United States
Department of
Agriculture

Forest
Service

September 2013

Environmental Assessment

Clay County Shooting Range Project

Tusquitee Ranger District
Nantahala National Forest

Clay County, North Carolina

Responsible Official
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Contents

Summary

Proposed Action:

The Nantahala National Forest is evaluating a proposal to provide a safe and environmentally sound and secure public shooting facility to serve the local community of Clay County, North Carolina. The proposed action addresses the lack of a facility that is designed to minimize the impacts to physical, biological and social resources from dispersed shooting on National Forest System lands in Clay County.

Shooting ranges are consistent with Forest Service policy (FSM 2335.4) which allows for the authorization of target ranges on the National Forest when the use is consistent with Forest Plan standards and guidelines and when the authorization would enhance forest management (by improving public safety, providing recreational opportunities or consolidating dispersed target shooting). Policy also directs the forest to enter into agreements with state governments, local governments or private organizations to provide for cost-sharing for target range design, construction, operation and maintenance, with title to the target range improvements remaining with the government.

Location of Proposed Action:

Near the end point of Passmore Spur Road in the Perry Creek watershed off Nelson Ridge Road, Clay County, North Carolina (Alternative B (Modified)) and off Barnett Creek Road north of Highway 64 East near the Clay County / Macon County line (Alternative C).

Tusquitee Ranger District, Clay County, NC

Type of Statement:

Environmental Assessment

Responsible Official:

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Lead Agency:

USDA Forest Service

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Chapter 1 – Purpose and Need

1.1 Introduction and Document Structure

The Forest Service has prepared this Environmental Assessment (EA) in compliance with the National Environmental Policy Act (NEPA) and other relevant federal and state laws and regulations. This Environmental Assessment discloses the direct, indirect, and cumulative environmental impacts that would result from the proposed action and alternatives. This document is based upon the best available science, including peer-reviewed scientific literature, state and federal agency reports and management input, discussions with scientists and other professionals, and ground-based observations. The EA is organized into five parts:

- *Chapter 1*: The section includes background information on the history of the project proposal, the purpose of and need for the project, and the agency's proposal for achieving that purpose and need. This section also details how the Forest Service informed the public of the proposal and how the public responded.
- *Chapter 2*: This section provides a more detailed description of the agency's proposed action as well as alternative methods for achieving the stated purpose. Maps, a table, and discussion compare the attributes of the alternatives that were considered. These alternatives were developed based on significant issues raised by the public and other agencies. This discussion also includes design criteria proposed to mitigate impacts to resources.
- *Chapter 3*: This section describes the affected environment and the environmental consequences of implementing the proposed action and other alternative(s). This analysis is organized by resource area. Within each section, the affected environment is described first, followed by the effects of the No Action Alternative. No Action provides a baseline for evaluation and comparison of the other alternative(s) that follow.
- *Chapter 4*: This section provides a list of preparers and agency representatives consulted during the development of the environmental assessment.
- *Appendices*: The appendices provide more detailed information to support the analyses presented in the environmental assessment.

Additional documentation, including more detailed analyses of project-area resources, may be found in the project planning record located at the Tusquitee Ranger District office in Murphy, North Carolina.

1.2 Background

In 2002 the Clay County Sports Club (CCSC) requested that the Forest Service provide a site on the Tusquitee Ranger District in Clay County, North Carolina for a public outdoor shooting range. Consistent with Forest Service policy, the CCSC proposed entering into a volunteer agreement through which, at CCSC expense, it would:

- Build a shooting range to Forest Service standards, including backstops, covered shooting stations, and road improvements;
- Maintain the facility in perpetuity, with the title to the range and all improvements and revenues generated by user fees being property of the United States.

The CCSC entered into a cost recovery agreement with the Forest Service and provided funding for the environmental analyses and documentation necessary for the Forest Service to consider the proposal.

1.3 Purpose and Need for Action

There is no public or private shooting range in Clay County. While there are other public shooting facilities in neighboring counties, including the Panthertop Shooting Range in Cherokee County, NC, the Dirty John Shooting Range in Macon County, NC, the Moss Knob Shooting Range in Jackson County, NC, and the Atoah Shooting Range in Graham County, NC some members of the public feel those ranges are not close enough to fully serve the local community. The Chatuge Gun Club operates a range on the Chattahoochee National Forest in neighboring Towns County, Georgia through a special use authorization. The Chatuge Gun Club range, however, is only open to public use for two hours on the second Sunday of each month and the club is not actively seeking new members outside the two Georgia counties that border the facility (Jones 2011).

From Hayesville, the Panthertop Shooting Range is approximately a 25 mile drive; the Dirty John Shooting Range approximately a 42 mile drive; the Moss Knob Shooting Range is approximately a 48 mile drive; and the Atoah Shooting Range is approximately a 51 mile drive. Driving times to these neighboring facilities vary, obviously, with distance and speed. From Hayesville, the nearest public facility, Panthertop Shooting Range is approximately a 35 to 40 minute trip.

For these reasons, local residents frequently use privately owned lands in Clay County for target practice or dispersed across the forest. Because no area in Clay County has been specifically designed for this use, unsafe conditions may exist from dispered shooting on the forest. Clay County reported a population of 8,775 people in the 2000 Census. In the 2010 Census, the population had grown to 10,587, a 20.6% increase. Given the population growth and corresponding residential development, a safe, convenient public range could reduce dispersed shooting activity in the county.

The purpose of the proposal is to provide a safe and environmentally sound and secure public shooting facility to serve the local community of Clay County, North Carolina. The need for the proposal is to address the lack of a facility that is designed to minimize the impacts to physical, biological and social resources. A related need is for a shooting facility that is closer to the population centers of Clay County to meet the needs of local residents. The EA responds to the CCSC's request by developing and evaluating alternatives related to the proposed action and analyzing and disclosing the effects to the environment associated with each alternative.

Shooting range facilities are consistent with Forest Service policy (FSM 2335.4) which allows for the authorization of target ranges on the National Forest when the use is consistent with Forest Plan standards and guidelines and when the authorization would enhance forest management (by improving public safety, providing recreational opportunities or consolidating dispersed target shooting). Policy also directs the forest to enter into agreements with state governments, local governments or private organizations to provide for cost-sharing for target range design, construction, operation and maintenance, with title to the target range improvements remaining with the government.

1.4 Project Location

Two sites are proposed; both are in Clay County and are located approximately nine aerial miles east of the county seat of Hayesville, North Carolina. Figure 1 shows the general vicinity of both sites. Figure 2 shows a more detailed view of Alternative B (Modified), also referred to as the Perry Creek Shooting Range site; Figure 3 shows a more detailed view of Alternative C, also referred to as the Chestnut Branch Shooting Range site. Figures 2 and 3 use arrows to show the direction of the firing lanes.

The Perry Creek site is located in the subwatershed that drains into Perry Creek, and further downstream into Tusquitee Creek. The Perry Creek site was the site of a silvicultural treatment in 1996 and now supports a stand of yellow poplar saplings. It is at 2,900 feet elevation, approximately 1,000 feet below the Chunky Gal Trail, which is located on a ridge approximately 0.7 mile to the east. The nearest private property is about 1.5 miles west of the Perry Creek site, on Tusquittee Creek. Access to the Perry Creek site is made by turning off U.S. Highway 64 onto Cold Branch Road (SR1330), driving six miles on Nelson Ridge Road (Forest Service Road 351), and taking Passmore Spur (FSR 351D) to its end. The site is approximately 13 miles driving distance (approximately 30 to 35 minutes) from Hayesville.

The Chestnut Branch site is located at the end of Barnett Creek Road (FSR 6236), 1.6 miles from its junction with U.S. Highway 64, in the Chestnut Branch watershed at approximately 4,000 feet in elevation. The Chunky Gal Trail is approximately one mile east and approximately 500 feet above the proposed Chestnut Branch site. The nearest private property is located approximately 1.5 miles east of the Chestnut Branch site on a southwest ridge of Milksick Knob near the Clay County line. Access to the site is made by taking U.S. Highway 64 east towards Franklin and turning left onto FSR 6236 at Glade Gap and continuing to the end of FSR 6236. The site is approximately 17 miles driving distance (approximately 25 to 30 minutes) from Hayesville.

Figure 1: Vicinity map of the proposed Perry Creek and Chestnut Branch Shooting Range sites.

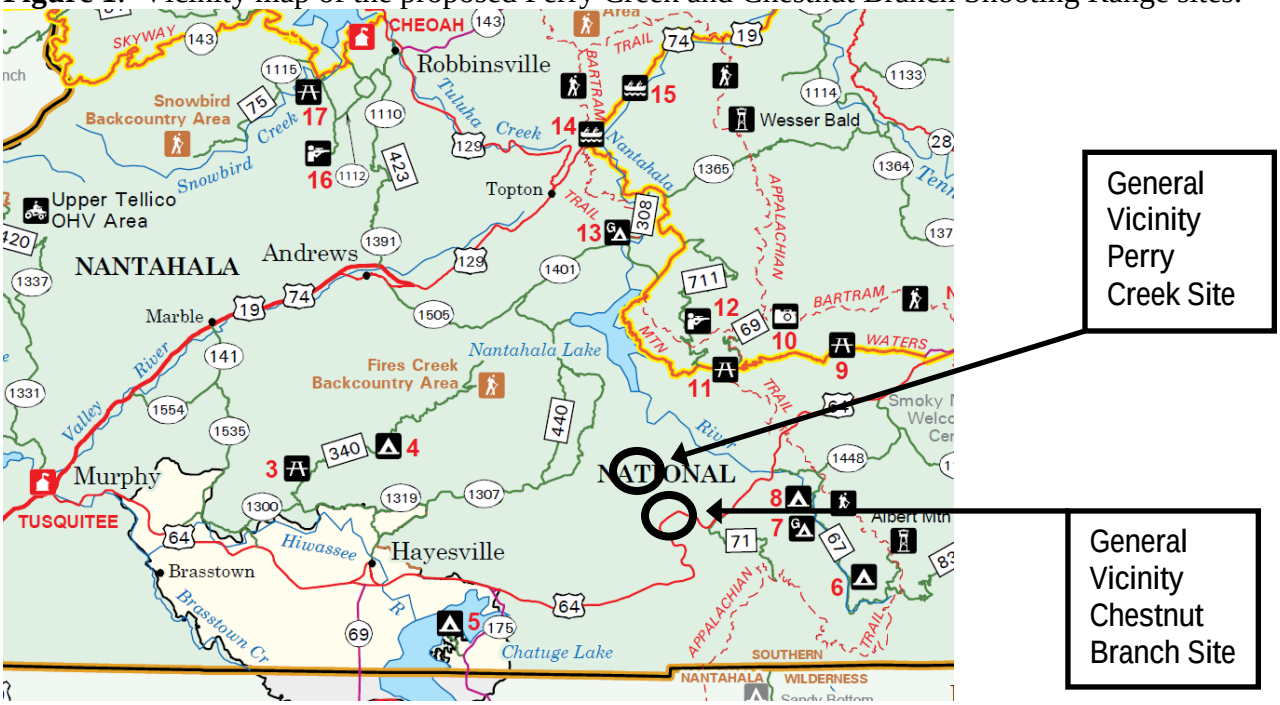


Figure 2: Detailed map of the proposed Perry Creek Shooting Range site.

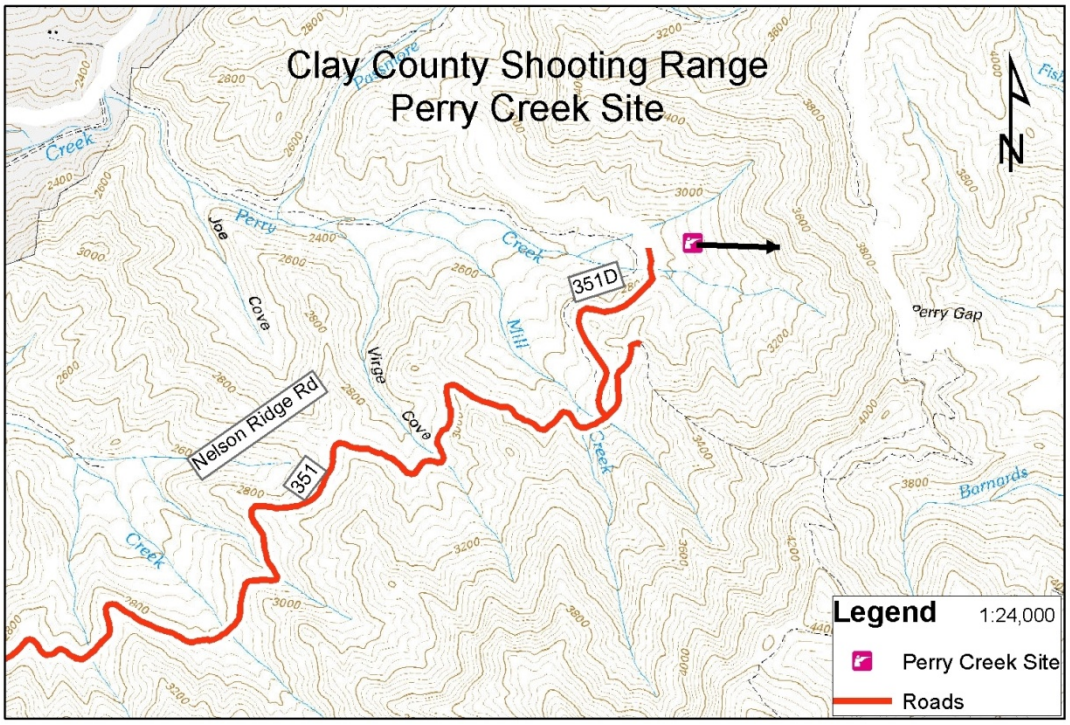
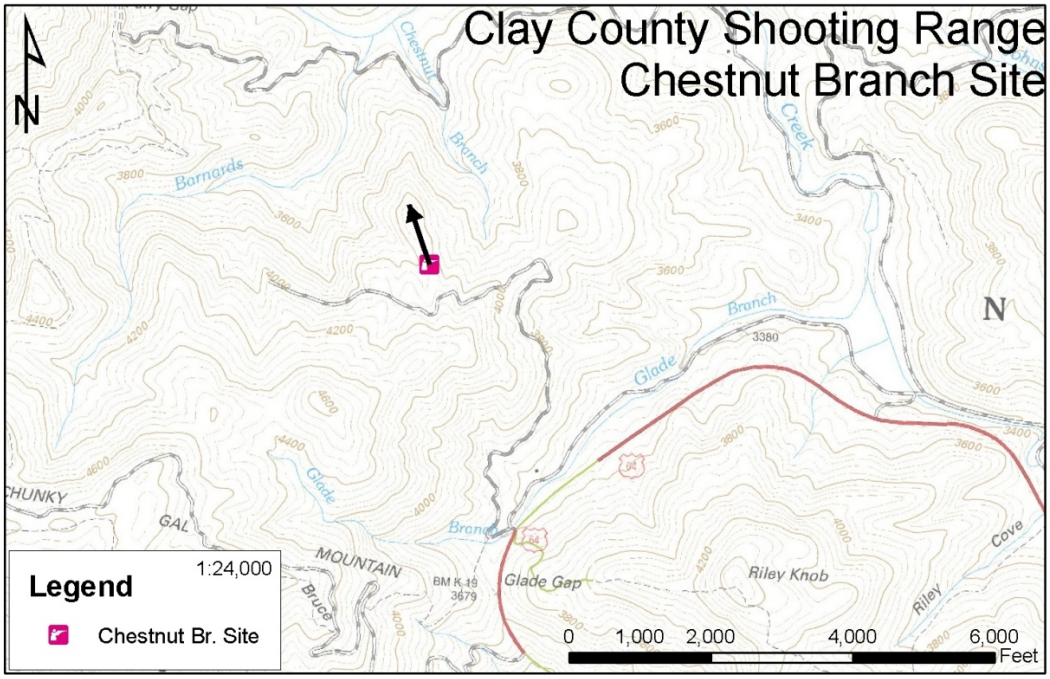


Figure 3: Detailed map of the proposed Chestnut Branch Shooting Range site.



1.5 Proposed Action

To meet the purpose and need for action, the Forest Service proposes to develop approximately three to five acres at one of the sites as a recreational shooting range. The land would be cleared of vegetation, and the terrain reshaped with heavy equipment to create five to eight covered shooting lanes and clean soil backstops. To access the site, the project would improve road conditions by reconstructing or reconditioning portions of the existing Forest Service roads and, in the case of the Perry Creek site, adding approximately 1,300 feet to the road system. Design measures used to control erosion would include seeding exposed soil with a grass seed mixture, hardening the access road and parking area with gravel, and installing sediment control measures such as silt fences. The facility would also include covered shooting stations, sign boards, and a portable restroom facility.

Based on the environmental analysis, the Tusquitee District Ranger will decide whether to allow the development and management of a shooting range and under what conditions. The responsible official will decide whether to implement an action alternative, a modified action alternative, or the no action alternative. If an action alternative is selected, it will include:

- Which action best meets the purpose and need?
- How well does it maintain and protect physical, biological and social resources?
- What design criteria and monitoring requirements are needed?

1.6 Public Involvement

The project has been listed in the National Forests in North Carolina's Quarterly Schedule of Proposed Actions (SOPA) each quarter of the calendar year since July, 2002. The SOPA is mailed to a forest-wide list of more than 100 addresses, and is posted on the Forest's web site.

Public scoping began in November, 2002, when District Ranger Charles Miller mailed a letter to 35 individuals known to be interested in activities on the lands managed by the Tusquitee Ranger District. The letter requested comments from the public in regards to a proposed shooting range site on Birch Cove off Nelson Ridge Road. Notice of this proposal and request for comments was published in both the Clay County Progress and the Cherokee Scout on November 26, 2002.

On May 11, 2005, District Ranger R.E. Vann mailed a second letter to 79 individuals, requesting comments on four possible sites for a shooting range in Clay County: Birch Cove, Tuni Road, Chestnut Branch, and Bob Branch.

On October 4, 2007, Acting District Ranger Michael White mailed a third letter to 63 individuals. The letter gave notice of a fifth possible site for a shooting range at the end of Nelson Ridge Road, on Passmore Road, near Perry Creek.

On May 19, 2010 the Forest Service released an Environmental Assessment for the Clay County Shooting Range Project and invited the public to review the document and to provide substantive comments on the proposed actions during a 30 day period. The legal notices formally initiating the comment period were published in the *Clay County Progress* and in the *Cherokee Scout* on May 20, 2010.

The Forest Service issued a decision in October of 2010. The decision was withdrawn in January 2011 to incorporate additional analysis on the topics of traffic, dust, and noise from the proposed action and alternatives. The revised EA was released for public notice and comment in August 2012, with legal notice published in the *Clay County Progress* on August 23, 2012. District Ranger Lauren Stull issued a decision on June 3, 2013, with legal notice published in the *Clay County Progress* on June 6, 2013.

A procedural error in the 2012 notice and comment and 2013 decision processes required the Forest Service to withdraw the June 3, 2013 decision. The legal notice of the opportunity to comment on the proposed action and the legal notice of decision were published in the *Clay County Progress*. The newspaper of record for the Tusquitee Ranger District is *The Cherokee Scout*. According to 36 CFR 215.5(b)(2), both of these legal notices must be published in the applicable newspaper of record. Accordingly, the EA was presented to the public for notice and comment in August 2013 with a letter to interested parties and through a legal notice which was published in *The Cherokee Scout* on August 14, 2013.

1.7 Key Issues Considered

The Interdisciplinary Team carefully reviewed the comments received during the public comment periods and separated the issues into two groups: those key to the decision to be made and those considered to be concerns. Key issues are those directly or indirectly caused by implementing the proposed action. Other concerns which were removed from further discussion were those identified as:

- Outside the scope of the proposed action,
- Already decided by law, regulation, the Forest Plan, or other higher level decision,
- Not relevant to the decision to be made,
- Conjectural and not supported by scientific fact or factual evidence,
- General comment.

1.7.1 Key Issues

Key issues associated with this project, as identified through the public comment process are:

- **The impacts of noise created by shooting from a single concentrated point**. The concern is that the proposed shooting range at Perry Creek would produce a constant or continuous sound of gunshot, which would be a loud and persistent impact to residents in the Upper Tusquittee Valley. This issue is addressed by development of an alternative site near Chestnut Branch (Alternative C), and by conducting sound tests at the Perry Creek location as described in Section 3.3 of the EA. Measures to mitigate noise would be implemented, as needed, if an action alternative is selected.
- **The impacts to recreational hikers on the Chunky Gal Trail**. The concern is that the sound of gunfire from the range would impact the solitude that is sought by Chunky Gal trail hikers. This issue is addressed by conducting analysis to estimate the sound levels that would

reach the trail and to determine the area of the trail that would be affected if an action alternative is selected.

- **Traffic and safety on Nelson Ridge Road.** The concern is that if the Perry Creek site is selected, the increase in traffic on Nelson Ridge Road would exceed the capacity of the road to safely handle the number of cars using it. This issue is addressed by collecting data from traffic counters on Nelson Ridge Road to determine the current traffic load, by projecting expected traffic volume if a shooting range is constructed, and comparing that to Forest Service road maintenance objectives. In addition, traffic calming measures such as broad based dips, posted speed limits, stop signs, and other design criteria to limit the speed of vehicles on the road would be developed if the action alternative is selected.
- **Effects of airborne road dust on human health.** The concern is that if the Perry Creek site is selected, the increase in traffic on Nelson Ridge Road would generate airborne dust levels containing small particulate matter that exceed Environmental Protection Agency (EPA) standards and result in conditions hazardous to human health. This issue is addressed by conducting a study of local road conditions and of current and projected traffic loading to model existing and projected dust levels to determine if threats to human health from airborne road dust currently exist or may be generated if the Perry Creek site is selected.
- **Concerns regarding lead contamination.** The concern is that lead would leach from the backstops and contaminate soil and water resources. If an action alternative is selected, best management practices for lead management at outdoor ranges would be implemented to minimize buildup of lead in the soil and also to minimize the movement of lead in the groundwater (see Design Criteria in Section 2.1.4 and Appendix A). These best management practices have proven effective at controlling lead at outdoor shooting ranges. A detailed review of Forest Service experience managing lead at the Panthertop Shooting Range in Cherokee County indicates that lead abatement procedures, a design criterion of the proposed Clay County Shooting Range, have worked as intended.

1.7.2 Other Concerns

Comments identified as other concerns through the public comment process are:

- Concerns regarding the safety of recreational users and residents, especially the risk posed by stray bullets leaving the range, either by skipping off the soil and over the berms, or, less likely, due to intentional misuse of the range by irresponsible users. This is not a key issue because Forest Service analysis (presented in Section 3.3.5 of this document, Human Health and Safety) does not support the premise that shooting ranges are unsafe.
- Concerns regarding wildlife, migratory birds, nesting birds and bear sanctuaries. This is not a key issue because it is not supported by scientific research (Larkin, 1996, Doresky, et al., 2001). Most research on sound impacts to wildlife has addressed issues in aquatic environments, especially as they affect wildlife behavior and communication. Doresky, et al. (2001), however, report that federally-endangered red-cockaded woodpeckers exhibit no response to training activities, including gunfire, on a military base. Based on these studies and experience with other public shooting facilities, the Forest Service concludes that some wildlife species would acclimate to the new conditions and others would adjust by avoiding the area when users are present and that the range would not have an appreciably negative impact on wildlife.

- Concerns regarding wilderness areas. This is not a key issue because it is not in conflict with the proposed action. Most direct and indirect effects of the range should be confined to the immediate vicinity of the proposed treatment areas. The closest wilderness area, the Southern Nantahala Wilderness, is approximately six miles south of the proposed Perry Creek site, in the opposite direction of the shooting lanes, and behind two higher ridges that are expected to prevent sound from traveling directly into the wilderness. The Southern Nantahala Wilderness is approximately four miles from the proposed Chestnut Branch site. Effects to the wilderness areas, including noise, are considered highly unlikely.
- Concerns regarding the availability of other shooting facilities in adjacent counties. This is not a key issue because it is not in conflict with the proposed action. The presence of other shooting ranges in the general vicinity does not mean there is not a need for a range in Clay County.
- Concerns regarding site closure and remediation. This is not a key issue because site closure is outside the scope of the proposed action.
- Concerns regarding increases in wildfires. This is not a key issue because it is not supported by science or data concerning fire ignitions in the area. There is no evidence that recreational shooters pose any greater risk to wildfire activity than recreationists that are already using the area.
- Concerns regarding visual resources. This is not a key issue because it not in conflict with the proposed action. The proposed shooting range sites would impact three to five acres of National Forest System lands. The combination of slopes and vegetation surrounding the sites should screen the range sites from most viewpoints. (See Section 3.3.3 for further analysis of visual effects.)
- Concerns regarding litter and human waste. This is not a key issue because the effects are expected to be limited in duration, extent, or intensity. Trash cans and portable toilets would be placed at the range as an administrative action to help address potential issues with trash and waste.
- Concerns regarding the values of private property near the shooting range. This is not a key issue because it is not supported by scientific research. The Forest Service searched the literature and consulted with social scientists and legal experts and could not find scholarly research proving a direct and statistically significant link that shooting ranges devalue surrounding property.
- Concerns regarding quality of life issues, such as solitude, tranquility, peace of mind, and the pristine nature of the area. This is not a key issue because the effects are expected to be limited in duration, extent, or intensity. Shooting activities would only occur during designated hours, and would be confined to a small area designed to mitigate offsite effects.
- Concerns regarding potential impacts to the Chunky Gal and Chestnut Branch Slopes Natural Heritage Areas. This is not a key issue because it is not in conflict with the proposed action. The natural heritage areas are approximately two miles from the proposed shooting range sites. Most of the direct effects of the range would be confined to the proposed treatment area, and therefore would not impact the heritage areas. The heritage areas are also separated from the proposed range sites by an intervening ridge, which should protect the areas from indirect effects due to noise. In addition, the heritage areas were created to protect botanical resources such as old growth forest and rare species, and none of these resources would be negatively impacted by the indirect effects expected from a shooting range.

- Concerns regarding the listing of Mull Farm on the National Register of Historic Places. This is not a key issue because it is not in conflict with the proposed action.
- Concerns regarding the Appalachian Trail. This is not a key issue because it is not in conflict with the proposed actions. The closest approach of the Appalachian Trail is approximately six miles east of the proposed range, at both White Oak Stamp and Panther Knob. At this distance, the Forest Service expects no direct or indirect effects from the range.
- Concerns regarding endangered threatened and sensitive species, especially to bog turtle habitat and the green pitcher plant. This is not a key issue because it is not in conflict with the proposed actions. The proposed treatment area was surveyed for rare species, and none were found. In addition, the survey area did not contain suitable habitat for any federally endangered or threatened species, such as the bog turtle and the green pitcher plant. Because the species were not present in the proposed treatment area, the Forest Service expects no direct, indirect or cumulative effects to any endangered, threatened or sensitive species. (See Section 3.2.3 for further analysis of endangered, threatened and sensitive species.)
- Concerns regarding compliance with the American Disabilities Act. This is not a key issue because it is not in conflict with the proposed actions. The shooting range would comply with the ADA to the full extent of the law.
- Concerns regarding air quality. This is not a key issue because the effects are expected to be limited in duration, extent, or intensity.
- Concerns regarding project funding. This is not a key issue because it is not in conflict with the proposed actions. Funding for environmental effects analysis and construction will be provided by private sources.
- Concerns regarding the Wilderness Society's Boteler Peak Mountain Treasure. This is not a key issue because it is not in conflict with the proposed actions. The National Forests in North Carolina do not classify the Wilderness Society's Mountain Treasure Areas as one of several Special Interest Areas in the Nantahala and Pisgah National Forests Land and Resource Management Plan.
- Concerns regarding an unroaded area contiguous with the Boteler Peak inventoried roadless area. This is not a key issue because it is not in conflict with the proposed action. The proposed treatment sites are not located within recognized roadless areas.
- Concerns regarding the intent of Management Area 3B direction at the proposed Perry Creek location. This is not a key issue because it is not in conflict with the proposed actions. Management areas, as described in the forest plan, suggest a desired future for the area as a whole. The proposed action does not violate the "few open roads" guidance for MA3B and open road density would not exceed plan standards. Habitat needs of the wildlife favored by MA3B would not be appreciably altered. The Forest Service estimates that high use at the site would result in between six and eight additional vehicles per day on the existing road, and overall impacts from motorized vehicles would continue to be limited.
- Concerns regarding forest fragmentation. This is not a key issue because it is not supported by scientific evidence. Forest fragmentation is typically applied at the landscape level, to describe woodlands that are isolated from other woodlands. This is a conservation issue because certain species, such as black bears and birds found in the forest interior require large, uninterrupted blocks of forest. In addition, isolated forests tend to lose diversity more rapidly than the same amount of contiguous forest. The effects of the shooting range – clearing three to five acres of land and reconstructing a short section of a single-lane road – are unlikely to substantially alter the ecological characteristics of the surrounding forest.

- Concerns regarding archeological, historical or cultural resources. This is not a key issue because it is not in conflict with the proposed actions. No National Register of Historic Places eligible properties or archeological sites were found during field surveys of the project's proposed area of potential effect. The State Historic Preservation Office and the Eastern Band of Cherokee Indians Tribal Historic Preservation Officer have been provided with an archeological report and both concurred with the determination of no effect on eligible sites (see Section 3.1.4).
- Concerns regarding old growth forests. This is not a key issue because it is not in conflict with the proposed actions. The proposed treatment sites have not been designated old growth forest by the Forest Service.
- Concerns regarding soil and water resources, including erosion, sedimentation, siltation, and impacts to trout habitat. The concern is that ground disturbance associated with constructing a shooting facility and parking area would result in erosion and sedimentation that would contribute nonpoint-source water pollution to perennial streams. This is not a key issue because design criteria including streamside buffer zones, silt fences, and soil stabilization and water control measures would be taken during construction. The road and shooting facilities would comply with applicable laws and regulations concerning soil disturbance and water quality (see Sections 3.1.1 and 3.1.2 for further analysis of soil and water issues) which have been demonstrated by research to minimize erosion and sedimentation.

2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

2.1 ALTERNATIVES CONSIDERED IN DETAIL

2.1.1 Alternative A – No Action

Alternative A is the No Action Alternative. No actions would be taken to establish a shooting range in Clay County.

2.1.2 Alternative B – Perry Creek Site, Modified

Alternative B (Modified) would develop approximately three to five acres off Passmore Spur Road near Perry Creek as a recreational shooting range. This alternative is modified to end the seasonal closure of Nelson Ridge Road.

- Approximately three to five acres would be cleared of all vegetation and the terrain shaped with heavy equipment, such as a dozer, to create five to eight shooting lanes and earthen backstops.
- To access the site, the first 2,000 feet of Passmore Spur Road would be removed from storage and would receive maintenance treatments, including mowing, light grading, and spreading gravel aggregate to accommodate passenger vehicles. The remainder of Passmore Spur Road would remain closed and in storage. Approximately 1,300 feet of single lane, gravel road on an existing old logging road prism would be constructed and added to the forest road system to connect Passmore Spur Road to the range site. A

parking area capable of accommodating approximately ten vehicles would be constructed.

- The shooting range would include five to eight covered shooting stations, sign boards, and a portable restroom facility. The range would be open for day use only.
- Design measures to control erosion would include seeding exposed soil with a grass seed mixture, hardening the access road and parking area with gravel, and installing sediment control measures such as silt fences.
- Design measures to reduce nuisance gunfire noise would include incorporating sound baffling components into range structures, vegetation, and landscaping, limiting the caliber of firearms and types of targets allowed at the facility, and, if needed, adjusting hours of operation.
- Design measures to prevent lead contamination include the construction and maintenance of a clean soil backstop, treatments to manage the pH of the shooting lanes and backstop, and routine monitoring of the lead content of soil and water (see also Section 2.1.4 and Appendix A).
- Design measures to avoid effects to ground nesting bird species, including ruffed grouse, during construction activitites would prohibit ground disturbance during the nesting season from early April until the middle of June.
- Design measures to address traffic safety on Nelson Ridge Road would include posting and enforcing speed limits and installing speed bumps, broad based dips, and additional signage.

Nelson Ridge Road is designated as Maintenance Level 3, and its Road Management Objective would not need to be changed to reflect the projected increase in vehicular use. The Forest Service gate on Nelson Ridge Road at the entrance to the national forest has traditionally been closed and locked from January 1st to March 31st annually. This annual seasonal closure would not be continued under the modified Alternative B (Modified), and would be open year round.

The Perry Creek site is located on lands designated as Management Area 3B (MA3B). The Forest Plan describes MA3B as areas emphasizing a sustainable supply of timber, but with few open roads and limited disturbance associated with motorized vehicles. This management area also provides for the habitat needs of wildlife such as wild turkey, deer, a variety of small mammals, and other species that will benefit from a managed forest with limited motorized access. A sustainable supply of timber is achieved through regulating the growth and removal of trees through time. Access to the forest is desired during the time timber is harvested, though most roads are closed at other times. Although a regulated forest is desired, some natural forest settings will be present. The visitor may encounter forest management activities in progress, including timber harvest, road building and timber stand improvement. Wildlife compatible with or that benefit from these conditions, such as deer, raccoon, and other small mammals are likely to be present. Black bear also use these areas, though they do not provide the best black bear habitat. Recreationists use these areas for hiking, mountain biking, horseback riding, hunting and other activities. The visitor may encounter other forest users, but not as frequently as in areas with open roads. Habitat needs of the wildlife favored by MA3B would not be appreciably altered. The Forest Service estimates that high use at the site would result in between six and eight additional vehicles per day on the existing road, and overall impacts from motorized vehicles would continue to be limited.

2.1.3 Alternative C – Chestnut Branch Site

Alternative C would develop three to five acres on Barnett Creek Road (FSR 6236), as a recreational shooting range.

- Approximately three to five acres would be cleared of all vegetation and the terrain shaped with heavy equipment, such as a dozer, to create four or five shooting lanes and earthen backstops.
- To access the site, the portion of Barnett Creek Road beyond the existing Forest Service gate, a total of approximately 2,100 feet, would be reconditioned to accommodate traffic, including a water crossing that currently does not meet road management objectives. Approximately 1,200 feet of new single lane gravel road would be constructed to connect the parking area with Barnett Creek Road.
- A parking area capable of accommodating approximately ten vehicles would be constructed.
- The shooting range would include four to five covered shooting stations, sign boards, and a portable restroom facility. The range would be open for day use only.
- Design measures to control erosion would include seeding exposed soil with a grass seed mixture, hardening the access road and parking area with gravel, and installing sediment control measures such as silt fences.
- As needed, the facility would include features to contain and to reduce nuisance gunfire noise, incorporating sound baffling components into range structures, vegetation, and landscaping.
- Design measures to prevent lead contamination include the construction and maintenance of a clean soil backstop, treatments to manage the pH of the shooting lanes and backstop, and routine monitoring of the lead content of soil and water (see also Section 2.1.4 and Appendix A).
- Design measures to avoid effects to ground nesting bird species, including ruffed grouse and ovenbirds during construction activities would prohibit ground disturbance during the nesting season from early April until the middle of June.

The Chestnut Branch site is located on lands designated as Management Area 4D (MA4D). The Forest Plan describes MA4D as areas emphasizing high quality wildlife habitat for wildlife requiring older forests and freedom from disturbance from motorized vehicles, particularly for black bear. The Forest Plan describes opportunities for non-motorized recreational uses including hunting, fishing, viewing wildlife, horseback riding, bicycle riding and hiking. Habitat needs of the wildlife favored by MA4D would not be appreciably altered. The Forest Service estimates that high use at the site would result in between six and eight additional vehicles per day on the existing road which is currently utilized by rock hounds to access Corumdum Knob, and overall impacts from motorized vehicles would continue to be limited.

2.1.4 Further Design Measures to Manage Potential Impacts from Noise and Lead

Sound management is an important consideration at both of the proposed sites. These techniques can be used alone or in combination, depending on the needs and issues of specific ranges. Some or all of these approaches could be used to reduce noise.

