducting managed deer hunts since 1995. Average annual removal of deer is 200 to 400 (Mike Dudley, USDA-ARS biological science technician, pers. comm. June 10, 2008, reported in S. Bates pers. comm. 2008c). 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).

Direct Reduction — Lethal removal of deer; includes both sharpshooting and capture/euthanasia.

The Mason Neck National Wildlife Refuge (NWR), located in northeastern Virginia, 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 Maryland Department of Natural Resources has issued two permits to conduct reproductive control studies, one to the USDA Wildlife Services for research on the effectiveness of GonaCon® immunocontraceptive vaccine (GCIV) on female white-tailed deer in the White Oaks Federal Research Center in White Oak, Maryland, 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 (NIST) site in Gaithersburg, Maryland. APHIS has been conducting 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 (K. Sullivan, Maryland State Director, USDA-Wildlife Services, Wildlife Society Meeting presentation, 9/20/2007, as reported by S. Bates, pers. comm. 2008b). These numbers give some sense of the current effectiveness of this product, which is discussed in more detail in "Chapter 2: Alternatives."

The NIST site and the NPS Fire Island National Seashore are using 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), and the FDA is trying to transfer registration responsibility to the Environmental Protection Agency. Registration for non-research use may be available in five or more years.

Other local governments or local institutions have also completed studies to develop deer management plans, including Fairfax County, Virginia, and Montgomery County, Maryland. The Fairfax County plan incorporates a combination of hunting and sharpshooting to manage the deer population (Fairfax County 2003). The Montgomery County plan includes a comprehensive management approach incorporating education, lethal means (sharpshooting, hunting), and non-lethal means (fencing, repellents) (Montgomery County 2004). The National Conservation Training Center in Shepherdstown, West Virginia, has a deer management plan that relies on managed hunts for deer management.

Other Vegetation Management Issues

Role of Invasive Exotic Plant Species

Invasive nonnative plants (exotics) seriously threaten the integrity of native habitats, including eastern deciduous forests, by aggressively displacing and killing native plants, reducing native habitats, and reducing forest regeneration (Bratton 1982). The exotics problem is particularly acute in urban parklands where the extensive edges and frequent human disturbances enhance opportunities for aggressive exotic plants to become established (NPS 2004a).

Rock Creek Park, within the city of Washington, D.C., is one of the largest natural, urban forests within the United States. The park is comprised of 2,980 acres of mostly natural forest with 72 miles of boundary and more than 1,000 adjacent neighbors. This boundary (edge) interfaces the forest with streets and other urban landscape components, especially numerous landscaped private properties. Of the 41 most aggressive exotics, 40 are horticultural plants (NPS 2004a).

Deer exclosure/fenced plot at edge of forest overrun by invasive plants. The plot was discarded because the number of nonnative plants biased the data.

Ornamental vines like Asiatic bittersweet (*Celastrus orbiculatus*), porcelain berry (*Ampelopsis brevipedunculata*), and English ivy (*Hedera helix*) kill trees along the edges of forest openings. Multiflora rose (*Rosa multiflora*) forms occasional dense thickets that out-compete native shrubs and ground covers. Herbaceous invaders like lesser celandine (*Ranunculus ficaria*) and Japanese stiltgrass (*Microstegium vimineum*) blanket the floodplain, crowding out native herbaceous species and, in some cases, changing soil chemistry to make it harder for native plants to recover. Most invasive plants get started and thrive in open, disturbed areas where there is ample space and light. However, several of the most aggressive invaders [Asiatic bittersweet, English ivy, burning bush (*Euonymus alatus*), privet (*Ligustrum* spp.), viburnums (*Viburnum* spp.), Japanese barberry (*Berberis thunbergii*), garlic mustard (*Alliaria petiolata*),

lesser celandine, and Japanese stiltgrass] also penetrate undisturbed forest interiors, reducing light levels to the forest floor, limiting regeneration, and displacing native shrubs and saplings (NPS 2004a).

Between the late 1970s and 1995, park staff implemented various pilot programs to document the spread of exotics and find treatments for the most obvious threats (Fleming, 1978-1995, unpublished data). Under the direction of Richard Hammerschlag, research scientist at USGS-Biological Resources Discipline, a research project was initiated in 1996 to determine the environmentally safest and most effective chemical means of controlling Asiatic bittersweet and porcelain berry, as well as other woody exotics (Salmons 2000). At the same time, park staff have implemented an exotics management program using this information. Efforts have thus far been directed at extending the areas treated during the research. Research plots were positioned in the densest areas of Asiatic bittersweet and porcelain berry and at the upstream end of Rock Creek. Starting at these heavily infested areas allowed staff to remove the seed source for many woody vines in the Rock Creek floodplains. These floodplains also contain ephemeral ponds, an important wildlife habitat. The park has started to prioritize work and identify what criteria will be used to assist park managers in implementation. In addition, some parts of the park have not been as thoroughly surveyed as the Rock Creek watershed, where the research has been conducted. The invasive exotic management plan will be updated as the park learns more about exotics and the resources they threaten within the park (NPS 2004a).

Anthracnose — Any of several plant diseases caused by certain fungi and characterized by dead spots on the leaves, twigs, or fruits.

Role of Pests and Disease

In addition to exotic plants, Rock Creek's forests are susceptible to pests, such as insects and disease, as described below.

- Chestnut Blight—A fungus (*Cryphonectria* [*Endothia*] *parasitica*) was accidentally introduced into New York City in the early 1900s from trees imported from Asia, destroying its new host, the American chestnut *(Castanea dentata*), throughout its range from Maine to Alabama.
- Dogwood Anthracnose—Native dogwood trees (*Cornus florida*) have succumbed to the dogwood anthracnose, a disease caused by the fungus (*Discula destructive)*, which attacks flowering dogwood trees.

Female gypsy moth

- Gypsy Moth—Gypsy moths (*Lymantria dispar*), target a number of tree species found in the park including chestnut oak (*Quercus prinus*), white oak, red oak (*Q. rubra*), black oak (*Q. velutina*), scarlet oak (*Q. coccinea*), American beech, and various hickories. Gypsy moth caterpillars feed on the leaves of these hardwood trees and can cause complete defoliation of a tree. This affects the vigor and general health of forests and shade trees, leading to tree death, and subsequently altering wildlife habitat and affecting water quality and quantity. Gypsy moths first appeared in Rock Creek Park in the late 1970s. An integrated pest management plan for the park was developed by the NPS Center for Urban Ecology and the USDA Forest Service in 1983. Direct suppression through aerial application of the biological insecticides *Bacillus thuringiensis* (B.t.) and the gypsy moth specific nucleopolyhedrosis virus (Gypchek®) occurred from 1987 through 1989 (Favre et al. 1993).
- Hemlock Woolly Adelgid—The hemlock woolly adelgid (*Adelges tsugae*) feeds by sucking sap from young needles of eastern hemlock (*Tsuga canadensis*), which causes them to drop

prematurely. Extensive tree death is accompanied by detrimental environmental effects, such as the loss of ecological function, the loss of wildlife habitat (in the northeast United States, 96 bird and 47 mammal species are associated with hemlock forests for some critical component of their life cycle), soil erosion, changes in water quality, loss of aesthetics, and diminished recreational opportunities.

Role of Fire

Fire is an active and powerful natural force, which has the potential to affect all areas of the park and all facets of park management at various times and to varying degrees. Rock Creek Park's Fire Management Plan (FMP; NPS 2004c) is essentially a fire suppression plan (no prescribed burns are allowed) due to the urban nature of the park. Therefore, vegetation has not been affected or controlled by the use of prescribed fires, and any unplanned fires in the park are immediately suppressed.

DESIRED CONDITIONS

This section defines the desired conditions for Rock Creek Park, which are connected to this plan's purpose, need, and objectives. Several objectives were factored into the definition of desired conditions: allowing for a deer population within the park while protecting other park resources; protecting the natural abundance, distribution, and diversity of native plant species by reducing excessive deer browsing, trampling, and nonnative seed dispersal; and developing and implementing informed, scientifically-based vegetation impact levels and corresponding measures of deer population density that would serve as a threshold for taking prescribed management actions within the park.

This plan/EIS addresses desired conditions for Rock Creek Park, the desired condition of the deer population, and the desired condition of the forest.

DESIRED DEER POPULATION CONDITION

Deer are a natural part of the ecosystem and play an important role in it. One of the objectives of this plan is to allow for a deer population within the park while protecting other park resources. Therefore, the team needed to consider what a desired deer population condition for Rock Creek Park was to ensure that actions taken under this plan would meet objectives. For this plan, a desired deer population is one that allows the forest to naturally regenerate, while maintaining a deer population within the park. The measure of deer density that would meet this condition is described more in chapter 2.

DESIRED FOREST CONDITIONS

One of the objectives of this plan is to reduce adverse effects of deer browsing pressure on native plant species, which include the seedlings of forest species. A desired forest condition would be a forest community that has the ability to maintain forest structure (i.e., tree density, size, and age classes), function, species diversity, and natural processes by natural tree replacement. The scientifically-based vegetation impact levels that would serve as a threshold for taking prescribed management actions to meet this desired condition are described more in chapter 2.

SCOPING PROCESS AND PUBLIC PARTICIPATION

The National Environmental Policy Act (NEPA) regulations 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 and identify significant issues to be analyzed in depth in this plan, internal scoping was conducted with park staff and other parties associated with preparing this document. As a result of this scoping effort (see "Chapter 5: Consultation and Coordination," for

additional information), several issues were identified as requiring further analysis in this plan. These issues represent existing conditions, as well as concerns that might arise during implementation of alternatives.

ISSUES AND IMPACT TOPICS

The issue statements developed by the interdisciplinary team are presented below. These issues formed the basis for the impact topics discussed in chapters 3 and 4 of this environmental impact statement.

Vegetation

An overabundance of deer could possibly alter and affect forest regeneration patterns in the park, as well as the diversity of species within the park, by reducing the understory and affecting the natural diversity of dominant tree species. Vegetation monitoring in Rock Creek Park has demonstrated a decline in shrubs and seedlings since 1991. As previously described, from 2001 to 2004, the paired unfenced-fenced plots showed that plant cover outside the fenced plots decreased substantially compared to plant cover inside the fenced plots. 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 there is some understory vegetation and the browse line is not widespread at Rock Creek Park, 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.

The excessive browsing associated with an overabundance of deer in Rock Creek Park could adversely affect regeneration of vegetation in riparian areas. Riparian areas are important, because of their relatively high biological diversity. The level of deer browsing in these areas that would be associated with an overabundance of deer in Rock Creek Park could prevent regeneration in these areas and negatively affect the riparian areas. Currently, no data exist on deer impacts to riparian areas within the park.

Increased deer activity can promote nonnative species through habitat alteration and seed dispersal. An increase in nonnative species could have a negative impact on the park's native plant communities. Deer activity, such as browsing, trampling, and seed dispersal through waste or attachment to hair, has the potential to increase the number and type of nonnative species within the park (Myers et al. 2004; Vellend 2002; Williams and Ward 2006; Willson 1993). As the number of nonnative species increases, the native species within the park encounter increased competition and are adversely affected.

Deer management activities could result in areas of increased deer use, if bait is used to attract deer to a particular area. This could have a disproportionate impact to vegetation in areas near established bait piles. In addition, fencing that keeps deer away from vegetation results in increased browsing pressure outside of the fenced area, as well as decreased browsing pressure inside the fenced area.

Soils and Water Quality

Deer overabundance has led to increased deer browsing and a reduction in the understory vegetation in Rock Creek Park, as shown in the data from the long-term and paired vegetation plots. As the understory cover decreases, soils become more susceptible to erosion, which can lead to sedimentation and degradation of the park's water resources. Certain deer management actions can also disturb soils and affect water quality, including construction of fencing, especially in riparian areas that are already impacted by erosion.

Peirce Mill Dam and fish ladder

Floodplains and Wetlands

The removal of ground vegetation as a result of overabundance of deer and their activities (i.e., browsing, trampling, creating trails) may increase erosion and stormwater runoff and affect floodplains and wetland habitats. As the deer population increases, the amount of deer browsing and trampling of vegetation increases, thus reducing the amount of ground cover within the forest. As ground cover decreases, stormwater runoff and erosion increase. Water retention in the forest is related to the amount of ground cover. Some of the vegetation in floodplains could be affected, and there could be a degradation of wetland habitat from the increased erosion and sedimentation. Although some impacts to floodplains and wetlands may be attributed to deer activity, there are other factors from both inside and outside the park that also influence floodplains and wetlands, and contribute to the majority of impacts to these resources. Among these factors are land use changes, the large amount of impervious surfaces in Washington, DC, and the loss of ground cover and trampling of vegetation by park users. Also, several of the large exclosures proposed as part of one management alternative would be located within the 100-year floodplain and possibly within wetlands.

Wildlife and Wildlife Habitat

White-tailed Deer—Maintaining a healthy, viable deer population, while protecting other park resources within Rock Creek Park, is imperative to this plan. Rock Creek Park has monitored the number and density of the deer population through spotlight counts, FLIR, and Distance Sampling. Survey results indicate an overabundance of deer. Although high deer densities may adversely affect plants and other wildlife species, deer themselves are an important park resource. It is important that this plan maintain a deer population in the park while taking action to reduce adverse effects to the deer population itself.

Other Wildlife—At certain levels, deer overabundance adversely affects other wildlife and/or habitat by reducing habitat diversity 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 birds (deCalesta 1994; McShea 2000; McShea and Rappole 2000). Park staff are concerned that deer may be affecting other species, including breeding birds; however, there are no park-specific data to show that impacts to ground-nesting species have occurred from deer browsing (S. Bates, pers. comm. 2008d).

Changes in water quality from the removal of ground vegetation as a result of overabundance of deer and their activities (i.e., browsing, trampling, creating paths) have the potential to adversely affect unique and important fish habitats located within Rock Creek Park. Issues related to unique or essential fish habitat are similar to those for surface water. As the deer population increases, so does the amount of deer browsing and trampling of vegetation, reducing the amount of ground cover within the forest. As the ground cover decreases, the amount of stormwater runoff and erosion also increases and could degrade water quality, including unique and essential fish habitat. Efforts are currently underway in the park to improve fish habitat. As a part of the Woodrow Wilson Bridge project mitigation, man-made barriers to fish movement in Rock Creek Park have been removed. This project, which began in December 2003, removed or bypassed several man-made barriers that for generations had prevented herring and other migratory fish from returning to primordial spawning areas located upriver. A total of 23 fish barriers were removed or modified in several streams that empty into the Potomac River. In Rock Creek Park, six fish barriers were removed or modified, while two more were removed from the adjacent National Zoological Park. Furthermore, a fish ladder was constructed at the Peirce Mill dam to provide access to the habitat above the dam for migrating fish.

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 during specific time periods and associated noise could result in temporary behavior changes and avoidance of management areas.

Rare, Unique, Threatened, or Endangered Species

The NPS is required under the Endangered Species Act (ESA) to ensure that federally listed species and their designated critical habitats are protected on lands within the agency's jurisdiction. Only one federally listed species, the endangered Hay's Spring amphipod, is known to inhabit the park. The Hay's Spring amphipod was discovered in five groundwater springs in Rock Creek Park in 1998. Another rare species, Kenk's amphipod (*Stygobromus kenki*), also known as the Rock Creek groundwater amphipod, was identified in park springs (NPS 1997a). Kenk's amphipod is not listed under the ESA, and recently the U.S. Fish and Wildlife Service (USFWS) found that the petition for listing did not contain sufficient scientific or commercial information indicating that listing of this species was warranted (USFWS 2007b). In addition, three other *Stygobromus* species of amphipods that are listed by the state of Maryland as rare or uncommon have been located in or near the park (Maryland Department of Natural Resources, Heritage and Biodiversity Conservation Program 2003). Habitat for these species may be vulnerable to impacts from deer overabundance and their related activities (i.e., trampling, browsing, seed dispersal, etc.). If studies can show that surface erosion can lead to impacts on the quality of underground water resources, then the erosion caused by deer could, in turn, affect the amphipod species. Protection of the amphipods will be considered in this deer management plan.

Rare species are also identified by the District of Columbia, Maryland, and Virginia. The Virginia species are not known in the park and it is not likely that they will occur because of the separation from Virginia by the Potomac River, as well as the presence of different habitats. However, there are several plant species that have been or are currently listed as rare by Maryland Department of Natural Resources that, although rare, have been documented in Rock Creek Park. Several animal species with known occurrences in Rock Creek Park are listed as rare or uncommon by Maryland. While the District of Columbia does not provide special protection for listed species, it has identified species of concern, called species of greatest conservation need, within the area in its Wildlife Action Plan (District of Columbia 2006). Because of the habitat value provided by Rock Creek Park, many of these species are found in the park. Habitats preferred by these species generally include springs, seeps, wetlands, and waterways and/or associated moist forested areas. While the NPS is not under any legal obligation to protect state- or locally-listed species, the park enabling legislation supports maintaining these as part of the park's natural heritage, and NPS management policies state that these should be addressed in environmental assessments of proposed actions (NPS 2006). These species have the potential to be impacted by an overabundance of deer as a result of habitat alteration as discussed under soils, water resources, and vegetation.

Cultural/Historic Resources – Cultural Landscapes

An overabundance of deer and the resulting deer browsing could impact the cultural landscapes within Rock Creek Park. Rock Creek Park consists of many diverse units varying from carefully designed landscapes to natural forested areas. The cultural landscapes at Rock Creek Park reflect the relationship between what is natural and what is man-made. Dumbarton Oaks Park is an example of a designed landscape within the park. Whether natural or designed, an overabundance of deer and the resulting deer browsing can impact the cultural landscape of an area and affect the historic integrity of a given site. Certain deer management activities that result in the construction of fences or the alteration of the landscape could impact designated cultural landscapes.

Peirce Barn

Soundscapes

Certain deer management activities may cause disturbance to park soundscapes. The deer management strategies discussed included the use of sharpshooting and/or contraceptives by dart gun. Firearm noise resulting from such management activities could affect park visitors and wildlife. Rock Creek Park is an urban park and, while the park is located in an area of high ambient noise, residents have expressed concern for noises related to firearms, and this concern would be taken into consideration in the creation of a deer management plan. It is unlikely that firearm discharge noise would have a substantial impact due to the likelihood that noise suppression devices for the firearms would be recommended as part of the management activity. These devices would render the noise level to be substantially below typical noise associated with vehicle traffic and recreational activities. Current sources of ambient noise in the park include a variety of visitor uses (e.g., traffic, special events, athletic fields, picnicking, etc.), flight paths over the park including helicopters and military flyovers, landscaping activities both within the park by contractors and on adjoining lands, commuter traffic, emergency service vehicles, and the activities of adjacent property owners (i.e., community events at schools or churches), as well as other noises common to urban areas.

Visitor Use and Experience

The presence or absence of deer in Rock Creek Park could be an important component of the visitor experience for some park users and alteration of the number of deer through a Deer Management Plan would impact this experience. Many visitors come to Rock Creek Park units to enjoy the natural areas. For some park visitors, seeing a deer is an important part of the park experience and for others, deer are an unwelcome intrusion. At one town hall meeting, approximately half of the participants favored deer in the area and the other half looked upon the presence of deer unfavorably. 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 that come to see species within that habitat. Deer have direct impacts on the community gardens that are maintained by park users, most of which have been fenced to protect them from deer browsing.

