

*Avoidance Techniques*

There are no avoidance techniques that would completely avoid impacts to migratory birds by selection of the partial-build or build alternatives.

*Minimization Techniques*

Few methods are available for minimizing the negative impacts of possible construction. The direct threats to migratory birds via habitat loss, habitat fragmentation, and noise may be reduced by reducing the size of a construction footprint or the construction time span. Predation to bird nests may be reduced by minimizing litter on construction sites and around tourist areas post-construction, if construction occurs. As construction activities may provide habitat and foraging pathways for nest predators, reducing the amounts of refuse associated with disturbed areas may reduce initial populations of these organisms. This minimization technique may be most effectively attempted via education.

*Mitigation Techniques*

GSMNP is committed to mitigation of impacts as part of its ongoing Park policies; however, mitigation opportunities for impacts to migratory bird within GSMNP are limited. Mitigation of impacts that cannot be avoided or minimized may include funding for habitat creation and restoration, rare species management, and the establishment of interpretive programs related to interactions between the natural environment and development. Since opportunities within the Park to restore migratory bird habitat are limited, GSMNP will seek cooperative opportunities with established conservation trusts to restore fragmented landscapes adjacent to the park boundaries.

**4.4.8.4 Impairment Evaluation**

Impairment of migratory birds in GSMNP and along the AT would not occur under the No-Action Alternative, Monetary Settlement Alternative, Laurel Branch Picnic Area, and the Partial-Build Alternative to Bushnell. The Northern Shore Corridor is not likely to impair migratory birds in GSMNP or along the AT based on the information obtained to date. Due to the magnitude of this alternative, it is likely that additional NEPA documentation would be required to address site specific impacts not currently known and to determine detailed mitigation measures as they relate to final design. The impairment determination related to migratory birds would be re-evaluated in such documentation.

**4.4.9 Invasive Exotics****4.4.9.1 Methodology for Assessing Impacts**

Analysis of impacts by invasive exotics on floral and faunal communities within the project study corridors utilizes the length of the road to determine potential impacts. Approximate length of impact was calculated

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using ArcGIS. Impacts were also assessed based on known locations of invasive exotic species occurring within the proposed construction footprints. These known locations are based on data provided by GSMNP, INHS, and 2004 field surveys (see Section 3.4.9.1 and Appendix N for more information on these surveys).

#### Type

Impact types are either beneficial or adverse. Beneficial impacts would have a positive effect to existing floral and faunal communities. Adverse impacts would have a negative effect on existing floral and faunal communities.

#### Duration

Short-term impacts are those that would occur for less than 1 year, typically as an episodic or temporary event. Long-term effects occur as a result of construction activities at a specific location throughout the life of construction (this is assumed to be between 1 year and 15 years), but the impact is more than that of a temporary event. Permanent impacts are considered to be anything that persists throughout the construction period.

#### Context

Context is defined as site-specific, local, or regional. Site-specific impacts would occur within the construction footprint where the roadsides would provide optimal habitat for sun-tolerant invasive, exotic plant species. Local impacts include the area within 2 miles (3.2 km) of the construction footprint or the northern shore of Fontana Lake (whichever is less). Regional impacts are those impacts that would occur in the area bounded by the northern shore of Fontana Lake, south of the North Carolina/Tennessee state line, east of Twentymile Ridge, and west of Noland Creek.

#### Intensity

Intensity is the degree to which resources would be affected and is categorized as no/negligible, minor, moderate, or major. The definitions for each category are based on the best available scientific information and are specific for an individual EIS. The following intensity definitions apply to the broad range of invasive exotic species that could impact GSMNP and the factors that could influence their distribution, such as potential for introduction, increased access, soil modification, and disturbance. There is no scientific literature available that provides a scale to define or rank the severity of impacts from a project. Therefore, the following intensity definitions are based on best professional judgment of what is reasonable considering the influencing factors listed. The definitions for the impacts from invasive exotics are based on the length of construction footprint.

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*No/Negligible*

No impacts or impacts that would increase accessibility and roadside edge to occur from construction of fewer than 5 miles (8.0 km) of new road.

*Minor*

Increased accessibility and roadside edge occur from construction of more than 5 miles (8.0 km) but fewer than 10 miles (16.1 km) of new road.

*Moderate*

Increased accessibility and roadside edge occur from construction of more than 10 miles (16.1 km) but fewer than 20 miles (32.2 km) of new road.

*Major*

Increased accessibility and roadside edge occur from construction of more than 20 miles (32.2 km) of new road.