- Operational approaches – Restrictions on the number of users as well as the type, size, and caliber of firearms can be used to limit the amount of sound generated at the range.
- Site considerations – Firing lines can be oriented to direct shooting away from sound-sensitive areas.
- Engineering approaches – Sound control can result from structures that reflect, absorb, contain or isolate the sound. Berms and non-porous walls can serve to deflect and absorb sound, while vegetated berms also provide a visual screen. Characteristics such as berm size, shape, and width all contribute to the effectiveness of the berm. Design elements, such as a solid wall placed behind shooting stations can direct sound away from sensitive areas.
- Vegetation approaches – Vegetation can be a simple and effective way to reduce sound. This can be achieved by preserving existing vegetation or by planting selected species. Evergreens are often used because they retain sound-absorbing foliage year-round. Hedges of various species may also increase sound-buffering while serving as a windbreak for the range.

The following design criteria for lead management at both sites would be implementated:

- Control and containment of lead bullets and bullet fragments. An earthen berm and backstop 15-20 feet high with a slope as steep as possible would be used to contain bullets and bullet fragments. The upper most 1 to 2 feet of the berm would be free of large rocks and other debris and the entire berm would be vegetated to prevent erosion of the berm/backstop. This option was selected because it effectively and safely contains the lead in the berm/backstop at minimal cost.
- Prevention of Lead Migration through the following actions:
  - *Lime Addition.* The pH of the soil over the entire range area would be monitored annually with the goal to keep the general soil pH between 6.5 and 8.5. Lime would be applied as needed at rates necessary to maintain the optimum pH level.
  - *Reducing capillarity action within the backstop*. Because most porosity in soil material is of capillary size, breaking this capillary action within the backstop would reduce the exposure of lead to water. This would be done by adding a layer of limestone or gravel to the base of the backstop during construction. This would reduce the rate of deterioration of spent bullets, erosion of the backstop, and the amount of lead going into solution.
  - *Controlling runoff*. Controlling the velocity of the runoff is critical, and can be adequately addressed during construction and maintenance by insuring that vegetation cover is maintained on the site, preferably with fast growing turf grasses as well as proper grading and leveling of the site. Water diversion devices would be constructed where needed to keep any off-site runoff water from flowing onto the lead impact areas.
  - *Engineered runoff controls*. A filter bed with containment trap would be constructed at the backstop/berm area. Filter beds would be established at the front base of the backstop. The filter would consist of two layers; a sand bed underlain by limestone gravel or other neutralization materials. After the water runoff passes through the filter bed it would drain into a perforated drainage pipe located within the limestone gravel. The perforated pipe would then drain into a containment trap which would

cause any lead still contained in the runoff water to settle. Operation and maintenance would be minimal, involving mostly periodic removal of debris and occasional replacement of the limestone.

- Lead Removal and Recycling. To ensure that lead is not "discarded" or "abandoned" within the meaning of the RCRA statute (i.e., a hazardous waste); periodic lead removal activities would be planned for and conducted. The simplest and most cost effective is simple hand raking and sifting. Once collected the lead would be taken to a recycler or reused. Those conducting hand raking and sifting would use standard precautions to protect themselves from exposure to lead. These activities would be done as a minimum once every 5 years.
- Documenting Activities and Record Keeping. Records would be kept on the type of BMP(s) implemented, the date of service and who did the service and these records would be retained by the Forest Service.
- *Phosphate Addition*. The addition of phosphate could be considered to bind the lead particles on any section of the range that is not easily accessible when reclaiming spent lead. Phosphate does not adjust soil pH, but it binds the lead particles preventing them from moving in solution. This BMP would be optional based on the identified need at a later date.

2.2 ALTERNATIVES NOT CONSIDERED IN DETAIL

Three alternatives have been eliminated from detailed study.

2.2.1 Alternative 1 – Birch Cove Site

This alternative site was eliminated from detailed study over concern the shooting noise would be a nuisance to people residing in the area. The noise could not be mitigated, reduced or eliminated. A shooting test performed at this site demonstrated that nuisance noise from a rifle could be heard from most of the residences in the vicinity.

2.2.2 Alternative 2 – Bob Branch Site

This alternative site near Bob Branch was eliminated from detailed study over concern the shooting noise would be a nuisance to people residing in the area. The noise could not be mitigated, reduced or eliminated. A shooting test performed at this site demonstrated that nuisance noise from gunfire could be heard from most of the residences in the vicinity.

2.2.3 Alternative 3 – Tuni Gap Site

This alternative site on Tuni Gap road was eliminated from detailed study due to concern over damage to archeological resources at the site.

2.3 ALTERNATIVE COMPARISON

Attribute	Perry Creek Site	Chestnut Branch Site
Driving Distance to Hayesville	13 Miles	17 Miles
Driving time from Hayesville	30 - 35 Minutes	25 - 30 Minutes
Land Clearing	Three to Five Acres	Three to Five Acres
Number of Shooting Lanes	Five to Eight	Four to Five
Road Maintenance	2,000 feet Passmore Spur	2,300 feet
New Road Construction	1,300 feet	1,200 feet
Construct / Reconstruct Water Crossings?	No	Yes
Months Open	Year Round	Year Round
Management Areas Affected	3B	4D
Elevation	2,900 feet	4,000 feet
Nearby Waters	Class C and Trout Waters	Class C and Outstanding Resource Waters

3.0 ENVIRONMENTAL CONSEQUENCES

3.1 NATURAL RESOURCES

3.1.1 Soils

Soils in the area of both alternatives are classified as Typic Dystrochrepts by the USDA Natural Resources Conservation Service. Typic Dystrochrepts are included in the Inceptisol soil order, (from Latin inceptum, "beginning") whose defining characteristic is minimal horizon development. They are more developed than soils in the Entisol order, but still lack the features that are characteristic of other soil orders.

Inceptisols are widely distributed and occur across a wide range of ecological settings. They are often found on fairly steep slopes, young geomorphic surfaces, and on resistant parent materials. Land use varies considerably with Inceptisols. A sizable percentage of Inceptisols are found in mountainous areas and are used for forestry, recreation, and watershed purposes.

Alternative A

Alternative A is the no action alternative. Soil formation and development processes would continue unimpeded.

Alternative B (Modified)

Existing Condition. The soils in the proposed treatment area include the Edneyville-Chestnut complex and the Plott fine sandy loam. Neither soil is classified as Prime Farmland. Each soil is discussed briefly below.

Edneyville-Chestnut complex (EdE), 30 to 50 percent slopes, stony. This soil complex occurs on mountain slopes and ridges. Both soil components are well drained and have high water movement in the most restrictive layer. The depth to a root restrictive layer is greater than 60 inches in the Edneyville component and 20 to 40 inches in the Chestnut component. The pH of both components ranges from 3.5 to 6.0. This soil occurs on the eastern end of the project area, near the proposed shooting lanes and parking lot.

Plott fine sandy loam (PwD), 15 to 30 percent slopes, stony. This soil occurs on mountain slopes. This soil is well drained with a depth greater than 60 inches to a root restrictive layer. Water movement is high in the most restrictive layer. The pH ranges from 3.5 to 6.0. This soil occurs on the western end of the project area, along the area of the proposed single-lane road.

Alternative C

Existing Condition. The soils in the proposed treatment area include Edneyville-Chestnut complex, Cullasaja-Tuckasegee complex, and Plott fine sandy loam. None are classified as Prime Farmland. Each soil is discussed briefly below.

Edneyville-Chestnut complex (EdD, EdE), 15 to 50 percent slopes, stony. This soil complex occurs on mountain slopes and ridges. Both soil components are well drained and have high water movement in the most restrictive layer. The depth to a root restrictive layer is greater than 60 inches in the Edneyville component and 20 to 40 inches in the Chestnut component. The pH of both components ranges from 3.5 to 6.0. This soil occurs throughout most of the proposed treatment area.

Cullasaja-Tuckasegee complex (CuE), 30 to 50 percent slopes, stony. This soil complex occurs on mountains and coves. Both soil components are well drained with a depth greater than 60 inches to a root restrictive layer. Water movement is high in the most restrictive layer. The pH of this complex ranges from 4.5 to 6.5. This soil occurs along the southwestern edge of the proposed treatment area.

Plott fine sandy loam (PwF), 50 to 95 percent slopes, stony. This soil occurs on mountain slopes. This soil is well drained with a depth greater than 60 inches to a root restrictive layer. Water movement is high in the most restrictive layer. The pH ranges from 3.5 to 6.0. This soil occurs at the northeastern tip of the proposed treatment area.

Environmental Consequences

Direct and Indirect Effects. Alternative A would have no direct or indirect impacts to soil. Alternatives B (Modified) and C would have direct impacts to soil due to the grading and land shaping activities that would occur during construction. Impacts from construction would be short-lived and limited to the footprint of the facilities. Best Management Practices (BMPs) would be established for sediment and erosion control during construction activities to reduce soil erosion, including seeding disturbed soil with grass seed mixtures, installing silt fences during construction to minimize erosion, hardening road and parking surfaces with gravel aggregate, and designing hardened surfaces to control water flow. BMPs for lead management (see Section 2.1.4 and Appendix A) would reduce or eliminate lead contamination outside the

shooting range under Alternatives B (Modified) and C. Implementation of BMPs would prevent indirect impacts to soils outside of the proposed treatment area. Impacts to soils from the operation of the facility would be limited to the footprint of the facilities and would exist as long as the facility is operational.

Cumulative Effects. The analysis area for cumulative effects includes the shooting range sites, access roads and immediately adjacent areas. Direct impacts from lead contamination would be mitigated (see design criteria in Chapter 2) and there are no other activities that would contribute to lead contamination. For Alternative B (Modified), potential effects from the past timber management activities were mitigated through use of BMPs. No other past, present or reasonably foreseeable actions are known that would contribute to potential erosion or lead contamination. For Alternative C, no past, present or reasonably foreseeable projects are known to impact soils. Therefore, for both alternatives, no additional cumulative effects would occur beyond the effects from the proposed action.

3.1.2 Water Quality

Alternative A

Alternative A is the no action alternative. Water quality would be affected by a variety of natural factors (examples include type and extent of vegetative cover; precipitation events influencing baseflow, peakflow, and stormflow; leaching; and background levels of sedimentation consistent with forested environments), and human-induced factors (examples include airborne pollutants; silvicultural treatments; vehicular traffic; and road maintenance).

Alternative B (Modified)

Existing Condition. The proposed treatment area is drained by three tributaries (two perennial, one intermittent) which are the headwaters of Perry Creek. Perry Creek flows into Tusquitee Creek in the Hiwassee River Watershed (USGS Cataloging Unit: 06020002) of the Hiwassee River Basin. The tributaries are Class C and Tr (trout) waters. Class C waters are suitable for aquatic life propagation and maintenance of biological integrity (including fishing and fish), wildlife, secondary recreation, agriculture and any other usage except for primary recreation or as a source of water supply for drinking, culinary or food processing purposes. This classification prohibits a discharge of lead into surface waters that exceed 3.1 ug/L at the discharge point (15A NCAC 02B .0211). The Tr designation is given to those waters suitable for natural trout propagation and maintenance of stocked trout. Two tributaries begin southeast of the site and the other begins northeast of the site. The smaller, intermittent tributary flows near the single-lane road for approximately 50 feet, and then flows below surface. A channel continues along the single-lane road, but flows only during storm events. The perennial tributaries begin approximately 650 feet from the proposed treatment area and are no less than 250 feet from the proposed treatment area.

Alternative C

Existing Condition. The proposed treatment area is drained by two perennial tributaries, Chestnut Branch and an unnamed tributary of Barnards Creek. Chestnut Branch is a tributary of Barnards

Creek. Barnards Creek flows into Buck Creek, which is a tributary of the Nantahala River in the Upper Little Tennessee River watershed (USGS cataloging unit: 06010202). The tributaries draining the proposed treatment area are classified as Class C, Outstanding Resource Waters. Outstanding resource waters (ORW) are unique and special waters of exceptional state or national recreational or ecological significance which require special protection to maintain existing uses. This designation prohibits the establishment of new discharges or expansions of existing discharges. Where developments require an Erosion and Sedimentation Control Plan, specific storm water requirements for ORW waters shall be implemented (15A NCAC 02B .0225). These storm water control provisions include utilizing vegetated conveyances to transport storm water and maintaining a 30 foot vegetated buffer (15A NCAC 02H .1007).

The unnamed tributary flows within approximately 80 feet of the proposed treatment area along the western edge. Chestnut Branch is approximately 750 feet east of the proposed treatment area.

Environmental Consequences

Direct and Indirect Effects. Alternative A would have no direct or indirect impacts to water quality. Alternatives B (Modified) or C would have no direct impacts since no streams or wetlands were present within the proposed treatment area. BMPs, including seeding disturbed soil with grass seed mixtures, installing silt fences during construction to minimize erosion, hardening road and parking surfaces with gravel aggregate, designing hardened surfaces to control water flow, and delineating and maintaining vegetative buffer zones, will be established to reduce or eliminate sedimentation. A lead abatement plan has been prepared using BMPs for lead management on outdoor shooting ranges. No lead is expected to enter surface waters since the BMPs for lead and erosion control, when correctly implemented, have proven effective at preventing the introduction of lead into waters. The 3.1 ug/L lead standard for ORW streams should not be exceeded given the site characteristics and BMPs developed for the action alternatives.

Cumulative Effects. Due to the lack of direct and indirect impacts, there would be no cumulative impacts to surface water quality for either Alternative B (Modified) or Alternative C.

3.1.3 Air Quality

Air quality monitoring in the Great Smoky Mountains National Park and along the Blue Ridge Parkway indicates that pollution in the Southern Appalachians has greatly increased over the past 50 years. Much of the pollution is produced by power plants, industry, and automobiles, both within and outside the Southern Appalachians. Air quality within the proposed treatment areas of Alternatives B (Modified) and C appears to be consistent with the surrounding areas, with no major local activities contributing to airborne pollution. Small scale sources of dust and fine particulate matter include, but are not limited to wildfire events, possible future prescribed burning and a very low likelihood of airborne dust from vehicular traffic.

Alternative A

Alternative A, the no action alternative, would have no effect on air quality. Air quality would be affected by factors unrelated to this project.

Alternatives B (Modified) and C

The proposed sites would be exposed to coarse and fine airborne particulates during land clearing, grading, and construction activities. These effects would be of short duration and limited to the immediate vicinities of the proposed sites. Airborne road dust would be generated from gravel roads and parking areas from vehicles accessing the range, but this increase is expected to be marginal given that normal use is projected to be between six and eight additional vehicles per day, on average, above current use levels. While road dust is a nuisance, independent research conducted for this project on airborne dust indicates that the fine particulates would not be a human health issue given the projected vehicular traffic loads and driving speeds. Refer to section *3.3.5 Human Health and Safety* for a detailed discussion regarding dust effects. Some particulate matter would result from grass mowing, sweeping, leaf raking, and other maintenance activities. These events are expected to be of short duration and would not be a continuous impact to air quality at either of the proposed range sites.

Environmental Consequences

Direct and Indirect Effects. No direct or indirect impacts are anticipated under Alternative A. Short term, temporary impacts to air quality would result under Alternative B (Modified) and C during construction activities. There would also be increased road dust associated with additional vehicular traffic along the gravel access roads.

Cumulative Effects. Three prescribed burn units are located in the vicinity of both proposed sites. These units are burned on a three to five year rotation, with firing activities completed in a single day. No other past, present, or reasonably foreseeable activities affecting air quality are known for the sites or access roads, therefore there would be no cumulative effects beyond those resulting from the existing prescribed burns and the proposed activities.

3.1.4 Cultural/Historical Resources

Native Americans and early settlers in Clay County most often utilized the flattest terrain found in river valleys, the lower slopes of coves, and broad ridges for home sites and farms. Accordingly, gently sloping land is more likely to contain sites eligible for protection under Sections 106 and 110 of the National Historic Preservation Act (NHPA) and is subject to archaeological survey. When artifacts are found, the Forest Service and the State and Tribal Historic Preservation Offices determine if a historic site has been located, and if so, if it is eligible for protection under the NHPA. Eligible sites are avoided or protected during project implementation and long-term monitoring protocols are established. As both proposed range sites are on gently sloping land, both sites were surveyed.

Alternative A

Alternative A is the no action alternative. No cultural or historical resources would be affected.

Alternative B (Modified)

Existing Condition. A large portion of the proposed treatment area was surveyed in 1994 by Dave Dyson, Forest Service archeologist for the Nantahala National Forest, prior to the

silvicultural treatments conducted in the area in 1996. Legacy Research Associates of Durham, NC conducted an intensive archeological survey on the remainder of the proposed treatment area on February 14, 2008. The survey was conducted in compliance with Sections 106 and 110 of the National Historic Preservation Act of 1966 (as amended), the Archeological and Historical Preservation Act of 1974, Executive Order 11593, 36 CFR parts 60-66 and 800 (as appropriate). The survey met the specifications of the North Carolina State Historic Preservation Office guidelines and the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation (Federal Register 48). No cultural resources were identified during the 1994 or 2008 survey.

Alternative C

Existing Condition. TRC Solutions of Asheville, NC conducted the Phase I archeological survey and a cultural resources background study. The survey was conducted in compliance with Sections 106 and 110 of the National Historic Preservation Act of 1966 (as amended), the Archeological and Historical Preservation Act of 1974, Executive Order 11593, 36 CFR parts 60-66 and 800 (as appropriate). The survey met the specifications of the North Carolina State Historic Preservation Office guidelines and the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation (Federal Register 48). No archeological sites were known at the Chestnut Branch site prior to the TRC Solutions survey. Two sites with lithic scatter were documented during the surveys.

A Phase II archeological survey was conducted to determine if the sites were eligible for the National Register of Historic Places (NRHP). New South Associates of Greensboro, NC conducted the survey. Although some artifacts were located during the survey, the sites were recommended not eligible for NRHP because they did not have any of the attributes required for eligibility. The State Historic Preservation Office and the Eastern Band of Cherokee Indians Tribal Historic Preservation Officer have been provided with an archeological report and both concurred with the determination of no effect on NRHP eligible sites.

Environmental Consequences

Direct and Indirect Effects. No direct or indirect impacts to cultural resources would occur under the Alternative A. Because no artifacts or cultural resources were documented at the proposed range site at Alternative B (Modified), no direct or indirect impacts are anticipated. Artifacts (lithic scatter) were discovered in the proposed range site at Alternative C during both the Phase I and Phase II archeological surveys. No cultural features were encountered, nor are any expected to be on the site due to the lack of deposition since the Late Archaic, erosion and mixing of the topsoil, and forest management activities. Construction activities could expose or compact any remaining artifacts on the site but would not result in a loss of features key to understanding history or prehistory of the area and its peoples.

Cumulative Effects. No other past, present, or reasonably foreseeable activities affecting cultural resources are proposed for either sites or access roads, therefore there would be no cumulative effects beyond those resulting from the alternatives.

3.1.5 Inventoried Roadless Areas

Existing Condition. The proposed shooting range sites are near the Boteler Peak Inventoried Roadless Area with the proposed Chestnut Branch site being located approximately 1.5 miles away and the Perry Creek site being located approximately 3/4 of a mile away from the nearest boundaries of the roadless area.

Environmental Consequences

Direct and Indirect Effects. No direct or indirect impacts to inventoried roadless areas are anticipated under Alternative A. Given the orientation of the shooting lanes at Alternative C, its distance from the Boteler Peak Roadless Area, and based on results of sound tests, the Forest Service believes that impacts to the roadless area from gunfire noise from Alternative C would be minimal. Alternative B (Modified) is in closer proximity to the roadless area. The Forest Service believes that gunfire from the Perry Creek site may be heard in some portions of the Boteler Peak Roadless Area. However there would be no effects to roadless area status. The Boteler Peak Roadless Area is subject to sounds from the Shooting Creek Community and from US Highway 64 and other roads in the vicinity.

Cumulative Effects. While some noise from the range may be apparent in the roadless area from the Perry Creek site, noise is not a factor in determining roadless area status. Noise impacts to the Boteler Peak IRA would still be minimal even when added to existing sounds in the area. Cumulatively, there would not be an impact to the roadless character.

3.2 BIOLOGICAL RESOURCES

The analysis in this document tiers to the Final Environmental Impact Statement (FEIS) for the Land and Resource Management Plan for the Nantahala and Pisgah National Forests (Forest Plan) and to the FEIS for Vegetation Management in the Appalachian Mountains.

The Tusquitee Ranger District interdisciplinary team screened these actions for the presence of any one of the extraordinary circumstances identified in FSH 1909.15-2008-1. Fish and Wildlife Associates, Inc. of Whittier, NC, conducted field surveys of the proposed treatment area on the proposed Perry Creek treatment area (Alternative B (Modified)) during September 2007, October 2007, and January 2009. Fish and Wildlife Associates also conducted field surveys of the proposed Chestnut Branch treatment area (Alternative C) in October 2008 and January 2009. For more detail, refer to the Biological Evaluation in Appendix B of this Environmental Assessment.

3.2.1 Bounds of Analysis

Botanical Resources

The bounds for the botanical resources analysis include the proposed shooting range sites, the access roads and roadsides.

Terrestrial Wildlife Resources

The bounds for terrestrial wildlife analysis are based primarily on available habitat within the proposed treatment areas. Adjacent habitat may also be considered when evaluating the potential of wildlife use in the project vicinity.

Aquatic Resources

The bounds for the aquatic analysis include the treatment areas and aquatic resources downstream from the treatment areas (down to Perry Creek for Alternative B (Modified) and down to Barnard's Creek for Alternative C).

3.2.2 Existing Condition of Biological Resources

Perry Creek Site

The Perry Creek site is located in the subwatershed that drains into Perry Creek, and further downstream into Tusquittee Creek. It is at 2,900 feet elevation, about 1,000 feet below the Chunky Gal Trail, which is located on a ridge about 0.7 miles to the east. Access to the Perry Creek site is made by turning off U.S. Highway 64 onto Cold Branch Road (SR1330), then six miles to the end of Nelson Ridge Road (FSR 351), and out Passmore Spur (FSR 351D) (Figure 2, page 5).

The site contains a representative example of a mid-elevation mixed mesophytic deciduous forest with elements of montane oak-hickory forest. The terrain shape is a gently sloping bench between two drainages of Perry Creek located at the base of steeper terrain that forms part of the western slope of Chunky Gal Mountain. Soils are comprised of series in the Inceptisol soil order and include the Edneyville-Chestnut complex and Plott fine sandy loam. The landform and soil characteristics are consistent with those that support rich cove forest.

In 1996 the site was the location of a silvicultural treatment designed to favor hardwood species. The woody vegetation on the site contains abundant yellow poplar *(Liriodendron tulipifera)* that sprouted in response to regeneration cuttings. The young stand currently has a closed canopy which limits the amount of light that reaches the understory, resulting in a minimal shrub and understory component. The area contains no special habitats or features of limited availability on the Nantahala National Forest.

The Forest Plan describes the levels of management practices, production, and protection that may take place on specific "Management Areas" (MA) designated across the Forest. The proposed site is located in the headwaters of Perry Creek within MA 3B which emphasizes a regulated forest through timber harvest, with few open roads (approximate 0.5 miles of open road per square mile of land). The Forest Plan describes opportunities for nonmotorized recreational uses such as hiking, mountain biking, horseback riding, and hunting.

Within the proposed Perry Creek site, only a few mature *Liriodendron tulipifera* are present, while most of the site consists of young, sapling size trees. Sapling trees included *Robinia*

pseudoacacia, Acer rubrum, Halesia tetraptera, Quercus rubra, and *Liriodendron tulipifera*. Other species found within the three-acre tract are *Ilex opaca, Rhus typhina, Eupatorium purpureum, Oenothera biennis, Potentilla canadensis, Polystichum acrostichoides, Pyrularia puberia, Aralia spinosa, Rubus sp., Vitis sp., Aristolochia macrophylla, Smilax sp., Desmodium sp., Toxicodendron radicans,* and *Dennstaedtia punctilobula.*

Vegetation in the old logging road differs from the forested portion of the site due to more sunlight and past soil disturbance. Common species encountered on the road bed included *Potentilla canadensis, Aster sp., Rubus sp., Polystichum acrostichoides, Aralia spinosa, Pycnanthemum sp., Geum sp., Lobelia siphilitica, Thalictrum thalictroides,* and *Fragaria virginiana*. The forest immediately adjacent to the single lane road is more characteristic of rich cove forest.

A variety of terrestrial wildlife would be likely to utilize habitat in the proposed range site and project vicinity of Alternative B (Modified), including birds, mammals, reptiles, amphibians, and terrestrial invertebrates. Evidence and/or sightings of the following species were documented: wild boar, ruffed grouse, small mammals (rodents), coyote, slate-colored junco, and black-capped chickadee.

One perennial stream was north of the tract and one perennial and one intermittent stream were south of the tract. All three tributaries are the headwaters of Perry Creek. The perennial streams were 250 to 650 feet from the treatment area. The intermittent stream ran along the approach road for approximately 100 feet, before the flow went below the surface. Benthic macroinvertebrates were observed in the perennial streams, but they are not likely to support fish. The intermittent stream was dry during the field surveys, with the exception of the January survey. No benthic macroinvertebrates were observed in the intermittent stream and fish are not likely to be present.

Chestnut Branch Site

The proposed treatment area is located in the subwatershed of Chestnut Branch approximately 1.6 miles from where Barnett Creek Road leaves U.S. Hwy 64 near Chestnut Branch at about 4,000 feet in elevation. The Chunky Gal Trail is about one mile west and about 500 feet above the proposed Chestnut Branch site. Access to the Chestnut Branch site is made by taking U.S. Highway 64 east towards Franklin and turning left onto FSR 6236 at Glade Gap and continuing to the end of FSR 6236. (Figure 3, page 6)

The site contains a representative example of northern deciduous hardwood forest with elements of high elevation red oak forest plant communities. The terrain is a gently-sloping ridge that trends northward across a saddle to a small knob. Soils are comprised of series in the Inceptisol soil order and include the Edneyville-Chestnut complex, the Cullasaja-Tuckasegee complex, and Plott fine sandy loam.

The site has not been subject to any recent silvicultural treatments and hosts predominantly second growth forest with much of the woody vegetation on the site composed of various species in the Quercus genus. The understory and herbaceous layer is comprised of species typical of

these forest types. The area contains no special habitats or features of limited availability on the Nantahala National Forest.

The Chestnut Branch site is located on lands designated as Management Area 4D (MA4D). The Forest Plan describes MA4D as areas emphasizing high quality wildlife habitat for wildlife requiring older forests and freedom from disturbance from motorized vehicles, particularly for black bear. The Forest Plan describes opportunities for nonmotorized recreational uses including hunting, fishing, viewing wildlife, horseback riding, bicycle riding and hiking.

A few species are common in the proposed range site including *Robinia pseudoacacia, Prunus pensylvanica, Acer rubrum*, and *Liriodendron tulipifera*. Other species present included *Betula allegheniensis, Quercus montana, Quercus rubra, Prunus serotina, Acer pensylvanicum, Amelanchier sp., Magnolia acuminata, Sassafras albidum, Crataegus sp., Tsuga canadensis, Fagus grandifolia, Hamamelis virginiana, Kalmia latifolia, Rhododendron sp., Tilia americana, Carya spp.*, and *Oxydendrum arboreum*. Herbaceous species encountered in the field survey included *Hydrangea arborescens, Polystichum acrostichoides, Thelypteris noveboracensis,* and *Polygonum sp*. *Vitis sp*. is a common vine growing in the proposed site.

A variety of terrestrial wildlife would be likely to utilize habitat in the proposed treatment area and project vicinity of Alternative C including birds, mammals, reptiles, amphibians, and terrestrial invertebrates. Evidence and/or sightings of the following species were documented: coyote, deer, and pileated woodpecker.

A small, perennial stream (unnamed tributary of Barnard's Creek) was immediately west of the treatment area. The stream was approximately one foot wide, with six inch to one foot banks, and was one to two inches deep. The substrate was gravel and sand. This small stream is not likely to support fish, but stonefly larvae were observed on the stream substrate.

Alternative A

Under Alternative A, conditions at both sites would be subject to natural processes of disturbance and succession. The areas would continue to be used by wildlife and humans similar to current practices. There are no known reasonably foreseeable actions by the Forest Service or nearby private landowners that would change the character of the sites under Alternative A. There would be no effects to Federally proposed, endangered, or threatened species, forest sensitive species, forest concern species, management indicator species, or special forest communities.

Alternative B (Modified) and Alternative C

Proposed actions under Alternative B (Modified) are described in detail in Section 2.1.2; proposed actions under Alternative C are described in detail in Section 2.1.3. Effects to Federally proposed, endangered, or threatened species, forest sensitive species, forest concern species, management indicator species, and special forest communities under Alternatives B (Modified) and C are described in Sections 3.2.3, 3.2.4, and 3.2.5.

3.2.3 Threatened, Endangered and Sensitive Species (TES)

The Nantahala-Pisgah National Forests maintains lists of proposed, endangered, threatened and Forest Service sensitive species on NFS (National Forest System) lands; all of these species were originally considered for further analysis of effects from the proposed alternatives. The lists were filtered by considering only those species listed by the North Carolina Natural Heritage Program (NCNHP) or the United States Fish and Wildlife Service (USFWS) as occurring or probably occurring in Clay County, with the exception of terrestrial wildlife. Due to the mobility of terrestrial wildlife, the filtered list also included species occurring or probably occurring in nearby counties (Cherokee, Graham, Macon, and Swain). A total of 52 species remained after this cut, and included 20 plant species, 31 terrestrial animal species, and 1 aquatic animal species. A list of the 52 species, including a brief habitat description, is provided in the appendices to this EA.

Each list was further narrowed by eliminating those species requiring habitats not found within the proposed treatment areas. Species with well-defined habitat requirements (spray cliffs, granitic domes, caves, rock outcrops, talus slopes, bogs, wetlands, spruce-fir forests, etc.) were eliminated from further consideration.

Habitat preferences and ranges of these plant and animal species were based on a variety of sources, including the NCNHP database, USFS lists, NatureServe© database, personal communication with USFS personnel, and other reference materials. Natural community classification followed Schafale and Weakley (1990).

The following USFS specialists were consulted during the process of species evaluation: Doreen Miller - Nantahala National Forest wildlife biologist (retired); Jason Farmer - Nantahala National Forest fisheries biologist; Duke Rankin – former Nantahala National Forest botanist; Sheryl Bryan – National Forests in North Carolina wildlife biologist; and Gary Kauffman – National Forests in North Carolina botanist.

In an effort to ensure as complete an analysis as possible, the NCNHP database was queried for botanical and fisheries TES element occurrences within the general vicinity of the proposed treatment areas and, in the case of terrestrial wildlife, within two miles of the project vicinity for the action alternatives. No species tracked by NCNHP is known to occur within either proposed treatment areas; however, two species may occur in the proposed treatment area of Alternative B (Modified): the eastern small-footed bat (*Myotis leibii),* and the Indiana bat *Myotis sodalis*. One threatened and one sensitive species are known to occur within two miles of the project vicinity of Alternative B (Modified): the bog turtle (*Glyptemys muhlenbergii)* and Piedmont meadowrue (*Thalictrum macrostylum).* Habitat for the bog turtle is not present in the project areas, nor do the aquatic features connect habitats suitable for supporting populations of this species. Therefore, it was eliminated from further analysis. One threatened species, Piedmont meadowrue, is known to occur within two miles of the project vicinity of Alternative C. Potential effects on this species are discussed in Section 3.2.3.1.

3.2.3.1 Botanical Species

Of the 20 botanical species that remained after filtering by county, nine species remained for further analysis for Alternative B (Modified) and three species for Alternative C. These species remained because their general habitat requirements were present in a proposed treatment area. Table 3.2.3.1 lists the species with general habitat requirements in the proposed treatment areas.

Based on more specific habitat requirements, six of the nine Alternative B (Modified) species and one of the three Alternative C species do not have a high potential to occupy the proposed treatment areas.

Table 3.2.3.1. Botanical PET and forest sensitive species with general habitat requirements within the proposed treatment area of Alternative B (Modified) and C.

Designation	Scientific Name	Common Name	Specific Habitat Requirements	Likelihood of Occurrence	
				Alt B	Alt C
Sensitive	*Sceptridium jenmanii*	Alabama grape fern	no information available on specific habitat requirements	Not likely to occur	Not likely to occur
Sensitive	*Euphorbia purpurea*	glade spurge	mid- to high elevation rich cove with high nutrient soils	Likely to occur	Likely to occur
Sensitive	*Helianthus glaucophyllus*	whiteleaf sunflower	moist forests or woodland edges at mid-elevations, 3,200 to 4,900 feet.	Likely to occur	Likely to occur
Sensitive	*Juglans cinerea*	butternut	moist, nutrient-rich forests on lower slopes, ravines, or bottomland, floodplain forests.	Likely to occur	Not likely to occur
Sensitive	*Monotropsis odorata*	sweet pinesap	slopes or bluffs with abundant heaths, primarily *Rhododendron maximum*	Likely to occur	Not likely to occur
Sensitive	*Thalictrum macrostylum*	Piedmont meadowrue	rich wooded slopes, as well as cliffs, low meadows, and limestone sinks	Likely to occur	Not likely to occur
Sensitive	*Trillium pusillum* var. *ozarkanum*	Alabama least trillium	under *Quercus coccinea* and *Kalmia latifolia*	Not likely to occur	Not likely to occur
Sensitive	*Viola appalachiensis*	Appalachian violet	old roadbeds through coves	Likely to occur	Not likely to occur
Sensitive	*Drepanolejeunea appalachiana*	A liverwort	present in small, low-density populations throughout high-elevation, moist forests in the mountains..	Not likely to occur	Not likely to occur
Sensitive	*Prenanthes roanensis*	Roan rattlesnakeroot	wooded slopes or grassy balds above 4,000 feet	Not likely to occur	Likely to occur

No effects to these seven species or their habitats are anticipated. Species with a high potential of occupancy for either Alternative B (Modified) or C are discussed in the following pages.

Butternut (*Juglans cinerea*) Alternative B (Modified)
Environmental Baseline – General habitat for butternut includes rich cove forest, mesic oak-hickory forest, and montane alluvial forest. This species has a high potential to grow in moist, nutrient-rich forests (Weakley 2008) on lower slopes, ravines, or bottomland, floodplain forests. This species has high potential to occupy the proposed treatment area because it does include the high potential habitat described above.

Available Inventories Information - No previous surveys have been conducted in the project vicinity, although surveys have been conducted for unrelated Forest Service projects within 2-3 miles. *Juglans cinerea* was not documented during those surveys. In addition, FWA conducted surveys of the proposed treatment areas, and *Juglans cinerea* was not encountered.

Direct and Indirect Impacts- Because *Juglans cinerea* was not present in the proposed treatment area, nor has it been documented in the vicinity, no direct or indirect impacts are anticipated.

Cumulative Impacts- Due to the lack of direct and indirect impacts, there would be no cumulative impacts as a result of this project.

Piedmont meadowrue (*Thalictrum macrostylum*) Alternative B (Modified)
Environmental Baseline – General habitat for piedmont meadowrue includes serpentine forest and moist woods. This species has a high potential to occur on rich wooded slopes, as well as cliffs, low meadows, and limestone sinks. Weakley (2008) suggests it may be associated with circumneutral soils or serpentine barrens. The Perry Creek site may contain potential habitat; rich wooded slopes are present within the proposed treatment area. *Thalictrum macrostylum* was not documented in surveys of the treatment area conducted by FWA.

Direct and Indirect Impacts- Because *Thalictrum macrostylum* was not found in the proposed treatment area, no direct impacts are anticipated. Potential habitat exists, however, so an indirect loss of some potential habitat for this species would result if the project is implemented.

Cumulative Effects – No other past, present, or reasonably foreseeable activities affecting this species are proposed for either sites or access roads, therefore there would be no cumulative effects beyond those resulting from the proposed activities.

Appalachian violet (*Viola appalachiensis*) Alternative B (Modified)
Environmental Baseline – General habitat for Appalachian violet includes serpentine woodlands or rich cove forest. This species has a high potential to occur on old roadbeds through coves (Weakley 2008). This species has a high potential to occupy the proposed treatment area because the area includes an old roadbed through rich cove Forest.

Available Inventories Information - Previous surveys were conducted in the project vicinity prior to the silvicultural activity in 1996. *Viola appalachiensis* was not documented during that survey. FWA conducted surveys of the proposed treatment area for this project and *Viola appalachiensis* was not encountered.