Visitors stroll at Rock Creek Park

Deer management activities have been, and will continue to be, affected by the public perception of deer and other wildlife. From 2000–2005, the park received two reports of deer running through plate glass windows at neighboring residences. These few instances of damage to personal property resulting from deer influence the public perception within the community. Likewise, park staff have reported that public outreach indicates that a portion of the District of Columbia community has a general fear of wildlife, including deer.

Proposed deer management activities may require certain areas of the park to be closed to the general public during management activities, affecting visitor use and experience. If deer management activities were to decrease the number of deer in the park, chance sightings by visitors would also decrease. Some visitors to the park 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 park, causing less visitor satisfaction. Conversely, as the number of deer increase, other resources that visitors come to see, such as songbirds, may decrease. Increased deer browse has the potential to impact these other resources and impact the satisfaction of these visitors.

Visitor and Employee 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 Rock Creek Park visitors, local residents, and Rock Creek Park employees. All deer management activities would need to be conducted in a manner to ensure the safety of park visitors and employees.

The majority of incidents within Rock Creek Park are a result of vehicle accidents. A primary safety issue for visitors and local residents related to this plan involves injuries from deer/vehicle collisions. In past studies, the number of deer/vehicle collisions has been correlated to both traffic volume and greater deer abundance. However, a working group within the D.C. metro region, including Rock Creek Park, found in comparing data from 1995 and 2003 that traffic volumes remained basically the same or decreased somewhat, while deer/vehicle collisions increased (Metropolitan Washington Council of Governments 2006), indicating that the number of deer may be an important factor in the increased number of accidents occurring. Deer/vehicle collisions within the park are most common along Military Road, Oregon Avenue, Beach Drive, and Rock Creek and Potomac Parkway.

Socioeconomic Resources

An overabundance of deer could lead to increased browsing of landscape vegetation on neighboring properties, having a negative economic impact on those landowners. Current Rock Creek Park deer management activities include communicating with neighboring landowners and addressing questions and concerns. Residents contact the park to complain about deer that have entered private property and have eaten their landscaping, causing aesthetic and economic impacts. The park, in turn, provides advice to the landowners regarding landscape plantings that may be less palatable to deer, methods to exclude deer, as well as recommendations on scare devices and repellents. Certain deer management activities would need to be coordinated with neighbors and would affect neighboring landscaping due to a change in the number of deer present in certain areas of the park.

Park Management and Operations

Deer management activities must take into consideration the deer management actions of adjacent municipalities to enhance deer management success within the park. Rock Creek Park is an urban park with multiple jurisdictions as neighbors, including the District of Columbia and Montgomery County, Maryland. The District of Columbia does not actively manage deer, but does assist Rock Creek Park with responding to deer complaints and has hired several wildlife biologists to address potential deer issues. Deer overbrowsing is listed as a threat to terrestrial ecosystems in the DC Wildlife Action Plan, and NPS participated in developing the plan (Pfaffko 2006). Rock Creek Park and the District of Columbia have collaborated on deer management issues in the past, including the Metropolitan Washington Council of Government's Wildlife Vehicle Collision working group, and will continue to work together on deer-related issues in the future.

Park neighbors

The adjacent jurisdiction of Montgomery County, Maryland has had an active deer management program since 1995 (Montgomery County 1995a). The county and the District of Columbia have stated they would like to be a partner with the park for deer management efforts.

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. Additional deer management activities undertaken by park staff could affect other areas of park operations.

Park interpretive or educational staff would need to allocate additional time and resources to enhance public awareness and understanding of NPS resource management issues, policies, and mandates, as they pertain to deer management. Implementing deer management activities would require conducting public outreach efforts on the part of park staff.

OTHER ISSUES CONSIDERED BUT DISMISSED FROM FURTHER CONSIDERATION

The following impact topics and/or issues were dismissed from further analysis, as explained below:

- Geohazards: A geohazard is an event related to geological features and processes that cause loss of life and severe damage to property and the natural and built environment, such as an earthquake or rock slide. There are no known geohazards within the park that would be affected by the creation or implementation of a white-tailed deer management plan.
- Prime Farmlands: There are no designated prime farmland soils in the park.
- Air Quality: Potential sources of air quality emissions from the implementation of a white-tailed deer management plan include the use of a few vehicles to carry out the prescribed management activities and possibly firearm discharges. Although Rock Creek Park is located in an area classified by the U.S. Environmental Protection Agency as severe nonattainment for ozone, it was determined that the increase in air emissions from these activities would be extremely minimal and short-term, resulting in only negligible impacts to the regional air quality. Therefore, air quality was dismissed as an issue.
- Streamflow Characteristics: The proposed action would not occur in any area or involve management actions that would potentially impact streamflow.
- Marine or Estuarine Resources: There are no marine or estuarine resources in any of the Rock Creek Park units.
- Land Use: Implementation of a white-tailed deer management plan would not affect how surrounding land is used including occupancy, income, ownership, or type of use. The proposed plan would be consistent with surrounding land uses and would not have an effect.
- Unique Ecosystems, Biosphere Reserves, and World Heritage Sites: There are no known biosphere reserves, World Heritage sites, or unique ecosystems listed in the park. Rock Creek Park is part of the Chesapeake Bay Watershed; however, actions related to the deer management plan would not affect the watershed.
- Museum Collections: The implementation of a White-tailed Deer Management Plan in Rock Creek Park would mainly occur within the forested areas of the park and would not have any effects on the park's museum collections.
- Historic Structures: Although there are historic structures that are listed or eligible for listing in the National Register of Historic Places, there would be no negligible impacts on these structures from implementing, or not implementing, a white-tailed deer management plan in Rock Creek

Park. Designed landscapes, such as Dumbarton Oaks Park, would be addressed under cultural landscapes.

- Archeological Resources: Any impacts to park archeological resources as a result of deer management activities would be negligible. Although digging for fencing or other land disturbance could occur, this would be limited to small areas and would avoid areas of known archeological resources. Monitoring would occur and installations would be halted should any archeological resources be discovered.
- Ethnographic Resources: No ethnographic resources or issues have been identified at Rock Creek Park.
- Impacts to Soils from Construction: Any deer management actions that would involve construction, such as erecting exclosures under alternative B or digging pits for waste and/or carcass disposal in disturbed areas under alternatives C or D, could potentially impact soils. However, it was determined that such impacts would be no more than negligible because of the small area disturbed for fence construction, and because disposal pits would be constructed in previously disturbed locations. Therefore, this issue was dismissed from further analysis.
- Water Quality Effects other than Sedimentation: Although there could be other effects on water quality from deer droppings or from the limited application of repellents, the impacts would be so minor and/or localized that these aspects of water quality were not carried through for detailed analysis, and the analysis was focused on effects from erosion and sedimentation.
- Energy Resources and Resource Conservation: The implementation of a white-tailed deer management plan would not be expected to affect energy resources or resource conservation within the park.
- Environmental Justice: The actions under this plan are not expected to have a disproportionate or significant adverse effect on any low income or minority populations in the area.

RELATED LAWS, POLICIES, PLANS, AND CONSTRAINTS

NATIONAL PARK SERVICE ORGANIC ACT

By enacting the NPS Organic Act of 1916, Congress directed the U.S. Department of the Interior and the 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 Redwood National Park Expansion Act of 1978 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).

Despite these mandates, the Organic Act and its amendments afford the NPS latitude when making resource decisions that balance visitor use and resource preservation. Through these acts Congress "empowered [the NPS] with the authority to determine what uses of park resources are proper and what proportion of the parks resources are available for each use" (*Bicycle Trails Council of Marin v. Babbitt,* 82 F.3d 1445, 1453 (9th Cir. 1996)).

Courts have consistently interpreted the Organic Act and its amendments to stress resource conservation. *Michigan United Conservation Clubs v. Lujan,* 949 F.2d 202, 206 (6th Cir. 1991) states, "Congress placed specific emphasis on conservation." The *National Rifle Ass'n of America v. Potter,* 628 F. Supp. 903, 909 (D.D.C. 1986) states, "In the Organic Act Congress speaks of but a single purpose, namely, conservation." The policy dictates, "when there is a conflict between conserving resources and values and providing for the enjoyment of them, conservation is to be predominant (NPS 2006, sec. 1.4.3).

Because conservation remains predominant, the NPS seeks to avoid or to minimize adverse impacts on park resources and values. However, the NPS has discretion to allow negative impacts when necessary (NPS 2006, sec. 1.4.3).

While some actions and activities cause impacts, the NPS cannot allow an adverse impact that constitutes a resource impairment (NPS 2006, sec. 1.4.4). Actions that impair park resources are prohibited unless a law directly and specifically allows for such actions (16 USC 1 a-1). An action constitutes an impairment when, in the professional judgment of the responsible manager, its impacts "harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values" (NPS 2006, sec. 1.4.5). To determine impairment, the NPS must evaluate "the particular resources and values that would be affected; the severity, duration, and timing of the impact; the direct and indirect effects of the impact; and the cumulative effects of the impact in question and other impacts" (NPS 2006, sec. 1.4.5). Therefore, this plan assesses the effects of the management alternatives on park resources and values, and determines if these effects would cause impairment.

An impact on any park resource or value may constitute an impairment, but an impact would be more likely to constitute an impairment to the extent that it has a major adverse effect on a resource or value whose conservation is:

- necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- key to the natural or cultural integrity of the park; or
- identified as a goal in the park's GMP or other relevant NPS planning documents

NATIONAL PARK SERVICE MANAGEMENT POLICIES 2006

Several sections from the NPS *Management Policies 2006* (NPS 2006) are relevant to deer management in Rock Creek Park, 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 2006, sec. 4.4.1).

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 2006, sec. 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 2006, sec. 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 to 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 2006, sec. 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 2006, sec. 4.4.2.1).

DIRECTOR'S ORDER 12: CONSERVATION PLANNING, ENVIRONMENTAL IMPACT ANALYSIS, AND DECISION MAKING AND HANDBOOK

NPS Director's Order 12 and its accompanying handbook (NPS 2001) lay the groundwork for how the NPS complies with the 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 to 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. Director's Order 12 also requires that an analysis of impairment to park resources and values be made as part of the NEPA document.

NATIONAL ENVIRONMENTAL POLICY ACT OF 1969, AS AMENDED

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

NATURAL RESOURCES REFERENCE MANUAL, NPS-77 (1991)

The *Natural Resource Reference Manual 77*, 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 NATIONAL PARK SERVICE POLICY

Redwood Amendment to the General Authorities Act

Reasserting the system-wide standard of protection established by Congress in the original Organic Act, the Redwood Amendment stated:

> The authorization of activities shall be construed and the protection, management, and administration of these areas shall be conducted in light of the high public value and integrity of the national park system and shall not be exercised in 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 (P.L. 95-250, USC Sec 1a-1).

Congress intended the language of the Redwood Amendment to the General Authorities Act 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 General Authorities Act, as amended by the Redwood amendment, use different wording ("unimpaired" and "derogation") to describe what the NPS must avoid, they define a single standard for the management of the national park system—not two different standards. For simplicity, Management Policies uses "impairment," not both statutory phrases, to refer to that single standard.

Endangered Species Act of 1973, as Amended

The purpose of the ESA 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.

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 species of concern.

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 National Register of Historic Places. 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. Section 24.4(f) states that "units of the National Park System contain natural, recreation, historic, and cultural values of national significance as designated by Executive and Congressional action." In describing appropriate activities, it states that "[a]s a general rule, consumptive resource utilization is prohibited."

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 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.

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 Rock Creek Park and Administered Units

The following plans for Rock Creek Park need to be considered in the development of this plan.

Natural Resources Management Plan (NPS 1996)

The Natural Resources Management Plan for Rock Creek Park (NPS 1996a) provides specific management objectives for Rock Creek Park based on the park's Statement for Management. The Natural Resources Management Plan will be updated as a Resource Stewardship Strategy when NPS issues guidelines for the updated plan. Although the NPS has not yet adopted the new guidelines for Resource Stewardship strategies, the Resources Management Plan for Rock Creek Park is used as a general guide to past planning efforts until a new resource stewardship strategy is completed. Resource related management objectives in the existing plan require that the park:

- Seek information, through research or other means, on the natural processes of the park's natural areas in order to perpetuate park resources and to enhance opportunities for resource-compatible public use and enjoyment.
- Preserve and perpetuate the park's plant and wildlife resources in as natural a condition as possible, and reduce the adverse effects of human activities and exotic species on the natural environment.
- Identify, protect, and perpetuate the park's historic resources, including mills, Civil War fortifications, and archeological sites.

- Monitor and evaluate current recreational uses of the park lands and redirect these activities in order to reduce adverse impacts.
- Foster understanding and appreciation of the park's natural and cultural values through interpretive and educational programs focusing on Rock Creek's biological, geological, historic, and prehistoric resources.
- Provide for public use and enjoyment of the park through the provisions of varied facilities, services, and programs that are compatible with perpetuating the park's natural and cultural values.
- Establish contact and cooperation with citizens' associations, governmental agencies, and other groups or individuals that surround and have direct effects on or interests in the welfare of the park.

The Natural Resources Management Plan is a strategic planning document and a key element in good management and resource preservation. These management objectives are addressed in a series of project statements which consider natural and cultural resource problems, activities, or issues. The plan does not directly address deer management at the park.

Cultural Landscape Reports and 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:

- Dumbarton Oaks Cultural Landscape Report (NPS 2000a)—The need to document the Dumbarton Oaks Park historic landscape became apparent in 1985 when the NPS recognized that the garden was being managed as a natural, rather than a cultural resource. The landscape report was created to provide guidance for stabilizing existing resources such as focal points and waterway features. This effort led to the 1997 *Preservation Maintenance Plan for Dumbarton Oaks Park,* which details cultural landscape maintenance.
- Peirce Mill Cultural Landscapes Inventory (NPS 2003b)—In 1997, the Peirce Mill landscape was identified as a component landscape of Rock Creek Park (Reservation 339). The landscape is identified as the property owned by Peirce Shoemaker that was transferred to the federal government after the creation of the park in 1890 and is distinctive from the rest of Reservation 339 because of the physical history of the site and the character of the area.
- Linnaean Hill Cultural Landscapes Inventory (NPS 2003a)—In 1997, the Linnaean Hill landscape was identified as a component landscape of Rock Creek Park (Reservation 339). The landscape is the property of Joshua Peirce Klingle that was transferred to the federal government after the creation of the park in 1890 and is distinctive from the rest of Reservation 339 because of the physical history of the site and the character of the area.

Draft Long Range Interpretive Plan (NPS 2003)

The Rock Creek Park Draft Long Range Interpretive Plan (NPS 2003d) provides an assessment of current conditions in the interpretation and educational program for Rock Creek Park, establishes goals for the future direction and development of that program, and establishes priorities necessary to get there.

Fort Circle Parks Final Management Plan/Environmental Assessment (NPS 2004)

The Fort Circle Parks Final Management Plan (NPS 2004b), finalized in September 2004, provides a unifying management concept for significant historic resources associated with the Civil War defenses of

Washington that would allow these resources to be preserved for future generations, and interpreted in a coherent, easily understandable manner. This plan sets forth a series of desired visitor experience and resource condition statements to guide the management of these units for the next 10 to 15 years.

Environmental Commitment Statement (NPS 2004)

In July 2004, Rock Creek Park issued a statement (NPS 2004f) that summarizes a commitment to manage park resources and the multiple sites in the District of Columbia under park jurisdiction as outlined by the principles and practices described in the Organic Act of 1916, which state "we are to conserve the scenery and the natural and historic objects and the wildlife 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."

Draft Invasive Exotic Plant Management Plan (NPS 2004)

The Draft Invasive Exotic Plant Management Plan (NPS 2004a) describes the principles under which exotic plant management is prioritized and undertaken for all the natural areas within Rock Creek Park. The plan details methods to be used, with the understanding that methods will be adapted as more effective and efficient methods are developed and/or monitoring indicates that current methods are ineffective. NEPA compliance is conducted as needed.

Rock Creek Park and Rock Creek and Potomac Parkway Final General Management Plan/Environmental Impact Statement (2005; Record of Decision 2007)

The 2005 *Rock Creek Park and Rock Creek and Potomac Parkway Final General Management Plan* (NPS 2005a) is the basic guidance document for the management of these units for the next 10 to 15 years. The purpose of the plan is to specify resource conditions and visitor experiences to be achieved in the park and parkway, and to provide the foundation for decision-making and preparation of more specific resource plans regarding the management of the park and parkway. The 2005 plan is the first comprehensive plan prepared for Rock Creek Park. The central issue for management planning in Rock Creek Park is how to meet the often conflicting purposes of protecting the scenic, natural, and cultural resources of the park, while concurrently providing for appropriate public use of these resources.

The 2005 *Final General Management Plan*, which was finalized in a 2007 Record of Decision, outlines the following desired conditions for Rock Creek Park and the Rock Creek and Potomac Parkway that would be applicable to a deer management plan:

Natural Resource Management Requirements

- Native species populations that have been severely reduced or extirpated are restored where feasible and sustainable.
- Invasive species are reduced in number and area, or eliminated from natural areas of the park.
- Federal- and District-listed threatened or endangered species and their habitats are protected and sustained.
- Native plant and animal species function in as natural a condition as possible, except where special management considerations are allowable under policy.
- Surface waters and groundwater are protected or restored such that water quality as a minimum meets all applicable District of Columbia water quality standards.

Cultural Resource Management Requirements

- Archeological sites are protected in an undisturbed condition unless it is determined through formal processes that disturbance or natural deterioration is unavoidable.

Visitor Experience and Park Use Requirements

- Visitor and employee safety and health are protected.
- Visitors have opportunities to enjoy the park in ways that leave park resources unimpaired for future generations.
- Visitors understand and appreciate park values and resources and have the information necessary to adapt to the park's environments.

Special Use Management Requirements

- Resources outside of the park are managed in such a way that the park will be safeguarded.
- The NPS works cooperatively with others to anticipate, avoid, and resolve potential conflicts and address mutual interests.

All alternatives considered for the development of a White-tailed Deer Management Plan were developed within the framework of the park's GMP/EIS.

Fire Management Plan (NPS 2004)

Rock Creek Park's Fire Management Plan (FMP; NPS 2004c) is a component of the overall resources management program. It integrates fire management objectives with other resource management programs. The FMP provides a detailed action program that is consistent with NPS Management Policies 2006 and DO/RM-18 (NPS 1999, 2006), and will assist the park in its efforts to preserve, maintain, and protect natural and cultural resources.

The FMP is essentially a fire suppression plan, due to its urban surroundings. This FMP documents the fire management objectives, operational programs, and research required to effectively manage wildland fire at Rock Creek Park. Implementation of the plan allows all wildfires to be suppressed as safely and as quickly as possible. A prescribed fire program is not included in the FMP because Rock Creek Park is an urban park with 72 miles of boundary lines that would severely limit the use of prescribed fires. Air quality standards and visibility requirements for local air traffic further restrict the use of prescribed fire.