**4.4.9.2 Summary of Impacts**

Both direct and indirect impacts to the natural environment may occur from the spread of invasive exotic species if a partial-build or build alternative is selected. Impacts from invasive exotic species are based on the approximate length of roadway proposed for each alternative since the road will serve as a source and distribution pathway for invasive exotic species to impact the current natural environment. Table 4-22 provides a comparison of the length of each option and the change from the baseline.

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Table 4-22. Invasive Exotic Impact Indicator - Length of New Roadway<sup>1</sup>

	Laurel Branch Picnic Area <sup>2</sup>	Partial-Build Alternative to Bushnell (baseline)	Southern Option at Forney Creek Embayment	Northern Shore Corridor (baseline)	Southern Option at Forney Creek Embayment	Southern Option at Hazel/Eagle Creek Embayments	Southern Option Crossing Fontana Dam
<b>Primitive Park Road</b>							
Total Length in miles (km)	0.8 miles (1.3 km)	8.0 miles (12.9 km)	1.5 miles (2.4 km) less than baseline	34.3 miles (55.2 km)	1.5 miles (2.4 km) less than baseline	2.3 miles (3.7 km) less than baseline	1.6 miles (2.6 km) less than baseline
<b>Principal Park Road</b>							
Total Length in miles (km)	NA	6.5 miles (10.5 km)	1.3 miles (2.1 km) less than baseline	30.8 miles (49.6 km)	1.3 miles (2.1 km) less than baseline	3.1 miles (5.0 km) less than baseline	1.5 miles (2.4 km) less than baseline

1 All values shown are approximate and based on functional designs prior to mitigation.

2 The entrance/exit road to Laurel Branch Picnic Area is best discussed as a Primitive Park Road, but its design does not necessarily conform to the NPS design criteria for a Primitive Park Road.

NA Not Applicable.

### Road and Disturbance

According to NPS 2001 Management Policies, exotic species will not be allowed to displace native species if displacement can be prevented (NPS 2001f). Road construction is anticipated to encourage the spread of invasive exotic species by creating favorable conditions such as disturbed roadside, forest edges, and open spaces. The increase in the density of roads and traffic volume facilitates the spread of exotic diseases and insects (Trombulak and Frissel 2000). Roads increase the likelihood for dispersal of invasive exotic species by altering existing habitat conditions, making invasion more likely by stressing or removing native species, and allowing easier movement by wild or human vectors (Trombulak and Frissel 2000). Some exotic species prefer the roadside habitat and other disturbed areas for establishment (Wester and Juvik 1983; Henderson and Wells 1986; Tyser and Worley 1992; Wein et al. 1992). Alterations in canopy structure of forests promote the invasion by exotic understory plants which affect animal communities. Not only roads but riparian zones along streams may serve as a corridor for dispersal of plants, including exotic species (Gregory et al. 1991). Disturbances that occur along roads and streams such as road construction, traffic, maintenance activities, and flooding may aid in plant or seed dispersal, through the removal of competitors,

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overcoming impenetrable closed canopy forests, and modification of light levels in potential invasion sites (Parendas and Jones 2000).

#### *Habitat Modification*

The modification of soils during road construction can facilitate the spread of invasive exotic species along roadsides (Greenberg et al. 1997). Changes in soil chemistry would occur from disturbances such as road construction. Due to the disturbance, the organic matter content will be lower in the disturbed areas than in the undisturbed areas resulting in increased nitrogen availability in the disturbed areas. The litter of annual exotic species decomposes faster and would allow for such an increase in mineralization and for the subsequent larger amounts of an available nitrate and ammonium than in the slower-decomposing litter found in the undisturbed community (Jackson et al. 1988; Hart et al. 1993; Zink 1994). As the available nutrients increase and are more rapidly used by weedy species, a feedback loop is initiated favoring the persistence of weedy species (Chapin 1980). Roads may serve as conduits for wind and may break the canopy layer, allowing more solar energy to reach the ground. A significant difference has been observed in soil pH and plant community composition associated with wind caused differences in leaf litter depths (Haskell 2000). These changes may provide more optimal habitats for invasive exotics. These impacts cause the loss of native plant habitat due to the loss of shading, temperature changes, new wind patterns, changes in soils conditions, and creation of roadside habitats.