Direct and Indirect Impacts- Because *Viola appalachiensis* was not found in the proposed treatment area, nor has it been documented in the project vicinity, no direct impacts are

anticipated. Positive indirect impacts could accrue from construction and management activities and road reconstruction that could create potential habitat. Negative indirect impacts could accrue from the same activities if noxious weeds or NNIS occupy potential habitat.

Cumulative Effects – No other past, present, or reasonably foreseeable activities affecting this species are proposed for either sites or access roads, therefore there would be no cumulative effects beyond those resulting from the proposed activities.

Whiteleaf sunflower (*Helianthus glaucophyllus*) Alternative C
Environmental Baseline - General habitat for whiteleaf sunflower includes Rich Cove Forest, Northern Hardwood Forest, High Elevation Red Oak Forest, Mesic Oak-Hickory Forest, and roadsides. This species has a high potential to occur in moist forests or woodland edges at mid-elevations, 3,200 to 4,900 feet. This species has a lower potential to occur at elevations below 3,200 feet (Weakley 2008). This species was not observed during surveys conducted by FWA personnel.

Direct and Indirect Impacts- Due to the lack of high potential habitat and not observing the species during field surveys, no direct impacts are anticipated. Constructing the facility would result in more sunlight along forest edges around the facility and the roads leading to it. This would have an indirect impact by creating suitable habitat.

Cumulative Effects – No other past, present, or reasonably foreseeable activities affecting this species are proposed for either sites or access roads, therefore there would be no cumulative effects beyond those resulting from the proposed activities.

Roan rattlesnakeroot (*Prenanthes roanensis*) Alternative C
Environmental Baseline – Habitat for *Prenanthes roanensis* has been described as mountain forests and grassy balds at high elevations (Weakley 2008), as well as rich woods; moist grass sites or heath balds; moist, open, wooded slopes; roadsides and parking areas; along trails, and borders of and clearings in forests. Little information is available on the specific habitat requirements, however, it appears open habitats may be preferred. This species was not observed during surveys conducted by FWA personnel.

Direct and Indirect Impacts- This species was not observed during field surveys, no direct impacts are anticipated. Constructing the facility would result in more sunlight along forest edges around the facility and the roads leading to it. This would have an indirect impact by creating suitable habitat.

Cumulative Impacts- No other past, present, or reasonably foreseeable activities affecting this species are proposed for either sites or access roads, therefore there would be no cumulative effects beyond those resulting from the proposed activities.

Determination of Effect

Because **no endangered or threatened plant species were located** in the proposed treatment areas, there would be **no direct, indirect or cumulative effects** to any endangered or threatened

plant species. Consultation with the U. S. Fish and Wildlife Service is not required for botanical species.

For the sensitive plant species *Juglans cinerea, Thalictrum macrostylum, Helianthus glaucophyllus,* and *Prenanthes roanensis*, **the project may impact individuals, but is unlikely to affect the viability of the species across the forest as a whole or lead to a trend towards federal listing**. For all other sensitive plant species, there would be **no direct impact to any sensitive plant species because they were not located in the proposed treatment areas**. Positive indirect effects include increases in potential habitat for *Viola appalachiensis, Helianthus glaucophyllus,* and, at Chestnut Branch, *Prenanthes roanensis*. Negative indirect effects include potential increases in competition from noxious weeds and non-native invasive species for *Viola appalachiensis*.

3.2.3.2 Wildlife Species

Of the 31 terrestrial species that remained after filtering by counties, a total of 15 species remained for further analysis, based on general habitat requirements of those species. Table 3.2.3.2 lists the species whose general habitats occurred within the proposed treatment areas. Based on more specific habitat requirements, four species had a high potential to occupy the proposed treatment areas of both Alternative B (Modified) and Alternative C. No effects or impacts to the remaining 11 species or their habitats are anticipated.

Table 3.2.3.2. Terrestrial wildlife PET and forest sensitive species with general habitat requirements within the proposed treatment area of Alternative B (Modified) and C.

Designation	*Scientific Name* Common Name	Specific Habitat or Distribution	Analyzed Further?
Endangered	*Puma concolor couguar* Eastern Cougar[1]	extensive forests in remote areas	No, presumed extirpated
Endangered	*Myotis sodalis* Indiana Bat[1]	hollow trees or under loose bark of living or dead trees standing in sunny openings	**Yes**
Sensitive	*Callophrys irus* Frosted Elfin[3] (a butterfly)	open woods or forest edges with *Baptisia sp*. and *Lupinus sp*.	No, specific habitat not present
Sensitive	*Corynorhinus rafinesquii rafinesquii* Rafinesque's Big-eared Bat[1]	abandoned buildings or caves for summer roosting and maternity colonies	No, specific habitat not present
Sensitive	*Desmognathus santeetlah* Santeetlah Dusky Salamander[1]	Unicoi Mountains, Great Smoky Mountains National Park, and Great Balsam Mountains	No, outside of local range
Sensitive	*Microtus chrotorrhinus carolinensis* Southern Rock Vole[3]	Rocky areas in spruce-fir, northern hardwoods, and grassy balds	No, specific habitat not present
Sensitive	*Myotis leibii* Small-footed bat[1]	Hemlock forests, rock crevices, caves, mines, buildings	**Yes**
Sensitive	*Nesticus silvanus* Cave spider[3]	spruce-fir forests	No, specific habitat not present
Sensitive	*Paravitrea placentula* Glossy Supercoil[1] (snail)	associated with *Betula alleghaniensis* and *Tsuga canadensis*	No, specific habitat not present

Designation	*Scientific Name* Common Name	Specific Habitat or Distribution	Analyzed Further?
Sensitive	*Plethodon aureolus* Tellico Salamander[1]	restricted range in Monroe and Polk Counties, TN; & Cherokee and Graham Counties, NC	No, outside of local range
Sensitive	*Plethodon teyahalee* Southern Appalachian Salamander[1]	mature, mesic, hardwood forests	**Yes**
Sensitive	*Sorex palustris punctulatus* Southern Water Shrew[2]	streambanks of medium-sized streams, with rhododendron cover	No, specific habitat not present
Sensitive	*Speyeria Diana* Diana Fritillary[1] (a butterfly)	mesic, cove forests with *Viola sp*. below 4,000 feet	**Yes**
Sensitive	*Thryomanes bewickii altus* Appalachian Bewick's Wren[3]	woodland borders or openings, farmlands, or brushy fields more often at high elevations	No, specific habitat not present

[1]General habitat requirements for these species were present in the proposed treatment areas of both Alts B and C.
[2]General habitat requirements for these species were present in the proposed treatment area of Alternative B (Modified).
[3]General habitat requirements for these species were present in the proposed treatment area of Alternative C.

Indiana bat (*Myotis sodalis*) – Alternatives B (Modified) and C

Environmental Baseline – In summer, habitat consists of wooded or semiwooded areas. This species has high potential to occur in hollow trees or under loose bark of living or dead trees standing in sunny openings. This habitat is used by small maternity colonies to bear their offspring. Though maternity sites have been reported as occurring mainly in riparian and floodplain forests, recent studies indicate that upland habitats are used by maternity colonies much more extensively than previously reported. In recent years, colonies of reproductively active female Indiana bats have been documented in nearby Graham and Cherokee Counties in North Carolina. In winter, caves are utilized for hibernation. Most caves and cave-like habitats in western North Carolina do not have suitable conditions to provide wintering habitat for Indiana bats.

Due to the lack of suitable maternity colony trees at the proposed sites (large trees with exfoliating bark located in sunny areas), this species does not have a high potential to utilize either of the proposed treatment areas for maternity sites. It is possible that either site could be utilized periodically for foraging; however, the habitat at both sites would be considered suboptimal for foraging Indiana bats as well, due to the limited availability of riparian and floodplain trees which are considered optimal foraging habitat. Roads to the site could be utilized by individuals as travel corridors. To reduce the likelihood of direct effects to Indiana bats and indirect effects to Indiana bat habitat, this project would comply with the Terms and Conditions in the Biological Opinion of the U. S. Fish and Wildlife Service for the protection of the Indiana bat on the Nantahala and Pisgah National Forests.

Available Inventories Information – No mist net surveys have been conducted in the project vicinity. However, a qualitative assessment for potential roost trees was conducted at both sites. No potential roost trees were documented in either of the proposed treatment areas.

Direct and Indirect Effects – Based on the lack of suitable or potential roost trees that would be affected, effects on the Indiana bat population would be unlikely, and would not reach the scale

where an adverse effect or actual take occurs. The sequence of events that would result in a tree being cut down in which a bat is roosting is unlikely; therefore, direct effects to Indiana bats should not occur.

At either proposed site, approximately 3-5 acres of foraging habitat would be affected as a result of this project. Indiana bats are known to use highly altered and fragmented landscapes. They may respond favorably to habitat disturbance, particularly where forests are even-aged and closed-canopied.

Cumulative Effects – The effects of this project, when combined with other projects affecting Indiana bats in the five-county area currently subject to the terms and conditions of the Biological Opinion, would not exceed the allowable take as specified in the Biological Opinion (USFWS 2010).

Determination of Effect – Alternatives B (Modified) and C **may affect, but are not likely to adversely affect** the Indiana bat (*Myotis sodalis*). This species has not been documented near either of the proposed treatment areas; nor within Clay County. Habitat within the proposed treatment areas is not suitable for maternity colonies, and is not optimal for foraging. The probability of either of the proposed treatment areas being used by Indiana bats is very low. Standards and guides for the protection of this species, as listed in Amendment 25of the Land and Resource Management Plan, would also be followed to ensure that the project would have no effect on this species. The alternatives included in this project would have no effect on any other federally proposed or listed terrestrial animal species.

Eastern small-footed bat (*Myotis leibii*) – Alternatives B (Modified) and C
Environmental Baseline - This species is thought to roost in hemlock forests, rock crevices, caves, mines, bridges or buildings, and uses other habitats for feeding. Little is known regarding summer nursery sites and summer foraging or roosting habitat.

Direct and Indirect effects - In Alternatives B (Modified) and C, tree felling operations to clear sites could impact individuals through direct crushing. Creating openings in the canopy could improve feeding habitat for forest bats, which are attracted to the insects supported by grassy/brushy habitat areas. No special roosting habitats, such as hemlock forests, rock crevices, caves, mines, bridges or buildings would be adversely affected. Road construction should not affect the habitat. Individuals may use roads as travel corridors.

Cumulative Effects **–** No other past, present, or reasonably foreseeable activities affecting this species are proposed for either sites or access roads, therefore there would be no cumulative effects beyond those resulting from the proposed activities.

Determination of Effect - This species has been collected from most counties in western North Carolina, although it is rarely trapped during mist-netting surveys. The species has probably benefited from past forest management, which created new forest openings to offset the concurrent maturation of other forest stands. This project may impact individuals of this species, but benefit the foraging habitat. This project is not likely to cause a trend to federal listing or a loss of viability across the Forest.

Southern Appalachian salamander (*Plethodon teyahalee*) - Alternatives B (Modified) and C
Environmental Baseline - This species occurs in forests made up of birch, beech, hemlock, witch hazel, mountain laurel, and rhododendron. Adults have been found up to 5,000 feet in elevation. The highest densities of this species were in mature, mesic, hardwood forests (Petranka 1998); however the species has been recorded in a wide variety of forest types and elevations within the Nantahala National Forest. This species has potential to occur in both of the proposed treatment areas, as they include many of the associate botanical species listed above.

Direct and Indirect Effects – Direct impacts to *Plethodon teyahalee* may result during land clearing activities. Individuals within either of the treatment areas could be subject to crushing or displacement during construction, crushing by vehicles traveling to and from the site, and by the use of sediment traps. Indirect impacts include the loss of 3-5 acres) of suitable habitat with either Alternative B (Modified) or C.

Cumulative Effects – No other past, present, or reasonably foreseeable activities affecting this species are proposed for either sites or access roads, therefore there would be no cumulative effects beyond those resulting from the proposed activities.

Determination of Effect – This project may impact individuals but is not likely to cause a loss of viability across the Forest or a trend toward federal listing.

Diana fritillary (*Speyeria diana*) - Alternatives B (Modified) and C
Environmental Baseline – This butterfly species is found in moist forests in the southwestern mountains at all elevations and has been observed in various habitats. It is thought to be fairly common across Graham, Swain, Cherokee, Clay and Macon counties. The adults nectar on joe-pye-weed, ironweed, and butterflyweed; violets are important for the larvae which feed on the foliage. The species occurs in different forest types, but seems to prefer roadsides through cove forests. Both of the proposed treatment areas contain mesic deciduous forests; however, neither site supports an abundance of violets.

Direct and Indirect Effects – If individual adults or larvae are present on either proposed activity area at the time of land clearing, direct impacts to *Speyeria diana* include crushing or displacement. The likelihood of direct impacts is relatively low, since neither site supports an abundance of violets, and maintenance of existing roadsides would not change. Construction of a shooting range at either site would not eliminate roadside habitat; indirect impacts would likely be positive, as edge habitat would be created around the perimeter of the shooting range. Airborne road dust from vehicular traffic may cover plants used by adults and larvae, reducing individual survival, and may coat eggs, reducing hatching. Construction would result in conditions favorable to plants used by adults for nectaring.

Cumulative Effects – No other past, present, or reasonably foreseeable activities affecting this species are proposed for either sites or access roads, therefore there would be no cumulative effects beyond those resulting from the proposed activities.

Determination of Effect – This species has benefited from past forest management, which created new forest roadside habitat. Neither alternative would eliminate current roadside habitat. Both alternatives would create permanent edge habitat at the perimeter of the shooting range, which

could provide new habitat for this species. This project may impact individuals but is not likely to cause a trend to federal listing or a loss of viability.

3.2.3.3 Aquatic Species

One aquatic species remained after filtering by county, *Cambarus parrishi*. This species occurs in the headwaters of the Hiwassee River. No streams occur within the immediate treatment areas and there would be no impacts to streams in the project vicinity. BMPs would be used to control sediment and erosion and to prevent or minimize lead contamination. No direct, indirect, or cumulative effects on this species or its habitat are anticipated.

Because no threatened, endangered, or sensitive aquatic species were located in the proposed treatment areas, there would be no direct, indirect or cumulative effects to any endangered or threatened or sensitive aquatic species.

3.2.4 Biological Communities, Special Habitats, and MIS

The following three tables support the analysis that follows for biological communities, special habitats, and management indicator species (MIS).

Table 3.2.4.1. Biological communities and associated Management Indicator Species (Amendment 17, 2005).

Biological Community	Management Indicator Species (MIS)	Analyzed Further/Evaluation Criteria*	
		Alt B	Alt C
Fir dominated communities at high elevations	Fraser fir	No	No
Northern hardwood forests	Ramps	No	Yes
Carolina hemlock forests	Carolina hemlock	No	No
Rich Cove forests; mesic mixed mesophytic communities	Ginseng	Yes	No
Xeric yellow pine forests	Pine warbler	No	No
Reservoirs	Largemouth bass	No	No
Riparian forests	Acadian flycatcher	No	No
Coldwater streams	Wild Brook, Brown, and Rainbow Trout	No	No
Coldwater streams	Blacknose dace	No	No
Warmwater streams	Smallmouth bass	No	No

The only biological communities that occur in the activity areas are northern hardwood forests (Alternative C) and rich cove, mesic mixed mesophytic forest (Alternative B (Modified)). MIS representing these communities are ramps and ginseng, respectively. Therefore the MIS associated with the other biological communities will not be analyzed further.

Table 3.2.4.2. Special habitats and associated Management Indicator Species (using Forest Plan EIS, Table III-9 and Amendment 17).

Special Habitats	Management Indicator Species (MIS)	Analyzed Further/Evaluation Criteria*	
		Alt B (Mod)	Alt C
Old Forest Communities (100+ years old)	Black bear	No	No
Early successional (0-10 years old)	Rufous-sided (eastern) towhee	No	No
Early successional (11-20 years old)	Ruffed grouse	Yes	No
Soft mast-producing species	Ruffed grouse	Yes	Yes
Hard mast-producing species (>40 years)	Black bear	No	Yes
Large contiguous areas with low levels of human disturbance	Black bear	Yes	Yes
Large contiguous areas of mature deciduous forest	Ovenbird	No	Yes
Permanent grass/forb openings	White-tailed deer	No	No
Snags	Pileated woodpecker	No	Yes
Downed woody debris	Ruffed Grouse	Yes	Yes

The special habitats in the project areas are Early successional (11-20), soft mast producing species, hard mast producing species, large contiguous areas, snags, and downed woody debris. Species representing these would be analyzed further: ruffed grouse, black bear, ovenbird, and pileated woodpecker.

Table 3.2.4.3. MIS species to be analyzed, estimated population trend, and biological community or special habitat indicated by the species (using Forest Plan EIS, Table III-9 and Amendment 17).

MIS	Population Trend (estimate)	Associated Biological Community or Special Habitat Component		
Black Bear	Increasing	Hard mast-producing species	Contiguous areas with low disturbance	
Pileated Woodpecker	Stable	Snags and dens (>22 dbh)		
Ovenbird	Stable	Large Contiguous Forest Areas		
Ruffed Grouse	Stable	Soft mast producing species	Early successional (11-20)	Downed woody debris
Ginseng	Decreasing	Rich cove forests		
Ramps	Stable	Northern hardwoods		

Management Indicator Species (MIS) monitor Forest Plan implementation and effects on diversity and population viability of all native and desirable non-native plants and animals.

3.2.4.1 Biological Communities

Of the ten biological communities designated for MIS analysis in the Forest Plan, two are contained in the proposed range sites: rich cove/mesophytic forests in Alternative B (Modified), and northern hardwood forests in Alternative C (Table 3.2.4.1). Because these biological

communities were located in the proposed treatments areas, additional analyses to determine effects were conducted. Because the other biological communities were not located in the proposed treatment areas, they should exhibit no effects from the project, and therefore were excluded from further analysis.

Effects by Alternative

Alternative A
Alternative A is the No Action Alternative. Given that there are young, developing stands at both of the proposed range sites, forest succession processes would continue as influenced by natural and human-induced disturbances. Habitat conditions would change over time, influenced by changes in the structure and composition of the vegetation communities.

Alternative B (Modified)
This site would be accessed by a single lane road connecting the proposed parking area with Passmore Spur Road. Although classified as new construction, this road would be located in an existing template of a temporary timber road used by heavy equipment during a silvicultural treatment in 1996. This old road bed contains approximately 0.6 acres of young rich cove forest. Road improvements and widening would impact the community, resulting in the loss of this vegetation (Table 3.2.4.4). This effect is so small that there would be no change in the distribution of this community across the Forest.

Table 3.2.4.4. Estimated changes in biological communities as a result of the Clay County Shooting Range Project.

Biological Community	Alternative A	Alternative B (Modified)	Alternative C
Northern hardwood forests	None affected.	None affected.	Approximately 3-5 acres would be permanently impacted.
Rich Cove forests; mesic mixed mesophytic communities	None affected.	Approximately 0.6 acres would be permanently impacted.	None affected.

Alternative C
The proposed treatment area is comprised of northern hardwood forest with elements of high elevation red oak forest. Approximately three to five acres would be permanently cleared for the proposed shooting range (Table 3.2.4.4), resulting in a loss of three to five acres of this community. This effect is so small that there would be no change in the distribution of this community across the Forest.

Cumulative Effects **–** There would be no cumulative effect from this project on the distribution of communities across the Forest.

3.2.4.2 Special Habitats

Of the ten special habitats designated for MIS analysis in the Forest Plan, a total of six occur in at least one of proposed treatment areas (Table 3.2.4.2). Because these special habitats were located in the proposed treatments areas, they underwent additional analysis for effects. Since the

other special habitats listed in Table 3.2.4.2 were not located in the proposed treatment areas, they should exhibit no effects from the project and were excluded from further analysis.

Effects by Alternative

Alternative A
Alternative A is the No Action Alternative. Given that there are young, developing stands at both of the proposed range sites, forest succession processes would continue as influenced by natural and human-induced disturbances. Habitat conditions would change over time, influenced by changes in the structure and composition of the vegetation communities.

Alternative B (Modified)
Three special habitats occur within the activity area: early successional habitat (11-20 years), soft-mast producing species, and downed woody debris. The site is located in 11-20 year old early successional habitat created by previous silvicultural activities. Two soft-mast producing species were observed within the activity area: blackberries and grapes. Downed woody debris on the site included small branches, twigs, and a few large logs. A fourth special habitat, contiguous areas with low disturbance, surrounds the proposed treatment area, may be indirectly affected by noise and traffic, and therefore also underwent additional analysis for effects. These special habitats are associated with two MIS species, ruffed grouse and black bear (3.2.4.3).

In the short term, soft-mast producing species would be negatively impacted by construction activities. In the long term, however, soft-mast producing species may reestablish along the perimeter of the treatment area, producing a net positive effect, if the re-established soft mast species are more common than the current condition. Downed woody material in the proposed treatment area would be removed during construction, producing a negative effect of three to five acres of lost special habitat. In the context of the extensive forest community surrounding the proposed treatment area, however, this represents a minimal decrease in potential habitat. The indirect effects of noise and traffic to the surrounding areas of contiguous forest with low disturbance would increase when the shooting range is in use, and would continue for the life of the range. Noise and traffic, however, would be mitigated to some degree by construction techniques.

Alternative C

Five special habitats occur within the activity area: soft-mast producing species, hard-mast producing species, downed woody debris, snags, and large contiguous forest with low levels of human disturbance. Four soft-mast producing species were observed within the activity area: *Prunus spp*., *Smilax spp*., *Vitis sp*. and *Rubus spp*. Hard-mast producing species were *Quercus spp*. and *Carya spp*. Downed woody debris on the site included small branches, twigs, and a few large logs. A few short snags were present in the proposed treatment area. The proposed treatment area is located on forest lands with low levels of human disturbance. These special habitats are associated with four MIS species, ruffed grouse, black bear, pileated woodpecker, and ovenbird (Table 3.2.4.3).

In the short term, soft-mast producing species would be negatively impacted by construction activities. In the long term, however, soft-mast producing species may reestablish along the perimeter of the treatment area, producing a net positive effect, if the re-established soft mast species are more common than the current condition. The indirect effects of noise and traffic to the surrounding areas of contiguous forest with low disturbance would increase when the range is in use, and would continue for the life of the range. Noise and traffic, however, can be mitigated to some degree by construction techniques.

Approximately three to five acres of hard mast producing species, downed woody material, snags and large, contiguous mature forest would be permanently lost. In the context of the extensive forest community surrounding the proposed treatment area, however, this represents a minimal decrease in potential habitat.

Cumulative Effects **–** Direct and indirect effects to the special habitats are so small that there would be no change in the distribution of these special habitats across the Forest.

3.2.4.3 Management Indicator Species

Management Indicator Species Alternative A
Alternative A is the no action alternative. Given that there are young, developing stands at both of the proposed range sites, forest succession processes would continue as influenced by natural and human-induced disturbances. Habitat conditions would change over time, influenced by changes in the structure and composition of the vegetation communities. Some of those changes would result in short-term increases and decrease in management indicator species, consistent with natural processes in the forest.

Management Indicator Species Alternative B (Modified)
All MIS potentially affected by Alternative B (Modified), as determined by the analyses for Biological Communities and Species Habitats, underwent further analysis for species-specific effects (see Table 3.2.4.3 on page 33 and Table 3.2.4.5 on page 37).

Ginseng (*Panax quinquefolius)*
Ginseng (*Panax quinquefolius*) prefers rich cove forest on slopes or ravines in the Southern Appalachians. Often these forests have a relatively sparse shrub understory. Although soil characteristics can vary, vigorous populations are typically found in soils that are acidic, well-drained, and have a good humus component. Ginseng often occurs on north- and east-facing slopes, but has also been documented on all aspects. Estimated population trends are decreasing on Nantahala-Pisgah Forest lands.

Ginseng was not observed during the field surveys. The Perry Creek site located within rich cove forest does not itself have rich cove characteristics.. Sapling size hardwoods are present creating a dense shrub layer, which is considered suboptimal ginseng habitat.

Direct and Indirect Effects. Implementation of Alternative B (Modified) would result in the permanent loss of approximately three to five acres of suitable but suboptimal habitat within the proposed treatment area and associated access road.

Table 3.2.4.5. Estimated changes in special habitats as a result of the Clay County Shooting Range Project.

Special Habitats	Alternative A	Alternative B (Modified)	Alternative C
Old forest communities (100+ years old)	None affected.	None affected.	None affected.
Early successional communities (0-10 yr)	None affected.	None affected.	None affected.
Early successional communities (11-20 yr)	None affected.	Three to five acres would be impacted.	None affected.
Soft mast-producing species	None affected.	Short term: soft-mast producing species would be impacted. Long term: soft-mast producing species may reestablish along the perimeter of the treatment area.	Short term: soft-mast producing species would be impacted. Long term: soft-mast producing species may reestablish along the perimeter of the treatment area.
Hard mast-producing species	None affected.	None affected.	Hard-mast producing species in the 3 to 5 acre treatment area would be impacted.
Contiguous areas with low disturbance	None affected.	The amount of disturbance would increase during shooting and construction activities.	The amount of disturbance would increase during shooting and construction activities.
Large contiguous mature forest	None affected.	None affected.	Three to five acres of mature forest would be impacted.
Permanent grass/forb openings	None affected.	None affected.	None affected.
Snags	None affected.	None affected.	The few snags present in the treatment area would be permanently impacted.
Downed woody material	None affected.	Downed woody material in the footprint of the proposed treatment area would be removed.	Downed woody material in the footprint of the proposed treatment area would be removed.

Cumulative Effects. No direct impacts to ginseng are anticipated. Indirect impacts to ginseng are limited to the long-term loss of approximately three to five acres of suitable habitat in the analysis area. The cumulative effect of the project, therefore, is the long-term loss of approximately three to five acres of suitable habitat. Due to the limited extent of habitat loss, compared to the much larger amount of habitat available across the Forest, this cumulative effect would not alter the current population trend of ginseng on the Nantahala/Pisgah National Forest lands.

Ruffed grouse (*Bonasa umbellus*)

Ruffed grouse prefer dense, young forest with available drumming logs. Both breeding and nesting habitats occur in this type of forest, although nesting habitats may be less dense in young forest. A ruffed grouse diet typically consists of foliage, fruits, and insects. A ruffed grouse was heard drumming along the single-lane road during the January 2009 survey. The estimated population trend on the Nantahala-Pisgah Forest lands is stable.

Special habitats present in the proposed treatment area that are associated with this species include soft mast-producing species, early successional habitat, and downed woody debris. Two

soft mast-producing species were present within the proposed treatment area, *Rubus sp*. and *Vitis sp*. A few suitable drumming logs and an abundance of downed twigs were present in the proposed treatment area.

Direct and Indirect Effects. Alternative B (Modified) may have direct impacts on ruffed grouse if construction is conducted during the nesting season (early April to mid-June). Due to the mobility of the species, direct impacts are unlikely if construction is conducted outside of the nesting season. Negative indirect impacts include a three to five acre loss of early successional habitat and a loss of downed woody debris.

Cumulative Effects. Due to the limited and localized impacts anticipated for ruffed grouse, the cumulative effect of the project should be minimal, and highly unlikely to change the overall population trend for the ruffed grouse on the Nantahala-Pisgah Forest lands.

Black bear (*Ursus americanus*)
Black bear prefers large areas of mixed forest with a thick understory and low levels of human disturbance. During inactive periods, black bears den in hollow logs, above-ground tree cavities, under fallen logs, or underground, cave-like areas. The estimated population trend on the Nantahala-Pisgah Forest lands is increasing.

No evidence or sightings of black bear were observed during the field surveys. No den habitat was available in the proposed treatment area. The possibility of black bear foraging or passing through the proposed treatment area is likely.

Direct and Indirect Effects. Alternative B (Modified) would have no direct impacts on black bear. Indirect impacts on black bear would include avoidance of the area during shooting activities and construction. The project would decrease contiguous forest habitat by three to five acres.

Cumulative Effects. The cumulative effects of the project are the same as the indirect effects: avoidance of the area, and the loss of three to five acres of potential habitat. In comparison to the amount of potential habitat in the surrounding forest communities, however, these effects are highly to change the overall population trend for the black bear on the Forest.

Management Indicator Species Alternative C
All MIS potentially affected by Alternative C, as determined by the analyses for Biological Communities and Species Habitats, underwent further analysis for species-specific effects.

Ramps (*Allium tricoccum*)
Ramps occur in northern hardwood forests, cove forests, and mesic slopes. Ramps are sensitive to changes in light and soil moisture, which make them a good MIS for the northern hardwood forest community. The estimated population trend on the Nantahala-Pisgah Forest lands is stable.

No ramps were observed in the proposed treatment area. The treatment area was considered northern hardwood forest with high elevation red oak forest components. The latter forest type

indicates the proposed treatment area is more xeric than mesic and therefore may not be suitable for ramps.

Direct and Indirect Effects. Alternative C would have no direct or indirect impacts on ramps due to the lack of plants in the treatment area, as well as lack of suitable habitat.

Cumulative Effects. Due to the lack of direct and indirect impacts, there would be no cumulative impacts as a result of this project.

Ruffed grouse (*Bonasa umbellus*)
Ruffed grouse prefer dense, young forest with available drumming logs. Both breeding and nesting habitats occur in this type of forest, although nesting habitats may be less dense while still occurring in young forest. A ruffed grouse diet typically consists of foliage, fruits, and insects. The estimated population trend on the Nantahala-Pisgah Forest lands is stable.

Special habitats present in the proposed treatment area associated with this species include soft mast-producing species and downed woody debris. Four soft mast-producing species were present within the proposed treatment area, *Prunus spp*., *Smilax sp*., *Rubus sp*. and *Vitis sp*. A few suitable drumming logs and downed twigs were present in the proposed treatment area.

Direct and Indirect Effects. Alternative C may have direct impacts on ruffed grouse if construction is conducted during the nesting season (early April to mid-June). Due to the mobility of the species, direct impacts are unlikely if construction is conducted outside of the nesting season. Negative indirect impacts include a three to five acre loss of habitat with soft-mast producing species and downed woody debris. Species that grow in open areas, such as *Rubus* spp., may reestablish along the perimeter of the treatment area.

Cumulative Effects. Due to the limited and localized impacts anticipated for ruffed grouse, the cumulative effect of the project would be minimal, and unlikely to change the overall population trend for the ruffed grouse on the Nantahala-Pisgah Forest lands.

Black bear (*Ursus americanus*)
Black bear prefers large areas of mixed forest with a thick understory and low levels of human disturbance. During inactive periods, black bears den in hollow logs, an above-ground tree cavity, under a fallen log, or underground, cave-like areas. The estimated population trend on the Nantahala-Pisgah Forest lands is increasing.

No evidence or sightings of black bear were observed during the field surveys. No den habitat was available in the proposed treatment area. The possibility of black bear foraging or passing through the proposed treatment area is likely.

Direct and Indirect Effects. Alternative C would have no direct impacts on black bear. Indirect impacts on black bear would include avoidance of the area during shooting activities and construction. The project would decrease contiguous forest habitat by three to five acres.

Cumulative Effects. The cumulative effects of the project are the same as the indirect effects: avoidance of the area, and the loss of three to five acres of potential habitat. In comparison to the amount of potential habitat in the surrounding forest communities, however, these effects are unlikely to change the overall population trend for the black bear on the Forest.

Pileated woodpecker (*Dryocopus pileatus*)
Pileated woodpecker prefers dense, deciduous forests with a tall, closed canopy and high basal area. Nests are built in cavities in snags, usually shaded, and typically 16 to 55 feet above the ground. The pileated woodpecker primarily feeds on carpenter ants and beetle larvae by chiseling into trees, stumps, or logs. It would also eat other insects, fruit, and seeds. The estimated population trend on the Nantahala/Pisgah Forest lands is stable.

A pileated woodpecker was heard near the project vicinity. Snag trees were present that may provide suitable nesting habitat; however, most of the snags may be too low to the ground for nest cavities (below 16 feet). The possibility of a pileated woodpecker foraging in the proposed treatment area is likely.

Direct and Indirect Effects. No direct impacts are anticipated. Indirect impacts are limited to the loss of small snags and downed debris for foraging.

Cumulative Effects. Due to the limited extent of impacts, and abundance of nesting and foraging habitat across the forest, especially in comparison to the amount of potential habitat in the surrounding forest communities, these effects are unlikely to change the overall population trend for pileated woodpeckers on the Forest.

Ovenbird (*Seiurus aurocapilla*)
Ovenbird nests in older, closed deciduous or mixed forest with deep leaf litter and little understory. The ovenbird has been documented nesting in the following forest types: oak-hickory, oak-pine, maple-basswood, maple-birch, maple-birch-beech, hemlock, aspen, and spruce. The estimated population trend on the Nantahala/Pisgah Forest lands is stable.

The ovenbird was not documented during field surveys, although adequate habitat was present in the proposed treatment area. The possibility of an ovenbird foraging or nesting in the treatment area is likely.

Direct and Indirect Effects. Alternative C may have direct impacts to this species if construction activities are conducted during the nesting season. Due to the mobility of the species, direct impacts are unlikely if construction was conducted outside of the nesting season. Indirect impacts on the ovenbird may include avoidance of the area during shooting activities and construction. The action would result in a loss of three- to five-acres within contiguous forest habitat.

Cumulative Effects. In comparison to the amount of potential habitat in the surrounding forest communities, these effects are unlikely to change the overall population trend for the ovenbirds on the Forest.

3.2.5 Forest Concern Species

Fish and Wildlife Associates, Inc. conducted field surveys of the proposed treatment area at Perry Creek (Alternative B (Modified)) during September 2007, October 2007, and January 2009. Field surveys of the Chestnut Branch area (Alternative C) occurred on October 2008 and January 2009.

The Nantahala-Pisgah National Forests maintains a list of Forest Concern (FC) species on NFS lands; all of these species were originally considered (see Appendix C). The list was filtered by considering only those species listed by the North Carolina Natural Heritage Program (NCNHP) or the United States Fish and Wildlife Service (USFWS) as occurring or probably occurring in Clay County, with the exception of terrestrial wildlife. Due to the mobility of terrestrial wildlife, the filtered list also included species occurring or probably occurring in nearby counties (Cherokee, Graham, Macon, and Swain). A total of 82 species remained after this filter, and included 36 plant species, 37 terrestrial animal species, and 9 aquatic animal species. Appendix D contains lists of these species.

Each list was further narrowed by eliminating those species requiring well-defined habitat habitats, such as spray cliffs, granitic domes, caves, rock outcrops, talus slopes, bogs, wetlands and spruce-fir forests, that were not found within the proposed treatment areas. Habitat preferences and ranges of these plant and animal species were based on a variety of sources, including the NCNHP database, USFS (TES, FC and MIS) lists, NatureServe© database, personal communication with USFS personnel, and other reference materials. Natural community classification followed Schafale and Weakley (1990).

Aquatic Species

Nine aquatic Forest Concern Species are known to occur in Nantahala/Pisgah National Forest and Clay County. No aquatic habitats are present within either of the proposed treatment areas. An intermittent stream runs along a portion of the approach road to the Alternative B (Modified) proposed treatment area, which would be unlikely to support any aquatic organisms. Appropriate sediment and erosion control measures would be taken to control impacts to the intermittent stream. Because no aquatic habitats that are likely to support aquatic species are present in the proposed treatment area, no forest concern species would be further analyzed.

3.2.5.1 Botanical Species

After removing species that require specialized habitats not present in the analysis area, the list was further narrowed by eliminating species with general habitat requirements not found in the proposed treatment areas.

Alternative A

Alternative A is the no action alternative. Given that there are young, developing stands at both of the proposed range sites, forest succession processes would continue as influenced by natural and human-induced disturbances. Habitat conditions would change over time, influenced by changes in the structure and composition of the vegetation communities. Some of these changes may benefit forest concern species.

Alternative B (Modified)

Of the 36 botanical forest concern species occurring in Clay County, 16 species were considered to have potential habitat in the proposed treatment area (Table 3.2.5.1). The NCNHP Virtual Workroom was accessed to determine if any of the 16 botanical species occur within the proposed treatment area. No botanical species were listed as occurring within the proposed treatment area, but *Carex leptonervia*, *Carex woodii*, *Carex purpurifera*, *Hackelia virginiana*, and *Parnassia grandifolia* have been documented within two miles of the project vicinity.