Watershed Condition Assessment Program (ongoing)

During 2006-2014, the Watershed Condition Assessment (WCA) Program plans to fund a comparable natural resource condition assessment for each of the 270 parks in the 32 NPS Vital Signs Monitoring networks. Each assessment gives the receiving park a snapshot-in-time evaluation of current condition status, critical data gaps, and resource condition influences relative to a strategic subset of natural resource attributes and indicators. The assessments also strive to provide a holistic, science-based roll-up and report on overall condition status by park areas of greatest management interest (e.g., by watersheds, habitat/ecosystem types, or management zones). Assessments will help park managers and planners describe and quantify characteristics of Desired Conditions for each park's "fundamental" and "other important" natural resources and values. Rock Creek Park's Draft Watershed Condition Assessment will be completed in 2009 (J. Sherald, pers. comm. 2008).

ALTERNATIVES

This "Alternatives" chapter describes the various actions that could be implemented for current and future management of white-tailed deer (*Odocoileus virginianus*) in Rock Creek Park. 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 is summarized in table 12 at the end of this chapter.

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

The alternatives under consideration must include a "no action" alternative, as prescribed by NEPA regulations at 40 Code of Federal Regulations (CFR) 1502.14. The no action alternative in this document is the continuation of the park's current management actions and policies related to deer and their effects on vegetation.

The interdisciplinary planning team, with feedback from the public and the science team during the planning process, developed three action alternatives. These alternatives meet, to a large degree, the objectives developed for this plan and also the purpose of and need for action as expressed 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 Draft White-tailed Deer Management Plan / Environmental Impact Statement (plan/EIS), as well as the background information used in setting a deer density goal and an action threshold for implementing the preferred alternative, based on regeneration of tree seedlings. All alternatives were developed to meet the purpose, need, and objectives of this plan. Input from the science team and the public was considered and used to refine the preliminary alternatives as the planning process progressed.

The alternatives selected for detailed analysis are briefly described below. This is followed by a description of Rock Creek's deer density goal and the threshold for taking action, which are needed to fully understand the action alternatives (i.e., alternatives B, C, and D). Next, detailed descriptions of each alternative are presented, followed by a discussion of adaptive management and how it could be applied to the alternatives. The remainder of the chapter addresses alternatives that were considered but eliminated from detailed analysis and the identification of the agency's preferred and the environmentally preferred alternative.

NO ACTION ALTERNATIVE

- ***Alternative A: No Action*** — Current deer management actions and policies would continue under alternative A, including monitoring deer density and relative numbers, monitoring vegetation, data management, and opportunity for research. Protective caging and limited use of deer repellents may also be used to protect rare plants in natural areas and small areas in landscaped and cultural areas. Current educational and interpretive measures, as well as inter-jurisdictional communication, would continue. No new actions would occur to reduce the effects of deer overbrowsing.

ACTION ALTERNATIVES

- ***Alternative B: Combined Non-Lethal Actions*** — Alternative B would include all actions described under alternative A, but would also incorporate several non-lethal actions to protect forest seedlings, promote forest regeneration, and gradually reduce deer numbers in the park. The additional actions would include the construction of large-scale deer exclosures (large fenced areas) and reproductive control of does via sterilization and an acceptable reproductive control agent when feasible. Reproductive control implementation may require construction of temporary holding areas to house captured deer prior to treatment.
- ***Alternative C: Combined Lethal Actions*** — Alternative C would include all actions described under alternative A, but would also incorporate two lethal deer management actions to reduce the herd size. The additional actions would include reduction of the deer herd by either sharpshooting or by implementing capture and euthanasia of individual deer, to be used in limited circumstances where sharpshooting may not be appropriate.
- ***Alternative D: Combined Lethal and Non-Lethal Actions*** — Alternative D would include all actions described under alternative A, but would also include a combination of certain additional lethal and non-lethal actions from alternatives B and C to reduce deer herd numbers. The lethal actions would include both sharpshooting and capture/euthanasia and would be taken initially to quickly reduce the deer herd numbers. Population maintenance would be conducted via reproductive control methods if these are available and feasible; if not, sharpshooting would be used as a default option for maintenance.

DEER DENSITY GOAL AND THRESHOLD FOR TAKING ACTION UNDER THE ACTION ALTERNATIVES

The action alternatives (B, C, and D) contain actions to support forest regeneration and to protect, conserve, and restore native species and cultural landscapes. Before an action alternative may be implemented, the park must first determine (1) when action needs to be taken (i.e., when damage to forest vegetation reaches unacceptable levels); and (2) how many deer would need to be removed (for those alternatives that include deer removal). The following discussion describes both the threshold for taking action (which is related to vegetation impacts from deer browsing) and the deer density goal (which would be used to determine the number of deer that would be removed).

INITIAL DEER DENSITY GOAL

The deer density goal refers to an appropriate density that would allow for natural forest regeneration. This deer density would then be used as an appropriate goal for deer reduction under any of the action alternatives that include this action. 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 types in Rock Creek Park include beech (*Fagus* spp.)-white oak (*Quercus alba*)-mayapple (*Podophyllum peltatum*), tulip poplar (*Liriodendron tulipifera*), and chestnut oak (*Quercus prinus*), with mostly sycamore (*Platanus occidentalis*)-green ash (*Fraxinus pennyslvanica*) in floodplains and stream corridors. Research has suggested that in cherry (*Prunus* spp.)/maple (*Acer* spp.) forest types in the Allegheny Plateau (western Pennsylvania, West Virginia, and eastern Ohio), deer density should be 20 to 40 animals per square mile in unmanaged areas, and 15 to 18 animals in managed timber areas, to maintain natural regeneration (Tilghman 1989). Marquis et al. (1992) suggested that tree regeneration fails with deer densities at 32 deer per square mile. This research also demonstrated that a species shift occurs in beech/birch (*Betula* spp.)/maple forests at 18 deer per square mile, while an oak (*Quercus* spp.)/hickory (*Carya* spp.) forest successfully regenerates at 6 deer per square mile (Marquis et al. 1992). Research by deCalesta (1992, 1994) showed that seedling richness 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. Horsley et al. (2003) showed that negative impacts began in cherry/maple forests at 20 deer per square mile within the Allegheny Plateau from 1979 to 1989. In a study in the Central Adirondacks in maple/beech/birch, hemlock (*Tsuga* spp.)/birch, and spruce (*Picea* spp.)/fir (*Abies* spp.) forest types, Sage et al. (2003) found good tree regeneration with a density of 13 deer per square mile from 1954 to 2001. In 2006, the deer density at Rock Creek Park was 58 deer per square mile and in 2007 the deer density had climbed to 82 per square mile (K. Ferebee, pers. comm. 2008a). These figures exceed all deer density levels recommended for tree regeneration in similar forests.

As previously described, 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 "Scientific Background" 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 Rock Creek, the park 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" section.

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

THRESHOLD FOR TAKING ACTION

The science team also discussed methods of identifying an appropriate threshold for taking action to protect vegetation. Because the deer population is to be managed based on the success of forest regeneration, tree seedlings must be monitored to determine at what point the 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."

Since 1990, various vegetation-monitoring projects have been conducted within Rock Creek Park. In 1990, 27 long-term plots (unfenced) were randomly located throughout the park to capture general changes in the vegetation over time. These plots have been monitored every four years starting in 1991. Tree seedling data collected from these plots could be used to determine if action needs to be taken to limit deer browsing impacts.

Paired fenced/unfenced plot showing vegetation conditions inside and outside of the fence.

The regeneration standard adopted by the park was developed based on research by Dr. Susan Stout (1999) in a similar eastern hardwood forest environment in Cuyahoga National Recreation Area, now known as Cuyahoga National Park (McWilliams et al. 1995). While ecological histories may vary, there are many similarities between the forests at Cuyahoga and Rock Creek Park 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 different levels of deer herbivory. The seedlings were divided into eight height classes. Based on this work, Stout recommended regeneration thresholds for Cuyahoga. These thresholds were converted into Rock Creek's plot size, which includes a sampling area of four 2-meter × 2-meter (6.56-foot × 6.56-foot) subplots contained within each of the 27 long-term unfenced plots. At Rock Creek Park, Stout's results indicated that under conditions of low deer density, successful regeneration would be defined as having 51 seedlings or more within the four 2-meter × 2-meter (6.56-foot × 6.56-foot) subplots (a total sampling area of 16 square meters [172 square feet] or 0.0016 hectares [0.004 acres]) in 67% or more of the long-term monitoring plots (table 3). Low deer density has been defined as that from 13 to 21 deer per square mile relative to levels observed in the Mid Atlantic Region (Horsley et al. 2003) and is in the range of the desired deer density proposed for this plan. High deer density has been defined as 56 to 64 deer per square mile (Horsley et al. 2003). Under high deer densities, successful regeneration is defined as having 153 seedlings per 16 square meters (172 square feet). The following table summarizes this information.

TABLE 3. MINIMUM NUMBER OF SEEDLINGS/PLOT

Deer Density[a] (deer/mi^2)	16 Square Meter Plot
Low	51
High	153

Source: Stout 1999

Note: Low density = 67% of plots have 51 seedlings or more

High density = 67% of plots have 153 seedlings or more

Low density = 13–20 deer/mi^2

High density = 56–64 deer/mi^2

Source: Horsley et al. 2003

Based on the science team's review of the literature, the park decided to use Stout's suggested regeneration standard as the threshold for taking action under this plan. That is, at low deer densities, successful forest regeneration would be indicated when there are 51 seedlings or more within the subplots in 67% or more of the unfenced long-term plots monitored by the park. The park would determine the level of regeneration every four years from data collected from the plots, as described in the monitoring plan presented in appendix A.

Caging — Small scale fencing placed around individual plants to protect them from deer browsing.

ALTERNATIVE A: NO ACTION (EXISTING MANAGEMENT CONTINUED)

Under the "no action" alternative, Rock Creek Park would continue to implement current management actions and policies related to deer and their effects. This would include deer population monitoring (including Distance Sampling), as well as caging of small areas and using small amounts of repellents to protect native plants and ornamental landscaping. Current monitoring efforts would continue to record deer browsing impacts and deer population numbers within the park, although specific monitoring actions may be modified or discontinued over time, depending on the results and 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 inter-jurisdictional agencies would continue. No additional deer management actions to reduce the deer population would occur under this alternative.

Because alternative A includes no measures to reduce the white-tailed deer population or to control population growth, it is assumed that the population would stay at high levels, albeit with annual fluctuations and may gradually increase over the life of the plan (15 years). The amount of increase is unknown; however, high deer density is expected to continue to negatively affect vegetation (NPS 2007d), and deer density would likely reach or exceed the previously recorded high of 98 deer per square mile, with numbers fluctuating annually due to factors such as weather, herd health, removals outside the park (by other agencies), and food availability. 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 also 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 would be modified as necessary to better understand any correlations between the two.

Monitoring and data collection activities that would be common to all alternatives could include any or all of the following:

- Monitoring deer numbers by parkwide observations. The park would continue to use the Distance Sampling method to estimate the deer population density annually using an established protocol (NPS 2004g).
- Use of spotlight surveys to monitor population composition (i.e., age, sex ratios).
- Monitoring tree seedlings to determine the status of forest regeneration. Paired plots would be read annually, while the 27 long-term plots would continue to be read every four years (three times during the 15-year life of this plan).
- Monitoring deer health as the population shows signs of disease or if a disease has been discovered within the region. Appendix B and the following section specifically outline actions being taken to address chronic wasting disease (CWD).
- Tracking of research related to deer management, including the outcome of actions being taken by neighboring jurisdictions, and the latest research on various deer management methods, including reproductive control.
- Monitoring the costs of these actions, including those related to staff time, training, administrative, legal, and public communications, plus the costs of monitoring as described above.

Chronic Wasting Disease (CWD) — A slowly progressive, infectious, self-propagating neurological disease of captive and free-ranging deer, elk, and moose.

Under all of the alternatives, Rock Creek Park may solicit the help of skilled volunteers. Where hunting is not authorized, the use of skilled volunteers, pursuant to the *Volunteers in Parks Act*, to assist the National Park Service (NPS) in reducing deer populations is compatible with existing laws, regulations, and NPS policy. For the purposes of this plan/EIS, skilled volunteers would not be used to implement the administering of reproductive controls or lethal reduction (firearms or chemicals). Safety concerns related to high visitation, park boundaries, and topography make this an infeasible option. However, skilled volunteers could be used to assist in the implementation of other elements included in the action alternatives.

All actions involving direct management of individual animals would be conducted in accordance with American Veterinary Medical Association (AVMA) recommendations for the humane treatment of animals to the greatest extent possible (see AVMA website at <www.avma.org/resources/euthanasia.pdf> for examples). Every effort would be made to minimize the degree of human contact during procedures that require the handling of deer (AVMA 2001).

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

CHRONIC WASTING DISEASE

CWD is in the family of diseases known as the transmissible spongiform encephalopathies (TSEs) or prion diseases. Other TSEs include scrapie in sheep, bovine spongiform encephalopathy (BSE or mad cow disease), and Creutzfeldt-Jakob disease (CJD) in humans. Chronic wasting disease 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 and could result in impacts on the recreational value of these species. Also, although wildlife biologists are still learning about this relatively new disease, studies have shown that greater density of deer and other ungulates increases the likelihood of transmission of CWD (see appendix B).

Generally, the NPS has identified two levels of action pertaining to CWD based on risk of transmission (see appendix B): (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 2007, the nearest known case of CWD in free-ranging deer is greater than 100 miles from Rock Creek Park. Therefore, the park would continue to take the following actions under the existing categorical exclusion provisions.

Surveillance/Testing

The park would continue to perform opportunistic surveillance on available carcasses. Opportunistic surveillance means taking biological samples from available dead animals (e.g., road kill, predation). This does not mean animals would be killed for the purpose of CWD surveillance. Opportunistic sampling is likely to be a more sensitive measure of disease detection 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.

In addition, the park staff is currently under direction to report any deer exhibiting clinical signs of CWD to the NPS Biological Resources Management Division for direction on additional action or testing. This targeted surveillance generally involves lethal removal and testing of any deer exhibiting clinical signs consistent with CWD. If CWD would be found within 60 miles of the park, opportunistic surveillance efforts would continue and targeted surveillance (lethal removal and testing) may be required.

Coordination

The park would continue to coordinate with the state wildlife agencies and the District of Columbia regarding CWD surveillance methods and results.

Disposal/Consumption

The park 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.

LIMITED USE OF SMALL AREA PROTECTIVE FENCING (CAGES)

In areas containing landscape plantings, new restoration plantings, or rare plant species, the park would consider caging of individual plants and small groups of plants to protect them from deer browsing. 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. If rare understory plant species that deer browse are found in the park, they would be protected with caging.

The caging 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 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.

LIMITED APPLICATION OF REPELLENTS

The park may consider use of small amounts of commercially available deer repellents in landscaped areas. Repellents could also be used on plantings in cultural landscape areas where caging would be undesirable because of its visual impact.

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 is supposed to be 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 taste that is offensive to deer, such as hot pepper juice. 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, such as Plantskydd®, Liquid Fence®, and Deer Busters®, have the longest residence time (period of effectiveness between applications). Many other brands are also commercially available (e.g., Deer Blocker®, Gempler's®, Deer-Off®, Scoot Deer®, and Deer Scram®). 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. Many commercial repellents indicate that they persist after normal rain events, with varying persistence of one to six months. In all cases, the NPS Integrated Pest Management Coordinator would approve the repellents used.

Commercially available deer repellents would 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. Repeated applications of spray repellents would be necessary due to weather and emergence of new growth. Because the effectiveness of repellents is variable, they would be used on an experimental basis until the level of effectiveness was established. Large-scale application of repellents is not practical due to high application cost, label restrictions on use, and variable effectiveness.

EDUCATIONAL AND INTERPRETIVE MEASURES

Communication with 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. The park's website would also be used to discuss what the park is doing related to deer management and relevant articles may be published in local newspapers.

CONTINUED AGENCY AND INTER-JURISDICTIONAL COOPERATION

The park would continue to coordinate with other wildlife management agencies (Maryland National Capital Park and Planning Commission, DC Division of Fisheries and Wildlife) on the implementation of deer management efforts. Chapter 1 ("Purpose of and Need for Action") contains additional information on the neighboring agencies and jurisdictions with whom the park would consult on this planning effort.

IMPLEMENTATION COSTS

The costs associated with alternative A would primarily be for monitoring, plus limited small area protective caging and repellent application, as shown in table 4.

TABLE 4. COST ESTIMATE — ALTERNATIVE A: NO ACTION

Action	Assumptions	Annual Cost	Cost for the 15-year Planning Period
Population Trend Counts (Spotlight Surveys)	Four nights of survey (three hours each night for three staff) plus data analysis	$1,400	$21,000
Distance Sampling	Three nights of survey (2 ½ hours each night for three staff) plus data analysis	$1,200	$18,000
Radio Telemetry	One deer tracked – average 42 times per year – tracking plus analysis	$2,000	$30,000
Vegetation Monitoring of Existing Plots	Data collection and analysis • 17 paired plots • 27 long-term permanent plots	$12,000 annually $22,000 every 4 years	$180,000 $66,000
Maintenance of Existing Monitoring Plots	Assumes five hours labor	$200	$3,000
Small Area Protective Caging	Small areas caged	$100	$1,500
Repellent Use	Limited use around developed/landscaped areas – 5 gallons at $100 per gallon (concentrate)	$500	$7,500
		Total	**$327,000**

The cost associated with CWD testing is not included in the table, since it is assumed that any lab testing would be conducted by the NPS Biological Research Management Division at no cost to the park. Also,

the collection cost (physical collection of a sample from the carcass) is expected to be minimal, since 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 testing would be covered in existing labor costs and not itemized in table 4.

ALTERNATIVE B: COMBINED NON-LETHAL ACTIONS — LARGE EXCLOSURES AND REPRODUCTIVE CONTROL OF DOES

A combination of non-lethal actions would be implemented under alternative B, in addition to the actions described under alternative A, to protect forest seedlings, promote forest regeneration, and gradually reduce deer numbers in the park. The additional actions would include constructing large-scale fenced exclosures, and controlling doe reproduction through surgical sterilization and use of an approved reproductive control agent.

During the development of the alternatives, it was determined that implementation of any of the non-lethal actions alone would be insufficient to address forest regeneration and would not meet plan objectives. For example, the use of fencing alone would not reduce deer density. The use of reproductive control alone would take longer to have an effect and would not provide immediate protection for tree seedlings or sensitive vegetation. Therefore, alternative B includes a combination of non-lethal actions.

ADDITIONAL ACTIONS PROPOSED UNDER ALTERNATIVE B

LARGE EXCLOSURES

In addition to the small area protective caging that would be installed in select areas under all alternatives, alternative B would include large exclosures to further allow reforestation. A large deer exclosure is defined as a fenced area of more than 5 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 park's forest regeneration goal would be from 5% to 10% of the forested area (Bowersox, pers. comm. 2005). Based on this, park staff would construct up to 14 large exclosures of various configurations to fit the landscape, each covering from about 7 to 25 acres or up to a total of approximately 167 acres. This represents approximately 5% of the entire park and approximately 10% of the main park reservation, which is largely forested. The exclosures would be initially located throughout the main park unit (Reservation 339), with their 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 park's topography and current trails systems; and they avoid steep slopes and existing long-term vegetation monitoring plots. Areas containing valuable habitats (i.e., areas that are diverse, sensitive, free of invasive plants, and/or relatively pristine) would be targeted for protection. Potential deer exclosure locations are shown in figure 4 and are listed in table 5.