#### *Introduction/Spread of Invasive Exotic Species*

The following invasive exotic species were identified by the NPS as being most likely to impact the Park as a result of road construction. The following species are currently not known to exist within the project study corridors. This is not intended to be a comprehensive list of all invasive exotics that could impact the Park. Three invasive exotic vertebrates that could be introduced into the project study corridors include the Norway rat (*Rattus norvegicus*), European starling (*Sturnus vulgaris*), and brown-headed cowbird. The brown-headed cowbird is a Central U.S. Plains species that has expanded its range due to land use and is thought to be responsible for reducing the populations of woodland song birds by half (Cassidy and Scheffel 1990). More information on the possible impacts from this bird is in Section 4.4.8.2. Invertebrates that could be introduced are the red imported fire ant (*Solenopsis invicta*), gypsy moth (*Lymantria dispar*), Chinese jumping worm (*Amyntas hilgendorfi*), and Asian tiger mosquito (*Aedes albopictus*). The Chinese jumping worm has been located near the project study area. This species removes the leaf litter from the forest floor which threatens many species by disrupting the food chain. The leaf litter contains invertebrates which many animals such as birds and salamanders rely on as a food source (Langdon, personal communication, 2005; Haskell 2000). Red imported fire ants establish themselves in disturbed habitats and along forest edges. Plants or planting material from infested areas that may be used in landscaping risk the spread of the red imported fire ant (ISSG 2005). Invasive exotic plant species that may potentially be introduced and spread into the project study corridors include: tree-of-heaven (*Ailanthus altissima*), princess tree (*Paulownia tomentosa*), garlic mustard (*Alliaria petiolata*), gill-over-the-ground (*Glechoma hederacea*), colt's foot (*Tussilago farfara*), Chinese silver grass (*Miscanthus sinensis*), and musk thistle (*Carduus*

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*nutans*). Forest diseases that have not been found within the project study corridors but could be introduced during construction activities are sudden oak death (SOD), and Dutch elm disease (DED). There is also potential threat to wild canid species, such as foxes and coyotes, from domestic pets. Domestic dogs have brought diseases such as canine parvovirus and sarcoptic mange to native wildlife (Daszak et al. 2000). Such diseases could have detrimental effects to wild canid species populations within the Park.

### *Beneficial Impacts*

Beneficial impacts are anticipated from increased access to interior portions of the Park that would facilitate monitoring and control of invasive exotic species populations that already exist within the project study corridors. There are potential beneficial impacts regarding the wild hog population in the Park because increased access may facilitate hog-trapping.

#### 4.4.9.2.1 No-Action

The No-Action Alternative would involve no construction or alteration to the natural environment. For this reason, no impacts from invasive exotics to existing flora and fauna would be expected within GSMNP.

#### 4.4.9.2.2 Monetary Settlement

The Monetary Settlement Alternative would not involve alterations to the natural environment within GSMNP. Therefore, this option would presumably have no impact from invasive exotics to existing Park flora and fauna.

#### 4.4.9.2.3 Laurel Branch Picnic Area

The Laurel Branch Picnic Area would have approximately 0.8 mile (1.3 km) of impacts. Impacts from invasive exotic species are anticipated to be adverse, negligible, local, and permanent. This option would not involve significant penetration of the Park and would impose a limited risk of invasion of exotic species. Impacts anticipated from existing invasive exotics would be from the degradation of native plant and animal species habitat, caused by picnic area construction. These disturbed areas would be favorable for the spread of existing invasive exotics that exist near and/or along Lake View Road. There are no monitored populations of invasive exotic species within Laurel Branch Picnic Area. However, there are several locations of invasive exotic plants along Lake View Road that may spread into the Laurel Branch Picnic Area including Japanese honeysuckle, Oriental bittersweet, princess tree, and tree-of-heaven. These invasive exotic plants may spread into the project study corridors at disturbed locations such as forest margins and open areas. Vertebrates such as the house mouse and the Norway rat may be attracted to the Laurel Branch Picnic Area due to human trash accumulation and picnic shelters that could accommodate these rodents.

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## 4.4.9.2.4 Partial-Build Alternative to Bushnell (Primitive and Principal Park Roads)

The baseline Partial-Build Alternative to Bushnell would cause approximately 8.0 miles (12.9 km) of impact from the Primitive Park Road and approximately 6.5 miles (10.5 km) of impact from the Principal Park Road. Impacts from both the Principal and Primitive Park Roads are expected to be adverse, minor, regional, and permanent due to invasive plants such as mimosa, princess tree, kudzu, and multiflora rose proliferating in newly-formed sunny locations along roadsides and forest edges. Populations of invasive exotic plants within the project study corridors surrounding the baseline Partial-Build Alternative to Bushnell include two locations of kudzu, two locations of white poplar, and one location of common privet. The European starling may be attracted to the proposed buildings and picnic shelters on the Bushnell peninsula. The Norway rat and the house mouse may also be introduced to the Bushnell peninsula and may inhabit areas where human trash accumulation may occur around facilities providing food and shelter for these rodents. The wild hog is the only invasive exotic vertebrate known to occur within the construction footprint of the Partial-Build Alternative to Bushnell. Adverse impacts may occur due to the illegal release of wild hogs into the Park.