Table 3.2.5.1. Botanical forest concern species occurring in Clay County, with general habitat requirements occurring in the proposed treatment area of Alternative B (Mod.)

Group	Species	Common Name	Habitat*
Vascular Plant	*Brachyelytrum septentrionale*	Northern shorthusk	Serpentine Forest, Northern Hardwood Forest, **Rich Cove Forest**
Vascular Plant	*Carex cherokeensis*	Cherokee sedge	Montane Alluvial Forest, **Roadside**, **Rich Cove Forest**
Vascular Plant	*Carex leptonervia*	A wood sedge	Boulderfield Forest, Northern Hardwood Forest, High Elevation Seep, **Rich Cove Forest**
Vascular Plant	*Carex oligocarpa*	Few-fruited sedge	**Rich Cove Forest**
Vascular Plant	*Carex purpurifera*	Purple sedge	**Rich Cove Forest**, Montane Alluvial Forest
Vascular Plant	*Carex woodii*	Wood's sedge	Northern Hardwood Forest, **Rich Cove Forest**, Acidic Cove Forest, Mesic Oak-Hickory Forest
Vascular Plant	*Frasera caroliniensis*	Columbo	**Rich Cove Forest**, Mesic Oak-Hickory Forest
Vascular Plant	*Hackelia virginiana*	Virginia stickseed	**Woods and thickets**, circumneutral soils
Vascular Plant	*Hexalectris spicata*	Spiked crested coralroot	**Rich Cove Forest**, Glade, Mesic Oak-Hickory Forest, Mafic rock
Vascular Plant	*Liparis loeselii*	Yellow widelip orchid	Seep, **Roadside**
Vascular Plant	*Oenothera perennis*	Little evening primrose	Southern Appalachian Bog, **Roadside**
Vascular Plant	*Parnassia grandifolia*	Largeleaf grass-of-parnassus	Seep, Fen, Serpentine Woodland, **Roadside**, Mafic rock
Vascular Plant	*Platanthera grandiflora*	Greater purple fringed orchid	High Elevation Seep, Grassy Bald, **Roadside**, Northern Hardwood Forest
Vascular Plant	*Ranunculus fascicularis*	Early buttercup	**Roadside**, Serpentine Woodland
Vascular Plant	*Smilax hugeri*	Huger's carrionflower	**Rich Cove Forest**, Mesic Oak-Hickory Forest, Mafic Rock
Nonvascular Plant	*Scopelophila ligulata*	Ligulate scopelophila moss	Copper-rich soils, **Roadsides**

*Bolded habitat indicated presence in the proposed treatment area.

A community type known to support rare and endemic botanical species, Serpentine Forest, occurs within two miles of the project vicinity. Prior to the field survey, the potential for this community type to occur in the proposed treatment area was considered. Neither the treatment area, nor the surrounding habitat, had characteristics of Serpentine Forest. Serpentine habitats are

typically well-drained and lack nutrients. As described above, the site was located in Rich Cove Forest, a high nutrient community. As a result, species characteristically associated with serpentine habitats are unlikely to grow in rich cove forests.

Under Alternative B (Modified), there would be no direct, indirect, or cumulative impacts to any botanical forest concern species because none were found in field surveys, none have been documented, and/or none are known to occur within the proposed treatment area.

Alternative C

Of the 36 botanical forest concern species occurring in Clay County, 11 species were considered to have potential habitat in the proposed treatment area (Table 3.2.5.2). The NCNHP Virtual Workroom and Element Occurrences were accessed to determine if any of the 11 botanical species occur within the proposed treatment area. No botanical species were listed as occurring within the proposed treatment area; however, *Brachyelytrum aristosum*, *Carex leptonervia*, *Carex woodii*, *Cypridpedium parviflorum* var. *parviflorum*, and *Parnassia grandifolia* have been documented within two miles of the project vicinity. These species were not found during field surveys at the site.

Under Alternative C, there would be no direct, indirect, or cumulative impacts to any botanical forest concern species because none were found in field surveys, none have been documented, and/or none are known to occur within the proposed treatment area.

Table 3.2.5.2. Botanical forest concern species occurring in Clay County, and with general habitat requirements in the proposed treatment area of Alternative C.

Form	Species	Common Name	Habitat*
Vascular plant	*Brachyelytrum aristosum*	Northern Shorthusk	Serpentine Forest, **Northern Hardwood Forest**, Rich Cove Forest
Vascular plant	*Carex cherokeensis*	Cherokee Sedge	Montane Alluvial Forest, **Roadside**, Rich Cove Forest
Vascular plant	*Carex leptonervia*	A Wood Sedge	Boulderfield Forest, **Northern Hardwood Forest**, High Elevation Seep, Rich Cove Forest
Vascular plant	*Carex woodii*	Wood's Sedge	**Northern Hardwood Forest**, Rich Cove Forest, Acidic Cove Forest, Mesic Oak-Hickory
Vascular plant	*Cypripedium parviflorum var. parviflorum*	Small Yellow Lady's-slipper	**High Elevation Red Oak Forest**
Vascular plant	*Liparis loeselii*	Fen Orchid	Seep, **Roadside**
Vascular plant	*Oenothera perennis*	Perennial Sundrops	Southern Appalachian Bog, **Roadside**
Vascular plant	*Parnassia grandifolia*	Large-leaved Grass-of-parnassus	Seep, Fen, Serpentine Woodland, **Roadside**, mafic rock
Vascular plant	*Platanthera grandiflora*	Large Purple-fringed Orchid	High Elevation Seep, Grassy Bald, Roadside, **Northern Hardwood Forest**, Southern Appalachian Bog
Vascular plant	*Ranunculus fascicularis*	Early Buttercup	**Roadside**, Serpentine Woodland
Moss	*Scopelophila ligulata*	Copper Moss	Copper-rich Soils, **Roadsides**

*Bolded habitat indicated presence in the proposed treatment area.

3.2.5.2 Terrestrial Wildlife Species

Terrestrial wildlife Forest Concern species that require specialized habitats not present in either proposed activity area were eliminated from further analysis. Species that are endemic to an area outside of the project vicinity were also eliminated from further consideration. This left twenty-one terrestrial animal Forest Concern species to be evaluated further (Table 3.2.5.3).

Additionally, the NCNHP Virtual Workroom was accessed to determine if any of the species listed in Table 3.2.5.3 have been previously documented in either of the proposed treatment areas. None of these species have been documented within either treatment area; however four terrestrial animal Forest Concern species have been documented near one or both of the proposed treatment areas. One terrestrial species, long-tailed salamander (*Eurycea longicauda longicauda),* occurs within two miles of the proposed treatment area of Alternative B (Modified). Four terrestrial species, gorgone checkerspot (*Chlosyne gorgone),* long-tailed salamander *(Eurycea longicauda longicauda),* cerulean warbler (*Dendroica cerulea),* and *tawny crescent (Phyciodes batesii maconensis*), occur within two miles of the proposed treatment area of Alternative C.

Project-specific habitat surveys were conducted by Fish and Wildlife Associates for the 21 species in Table 3.2.5.3. Suitable habitat for 10 of the 21 terrestrial wildlife Forest Concern species exists in the proposed treatment area for Alternative B (Modified). Similarly, suitable habitat for 9 of the 21 terrestrial wildlife Forest Concern Species exists in the proposed treatment area for Alternative C. Therefore, potential effects of the proposed activity on 13 terrestrial animal Forest Concern species will be analyzed. These species are highlighted in Table 3.2.5.3.

Table 3.2.5.3. Terrestrial forest concern species, habitat requirements, and likelihood of occurrence in the proposed treatment areas of Alternatives B (Modified) and C.

Life Form	Species	General Habitat	Likelihood of Occurrence	
			Alt B (Mod)	Alt C
Land Snail	*Appalachina chilhoweensis* (queen crater)	under leaf litter and rock piles in rich coves	Not likely to occur[2,4]	Not likely to occur[2,4]
Land Snail	*Glyphyalinia junaluskana* (dark glyph)	moist leaf litter in mixed, mesic woods on mountainsides	Not likely to occur[2,4]	Not likely to occur[2,4]
Land Snail	***Glyphyalinia pentadelphia* (pink glyph)**	**pockets of moist leaves in rich or acidic cove forests**	**May occur[3]**	**Not likely to occur[2]**
Land Snail	*Haplotrema kendeighi* (blue-footed lancetooth)	mountainsides in leaf litter or crawling on the ground in wet weather ; mixed or cove hardwood forests	Not likely to occur[2,4]	Not likely to occur[2,4]
Land Snail	*Helicodiscus fimbriatus* (fringed coil)	leaf litter and under rocks on wooded hillsides, crevices in slates; no actual records	Not likely to occur[2,4]	Not likely to occur[2,4]
Land Snail	*Paravitrea lamellidens* (lamellate supercoil)	deep moist leaf litter and ravines in acidic cove, rich cove, and montane-oak hickory forests	Not likely to occur[2,4]	Not likely to occur[2,4]
Land Snail	*Paravitrea umbilicaris* (open supercoil)	cove forests with rocky slopes	Not likely to occur[2,4]	Not likely to occur[2,4]

Life Form	Species	General Habitat	Likelihood of Occurrence	
			Alt B (Mod)	Alt C
Land Snail	***Patera clarki clarki*** **(dwarf proud globe)**	**Rich cove forest, high elevation red oak forest, leaf litter on mountainsides**	**May occur[3]**	**May occur[3]**
Land Snail	*Zonitoides patuloides* (Appalachian gloss)	deep, moist leaf litter on mountainsides or in ravines, beneath bark of logs	Not likely to occur[2]	Not likely to occur[2]
Butterfly	***Autochton cellus*** **(golden-banded skipper)**	**moist woods near streams or ponds; nectar -- blackberry, trailing arbutus, hollyhock, and abelia; host -- legumes, mainly hog peanut**	**May occur[4]**	**Not likely to occur[2]**
Butterfly	***Celastrina nigra*** **(dusky azure)**	**rich, moist deciduous forests; nectar - wild geranium; host - goat's beard**	**Not likely to occur[2]**	**Known to Occur**
Butterfly	***Chlosyne gorgone*** **(gorgone checkerspot)**	**woodland borders and openings; host plants are sunflowers and other tall composites**	**May occur[3]**	**May occur[3]**
Butterfly	***Phyciodes batesii maconensis*** **(tawny crescent)**	**rocky ridges and woodland openings at higher elevations; host plants -** ***Aster undulatus***	**Not likely to occur[2]**	**May occur[3]**
Butterfly	***Polygonia progne*** **(gray comma)**	**rich deciduous forests; host plants - mainly gooseberries (*Ribes*), but also on wild azalea (*Rhododendron nudiflorum*)**	**May occur[3]**	**Not likely to occur[2]**
Wingless Grasshopper	***Melanoplus cherokee*** **(Cherokee melanoplus)**	**woodlands, 1800' - 5100'**	**May occur**	**May occur**
Wingless Grasshopper	***Melanoplus viridipes eurycerus*** **(green-legged melanoplus)**	**woodlands and forest edges**	**May occur**	**May occur**
Amphibian	***Eurycea longicauda longicauda*** **(long-tailed salamander)**	**streams, seeps, springs in moist woods and floodplains; breeds in streams/ponds**	**May occur[3]**	**May occur[3]**
Bird	***Dendroica cerulea*** **(cerulean warbler)**	**mature hardwood forests; steep slopes and coves in mountains**	**Not likely to occur[2]**	**May occur[3]**
Bird	***Sphyrapicus varius appalachiensis*** **(Appalachian yellow-bellied sapsucker)**	**mature, open hardwoods with scattered dead trees above 3500', breeding season only**	**May occur[3]**	**May occur[3]**
Bird	***Vermivora pinus*** **(blue-winged warbler)**	**low elevation (below 3000') brushy fields and thickets, breeding season only**	**May occur[3]**	**Not likely to occur[4]**
Bird	*Vireo gilvus* (warbling vireo)	open groves of hardwoods along rivers and streams below 3000'	Not likely to occur[4]	Not likely to occur[4]

[1]Species has been documented in a nearby county, but the population is endemic to that area.
[2]Species or suitable habitat was not observed during project-specific or vicinity (county) surveys.
[3]General habitat present and species is known to occur in Clay County.
[4]General habitat present but species is not known to occur in Clay County.

Land Snails

Pink Glyph (*Glyphyalinia pentadelphia*)

This species has been documented in Clay County. General habitat includes Rich Cove and Acidic Cove Forests. Associate species include *Allogona profunda* (broad-banded forest snail), *Halesia sp*. (silverbell), and *Aesculus octandra* (yellow buckeye) (Pilsbry 1946). General habitat and associate species (*Halesia sp*.) occur in the proposed treatment area for Alternative B (Modified), but not Alternative C.

Alternative A

No action would occur in Alternative A, but given that there are young, developing stands at both of the proposed range sites, forest succession processes would continue as influenced by natural and human-induced disturbances. Habitat conditions would change over time, influenced by changes in the structure and composition of the vegetation communities. Some of these changes may benefit the pink glyph.

Alternative B (Modified)

Direct and Indirect Effects. If present within the proposed activity area, direct impacts could occur as individual *G. pentadelphia* could be crushed or directly displaced during land clearing activities. Indirect impacts consist of the loss of three to five acres of forested habitat.

Cumulative Effects. Past actions such as timber sales or road construction may have directly impacted individuals and could have altered or eliminated forested habitat. These impacts would also result from the proposed action. Due to the small size of the proposed treatment area in relation to the availability of rich cove habitat across the Forest, cumulative effects are unlikely to impact current population trends.

Determination of Effect. Implementation of Alternative B (Modified) may impact individual *Glyphyalinia pentadelphia* but is not likely to lead to a loss of species viability across the Forest or to a trend towards federal listing.

Alternative C

Due to the lack of general habitat, this species is not likely to occur in the proposed treatment area. As a result, the project would produce direct, indirect or cumulative effects to the species. Implementation of Alternative C would not impact *Glyphyalinia pentadelphia*.

Dwarf Proud Globe (*Patera clarki clarki*)

This species has been documented in Clay County and the surrounding counties, but it not known to occur in the vicinity of either proposed treatment area. General habitat includes Rich Cove, High Elevation Red Oak, and Mesic Mixed Hardwood Forests. *Patera clarki clarki* has a

high potential to occur in habitats with *Acer pensylvanicum*, *A. saccharum*, *A. rubrum,* and *Aesculus flava* present (Pilsbry 1946).

Alternative A

No action would occur in Alternative A, but given that there are young, developing stands at both of the proposed range sites, forest succession processes would continue as influenced by natural and human-induced disturbances. Habitat conditions would change over time, influenced by changes in the structure and composition of the vegetation communities. Some of these changes may benefit the dwarf proud globe.

Alternative B (Modified)

The proposed treatment area contains general habitat for *P.clarki clarki***.** *Acer rubrum* was present within the proposed treatment area, but was not particularly abundant. The other associate species, which are generally less common than *Acer rubrum*, were not present in the proposed treatment area.

Direct and Indirect Effects. If present within the proposed activity area, direct impacts could occur as individual *P. clarki* could be crushed or directly displaced during land clearing activities. Indirect impacts consist of the loss of three to five acres of forested habitat.

Cumulative Effects. Past actions such as timber sales or road construction could have directly impacted individuals and could have altered or eliminated forested habitat. These impacts may also result from the proposed action. Due to the small size of the proposed treatment area in relation to the availability of rich cove habitat across the Forest, cumulative effects are unlikely to impact current population trends.

Determination of Effect. Implementation of Alternative B (Modified) may impact individual *Patera clarki clarki* but is not likely to lead to a loss of species viability across the Forest or to a trend towards federal listing.

Alternative C

The proposed treatment area contains general habitat for *Patera clarki clarki***.** Several *Acer* species were present within the proposed treatment area, but was not particularly abundant. The other associate species, which are less common than *Acer rubrum*, were not present in the proposed treatment area.

Direct and Indirect Effects. If present within the proposed activity area, direct impacts could occur as individual *P. clarki* could be crushed or directly displaced during land clearing activities. Indirect impacts consist of the loss of three to five acres of forested habitat.

Cumulative Effects. Past actions such as timber sales or road construction could have directly impacted individuals and could have altered or eliminated forested habitat. These impacts may also result from the proposed action. Due to the small size of the proposed treatment area in

relation to the availability of rich cove habitat across the Forest, cumulative effects are unlikely to impact current population trends.

Determination of Effect. Implementation of Alternative C may impact individual *Patera clarki clarki* but is not likely to lead to a loss of species viability across the Forest or to a trend towards federal listing.

Butterflies

Golden-banded Skipper (*Autochton cellus*)

The golden-banded skipper has been documented in Graham, Macon, Cherokee and Swain Counties, but not in Clay County. This species has a high potential to occur in moist woods near streams or ponds. Adults feed on nectar from blackberry, trailing arbutus, hollyhock, and abelia. Hog peanut is the primary host for caterpillars (Opler et al. 2006).

Alternative A

No action would occur in Alternative A, and given that there are no streams or ponds in the vicinity of either of the proposed treatment sites, and given that the species has never been documented in Clay County, it is unlikely that forest succession processes that would occur under the no action alternative would result in conditions favorable to the golden banded skipper.

Alternative B (Modified)

Existing Condition. General habitat, including moist woods, occurs in the proposed treatment area; however no streams or ponds occur in the proposed treatment area. Adult nectar plants and host plants, blackberry and hog-peanut, are also present within the proposed treatment area.

Direct and Indirect Effects. Direct impacts to individuals may result from the proposed action, as any individuals present within the proposed activity area could be crushed or directly displaced during land clearing activities. Nectar and host plants would be impacted as a result of the proposed action. Due to the tendency of *Rubus sp*. to colonize disturbed areas, however, it would likely reestablish itself along the perimeter of the proposed treatment area. Both blackberry and hog-peanut are common species and with only a small loss of these plant species, negative indirect impacts are expected to be minimal.

Cumulative Effects. The impacts of past actions such as timber sales could have crushed plants with eggs or caterpillars. These impacts may also result from the proposed action. Blackberry and hog-peanut may recolonize after construction activities, although blackberry is more likely. Due to the small size of the proposed treatment area and the widespread availability of habitat and host/nectar plants across the Forest, however, cumulative effects are unlikely to significantly impact current population trends.

Determination of Effect. Implementation of Alternative B (Modified) may impact individual *Autochton cellus* but is not likely to lead to a loss of species viability across the Forest or to a trend towards federal listing.

Alternative C

Due to the lack of general habitat, this species is not likely to occur in the proposed treatment area. As a result, the project would produce direct, indirect or cumulative effects to the species. Implementation of Alternative C would not impact *Autochton cellus*.

Dusky Azure (*Celastrina nigra*)

The dusky azure has been documented in Clay and Macon Counties. General habitat for this species includes shaded, moist, deciduous woods. Adults are often seen feeding on wild geranium. The caterpillar host plant is goat's beard (Opler et al. 2006).

Alternative A

No action would occur in Alternative A, but given that there are young, developing stands at both of the proposed range sites, forest succession processes would continue as influenced by natural and human-induced disturbances. Habitat conditions would change over time, influenced by changes in the structure and composition of the vegetation communities. Some of these changes may benefit the dusky azure.

Alternative B (Modified)

This species is not likely to occur in the proposed treatment area. While general habitat conditions for the species occur in the proposed treatment area, host and nectar plants were not observed. As a result, the project would produce direct, indirect or cumulative effects to the species. Implementation of Alternative B (Modified) would not impact *Celastrina nigra*.

Alternative C

This species is known to occur on the roadsides of FSR# 6236 (Barnett Creek Road), which would be used to access the shooting range under Alternative C. These occurrences are located along the roadsides of the portion of Barnett Creek Road presently open to public traffic. No additional reconditioning or maintenance is scheduled for this section of Barnett Creek Road. The portion of Barnett Creek Road beyond the existing USFS gate would require reconditioning to accommodate traffic. General habitat occurs in the proposed treatment area, but host and nectar plants were not observed on the portion of the site to be cleared for construction of the proposed shooting range.

Direct and Indirect Effects. In the absence of host or nectar plants, the dusky azure is not likely to occur within the area to be cleared during construction. However, this species occurs on roadside vegetation on the stretch of Barnett Creek Road en route to the proposed shooting range. This portion of road is not scheduled to be altered during construction of the proposed shooting range. Therefore, no direct or indirect impacts on the dusky azure are anticipated.

Cumulative Effects. Due to the lack of direct and indirect impacts, there would be no cumulative impacts as a result of this project.

Determination of Effect. Because the species is known to be in the vicinity of the proposed activity, implementation of Alternative C may impact individual *C. nigra* but such impacts are unlikely and would not likely to lead to a loss of species viability across the Forest or to a trend towards federal listing.

Gorgone Checkerspot (*Chlosyne gorgone*)

This species has been documented in Clay and Macon Counties. General habitat includes woodland openings and borders. This species has a high potential to occur where host plants are present. Host plants include sunflowers, rosinweeds, and other tall composites.

Alternative A

No action would occur in Alternative A, but given that there are young, developing stands at both of the proposed range sites, forest succession processes would continue as influenced by natural and human-induced disturbances. Habitat conditions would change over time, influenced by changes in the structure and composition of the vegetation communities. Some of these changes may benefit the gorgone checkerspot.

Alternative B (Modified)

This species has a high potential to occupy the proposed treatment area; limited openings and borders are present and host plants were observed. This species has also been documented approximately five miles from the proposed treatment area.

Direct and Indirect Effects. Direct impacts to individuals may result from the proposed action, as any individuals present within the proposed activity area could be crushed or directly displaced during land clearing activities. Nectar and host plants would be impacted as a result of the proposed action. Due to the tendency of sunflowers to colonize disturbed areas, however, this habitat would likely reestablish itself along the perimeter of the proposed treatment area. Host and nectar plants are fairly common species, and with only a small loss of these plant species, negative indirect impacts are expected to be minimal.

Cumulative Effects. The impacts of past actions such as timber sales could have crushed plants with eggs or caterpillars. These impacts may also result from the proposed action. Host and nectar plants may recolonize after construction activities. Due to the small size of the proposed treatment area and the widespread availability of habitat and host/nectar plants across the Forest, however, cumulative effects are unlikely to significantly impact current population trends.

Determination of Effect. Implementation of Alternative B (Modified) may impact individual *Chlosyne gorgone* but is not likely to lead to a loss of species viability across the Forest or to a trend towards federal listing.

Alternative C

This species is known to occur on the roadsides of FSR# 6236 (Barnett Creek Road), which would be used to access the shooting range under Alternative C. These occurrences are located along the roadsides of the portion of Barnett Creek Road presently open to public traffic. No additional reconditioning or maintenance is scheduled for this section of Barnett Creek Road. The portion of Barnett Creek Road beyond the existing USFS gate would require reconditioning to accommodate traffic. General habitat occurs in the proposed treatment area, but host and nectar plants were not observed on the portion of the site to be cleared for construction of the proposed shooting range.

Direct and Indirect Effects. In the absence of host or nectar plants, the gorgone checkerspot is not likely to occur within the area to be cleared during construction. However, this species occurs on roadside vegetation on the stretch of Barnett Creek Road en route to the proposed shooting range. This portion of road is not scheduled to be altered during construction of the proposed shooting range. Therefore, no direct or indirect impacts on the *C. gorgone* are anticipated.

Cumulative Effects. Due to the lack of direct and indirect impacts, there would be no cumulative impacts as a result of this project.

Determination of Effect. Because the species is known to be in the vicinity of the proposed activity, implementation of Alternative C may impact individual *Chlosyne gorgone* but such impacts are unlikely and would not likely to lead to a loss of species viability across the Forest or to a trend towards federal listing.

Tawny Crescent (*Phyciodes batesii maconensis*)

This species has been documented in Clay County, as well as many of the surrounding counties. It occurs on rocky ridges and woodland openings at higher elevations. Within these habitats, this species has a high potential to occur where host plants are present, which include many *Aster* species, and particularly *Aster undulatus*.

Alternative A

No action would occur in Alternative A, but given that there are young, developing stands at both of the proposed range sites, forest succession processes would continue as influenced by natural and human-induced disturbances. Habitat conditions would change over time, influenced by changes in the structure and composition of the vegetation communities. Some of these changes may benefit the tawny crescent.

Alternative B (Modified)

This species is not likely to occur in the proposed treatment area. While general habitat conditions for the species occurs in the vicinity of the proposed treatment area, host and nectar plants were not observed. As a result, the project would produce direct, indirect or cumulative

effects to the species. Implementation of Alternative B (Modified) would not impact *Phyciodes batesii macinensis*.

Alternative C

This species is known to occur on the roadsides of FSR# 6236 (Barnett Creek Road), which would be used to access the shooting range under Alternative C. These occurrences are located along the roadsides of the portion of Barnett Creek Road presently open to public traffic. No additional reconditioning or maintenance is scheduled for this section of Barnett Creek Road. The portion of Barnett Creek Road beyond the existing USFS gate would require reconditioning to accommodate traffic. General habitat occurs in the proposed treatment area, but host and nectar plants were not observed on the portion of the site to be cleared for construction of the proposed shooting range.

Direct and Indirect Effects. In the absence of host or nectar plants, the tawny crescent is not likely to occur within the area to be cleared during construction. However, this species occurs on roadside vegetation on the stretch of Barnett Creek Road en route to the proposed shooting range. This portion of road is not scheduled to be altered during construction of the proposed shooting range. Therefore, no direct or indirect impacts on *P. batesii maconensis* are anticipated.

Cumulative Effects. Due to the lack of direct and indirect impacts, there would be no cumulative impacts as a result of this project.

Determination of Effect. Because the species is known to be in the vicinity of the proposed activity, implementation of Alternative C may impact individual *Phyciodes batesii maconensis* but such impacts are unlikely and would not likely to lead to a loss of species viability across the Forest or to a trend towards federal listing.

Gray Comma (*Polygonia progne*)

This species has been documented in Clay and Swain Counties. General habitat requirements for this species include rich deciduous or coniferous forest. This species has a high potential to occupy areas along dirt roads, streams, or within clearings. Adults feed on sap, rarely nectar. Host plants for caterpillars include *Ribes sp*. and *Rhododendron nudiflorum* (Opler et al. 2006).

Alternative A

No action would occur in Alternative A, but given that there are young, developing stands at both of the proposed range sites, forest succession processes would continue as influenced by natural and human-induced disturbances. Habitat conditions would change over time, influenced by changes in the structure and composition of the vegetation communities. Some of these changes may benefit the gray comma.

Alternative B (Modified)

Existing Condition. Habitat for this species is present within the proposed treatment area. However, no host plants were identified in the area. Adults could use habitats in or near the

proposed treatment area. Rich deciduous forest occurs in the proposed treatment area; streams and dirt roads occur near the area. In the absence of host plants, it is unlikely that caterpillars of this species occur in the proposed treatment area.

Direct and Indirect Effects. If present within the proposed activity area, adults could be directly impacted due to crushing or displacement during land clearing activities. Indirect impacts consist of the temporary disturbance of a small amount of edge habitat along the logging road to the proposed shooting range site. In the long term, the shooting range would create additional habitat in the form of edge, clearings, and roadside through the rich deciduous forest at this site.

Cumulative Effects. The impacts of past actions such as timber sales could have directly impacted individuals and could have altered or eliminated forested habitat. These impacts may also result from the proposed action. Due to the small size of the proposed treatment area versus the widespread availability of edge, clearing, and roadside habitat through rich deciduous forest across the Forest, however, cumulative effects are unlikely to significantly impact current population trends.

Determination of Effect. Implementation of Alternative B (Modified) may impact individual *Polygonia progne* temporarily during land clearing activities; however, habitat would be created for this species in the long-term. These impacts and would not lead to a loss of species viability across the Forest or to a trend towards federal listing. In fact, local populations of *P. progne* may expand after project implementation.

Alternative C

This species is not likely to occur in the proposed treatment area. While general habitat conditions for the species occurs in the vicinity of the proposed treatment area, host and nectar plants were not observed. As a result, the project would produce direct, indirect or cumulative effects to the species. Implementation of Alternative C would not impact *Polygonia progne*.

Wingless Grasshoppers

Cherokee & Green-legged Melanoplus (*Melanoplus cherokee & M. viridipes eurycerus*)

Little information is available regarding the distribution, records, and specific habitat requirements of these grasshopper species. General habitat includes woodlands from 1,800 to 5,100 feet in elevation for *Melanoplus cherokee*; general habitat for *Melanoplus viridipes eurycerus* includes woodlands and forest edges.

Alternative A

No action would occur in Alternative A, but given that there are young, developing stands at both of the proposed range sites, forest succession processes would continue as influenced by natural and human-induced disturbances. Habitat conditions would change over time, influenced by changes in the structure and composition of the vegetation communities. Some of these changes may benefit the Cherokee and green-legged melanoplus.

Alternatives B (Modified) and C

The likelihood of occurrence within either of the proposed treatments area is unknown due to the lack of information regarding specific habitat requirements for these species. General habitat is present in both of the proposed treatment areas.

Direct and Indirect Effects. If present, direct impacts to individuals may result from the proposed action, as any individuals present within the proposed activity area could be crushed or directly displaced during land clearing activities. Indirect impacts may consist of general habitat being temporarily impacted during land clearing activities; however, both alternatives would result in the creation of edge habitats between open and wooded areas. This increase in local habitat diversity would improve habitat for wingless grasshoppers and other edge species.

Cumulative Effects. Past actions such as timber sales could have directly impacted individuals, and could have improved habitat through increased habitat diversity and edge creation. These impacts may also result from the proposed action. Due to the small size of the proposed treatment area versus the widespread availability of general habitat across the Forest, cumulative effects are unlikely to significantly impact current population trends.

Determination of Effect. Implementation of Alternative B (Modified) may impact individual *Melanoplus cherokee & M. viridipes eurycerus* temporarily during land clearing activities; however, habitat would be created for these species in the long-term. These impacts and would not lead to a loss of species viability across the Forest or to a trend towards federal listing. In fact, local populations of *Melanoplus cherokee & M. viridipes eurycerus* may expand after project implementation.

Salamanders

Long-tailed Salamander (*Eurycea longicauda longicauda*)

This species has been documented in Clay, Graham, and Macon Counties. The long-tailed salamander has a high potential to occur along streams, near seepages, or caves. This species would also wander far from water during wet conditions (Conant and Collins 1991, Petranka 1998, and Bartlett and Bartlett 2006). *Eurycea longicauda longicauda* has been documented within two miles of both of the proposed treatment areas.

Alternative A

No action would occur in Alternative A, but given that there are young, developing stands at both of the proposed range sites, forest succession processes would continue as influenced by natural and human-induced disturbances. Habitat conditions would change over time, influenced by changes in the structure and composition of the vegetation communities. Some of these changes may benefit the long-tailed salamander.

Alternatives B (Modified) and C

This species does not have a high potential to inhabit either of the proposed treatment areas since neither of the proposed treatment area contains streams, seepages, or caves. However, both areas have streams close enough to the proposed treatment area that *Eurycea longicauda longicauda* may travel across the areas during wet conditions.

Direct and Indirect Effects. Because this species wanders far from water in wet conditions and has been documented within two miles of both the Alternative B (Modified) and C proposed treatment areas, direct impacts to individuals may occur during land clearing and construction activities. Individuals passing through either of the proposed activity areas could be crushed. This potential impact can be reduced by avoiding work during wet periods. No indirect impacts are anticipated because this species is not dependent upon habitats within either of the proposed treatment areas.

Cumulative Effects. The impacts of past actions such as timber sales could have crushed individuals. These impacts may also result from the proposed action. Due to the relatively low likelihood that many individuals would be present within the proposed activity areas during construction activities, however, cumulative effects are unlikely to significantly impact current population trends.

Determination of Effect. Implementation of Alternative B (Modified) or C may impact individual *E. longicauda longicauda* during land clearing activities; however, this impact can be lessened by avoiding work during wet periods. These impacts and would not lead to a loss of species viability across the Forest or to a trend towards federal listing of *E. longicauda longicauda*.

Birds

Cerulean Warbler (*Dendroica cerulea*)

This species has been documented in Clay, Graham, and Macon Counties. The cerulean warbler has a high potential to occur in mature, deciduous forests, typically with mesic conditions.

Alternative A

No action would occur in Alternative A, but given that there are young, developing stands at both of the proposed range sites, forest succession processes would continue as influenced by natural and human-induced disturbances. Habitat conditions would change over time, influenced by changes in the structure and composition of the vegetation communities. Some of these changes may benefit the cerulean warbler.

Alternative B (Modified)

The forest on the proposed treatment area is less than 20 years old, and does not provide habitat for this species. This species is not likely to occur in the proposed treatment area, although general habitat conditions for the species occur in the vicinity. As a result, the project would

produce direct, indirect or cumulative effects to the species. Implementation of Alternative B (Modified) would not impact *Dendroica cerulea*.

Alternative C

This species has been documented within two miles of the proposed treatment area. The proposed treatment area contains an area of mature, deciduous forest and an area which was harvested within the past 20 years. The portion of the proposed treatment area containing mature forest would provide habitat for the cerulean warbler, whereas the adjacent, younger forest would not be considered optimal habitat.

Direct and Indirect Effects. Direct impacts to individuals may occur if nests with eggs, hatchlings, or fledglings are present during land clearing. This potential impact can be lessened by avoiding work during nesting and fledging periods. Indirect impacts would include changes in available habitat. Depending on the exact orientation and layout of the proposed shooting range, up five acres of habitat would be permanently lost.

Cumulative Effects. The proposed treatment area is not entirely composed of mature forest; the western portion is a 20-year old clear cut. This project would result in the loss of up to five acres of potential habitat. Due to the small size of the proposed treatment area, relative to the availability of mature deciduous habitat across the Forest, however, cumulative effects are unlikely to significantly impact current population trends.

Determination of Effect. Implementation of Alternative C may impact individual *Dendroica cerulea* during land clearing activities; however, this potential impact can be lessened by avoiding work during nesting and fledging periods. These impacts and would not lead to a loss of species viability across the Forest or to a trend towards federal listing.

Appalachian Yellow-bellied Sapsucker (*Sphyrapicus varius appalachiensis*)

This species has been documented in Clay and surrounding counties. The Appalachian yellow-bellied sapsucker occurs in deciduous or mixed forest. During the breeding season, it has a high potential to occur in mature, open hardwoods with scattered dead trees, over 3,500 feet in elevation.

Alternative A

No action would occur in Alternative A, but given that there are young, developing stands at both of the proposed range sites, forest succession processes would continue as influenced by natural and human-induced disturbances. Habitat conditions would change over time, influenced by changes in the structure and composition of the vegetation communities. Some of these changes may benefit the Appalachian yellow-bellied supsucker.

Alternative B (Modified)

The forest on the proposed treatment area does not provide habitat for *Sphyrapicus varius appalachiensis*, although general habitat conditions for the species occurs in the vicinity. As a result, the project would produce direct, indirect or cumulative effects to the species. Implementation of Alternative B (Modified) would not impact *S. varius appalachiensis*.

Alternative C

The proposed treatment area contains an area of mature, deciduous forest and an area which was harvested within the past 20 years. The portion of the proposed treatment area containing mature forest would provide habitat for the Appalachian yellow-bellied sapsucker, whereas the adjacent, younger forest would not be considered optimal habitat.

Direct and Indirect Effects. Direct impacts to individuals may occur if nests with eggs, hatchlings, or fledglings are present during land clearing. This potential impact can be lessened by avoiding work during nesting and fledging periods. Indirect impacts would include changes in available habitat. Depending on the exact orientation and layout of the proposed shooting range, up five acres of habitat would be permanently lost.

Cumulative Effects. The proposed treatment area is not composed entirely of mature forest; the western portion is a 20-year old clear cut. This project would result in the loss of up to five acres of potential habitat. Due to the small size of the proposed treatment area, relative to the availability of mature deciduous habitat across the Forest, however, cumulative effects are unlikely to significantly impact current population trends.

Determination of Effect. Implementation of Alternative C may impact individual *S. varius appalachiensis* during land clearing activities; however, this potential impact can be lessened by avoiding work during nesting and fledging periods. These impacts and would not lead to a loss of species viability across the Forest or to a trend towards federal listing.