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

TABLE 5. PROPOSED DEER EXCLOSURES

Name	Approximate Perimeter in Feet (Meters)	Approximate Acres
Northern Floodplain	3,329 (1,015)	10
Weir Pond	4,050 (1,235)	20
Pinehurst West	4,497 (1,371)	17
Holly Trail	2,440 (744)	8
Rolling Meadows	2,306 (703)	7
Ross Drive	4,592 (1,400)	25
West Spring	2,706 (825)	11
Grant Road	2,900 (884)	9
H3	2,217 (676)	7
Pinehurst Central	3,680 (1,122)	16
Floodplain 2	2,578 (786)	7
Wise Road South	3,293 (1,004)	10
Wise Road North	3,004 (916)	7
Military Road	3,949 (1,204)	13
TOTAL	**45,541 (13,885)**	**167**

Although these locations appear to meet the siting criteria for the most part, these locations may be adjusted based on final field verification of current conditions when the plan is implemented.

The deer exclosures would be a minimum of 8 feet high and would consist of woven wire with 3- to 4-inch openings to allow some small animals to move freely through the fence. Metal posts would be placed approximately every 20 feet along each side of the exclosure, with pressure-treated 4-inch by 4-inch wooden posts set in concrete as corner supports. Electric fencing would not be used in the park based on concerns for 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. Visitors would not be able to use the areas included in the exclosures during or after construction for approximately 10 years. Park staff would maintain all exclosures. A visual inspection would be performed once a month and after storm events. Maintenance on the exclosures would be performed on an as needed basis but a minimum of four times a year. If deer are found within an exclosure, they would be removed, as would any other animals that appeared to be trapped within the exclosure and repairs made as needed.

Proposed Deer Exclosures

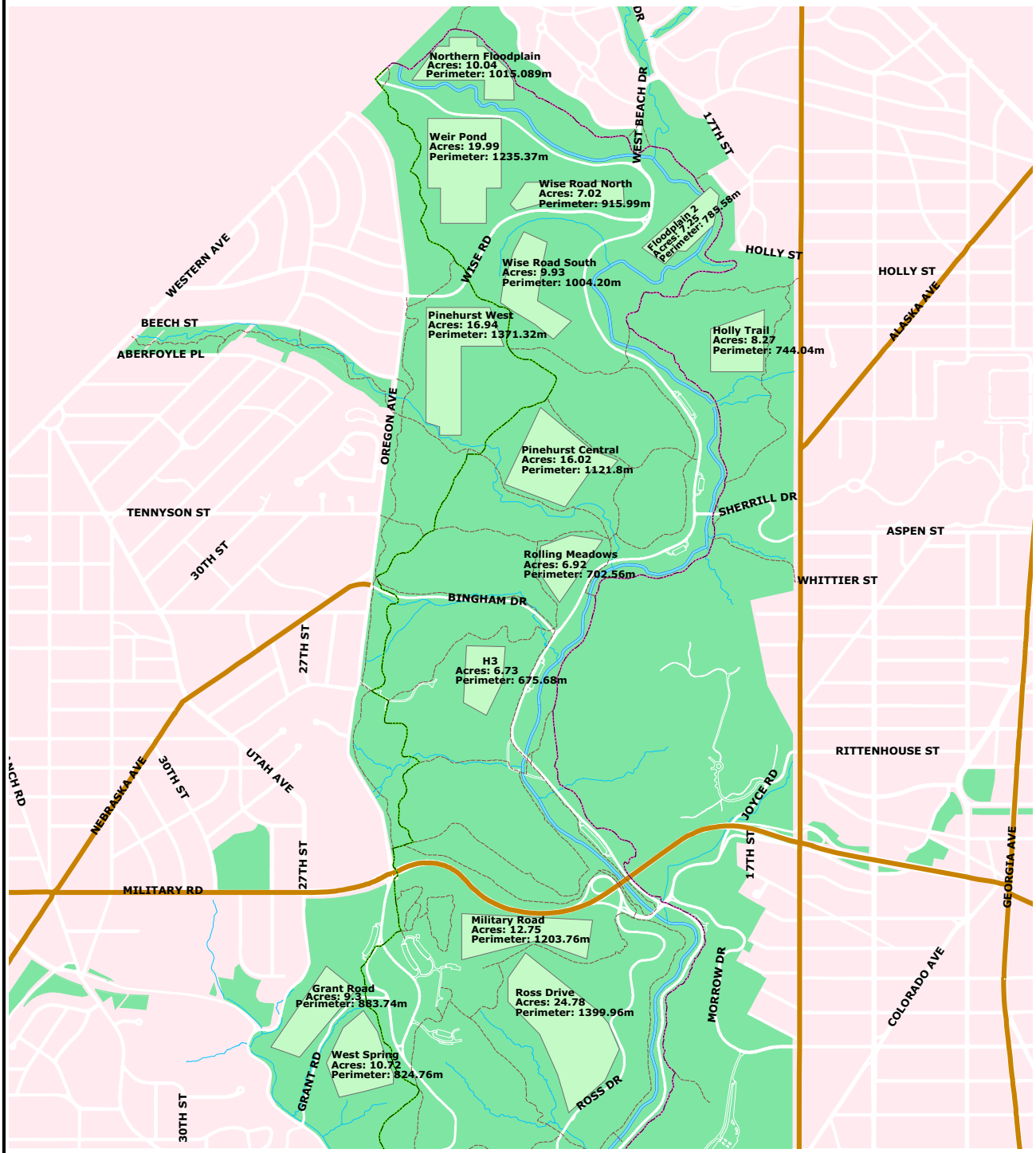


Figure 4. Proposed Deer Exclosures

It is estimated that up to 10 years would be required for seedling growth in the exclosures to exceed the typical deer browsing height (approximately 60 inches or 150 centimeters) (Horsley et al. 2003). After seedlings exceeded this height, the exclosures would 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 the exclosures in alternative B would achieve woody forest regeneration in about 5% to 10% of the entire park over the 15-year life of the plan (the 5% originally fenced for the first 10 years that has grown beyond the reach of deer, plus the additional 5% fenced in the second round of fencing in years 11 through 20). However, the herbaceous layer in the original exclosures would be exposed to deer browsing pressure after the exclosure was removed; therefore, the herbaceous regeneration would be met within a maximum of about 5% of the entire park at any one time.

REPRODUCTIVE CONTROL OF DOES

This alternative would use both sterilization of does and use of an acceptable reproductive control agent (when feasible) in a phased approach to control population growth and eventually reduce the size of the population through natural mortality.

Sterilization

Sterilization of does would be the initial action taken. Even though both sexes can be treated, surgical sterilization is more effective on females in polygamous populations 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 the surgical removal of ovaries or a 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 the potential for higher incidence of infection than in a controlled environment. If field surgery is required, a temporary or mobile field station could be set up to minimize potential for infection and reduce impacts to visitors (Mathews et al. 2005). Because surgical sterilization is permanent, the animal is handled only once.

Few documented studies were found regarding the use of surgical sterilization of white-tailed deer as a population control measure. The Milwaukee County Zoo sterilized 16 deer on zoo grounds (which are fenced) between 1990 and 1995 with positive results. This provided the basis for a study in Highland Park, Illinois, between 2002 and 2005, in which 66 deer were sterilized over the 3-year period (Mathews et al. 2005). The treatment area was approximately 8.5 square miles, unfenced, and consisted of a mix of large residential lots, parks, forest preserves, and golf courses. The deer density was estimated at six to eight deer per square mile prior to the study, with a goal of five deer per square mile. The Illinois Department of Natural Resources believes that this program was not effective and that the high number of road-killed deer was the main factor in keeping deer densities low. Therefore, the program has been suspended (S. Bates, pers. comm. with Marty Jones, Deer Program Manager, Illinois Department of Natural Resources, May 8, 2008, reported in S. Bates pers.comm. 2008d).

Even though the deer density and density goals in the Highland Park study are different from those identified for Rock Creek Park, the methods for implementation could be applied. Therefore, implementation of this method follows the parameters used in the study; however, actual implementation may be modified as more information is learned about this method of population control.

There are a number of concerns regarding implementing this control method, primarily due to the lack of experience in using it as a population control in free-ranging deer and the limited data available on the structure of the population (age statistics) within the park. Surgical sterilization results in permanent

sterilization of the treated deer; therefore, it would require active monitoring of the population to identify the proper number of deer to be treated annually to ensure a long-term population in the park.

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 park, availability of veterinarian and surgical facilities (at zoo or mobile field unit), and mortality and recruitment rates. Based on the ligation procedures used in Illinois (Mathews et al. 2005), the procedure can be done while the doe is pregnant without affecting the fetus(es). Thus, the population would continue to increase in the initial years of implementation, until the recruitment rate drops below the mortality rate.

There is concern that sterilization could affect breeding and social behavior (extended rut) due to loss of production of reproductive hormones. Specific effects are not well documented, but deer would be expected to react in a similar way to deer that have been treated with reproductive control agents (see the "Reproductive Controls" section and appendix C). Monitoring of deer behavior would be part of adaptive management under this alternative. Also, some handling-related mortality could occur under this method due to tranquilizer use and stress on the doe.

Administration of Sterilization

***Timing of Application*—**Surgical sterilization could be administered at anytime during the year; however, it would primarily be conducted between October and April when capturing deer is expected to be easiest and temperatures provide the least amount of stress on the animals. It was assumed that implementation would start in year 1 of the plan, provided that the use of reproductive control agents is not feasible at that time (see criteria under "Reproductive Controls," below).

Number of Does Treated—To effectively reduce population size, treatment with a reproductive control measure must decrease the reproductive rate to less than the mortality rate. In urban deer populations, mortality rates are approximately 10%. Based on research of reproductive controls in a free-ranging deer population, it would be necessary to treat at least 90% of the does annually in order to halt population growth (Hobbs et al. 2000; Rudolph et al. 2000). After several years of application at this rate of treatment, a small (e.g., 5%) reduction in the population could be expected (Hobbs et al. 2000).

Rock Creek's 2007 parkwide deer population is estimated at 385 deer (82 deer per square mile by 4.69 square miles of parkland). The park has estimated through sampling data that does comprise 65% of the population (or 250 does) (K. Ferebee, pers. comm., 2008g). Therefore, to control population growth, a minimum of 225 does (90% of 250) would need to be treated. However, because of the number of deer in the park and the time it would take to capture and sterilize that many deer, sterilization would need to be phased in over a number of years. It is estimated that about two does may be treated in a day, depending on veterinarian and staff availability and capture success. Based on this estimate, the park would be able to sterilize up to 45 does per year, resulting in it taking a minimum of five years to reach the treatment goal of 90%. It was assumed for the purposes of this plan that up to 10 does per year thereafter would require reproductive control in order to control population growth from the untreated does.

Application Procedures—Treated does would need to be marked for identification to avoid future capture of the same does. This can be accomplished using ear tags. With the ear tag technique, each doe must be captured and handled at least once initially, which would be done at the time of sterilization.

Given the number of does that would need to be treated initially, bait piles would be used to concentrate does in certain locations so that the trapping or darting could be done as efficiently as possible. As many does as possible would be treated annually until 90% of the does had been sterilized. If more does were captured at once than could be treated, temporary holding areas may be necessary to house deer prior to treatment. Holding areas would be in compliance with AVMA standards and the holding period would not be more than a day.

Visitor access would be restricted in certain areas of the park during the treatment period. The areas targeted for treatment would be chosen based on maximizing deer availability and accessibility, while minimizing disruption to visitor experience. The sterilization of does would be conducted throughout the day depending on vet availability and trapping success and would primarily occur between October and April.

Reproductive Control

Use of acceptable reproductive control agents with does would be phased in under alternative B when feasible, which is defined for this plan as when the following criteria are met:

- there is a federally approved fertility control agent for application to free-ranging populations;
- the agent provides multiple year (more that three years) efficacy;
- the agent can be administered through remote injection;
- the agent would leave no residual in the meat (meat would be safe for human consumption); and
- overall there is substantial proof of success in a free-ranging population, based on science team review.

Immunocontraceptive — A reproductive control 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.

Such an agent is not currently available; however, several reproductive control agents are currently being developed and tested for use in deer population control (Fraker et al. 2002). These include porcine zona pellucida (PZP) (Naugle et al. 2002; Turner et al. 1996; Kilpatrick et al. 1992); uniquely formulated PZP, such as SpayVac®; Gonadotropin Releasing Hormone (GnRH) (Miller et al. 2000, 2001; Curtis et al. 2002; Fraker et al. 2002); prostaglandin $F_{2\alpha}$ (DeNicola et al. 1997); and leuprolide (Baker et al. 2002, 2004). Each of these agents is described in detail in appendix C, which provides an overview of reproductive control technologies for deer management. Table 6 lists those that could be considered for use in this plan. However, until an agent that meets NPS criteria is available and feasible, sterilization would continue to be used for population control in subsequent years. But, for purposes of the analysis and cost estimate for this plan, it is assumed that leuprolide, a currently available agent with single-year application, would be used.

While neither the U.S. Food and Drug Administration (FDA) nor the EPA has approved a product specifically for the purpose of controlling reproduction in white-tailed deer as of the date of this document, sSeveral FDA-approved products are available for therapeutic (medical) use in either domestic animals (prostaglandin $F_{2\alpha}$) or humans (leuprolide). These products can be used with a veterinary prescription under the *Animal Drug Use and Clarification Act of 1994*. The prescribing veterinarian and the client (the national park unit) must clearly understand how and why the drug would be used in an off-label manner. It is the responsibility of the prescribing veterinarian to give an appropriate meat withdrawal period for food-producing animals that may enter the human food chain. The veterinarian may determine there is no meat withdrawal period for a particular drug. If this is the case, the animal does not need to be marked. If there is a meat withdrawal period, then the animal needs to be appropriately marked.

TABLE 6. REPRODUCTIVE CONTROL AGENTS

Issue	Standard or Native PZP Vaccine	SpayVac® (PZP vaccine)[a]	GnRH Vaccine (e.g., GonaCon®)	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 (LH and FSH) secretion, which stops folliculogenesis and ovulation	Prevents secondary hormone (LH and FSH) secretion, which stops folliculogenesis and ovulation
How Administered	Injection	Injection	Injection	Injection
Number of Doses	Twice initially and an annual booster	Initially a single injection; if and when antibodies decline, female would need to be retreated	Likely a single injection initially; if and when antibodies decline, retreatment would be required	Current formulation — annually
Timing	Treat prior to breeding season and allow sufficient time for antibody development	Treat prior to breeding season and allow sufficient time for antibody development	Treat prior to breeding season and allow sufficient time for antibody development	Treat immediately prior to breeding season on an annual basis

Notes:
FSH = follicle stimulating hormone
LH= luteinizing hormone

Other reproductive control agents are currently available only for research use and are available under an Investigational New Animal Drug exemption by the FDA. The important aspect of a research setting is that new information regarding the safety and efficacy of the experimental drug is carefully and systematically gathered by a researcher. The use of reproductive control agents for population management would likely require approval from the Environmental Protection Agency and individual state resource agencies would have final project approval.

Under alternative B, if the criteria for use of a reproductive control agent were met, the park would initiate a reproductive control program using an approved agent. For purposes of this discussion, it is assumed that leuprolide or a similar agent would be used (see appendix C for more details on reproductive control agents). The park would also monitor the status of ongoing reproductive control research. If advances in technology could benefit deer management in the park, then the future choice of a reproductive control agent could change, and the final choice would be determined by availability, cost, efficacy, duration, and safety at the time the action was implemented.

Administration of the Reproductive Control Agent

***Timing of Application*—**Leuprolide (or a similar agent) would need to be administered in the two months prior to the deer rut (the breeding season). At Rock Creek Park, the application of leuprolide would occur primarily in September and October.

Number of Does Treated—As previously discussed, 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 unsterilized does annually in order to halt population growth (Hobbs et al. 2000; Rudolph et al. 2000). After several years of application at this rate of treatment, a small (e.g., 5%) reduction in the population could be expected (Hobbs et al. 2000).

At Rock Creek, assuming 45 does are treated each year, surgical sterilization would be used in years 1 to 5 to treat approximately 90% of the does in the park (about 225 does, based on 2007 data). It was also assumed for purposes of this plan that 10 to 12 does would need to be treated annually starting in year 6, using a reproductive control agent if one is available and feasible, but sterilization would be used as a back-up method if no drugs met the required use criteria. The annual number treated would be managed adaptively to manage population growth and slowly reduce the population size through mortality.

Application Procedures—Depending on the reproductive control agent to be used, treated does would need to be marked for non-consumption. This could be accomplished using ear tags with a unique identifier and a statement "Not for Human Consumption." The ear tag would also facilitate identification of which does have been treated. With the ear tag technique, each doe must be captured and handled at least once initially and may require additional annual treatment. Tracking and capturing previously treated does would require time to locate the doe or to lure it to a trap site so that it could be temporarily restrained and treated. After does have been handled one or more times, successfully capturing them for subsequent treatments can become very difficult (Rudolph et al. 2000. Given that the number of deer to be treated would be small, locating the deer to be treated may be the most time consuming part of implementing this method under this alternative. Radio collars may be considered if tracking becomes prohibitive.

One method that has been developed to deliver treatments without the physical capture or handling of does is a remote application (biobullet) delivered with a dart-type gun (similar to a shotgun). With this method the biobullets remain with the doe and it is not necessary to recover spent darts. Factors for consideration with this method include the maximum distance to the doe that allows the needed penetration for delivery, consistency in dosage delivery, and accurate documentation of which deer have been treated. This method would still require some marking technique to prevent multiple dosing of the same animal.

Telemetry darting would be the primary capture method used because leuprolide has not yet been successfully delivered from a biobullet. With this method a tranquilizer dart is fitted with a radio transmitter, which allows the animal to be located after the tranquilizer has taken effect. The dart is then recovered, the doe marked, the control agent administered, and the doe released. Some handling-related mortality could occur under this method due to tranquilizer use and stress on the doe (DeNicola and Swihart 1997; Kilpatrick et al. 1997); no more than 5% mortality would be accepted by the park. The application of annual treatments by remote delivery can be time consuming and expensive, and human and animal safety precautions must be addressed. An alternative capture method would include the use of traps or nets.

Bait piles could be used to concentrate does in certain locations so that the darting could be done as efficiently as possible. As many does as possible would be treated daily until 90% of the unsterilized does had been treated. Visitor access would be restricted in certain areas of the park during the treatment period. The areas targeted for treatment would be chosen based on maximizing deer presence and accessibility, while minimizing disruption to visitor experience. The treatment of does would be conducted during the off-peak visitor hours (early morning and evening) and weekdays to the extent possible, but would need to occur in the period immediately preceding the deer rut (September and October).

Training—Regardless of the technique implemented, NPS employees or their authorized agents trained in the administration of reproductive controls would perform these activities. Training would include safety measures, particularly related to use of the dart gun, to protect both visitors and NPS employees. If more than one shooting location was used to remotely administer controls with dart guns, these areas would be adequately separated for safety reasons. NPS employees or their authorized agents would also be qualified to handle live does in order to prevent disease transmission or any harm to the animal or the employee.

MONITORING

LARGE EXCLOSURES

As deer were excluded from feeding within the large exclosures, open (non-treated) areas 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 and appendix A. Additional monitoring of the 14 exclosures (some may have multiple monitoring plots) would also be conducted on a four-year rotation, with up to six large exclosures (and adjacent paired unfenced plots) monitored each year.