*Southern Option at Forney Creek Embayment (Primitive and Principal Park Roads)*

As compared to the baseline Partial-Build Alternative to Bushnell, the Southern Option at Forney Creek Embayment would have approximately 1.5 (2.4 km) fewer miles of impact from the Primitive Park Road and approximately 1.3 fewer miles (2.1 km) of impact from the Principal Park Road. This option reduces the potential for impacts by decreasing the construction footprint length, thereby reducing invasive exotic species ability to penetrate more interior sections of the Park. This option is closer to the lake shore resulting in less of an impact to interior portions of the Park. There is no change from the baseline Partial-Build Alternative to Bushnell to known populations of invasive exotic species.

## 4.4.9.2.5 Northern Shore Corridor (Primitive and Principal Park Roads)

The baseline Northern Shore Corridor would impact approximately 34.3 miles (55.2 km) with the Primitive Park Road and approximately 30.8 miles (49.6 km) with the Principal Park Road. These impacts are anticipated to be adverse, major, regional, and permanent. This alternative would fragment forested habitat, providing increased access for invasive exotics throughout the project study corridors. Populations of invasive exotic plants within the baseline Northern Shore Corridor include eight locations of kudzu, two locations of Oriental bittersweet, six locations of periwinkle, one location of Japanese honeysuckle, two locations of white poplar, three locations of English ivy, one location of mimosa, one location of Japanese wisteria, three locations of common privet, and one location of wineberry. Currently the wild hog is the only invasive exotic vertebrate known to occur within the construction footprint of the baseline Northern Shore Corridor. Habitat fragmentation may allow parasitic bird species, such as the brown-headed cowbird, to invade interior communities and compete with native bird species. For this option, the road acts as a corridor in which wind-dispersed invasive seeds, such as princess tree and white poplar, and for diseases such as DED could spread. Negative impacts may occur due to the illegal release of wild hogs into the Park.

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*Southern Option at Forney Creek Embayment (Primitive and Principal Park Roads)*

As compared to the baseline Northern Shore Corridor, the Southern Option at Forney Creek Embayment would result in approximately 1.5 fewer miles (2.4 km) of impact from the Primitive Park Road and approximately 1.3 fewer miles (2.1 km) of impact from the Principal Park Road. This option would reduce the potential for impacts by decreasing the construction footprint length and providing less access for invasive exotic species to invade interior portions of existing floral and faunal communities within the Park. There is no change from the baseline Northern Shore Corridor to known populations of invasive exotic species.

*Southern Option at Hazel and Eagle Creek Embayments (Primitive and Principal Park Roads)*

As compared to the baseline Northern Shore Corridor, the Southern Option at Hazel and Eagle Creek Embayments would have approximately 2.3 fewer miles (3.7 km) of impacts from the Primitive Park Road and approximately 3.1 fewer miles (5.0 km) of impact from the Principal Park Road. This option would decrease the construction footprint, thereby decreasing the potential for invasive species to penetrate interior portions of the Park. This option avoids impacts to known locations of invasive exotic plants such as white poplar, kudzu, Oriental bittersweet, Japanese honeysuckle, periwinkle, common privet, and English ivy.

*Southern Option Crossing Fontana Dam (Primitive and Principal Park Roads)*

As compared to the baseline Northern Shore Corridor, the Southern Option Crossing Fontana Dam would have approximately 1.6 fewer miles (2.6 km) of impact from the Primitive Park Road and approximately 1.5 fewer miles (2.4 km) of impact from the Principal Park Road. This option would reduce the amount of new roadside habitat, reducing the potential for invasive exotics to colonize interior portions of the Park. This option does not avoid previously mentioned locations of invasive exotics and impacts additional locations of periwinkle and Oriental bittersweet.

**4.4.9.2.6 Cumulative Impacts**

Cumulative effects were determined by combining the direct and indirect impacts of the alternatives with other past, present, and reasonably foreseeable future actions in the area. Past actions introduced invasive exotics and increased them in the area. Currently, there are approximately 35 invasive exotic species within the Park. Actions that have the potential to increase and spread invasive exotics within the study area include construction on the Ravensford site, completion of the Foothills Parkway, and private development. The Northern Shore Corridor would have major impacts as this alternative would fragment forested habitat providing increased access for invasive exotics throughout the corridor. Given the location of other projects in the study area, cumulative impacts would be negligible.