Blue-winged Warbler (*Vermivora pinus*)

This species has been documented in Cherokee, Graham, and Macon Counties, but has not been documented in Clay County. The blue-winged warbler occurs in North Carolina only during the breeding season. Habitat for this species includes brushy hillsides and early- to mid-successional habitats, especially abandoned farmland and forest clearings. This species is reported to breed at forest/field edges, often shaded by large trees.

Alternative A

No action would occur in Alternative A, but given that there are young, developing stands at both of the proposed range sites, forest succession processes would continue as influenced by natural and human-induced disturbances. Habitat conditions would change over time, influenced by changes in the structure and composition of the vegetation communities. Some of these changes may benefit the blue-winged warbler.

Alternatives B (Modified) and C

Both proposed treatment areas currently contain early- to mid-successional habitats, as well as limited edge habitats. This species has not been documented within two miles of either proposed activity area, but suitable habitat occurs on both.

Direct and Indirect Effects. If construction is conducted during the nesting season, direct impacts to nests, eggs, or hatchlings may result. This potential impact can be lessened by avoiding work during nesting and fledging periods. Indirect impacts would be due to the disturbance of

approximately three to five acres of potential habitat at either site. Construction of a shooting range at either site would create a forest clearing and additional edge habitat, resulting in an increase in suitable habitat over the long term.

Cumulative Effects. Due to limited extent of the proposed treatment area, and the creation of possible habitat over the long term, cumulative effects are unlikely to significantly impact current population trends

Determination of Effect. Implementation of Alternative B (Modified) or C may impact individual *Vermivora pinus* during land clearing activities. This potential impact can be lessened by avoiding work during nesting and fledging periods. However, habitat would be created for this species in the long-term. These impacts and would not lead to a loss of species viability across the Forest or to a trend towards federal listing. In fact, local populations of *V. pinus* may expand after project implementation.

Summary of Effects to Terrestrial Wildlife Forest Concern Species

Table 3.2.5.4. Determination of effect of the proposed activities on terrestrial wildlife forest concern species.

Life Form	Species	Determination of Effect		
		Alternative A	Alternative B (Modified)	Alternative C
Land Snail	*Glyphyalinia pentadelphia* (pink glyph)	No impact	May impact individuals	No impact
Land Snail	*Patera clarki clarki* (dwarf proud globe)	No impact	May impact individuals	May impact individuals
Butterfly	*Autochton cellus* (golden-banded skipper)	No impact	May impact individuals	No impact
Butterfly	*Celastrina nigra* (dusky azure)	No impact	No impact	May impact individuals
Butterfly	*Chlosyne gorgone* (gorgone checkerspot)	No impact	May impact individuals	May impact individuals
Butterfly	*Phyciodes batesii maconensis* (tawny crescent)	No impact	No impact	May impact individuals
Butterfly	*Polygonia progne* (gray comma)	No impact	May impact: benefit	No impact
Wingless Grasshopper	*Melanoplus cherokee* (Cherokee melanoplus)	No impact	May impact: benefit	May impact: benefit
Wingless Grasshopper	*Melanoplus viridipes eurycerus* (green-legged melanoplus)	No impact	May impact: benefit	May impact: benefit
Amphibian	*Eurycea longicauda longicauda* (long-tailed salamander)	No impact	May impact individuals*	May impact individuals*
Bird	*Dendroica cerulea* (cerulean warbler)	No impact	No impact	May impact individuals**
Bird	*Sphyrapicus varius appalachiensis* (Appalachian yellow-bellied sapsucker)	No impact	Ni impact	May impact individuals**

Life Form	Species	Determination of Effect		
		Alternative A	Alternative B (Modified)	Alternative C
Bird	*Vermivora pinus* (blue-winged warbler)	No impact	May impact individuals**	May impact individuals**

* These impacts can be reduced by avoiding site construction during wet periods.
** These impacts can be reduced by avoiding site construction during the breeding and nesting season (generally April 15 through September 15, but may vary by species).

3.2.6 Impacts of Noise on Wildlife

Wildlife may not respond to noise the same way as humans. The audible, high-frequency (>500 HZ) sounds of gun shots are considered the most damaging to human hearing. Because wildlife would probably avoid the shooting range during its use by forest visitors, few if any animals would receive the same dose of high-frequency sound experienced by the people at the firing line. As a result, hearing damage from shooting noise concerns humans, but probably not wildlife.

Elevated sound levels impact wildlife and humans differently, and the impacts of sound on wildlife have been found to vary substantially depending on the species, the type of sound, and the context. Larkin (1996) summarizes available information regarding sound impacts of various military activities, including small arms fire, on wildlife individuals and populations. Impacts such as decreased reproductive success have been documented in some studies involving very loud noises such as low-flying aircraft or projectile shock waves. Wildlife responses to small arms fire, however, were typically limited to avoidance of the active shooting range. Based on this and on research conducted by Doresky, et al. in 2001 on red cockaded woodpeckers at military installations, and experience with other public shooting facilities, the Forest Service concludes that some wildlife species would acclimate to the new conditions and others would adjust by avoiding the area when users are present and that the range would not have an appreciably negative impact on wildlife.

Analysis of Effects by Alternative

Alternative A

The no action alternative would produce no additional noise, and therefore would not produce any effects to wildlife due to increases in noise.

Alternatives B (Modified) and C

Under Alternatives B (Modified) and C, no sound-related direct impacts to local wildlife populations are expected due to a shooting range, because most of the animals would simply avoid the range and any potential direct effects. Most wildlife species in the area would likely habituate to the sound and activity at the range and remain unaffected. Some species, particularly game species, may avoid the general vicinity of a shooting range, because they may associate the noise with hunting activities.

3.3 HUMAN ENVIRONMENT

In this section of the EA, specifically noise impacts from Alternative B (Modified) (Section 3.3.1), traffic on Nelson Ridge Road (Section 3.3.4), and dust impacts to human health on Nelson Ridge Road (Section 3.3.5), detailed studies and tests were made on potential effects at the proposed Perry Creek site in response to comments received by the public during scoping, during notice and comment periods, and in response to meetings with appellants following the 2010 decision. Similar analyses were not conducted at the proposed Chestnut Branch site due to the differences between the two locations, with the Perry Creek site accessed on a road that crosses a half mile section of private property and which is in close proximity to private residences, conditions that do not occur at the Chestnut Branch location. Accordingly, the Forest Service determined that more detailed analyses of noise, traffic, and dust were not warranted at the Chestnut Branch site, nor were they requested by members of the public.

3.3.1 Noise

Unwanted noise from the shooting range was identified as a key issue during scoping. Unwanted noise can be an issue at private residences near the range and for recreational users in the surrounding forest. Current noise levels in the proposed treatment areas are generated primarily by natural sources, and include (but are not limited to) wind, flowing water, birds, insects (e.g. cicadas, katydids), and thunder. These ambient sounds vary in duration and intensity throughout the day, ranging from noise equivalent to a whisper (gentle breezes) to louder than yelling (nearby thunder). Natural ambient sounds in the treatment area also have a seasonal component, with winter conditions resulting in the lowest noise levels and spring and summer producing the most. While a subjective assessment, for the purposes of this EA the sound levels at the proposed treatment areas will be classified as being of predominantly low intensity.

Visitors using any shooting range should understand the effects of noise on shooters, and take appropriate steps to safeguard their hearing. As a result, effects to forest visitors actively using the range will not be considered further.

The impact of noise to residents in proximity to the Perry Creek location (Alternative B (Modified)) was raised as an issue during the scoping process. To assess the potential impacts of noise from Alternative B (Modified), Forest Service personnel, employees from other resource agencies, and members of the local community conducted a test in April 2008 prior to leaf out of trees at the proposed Perry Creek site. The test occurred on a clear, still day, conditions selected in an effort to maximize the potential for sound to carry as far as possible. The Forest Service arranged to have a marksman fire a total of ten shots with two firearms: (1) a rifle chambered for a. 300 Winchester magnum round and (2) a rifle chambered for a .308 Winchester round. Both firearms were selected as they are considered among the loudest of the commercially available firearms likely to be encountered at a Forest Service shooting range.

The test actions were coordinated via two-way radios throughout the test's duration. The test leader was stationed at the tract of private property nearest to the proposed Perry Creek site; other team members were stationed on other nearby parcels of private land; the marksman was stationed at the proposed Perry Creek site. The test leader used his radio to direct the marksman

to discharge the firearm and also to alert listeners to anticipate each test shot. The marksman discharged each test shot five seconds after receiving the radio signal from the test leader.

The test leader believed he was able to hear a very faint report from some, but not all, of the test shots. None of the other listeners reported hearing any of the test shots. The test was conducted in the absence of the sound mitigating features that would be included in the facility design parameters.

Accordingly, the Forest Service concluded that sound from the range would not be a loud and persistent impact to residents in closest proximity to the proposed Perry Creek site. Likewise, that sound from the range would not be a loud and persistent impact to other residents in the upper Tusquitee Valley living a greater distance from the proposed site.

Concerns were raised during the May 2010 notice and comment period about the validity and accuracy of the 2008 sound test. In contrast, no concerns were raised at that time by the public over the potential for sound impacts from the Chestnut Branch site (Alternative C). To address these concerns, in June 2010 the Forest Service contracted with an independent sound consultant to conduct a noise evaluation on both proposed sites to hikers using the Chunky Gal Trail and to nearby private residences. The study and findings are presented in their entirety in Appendix C.

All calculations were conducted using a "worst case hour" approach that included 150 rounds of rifle fire and 150 rounds of pistol fire within one 60 minute period. The firearms used to generate the model were an M/87 rifle using .308 Winchester Match ammunition and a Beretta 9mm M92 F compact pistol using Norma 9mm Luger safety ammunition. International Organization for Standardization (ISO) and American National Standards Institute (ANSI) protocols were used. From the report: *"Source data were taken from a measured set of European data that contains octave-band spectra for 8 directions around the weapon. Propagation from the range to the receiving locations was calculated using ISO 9613 Part 2. The A-weighted Sound Exposure Level (SEL) was calculated from the octave-band spectrum at each receiver location. Hourly LEQ (equivalent continuous sound level) were calculated from the single event A-weighted SEL. In accordance with ANSI S12.9 Part 4 and ISO 1996 Part 1, a 12 dB penalty was added to small arms noise."* The simulation also factored in local weather patterns, variations in humidity, cloud cover, and other variables.

The test results showed that private residences in the Upper Tusquittee Valley would not be impacted by loud gunfire noise from either of the proposed range locations, with sound levels from the worst case hour ranging from 26.2 to 37.5 decibels of A-weighted sound exposure level (ASEL). For comparison, normal conversational speech at three to five feet produces between 40 to 60 decibels, a running vacuum cleaner produces approximately 80 decibels, and a running lawn mower produces approximately 85 decibels.

A private residence in the Rainbow Springs area, however, would experience marginal noise impacts from the proposed Chestnut Branch site (Alternative C) approximating those generated by a normal conversation within three to five feet of the listener under the test parameters. The results showed that the Chunky Gal Trail would experience about equal amounts of noticeable gunfire sound from both of the proposed range sites during conditions analogous to the worst case hour, and that gunfire noise would range from 67.1 to 67.9 decibels of ASEL, with the highest readings coming from pistol fire from the Perry Creek site. The cumulative impact to

trail users, however, was expected to be higher from the proposed Chestnut Branch site since hikers would be exposed to noise for longer periods of time due to the orientation of the firing lines at that site and the influence of topography between the Chestnut Branch site and the trail.

In response to concerns over the validity and accuracy of the computer simulation, and in response to requests from the public that a live fire test be conducted for the Perry Creek location (Alternative B (Modified)), the Forest Service agreed to conduct a third sound test at the Perry Creek location to assess impacts to listening sites selected by residents. The test was conducted on March 16, 2012, prior to leaf out on a clear calm day with some light winds, conditions selected in an effort to maximize the potential for sound to carry as far as possible. As with the first live-fire test in 2008, the exercise was conducted in the absence of the sound mitigating features that would be included in the facility design parameters.

A total of seven sites were selected by local residents for testing. Listening teams composed of residents, Forest Service personnel, and members of the Clay County Sports Club (CCSC) were positioned at the seven locations to record results. Listeners were asked to record the background ambient sounds they observed prior to and during the test period and to rate those sounds relative to a range of human speech, from whispering to shouting. Likewise, listeners were directed to record gunfire sounds generated by the test periods relative to the same range of human speech. While this comparison is unable to capture spectral differences between human speech and other sounds, it does provide a consistent way to relate sound relative to the volume of familiar sounds.

To simulate the heaviest possible use, the Forest Service recruited eight volunteers, two residents and six CCSC members, to shoot from the Perry Creek site during the test. Firearms that are commonly encountered at recreational shooting ranges were used: four pistols (a .38 caliber revolver, a 9mm semi-automatic pistol, a .45 caliber semi-automatic pistol, and a .357 caliber revolver) and four rifles (two chambered to shoot.308 Winchester ammunition, one chambered to shoot .30-06 ammunition, and one chambered to shoot.270 Winchester ammunition). Two Forest Service employees served as safety officers to coordinate the shooting.

Three one-minute live fire periods were conducted during a twenty minute interval. Each pistol shooter fired between twelve and eighteen rounds per period and each rifle shooter fired between three and six rounds per period. Shooting was continuous with multiple shots fired simultaneously. The rate of fire was between 60 to 80 rounds per minute, equivalent to between 3,600 and 4,800 rounds per hour, firing rates 24 times and 32 times higher, respectively, than the computer simulations, and higher than commonly occurs at public ranges managed by the Forest Service. Listening teams recorded their findings on evaluation forms. Data are summarized in Table 3.3.1.

No gunfire sounds were heard at four of the seven locations: Nancy Lane, 9500 block of Tusquittee Road, 10700 block of Tusquittee Road, and 700 block of Chairmaker Lane. Listening teams at two locations, 8800 block of Tusquittee Road and 10400 block of Tusquittee Road, recorded gunfire during Period 2 (Table 3.3.1).

Gunfire sounds were heard during all three of the test periods at the 200 block of Mull Road. During one test period the sounds were louder than a whisper and louder than low conversational speech, but were not louder than normal conversational speech. During two test periods gunfire sounds were louder than a whisper but not louder than low conversational speech (Table 3.3.1).

Table 3.3.1. Summary of the live fire sound test, March 16, 2012.

Listening Location	Background Ambient Sounds	Test Period 1	Test Period 2	Test Period 3
700 block of Chairmaker Drive	Birds, creek, barking dogs. Louder than low conversational speech.	X	X	X
Nancy Lane	Wind chimes, wind in trees, thunder. Louder than a whisper.	X	X	X
8800 block of Tusquittee Road	Birds, creek, traffic, airplanes, wind in trees, rooster, barking dogs, crows. Louder than normal conversational speech.	X	Gunfire heard. Louder than low conversational speech.	X
10400 block of Tusquittee Road	Birds, wind in trees, airplanes. Louder than low conversational speech.	X	Gunfire heard. Louder than a whisper.	X
9500 block of Tusquittee Road	Birds, traffic, creek, airplanes. Louder than a whisper.	X	X	X
10700 block of Tusquittee Road	Creek, birds, wind in trees, rooster, airplanes. Louder than low conversational speech.	X	X	X
200 block of Mull Road	Creek, birds, traffic. Louder than a whisper.	Gunfire heard. Louder than a whisper.	Gunfire heard. Louder than low conversational speech.	Gunfire heard. Louder than a whisper.

X = no gunfire heard.

Two listeners were stationed along the Chunky Gal Trail during the live fire test. Both listeners heard the sound of gunfire during all three test periods. Both reported the gunfire as louder than projected conversational speech, and almost as loud as shouting. Both also reported that gunfire

sound reverberated and echoed for a period after firing stopped, approximately as loud as the initial sounds of gunfire but diminishing over time as the sound pressure waves dissipated.

This test produced more noise than was modeled by the computer simulations for both the Upper Tusquittee Valley and for the Chunky Gal Trail. This was largely due to the substantially higher number of rounds per hour during the March 2012 live fire test, conditions purposefully produced to demonstrate a very heavy use scenario with all shooting lanes occupied and all shooters firing their guns as rapidly as possible. Forest Service experience with other recreational shooting ranges has shown that such very heavy events seldom occur, and when they do, they are of short duration.

Alternative A

The no action alternative would produce no additional noise, and therefore would produce no direct, indirect or cumulative effects to the human environment due to noise.

Alternative B (Modified)

Direct and Indirect Impacts. The project would produce marginal direct but few indirect effects to local residents due to noise. The results of the three sound tests show that in the absence of design criteria to reduce range sound as described on pages 12, 13, and 14, gunfire noise from the Perry Creek site would be audible in the upper Tusquittee Valley in areas adjacent to the confluence of Perry Creek and Tusquittee Creek. Sound exposure levels would be analogous to normal conversational speech even at the unusually high rates of fire from the 2012 live-fire test. Sounds generated by the proposed shooting range would likely be heard by forest users on portions of Nelson Ridge Road (FSR 351) and Passmore Spur Road (FSR 351D), with impacts varying with proximity to the proposed range. Hikers on segments of the Chunky Gal Trail (Figure 3, page 68) would experience direct impacts from gunfire noise, with the greatest impacts at the trail's closest approach to the proposed facility. The noise would approximate the sound of nearby normal conversations under heavy use levels and would approximate the sound of very loud conversational speech (almost as loud as shouting) during infrequent periods of very heavy use. The Forest Service estimates that between two and three miles of the Chunky Gal trail may experience sounds from the shooting range. As the Chunky Gal Trail is approximately 21 miles long, hikers using the trail while shooters are using the range would experience range related sound for 9.5% to 14.3% of the total trail miles under this proposal.

Cumulative Impacts. Cumulative impacts to local residents from noise include all human-induced sounds in the area, including vehicular traffic, domesticated animals, small engine sources (e.g. tractors, lawn mowers, leaf blowers, tillers, string-trimmers), and overflying aircraft. The proposed Perry Creek shooting range would be a facet of the sounds of human activity in the area. There are approximately 209 miles of hiking trails on Forest Service land in Clay County. Some, including the Appalachian Trail, cross highways and hikers are subjected to sounds of passing vehicles for a portion of their outing. With two to three miles of Chunky Gal Trail subjected to sound from the shooting range, and with 209 miles of trails in the county, 1.44% of the trail system in the county would be affected by sounds from the range, leaving 98.56% of the trail system unaffected by this proposed action. Sound from the shooting range may also be heard by forest visitors near the proposed treatment area. Because noise levels in the area are currently low, the cumulative impact to forest visitors in the area would be the noise

emanating from the shooting range. To diminish these effects, the Forest Service would implement management actions to contain and reduce noise emanating from the shooting range as needed.

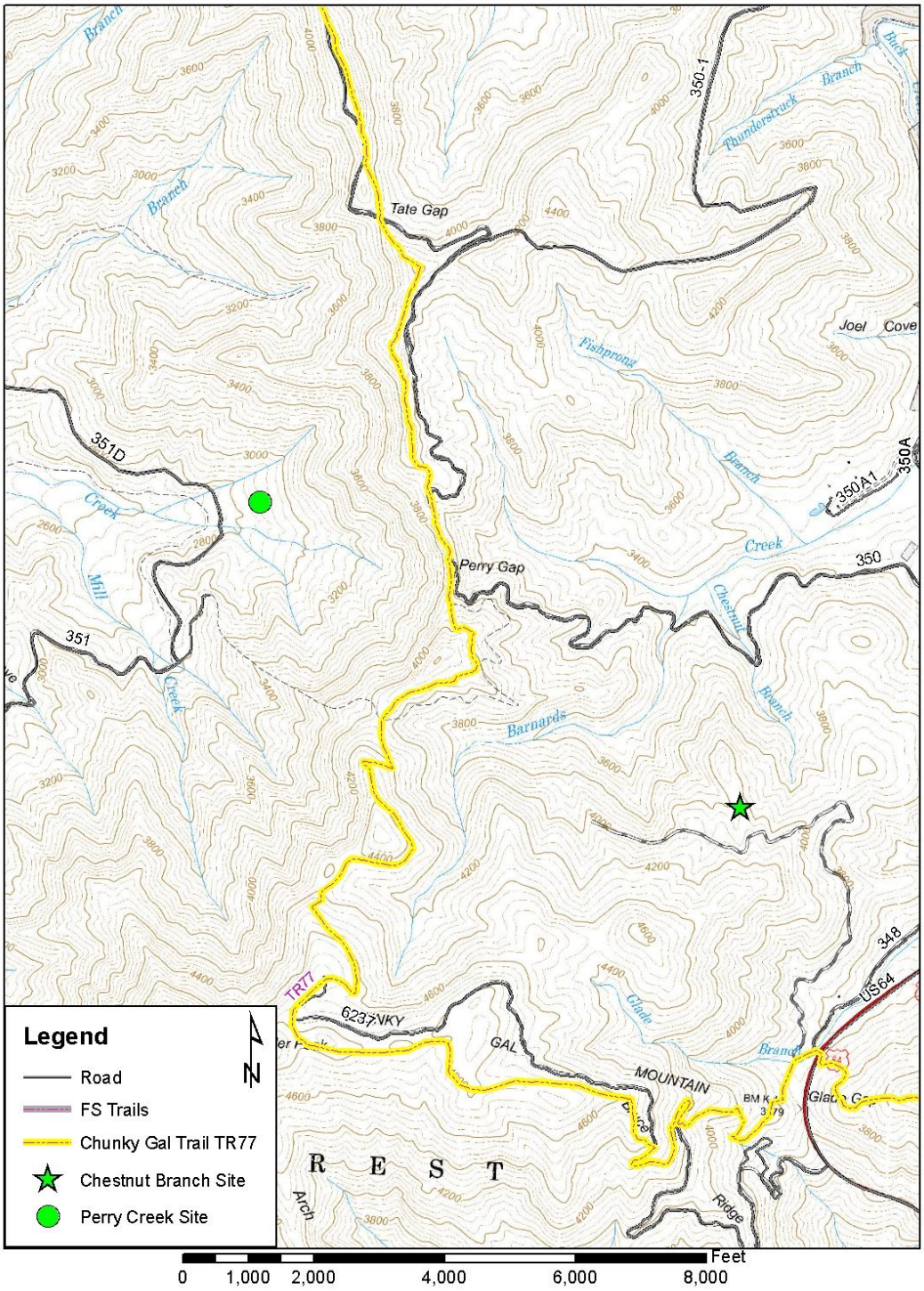
Alternative C

The Chestnut Branch site is surrounded by national forest, with the nearest residences 1.5 miles to the east. Results from the contracted noise evaluation indicate that one residence in proximity of the proposed site would receive marginal impacts from gunfire noise from the Chestnut Branch location, with sound exposure levels analogous to low conversational speech. During the 2012 and 2013 notice and comment periods, the Forest Service received letters from residents of a private development on Milksick Knob east of the proposed Chestnut Branch location. In the letters they described conducting their own live fire test and that the sound of gunfire was clearly noticeable in their subdivision. The Forest Service did not conduct a live fire test at this location during the supplemental analysis period after the withdrawal of the 2010 decision because residents in the area did not communicate their concerns with the Chestnut Branch site at that time.

Direct and Indirect Impacts. Based on the 2010 computer model, the project would produce marginal direct but few indirect effects to local residents due to noise. Based on comments received in 2012, sound from the range could produce direct and indirect impacts to residents living on Milksick Knob. Sounds generated by the proposed shooting range would likely be heard by forest visitors on portions of Barnett Creek Road (FSR 6236), the rock-hounding area at Corundum Knob, and portions of Perry Gap Road (FSR 350), potentially including undeveloped camping areas at the junction with Buck Creek Road. Hikers on segments of the Chunky Gal Trail (Figure 3, page 68) would experience direct impacts from gunfire noise, with the greatest impacts at the trail's closest approach to the proposed facility. The noise would approximate the sound of nearby normal conversations under heavy use levels and would approximate the sound of very loud conversational speech (almost as loud as shouting) during infrequent periods of very heavy use. The Forest Service estimates that between two and three miles of the Chunky Gal trail may experience sounds from the shooting range. As the Chunky Gal Trail is approximately 21 miles long, hikers using the trail while shooters are using the range would experience range related sound for 9.5% to 14.3% of the total trail miles.

Cumulative Impacts. Cumulative impacts to local residents from noise include all human-induced sounds in the area, including vehicular traffic, domesticated animals, small engine sources (e.g. tractors, lawn mowers, leaf blowers, tillers, string trimmers), and overflying aircraft. The proposed Chestnut Branch shooting range would be a facet of the sounds of human activity in the area. There are approximately 209 miles of hiking trails on Forest Service land in Clay County. Some, including the Appalachian Trail, cross highways and hikers are subjected to sounds of passing vehicles for a portion of their outing. With two to three miles of Chunky Gal Trail subjected to sound from the shooting range, and with 209 miles of trails in the county, 1.44% of the trail system in the county would be affected by sounds from the range, leaving 98.56% of the trail system unaffected by this proposed action. Due to the proximity of U.S. Highway 64, current noise levels in the proposed treatment area are higher than in the proposed treatment area of Alternative B (Modified). In the absence of direct or indirect impacts, no cumulative impacts to local residents are anticipated.

Figure 3. Proximity of the Two Proposed Range Sites to the Chunky Gal Trail



3.3.2 Recreational Resources

Current recreational activities in the analysis area, as determined by informal field surveys by the Interdisciplinary Team, include hiking, horseback riding, camping, fishing and hunting, and rock hounding. Constructing a shooting range would create an additional recreational resource for visitors to the area.

Recreation Opportunity Spectrum. The analysis areas for both alternatives are managed for a Roaded Natural 2 Recreation Opportunity Spectrum (ROS), as described in the Forest Land and Resource Management Plan (LRMP, or Forest Plan, p. III-73 and III-83).

The desired ROS **setting**, as described on page G-4 of the LRMP "Area is characterized by predominantly natural-appearing environments with moderate evidences of the sights and sounds of people. Such evidences usually harmonize with the natural environment, interaction between users may be low, but with evidence of other users prevalent. Resource modification and utilization practices are evident, but harmonize with the natural environment."

The desired ROS **experience**, as described on page G-5 of the LRMP "About equal probability to experience affiliation with other user groups and for isolation from sights and sounds of humans. Opportunity to have a high degree of interaction with the natural environment." The experience also emphasizes a high degree of interaction with the natural environment. Opportunities for both motorized and non-motorized forms of recreation are possible, but non-motorized opportunities dominate.

The desired ROS for **evidence of humans** emphasizes natural-appearing settings that may have modifications, ranging from easily noticed to strongly dominant (LRMP, p. G-6). From sensitive travel routes and use areas, however, these alterations generally remain unnoticed or visually subordinate. There is strong evidence of designated roads and/or highways.

The desired ROS for **social setting** emphasizes moderate social contacts on roads, but low to moderate contacts on trails and away from roads (LRMP, p. G-6).

Analysis of Effects by Alternative

Alternative A

Alternative A is the no action alternative. There would be no direct, indirect or cumulative effects to any recreational resources in the analysis area. Because no area in Clay County has been specifically designed for target shooting, unsafe conditions that may exist from dispersed shooting on the forest would continue. The county would not have a target shooting range that is designed to minimize the impacts to physical, biological and social resources.

Alternative B (Modified)

Direct and Indirect Effects.

Hiking. Most of the hiking in the analysis area occurs on the Chunky Gal Trail, which traverses its eastern boundary. Results of the sound tests indicate that hikers on segments of the Chunky

Gal Trail would experience direct impacts from gunfire noise, with the greatest impacts at the trail's closest approach to the proposed facility. The noise would approximate the sound of nearby normal conversations under heavy use levels and would approximate the sound of very loud conversational speech (almost as loud as shouting) during infrequent periods of very heavy use. The Forest Service estimates that between two and three miles of the Chunky Gal trail may experience sounds from the shooting range. As the Chunky Gal Trail is approximately 21 miles long, hikers using the trail while shooters are using the range would experience range related sound for 9.5% to 14.3% of the total trail miles.

The shooting range may also be visible from the Chunky Gal Trail, especially in the winter, but, given its distance from the range and its small size in an otherwise forested landscape, the Forest Service expects the visual effects to be both small and consistent with the general views from the trail, which encompass both national forest and privately-held lands.

Horseback riding. Most of the horseback riding in the analysis area occurs on the Chunky Gal Trail. Portions of the Chunky Gal Trail may be directly affected by noise and visual impacts, especially in the winter, when the proposed activity site is most likely to be visible from the ridge containing the trail. In general, however, the Forest Service expects direct effects from noise and visual impacts to be similar to the effects experienced by hikers on the Chunky Gal Trail.

Camping. Due to its relative inaccessibility, the analysis area immediately surrounding the proposed treatment site contains virtually no dispersed camping sites. Because camping in the analysis area is very limited, the Forest Service expects very limited direct and indirect effects to campers. In addition, Chunky Gal Mountain contains many dispersed camping opportunities that would easily absorb any campers displaced from the Perry Gap area. These other camping areas are several miles distant, and screened by intervening ridges. As a result, Chunky Gal Mountain contains a large number of dispersed campsites that would not be directly or indirectly affected by the proposed shooting range.

Fishing and Hunting. Anglers in the analysis area generally fish in large creeks below the elevation of the proposed shooting range. Hunters in the analysis area generally park on Forest Service roads at locked gates and walk into the forest to hunt. Both groups may be directly affected by noise, and hunters may be indirectly affected by the effects of wildlife to the noise, if they are within hearing range of the proposed treatment area. The noise, however, would be intermittent, and the national forest surrounding the analysis area offers many fishing and hunting opportunities that would not be directly or indirectly affected.

Rock Hounding. Rock hounding in the area is largely confined to the Corundum Knob Rock hounding area on the Chestnut Branch Road, approximately 1.5 miles due east of the proposed treatment area. The rock hounding area is also behind and below the main ridge of the Chunky Gal Mountains. The distance and intervening ridge should prevent any direct and indirect effects to rock hounds in the Corundum Knob area.

Recreational Shooting. Alternative B (Modified) would provide a new recreational opportunity in the area. The addition of a shooting range would provide a safe and controlled environment for recreational shooting not found elsewhere on NFS lands in Clay County.

Cumulative Effects.

The shooting range would be an additional recreation activity in the area. No other past or present actions would affect recreation opportunities in the vicinity of the treatment area. The Forest Service is currently conducting an assessment of the extent and impact of rock hounding activity in the area as part of a process to refine Forest Service policy pertaining to rock hounding on national forest lands. This is the only reasonably foreseeable action that would affect recreation in the area.

Alternative C

Direct and Indirect Effects.

Hiking. Most of the hiking in the analysis area occurs on the Chunky Gal Trail, which traverses its western boundary. The trail briefly parallels Perry Gap Road (FSR 350), and eventually crosses the spine of the Chunky Gal Mountains about one mile due west of the proposed shooting range. For approximately one mile, the trail runs along the edge of the Barnards Creek drainage, and is not screened from the proposed shooting range by an intervening ridge. Hikers on segments of the Chunky Gal Trail would experience direct impacts from gunfire noise, with the greatest impacts at the trail's closest approach to the proposed facility. The noise would approximate the sound of nearby normal conversations under heavy use levels and would approximate the sound of very loud conversational speech (almost as loud as shouting) during infrequent periods of very heavy use. The Forest Service estimates that between two and three miles of the Chunky Gal trail may experience sounds from the shooting range. As the Chunky Gal Trail is approximately 21 miles long, hikers using the trail while shooters are using the range would experience range related sound for 9.5% to 14.3% of the total trail miles.

The shooting range may also be visible from the Chunky Gal Trial, especially in the winter, but, given its distance from the range and its small size in an otherwise forested landscape, the Forest Service expects the visual effects to be both small and reasonably consistent with the general views from the trail, which encompass both national forest and privately-held lands.

Horseback riding. Most of the horseback riding in the analysis area occurs on the Chunky Gal Trail, along Buck Creek Road, and along Forest Service roads that connect with Buck Creek Road. Most of these riding trails are one or more miles from the proposed treatment area, and buffered by intervening ridges that should prevent direct effects from noise and visual impacts. Portions of the Chunky Gal trail that are exposed to the shooting range would be directly affected by noise and visual impacts, especially in winter conditions. In general, however, the Forest Service expects effects from noise and visual impacts on horseback riders on the Chunky Gal Trail would be similar to the effects expected for hikers along the trail.

Camping. Dispersed camping sites parallel Buck Creek on the eastern boundary of the analysis area. These are popular with campers and anglers, but the sites are approximately a mile away from the proposed shooting range and behind an intervening ridge. As a result, the Forest Service expects no direct or indirect effects to campers using the dispersed campsites along Buck Creek.

Fishing and Hunting. Anglers in the analysis area generally fish in large creeks below the elevation of the proposed shooting range, especially in Buck Creek, along the eastern edge of the

analysis area. Anglers may be directly affected by noise, if they are within hearing range of the proposed range. The noise, however, would be intermittent, and the national forest surrounding the analysis area offers many fishing opportunities that would not be directly or indirectly affected by the range, including Buck Creek.

Hunters in the analysis area generally park on Forest Service roads at locked gates and walk into the forest. They may be directly affected by noise, and indirectly affected by the wildlife response to noise, if they are within hearing range of the proposed range. The noise, however, would be intermittent, and the national forest surrounding the analysis area offers many hunting opportunities that would not be directly or indirectly affected by the range.

Rock Hounding. The parking area for the Corundum Knob Rock hounding Area is approximately 0.4 miles due east of the proposed shooting range, along Chestnut Branch Road. Most of the rock hounding area is east of the knob, which should prevent direct effects to recreational rock hounds, especially for noise and visual impacts. Rock hounds collecting on top of Corundum Knob, or in the parking area, may be affected by noise during shooting periods, and would likely see the visual impacts of the range. As firing lines are oriented away from rock hounding areas, rock hounds would not be subjected to the risk of stray bullets from range users.

Recreational Shooting. Alternative C would provide a new recreational opportunity in the area. The addition of a shooting range would provide a safe and controlled environment for recreational shooting not found elsewhere on NFS lands in Clay County.

Cumulative Effects.

The shooting range would be an additional recreation activity in the area. No other past or present actions would affect recreation opportunities in the vicinity of the treatment area. The Forest Service is currently conducting an assessment of the extent and impact of rock hounding activity in the area as part of a process to refine Forest Service policy pertaining to mining on national forest lands. This is the only reasonably foreseeable action that would affect recreation in the area.

3.3.3 Scenery Effects

The ROS described in the previous section determines the Visual Quality Objectives for the sites (or VQO; LRMP, Appendix G).

The desired VQO **setting** for Roaded Natural 2 is characterized by predominately natural-appearing environments with moderate evidences of the sights and sounds of people (LRMP, p. G-1). Such evidences usually harmonize with the natural environment; interaction between users may be low, but with evidence of other users prevalent. Resource modification and utilization practices are evident, but harmonize with the natural environment.

Alternative A

The no action alternative would produce no effects to scenery.

Alternative B (Modified)

The proposed treatment area is located within a deep, sheltered cove. As a result, the area is not likely to be visible from surrounding areas generally frequented by the public. The proposed treatment area may be visible by hikers on Chunky Gal Trail, and would add additional evidence of the sights (three to five cleared acres) and sounds of people to the landscape that presents other sights and sounds of people to trail hikers and other forest visitors. Visibility from the trail is contingent upon the type and consistency of the vegetation along the trail. A dense, forested habitat is likely to obstruct visibility between the trail and the proposed treatment area during the leaf season, with the facility more evident in winter during leaf-off. The range would not be visible to people at lower elevations.

Direct and Indirect Effects. The clearing of the proposed treatment area would be visible to hikers on Chunky Gal Trail. The location of the proposed site in a sheltered cove should minimize its visibility from other vantage points.

Cumulative Effects. Cumulative impacts would consist of the addition of approximately three to five acres of cleared land to the surrounding area. Effects from the range would persist as long as the facility is in operation.

Alternative C

The proposed treatment area is located on a saddle of a ridge lead and therefore is generally more visible on the landscape than Alternative B (Modified). The proposed treatment area may be visible by hikers on Chunky Gal Trail, and would add additional evidence of the sights (three to five cleared acres) and sounds of people to the landscape that presents other sights and sounds of people to trail hikers and other forest visitors. Visibility from the trail is contingent upon the type and consistency of the vegetation along the trail. A dense, forested habitat is likely to obstruct visibility between the trail and the proposed treatment area during the leaf season, with the facility more evident in winter during leaf-off. The range may be visible to people from vantage points at lower elevations.