Vegetation sampling within an unfenced plot, which is a specific area that allows effects on deer browsing to be seen when compared to the adjacent fenced plot.

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 et al. 2000). To monitor treated animals, surveys would be conducted in the summer, at which time observations would indicate if reproduction had occurred (referred to as a fawn survey). Additional observations would be made during the annual Distance Sampling surveys conducted in the fall.

CHRONIC WASTING DISEASE

Testing for CWD would occur as described under alternative A, i.e. the park would continue to perform opportunistic and targeted surveillance under the existing categorical exclusion provisions.

IMPLEMENTATION COSTS

Costs of implementing alternative B would include the same costs described under alternative A (continued monitoring programs, limited small area protective caging, and repellent use), plus costs of constructing and maintaining large exclosures, and reproductive control and monitoring. The overall cost of implementing alternative B would depend on the number of deer treated, methods used, number of personnel, and monitoring costs. These costs are not yet explicitly defined, but estimates based on certain assumptions are provided in table 7.

TABLE 7. COST ESTIMATE — ALTERNATIVE B: NON-LETHAL ACTIONS

Action	Assumptions	Annual Cost	Cost for the 15-year Planning Period
Same actions as alternative A (common to all alternatives)	See alternative A		$327,000
Large Exclosures			
Construction	14 exclosures (total of 45,540 linear feet of fence at $5 per linear foot)	$227,700 (first year only)	$227,700
Relocation	Every 10 years at 75% of original cost	$170,775 (once every 10 years)	$170,775
Maintenance	Four visits per year per exclosure plot (48 staff days; $17,535); also storm damage materials and labor cost (varies by year; estimated average $10,317) Monthly inspection of all exclosures - $3,517	$31,369	$470,535
Vegetation Monitoring	Additional vegetation monitoring in six large exclosures per year (three staff, three hours each per exclosure) plus analysis	$5,500	$82,500
Surgical Sterilization	45 deer per year treated in years 1 through 5 at $1,000 per deer	$45,000 in years 1 through 5	$225,000
Reproductive Control[a]	Cost would depend on number of deer treated and current available technology Assume up to 10 does treated each year, beginning at year 6	$1,000 per deer × 10 does = $10,000 for 10 years	$100,000
Additional Deer Population Monitoring	Three days of survey plus data analysis each summer (fawn survey) May include global positioning system tracking of does if radio collars are used on sterilized deer	$5,000	$75,000
		Total	**$1,678,510**

a. Total cost could be reduced considerably if reproductive control costs could be decreased based on improved technology.

LARGE EXCLOSURES

Large exclosures would be a minimum of 8 feet tall, using woven wire fence, metal fence posts, and wooden 4- by 4-inch posts set in concrete on the corners. Material and installation costs are estimated at $5 per linear foot of fence (K. Ferebee, pers. comm. 2008g). The park has estimated approximately 45,540 linear feet of fence needed to construct the 14 large exclosures and that it would take up to 150 working days to construct all exclosures.

Exclosures would be relocated approximately every 10 years. Costs for this are estimated at 75% of the original cost to relocate 14 exclosures.

Maintenance costs could be substantial due to the remoteness of some exclosures and potential vandalism. Labor to inspect and maintain fences is estimated at approximately 12 days with 2 staff, assuming up to four visits per year. Using an average hourly rate for the two staff and 12 days to cover all of the exclosures per visit, the annual maintenance cost would be $17,535 for labor. An additional $10,317 per year would be needed for maintenance materials and additional visits due to storm damage. Monthly inspections would add another $3,517 annually. The additional annual vegetation monitoring cost for six exclosures per year would be approximately $5,500 (based on annual monitoring and analysis costs used in alternative A).

SURGICAL STERILIZATION

The costs identified by Mathews et al. (2005) were $1,000 per deer, with about $600 for the veterinarian, $150 in drugs, and $250 in labor for capture and monitoring prior to and after release. The labor costs for capturing deer may be the most variable, since they are dependent on the deer and park conditions and the need for construction of temporary holding facilities. The amount of time for post-surgery monitoring may also vary depending on the surgical method used and the length of time and frequency of monitoring for surgery-related mortality. For this analysis, an estimate of $5,000 was used to cover a summer fawn survey and potential for global positioning system monitoring of sterilized does.

REPRODUCTIVE CONTROL

A study in New York (one of the few 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 et al. 2000). Vaccine trials in Connecticut cost $1,128 per deer for 30 deer over two years, with 64% of the cost going to labor (Walter et al. 2002). Cost to administer PZP at Fire Island was $186 per deer for labor and material in 2007. The number of treated deer has dropped from 246 in 1998 to 149 in 2005 but no total population number was given (Naugle and Rutberg 2007). The Northeast Deer Technical Committee (2008) reports a cost of $1,000 per deer for immunocontraception.

Costs per deer would include costs for the reproductive control agent, labor and equipment, and bait piles. The estimated cost is $200 per dose of leuprolide. Additional handling and processing costs associated with delivering the treatment would also apply. In the urban setting at Rock Creek, the expected costs for implementing reproductive controls would likely be at the high end of the range, and for this analysis $1,000 per deer was used. However, these costs could vary based on improved technology and market demand once federal approval is obtained.

The additional monitoring required for reproductive controls would be as described under sterilization, with a summer fawn survey to document the number of fawns.

ALTERNATIVE C: COMBINED LETHAL ACTIONS — SHARPSHOOTING AND CAPTURE AND EUTHANASIA

Alternative C would continue the actions described under alternative A, with two types of lethal action used to reduce and control deer herd numbers. NPS or their authorized agents would conduct sharpshooting and capture and euthanasia to reduce the deer population.

ADDITIONAL PROPOSED ACTIONS UNDER ALTERNATIVE C

SHARPSHOOTING

Sharpshooting would be used to initially reduce the deer population in areas of the park and as a maintenance treatment if needed. Sharpshooting would involve using trained sharpshooters to shoot deer in designated areas, generally using firearms. However, the use of archery may be considered on a case–by–case basis in certain areas where use of firearms is not appropriate, such as near residences. Methods, removal numbers, and gender preferences are described in more detail below.

This action would continue for a minimum of three years, at which time it is estimated that the population would be reduced to the initial density goal of 15 to 20 deer per square mile.

Methods

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. They typically 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-power, small caliber rifles would be used from close range. 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 and night vision equipment would be used to reduce disturbance to the public. Activities would be in compliance with all federal firearm laws administered by the Bureau of Alcohol, Tobacco, and Firearms (ATF).

Qualified, trained federal employees or contractors would be used to implement this alternative. Every effort would be made to make the shootings as humane as possible.

In certain locations, sharpshooting may be done using archery (bow and arrow). Possible locations would include areas of the park that are too narrow or close to occupied buildings or residences. Shooting with bow and arrow would be done from close range by federal employees or contractors specifically experienced with this type of deer removal.

Sharpshooting with firearms would primarily occur at night (between dusk and dawn), primarily during late fall and winter months when deer are more visible and fewer visitors are in the park. In some restricted areas, sharpshooting may be done during the day if needed, which could maximize effectiveness and minimize overall time of restrictions. If this is done, the areas would be closed to park visitors. The public would be notified of any park closures in advance, exhibits regarding deer management would be displayed at visitor centers, and information would be posted on the park's website to inform the public of deer management actions. Visitor access could be limited as necessary while reductions were taking place, and NPS personnel and U.S. Park Police (USPP) would patrol public areas to ensure compliance with park closures and public safety measures.

Qualified federal employees or contractors trained in all aspects of sharpshooting actions would perform all sharpshooting activities. Training would include safety measures to protect both visitors and NPS employees. If more than one shooting location was used, areas would be adequately separated to ensure safety.

Bait stations could be used to attract deer to safe removal locations, concentrate deer, improve removal success, and allow the maximum use of ground as a backstop (i.e., shooting would be directed downward

toward the ground). Bait stations 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.

The park intends to donate all deer meat to local charitable organizations to the maximum extent possible.

CAPTURE AND EUTHANASIA

Capture and euthanasia would be used in limited circumstances where sharpshooting may not be appropriate. The preferred technique for this method would be for NPS employees or their authorized agents to trap deer, approach them on foot, and euthanize them. Activities would occur at dawn or dusk and in the fall or winter months when fewer visitors are in the park, but may occur at any time of day depending on deer activities.

Deer would be captured with nets, traps, or chemical immobilization by dart gun and euthanized as humanely as possible. Euthanasia methods could include a combination of penetrating captive bolt gun and potassium chloride, exsanguination, or other drugs considered to be humane. Several methods of wildlife trapping could be used, including but not limited to drop nets and box traps. Most trapping methods involve using bait to attract deer to a specific area or trap. Box traps involve a confined space that would safely hold deer, while net traps are triggered to drop over deer and restrain them for staff to approach (Lopez et al. 1998). The method of capture would be selected based on the specific circumstances (location, number of deer, accessibility).

Deer could also be immobilized by darting with a tranquilizer dart gun (Schwartz et al. 1997). This method could be used in cases where deer had not been successfully attracted to a trap area or when trapping is not practical. Similarly, if for some reason the penetrating captive bolt gun 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, when chemicals are used for either immobilization or for euthanasia, the meat from that animal may not be able to be donated as food and the carcass may be unsuitable for surface disposal. If this is the case, the carcasses would be buried or disposed of as described under the following disposal section.

Several actions would be taken to ensure safety of the operation. NPS employees or their authorized agents trained in the use of penetrating captive bolt guns or tranquilizer guns would perform these actions. Training would include safety measures to protect both visitors and NPS employees. NPS employees or authorized agents would also be qualified to handle live deer in order to prevent disease transmission and prevent any harm to an animal or an employee/agent. Appropriate safety measures would be followed when setting drop nets or box traps. Visitor access could be limited as necessary while capture and euthanasia activities were taking place, and USPP officers, supplemented by NPS park rangers, would patrol public areas to ensure compliance with park closures and public safety measures.

All actions would be conducted in accordance with American Veterinary Medical Association (AVMA) recommendations for the humane treatment of animals to the greatest extent possible (AVMA 2001).

The number of deer removed by capture and euthanasia would be recorded, including the age and sex, location of removal, circumstance requiring removal and capture, and lethal method used.

Numbers of Deer Removed (combination of sharpshooting and capture and euthanasia)

Based on the 2007 survey, Rock Creek's deer population is estimated at 385, or 82 deer per square mile for the 4.69 square miles of the entire park management unit. Park staff would determine the number of deer to be removed from the park based on the most recent survey and a population goal of 15 to 20 deer per square mile. At least three years would be required to reach this goal, given the limited accessibility to

some areas of the park and changes in population movements as the population decreased. Based on 2007 data, the following assumptions were used for analysis:

- *Year 1* — With concentrated efforts, about one-half of the deer could be removed the first year (193 deer: 183 from sharpshooting and 10 from capture and euthanasia), assuming periodic removal efforts over a five-month period (November to March). This would reduce the population to 192 deer or 41 deer per square mile.
- *Year 2* — Assuming a 20% growth rate in the deer herd (a general rate commonly used by deer managers considering reproduction, mortality, and recruitment), the deer population would be an estimated 230 deer by the second year. If half of this population was removed (115 deer: 105 from sharpshooting and 10 from capture and euthanasia), 115 deer would remain in the park, or about 25 deer per square mile.
- *Year 3* — Again assuming a 20% growth rate in the deer herd, the deer population would be an estimated 138 deer by the third year. If half of this population was removed (69 deer: 59 from sharpshooting and 10 from capture and euthanasia), 69 deer would remain in the park, or about 15 deer per square mile.
- *Subsequent Years* — Assuming the same 20% growth rate in the deer herd, about 14 deer would need to be removed annually in subsequent years to maintain the population at about 69 deer or 15 deer per square mile. This number may vary annually depending on success of previous removal efforts, deer adaptations to removal efforts, regeneration response, and other factors.

Several factors could influence the number of years to reach the initial deer density goal. A key factor would be the response of vegetation to reduced deer browsing pressure. Additionally, as the deer population decreased through successful reduction efforts, deer might become adapted to the capture operations and become more evasive, increasing the effort necessary to reach the removal numbers in any year. Existing reproduction and mortality rates might differ from the estimate used in this projection. If reproduction rates were higher and mortality lower than estimated, the population growth would be greater than 20%, and more deer would need to be removed, potentially increasing the time to reach the initial density goal. The converse would be true if reproduction rates were lower and mortality rates higher than estimated, resulting in fewer deer having to be removed, and efforts could take less time. Immigration of deer into the park could also have a substantial effect on the number of deer to be removed, especially if the goal was toward a low population density (Porter et al. 2004).

The number of females in the population would also influence reproduction rates. Does would be preferentially removed during the first few years (see following discussion), which would shift the herd composition to a 50:50 or less sex ratio. Reproduction should decrease as the number of females in the population decreases.

Gender Preference

During the first two to three years of removal, both does and antlered deer (bucks) would be removed based on opportunity, although there would be a preference for removing does 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. Harvest of does is necessary to stabilize or reduce populations, and for a rapid decrease in deer population, at least 15 does should be taken for every 10 bucks during the first three years of treatment (West Virginia University 1985).

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

Disposal

The park intends to donate as much deer meat to local charitable organizations as possible. If this is done, field dressing would occur in the park, and the entrails would be placed in barrels for disposal at a facility that accepts such waste from deer removal operations, or possibly buried if there is an appropriate location. The meat processor would work with charitable organizations to distribute the meat.

In cases where a few deer have been euthanized (without chemical use) at a given site, the waste or carcasses may be moved away from roads and trails and left on the surface to be naturally scavenged and/or decompose. Carcasses may also be taken to a location where they would be left in an isolated area away from the public to decompose and/or be scavenged. The selected disposal option would be dependent on the whether chemicals were used, suitability of meat for donation, amount of waste or carcasses, and distance from trails, roads, and nearby facilities and residences.

In cases where the meat from deer is unsuitable for donation to charity or surface disposal, the carcasses and waste would be buried on site or collected for disposal in an approved landfill. There are no landfills in the District, and the District's transfer station (garbage collection / sorting facility) does not accept dead animals; however, nearby Maryland landfills may accept dead animals as long as they are not diseased. The park would investigate the cost of sending carcasses to landfills in both Maryland and Virginia as the need arises.

If on-site burial is selected, any burial locations would be in previously disturbed sites in or near developed areas of the park. These sites would be generally devoid of vegetation except for weeds and outside any floodplain boundaries or wetlands. In addition, these sites would not be located within an area identified as an archeological site or as having archeological resources. Disposal pits would be approximately 8 feet wide by 8 feet long by 5 feet deep. They would be dug prior to removal activities and covered and surrounded with fencing to prevent entry. Soil removed from the pits would remain on site and be covered to prevent erosion. Carcasses and waste would be transported to the pit(s) within 12 hours, and a layer of carcasses and waste would be put into the pit. That layer would be covered by hand with approximately 1 foot of the soil that was removed from the pit. Another layer of carcasses and waste would be put on top of the soil layer and covered with approximately 1 foot of soil. The final layer of carcasses and waste would be covered with approximately 3 feet of soil. The soil covering the filled pit would be covered with straw or wood chips to prevent erosion. The fence would be secured between uses to prevent entry.

If the pits are not completely filled between removal activities or if the is soil frozen, the pit would be covered with tarps or plywood, and fencing would be installed to prevent entry and reduce visibility. When conditions permit, the carcasses and waste would be covered with soil or the pit filled. When the weather and season are appropriate, the soil covering the pits would be seeded with an NPS approved seed mix and mulched. Any soil not used to refill the pits would be used in other locations within the park.

Should CWD be found in the deer herd, the park would follow current NPS Public Health Service guidelines or NPS Standard Operating Procedures for storage and disposal of deer infected with the disease. A standard operating procedure is now under development for the NPS National Capital Region.

MONITORING

SHARPSHOOTING AND CAPTURE AND EUTHANASIA

Throughout the removal efforts, vegetation monitoring would be conducted, as described under alternative A and in appendix A, to document changes in deer browsing and forest regeneration that might result from reduced deer numbers. Vegetation monitoring would be conducted annually to document vegetation recovery. If the objectives were being met and changes in regeneration were observed as anticipated at the target deer density goal, removal efforts would be maintained at the level necessary to

keep the deer population at the target density. Adjustment of the removal goal in either direction from the initial deer density goal could be made based on how close the conditions indicated by the vegetation monitoring were to the park's forest regeneration objectives (see "Adaptive Management" section).

CHRONIC WASTING DISEASE

CWD opportunistic and targeted surveillance would occur as described under alternative A. Sharpshooting and the use of captive bolt gun may result in animals being unable to be tested (due to location of impact); however, CWD testing would be performed whenever possible. All animals sampled would be stored per approved standard operating procedures until test results are obtained. All deer testing negative for CWD would be donated in accordance with NPS Public Health guidelines.

IMPLEMENTATION COSTS

Costs of implementing alternative C would include the same costs described under alternative A (continued monitoring programs, limited small area protective caging), plus the cost of sharpshooting and capture/euthanasia. Costs to cover additional staffing using USPP that would likely be necessary for closing off all or portions of the park during sharpshooting have also been included. Estimated costs for alternative C are discussed below and summarized in table 8.

TABLE 8. COST ESTIMATE — ALTERNATIVE C: COMBINED LETHAL ACTIONS

Action	Assumptions	Annual Cost	Cost for the 15-year Planning Period
Same actions as described for alternative A (common to all alternatives)	See alternative A		$327,000
Sharpshooting[a]	Years 1–3 at $200 per deer (183 deer in year 1, 105 in year 2, and 59 in year 3)	Year 1 — $36,600 Year 2 — $21,000 Year 3 — $11,800	$399,100[a]
	Years 4–15 at $400 per deer (14 deer annually)	Years 4–15 — 14 deer × $400/deer = $5,600/year × 12 = $67,200	
	USPP staffing for park closure and safety	Year 1 — $75,000 Year 2 — $37,500 Year 3 — $22,500 Years 4–15 — 12 × $7,500 = $90,000 Subtotal - $225,000	
	Park staff support for park closures	Years 1–15 — 15 × $2,500/year = $37,500	
Capture and Euthanasia[b]	For estimate, assume up to 10 deer removed per year in years 1–3 and assume a maximum of five deer in years 4–15 at $500 per deer[b]	Year 1 — $5,000 Year 2 — $5,000 Year 3 — $5,000 Years 4–15 — $2,500/year = (12 x $30,000) + 15,000	$45,000
		Total	**$771,100**

a. This cost could increase if deer density goal is not reached by the fourth year.

b. Costs for this method would vary from $100 to $1,000 per deer, but is expected to be in the middle ($500) of this range.

SHARPSHOOTING

Factors affecting the final cost of implementing this alternative include deer density, number of deer to be removed, ease of access to deer, number and location of bait stations, equipment availability, amount of data to be collected from deer, and processing requirements. The greatest costs would generally be incurred when the deer and bait stations were difficult to access, when deer were wary of humans, the removal area was large, and when deer densities were lower (requiring more time to find each deer). Conversely, lower costs could be expected when the removal area was smaller, deer density was high (less time to find each deer), and deer were accustomed to human activities.

Costs and efficiencies of sharpshooting programs have been assessed in the literature. 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 et al. 2001). Gettysburg National Military Park reported that costs averaged $128 per deer, with 355 deer removed (Frost et al. 1997). Costs of up to $354 per deer were recently reported (DeNicola and Williamson 2008).