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**4.4.9.3 Options to Address Potential Impacts**

NPS would employ a sequence of avoiding adverse impacts from invasive exotic species to the extent practicable, minimizing impacts that could not be avoided, and mitigating for remaining adverse impacts via mechanical, cultural, biological, and chemical control methods. It will not be possible to avoid or mitigate for all impacts from invasive exotic species.

*Avoidance Techniques*

Avoidance examines all appropriate and practicable possibilities to avert impacts from invasive exotics to native floral and faunal communities. It would not be possible to avoid impacts with selection of a partial-build or build alternative. Any of these options would create habitat such as roadsides, forest edges, and open areas suitable for the introduction of invasive exotic species. There are many ways for invasive species to spread into disturbed areas. Invasive species can move on vehicles and in the materials they carry. Invasive plants can be moved from site to site during maintenance activities such as mowing. Seeds of invasive exotic species can be inadvertently introduced into the project study corridors on equipment and through the use of mulch, imported soil, gravel, or sod (USDOT 2000).

*Minimization Options*

Where no alternatives that avoid adverse impacts from invasive exotic species are found to be practicable, minimization steps must be employed to reduce adverse impacts. NPS Management Policies document states that “high priority will be given to managing exotic species that have, or potentially could have, a substantial impact on Park resources, and that can reasonably be expected to be successfully controllable. Lower priority will be given to exotic species that have almost no impact on Park resources or that probably cannot be successfully controlled” (NPS 2001f). All exotic plant and animal species that are not maintained to meet an identified Park purpose will be managed if control is prudent and feasible, and if the exotic species interferes with natural processes and the perpetuation of natural features, native species or natural habitats. Other examples for reasons of removal include disruptions in the genetic integrity of native species, disruptions in the accurate presentation of a cultural landscape, damage to cultural resources, or creating a hazard to public safety (NPS 2001f).

Minimizing the potential for invasion could include eradication strategies such as the use of an early warning system to identify and eradicate newly infested areas. Other examples include the use of cleaning systems for equipment entering the site, the minimization of soil disturbance, improving seeding equipment for steep slopes, and the use of cool season native grasses for use as a quick cover to provide for erosion control and the eliminate water quality issues (USDOT 2000). Additional minimization techniques include ensuring that all materials used for re-vegetation are free of invasive exotic plant seeds or material, immediately applying seed to disturbed areas to establish a good cover to reduce invasive plant competition, containing neighboring invasive exotic infestations, and establishing native competitive grasses. There is no guarantee

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that these minimization techniques will be successful. Success will be dependent upon available budget and the necessary pre-planning strategies.

#### *Mitigation Options*

After avoidance and minimization techniques have been applied to the maximum practicable extent, remaining impacts from invasive species must be offset through mitigation. The following strategies are examples provided in the NPS strategic plan for managing invasive exotic plants (NPS 1996). Examples include early detection and rapid response efforts, inventorying and monitoring of invasive exotic plants as well as the identification of key corridors of invasion and transporters of non-native plants and animals. Based on NPS Management Guidelines, mechanical control, cultural control, biological control, and chemical control methods are possible techniques that may be used to mitigate impacts from road construction (NPS 2002c). The use of power tools and hand tools could be used for the removal of herbaceous and shallowly-rooted plants which may be effective for some invasive exotic plant species. Work crews may be required to clean equipment and clothing before traveling to another site in order to prevent the contamination of another site with invasive exotic seeds. Cultural control techniques consist of education on cleanliness of vehicles and equipment, proper disposal of plant debris, and interpretive displays and programs on the threats of invasive exotic species. Biological control is the control of a pest by disrupting their ecological status, and through the use of organisms that are natural predators, parasites, or pathogens. An example of biological control includes using the ladybird beetle (*Sasajiscymnus tsugae*) to control HWA. Chemical control measures could be used such as soil management in favor of native species. The introduction of topsoil from the undisturbed surroundings may be enough to re-introduce native seeds. A light surface application of natural litter or sawdust will cause decomposing fungi to multiply and remove excess plant available nitrogen from the soil. The use of herbicides would be considered if the alternative means of control are not feasible (NPS 2001f). The best prevention efforts will not stop all invasive species introductions. Additional coordination will be needed to develop mitigation plans. The success of mitigation efforts are uncertain and may include additional costs.

#### **4.4.10 Protected Species**

##### **4.4.10.1 Federally Protected Endangered and Threatened Species**

###### 4.4.10.1.1 Methodology for Assessing Impacts

Impacts are assessed on the known population of bald eagles and the potential habitat for both the bald eagle and Indiana bat within or near the project study corridors. Impacts to other federally protected endangered and threatened species are negligible or discountable and are discussed in Appendix N.

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