Direct and Indirect Effects. The clearing of the proposed treatment area would be visible to hikers on Chunky Gal Trail. The area may also be visible from other vantage points in the area due to its position near a ridgetop.

Cumulative Effects. Due to the small size of the proposed treatment area, the distance from Chunky Gal Trail and the absence of other clearing activities on NFS lands in the immediate area, there are no cumulative effects beyond the effects of the proposed shooting range. Effects from the range would persist as long as the facility is in operation.

3.3.4 Vehicular Traffic

Both proposed range sites are accessed by single lane gravel roads with turnouts to allow opposing vehicles to pass each other. A decision to authorize a shooting range would increase number of vehicles on each road. Traffic safety, both to those using the roads, and in the case of the proposed Perry Creek site, to residents who use Nelson Ridge Road to access their property, was identified as a key issue during scoping.

Alternative A

Direct and Indirect Effects. The no action alternative would produce no additional vehicular use, and therefore would not produce any direct and indirect effects to traffic.

Cumulative Effects. Traffic loads, particularly on the section of road that crosses private property, would increase as private tracts are developed and occupied. If traffic volumes reach a point where safety is compromised, or where users routinely encounter opposing vehicles, property owner and easement holders would have to decide if the road needs to be widened or transferred to the North Carolina Department of Transportation for administration and maintenance.

Alternative B (Modified)

Access to the Perry Creek site is made by turning off U.S. Highway 64 onto Cold Branch Road (SR1330), driving six miles on Nelson Ridge Road (Forest Service Road 351), and taking Passmore Spur (FSR 351D) approximately 2,000 feet. The first half mile of Nelson Ridge Road crosses private property and is used by both the people whose driveways tie into Nelson Ridge Road as well as people who drive through the private section to enter the national forest. The Forest Service has an easement to cross the section of private land and the agency is responsible for maintaining the entire length of Nelson Ridge Road.

Gates on Nelson Ridge Road and Passmore Spur Road currently prevent public access to the proposed shooting range site for three months each year. The gate on Nelson Ridge Road has traditionally been closed from January 1 to March 31, although it is capable of safely accommodating year-round use. The gate on Passmore Spur is closed year-round. This annual seasonal closure would not be continued under the modified Alternative B (Modified), and both roads would be open year round.The remainder of Passmore Spur road beyond the proposed shooting range site would remain in storage and would be closed to vehicular access year round.

To determine current use of Nelson Ridge Road, the Forest Service installed two traffic counters. One was placed near Nelson Ridge Road's junction with Cold Branch Road to determine the total number of cars using the road. The second was placed just after the Forest Service gate to determine the number of cars that continued from the private section onto the national forest. The counters were in place from June 2 to December 31, 2011. Data were saved continuously to a memory card which recorded the number of cars using the road. Average daily traffic by month data are summarized in Table 3.3.4.1

Table 3.3.4.1 Average daily traffic on Nelson Ridge Road, June 2- December 31, 2011.

Average daily use by Month	June	July	August	September	October	November	December
All Vehicles	55	24	22	26	23	26	94
Vehicles on Private Section	50	17	16	17	13	17	85
Vehicles Continuing to National Forest	5	7	6	9	10	9	8

The data show that on average, between five and ten vehicles per day enter the national forest, and with the exception of June and December, approximately 16 vehicles per day, on average, access only the private section, for a total average between 21 and 26 vehicles per day.

Variations in daily use are not captured by averages, however. The Forest Service also looked at the minimum and maximum number of vehicles per day for each of the seven months of data. Those figures are displayed in Table 3.3.4.2.

Table 3.3.4.2 Daily variation in traffic levels on Nelson Ridge Road, June 2-December 31, 2011.

Month	All Vehicles Low	All Vehicles High	Private Section Low	Private Section High	Forest Service Low	Forest Service High
June	0	119	0	115	0	22
July	16	36	8	24	1	16
August	15	32	9	25	1	12
September	14	41	5	30	2	22
October	14	47	0	22	0	24
November	14	49	2	43	0	24
December	21	462	16	462	0	19

The daily variation table shows considerable range in the number of vehicles accessing the road each month. High numbers for June and December suggest that something was triggering the counters to read false positives. Forest Service engineering staff who work with these types of counters have found that vehicles parked near the counter or a metallic object placed near the counter can trigger such high readings.

Data are more consistent for the five months of July through November, both in terms of the average number of vehicles (Table 3.3.4.1) as well as the variation in traffic levels (Table 3.3.4.2). Accordingly, data from June and December are not considered in the final analysis.

The Forest Service believes that total daily use of Nelson Ridge Road ranges between 15 and 41 vehicles each day (averaging 24 vehicles per day), with between five and 29 of those vehicles remaining on the private section of the road each day (averaging 16 vehicles per day), and between one and 20 vehicles a day continuing on to the national forest (averaging eight vehicles per day). These findings are summarized in Table 3.3.4.3.

Table 3.3.4.3. Current and projected daily traffic on Nelson Ridge Road.

	Current Use	Projected Use	Current Average	Projected Average
All Vehicles	15 - 41	21 - 49	24	30 - 32
Vehicles on Private Section	5 - 29	5 - 29	16	16
Vehicles Continuing to National Forest	1 - 20	7 - 28	8	14 - 16

The Forest Service conducted a review of usage at the Panthertop Shooting Range in Cherokee County in an effort to estimate the number of cars that might be expected along Nelson Ridge Road if Alternative B (Modified) is selected. The Forest Service calculated average daily use at the Panthertop Shooting Range in 2009, 2010, and 2011. An average of six users per day accessed the Panthertop site in 2009, use averaged eight per day in 2010, and nine per day in 2011. For the purposes of this analysis, the Forest Service would use the highest figure and would base calculations on an average of nine users per day for the proposed Clay County Shooting Range.

Assuming that a range at the proposed Perry Creek site would experience roughly the same amount of use as the Panthertop site, the Forest Service believes that the average of nine cars per day is a valid estimate. The number of cars per day would probably be lower during the weekdays and higher on weekends, particularly Saturdays. Forest Service ranges are open only during daylight hours. Residents could expect to experience nine cars per day using the road above current use levels. Assuming a very heavy use day with twice the number of users residents could expect to experience up to 18 cars per day using the road above current use levels. Given that Nelson Ridge Road has only one entrance and outlet, these nine to 18 cars would account for between 18 and 36 trips past the Forest Service gate on Nelson Ridge Road.

Based on the data from the traffic counters and the projections from past use of the Panthertop Range, the Forest Service believes that daily use of Nelson Ridge Road would increase between six and eight vehicles per day if Alternative B (Modified) is selected. This would raise current use levels as follows:

- Daily use of Nelson Ridge Road would be 21 to 49 vehicles each day (30 - 32 vehicles per day average),
- Between five and 29 vehicles would remain on the private section of the road each day (16 vehicles per day average),
- Between seven and 28 vehicles a day would continue to the national forest (14 – 16 vehicles per day average).

Forest Service engineers note that a well maintained single lane gravel road with turnouts can accommodate 100 vehicles per day before reaching the threshold where further traffic load analysis needs to occur (Hicks 2010). Based on the current and projected traffic figures, the Forest Service believes that Nelson Ridge Road can safely absorb range-related vehicular use in addition to current use. If development of private property along the beginning of Nelson Ridge Road occurs, vehicular use could exceed 100 cars per day. At that point road users would need to consider taking action to accommodate higher levels of use.

Direct and Indirect Effects. Residents would experience direct effects of increased traffic on Nelson Ridge Road. This could result in increased frequency of encountering opposing traffic. Indirect effects include airborne road dust which can be a nuisance, impacts to the road prism that would require more frequent grading and maintenance, and litter from careless visitors. Visitors using Nelson Ridge Road to access the national forest but who are not coming to and from the range would experience direct effects of increased traffic, including increased frequency of encountering opposing traffic.

Cumulative Effects. The Forest Service anticipates that traditional uses of the road would continue. No other past, present, or reasonably foreseeable future Forest Service actions are known that would change the amount of use on the Forest Service section of Nelson Ridge Road from the expected increase in traffic due to the range. Future development of private property accessed by Nelson Ridge Road could increase traffic loads, particularly on the section of road that crosses private property. If traffic volumes reach a point where safety is compromised, or where users routinely encounter opposing vehicles, property owners and easement holders would have to decide if the road needs to be widened or transferred to the North Carolina Department of Transportation for administration and maintenance.

Alternative C

Currently, Barnett Creek Road beyond the parking area for the Corundum Knob rock hounding area is closed year-round by a Forest Service gate. If Alternative C is selected, this gate would be open year-round to allow access to the shooting range with the remainder of the road beyond the proposed range site closed to traffic.

Current traffic on Barnett Creek Road includes recreational rock hounds visiting the Corundum Knob parking area. The current parking area is largely user defined, accommodates three to five vehicles, and seems to be adequate to meet demand. As a result, the Forest Service estimates traffic along Barnett Creek Road from rock hounds at two to four cars per day at peak usage. In addition, the parking area may serve as a trailhead for horseback riders, estimated at one or two visits per week at peak usage.

Per the discussion for Nelson Ridge Road, the Forest Service projects that between five and eight vehicles per day would use Barnett Creek Road to access the proposed Chestnut Branch shooting range. Current use levels are projected to be fewer than five visitors each day to the rock hounding area, bring the total traffic load on Barnett Creek Road to approximately seven to 12 vehicles per day, well within safety standards for the road.

Direct and Indirect Effects. Because the gate on Barnett Creek Road would be open year-round, traffic on the road from the gate to the proposed range site would increase compared to current levels. Only minor direct effects and indirect effects are expected for rock hounds and other users of Barnett Creek Road.

Cumulative Effects. In addition to increased traffic due to the shooting range, traffic may increase due to forest visitors using the open road for non-shooting activities. As a result, the Forest Service expects cumulative increases to traffic, from all from visitors, to be higher than the increases due to shooting range visitors alone.

3.3.5 Human Health and Safety

Human health and safety is potentially an issue for forest visitors using the shooting range, to forest visitors in the immediate vicinity of the range, and to forest visitors and local residents using the access roads. An additional issue raised in scoping and in the notice and comment

period for the 2010 EA is the potential health hazards posed by fine particulate matter in airborne road dust generated by vehicles driving on the private section of Nelson Ridge Road.

Alternative A

Direct, Indirect, and Cumulative Effects. The no action alternative would not produce any direct, indirect, or cumulative effects to human health and safety.

Alternatives B (Modified) and C

Direct and Indirect Effects.

***Forest visitors using the shooting range*.** The Forest Service is considering the action alternatives to provide a safe and environmentally sound and secure public shooting facility to serve the local communities of Clay County, North Carolina. For both action alternatives, users would be required to use hearing and vision protection and to observe standard safety rules at the facility. As with all recreational activities on the national forest, however, forest visitors ultimately assume responsibility for their own actions while using the facilities.

The distance to the Perry Creek site may affect response times to emergencies. All remote locations on the national forest, including the site at Chestnut Branch, may be difficult and time consuming to access during times of emergency. Neither of the two proposed range locations is unusually remote or difficult to access compared to areas of the national forest accessible only by foot or horse, and forest users must recognize, and account for, the remote conditions when engaging in recreational activities on the national forest.

***Forest visitors in the immediate vicinity of the range*.** The concern is that bullets may leave range and strike a forest visitor as it may be possible for bullets to skip off the ground and over the berms, or, less likely, to be fired intentionally out of the range. This concern is much lower for the Perry Creek site since its orientation and location allows the middle elevation portion of Chunky Gal Mountain below Perry Gap to serve as a supplemental natural backstop well below the Chunky Gal Trail. The steeply upward sloping terrain of the mountain should capture any stray rounds that escape the range. In contrast, the Chestnut Branch site is located on a high saddle and the topography slopes away rapidly in two directions both downrange and to the sides of the proposed firing lines. Bullets that are not contained by the backstop have the potential to travel further from the Chestnut Branch site. Staff experience with Forest Service shooting ranges is that visitors to the ranges are no more likely to discharge their firearms irresponsibly than other forest visitors. The area immediately surrounding the site would be posted with signs warning non-facility users of the shooting range.

The Chunky Gal trail is approximately 0.7 miles (3,700 feet) away from and 1,000 feet above the proposed Perry Creek range site and the trails is approximately one mile away from and approximately 500 feet above the proposed Chestnut Branch site. In both cases persons on the trail would not be on a similar elevation contour as the range sites but rather would be several hundred to 1,000 feet above the firing lines. Because of this, the Forest Service has determined

that the combined distance and elevation factors do not put trail users in a hazardous situation relative to Alternative B (Modified) or Alternative C.

Forest visitors and local residents using the access roads. Refer to section 3.3.4 for an in-depth analysis of current and projected traffic use and the potential impacts under the three alternatives.

Cumulative Effects. A factor influencing cumulative effects is the ability of range users to communicate with first responders in case of an emergency. Cellular telephones can access the telecommunications network at the Chestnut Branch site but not at the Perry Creek site, which may affect response times if first responders are needed at that location. Constructing and operating a new recreation facility and the resulting increased use by forest visitors could increase the need for emergency response.

Airborne road dust from current and projected vehicular traffic on Nelson Ridge Road. The concern is that dust raised by traffic on the gravel road contains small particulate matter in concentrations exceeding Environmental Protection Agency (EPA) human health thresholds. To determine the health effects from traffic on Nelson Ridge Road, the Forest Service partnered with a nearby university to conduct independent research into airborne dust (Appendix D).

Particulate Matter (PM) is recognized as a hazardous pollutant at certain sizes and in certain concentrations. There are two main categories – particulate matter that is 10 microns (μm) or less in diameter and particulate matter that is 2.5μm or less in diameter. Particulate matter that is 10μm or less in diameter (PM10) is roughly the same as respirable particulates, and particulate matter that is 2.5μm or less in diameter (PM2.5) is the category of PM that is able to penetrate more deeply into the lungs and potentially into the bloodstream (Pope and Dockery 2006). PM over 10μm is not considered a human health risk. Experts give little consideration to the composition of the PM, simply the size class, although crystalline silica PM is specifically associated with silicosis (Tran et al. 2005).

Current EPA standards for PM concentrations per the National Ambient Air Quality Standards (NAAQS) for Particulate Matter (2006) were used for this analysis. The current EPA standard for PM10 in a 24-hour average concentration is 150μg/m3, not to be exceeded more than once per year over a three year average (2006). This standard was changed from 50μg/m3 annual arithmetic mean for PM10, reflecting the lack of scientific evidence proving a connection between health problems and long term exposure to PM10 particles at lower ambient levels. Particulate Matter 2.5 concentration standards were revised downwards in 2006 from 65μg/m3 in one 24-hour period to 35μg/m3 in one 24-hour period, while maintaining an annual mean of 15μg/m3 over three years. This change was made to recognize the health risks associated with both short and long term exposure to PM2.5 and the need to adequately protect public health. North Carolina Ambient Air Quality Standards are the same for PM10 as the NAAQS (North Carolina 2010a).

The atmospheric dispersion modeling system (AERMOD), the EPA's preferred regulatory model, was used to estimate current and projected human health effects from airborne road dust on Nelson Ridge Road. Samples of road dust were taken from Nelson Ridge Road for analysis in the laboratory to determine silt concentrations that would influence PM10 and PM2.5

concentrations. Samples were collected and processed using EPA methodology. Site-specific factors that would affect airborne road dust dispersal, including prevailing winds, the density and distribution of screening vegetation, and the elevation, location and distance of nearby private residences relative to the road were also quantified and used in the model.

Site data and emission factors were entered into the AERMOD program, along with static parameters including average annual days of significant precipitation (drier dust is more easily disturbed), vehicle clearance (which affects the initial plume height), and length of travel. Where the model required assumptions about parameters, values that generated the most dust were selected. Other model specific parameters were chosen consistent with the most recent BMPs. The model presents an accurate, but worst-case scenario. Twelve iterations of the model were run, varying the number and the speed of vehicles. The model estimated the maximum PM10 concentrations in micrograms per cubic meter in a 24 hour period. Per accepted practice, PM2.5 is calculated as 10% of PM10 concentrations.

Results show that it would take over 500 vehicles per day, with each vehicle driving 55 miles per hour from the entrance of Nelson Ridge Road to the Forest Service gate, to generate PM10 or PM2.5 concentrations at or above EPA thresholds for human health. Given that the maximum future traffic volume on Nelson Ridge Road is projected to be around 50 vehicles per day, and given that the topography and curves make it very difficult for vehicles to reach and to safely maintain speeds approaching 55 miles per hour for even short stretches of Nelson Ridge Road, the Forest Service concludes that airborne road dust from range-related traffic would not reach or exceed EPA thresholds for human health.

Airborne road dust can be a nuisance, coating exterior surfaces and affecting a person's use and enjoyment of his or her home. Paving the road would largely eliminate nuisance airborne dust. In the absence of paving, methods to suppress and minimize dust include posting and enforcing speed limits, installing traffic calming structures such as speed bumps at critical locations, and treating the road with calcium chloride, a binding agent.

Barnett Creek Road, the access route to the proposed Chestnut Branch site, does not pass near private residences. Given the similar conditions between Barnett Creek Road and Nelson Ridge Road, as well as the lighter current and projected traffic load, the Forest Service concludes that airborne road dust from range-related traffic would not reach or exceed EPA thresholds for human health.

Direct and Indirect Effects.

No direct or indirect effects on human health from airborne road dust would occur under Alternatives B (Modified) or C.

Cumulative Effects.

In the absence of direct and indirect effects, no cumulative effects on human health from airborne road dust would occur under Alternatives B (Modified) or C.

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6.0 APPENDICES

Appendix A: Lead Management
Appendix B: Biological Evaluation for the Clay County Shooting Range Project
Appendix C: 2010 Sound Test Report
Appendix D: Airborne Dust
Appendix E: Response to Comments

Appendix A: Lead Management

1.0 BACKGROUND

A Best Management Practice (BMP) plan was developed to provide information on lead management at the proposed shooting range, located on U.S. Forest Service property in Clay County, North Carolina. The practices suggested in this plan have been proven to effectively reduce or eliminate lead contamination and have been selected as the most appropriate BMP(s) for this facility based on site specific conditions.

Outdoor shooting ranges provide recreational facilities for millions of shooting sports enthusiasts in the United States. The potential environmental and health effects of range operations are a concern and this BMP plan will address those concerns. The Environmental Protection Agency the Centers for Disease Control and Prevention, and a large number of states have identified human exposure to all forms of lead as a major health concern in the United States.

Many owners and operators of ranges across all geographical areas of the country have successfully implemented BMPs at their ranges. Benefits from lead management include:

- Stewardship of the environment, natural resources, and wildlife
- Improved community relations
- Improved aesthetics of the range/good business practices
- Increased profitability through recovery/recycling lead, a valuable and finite resource

2.0 EFFECTS ON HUMAN HEALTH AND THE ENVIRONMENT

The main human exposure to lead associated with shooting ranges is through lead-contaminated soil. A secondary potential pathway is inhalation of lead dust by shooters during firing. Because wind is unlikely to move heavy lead particles very far, airborne dust is generally considered a potential threat only when there are significant structures that block air flow on the firing line. Range workers may also be exposed to lead dust while performing routine maintenance operations, such as raking or cleaning out bullet traps.

Lead can be introduced into the environment at shooting ranges in one or more of the following ways. Each of these pathways is site-specific and may or may not occur at individual ranges:

- Lead oxidizes when exposed to air and dissolves when exposed to acidic water or soil.

  When lead is exposed to acidic water and/or soil, it breaks down by weathering into lead oxides, carbonates, and other soluble compounds. With each rainfall, these compounds may be dissolved, and the lead may move in solution in the runoff waters. Decreases in water acidity will cause dissolved lead to precipitate out of solution. At pHs above 7.5, very little lead remains in solution. Ideal soil pH for shooting ranges is a range from 6.5 to 8.5. In moderately alkaline soils (pH 7-8.5) the lead precipitates out of solution and binds to the soil. This “binding” effect prevents lead from migrating to the subsurface. There are five factors which most influence the dissolving of lead in water:

- A*nnual precipitation rate*. In general, the higher the precipitation rate, the higher the potential risk of lead migration off-site in solution.
- *pH of Rain and Surface Water*. In general, the more acidic the rain and surface water, the more likely lead will migrate off-site.
- *Contact Time*. In general, the greater the contact time between the water and the lead, the more lead will be dissolved.
- *Soil Cover*. In general, organic material on the surface of the soil will absorb lead and remove it from a water solution.
- *pH of Groundwater*. The pH of the groundwater affects the pH of the surface water, affecting the solubility of any lead particles carried into the stream during storm runoff.

- Lead bullets, bullet particles, or dissolved lead can be moved by storm water/runoff.

The ability of water to transport lead is influenced by two factors: the velocity of the water and the weight or size of the lead fragment. There are five factors that most influence velocity of runoff and are described below:

- *Rainfall Intensity.* The greater the volume of rainfall during a short period of time, the faster the velocity created to carry the rainfall off-site.
- *Topographic Slope*. In general, the steeper the slope the faster the velocity of storm water runoff.
- *Soil Type*. For a given rainfall intensity, volume of runoff will be greater from areas underlain by clays or other low permeable soils than from sandy soil.
- *Velocity.* In general, the shorter the distance from the lead deposit to the boundary of the range, the more likely that the lead fragments in suspension will be transported off-site.
- *Vegetation Cover and Man-made Structures*. Structures such as dams and dikes reduce the water's velocity and greatly reduce the size and weight of lead particles the water can carry. Grass and other vegetation reduce runoff velocity and act as a filter to removed suspended solids from the water. Some vegetation can extract lead ions from the soils.

- Dissolved lead can migrate through soils to groundwater.

Acidic rainwater may dissolve weathered lead compounds and a portion of the lead may be transported in solution in groundwater beneath land surfaces. If the water flows through rocks containing calcium, magnesium, iron, or other minerals more soluble than lead, or through minerals that raise the pH of the water, then the lead in solution may be replaced by these other metals, allowing the lead to be bound to the soil. The factors most likely to affect the amount of lead carried by groundwater in solution are described below:

- *Annual Precipitation*. Generally, high precipitation rates result in more rapid rates of groundwater flow as well as a probable reduction (over geologic time) in calcium and

other soluble basic minerals that could raise the pH and cause lead to precipitate out of solution.

- *Soil Types*. Clays have a high ionic lead bonding capacity and more surface area to bond lead. Groundwater movement in clay is very slow, which increases the time for lead to bond to the clay. Low permeability reduces the amount of historical leaching and increases the probability of the presence of basic (pH-increasing) minerals that can precipitate out of solution or cause the lead to bond to the clay.
- *Soil Chemistry*. In general, the more basic minerals like calcium and magnesium present in soils, the greater the lead precipitation (removal) rate.
- *Depth to Groundwater*. In general, the shorter the distance traveled, the greater the risk that lead will migrate into the environment.
- *pH of Groundwater*. While there are other factors that influence solubility of lead in water, a good rule of thumb is that lead will precipitate out of solution when the pH of water is greater than about 7.5.

3.0 LEGAL REQUIREMENTS

Lead management programs at outdoor ranges must comply with, or consider, three laws: the Resource Conservation and Recovery Act (RCRA), the Clean Water Act (CWA), and The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).

3.1 The Resource Conservation and Recovery Act (RCRA)

This act provides the framework for the nation's solid and hazardous waste management program. RCRA potentially applies to many phases of range operation because lead bullets/shot, if abandoned, may be a solid and/or a hazardous waste and may present an actual or potential imminent and substantial endangerment. Court decisions involving the law have determined the following:

- During routine operations, shooting ranges are not viewed as facilities that manage hazardous wastes subject to RCRA regulations, and do not require RCRA permits.
- RCRA statute allows citizen suits to be brought if a range's shooting activities pose an "imminent and substantial endangerment to health or the environment."
- If lead shot/bullets are discarded, these materials are considered a solid waste as defined in the statute and the facility may be subject to citizen suits. If on the other hand, the discharged lead shot/bullets are recovered or reclaimed on a regular basis, no statutory solid waste would be present and imminent hazard suits would be avoided.
- Even though regulations have not been issued regarding gun club operations and environmental protection, ranges are still at risk of legal action under RCRA if they fail to routinely recover and reclaim lead, do not take steps to minimize lead release or migration, or if they abandon lead in berms.
- Lead shot/bullets are not considered a hazardous waste subject to RCRA at the time it is discharged.
- Lead, if recycled or reused, is considered a scrap metal and is, therefore, excluded from RCRA.

3.2 Clean Water Act (CWA)

The most common allegation under the CWA against ranges is that they violate the CWA if they do not have permits that allow spent ammunition to be discharged into water. There have been two court cases that have applied the provisions of CWA to civilian shooting ranges.

In the first case, the suit was dismissed because the range had ceased operating before the lawsuit was filed (the application of the CWA requires violations to be ongoing). In the second case, the court found that the mechanized target throwers, the concrete shooting platforms, and the range itself are considered point sources as defined by CWA and that expended shot and debris left in the water are pollutants as defined by CWA.

Both of these cases involved ranges that were shooting over or into wetlands and other navigable waters of the United States.

3.3 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

CERCLA imposes liability on past and present owners or operators of properties where a release of a hazardous substance into the environment exists. Under CERCLA, lead is considered a hazardous substance.

4.0 BENEFITS OF MINIMIZING LEAD'S ENVIRONMENTAL IMPACT

Ranges will benefit from proactively implementing successful BMPs in the following ways:

- Through a sound lead management program, shooting sports enthusiasts can reduce the potential of lead exposure and contamination to humans, animals, and the environment.
- A lead management program will result in improved public relations for the range and the shooting sports.
- The removal of spent lead from the range presents a clean, well maintained facility, which will increase customer satisfaction.
- Lead is a recyclable and finite resource and can be recovered and sold.
- By reducing or eliminating a potential source of lead migration in soil, surface water, and groundwater, range owners/operators may avoid costly and lengthy remediation activities.

5.0 BEST MANAGEMENT PRACTICES (BMPs) FOR OUTDOOR RANGES

To operate an outdoor range that is environmentally protective requires implementing an integrated lead management program, which incorporates a variety of appropriate BMPs. These BMPs create a four step approach to lead management.

- Step 1: Control and contain lead bullets and bullet fragments.

The most effective BMP for managing lead is bullet containment. There are a variety of containment options with the goal of trapping and containing the bullet. Options include:

- *Earthen berms and backstops*. Generally 15 to 20 feet high with a slope as steep as possible. The uppermost layer to a depth of 1 or 2 feet should be free of large rocks and other debris.
- *Sand traps*. Regular maintenance must be performed to remove larger particles from the impact area. Typically 15 to 20 feet high with the first 1 or 2 feet free of large rocks or other debris. An impermeable layer (clay or liner) may be used under the sand to prevent lead from contacting the soil under laying the trap.
- *Steel traps*. Located directly behind the targets so that expended bullets, along with bullet particles, are directed into some form of deceleration chamber. Once inside, the bullets decelerate until they fall into collection trays at the bottom of the chamber. Bullet recovery is easy but an increase in bullet dust and fragmented lead may be an additional concern. Increased cost is also a factor.
- *Lamella or rubber granule traps*. Lamella Trap uses tightly-hanging, vertical strips of rubber with a steel backing to stop bullets. Rubber granule traps uses shredded rubber granules, housed between a solid rubber front and a steel backing, to stop bullets. For both traps the bullets remain intact, thus eliminating lead dust, and back splatter. Both require more maintenance; could create a fire threat; will not withstand weather elements over the long term; and cause the rubber particles to melt to the lead bullets, making reclamation more difficult.
- *Shock absorbing concrete*. Extensively field tested by the military, this has become commercially available in recent years as a backstop material for small arms ranges.

- Step 2: Prevent migration of lead to the subsurface and surrounding surface water bodies.

  - *Monitoring and Adjusting Soil pH and Binding Lead*

    - *Lime Addition*. The ideal soil pH value for shooting ranges is between 6.5 and 8.5. There are a number of simple, relatively inexpensive ways to adjust soil pH and bind lead to the soil. Addition of lime over the area neutralizes the acidic soils, thus minimizing the potential for the lead to degrade. Another way to control lead migration in earthen backstops is to break the capillarity within the base of the backstop. Most porosity in the soil material is of capillary size, and, as a result, water is pulled upward into a capillary fringe within the base of the backstop. Breaking the capillarity by adding a layer of limestone or gravel to the base of the backstop should reduce the rate of deterioration of spent bullets, the erosion of the backstop, and the amount of lead going into solution.
    - *Phosphate Addition*. The addition of phosphate is not used to adjust soil pH but to bind the lead particles. It is generally used more often on parts of ranges not easily accessible by reclamation equipment.

  - *Controlling Runoff*. Controlling soil erosion and surface water runoff are important to preventing lead from migrating off-site. There are two factors that influence the

amount of lead transported off-site: the amount of lead fragments left on the range and the velocity of the runoff. Velocity of the water can be successfully controlled by using vegetative, organic, removable and/or permanent ground covers, and implementing engineered controls which slow down surface water runoff.

- *Vegetation Ground Cover*. Vegetation minimizes the amount of lead that will run off during heavy rainfall. Ground cover absorbs rainwater, which reduces the amount of water on the range, as well as the time the lead is in contact with the water. In addition, the ground cover will divert and slow down surface runoff, helping prevent lead from migrating off-site. Grasses yield the greatest benefit where the bullet impact areas are sloped. Utilize quick growing turf grass for the grass covering of backstops, which can be removed prior to reclamation and replanted thereafter. Avoid vegetation that attracts birds and other wildlife to prevent potential ingestion of lead by wildlife. Use grass to direct surface water drainage away from the target area. This will minimize the water's contact with lead bullet fragments, minimizing the potential for lead migration.
- *Mulches and Compost*. Mulches and compost can reduce the amount of water that comes in contact with the lead fragments. In addition, mulches and compost contain hermic acid, which is a natural lead chelating agent that actually sorbs lead out of solution and reduces its mobility. At a minimum, material should be two inches thick. These materials tend to be acidic (especially during decomposition), so, if low pH is a concern, a close watch will need to be kept on pH levels and the need for liming.
- *Surface Covers*. There are two basic types of covers, removable surface covers and permanent surface covers. Removable covers are generally considered for trap and skeet ranges and involve using plastic liners placed over the shotfall zone during non-use periods. Permanent covers can be used on impact and target areas to prevent rainwater from contacting the berms. Both options are expensive to use, and use of roof structures at the bullet impact areas must be carefully designed to avoid safety issues with ricochets.

o *Engineered Runoff Controls*. A "hard" engineered runoff control may be needed for ranges located in areas of heavy annual rainfall. Examples of hard controls include: filter beds, containment traps and detention ponds, dams/dikes, and ground contouring.

- *Filter Beds*. Engineered controls built into an outdoor range to collect and filter surface water runoff from the target range. The collected water is routed to a filtering system, which screens out larger lead particles, raises the pH of the water, and drains the water from the range area. Filter beds should be established at the base of the backstop. Filters typically consist of two layers; a fine-grained sand bed underlain by limestone gravel or other neutralization materials. After the runoff water passes through the filter bed, it drains into a perforated drainage pipe located within the limestone gravel. Operation and maintenance of filter beds are

minimal, involving mostly periodic removal of debris and occasional replacement of the limestone.

- *Containment Traps and Detention Ponds*. These are designed to settle out lead particles by causing runoff water to pass through these traps, allowing the lead bullet fragments to settle. Vegetation can be placed in the drainage path to increase the effectiveness of these traps/ponds.
- *Dams/Dikes*. These are used to reduce the velocity of the runoff water. These controls are most important at ranges where off-site runoff is a potential problem, such as ranges located uphill of a surface water body.
- *Ground Contouring*. By altering drainage patterns, the velocity of runoff can be reduced. This design in effect collects lead in the surface soils making lead reclamation as well as pH adjustment more critical.

- Step 3: Remove the lead from the range and recycle

To successfully minimize lead migration, the most important BMP for lead management is lead reclamation. To ensure that lead is not considered "discarded" or "abandoned" on the range within the meaning of the RCRA statute, periodic lead removal activities should be planned and conducted. This typically requires one or more of the following:

- *Hand Raking and Sifting*. A simple BMP that can be done by club members, particularly at small ranges, is raking and/or sifting bullet fragments from the soil. Sifting and raking activities should be concentrated at the surface layer. Once collected the lead must be taken to a recycler or reused. Avoid storing collected lead to avoid potential health, safety and regulatory concerns associated with storage of lead. Those conducting the hand raking and sifting reclamation should protect themselves from exposure to lead.
- *Renting mechanical separation machinery*.
- *Hiring a professional reclamation company*. These companies claim to recover 75%-95% of the lead in soils. This may or may not be economically feasible depending on the recoverability and amount of lead at the range.
- *Vacuuming*. Used most often for shotgun ranges to collect spent shot dispersed over a wider area.
- *Soil washing (physical and gravity separation).*

The frequency of lead removal is dependent on several factors including the number of rounds fired, the soil pH, annual precipitation, soil type and depth to groundwater. Lead quantity, as estimated by the number of rounds fired, is a factor in determining the appropriate frequency of reclamation at ranges. Establishing record keeping procedures to monitor the number of rounds fired is recommended. The NRA recommends a frequency of one to five years for lead cleanup, even on ranges with minimal use. Another source indicates that a minimum of 100,000 rounds per firing lane should be allowed before lead reclamation occurs.

- Step 4: Documentation of activities and retention of records

Documenting activities and keeping good records is important for effective lead management at a range. The type of BMP(s) implemented, the date of service, and who did the services are important records to keep.

6.0 BMPs SELECTED FOR IMPLEMENTATION UNDER THE PROPOSED ACTION

The following BMPs have been selected for implementation, based on effectiveness, safety, and cost:

- Control and containment of lead bullets and bullet fragments. An earthen berm and backstop 15-20 feet high with a slope as steep as possible would be used to contain bullets and bullet fragments. The upper most 1 to 2 feet of the berm would be free of large rocks and other debris and the entire berm would be vegetated to prevent erosion of the berm/backstop. This option was selected because it effectively and safely contains the lead in the berm/backstop at minimal cost.
- Prevention of Lead Migration through the following actions:
  - *Lime Addition.* The pH of the soil over the entire range area would be monitored annually with the goal to keep the general soil pH between 6.5 and 8.5. Lime would be applied as needed at rates necessary to maintain the optimum pH level.
  - *Reducing capillarity action within the backstop*. Because most porosity in soil material is of capillary size, breaking this capillary action within the backstop would reduce the exposure of lead to water. This would be done by adding a layer of limestone or gravel to the base of the backstop during construction. This would reduce the rate of deterioration of spent bullets, erosion of the backstop, and the amount of lead going into solution.
  - *Phosphate Addition*. The addition of phosphate should be considered to bind the lead particles on any section of the range that is not easily accessible when reclaiming spent lead. Phosphate does not adjust soil pH, but it binds the lead particles preventing them from moving in solution.
  - *Controlling runoff*. Controlling the velocity of the runoff is critical, and can be adequately addressed during construction and maintenance by insuring that vegetation cover is maintained on the site, preferably with fast growing turf grasses as well as proper grading and leveling of the site. Water diversion devices would be constructed where needed to keep any off-site runoff water from flowing onto the lead impact areas.
  - *Engineered runoff controls*. A filter bed with containment trap would be constructed at the backstop/berm area. Filter beds would be established at the base of the backstop. The filter would consist of two layers; a sand bed underlain by limestone gravel or other neutralization materials. After the water runoff passes through the filter bed it would drain into a perforated drainage pipe located within the limestone gravel. The perforated pipe would then drain into a containment trap which would cause any lead still contained in the runoff water to settle. Operation and maintenance would be minimal, involving mostly periodic removal of debris and occasional replacement of the limestone.