It is estimated that the sharpshooting part of this alternative would initially cost $200 per deer for the first 3 years, increasing to $400 per deer as the population decreased.

Costs for USPP staffing to close off the park during sharpshooting were estimated assuming that there would be 20 staff needed during a 6-hour night shift to close off all or parts of the park. Also, it was assumed that deer removal would require 10 nights in year 1, 5 nights in year 2, 3 nights in year 3, and 1 night in subsequent years, and that overtime pay would be required.

CAPTURE AND EUTHANASIA

The costs for capturing deer would likely vary. Factors would include the location of the removal, accessibility, type of trap or immobilization drug used, the means of deer disposal, and the type of euthanasia used. Based on the experience of park personnel, and the range of costs identified for capturing deer under the reproductive control action, costs could range from $100 to $1,000 per deer. An experienced contractor estimates that the minimum cost for capture and euthanasia would be $400 per animal (White Buffalo, Inc. 2005); therefore, actual costs for this method would likely be closer to the middle of the range ($500). It was assumed that 10 deer would be removed by this technique in the first three years, and a maximum of five deer per year in subsequent years.

ALTERNATIVE D: COMBINED LETHAL AND NON-LETHAL ACTIONS

Alternative D would include all actions described under alternative A, plus a combination of certain additional lethal and non-lethal actions from alternatives B and C to reduce deer herd numbers. The lethal actions would include both sharpshooting and capture/euthanasia, and these actions would be taken initially to quickly reduce the deer herd numbers. Reproductive control of does would be implemented to maintain the reduced herd numbers through sterilization or acceptable reproductive control agents, if feasible. If reproductive controls meeting required criteria become available sooner than expected, the park could select to use these first (before the initial sharpshooting), so that deer are not as hard to capture and more can be treated. However, for this analysis, it is assumed that sharpshooting would be conducted first and that population maintenance would be conducted via the most practicable method and could include a combination of lethal and non-lethal methods (i.e., sharpshooting could be used for maintaining the deer herd if necessary).

ADDITIONAL PROPOSED ACTIONS UNDER ALTERNATIVE D

SHARPSHOOTING

Sharpshooting would be used to initially reduce the deer population in areas of the park and as a maintenance treatment if needed. Generally, the methods described in alternative C, using sharpshooting instead of capture and euthanasia as the primary removal method, would be implemented. Sharpshooting would involve using trained sharpshooters to shoot deer in designated areas using small caliber rifles from close range. Removal numbers and gender preferences would also be similar to alternative C. This action would continue for a minimum of three years, at which time it is estimated that the population would be reduced to the initial density goal of 15 to 20 deer per square mile. The disposal methods described in alternative C would apply to alternative D as well.

CAPTURE AND EUTHANASIA

Capture and euthanasia would be implemented in areas where sharpshooting may be inappropriate (e.g., near residences where there could be a concern about safety or noise). This procedure would include trapping or immobilizing deer using the technique that would create the least amount of stress as described in alternative C. The disposal methods described under alternative C would apply to alternative D as well.

REPRODUCTIVE CONTROL

Reproductive control could be implemented, as described under alternative B, to maintain the deer population level. Assuming lethal actions reduced the deer population to the initial deer density goal after year 3, for this analysis it was assumed that an acceptable reproductive control agent (if available and feasible) would be used to maintain the desired population number starting in year 4. The success of using a reproductive control agent on a population that has undergone sharpshooting efforts 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 et al. 2004; Naugle et al. 2002). It should be expected that getting close enough to administer remote injections would become increasingly difficult after sharpshooting efforts due to deer behavior changes in response to previous human interaction. Sterilization would also be considered as a reproductive control maintenance option. This would reduce the number of does requiring treatment over the long term, although the initial cost per doe is about the same as reproductive control.

Assuming a park deer population of 69 deer (density of about 15 per square mile) following sharpshooting, with 65% (45) of the deer being does (K. Ferebee, pers.comm. 2008g), 41 does (45 × 90%) would need to be treated annually, assuming that leuprolide or a similar agent were used. If an agent like Gonacon® is available and meets the criteria established for use of reproductive control agents, the frequency of treatment and costs would be reduced (current formulations of Gonacon® last up to four years). However, until a reproductive control agent meets the use criteria described under alternative B, sharpshooting would be used for long-term maintenance of the reduced deer population size as needed (i.e., approximately 14 deer would be removed annually as described under alternative B).

MONITORING

Monitoring under this alternative would include the same opportunistic and targeted surveillance for CWD described under alternative A, as well as the same techniques described for capture and euthanasia (alternative C), and reproductive controls (alternative B). This would include spotlight surveys to assess the effectiveness of reproductive controls and vegetation monitoring to document changes in forest regeneration that would result from reduced deer numbers. The numbers of deer to be removed or treated in subsequent years would be adjusted based on the success of previous removal or reproductive control efforts, projected growth in the population, and vegetation and deer monitoring results.

IMPLEMENTATION COSTS

Costs of implementing alternative D would include the same costs described under alternative A, plus additional costs for sharpshooting, capture and euthanasia, and reproductive control. Estimated costs for alternative D based on assumptions provided are discussed below and summarized in table 9.

TABLE 9. COST ESTIMATE — ALTERNATIVE D: COMBINED LETHAL AND NON-LETHAL ACTIONS

Action	Assumptions	Annual Cost	Cost for the 15-year Planning Period
Same actions as described for alternative A	See alternative A		$327,000
Sharpshooting[a]	Years 1–3 at $200 per deer (183 deer in year 1, 105 in year 2, and 59 in year 3)	Year 1 — $36,600 Year 2 — $21,000 Year 3 — $11,800 Subtotal - $69,400	$241,900
	USPP staffing for park closure and safety (years 1–3 only)	Year 1 — $75,000 Year 2 — $37,500 Year 3 — $22,500 Subtotal - $135,000	
	Park staff support for park closures	Years 1–15 — 15 × $2,500/year = $37,500	
Capture and Euthanasia[b]	For estimate, assume up to 10 deer removed per year in years 1–3 at $500 per deer	Year 1 — $5,000 Year 2 — $5,000 Year 3 — $5,000	$15,000
Reproductive Control[c]	For estimate, assume treatment of 41 does annually starting in year 4 (for 12 years)	$1,000 per deer or $41,000 per year	$492,000
Deer Population Monitoring	Three days of survey plus data Analysis each summer (same as alternative B)	$5,000	$75,000
		Total	**$1,150,900**

a. This cost could increase if the deer density goal was not reached by the fourth year.

b. Costs for this method would vary but assumed mid-range cost of $500.

c. Reproductive control costs could be reduced considerably with improved technology. For example, if Gonacon® or a similar agent were used, with treatments needed only once every four years, costs after the first year of reproductive control could fall to about $20,000 per year. Reproductive control costs could similarly be reduced over the long term if sterilization is used.

SHARPSHOOTING

Factors affecting the final cost of implementing this alternative include deer density, number of deer to be removed, ease of access to deer, number and location of bait stations, equipment availability, amount of data to be collected from deer, and processing requirements. The greatest costs would generally be incurred when the deer and bait stations were difficult to access, when deer were wary of humans, the removal area was large, and when deer densities were lower (requiring more time to find each deer). Conversely, lower costs could be expected when the removal area was smaller, deer density was high (less time to find each deer), and deer were accustomed to human activities.

Costs and efficiencies of sharpshooting programs have been assessed in the literature. 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 et al. 2001). Gettysburg National Military Park reported that costs averaged $128 per deer, with 355 deer removed (Frost et al. 1997). Sharpshooting costs of up to $354 per deer were reported by DeNicola and Williamson (2008), and costs of $91 to $300 per deer were reported by McDonald and McKinley in 2009.

It is estimated that this alternative would cost $200 per deer. However, if sharpshooting were needed in the future years (e.g., if reproductive control or capture and euthanasia were not used for maintenance), costs could increase up to $400 per deer as the population decreased.

Costs for USPP staffing to close off all or portions of the park during sharpshooting were estimated assuming that there would be 20 staff needed during a 6-hour night shift, and that deer removal would require 10 nights in year 1, 5 nights in year 2, and 3 nights in year 3, and that overtime pay would be required..

CAPTURE AND EUTHANASIA

The cost for using capture and euthanasia to supplement the sharpshooting effort would be the same as described for alternative C. For the purposes of analysis for this plan, it is assumed that up to 10 deer would be removed per year in years 1–3 at $500 per deer.

REPRODUCTIVE CONTROL

For purposes of analysis for this plan, it is assumed that reproductive control would begin in year 4. Costs could be reduced considerably depending on the results of the lethal efforts, the cost per deer based on current technology, and the year treatment begins. To minimize costs (to reduce the number of deer to be treated), sharpshooting would occur before reproductive control is implemented. Sharpshooting would also focus on removing does to minimize reproduction. If reproductive control criteria are met, an acceptable reproductive control agent would be used to maintain the reduced population size. Until the criteria are met, reduction through sharpshooting would continue for population size maintenance.

ADAPTIVE MANAGEMENT

The U.S. Department of the Interior (USDI) requires that its agencies ". . . use adaptive management to fully comply" with the Council on Environmental Quality's (CEQ) guidance that requires "a monitoring and enforcement program to be adopted . . . where applicable, for any mitigation" required in a NEPA planning process (516 Departmental Manual [DM] 1.3 D[7]; 40 CFR 1505.2). In addition, the Department has recently outlined the adaptive management approach in a technical guide developed to provide guidance to all USDI bureaus and agencies (Williams et al. 2007).

According to the USDI Technical Guide (Williams et al. 2007), "Adaptive management is a systematic approach for improving resource management by learning from management outcomes (Sexton et al. 1999). 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 (Murray and Marmorek 2004). 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 (Bormann et al. 2006)."

Adaptive management should be used when decisions must be made despite uncertainty and 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 et al. 2007). The deer management situation at Rock Creek Park meets all of these conditions.

Appendix D provides more details about the phases of adaptive management as it would be applied to this deer management plan.

HOW ALTERNATIVES MEET OBJECTIVES

As stated in chapter 1, all action alternatives selected for analysis must meet all objectives to a large degree. The action alternatives must also 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 and EIS, which are stated on page 4. Alternatives that did not meet the objectives were not analyzed further (see the "Alternatives Eliminated from Further Consideration" section in this chapter).

Table 10 compares the alternatives by summarizing the elements being considered, while table 11 compares how each of the alternatives described in this chapter would meet the plan objectives. "Chapter 4: Environmental Consequences" describes the effects of each alternative on each impact topic, including the impact on recreational values and visitor experience. These impacts are summarized in table 12.

TABLE 10. COMPARISON OF ALTERNATIVES

	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
Management Actions	Continue deer monitoring, data gathering, data management and research, limited use of small area caging and repellents, plus education, outreach, and inter-jurisdictional cooperation	All actions under alternative A, plus: • Construct 14 large exclosures to protect vegetation from deer browsing throughout the main reservation of the park • Implement reproductive control of does, including sterilization for the first four years and subsequent reproductive control if available and feasible, based on criteria for use established by the park	All actions under alternative A, plus: • Use sharpshooting and limited capture and euthanasia to reduce deer herd numbers • Donate meat, if possible	All actions under alternative A, plus use a combination of techniques from alternatives B and C: • Use sharpshooting and limited capture and euthanasia to reduce deer herd numbers • Apply reproductive controls (if feasible) to maintain population size, with sharpshooting used periodically, if needed • Donate meat, if possible
Reduction in Deer Population	None, other than current sources of mortality	Potentially reduce deer population if 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 very gradual	Initially remove an estimated 193 deer, 115 deer in year 2, and 69 deer in year 3, with fewer deer in subsequent years. To maintain the population at target levels (15 to 20 deer per square mile), remove an estimated 14 deer beginning in year 4. Capture and euthanasia would account for 10 of the deer removed in the first three years and very few additional (five or less) in subsequent years	Similar to alternative C. Potential for future reductions through reproductive control (if feasible) used as a population maintenance tool, with sharpshooting available as back-up

	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
Time Required to Achieve Desired Forest Regeneration	Forest regeneration cannot be achieved without reducing browsing impacts	Five to 10% of park woody vegetation would be protected or regenerated by end of plan due to exclosures; reproductive control would contribute to additional forest regeneration by gradually limiting deer numbers	Would reduce deer population by year 3, with changes in regeneration expected 3-4 years after deer density goal is reached*, and trends toward regeneration success by end of plan *This was achieved at Gettysburg National Military Park (Niewinski et al. 2006)	Same as alternative C
Handling of Deer	Handling only as required for monitoring	No physical handling of deer required to drive them out of fenced areas Intensive physical handling of deer required for sterilization Reproductive control application could also involve trapping or a telemetry dart application that requires marking and handling of does. Handling and chemical applications would follow AVMA recommendations, but there would be increased stress levels in captured deer	No capture required for sharpshooting; capture and euthanasia requires capture and handling; would follow AVMA recommendations, but there would be increased stress levels in captured deer compared to other methods	Same as alternative B for reproductive control and alternative C for lethal actions
Monitoring	Continued inventorying vegetation monitoring and monitoring of deer population numbers to assess impacts	Continued monitoring as described under alternative A, plus monitoring of plants for signs of recovery within exclosures For reproductive control, monitoring of treated deer using additional fawn surveys to determine reproductive control effectiveness	Annual monitoring of plants for six years after deer density goal reached to identify any signs of forest recovery, plus continued monitoring as described under alternative A	Same as alternatives B and C

	Alternative A: No Action Alternative	**Alternative B: Combined Non-lethal Actions**	**Alternative C: Combined Lethal Actions**	**Alternative D: Combined Lethal and Non-lethal Actions**
Regulatory Considerations	No specific regulatory requirements	Same as alternative A, plus: Veterinarian prescription required pursuant to the *Animal Drug Use and Clarification Act* for off-label use in deer. The Environmental Protection Agency would likely authorize the use of reproductive control agents and individual state resource agencies would have final project approval Additional requirements could be prescribed by a veterinarian (e.g., meat withdrawal period, marking)	Same as alternative A plus: Any necessary ATF permits would be obtained Coordination with state/local/ nonprofit/private entities might be needed to donate meat Follow state/local regulatory requirements for any landfill disposal of deer	Same as alternatives B and C
CWD Testing	Testing coordinated with the state; primarily opportunistic surveillance	Same as alternative A	Same as alternative A	Same as alternative A
Park Closure or Restricted Access	None	Restricted access within exclosures or in areas of active reproductive control activities	Park closed or access restricted during management activities; closures or restrictions minimized by conducting activities during periods between dusk and dawn and primarily in late fall/winter for larger reductions	Same as alternatives B (reproductive control) and C
Adaptive Management	No specific adaptive management included under this alternative	Relocation of vegetation monitoring plots, changes in action thresholds or deer density goals, possible changes in number and locations of large exclosures, possible change in reproductive control agent used and its application procedures	Relocation of vegetation monitoring plots, changes in action thresholds or deer density goals, or possible changes to implementation procedures for this action	Relocation of vegetation monitoring plots, changes in action thresholds or deer density goals, possible change in reproductive control agent used and its application procedures or timing of use, as well as number of removal actions needed

	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
Estimated Cost (15-year Plan) with Leuprolide-type Reproductive Control Agent	$327,000	$1,678,510	$771,100	$1,150,900

TABLE 11. ANALYSIS OF HOW THE ALTERNATIVES MEET OBJECTIVES

Objective	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
Vegetation				
• Develop and implement informed, scientifically-based vegetation impact levels and corresponding measures of deer population density that would serve as a threshold for taking prescribed management actions within the park	Does not meet objective: Thresholds for taking action and deer density goal do not apply to the no action alternative	Fully meets objective: Plan provides action thresholds and target deer density for all action alternatives	Fully meets objective: Same as alternative B	Fully meets objective: Same as alternative B
• Protect the natural abundance, distribution, and diversity of native plant species within the applicable park units by reducing excessive deer browsing, trampling, and nonnative seed dispersal	Does not meet objective: No reduction in deer browsing pressure, resulting in insufficient tree regeneration and adverse effects on native plant species	Partially meets objective: Up to 10% of the park's woody vegetation protected over the life of the plan; a maximum of about 5% of the herbaceous cover totally protected at any one time A minimum of 10 years for reproductive control to be effective with current methods	Fully meets objective: Reduction of deer herd over a minimum of four years, helping to ensure tree regeneration and protection of native plants	Fully meets objective: Same as alternative C

Objective	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
• Maintain, restore, and promote a mix of native plant species and reduce the spread of nonnative plant species through effective deer management	Does not meet objective: No mix of native herbaceous plant species because of overbrowsing and continued contribution to the spread of invasive species	Partially meets objective: Mix of native herbaceous plant species in exclosures No native herbaceous species in park areas that cannot be fenced and continued contribution to the spread of invasive species due to overbrowsing outside exclosures	Fully meets objective: Forest regeneration likely because of a smaller deer herd, resulting in a mix of native herbaceous plant species Spread of invasive species due to overbrowsing would be reduced	Fully meets objective: Same as alternative C
Wildlife and Wildlife Habitat				
• Allow for a white-tailed deer population within the park while protecting other park resources	Does not meet objective: Deer population not in balance with the forest ecosystem Very limited protection for other park resources	Partially meets objective: A self-sustaining deer population, but at the expense of a healthy forest and other park resources Other park resources protected only within exclosures	Fully meets objective: Allows for a viable deer population and other park resources protected as a result of reducing the herd size	Fully meets objective: Same as alternative C
• Protect the natural abundance, distribution, and diversity of native animal species within the park by reducing excessive deer browsing, trampling, and nonnative seed dispersal	Does not meet objective: Continued browsing pressure would reduce the amount of habitat within the park and adversely affect other wildlife	Partially meets objective: Native habitat would be restored, but only very gradually and exclosures can affect the natural distribution of native species	Fully meets objective: Forest regeneration possible with a smaller deer herd, resulting in a protection of wildlife habitat	Fully meets objective: Same as alternative C
• Protect lower canopy and ground nesting bird habitat from adverse effects of deer browsing	Does not meet objective: No natural regeneration in lower canopy due to continued browsing pressure, reducing the amount of habitat for ground nesting birds within the park	Partially meets objective: Lower canopy and ground nesting bird habitat protected only in exclosures	Fully meets objective: Forest regeneration possible with a smaller deer herd, resulting in a lower forest canopy and ground nesting bird habitat	Fully meets objective: Same as alternative C

Objective	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
Threatened, Endangered, and Species of Special Concern				
• Protect habitat of rare plant and animal species from adverse effects of deer, such as excessive deer browsing, trampling, and nonnative seed dispersal.	Partially meets objective: Some sensitive plant species in limited locations protected by small caged exclosures	Partially meets objective: Caging required to protect sensitive herbaceous species that would never grow out of browse range No protection for species in park areas that cannot be caged	Fully meets objective: Most sensitive species protected if deer density goal is reached	Fully meets objective: Same as alternative C
Cultural Resources				
• Protect the integrity, variety, and character of the cultural landscapes by reducing excessive deer browsing, trampling, and nonnative seed dispersal	Partially meets objective: Landscaped area plantings protected from excessive deer browsing by caging, but no protection for the park's cultural landscapes	Partially meets objective: In addition to landscaped area plantings protected by caging, protection of vegetation within exclosures, but no protection for the park's overall cultural landscape outside exclosures	Fully meets objective: Forest regeneration allowed with a smaller deer herd, thus protecting the forest as a cultural landscape	Fully meets objective: Same as alternative C
Visitor Experience				
• Share information with the public regarding the deer population and the forest regeneration process and diversity, including the role of deer as part of a functioning park ecosystem, not the primary driving force within it	Partially meets objective: Education and outreach efforts continued, but with limited emphasis on deer management options	Fully meets objective: Public outreach would address deer management and forest regeneration under all action alternatives	Fully meets objective: Same as alternative B	Fully meets objective: Same as alternative B