- Lead Removal and Recycling. To ensure that lead is not "discarded" or "abandoned" within the meaning of the RCRA statute (i.e., a hazardous waste); periodic lead removal activities would be planned for and conducted. The simplest and most cost effective is simple hand raking and sifting. Once collected the lead would be taken to a recycler or reused. Those conducting hand raking and sifting would use standard precautions to protect themselves from exposure to lead. These activities would be done as a minimum once every 5 years.
- Documenting Activities and Record Keeping. Records would be kept on the type of BMP(s) implemented, the date of service and who did the service and these records would be retained by the Forest Service.

Appendix B: Supplemental Biological Evaluation for the Clay County Shooting Range Project

SUPPLEMENTAL BIOLOGICAL EVALUATION CLAY COUNTY SHOOTING RANGE PROJECT

1.0 INTRODUCTION

The Forest Service has prepared this Biological Evaluation (BE) in compliance with the National Forest Management Act (NFMA), the Endangered Species Act (ESA) and other relevant federal and state laws and regulations. This Biological Evaluation discloses the effects to (1) proposed, endangered and threatened wildlife and plant species and (2) forest sensitive wildlife and plant species that would result from the proposed action and alternatives. This document is based upon the best available science, including peer-reviewed scientific literature, state and federal agency reports and management input, discussions with scientists and other professionals, and ground-based observations.

The Tusquitee Ranger District of the USDA Forest Service is analyzing a proposal to develop a recreational shooting facility on National Forest System lands in Clay County, North Carolina. The purpose of this Biological Evaluation is to assess the direct, indirect, and cumulative effects that the shooting facility project may have on Federally proposed, endangered and threatened (PET) and forest sensitive species. The scope of this Biological Evaluation does not include possible environmental impacts not associated with PET and forest sensitive species. General environmental impacts are included in the Environmental Assessment.

General objectives of the Biological Evaluation are:

- to ensure that Forest Service actions do not contribute to loss of viability of any native or desired non-native plant or animal species or contribute to trends toward Federal listing of any species,
- to comply with the requirements of the Endangered Species Act that actions of Federal agencies not jeopardize the continued existence of a listed species or adversely modify critical habitat of federally listed species,
- to provide a standard process to ensure that PET and forest sensitive species receive full consideration in the decision-making process,
- to address the effects of management activities to PET and forest sensitive species habitat and/or potential habitat on the Nantahala/Pisgah National Forest TES species list, and
- to incorporate any mitigation measures specifically addressing any potential impacts from management activities related to this project to PET and forest sensitive species or their habitat or potential habitat.

2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

This section presents a detailed description of the alternatives. These alternatives were developed by the Interdisciplinary Team of specialists in response to identified issues and opportunities.

2.1 ALTERNATIVES CONSIDERED

2.1.1 Alternative A – No Action

Alternative A is the No Action Alternative. No actions would be taken to establish a shooting range in Clay County. Subject to natural and human-induced disturbances, plant communities would pass through seral stages in the successional process, providing habitat for a variety of botanical, terrestrial wildlife, and aquatic wildlife species.

2.1.2 Alternative B, Modified

Alternative B (Modified) would develop approximately three to five acres off Passmore Spur Road near Perry Creek as a recreational shooting range.

- Approximately three to five acres would be cleared of all vegetation and the terrain shaped with heavy equipment, such as a dozer, to create five to eight shooting lanes and earthen backstops.
- To access the site, the first 2,000 feet of Passmore Spur Road would be removed from storage and would receive maintenance treatments, including mowing, light grading, and spreading gravel aggregate to accommodate passenger vehicles. The remainder of Passmore Spur Road would remain closed and in storage. Approximately 1,300 feet of single lane, gravel road on an existing old logging road prism would be constructed and added to the forest road system to connect Passmore Spur Road to the range site. A parking area capable of accommodating approximately ten vehicles would be constructed.
- The shooting facility would include five to eight covered shooting stations, sign boards, and a portable restroom facility.
- Design measures to control erosion would include seeding exposed soil with a grass seed mixture, hardening the access road and parking area with gravel, and installing sediment control measures such as silt fences.
- Design measures to reduce nuisance gunfire noise would include incorporating sound baffling components into range structures, vegetation, and landscaping, limiting the caliber of firearms allowed at the facility, and, if needed, adjusting hours of operation.
- Design measures to prevent lead contamination include the construction and maintenance of a clean soil backstop, treatments to manage the pH of the shooting lanes and backstop, and routine monitoring of the lead content of soil and water (see also Section 2.1.4 and Appendix A in the EA).
- Design measures to avoid effects to ground nesting bird species, including ruffed grouse, during construction activitites would prohibit ground disturbance during the nesting season from early April until the middle of June.
- Design measures to address traffic safety on Nelson Ridge Road would include posting and enforcing speed limits and installing speed bumps, broad based dips, and additional signage.

Nelson Ridge Road is designated as Maintenance Level 3, and its Road Management Objective would not need to be changed to reflect the projected increase in vehicular use. The Forest Service gate on Nelson Ridge Road at the entrance to the national forest has traditionally been

closed and locked from January 1st to March 31st annually. This annual seasonal closure would not be continued under the modified Alternative B (Modified), and would be open year round.

The Perry Creek site is located on lands designated as Management Area 3B (MA3B). The Forest Plan describes MA3B as areas emphasizing a sustainable supply of timber, but with few open roads and limited disturbance associated with motorized vehicles. This management area also provides for the habitat needs of wildlife such as wild turkey, deer, a variety of small mammals, and other species that will benefit from a managed forest with limited motorized access. A sustainable supply of timber is achieved through regulating the growth and removal of trees through time. Access to the forest is desired during the time timber is harvested, though most roads are closed at other times. Although a regulated forest is desired, some natural forest settings will be present. The visitor may encounter forest management activities in progress, including timber harvest, road building and timber stand improvement. Wildlife compatible with or that benefit from these conditions, such as deer, raccoon, and other small mammals are likely to be present. Black bear also use these areas, though they do not provide the best black bear habitat. Recreationists use these areas for hiking, mountain biking, horseback riding, hunting and other activities. The visitor may encounter other forest users, but not as frequently as in areas with open roads. Habitat needs of the wildlife favored by MA3B would not be appreciably altered. The Forest Service estimates that high use at the site would result in between six and eight additional vehicles per day on the existing road, and overall impacts from motorized vehicles would continue to be limited.

2.1.3 Alternative C

Alternative C would develop three to five acres on Barnett Creek Road (FSR 6236), as a recreational shooting range.

- Approximately three to five acres would be cleared of all vegetation and the terrain shaped with heavy equipment, such as a dozer, to create four or five shooting lanes and earthen backstops.
- To access the site, the portion of Barnett Creek Road beyond the existing Forest Service gate, a total of approximately 2,100 feet, would be reconditioned to accommodate traffic, including a water crossing that currently does not meet road management objectives. Approximately 1,200 feet of new single lane gravel road would be constructed to connect the parking area with Barnett Creek Road.
- A parking area capable of accommodating approximately ten vehicles would be constructed.
- The shooting facility would include four to five covered shooting stations, sign boards, and a portable restroom facility.
- Design measures to control erosion would include seeding exposed soil with a grass seed mixture, hardening the access road and parking area with gravel, and installing sediment control measures such as silt fences.
- As needed, the facility would include features to contain and to reduce nuisance gunfire noise, incorporating sound baffling components into range structures, vegetation, and landscaping.

- Design measures to prevent lead contamination include the construction and maintenance of a clean soil backstop, treatments to manage the pH of the shooting lanes and backstop, and routine monitoring of the lead content of soil and water (see also Section 2.1.4 and Appendix A).
- Design measures to avoid effects to ground nesting bird species, including ruffed grouse and ovenbirds during construction activities would prohibit ground disturbance during the nesting season from early April until the middle of June.

The Chestnut Branch site is located on lands designated as Management Area 4D (MA4D). The Forest Plan describes MA4D as areas emphasizing high quality wildlife habitat for wildlife requiring older forests and freedom from disturbance from motorized vehicles, particularly for black bear. The Forest Plan describes opportunities for non-motorized recreational uses including hunting, fishing, viewing wildlife, horseback riding, bicycle riding and hiking. Habitat needs of the wildlife favored by MA4D would not be appreciably altered. The Forest Service estimates that high use at the site would result in between six and eight additional vehicles per day on the existing road which is currently utilized by rock hounds to access Corumdum Knob, and overall impacts from motorized vehicles would continue to be limited.

Figure 2.1.1 – Site map for Alternative B (Modified)

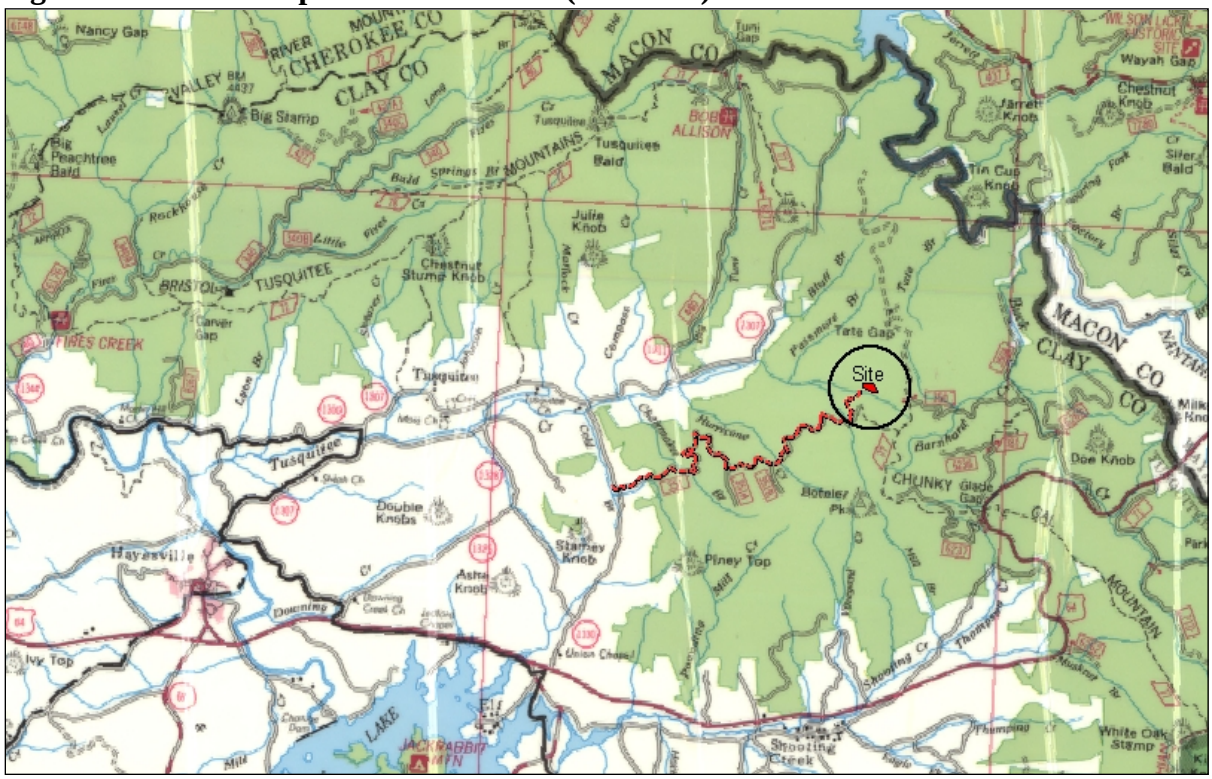
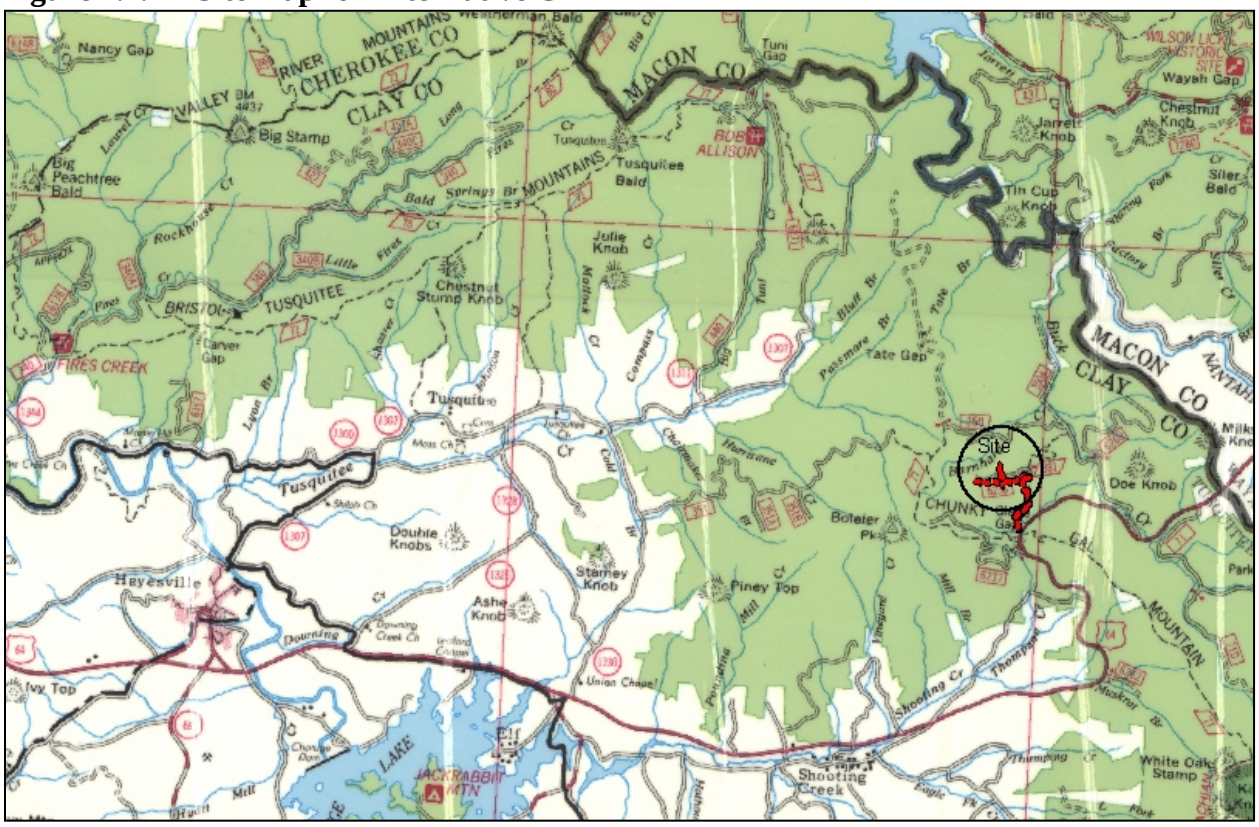


Figure 2.2.2 – Site map for Alternative C



3.0 THREATENED, ENDANGERED, AND FOREST SENSITIVE SPECIES

Fish and Wildlife Associates, Inc. personnel conducted field surveys in efforts to locate Federally proposed, endangered and threatened (PET) and forest sensitive botanical, terrestrial wildlife, and aquatic wildlife species at the proposed treatment area at Perry Creek (Alternative B (Modified)) during September 2007, October 2007, and January 2009. Field surveys of the Chestnut Branch treatment area (Alternative C) occurred in October 2008 and January 2009 (Fish and Wildlife Associates 2007, 2008, 2009).

3.1 BOUNDS OF ANALYSIS

3.1.1 BOTANICAL RESOURCES BOUNDS OF ANALYSIS

Due to the immobility of botanical resources, only species occurring within the proposed shooting range sites were considered in the analysis. Only species present at the proposed range sites would sustain direct impacts as a result of the implementation of this project. Any direct effects due to either Alternative B (Modified) or C are expected to be permanent, as the proposed shooting range would be maintained indefinitely. Under the no action alternative, Alternative A, temporal effects would be tied to natural and human-induced disturbances that are part of forest succession processes.

Alternative B (Modified)

Existing Condition
The proposed site is located within rich cove forest with elements of montane oak-hickory forest. Although located in an area that supported rich cove forest plant communities, the proposed site is at an earlier successional stage due to the silvicultural treatment conducted in 1996. The .25 mile proposed road construction is an old logging road and the proposed range site is in an area where previous harvesting activities occurred.

Within the proposed range site, only a few mature *Liriodendron tulipifera* are present, while most of the site consists of young, sapling size trees. Sapling trees included *Robinia pseudoacacia, Acer rubrum, Halesia tetraptera, Quercus rubra*, and *Liriodendron tulipifera*. Other species found within the three-acre tract are *Ilex opaca, Rhus typhina, Eupatorium purpureum, Oenothera biennis, Potentilla canadensis, Polystichum acrostichoides, Pyrularia puberia, Aralia spinosa, Rubus sp., Vitis sp., Aristolochia macrophylla, Smilax sp., Desmodium sp., Toxicodendron radicans*, and *Dennstaedtia punctilobula*.

Vegetation along the old logging road template differs from the forested portion of the site due to the increased solar radiation and higher level of past soil disturbance. Common species encountered on the road bed included *Potentilla canadensis, Aster sp., Rubus sp., Polystichum acrostichoides, Aralia spinosa, Pycnanthemum sp., Geum sp., Lobelia siphilitica, Thalictrum thalictroides,* and *Fragaria virginiana*. The forest immediately adjacent to the single lane road is more characteristic of rich cove forest.

Alternative C

Existing Condition
The proposed range site is located within northern hardwood forest with high elevation red oak forest components. The treatment area is a mix of mature and young forest. Immediately west, and a small portion of the site, is a 20 year old group selection harvest unit. East of the treatment area is mature forest.

A few species are common in the proposed treatment area including *Robinia pseudoacacia, Prunus pensylvanica, Acer rubrum,* and *Liriodendron tulipifera*. Other species present included *Betula allegheniensis, Quercus montana, Quercus rubra, Prunus serotina, Acer pensylvanicum, Amelanchier sp., Magnolia acuminata, Sassafras albidum, Crataegus sp., Tsuga canadensis, Fagus grandifolia, Hamamelis virginiana, Kalmia latifolia, Rhododendron sp., Tilia americana, Carya spp.*, and *Oxydendrum arboreum*. Herbaceous species encountered in the field survey included *Hydrangea arborescens, Polystichum acrostichoides, Thelypteris noveboracensis,* and *Polygonum sp. Vitis sp.* is a common vine growing in the proposed site.

3.1.2 TERRESTRIAL WILDLIFE BOUNDS OF ANALYSIS

Without conducting full surveys for terrestrial species, it can be difficult to determine the presence of some species. As a result, analysis of effects or impacts on terrestrial wildlife will be based primarily on available habitat within the proposed treatment area. Adjacent habitat may

also be considered when evaluating the potential of wildlife use in the project vicinity. Any direct effects due to either Alternative B (Modified) or C are expected to be permanent, as the proposed shooting range would be maintained indefinitely. Under the no action alternative, Alternative A, temporal effects would be tied to natural and human-induced disturbances that are part of forest succession processes.

Alternative B (Modified)

Existing Condition
A variety of terrestrial wildlife would be likely to utilize habitat in the proposed treatment area and project vicinity of Alternative B (Modified) including birds, mammals, reptiles, amphibians, and terrestrial invertebrates. Evidence and/or sightings of the following species were documented: wild boar, ruffed grouse, small mammals (rodents), coyote, slate-colored junco, and black-capped chickadee.

Alternative C

Existing Condition
A variety of terrestrial wildlife would be likely to utilize habitat in the proposed treatment area and project vicinity of Alternative C including birds, mammals, reptiles, amphibians, and terrestrial invertebrates. Evidence and/or sightings of the following species were documented: coyote, deer, and pileated woodpecker.

3.1.3 AQUATIC RESOURCES BOUNDS OF ANALYSIS

No aquatic resources were present in the proposed treatment areas of Alternatives B (Modified) and C; therefore, no direct impacts will result from the project. However, indirect and cumulative impacts were evaluated for aquatic resources that drain the proposed treatment areas.

Alternative B (Modified)

Existing Condition
One perennial stream was north of the tract and one perennial and one intermittent stream were south of the tract. All three tributaries are the headwaters of Perry Creek. The perennial streams were 250 to 650 feet from the treatment area. The intermittent stream ran along the approach road for approximately 100 feet, before the flow went below the surface. Benthic macroinvertebrates were observed in the perennial streams, but not likely to support fish. The intermittent stream was dry during the field surveys, with the exception of the January survey. No benthic macroinvertebrates were observed in the intermittent stream and fish are not likely to be present.

Alternative C

Existing Condition
A small, perennial stream (unnamed tributary of Barnard's Creek) was immediately west of the treatment area. The stream was approximately 1 foot wide, with 6 inch to 1 foot banks, and was

1 to 2 inches deep. The substrate was gravel and sand. This small stream is not likely to support fish, but stonefly larvae were observed on the stream substrate.

3.2.1 THREATENED, ENDANGERED, AND SENSITIVE SPECIES CONSIDERED

The Nantahala-Pisgah National Forests maintains lists of proposed, threatened, endangered (PET) and forest sensitive species on NFS lands; all of these species were originally considered. The lists were filtered by considering only those species listed by the North Carolina Natural Heritage Program (NCNHP) or the United States Fish and Wildlife Service (USFWS) as occurring or probably occurring in Clay County, with the exception of terrestrial wildlife. Due to the mobility of terrestrial wildlife, the filtered list also included species occurring or probably occurring in nearby counties (Cherokee, Graham, Macon, and Swain). A total of 52 species remained after this cut, and included 20 plant species, 31 terrestrial animal species, and 1 aquatic animal species. A list of the 52 species, including a brief habitat description, is provided in the appendices to this BE.

Each list was further narrowed by eliminating those species requiring habitats not found within the proposed treatment areas. Species with well-defined habitat requirements (spray cliffs, granitic domes, caves, rock outcrops, talus slopes, bogs, wetlands, spruce-fir forests, etc.) were eliminated from further consideration. For ease of comparison, Alternatives B (Modified) and C are evaluated concurrently in this section.

Habitat preferences and ranges of these plant and animal species were based on a variety of sources, including the NCNHP database, USFS lists, NatureServe© database, personal communication with USFS personnel, and other reference materials. Natural community classification followed Schafale and Weakley (1990).

The following USFS specialists were consulted during the process of species evaluation: Doreen Miller - Nantahala National Forest wildlife biologist (retired); Jason Farmer - Nantahala National Forest fisheries biologist; and Duke Rankin – former Nantahala National Forest botanist.

In an effort to ensure as complete an analysis as possible, the NCNHP database was queried for botanical and fisheries TES element occurrences within the general vicinity of the proposed treatment areas and, in the case of terrestrial wildlife, within two miles of the project vicinity for the action alternatives. No species tracked by NCNHP occur within either proposed treatment areas; however, due to low accuracy of the element occurrences, one species may occur in the proposed treatment area of Alternative B (Modified): *Myotis leibii*. One threatened and one sensitive species are known to occur within two miles of the project vicinity of Alternative B (Modified): *Glyptemys muhlenbergii* and *Thalictrum macrostylum*. Habitat for *Glyptemys muhlenbergii* (bog turtle) is not present in the project areas, nor do the aquatic features connect habitats suitable for supporting populations of bog turtles. Accordingly, it was eliminated from further analysis. One threatened species is known to occur within two miles of the project vicinity of Alternative C. Potential effects on *Thalictrum macrostylum* is discussed in Section 3.2.2.

3.2.2 BOTANICAL THREATENED, ENDANGERED, AND SENSITIVE SPECIES CONSIDERED

Of the 20 botanical species that remained after filtering by county, nine species remained for further analysis for Alternative B (Modified) and three species for Alternative C. These species remained because their general habitat requirements were present in a proposed treatment area. Table 3.2.2.1 lists the species with general habitat requirements in the proposed treatment areas.

Based on more specific habitat requirements, six of the nine species do not have a high potential to occupy the proposed treatment area of Alternative B (Modified) and one of the three of Alternative C. No effects to these seven species or their habitats are anticipated. Species with a high potential of occupancy for either Alternative B (Modified) or C are discussed below.

Butternut (*Juglans cinerea*) Alternative B (Modified)
Environmental Baseline – General habitat for butternut includes rich cove forest, mesic oak-hickory forest, and montane alluvial forest. This species has a high potential to grow in moist, nutrient-rich forests (Weakley 2008) on lower slopes, ravines, or bottomland, floodplain forests. This species has high potential to occupy the proposed treatment area because it does include the high potential habitat described above.

Available Inventories Information - No previous surveys have been conducted in the project vicinity, although surveys have been conducted for unrelated Forest Service projects within 2-3 miles. *Juglans cinerea* was not documented during those surveys. In addition, FWA conducted surveys or the proposed treatment area, *Juglans cinerea* was not encountered.

Direct and Indirect Impacts- Because *Juglans cinerea* was not present in the proposed treatment area, nor has it been documented in the vicinity, no direct or indirect impacts are anticipated.

Cumulative Impacts- Due to the lack of direct and indirect impacts, there will be no cumulative impacts as a result of this project.

Table 3.2.2.1. Botanical PET and forest sensitive species with general habitat requirements within the proposed treatment area of Alternative B (Modified) and C.

Designation	Scientific Name	Common Name	Specific Habitat Requirements	High Potential for Occupancy		Rationale
				Alt B Mod	Alt C	
Sensitive	*Sceptridium jenmanii*	Alabama grape fern	no information available on specific habitat requirements			Not observed in area
Sensitive	*Euphorbia purpurea*	glade spurge	mid- to high elevation rich cove with high nutrient soils	x	x	
Sensitive	*Helianthus glaucophyllus*	whiteleaf Sunflower	moist forests or woodland edges at mid-elevations, 3,200 to 4,900 feet.	x	x	Common, on the Nantahala; demonstrably secure regardless of effects
Sensitive	*Juglans cinerea*	butternut	moist, nutrient-rich forests on lower slopes, ravines, or bottomland, floodplain forests.	x		No suitable habitat at Alt C
Sensitive	*Monotropsis odorata*	sweet pinesap	slopes or bluffs with abundant heaths, primarily *Rhododendron maximum*	x		No suitable habitat at Alt C
Sensitive	*Thalictrum macrostylum*	Piedmont meadowrue	rich wooded slopes, as well as cliffs, low meadows, and limestone sinks	x		Strongly associated with barrens below Alt C
Sensitive	*Trillium pusillum* var. *ozarkanum*	Alabama least trillium	under *Quercus coccinea* and *Kalmia latifolia*			Not observed in the area
Sensitive	*Viola appalachiensis*	Appalachian violet	old roadbeds through coves	x		No suitable habitat at Alt C
Designation	**Scientific Name**	**Common Name**	**Specific Habitat Requirements**	**High Potential for Occupancy**		**Rationale**
				Alt B Mod	**Alt C**	
Sensitive	*Drepanolejeunea appalachiana*	A liverwort	present in small, low-density populations throughout high-elevation, moist forests in the mountains..		x	No suitable habitat at Alt B Mod
Sensitive	*Prenanthes roanensis*	Roan rattlesnakeroot	wooded slopes or grassy balds above 4,000 feet		x	No suitable habitat at Alt B Mod

Piedmont meadowrue (*Thalictrum macrostylum*) Alternative B (Modified)
Environmental Baseline – General habitat for piedmont meadowrue includes serpentine forest and moist woods. This species has a high potential to occur on rich wooded slopes, as well as cliffs, low meadows, and limestone sinks. Weakley (2008) suggests it may be associated with circumneutral soils or ultramafic outcrop barrens (serpentine). This treatment area may contain potential habitat; rich wooded slopes are present within the proposed treatment area. *Thalictrum macrostylum* was not documented in surveys of the treatment area conducted by FWA.

Direct and Indirect Impacts- Because *Thalictrum macrostylum* was not present in the proposed treatment area, no direct impacts are anticipated. Potential habitat exists, however, so an indirect loss of some potential habitat for this species would result if the project is implemented.

Cumulative Effects – Cumulative effects would be the same as the direct and indirect effects.

Appalachian violet (*Viola appalachiensis*) Alternative B (Modified)
Environmental Baseline – General habitat for Appalachian violet includes serpentine woodlands or rich cove forest. This species has a high potential to occur on old roadbeds through coves (Weakley 2008). This species has a high potential to occupy the proposed treatment area because the area includes an old roadbed through rich cove Forest.

Available Inventories Information - Previous surveys were conducted in the project vicinity prior to the silvicultural activity in 1996. *Viola appalachiensis* was not documented during that survey, although optimum habitat (old roadbeds) was not present at the time. FWA conducted surveys of the proposed treatment area and *Viola appalachiensis* was not encountered.

Direct and Indirect Impacts- Because *Viola appalachiensis* was not present in the proposed treatment area, nor has it been documented in the project vicinity, no direct impacts are anticipated. Positive indirect impacts could accrue from construction and management activities and road daylighting that could create potential habitat. Negative indirect impacts could accrue from the same activities if noxious weeds or NNIS occupy potential habitat.

Cumulative Effects – Cumulative effects would be the same as the direct and indirect effects.

Whiteleaf sunflower (*Helianthus glaucophyllus*) Alternative C
Environmental Baseline - General habitat for whiteleaf sunflower includes Rich Cove Forest, Northern Hardwood Forest, High Elevation Red Oak Forest, Mesic Oak-Hickory Forest, and roadsides. This species has a high potential to occur in moist forests or woodland edges at mid-elevations, 3,200 to 4,900 feet. This species has a lower potential to occur at elevations below 3,200 feet (Weakley 2008). However, this species was not observed during surveys conducted by FWA personnel.

Direct and Indirect Impacts- Due to the lack of high potential habitat and the lack of observations during field surveys, no direct impacts are anticipated. Constructing the facility would result in increased solar radiation and changes to microclimate along forest edges around the facility and the roads leading to it. This would have an indirect impact by creating suitable habitat.

Cumulative Effects – Cumulative effects would be the same as the direct and indirect effects.

Roan rattlesnakeroot (*Prenanthes roanensis*) Alternative C
Environmental Baseline – Habitat for *Prenanthes roanensis* has been described as mountain forests and grassy balds at high elevations (Weakley 2008), as well as rich woods; moist grass sites or heath balds; moist, open, wooded slopes; roadsides and parking areas; along trails, and borders of and clearings in forests. Little information is available on the specific habitat requirements, however, it appears open habitats may be preferred. This species was not observed during surveys conducted by FWA personnel.

Direct and Indirect Impacts- Due to the lack of observations during field surveys, no direct impacts are anticipated. Constructing the facility would result in increased solar radiation and changes to microclimate along forest edges around the facility and the roads leading to it. This would have an indirect impact by creating suitable habitat.

Cumulative Impacts- While there is a lack of direct impacts, the presence of some indirect impacts means that there will be cumulative impacts as a result of this project.

Determination of Effect

Because **no endangered or threatened plant species were located in the proposed treatment areas**, there should be no direct, indirect or cumulative effects to any endangered or threatened plant species. **Consultation with the U. S. Fish and Wildlife Service is not necessary** for botanical species.

For the sensitive plant species ***Juglans cinerea, Thalictrum macrostylum, Helianthus glaucophyllus,*** and ***Prenanthes roanensis***, the project **may affect individuals, but is unlikely to affect the viability of the species across the forest as a whole**. For all other sensitive plant species, there should be no direct effects to any sensitive plant species because they were not located in the proposed treatment areas. Positive indirect effects include increases in potential habitat for *Viola appalachiensis, Helianthus glaucophyllus,* and, at Chestnut Branch, *Prenanthes roanensis*. Negative indirect effects include potential increases in competition from noxious weeds and non-native invasive species for *Viola appalachiensis*. Cumulative effects would result from indirect effects, may impact individuals, but are unlikely to affect the viability of species across the forest as a whole.

3.2.3 TERRESTRIAL THREATENED, ENDANGERED, AND SENSITIVE SPECIES CONSIDERED

Of the 31 terrestrial species that remained after filtering by counties, a total of 15 species remained for further analysis, based on general habitat requirements of those species. Table 3.2.3.1 lists the species whose general habitats occurred within the proposed treatment areas. Based on more specific habitat requirements, three species had a high potential to occupy the proposed treatment areas of both Alternative B (Modified) and Alternative C. No effects or impacts to the remaining 13 species or their habitats are anticipated

Table 3.3.3.1. Terrestrial wildlife PET and forest sensitive species with general habitat requirements within the proposed treatment area of Alternative B (Modified) and C.

Designation	*Scientific Name* Common Name	Specific Habitat or Distribution	Analyzed Further?
Endangered	*Puma concolor couguar* Eastern Cougar[1]	extensive forests in remote areas	No, presumed extirpated
Endangered	*Myotis sodalis* Indiana Bat[1]	hollow trees or under loose bark of living or dead trees standing in sunny openings	**Yes**
Sensitive	*Callophrys irus* Frosted Elfin[3]	open woods or forest edges with *Baptisia sp*. and *Lupinus sp*.	No, specific habitat not present
Sensitive	*Corynorhinus rafinesquii rafinesquii* Rafinesque's Big-eared Bat[1]	abandoned buildings or caves for summer roosting and maternity colonies	No, specific habitat not present
Sensitive	*Desmognathus santeetlah* Santeetlah Dusky Salamander[1]	Unicoi Mountains, Great Smoky Mountains National Park, and Great Balsam Mountains	No, outside of local range
Sensitive	*Microtus chrotorrhinus carolinensis* Southern Rock Vole[3]	Rocky areas in spruce-fir, northern hardwoods, and grassy balds	No, specific habitat not present
Sensitive	*Myotis leibii* Small-footed Myotis[1]	Hemlock forests, rock crevices, caves, mines, buildings	**Yes**
Sensitive	*Nesticus silvanus* Cave spider[3]	spruce-fir forests	No, specific habitat not present
Sensitive	*Paravitrea placentula* Glossy Supercoil[1]	associated with *Betula alleghaniensis* and *Tsuga canadensis*	No, specific habitat not present
Sensitive	*Plethodon aureolus* Tellico Salamander[1]	restricted range in Monroe and Polk Counties in Tennessee, and Cherokee and Graham Counties in NC	No, outside of local range
Sensitive	*Plethodon teyahalee* Southern Appalachian Salamander[1]	mature, mesic, hardwood forests	**Yes**
Sensitive	*Sorex palustris punctulatus* Southern Water Shrew[2]	streambanks of medium-sized streams, with rhododendron cover	No, specific habitat not present
Sensitive	*Speyeria Diana* Diana Fritillary[1]	mesic, cove forests with *Viola sp*. below 4,000 feet	**Yes**
Sensitive	*Thryomanes bewickii altus* Appalachian Bewick's Wren[3]	woodland borders or openings, farmlands, or brushy fields more often at high elevations	No, specific habitat not present

[1]General habitat requirements for these species were present in the proposed treatment areas of both Alts B (Mod) and C.
[2]General habitat requirements for these species were present in the proposed treatment area of Alternative B (Modified).
[3]General habitat requirements for these species were present in the proposed treatment area of Alternative C.

Indiana bat (*Myotis sodalis*) - Alternatives B (Modified) and C

Environmental Baseline – In summer, habitat consists of wooded or semi-wooded areas. This species has high potential to occur in hollow trees or under loose bark of living or dead trees standing in sunny openings. This habitat is used by small maternity colonies to bear their offspring. Though maternity sites have been reported as occurring mainly in riparian and floodplain forests, recent studies indicate that upland habitats are used by maternity colonies much more extensively than previously reported. In recent years, colonies of reproductively active female Indiana bats have been documented in nearby Graham and Cherokee Counties in North Carolina. In winter, caves are utilized for hibernation. Most caves and cave-like habitats in western North Carolina do not have suitable conditions to provide wintering habitat for Indiana bats.

Due to the lack of suitable maternity colony trees (large trees with exfoliating bark located in sunny areas), this species does not have a high potential to utilize either of the proposed treatment areas for maternity sites. It is possible that either site could be utilized periodically for foraging; however, the habitat at both sites would be considered suboptimal for foraging Indiana bats as well, due to the limited availability of riparian and floodplain trees which are considered optimal foraging habitat. Roads to the site could be utilized by individuals as travel corridors and the increased number of vehicles using area roads could increase the collision risk. To reduce the likelihood of direct effects to Indiana bats and indirect effects to Indiana bat habitat, this project would comply with the Terms and Conditions in the Biological Opinion of the U. S. Fish and Wildlife Service for the protection of the Indiana bat on the Nantahala and Pisgah National Forests.

Available Inventories Information – No mist net surveys have been conducted in the project vicinity. No mist net surveys were conducted for this project; however, a qualitative assessment for potential roost trees was conducted at both sites. No potential roost trees were documented in either of the proposed treatment areas.