Objective	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
• Initiate cooperative efforts to address deer effects on the park and surrounding communities	Partially meets objective: Cooperative efforts exist and are ongoing, but lack of management actions limits what can be done to fully cooperate with surrounding communities	Fully meets objective: Would enable park to cooperate with surrounding communities	Fully meets objective: Same as alternative B	Fully meets objective: Same as alternative B
Park Management and Operations				
• Share information with park staff and other regional parks regarding the deer population and management strategies	Fully meets objective: Would share information as obtained	Fully meets objective: Same as alternative A	Fully meets objective: Same as alternative A	Fully meets objective: Same as alternative A

TABLE 12. SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
Vegetation	*Direct/Indirect Impact*: The impacts of large numbers of deer browsing on a very large percentage of the park's woody and herbaceous vegetation and consequently limiting natural regeneration would be adverse, long term, and major.	*Direct/Indirect Impact*: Since the benefits of reproductive control would not be fully realized within the life of this plan, overall impacts to woody and herbaceous vegetation would be adverse, long term, and major	*Direct/Indirect Impact*: Enhancing natural forest regeneration by quickly reducing deer browsing pressure and maintaining a smaller deer population through direct reduction would result in beneficial, long-term impacts. Over time as natural forest regeneration occurred, adverse, long-term, major impacts that could be expected if the deer herd continued unchecked would be reduced to minor levels.	*Direct/Indirect Impact*: Enhancing natural forest regeneration by quickly reducing deer browsing pressure and maintaining a smaller deer population through the use of reproductive control (and direct reduction if needed) would result in beneficial, long-term impacts. Over time as natural forest regeneration occurred, adverse, long-term, major impacts would be reduced to minor levels.
	Cumulative Impact: Would result in adverse, long-term, major	*Cumulative Impact*: Would result in long-term, moderate to major	*Cumulative Impact*: Would result in beneficial, long-term cumulative	*Cumulative Impact*: Would result in beneficial, long-term cumulative

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
	cumulative impacts.	adverse cumulative impacts.	impacts.	impacts.
	Potential for Impairment: Current conditions in the park indicate severe adverse impacts on vegetation resources. Under alternative A it is expected that impairment of vegetation resources would occur over the long term.	*Potential for Impairment*: It is not expected that impairment of vegetation resources would occur under this alternative.	*Potential for Impairment*: No impairment of vegetation resources would occur under this alternative.	*Potential for Impairment*: No impairment of vegetation resources would occur under this alternative.
Soils and Water Quality	*Direct/Indirect Impact*: Soil erosion and sedimentation due to loss of vegetation from increased deer browsing could result in adverse long-term, negligible to minor impacts on soils and water quality.	*Direct/Indirect Impact*: If deer displaced by the fenced exclosures concentrated in other areas of the park, resulting in increased loss of vegetation in those areas and a potential increase in soil erosion, adverse, long-term, minor impacts to soils and water quality could occur. Impacts would gradually shift to beneficial in the long term.	*Direct/Indirect Impact*: Immediately reducing the number of deer in the park and maintaining a sustainable population would result in beneficial, long-term impacts on soils and water quality.	*Direct/Indirect Impact*: Immediately reducing the number of deer in the park and maintaining a sustainable population would result in beneficial, long-term impacts on soils and water quality.
	Cumulative Impact: Would result in adverse, long-term, minor cumulative impacts on soil and water quality.	*Cumulative Impact*: Would result in adverse, long term, and minor cumulative impacts.	*Cumulative Impact*: Would result in adverse, long term, and minor cumulative impacts.	*Cumulative Impact*: Would result in adverse, long term, and minor cumulative impacts.
	Potential for Impairment: No impairment of soil or water resources would occur under this alternative.	*Potential for Impairment*: No impairment of soil or water resources would occur under this alternative.	*Potential for Impairment*. No impairment of soil or water resources would occur under this alternative.	*Potential for Impairment*: No impairment of soil or water resources would occur under this alternative.
Wetlands and Floodplains	*Direct/Indirect Impact*: Loss of vegetation from increased deer browsing, disturbance to small wetland areas and vernal pools and changes in species composition would result in adverse, long-term, moderate impacts on wetlands and	*Direct/Indirect Impact*: Use of exclosures to protect many of the park's forested wetlands would gradually result in beneficial long-term impacts to wetlands, although continued long-term minor to moderate adverse impacts would be expected in areas that are not fenced and in smaller wetland	*Direct/Indirect Impact*: Immediately reducing the number of deer in the park and maintaining a sustainable population would result in beneficial, long-term impacts on wetlands and floodplains.	*Direct/Indirect Impact*: Immediately reducing the number of deer in the park and maintaining a sustainable population would result in beneficial, long-term impacts on wetlands and floodplains.

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
	floodplains.	areas and seeps. Beneficial long-term impacts would also result from decreased vegetation loss. Construction of exclosures within the 100-year floodplain could result in short-term, minor adverse impacts on the floodplain.		
	Cumulative Impact: Would result in adverse, long-term, moderate impacts on wetlands and floodplains.	*Cumulative Impact*: Would result in adverse, long-term, moderate impacts on wetlands and floodplains.	*Cumulative Impact*: Would result in adverse, long term, minor to moderate cumulative impacts due mainly to past actions.	*Cumulative Impact*: Would result in adverse, long term, minor to moderate cumulative impacts due mainly to past actions.
	Potential for Impairment: No impairment of wetlands or floodplains would occur under this alternative.	*Potential for Impairment*: No impairment of wetlands or floodplains would occur under this alternative.	*Potential for Impairment*: No impairment of wetlands or floodplains would occur under this alternative.	*Potential for Impairment*: No impairment of wetlands or floodplains would occur under this alternative.
White-tailed Deer	*Direct/Indirect Impact*: Excessive deer browsing that would degrade habitat and limit food sources would result in long-term, moderate adverse impacts.	*Direct/Indirect Impact.* Because the benefits of reproductive control would not be fully realized within the life of this plan, overall impacts to deer habitat, and in turn deer, would be adverse, long term, and moderate as a result of habitat degradation and loss of food sources. There could also be long-term, major adverse impacts to individual deer from the physiological, biological, and behavioral effects associated with the use of reproductive control; however, long-term impacts to the population would be minor to moderate because the adverse effects would be offset over time by the benefits of population reduction.	*Direct/Indirect Impact*: The relatively rapid reduction of the deer herd and the resultant regeneration of forage would result in beneficial effects on deer herd health and would reduce adverse impacts to negligible or minor levels over the long term.	*Direct/Indirect Impact*: Enhancing natural forest regeneration by quickly reducing deer browsing pressure would result in beneficial, long-term impacts to deer and deer habitat. Over time as natural forest regeneration occurred, adverse, long-term, major impacts would be reduced to negligible to minor levels. If reproductive controls are used, there could also be long-term, major adverse impacts to individual deer from the physiological, biological, and behavioral effects associated with the use of reproductive control; however, long-term impacts to the population would be minor to moderate because the adverse effects would be offset over time by the benefits of population

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
				reduction.
	Cumulative Impact: Would result in adverse, long-term, moderate cumulative impacts.	*Cumulative Impact*: Would result in long-term, moderate adverse cumulative impacts.	*Cumulative Impact*: Would result in long-term, beneficial, cumulative impacts on deer herd health.	*Cumulative Impact*: Would result in beneficial, long-term cumulative impacts.
	Potential for Impairment: Although impacts to deer under alternative A could be severe, they would not approach the level of impairment over the long term.	*Potential for Impairment*: It is not expected that impairment of the white-tailed deer herd in Rock Creek Park would occur under this alternative.	*Potential for Impairment*: No impairment of the white-tailed deer population would occur under this alternative.	*Potential for Impairment*: No impairment of the white-tailed deer population would occur under this alternative.
Other Wildlife and Wildlife Habitat	*Direct/Indirect Impact*: A continued large deer population and related browsing, resulting in decreased plant diversity, increased invasive exotic plants, and reduced forest regeneration would result in adverse effects on other wildlife. A few predator species would benefit from a large deer population and an open understory; however, the impacts of large numbers of deer browsing on vegetation would adversely affect a large percentage of habitats for other wildlife (e.g., ground-nesting birds, frogs, snakes, and turtles), resulting in adverse, long-term, and negligible to potentially major impacts, depending on the species.	*Direct/Indirect Impact*: Construction of large, fenced exclosures over the life of the plan would protect some habitat; however, the remaining habitat would continue to be subject to a high degree of deer browsing, adversely impacting both ground and shrub layer habitat for many other species of wildlife until reproductive controls took effect and reduced the deer population. A few species would tend to benefit from a large deer population and an open understory but overall, impacts to other wildlife would be adverse, long term, and negligible to potentially major, depending on the species.	*Direct/Indirect Impact*: Rapid reductions in deer numbers in the park, thereby reducing deer browsing pressure on woody and herbaceous vegetation and allowing increased abundance and diversity of other wildlife that depend on understory vegetation would result in beneficial long term impacts. Adverse, long-term impacts would be reduced to negligible or minor levels over time.	*Direct/Indirect Impact*: Rapid reductions in deer numbers in the park, thereby reducing deer browsing pressure on woody and herbaceous vegetation and allowing increased abundance and diversity of other wildlife that depend on understory vegetation would result in beneficial long term impacts. Adverse, long-term impacts would be reduced to negligible or minor levels over time.
	Cumulative Impact: Would result in both adverse and beneficial impacts, with adverse, long-term, major cumulative impacts.	*Cumulative Impact*: Would result in both adverse and beneficial impacts, with overall adverse, long term, moderate to major cumulative impacts.	*Cumulative Impact*: Would result in long-term, beneficial, cumulative impacts.	*Cumulative Impact*: Would result in beneficial, long-term cumulative impacts.

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
	Potential for Impairment: As explained in "Vegetation" above, alternative A would not reverse the expected long-term continued growth in the deer population, and wildlife habitat would likely continue to be degraded. Although not all wildlife species would be affected to the same extent, impairment of those wildlife species that depend on the presence of ground cover and understory vegetation that are heavily browsed by deer could occur under this alternative over the long term.	*Potential for Impairment*: It is not expected that impairment of other wildlife species or habitat would occur under this alternative.	*Potential for Impairment*: No impairment of the white-tailed deer population would occur under this alternative.	*Potential for Impairment*: No impairment of the white-tailed deer population would occur under this alternative.
Rare, Unique, Threatened, or Endangered Species	*Direct/Indirect Impact*: Impacts to rare, unique, threatened, or endangered species under alternative A would be both beneficial and adverse. Adverse impacts to the federally listed Hay's spring amphipod (*Stygobromus hayi*) would be long term and negligible to minor. Beneficial impacts to state-listed plants would result from establishing caging around known individual plants and from establishing caging around newly discovered plants in the park. Overall, there would be adverse, long-term, negligible to major impacts to rare, unique, threatened, or endangered species, from excessive deer browsing and the associated habitat degradation that could result in lack of food or cover for	*Direct/Indirect Impact*: Adverse impacts to the federally listed Hay's spring amphipod would be long term and negligible to minor. Impacts to species listed or considered special status species by Maryland and the District of Columbia would be adverse, long term, and moderate to major, until reproductive controls on the park deer herd were effective. The placement and maintenance of large exclosures would include many species listed or considered special status species by Maryland and the District of Columbia, resulting in beneficial, long-term impacts. However, adverse, long-term, negligible to moderate impacts due to deer browsing would continue outside the exclosures.	*Direct/Indirect Impact*: The reduced deer density would minimize potential impacts on the habitat for the Hay's spring amphipod, resulting in long-term, beneficial effects that would reduce adverse impacts to negligible. Impacts on species listed or considered special status species by Maryland and the District of Columbia, as well as their habitat, would be beneficial and long term as a result of rapid reductions in deer numbers in the park that would reduce deer browsing pressure on woody and herbaceous vegetation. A few predators that use deer as a food source could be adversely affected by a lower deer density, as could scavengers that feed on deer carcasses, but this alternative	*Direct/Indirect Impact*: The reduced deer density would minimize potential impacts on the habitat for the Hay's spring amphipod, resulting in long-term, beneficial effects that would reduce adverse impacts to negligible. Impacts on species listed or considered special status species by Maryland and the District of Columbia, as well as their habitat, would be beneficial and long term as a result of rapid reductions in deer numbers in the park that would reduce deer browsing pressure on woody and herbaceous vegetation. Adverse, long-term impacts would be reduced to negligible or minor levels over time. A few predators and scavengers that use deer and their carcasses as a food source could be adversely affected by a

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
	such species.		could also increase the availability of other prey. Adverse, long-term impacts would be reduced to negligible or minor levels over time.	lower deer density or denser understory conditions, but this alternative could also increase the availability of other prey. Adverse, long-term impacts would be reduced to negligible or minor levels over time.
	Cumulative Impact: Would result in both adverse and beneficial impacts, with overall long-term, minor to major, adverse cumulative impacts.	*Cumulative Impact*: Would result in both beneficial and adverse impacts.	*Cumulative Impact*: Would result in long-term, beneficial, cumulative impacts.	*Cumulative Impact*: Would result in long-term, beneficial, cumulative impacts.
	Potential for Impairment: Impairment under alternative A would be possible for some of the state-listed plants that are palatable to deer, as well as habitat for rare, unique, threatened, or endangered species, because alternative A would not reverse the expected long-term continued growth in the deer population and damage to vegetation would likely continue, as described under "Vegetation" above. Therefore, it is expected that impairment of certain state-listed plants could occur over the long term.	*Potential for Impairment*: It is not expected that impairment of state-listed plants, as well as habitat for rare, unique, threatened, or endangered species, would occur over the long term.	*Potential for Impairment*: No impairment of rare, unique, threatened, or endangered species would occur under this alternative.	*Potential for Impairment*: No impairment of rare, unique, threatened, or endangered species would occur under this alternative.
Cultural Landscapes	*Direct/Indirect Impact*: The use of small cages and repellents to protect landscape plantings, new restoration plantings, or rare plant species at specified areas could result in beneficial, long-term, minor impacts to these parts of the park's vegetation. However, continued growth of the deer population and the associated	*Direct/Indirect Impact*: Constructing exclosures over the life of this plan would preserve some vegetation that is part of the cultural landscapes of the park. However, remaining vegetation within the park would continue to be adversely affected by deer browsing over the long term until reproductive controls became	*Direct/Indirect Impact*: Enhancing natural forest regeneration by quickly reducing deer browsing pressure and maintaining a smaller deer population through direct reduction would result in beneficial, long-term impacts.	*Direct/Indirect Impact*: Enhancing natural forest regeneration by quickly reducing deer browsing pressure and maintaining a smaller deer population through direct reduction would result in beneficial, long-term impacts.

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
	ongoing decline in the abundance and diversity of the native plant communities and cultural plantings would result in an adverse, long-term, minor to moderate impact to the park's cultural landscapes.	effective and the population decreased. Since the benefits of reproductive control would not be fully realized within the life of this plan, overall impacts to cultural landscapes would be adverse, long term, and minor to moderate.		
	Cumulative Impact: Would result in adverse, long-term, minor to moderate cumulative impacts.	*Cumulative Impact*: Would result in long-term, moderate adverse cumulative impacts.	*Cumulative Impact*: Would result in beneficial, long-term cumulative impacts.	*Cumulative Impact*: Would result in beneficial, long-term cumulative impacts.
	Potential for Impairment: No impairment of cultural landscapes would occur under this alternative.	*Potential for Impairment*: It is not expected that impairment of cultural landscapes would occur under this alternative.	*Potential for Impairment*: No impairment of cultural landscapes would occur under this alternative.	*Potential for Impairment*: No impairment of cultural landscapes would occur under this alternative.
Soundscapes	*Direct/Indirect Impact*: Actions taken to protect plants and monitor the deer population and park vegetation would result in an adverse, short-term, negligible adverse impact on soundscapes.	*Direct/Indirect Impact*: Intermittent construction of exclosures and reproductive control activities would result in short term, negligible to minor, adverse. impacts Individual construction and reproductive control activities would be short term, but would continue indefinitely into the future, resulting in both short- and long-term, negligible to minor, adverse impacts.	*Direct/Indirect Impact*: Sharpshooting would result in adverse impacts, primarily affecting nearby residents. Perception of the intensity of the impacts would vary depending on several factors, including timing, attenuation levels, and distance from the source, resulting in minor to moderate impacts to individuals experiencing the sound.	*Direct/Indirect Impact*: Sharpshooting would result in adverse impacts, primarily affecting nearby residents. Perception of the intensity of the impacts would vary depending on several factors, including timing, attenuation levels, and distance from the source, resulting in minor to moderate impacts to individuals experiencing the sound.
	Cumulative Impact: Would result in cumulative impacts ranging from minor to moderate and adverse depending on the source, due to the variety and abundance of noise sources that already exist around and within the park.	*Cumulative Impact*: Would result in cumulative impacts ranging from minor to moderate and adverse depending on the source, due to the variety and abundance of noise sources that already exist around and within the park.	*Cumulative Impact*: Would result in adverse, short and long term, and minor to moderate cumulative impacts. However, these impacts would be expected to decrease in the long term, as deer populations in all affected areas decrease and the need for direct reduction decreases as well.	*Cumulative Impact*: Would result in adverse, short and long term, and minor to moderate cumulative impacts. However, these impacts would be expected to decrease in the long term, as deer populations in all affected areas decrease and the need for direct reduction decreases as well.

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
	Potential for Impairment: No impairment of the park's soundscapes would occur under this alternative.	*Potential for Impairment*: No impairment of the park's soundscapes would occur under this alternative.	*Potential for Impairment*: No impairment of the park's soundscapes would occur under this alternative.	*Potential for Impairment*: No impairment of the park's soundscapes would occur under this alternative.
Visitor Use and Experience	*Direct/Indirect Impact*: Impacts to visitor use and experience 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). However, overall impacts related to a decreased ability to view scenery and other wildlife would be long term, minor to moderate and adverse.	*Direct/Indirect Impact*: Visitors would experience adverse, short-term impacts primarily due to aesthetics and closures of certain areas of the park, as well as a slight increase in occasional noise levels. These impacts would be offset by the educational and interpretive information, which would reduce adverse impacts to minor. Short-term impacts would eventually give way to beneficial, long-term impacts as the need for exclosures diminished and the deer population declined, resulting in a restored forest ecosystem throughout the park. Visitors focused primarily on seeing deer could be adversely impacted by the reduction in the herd size, but such an impact would be negligible to minor, as opportunities to view deer would still exist.	*Direct/Indirect Impact*: Adverse, short-term impacts that could occur if visitors were exposed to management actions would be offset by educational and interpretive information, resulting in negligible adverse impacts. Beneficial impacts would occur in the long term, as the forest regenerated and visitors could see increased plant and animal diversity, and enjoy enhanced scenery. Visitors focused primarily on seeing deer could be adversely impacted by the reduction in the herd size, but such impact would be negligible to minor, as opportunities to view deer would still exist.	*Direct/Indirect Impact*: Adverse, short-term impacts that could occur if visitors were exposed to management actions would be offset by educational and interpretive information, resulting in negligible adverse impacts. Beneficial impacts would occur in the long term, as the forest regenerated and visitors could see increased plant and animal diversity, and enjoy enhanced scenery. Visitors focused primarily on seeing deer could be adversely impacted by the reduction in the herd size, but such impact would be negligible to minor, as opportunities to view deer would still exist.
	Cumulative Impact: Would result in both adverse and beneficial (depending on an individual visitor's goals) impacts. Overall cumulative impacts would be long term, minor to moderate and adverse.	*Cumulative Impact*: Would result in mostly beneficial and long term cumulative impacts due to the effects of combined forest regeneration activities.	*Cumulative Impact*: Would result in cumulative impacts that would be primarily beneficial and long term.	*Cumulative Impact*. Would result in cumulative impacts that would be primarily beneficial and long term.

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
Visitor Safety	*Direct/Indirect Impact*: Because it is expected that no discernible effects to visitor safety would result from deer management actions, but vehicle collisions would continue, adverse, long-term, negligible to moderate adverse impacts could occur.	*Direct/Indirect Impact*: Adverse impacts to visitors would be short and long term and negligible from deer management, although the continued presence of a large number of deer over the life of the plan would continue to contribute to vehicle deer collisions on park roads and result in minor to moderate adverse impacts.	*Direct/Indirect Impact*: The extent of safety measures would result in adverse, short- and long-term, negligible to minor impacts, as it is expected that no discernible effects to visitor safety would occur from deer management actions and the possibility of deer-vehicle collisions would be diminished.	*Direct/Indirect Impact*: The extent of safety measures that would be used and locating activities away from park boundaries would result in adverse, short- and long-term, negligible impacts. The possibility of deer-vehicle collisions would be greatly diminished.
	Cumulative Impact: Would result in adverse, long term, and minor cumulative impacts.	*Cumulative Impact*: Would result in adverse, long term, and minor cumulative impacts.	*Cumulative Impact*: Would result in adverse, long term, and negligible to minor cumulative impacts.	*Cumulative Impact*: Would result in adverse, long term, and negligible to minor cumulative impacts.
Employee Safety	*Direct/Indirect Impact*: Because it is expected that no discernible effects to employee safety would occur as a result of deer management actions, impacts would be adverse, long term, and negligible.	*Direct/Indirect Impact*: Adverse impacts to government employees would be short and long term and negligible to minor.	*Direct/Indirect Impact*: Adverse, short- and long-term, negligible to minor impacts would occur.	*Direct/Indirect Impact*: Adverse, short- and long-term, negligible to minor impacts would occur.
	Cumulative Impact: Would result in adverse, long term, and negligible cumulative impacts.	*Cumulative Impact*: Would result in adverse, long term, and negligible cumulative impacts.	*Cumulative Impact*: Would result in adverse, long term, and negligible cumulative impacts.	*Cumulative Impact*: Would result in adverse, long term, and negligible to minor cumulative impacts.
Socio-economic Resources	*Direct/Indirect Impact*: The continued high numbers of deer and likely long-term increase in the deer population in Rock Creek Park would result in additional damage to landscaping in the surrounding areas and could result in varying impacts, ranging from minor to moderate and adverse.	*Direct/Indirect Impact*: Reproductive controls (if successful) would allow for only a gradual reduction in the number of deer, and there could be some displacement of deer from the park due to exclosures. The net effect on surrounding property could result in slightly greater damage to landscaping, the impacts of which would be long term and moderate.	*Direct/Indirect Impact*: The reduction of the existing deer populations in both the short and long term could result in fewer deer leaving the park and browsing landscaping on adjacent lands, with long-term beneficial effects that would reduce adverse impacts to negligible or minor levels.	*Direct/Indirect Impact*: The reduction of the existing deer populations in both the short and long term could result in fewer deer leaving the park and browsing landscaping on adjacent lands, with long-term beneficial effects that would reduce adverse impacts to negligible or minor levels.

Impact Topic	Alternative A: No Action Alternative	Alternative B: Combined Non-lethal Actions	Alternative C: Combined Lethal Actions	Alternative D: Combined Lethal and Non-lethal Actions
	Cumulative Impact: Would result in adverse, long term, and minor to moderate cumulative impacts.	*Cumulative Impact*: Would result in moderate adverse long-term cumulative impacts.	*Cumulative Impact*: Would result in long-term minor cumulative adverse impacts.	*Cumulative Impact*: Would result in long-term minor cumulative adverse impacts.
Park Management and Operations	*Direct/Indirect Impact*: Long-term demands on park staff and funding for managing the deer herd and protecting other park resources would result in adverse, long term, and minor to moderate impacts.	*Direct/Indirect Impact*: Installing and maintaining large exclosures and implementing and monitoring reproductive controls would result in long-term, moderate adverse impacts.	*Direct/Indirect Impact*: The need for additional staff time for monitoring and coordinating activities under alternative C would result in adverse, moderate impacts initially, reduced to minor over time.	*Direct/Indirect Impact*: The need for additional staff time for monitoring and coordinating activities under alternative C would result in adverse, moderate impacts initially, reduced to minor over time.
	Cumulative Impact: Would result in adverse, long-term, moderate cumulative impacts.	*Cumulative Impact*: Would result in adverse, long-term, moderate cumulative impacts.	*Cumulative Impact*: Would result in adverse, long-term, minor to moderate cumulative impacts.	*Cumulative Impact*: Would result in adverse, long-term, minor to moderate cumulative impacts.

ALTERNATIVES CONSIDERED BUT REJECTED

The following alternatives were considered but rejected as explained below:

MANAGED HUNT

A managed public hunt was considered as a preliminary alternative to reduce the white-tailed deer population. A public hunting alternative was not carried forward for further analysis because it would be inconsistent with existing laws, policies, regulations, and case law regarding public hunts in units of the National Park System; it would be inconsistent with long-standing basic policy objectives for National Park System units; and the likelihood that the NPS would change its long-standing Servicewide policies and regulations regarding hunting in parks is remote and speculative.

Throughout the years the NPS has taken differing approaches to wildlife management, but for the most part it has maintained a strict policy of not allowing hunting in park units of the national park system. In 1970, Congress passed the *General Authorities Act* and in 1978 the "Redwood Amendment," which clarified and reiterated that the single purpose of the NPS *Organic Act* is conservation. While the *Organic Act* gives the Secretary of the Interior the authority to destroy plants or animals for the purposes of preventing detriment to park resources, it does not give the Secretary authority to permit the destruction of animals for recreational purposes. In 1984, after careful consideration of congressional intent with respect to hunting in national parks, the NPS promulgated a rule that allows public hunting in national park areas only where "specifically mandated by Federal statutory law" (36 CFR 2.2). The NPS re-affirmed this approach in its *Management Policies 2006.*

Congress has not authorized hunting in any legislation for Rock Creek Park. Therefore, in order to legally allow hunting at the park, the current NPS hunting regulation would have to be changed, or Congress would need to specifically authorize hunting. The NPS has a legislative mandate to protect the natural and cultural resources within national parks in order to allow for their enjoyment by future generations. The NPS does not have a mandate to allow public hunting in national parks. At this time, the agency intends to exhaust all other possible alternatives before it attempts to change its governing laws, regulations, or policies due to concerns that such actions may have negative impacts on the visitors and resources of other parks in the national park system.

In addition to legal and policy-related concerns, a managed public hunt was also evaluated based on cost, efficiency, safety, and the likelihood of achieving long-term management goals. A managed hunt has not been shown to be more cost-effective or efficient than other direct reduction methods such as sharpshooting by agency personnel, which is currently allowed under NPS laws and policies. In fact, when compared to sharpshooting, a managed hunt lacks similar efficiency, safety, and the likelihood of successful long-term management.

Based on the literature, costs for managed hunts generally range between $83 and $237 for each deer removed (Warren 1997). A white-tailed deer study in Minnesota that compared four lethal removal methods found that the cost of a managed hunt averaged $117 per deer removed, based on the average net cost per deer after including revenues generated by selling permits to participating hunters (Doerr et al. 2001). Even after considering permit revenue, however, the cost of a managed hunt is not necessarily lower than other removal methods such as sharpshooting. Warren documents that costs for sharpshooting programs have ranged from $72 to $260 per deer harvested (Warren 1997). In the Minnesota study mentioned above, the cost for sharpshooting averaged $121 per deer harvested (compared to $117 per deer harvested in the managed hunt after revenue from license sales was considered; Doerr et al. 2001). Gettysburg National Military Park reported sharpshooting costs averaged $128 per deer (Frost et al. 1997). The range of costs for sharpshooting ($72 to $260 per animal harvested) substantially overlaps the range of costs reported for managed hunts ($83 to $237 per animal harvested), suggesting that there is a minimal to no cost savings by using citizen hunters.

Managed hunts are also less efficient in meeting ungulate reduction project goals when compared to sharpshooting. Doerr et al. noted that the highest harvest rate (0.55 deer per hour) was achieved when sharpshooters shot over bait. This was compared to hunting, which resulted in a rate of 0.03 deer per hour or 31 hunter-hours per deer killed. In addition to harvest rates, sharpshooting is also more selective than hunting. As the reduction in does was the primary goal, 59% of the hunting harvest was females, whereas 63% of the sharpshooting harvest was females (Doerr et al. 2001).

In addition to cost and efficiency, safety is also an issue to consider when using lethal control methods. It is suggested that sharpshooting offers safety features that a typical managed hunt does not. For example, sharpshooting over predetermined bait sites can establish shooting lanes and backstops. Also, sharpshooting can take place when park visitation is low or absent, reducing or eliminating public safety concerns. It is not suggested that hunts are not safe, and in areas where they are used, safety is a major concern that is addressed. However, the extensive planning and oversight that would be required to ensure a level of safety comparable to wildlife professionals engaged in sharpshooting activities would likely make a managed hunt less feasible.

The safety of park visitors and security in developed areas are concerns at Rock Creek Park. Fully addressing these two issues would reduce the area where a managed public hunt could occur, limiting its usefulness. For example, due to developed areas and potentially occupied buildings, approximately 20% of the park would be closed to a managed hunt. This percentage would increase as buffer zones around roads and parking areas would also be created to ensure visitor safety. In addition, the topography of the park would further limit public hunter access to more remote areas of the park. These necessary safety and security restrictions, as well as the landscape of the park, would make it difficult to meet the purpose, need, and objectives of this planning effort.

Several potential problems associated with a managed hunt could seriously impact its effectiveness as a management tool, especially over the long term. The critical assumption in using managed hunts is that an adequate number of hunters would participate annually. This assumption is extremely important because without adequate hunter numbers, management actions would likely fail or be postponed for a year, allowing ungulate populations to continue to increase. A number of studies that have analyzed managed hunts have shown that retaining adequate hunter numbers is difficult, especially as ungulate densities drop and management enters the maintenance phase. Hansen and Beringer (1997) noted that “managed firearm hunts . . . lasting more than two consecutive days are not cost effective because participation and harvest decline sharply after day 2.” In fact, they experienced difficulty in recruiting adequate hunters for areas where hunts had already been conducted. Kilpatrick and Walter documented a 66% decline in hunter applicants in Connecticut from the first to the second year of a controlled hunt. This translated into a 26% decrease in hunter participation after one year (Kilpatrick and Walter 1999). Without consistent annual hunter effort, long-term management through public hunting would likely be unsuccessful.

In conclusion, the NPS considered and rejected a managed public hunt as a reasonable alternative for this plan for the following reasons: (1) implementing a public hunt in this park would require changes to basic NPS regulations and policy or an act of Congress; (2) case law supports dismissing an alternative that would require a major change in long-standing basic policy; (3) other direct removal alternatives, such as using agency personnel as sharpshooters, could be implemented without changing current laws and policies and would better meet the purpose, needs, and objectives of the plan; and (4) other direct removal alternatives raise fewer safety concerns and would have substantially the same environmental effects as a managed hunt.

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 (*Canis lupis*) suggested that population reduction depends largely on the degree of annual immigration. With high immigration (which could be expected at Rock Creek because of the presence of deer on neighboring parklands), 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 non-dominant 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 winter-kill potential). The population dynamic and make up of the herd could suffer under this alternative.

Because of the concerns described above relating to effectiveness, population stability, and genetic variability, this alternative was dismissed from detailed analysis.

WOLF REINTRODUCTION

Relationships between predators and prey are complex, and the impact of predators on herbivore populations is variable (McCullough 1979). Wolves are efficient deer predators, but they have been eliminated from much of the United States. Reintroducing these predators into Rock Creek Park 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 1990), which is much larger than Rock Creek's 4.7 square miles. Most of the park area is surrounded by an urban or suburban environment, making it inappropriate for such predators to be reintroduced (MD DNR 1998). Other native animals, as well as domestic pets, could also become potential prey if wolves were reintroduced to the Rock Creek area.

For the reasons described above relating to effectiveness, habitat limitations, and human safety concerns, reintroduction of wolves was dismissed as a reasonable alternative.

CAPTURE AND RELOCATION

Capturing deer within Rock Creek Park and relocating them would be in violation of NPS policy regarding translocation, outlined in a Director's CWD Guidance Memorandum of July 26, 2002 (NPS 2002a). Even if the policy was not in effect, relocating deer to areas a sufficient distance from the park to ensure that they would not return would require permits, and because of concerns of CWD testing, possible quarantine processes would be required. Given the abundance of deer in Maryland and most of the United States, recipients for such a program would be very limited. Also, live capture and relocation methods 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). Due to the concerns discussed above relating to policy, costs, feasibility, and high mortality, capture and release was dismissed as a reasonable alternative.

SUPPLEMENTAL FEEDING

Providing supplemental food sources for deer would potentially decrease browsing pressure on vegetation resources at Rock Creek Park. However, increasing food sources would increase deer health and reproduction, leading to a growing deer population. In the long term this would compound problems associated with high deer numbers (MD DNR 1998). For these reasons, this alternative was dismissed.

FENCING THE ENTIRE PARK (OR EXCLUSIVE USE OF FENCING)

The entire park unit could be fenced to prevent deer from entering or leaving. A fence approximately 8 feet high would be needed to prevent deer from jumping over the barrier. However, vegetation within Rock Creek Park would continue to suffer the effects of deer browsing, the deer population within the fenced area would continue to increase, and the health of the contained herd would suffer. Therefore, all deer within the fenced area would either need to be removed or the deer population within the fence would need to be managed with other methods to meet the objectives of the park 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 park, and this would result in unacceptable impacts to visitor use, visual quality of the park, the cultural landscape of the park, and other wildlife species. Areas not fenced would be subject to increased pressure from deer browsing. For these reasons, exclusive use of fencing without other action to reduce deer numbers was eliminated as a reasonable alternative, but fencing was included as a component of alternative B.

CONTRAGESTIVES

A contragestive is an abortion drug applied after a doe becomes pregnant that terminates the pregnancy. Therefore, this method would need to be implemented annually. Depending on the stage of pregnancy, the drug could make the delivery of a dead fetus difficult if it is late in the pregnancy; however, if applied too early a doe could become pregnant again. Efficacy is approximately 75% to 80% depending on timing. Contragestive agents provide two distinct differences from contraceptive control methods: the time of application (during pregnancy rather than prior to) and the potential harm to the deer. This method could be used in conjunction with a contraceptive program to supplement their effectiveness, essentially treating animals missed with contraceptive treatments or those where the treatment was not effective. The difficulty then becomes how to determine which deer are pregnant. This would require either substantial monitoring/observation of the deer or recapturing of does to check for pregnancy.

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

WIDESPREAD USE OF REPELLENTS

Although limited use of commercially available repellents would be considered in small areas around landscaped vegetation, large-scale application of repellents is not practical due to the need for frequent applications resulting in high application cost, label restrictions on use, and variable effectiveness. Repeated applications of spray repellents would be necessary due to weather and emergence of new growth. Because the effectiveness of repellents is variable and is least effective with high deer densities and size of the areas that would require treatment, repellent use within the park as a management alternative was dismissed.

LANDSCAPE MODIFICATION/PLANTINGS

White-tailed deer are very adaptable animals and they will adjust their diets to available food sources. Therefore, trying to manage a deer population through managing the habitat to manipulate deer feeding behavior and movements in a highly fragmented environment, surrounded by suburban land uses would be extremely complex, inefficient, and likely unsuccessful.

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 goals of most parks, including Rock Creek. 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.

Landscape modification does not appear to be a viable option for reasons described above. Additionally, landscape modification actions to discourage deer density would also negatively impact other wildlife. Drastic landscape modification actions, such as removing large tracts of forests to eliminate deer cover, would require additional NEPA documentation. Based on the reasons above, this alternative was dismissed.

SPEED LIMIT REDUCTION

Implementation of a reduced speed limit through the park, with the intent to reduce deer/vehicle collisions, was raised by the public in public scoping as a desired action for the park to consider. However, this is not consistent with the objectives of the park nor would it address the problem being addressed by this plan, the overbrowsing of vegetation by deer. Therefore, this was not considered as an alternative element.

CONSISTENCY WITH THE PURPOSES OF THE NATIONAL ENVIRONMENTAL POLICY ACT

The *National Environmental Policy Act* requires an analysis of how each alternative meets or achieves the purposes of the act, as stated in 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 esthetically 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 would 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.

The CEQ has promulgated regulations for federal agencies' implementation of NEPA (40 CFR Parts 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: No Action

Alternative B: Combined Non-Lethal Actions

Alternative C: Lethal Action

Alternative D: Combined Lethal and Non-Lethal Actions

ENVIRONMENTALLY PREFERRED ALTERNATIVE

The NPS is required to identify the environmentally preferred alternative in its NEPA documents for public review and comment. Guidance from the CEQ states that the environmentally preferred alternative is "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 1981). Alternative D 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 best protect, preserve, and enhance the cultural and natural processes that support the park's forests and cultural landscapes by providing multiple management options to maintain low deer numbers. Although alternatives C and D are very close in meeting the guidance for identification of the environmentally preferred alternative, alternative D was selected primarily because it provides the park with the ability to select the least environmentally damaging option as science and technology advance. 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 park over the life of the plan.

NATIONAL PARK SERVICE PREFERRED ALTERNATIVE

To identify the preferred alternative, the planning team evaluated each alternative based on its ability to meet the plan objectives (see table 11) and the potential impacts on the environment ("Chapter 4: Environmental Consequences"). Alternative D was identified as the NPS preferred alternative.

Both alternatives C and D fully meet the plan objectives and are very close in their meeting of all objectives and 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 planning team are met. Alternative D provides for an efficient initial removal of deer, and the flexibility to address future removals in different ways. If reproductive control is used, there could be reduced impacts relating to visitors, safety, and the environment, by eliminating the need to close the park for extended periods of time and limiting the time that shooting would occur in the park.

Alternative B partially meets some 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. 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.

NPS will consider comments on this Draft Plan/EIS and may modify or adjust the preferred alternative accordingly. Any modifications or adjustments will be disclosed in the published Final EIS. A Record of Decision will follow the Final EIS and will be made available to the public.