Direct and Indirect Effects – Based on the small number of currently suitable or potential roost trees that would be affected, effects on the bat population would be unlikely, and would not reach the scale where an adverse effect or actual take occurs. The sequence of events that would result in a tree being cut down in which a bat is roosting is unlikely; therefore, direct effects to Indiana bats should not occur. Indiana bats are known to use highly altered and fragmented landscapes. They may respond positively to habitat disturbance, particularly where forests are even-aged and closed-canopied. A diverse landscape may benefit Indiana bats, as long as sufficient mature forest and numbers of quality roost trees are provided. Given the amount of tree cutting, the area would still provide vast numbers of roost trees and potentially suitable habitat for Indiana bats.

Approximately 3-5 acres (under Alternative B (Modified)) or 3-5 acres (under Alternative C) of suboptimal foraging habitat would be cleared as a result of this project. Indiana bats are known to use highly altered and fragmented landscapes. They may respond favorably to habitat disturbance, particularly where forests are even-aged and closed-canopied. A diverse landscape may benefit Indiana bats, provided that adequate areas of mature forest and suitable roost trees

remain. Given the limited extent of clearing associated with either Alternative B (Modified) or Alternative C, areas surrounding the proposed treatment areas would still provide large numbers of potential roost trees and potentially suitable habitat for Indiana bats.

Cumulative Effects – Due to the limited extent of suboptimal foraging habitat to be impacted by either of the proposed action alternatives, relative to available habitat on adjacent Forest lands, neither of the proposed actions would affect the availability of Indiana bat habitat in these areas.

Determination of Effect – Alternatives B (Modified) and C **may affect, but are not likely to adversely affect** the Indiana bat (*Myotis sodalis*). This species has not been documented near either of the proposed treatment areas; nor within Clay County. Habitat within the proposed treatment areas is not suitable for maternity colonies, and is not optimal for foraging. The probability of either of the proposed treatment areas being used by Indiana bats is very low. Standards and guides for the protection of this species, as listed in Amendment 25 of the Land and Resource Management Plan, will also be followed to ensure that the project will have no effect on this species. The alternatives included in this project will have no effect on any other federally proposed or listed terrestrial animal species.

Eastern small-footed bat (*Myotis leibii*) – Alternatives B (Modified) and C
Environmental Baseline - This species is thought to roost in hemlock forests, rock crevices, caves, mines, bridges or buildings, and uses other habitats for feeding. Little is known regarding summer nursery sites and summer foraging or roosting habitat. Suitable maternity habitat may be lacking across the Forest, if otherwise appropriate sites are not exposed to the sun.

Direct and Indirect effects - In Alternatives B (Modified) and C, tree felling operations to clear sites could impact individuals through direct crushing. Creating openings in the canopy could improve feeding habitat for forest bats, which are attracted to the insects supported by grassy/brushy habitat areas. No special roosting habitats, such as hemlock forests, rock crevices, caves, mines, bridges or buildings will be adversely affected. Road construction should not affect the habitat. Individuals may use roads as travel corridors, and some concern has been raised that there is a risk of collision with traffic from users leaving the range at dusk.

*Cumulative Effect**s*** – Cumulative effects would be the same as the direct and indirect effects.

Determination of Effect - This species has been collected from most counties in western North Carolina, although it is rarely trapped during mist-netting surveys. The species has probably benefited from past forest management, which created new forest openings to offset the concurrent maturation of other forest stands. This project may impact individuals of this species, but benefit the habitat. The adverse effects to individuals would be minor considering the status and distribution of this species on the Nantahala National Forest. Therefore, this project is not likely to cause a trend to federal listing or a loss of viability across the Forest.

Southern Appalachian salamander (*1.*) - Alternatives B (Modified) and C
Environmental Baseline - This species occurs in forests made up of birch, beech, hemlock, witch hazel, mountain laurel, and rhododendron. Adults have been found up to 5,000 feet in elevation. The highest densities of this species were in mature, mesic, hardwood forests (Petranka 1998); however the species has been recorded in a wide variety of forest types and elevations within the

Nantahala National Forest. This species has potential to occur in both of the proposed treatment areas, as they include many of the associate botanical species listed above.

Direct and Indirect Effects – Direct impacts to *Plethodon teyahalee* may result during land clearing activities. Individuals within either of the treatment areas could be subject to crushing or displacement during construction. Indirect impacts include the loss of 3-5 acres (Alternative B (Modified)) or 3-5 acres (Alternative C) of suitable habitat, crushing by vehicles traveling to and from the site, by the use of sediment traps, and by altering travel corridors.

Cumulative Effects – Cumulative effects would be the same as the direct and indirect effects.

Determination of Effect – This project will have only modest impacts on the viability of this species on the Forest.

Diana fritillary (*Speyeria diana*) - Alternatives B (Modified) and C

Environmental Baseline – The species is found in moist forests in the southwestern mountains at all elevations and has been observed in various habitats. It is thought to be fairly common across Graham, Swain, Cherokee, Clay and Macon counties. The adults nectar on joe-pye-weed, ironweed, and butterflyweed; violets are important for the larvae which feed on the foliage. This species occurs in different forest types, but seems to prefer roadsides through cove forests. Both of the proposed treatment areas contain mesic deciduous forests; however, neither site supports an abundance of violets.

Direct and Indirect Effects – If individual adults or larvae are present on either proposed activity area at the time of land clearing, direct impacts to *Speyeria diana* could be subject to crushing or displacement. The likelihood of direct impacts is relatively low, since neither site supports an abundance of violets and maintenance of existing roadsides will not change. Construction of a shooting range at either site will not eliminate roadside habitat; indirect impacts would likely be positive, as edge habitat would be created around the perimeter of the shooting range. Fugitive road dust from vehicular traffic may cover plants used by adults and larvae, reducing individual survival, and may coat eggs, reducing hatching. Construction will result in conditions favorable to plants used by adults for nectaring, creating habitat.

Cumulative Effects – Cumulative effects would be the same as the direct and indirect effects.

Determination of Effect – Forest-wide this species has probably benefited from past forest management, which created new forest roadside habitat. Neither alternative will eliminate current roadside habitat. Both alternatives will create permanent edge habitat at the perimeter of the shooting range, which could provide new habitat for this species. This project may impact individuals but is not likely to cause a trend to federal listing or a loss of viability.

3.2.4 AQUATIC THREATENED, ENDANGERED, AND SENSITIVE SPECIES CONSIDERED

One aquatic species remained after filtering by county, *Cambarus parrishi*. This species occurs in the headwaters of the Hiwassee River. No streams occur within the treatment areas and there would be no impacts to streams in the project vicinity. BMPs would be used to control sediment and erosion and to prevent or minimize lead contamination. No direct, indirect, or cumulative effects on this species or its habitat are anticipated.

Determination of Effect

Because no endangered or threatened aquatic species were located in the proposed treatment areas, there should be no direct, indirect or cumulative effects to any endangered or threatened aquatic species.

3.2.5 SUMMARY OF DETERMINATIONS OF EFFECT

This proposal may affect, but is not likely to adversely affect the Indiana bat (*Myotis sodalis*). This proposal would not affect (directly, indirectly, or cumulatively) any other proposed or listed Federal T&E species.

The Clay County Shooting Range Project may impact individuals of the sensitive wildlife species *Myotis leibii* (small-footed bat), *Plethodon teyahalee* (Southern Appalachian salamander), and *Speyeria diana* (diana fritillary) but is unlikely to affect the viability of the species across the forest as a whole. Such impacts would not lead to a loss of species viability across the Nantahala or Pisgah National Forests or a trend towards federal listing. This proposal would not impact any other Regional Forester's sensitive animal species.

No risk to population viability of any botanical federally listed species across the forest would occur as a result of the implementation of the Clay County Shooting Range Project. The project may impact individuals of the sensitive plants *Juglans cinerea, Thalictrum macrostylum, Helianthus glaucophyllus,* and *Prenanthes roanensis* but is unlikely to affect the viability of the species across the forest as a whole. Such impacts would not lead to a loss of species viability across the Nantahala or Pisgah National Forests or a trend towards federal listing. This proposal would not impact any other Regional Forester's sensitive plant species.

No risk to population viability of any aquatic federally listed or Regional Forester's sensitive species across the Forest would occur as a result of the implementation of the Clay County Shooting Range Project. The project would have no effect or impact on any federally listed or Regional Forester's sensitive aquatic species or their habitat.

4.0 LIST OF PREPARERS

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6.0 ATTACHMENTS

Attachment I

Threatened, Endangered, and Forest Sensitive Species
Nantahala/Pisgah National Forests

Group	Designation	Scientific Name	Common Name	Global Rank*	State Rank **
Mollusk	Endangered	*Alasmidonta raveneliana*	Appalachian Elktoe	G1	S1
Mammal	Endangered	*Corynorhinus townsendii virginianus*	Virginia Big-Eared Bat	G4T2	S1
Vascular plant	Endangered	*Geum radiatum*	Cliff Avens	G2	S2
Mammal	Endangered	*Glaucomys sabrinus coloratus*	Carolina Northern Flying Squirrel	G5T1	S2
Lichen	Endangered	*Gymnoderma lineare*	Rock Gnome Lichen	G2	S2
Vascular plant	Endangered	*Houstonia montana*	Mountain Bluet	G2	S2
Insect	Endangered	*Microhexura montivaga*	Spruce-Fir Moss Spider	G1	S1
Mammal	Endangered	*Myotis grisescens*	Gray Bat	G3	S1
Mammal	Endangered	*Myotis sodalis*	Indiana Bat	G2	S1
Mollusk	Endangered	*Pegias fabula*	Little-Wing Pearlymussel	G1	S1
Mammal	Endangered	*Puma concolor couguar*	Eastern Cougar	G1	SH
Vascular plant	Endangered	*Sagittaria fasciculata*	Bunched Arrowhead	G2	S2
Vascular plant	Endangered	*Sarracenia jonesii*	Mountain Sweet Pitcher Plant	G4T2	S1
Vascular plant	Endangered	*Sarracenia oreophila*	Green Pitcher Plant	G2	S1
Vascular plant	Endangered	*Sisyrinchium dichotomum*	White Irisette	G2	S2
Reptile	Threatened (S/A)	*Glyptemys muhlenbergii*	Bog Turtle	G3	S2
Vascular plant	Threatened	*Helonias bullata*	Swamp Pink	G3	S2
Vascular plant	Threatened	*Hexastylis naniflora*	Dwarf-Flowered Heartleaf	G3	S3
Vascular plant	Threatened	*Hudsonia montana*	Mountain Golden-Heather	G1	S1
Fish	Threatened	*Hybopsis (Cyprinella) monacha*	Spotfin Chub	G2	S1
Vascular plant	Threatened	*Isotria medeoloides*	Small Whorled Pogonia	G2	S2
Vascular plant	Threatened	*Liatris helleri*	Heller's Blazing Star	G2	S2
Mollusk	Threatened	*Patera clarki nantahala*	Noonday Globe	G2T1	S2
Vascular plant	Threatened	*Solidago spithamaea*	Blue Ridge Goldenrod	G1	S1
Vascular plant	Threatened	*Spiraea virginiana*	Virginia Spiraea	G2	S2
Vascular plant	Sensitive	*Aconitum reclinatum*	Trailing Wolfsbane	G3	S3
Liverwort	Sensitive	*Acrobolbus ciliatus*	A Liverwort	G3?	S1
Mussel	Sensitive	*Alasmidonta varicosa*	Brook Floater	G3	S1

Group	Designation	Scientific Name	Common Name	Global Rank*	State Rank **
Vascular plant	Sensitive	*Allium cuthbertii*	Striped Garlic	G4	S2
Liverwort	Sensitive	*Aneura maxima*	A Liverwort	G1	S1
Lichen	Sensitive	*Anzia americana*	A Foliose Lichen	G2	S1
Hornwort	Sensitive	*Aspiromitus appalachianus*	A Hornwort	G1	S1
Vascular plant	Sensitive	*Asplenium x ebenoides*	Scott's Spleenwort	G?	S1
Liverwort	Sensitive	*Bazzania nudicaulis*	A Liverwort	G2G3	S2
Vascular plant	Sensitive	*Berberis canadensis*	American Barberry	G3	S2
Vascular plant	Sensitive	*Boechera patens*	Spreading Rockcress	G3G4	S1
Moss	Sensitive	*Brachydontium trichodes*	Peak Moss	G2	S1
Moss	Sensitive	*Bryocrumia vivicolor*	Gorge Moss	G2	SH
Vascular plant	Sensitive	*Buckleya distichophylla*	Piratebush	G2	S2
Moss	Sensitive	*Buxbaumia minakatae*	Hump-Backed Elves	G2G3	SH
Crustacean	Sensitive	*Caecidotea carolinensis*	Bennett's Mill Cave Water Slater	G1G2	S1
Vascular plant	Sensitive	*Calamagrostis cainii*	Cain's Reedgrass	G1	S1
Insect	Sensitive	*Callophrys irus*	Frosted Elfin	G3	S2
Crayfish	Sensitive	*Cambarus chaugaensis*	Oconee Stream Crayfish	G2	S2
Crayfish	Sensitive	*Cambarus georgiae*	Little Tennessee River Crayfish	G1	S2S3
Crayfish	Sensitive	*Cambarus parrishi*	Hiwassee Headwaters Crayfish	G1	S2S3
Crayfish	Sensitive	*Cambarus reburrus*	French Broad Crayfish	G3	S3
Moss	Sensitive	*Campylopus paradoxus*	Paradoxical Campylopus	G3?	S1
Vascular plant	Sensitive	*Cardamine clematitis*	Mountain Bittercress	G3	S2
Vascular plant	Sensitive	*Carex biltmoreana*	Biltmore Sedge	G3	S3
Vascular plant	Sensitive	*Carex communis* var. *amplisquama*	Fox Mountain Sedge	G5T3	S1
Vascular plant	Sensitive	*Carex misera*	Miserable Sedge	G3	S3
Vascular plant	Sensitive	*Carex radfordii*	Radford's Sedge	G2	S1
Vascular plant	Sensitive	*Carex roanensis*	Roan Sedge	G2G3	S2
Liverwort	Sensitive	*Cephalozia macrostachya ssp. australis*	A Liverwort	G4T1	S1
Liverwort	Sensitive	*Cephaloziella massalongi*	A Liverwort	G3G5	S1

Group	Designation	Scientific Name	Common Name	Global Rank*	State Rank **
Liverwort	Sensitive	*Cheilolejeunea evansii*	A Liverwort	G1	S1
Vascular plant	Sensitive	*Chelone cuthbertii*	Cuthbert's Turtlehead	G3	S3?
Insect	Sensitive	*Cicindela ancocisconensis*	A Tiger Beetle	G3	S3
Vascular plant	Sensitive	*Cleistes bifaria*	Small Spreading Pogonia	G4	S2?
Vascular plant	Sensitive	*Coreopsis latifolia*	Broadleaf Coreopsis	G3	S3
Mammal	Sensitive	*Corynorhinus rafinesquii rafinesquii*	Rafinesque's Big-Eared Bat	G3G4	S2
Vascular plant	Sensitive	*Danthonia epilis*	Bog Oatgrass	G3G4	S3
Vascular plant	Sensitive	*Delphinium exaltatum*	Tall Larkspur	G3	S2
Vascular plant	Sensitive	*Desmodium ochroleucum*	Creamy Tick-Trefoil	G1G2	SH
Amphibian	Sensitive	*Desmognathus santeetlah*	Santeetlah Dusky Salamander	G3Q	S2S3
Vascular plant	Sensitive	*Diervilla rivularis*	Riverbank Bush-Honeysuckle	G3	S1
Liverwort	Sensitive	*Diplophyllum apiculatum var. taxifolioides*	A Liverwort	G5T1Q	S1
Liverwort	Sensitive	*Diplophyllum obtusatum*	A Liverwort	G2?	S1
Moss	Sensitive	*Ditrichum ambiguum*	Ambiguous Ditrichium	G3?	S1
Liverwort	Sensitive	*Drepanolejeunea appalachiana*	A Liverwort	G2?	S1
Moss	Sensitive	*Entodon concinnus*	Lime Entodon	G4G5	S1
Lichen	Sensitive	*Ephebe americana*	A Fructicose Lichen	G2G3	S1
Fish	Sensitive	*Etheostoma acuticeps*	Sharphead Darter	G3	S1
Fish	Sensitive	*Etheostoma vulneratum*	Wounded Darter	G3	S2
Insect	Sensitive	*Euchlaena milnei*	Milne's Euchlaena	G2G4	S1S3
Vascular plant	Sensitive	*Euphorbia purpurea*	Glade Spurge	G3	S2
Vascular plant	Sensitive	*Eurybia avita*	Alexander's Rock Aster	G3	SX
Amphibian	Sensitive	*Eurycea junaluska*	Junaluska Salamander	G3Q	S2
Bird	Sensitive	*Falco peregrinus*	Peregrine Falcon	G4	S1B,S2
Moss	Sensitive	*Fissidens appalachensis*	Appalachian Pocket Moss	G2G3	S2S3
Vascular plant	Sensitive	*Fothergilla major*	Large Witch-Alder	G3	S3
Liverwort	Sensitive	*Frullania appalachiana*	A Liverwort	G1?	S1?
Liverwort	Sensitive	*Frullania oakesiana*	A Liverwort	G3?	S1S2

Group	Designation	Scientific Name	Common Name	Global Rank*	State Rank **
Mussel	Sensitive	*Fusconaia barnesiana*	Tennessee Pigtoe	G2G3	S1
Vascular plant	Sensitive	*Gentiana austromontana*	Appalachian Gentian	G3	S2?
Vascular plant	Sensitive	*Geum geniculatum*	Bent Avens	G1G2	S1S2
Vascular plant	Sensitive	*Geum lobatum*	Lobed Barren-Strawberry	G2	S1
Vascular plant	Sensitive	*Glyceria nubigena*	Smoky Mountain Mannagrass	G2	S2
Bird	Sensitive	*Haliaeetus leucocephalus*	Bald Eagle	G4	S3B,
Vascular plant	Sensitive	*Hasteola suaveolens*	Sweet Indian-Plantain	G3G4	SH
Vascular plant	Sensitive	*Helianthus glaucophyllus*	Whiteleaf Sunflower	G3	S3
Mollusk	Sensitive	*Helicodiscus triodus*	Tallus Coil	G2	S1?
Vascular plant	Sensitive	*Heuchera longiflora*	Long-Flower Alumroot	G4	S2
Vascular plant	Sensitive	*Hexastylis contracta*	Mountain Heartleaf	G3	S1
Vascular plant	Sensitive	*Hexastylis rhombiformis*	French Broad Heartleaf	G2	S2
Moss	Sensitive	*Homaliadelphus sharpii*	Sharp's Homaliadelphus	G3	S1
Moss	Sensitive	*Hygrohypnum closteri*	Closter's Brook-Hypnum	G3	S1
Vascular plant	Sensitive	*Hymenophyllum tayloriae*	Gorge Filmy Fern	G2	S1S2
Vascular plant	Sensitive	*Hypericum graveolens*	Mountain St. John's-Wort	G3	S2S3
Vascular plant	Sensitive	*Hypericum mitchellianum*	Mitchell's St. John's-Wort	G3	S2S3
Insect	Sensitive	*Hypochilus coylei*	A Cave Spider	G3?	S3?
Insect	Sensitive	*Hypochilus sheari*	A Lampshade Spider	G2G3	S2S3
Lichen	Sensitive	*Hypotrachyna virginica*	A Foliose Lichen	G1G3	S1S2
Vascular plant	Sensitive	*Ilex collina*	Long-Stalked Holly	G3	S1
Vascular plant	Sensitive	*Juglans cinerea*	Butternut	G3	S2S3?
Vascular plant	Sensitive	*Juncus caesariensis*	Rough Rush	G2	S1
Bird	Sensitive	*Lanius ludovicianus migrans*	Migrant Loggerhead Shrike	G5T3Q	--
Mussel	Sensitive	*Lasmigona holstonia*	Tennessee Heelsplitter	G3	S1
Liverwort	Sensitive	*Lejeunea blomquistii*	A Liverwort	G1G2	S1
Moss	Sensitive	*Leptodontium excelsum*	Grandfather Mountain Leptodontium	G2	S1
Moss	Sensitive	*Leptohymenium sharpii*	Mount Leconte Moss	G1	S1

Group	Designation	Scientific Name	Common Name	Global Rank*	State Rank **
Vascular plant	Sensitive	*Liatris turgida*	Shale-Barren Blazing Star	G3	S1S2
Vascular plant	Sensitive	*Lilium grayi*	Gray's Lily	G3	S3
Liverwort	Sensitive	*Lophocolea appalachiana*	A Liverwort	G1G2	S1
Vascular plant	Sensitive	*Lysimachia fraseri*	Fraser's Loosestrife	G3	S3
Dragonfly	Sensitive	*Macromia margarita*	Mountain River Cruiser	G2G3	S2S3
Vascular plant	Sensitive	*Malaxis bayardii*	Appalachian Adder's-Mouth	G1G2	S1
Liverwort	Sensitive	*Mannia californica*	A Liverwort	G3?	S1
Vascular plant	Sensitive	*Marshallia grandiflora*	Large-Flowered Barbara's Buttons	G2	SH
Vascular plant	Sensitive	*Marshallia trinervia*	Broadleaf Barbara's Buttons	G3	SH
Liverwort	Sensitive	*Marsupella emarginata* var. *latiloba*	A Liverwort	G5T1T2	S1
Hornwort	Sensitive	*Megaceros aenigmaticus*	A Hornwort	G2G3	S2S3
Insect	Sensitive	*Melanoplus divergens*	Divergent Melanoplus	G2G3	S1S3
Insect	Sensitive	*Melanoplus serrulatus*	Serrulate Melanoplus	G1G3	S1S3
Liverwort	Sensitive	*Metzgeria furcata* var. *setigera*	A Liverwort	G4T1	S1
Liverwort	Sensitive	*Metzgeria temperata*	A Liverwort	G2Q	S1S2
Liverwort	Sensitive	*Metzgeria uncigera*	A Liverwort	G3	S1
Vascular plant	Sensitive	*Micranthes caroliniana*	Carolina Saxifrage	G3	S3
Vascular plant	Sensitive	*Micropolypodium nimbatum*	West Indian Dwarf Polypody	G4?	E
Mammal	Sensitive	*Microtus chrotorrhinus carolinensis*	Southern Rock Vole	G4T3	S3
Vascular plant	Sensitive	*Monotropsis odorata*	Sweet Pinesap	G3	S3
Mammal	Sensitive	*Myotis leibii*	Eastern Small-Footed Bat	G3	S2
Liverwort	Sensitive	*Nardia lescurii*	A Liverwort	G3?	--
Insect	Sensitive	*Nesticus cooperi*	Lost Nantahala Cave Spider	G1?	S1
Insect	Sensitive	*Nesticus crosbyi*	A Cave Spider	G1?	S1?
Insect	Sensitive	*Nesticus mimus*	Cave Spider	G2	S2?
Insect	Sensitive	*Nesticus sheari*	Cave Spider	G2?	S2?
Insect	Sensitive	*Nesticus silvanus*	Cave Spider	G2?	S2?
Dragonfly	Sensitive	*Ophiogomphus edmundo*	Edmund's Snaketail	G1G2	S1?

Group	Designation	Scientific Name	Common Name	Global Rank*	State Rank **
Dragonfly	Sensitive	*Ophiogomphus howei*	Pygmy Snaketail	G3	S1S2
Vascular plant	Sensitive	*Packera millefolium*	Divided-Leaf Ragwort	G2	S2
Mollusk	Sensitive	*Pallifera hemphilli*	Black Mantleslug	G3	S2
Mollusk	Sensitive	*Paravitrea placentula*	Glossy Supercoil	G3	S2
Liverwort	Sensitive	*Pellia appalachiana*	A Liverwort	G1Q	S1?
Lichen	Sensitive	*Peltigera venosa*	An Aquatic Lichen	G3	S2
Vascular plant	Sensitive	*Penstemon smallii*	Small's Beardtongue	G3	S3
Fish	Sensitive	*Percina burtoni*	Blotchside Darter	G2	S1
Fish	Sensitive	*Percina macrocephala*	Longhead Darter	G3	SX
Fish	Sensitive	*Percina squamata*	Olive Darter	G3	S2
Moss	Sensitive	*Philonotis cernua*	Dwarf Apple Moss	G3?	S1
Lichen	Sensitive	*Physcia pseudospeciosa*	A Foliose Lichen	G1?	S1
Liverwort	Sensitive	*Plagiochasma intermedium*	A Liverwort	G3?	S1
Liverwort	Sensitive	*Plagiochasma wrightii*	A Liverwort	G3?	S1
Liverwort	Sensitive	*Plagiochila austinii*	A Liverwort	G3	S1S2
Liverwort	Sensitive	*Plagiochila caduciloba*	A Liverwort	G2	S1
Liverwort	Sensitive	*Plagiochila echinata*	A Liverwort	G2	S1
Liverwort	Sensitive	*Plagiochila sharpii*	A Liverwort	G2G3	S2
Liverwort	Sensitive	*Plagiochila sullivantii* var. *spinigera*	A Liverwort	G2T1	S1
Liverwort	Sensitive	*Plagiochila sullivantii* var. *sullivantii*	Sullivant's Leafy Liverwort	G2T2	S2
Liverwort	Sensitive	*Plagiochila virginica* var. *caroliniana*	A Liverwort	G3T2	S1
Liverwort	Sensitive	*Plagiochila virginica* var. *virginica*	A Liverwort	G3T3	S1
Moss	Sensitive	*Plagiomnium carolinianum*	Carolina Star-Moss	G3	S2
Vascular plant	Sensitive	*Platanthera integrilabia*	White Fringeless Orchid	G2G3	SH
Moss	Sensitive	*Platyhypnidium pringlei*	Pringle's Eurhynchium	G2	S1
Amphibian	Sensitive	*Plethodon aureolus*	Tellico Salamander	G2G3Q	S2
Amphibian	Sensitive	*Plethodon teyahalee*	Southern Appalachian Salamander	G2G3Q	S3?
Amphibian	Sensitive	*Plethodon welleri*	Weller's Salamander	G3	S2

Group	Designation	Scientific Name	Common Name	Global Rank*	State Rank **
Vascular plant	Sensitive	*Poa paludigena*	Bog Bluegrass	G3	S1
Moss	Sensitive	*Polytrichum appalachianum*	Appalachian Haircap Moss	G3	S3
Liverwort	Sensitive	*Porella japonica ssp. appalachiana*	A Liverwort	G5?T1	SNR
Liverwort	Sensitive	*Porella wataugensis*	A Liverwort	G2	S1
Lichen	Sensitive	*Porpidia diversa*	A Crustose Lichen	G2G3	S1
Lichen	Sensitive	*Porpidia herteliana*	A Crustose Lichen	G2G3	S1?
Vascular plant	Sensitive	*Prenanthes roanensis*	Roan Rattlesnakeroot	G3	S3
Vascular plant	Sensitive	*Pycnanthemum beadlei*	Beadle's Mountain-Mint	G2G4	SNR
Vascular plant	Sensitive	*Pycnanthemum torrei*	Torrey's Mountain-Mint	G2	S1
Liverwort	Sensitive	*Radula sullivantii*	A Liverwort	G3	S2
Liverwort	Sensitive	*Radula voluta*	A Liverwort	G3	S1
Moss	Sensitive	*Rhachithecium perpusillum*	Budding Tortula	G3?	S1S2
Vascular plant	Sensitive	*Rhododendron vaseyi*	Pink-Shell Azalea	G3	S3
Liverwort	Sensitive	*Riccardia jugata*	A Liverwort	G1G2	S1?
Vascular plant	Sensitive	*Robinia hartwegii*	Hartweg's Locust	G2	S2
Vascular plant	Sensitive	*Robinia viscosa* var. *viscosa*	Clammy Locust	G3T3	S3
Vascular plant	Sensitive	*Rudbeckia triloba* var. *pinnatiloba*	Pinnate-Lobed Black-Eyed Susan	G5T3	S1
Vascular plant	Sensitive	*Rugelia nudicaulis*	Rugel's Ragwort	G3	S3
Vascular plant	Sensitive	*Sabatia capitata*	Cumberland Rose Gentian	G2	SNR
Vascular plant	Sensitive	*Sceptridium jenmanii*	Alabama Grape Fern	G3G4	S2
Moss	Sensitive	*Schlotheimia lancifolia*	Highlands Moss	G2	S1
Moss	Sensitive	*Scopelophila cataractae*	Agoyan Cataract Moss	G3	S1
Insect	Sensitive	*Scudderia septentrionalis*	Northern Bush Katydid	G3?	SH
Vascular plant	Sensitive	*Scutellaria ovata ssp. rugosa* var. *1*	Appalachian Skullcap	G2?Q	SH
Vascular plant	Sensitive	*Scutellaria saxatilis*	Rock Skullcap	G3	S1
Insect	Sensitive	*Semiothisa fraserata*	Fraser Fir Angle	G2?	S1S2
Vascular plant	Sensitive	*Shortia galacifolia* var. *brevistyla*	Northern Oconee Bells	G2G3T2	S2
Vascular plant	Sensitive	*Shortia galacifolia* var. *galacifolia*	Southern Oconee Bells	G2G3T2	S2

Group	Designation	Scientific Name	Common Name	Global Rank*	State Rank **
Vascular plant	Sensitive	*Silene ovata*	Mountain Catchfly	G3	S3
Vascular plant	Sensitive	*Solidago simulans*	Granite Dome Goldenrod	G2	S2
Mammal	Sensitive	*Sorex palustris punctulatus*	Southern Water Shrew	G5T3	S2
Insect	Sensitive	*Speyeria diana*	Diana Fritillary	G3	S3S4
Insect	Sensitive	*Speyeria idalia*	Regal Fritillary	G3	SH
Moss	Sensitive	*Sphagnum flavicomans*	A Peatmoss	G3?	SH
Liverwort	Sensitive	*Sphenolobopsis pearsonii*	A Liverwort	G2	S2
Moss	Sensitive	*Splachnum pennsylvanicum*	Southern Dung Moss	G2?	SH
Vascular plant	Sensitive	*Stachys clingmanii*	Clingman's Hedge-Nettle	G2Q	S1
Lichen	Sensitive	*Sticta limbata*	A Foliose Lichen	G3G4	S1
Crustacean	Sensitive	*Stygobromus carolinensis*	Yancey Sideswimmer	G1G2	S1
Moss	Sensitive	*Taxiphyllum alternans*	Japanese Yew-Moss	G3?	S1
Vascular plant	Sensitive	*Thalictrum macrostylum*	Small-Leaved Meadowrue	G3G4	S2
Vascular plant	Sensitive	*Thaspium pinnatifidum*	Mountain Thaspium	G2G3	S1
Vascular plant	Sensitive	*Thermopsis fraxinifolia*	Ash-Leaved Gloden-Banner	G3?	S2?
Bird	Sensitive	*Thryomanes bewickii altus*	Appalachian Bewick's Wren	G5T2Q	SHB
Moss	Sensitive	*Tortula ammonsiana*	Ammon's Tortula	G2?	S1
Insect	Sensitive	*Trechus carolinae*	A Ground Beetle	G1?	SU
Insect	Sensitive	*Trechus luculentus unicoi*	A Ground Beetle	G2T2?	SU
Insect	Sensitive	*Trechus mitchellensis*	A Ground Beetle	G1?	SU
Insect	Sensitive	*Trechus rosenbergi*	A Ground Beetle	G1?	SU
Insect	Sensitive	*Trechus satanicus*	A Ground Beetle	G1?	SU
Vascular plant	Sensitive	*Trillium pusillum* var. *ozarkanum*	Alabama Least Trillium	G3T3	S1
Vascular plant	Sensitive	*Trillium rugelii*	Southern Nodding Trillium	G3	S2?
Vascular plant	Sensitive	*Trillium simile*	Sweet White Trillium	G3	S2
Insect	Sensitive	*Trimerotropis saxatilis*	Rock-Loving Grasshopper	G2G3	S1S2
Vascular plant	Sensitive	*Tsuga caroliniana*	Carolina Hemlock	G3	S3
Mollusk	Sensitive	*Ventridens coelaxis*	Bidentate Dome	G3	S2

Group	Designation	Scientific Name	Common Name	Global Rank*	State Rank **
Vascular plant	Sensitive	*Viola appalachiensis*	Appalachian Violet	G3	S2
Lichen	Sensitive	*Xanthoparmelia monticola*	A Foliose Lichen	G2	S2?

*Global Rank

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GH	Of historical occurrence throughout its range.
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GU	Possibly in peril, but status uncertain; more information is needed.
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SA	Accidental or casual; one to several records for North Carolina, but the state is outside the normal range of the species.
SH	Historic record: the element is either extirpated from the county or quad, or there have not been any recent surveys to verify its continued existence.
SR	Reported from North Carolina, but without persuasive documentation for either accepting or rejecting the report.
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SZ_	Population is not of significant conservation concern; applies to transitory, migratory species.

Attachment II

Threatened, Endangered, and Sensitive Species that occur in Clay County,
(including adjacent counties for terrestrial wildlife species)

Group	Designation	Scientific Name	Common Name	Habitat
Botanical Species				
Vascular plant	Endangered	*Sarracenia oreophila*	Green Pitcher Plant	low elevation Southern Appalachian Bog
Vascular plant	Sensitive	*Carex misera*	Miserable Sedge	High Elevation Rocky Summit, Montane Acidic Cliff, High Elevation Granitic Dome
Vascular plant	Sensitive	*Euphorbia purpurea*	Glade Spurge	Northern Hardwood Forest, Rich Cove Forest, Mesic oak-hickory
Vascular plant	Sensitive	*Helianthus glaucophyllus*	Whiteleaf Sunflower	Rich Cove Forest, Northern Hardwood Forest, High Elevation Red Oak Forest, Mesic Oak-Hickory Forest, Roadside
Vascular plant	Sensitive	*Juglans cinerea*	Butternut	Rich Cove Forest, Mesic Oak-Hickory, Montane Alluvial Forest
Vascular plant	Sensitive	*Juncus caesariensis*	Rough Rush	low elevation Southern Appalachian Bog
Vascular plant	Sensitive	*Monotropsis odorata*	Sweet Pinesap	Rich Cove Forest, Mesic Oak-Hickory, Xeric Oak-Hickory, Pine-Oak/Heath Forest
Vascular plant	Sensitive	*Prenanthes roanensis*	Roan Rattlesnakeroot	Northern Hardwood Forest, Grassy Bald, Meadow, Roadside, High Elevation Red Oak Forest
Vascular plant	Sensitive	*Sceptridium jenmanii*	Alabama Grape Fern	Rich Cove Forest
Vascular plant	Sensitive	*Thalictrum macrostylum*	Small-Leaved Meadowrue	Serpentine Woodland, Serpentine Forest, moist woods?
Vascular plant	Sensitive	*Trillium pusillum var. ozarkanum*	Alabama Least Trillium	Rich Cove Forest, Mesic Oak-Hickory, mafic rock

Group	Designation	Scientific Name	Common Name	Habitat
Vascular plant	Sensitive	*Tsuga caroliniana*	Carolina Hemlock	Carolina Hemlock Forest, Montane Acidic Cliff, Pine-Oak/Heath, High Elevation Rocky Summit
Vascular plant	Sensitive	*Viola appalachiensis*	Appalachian Violet	Serpentine Woodland, Serpentine Forest, Rich Cove Forest, Mesic Oak-Hickory
Terrestrial Species				
Mammal	Endangered	*Glaucomys sabrinus coloratus*	Carolina Northern Flying Squirrel	mature spruce-fir and northern hardwoods generally above 4,000 feet
Insect	Endangered	*Microhexura montivaga*	Spruce-Fir Moss Spider	on rocks in spruce-fir forests
Mammal	Endangered	*Myotis grisescens*	Gray Bat	roosts in caves
Mammal	Endangered	*Myotis sodalis*	Indiana Bat	roosts in caves, hollow trees or under loose bark of trees in riparian areas
Mammal	Endangered	*Puma concolor couguar*	Eastern Cougar	contiguous forest
Reptile	Threatened (S/A)	*Glyptemys muhlenbergi*	Bog Turtle	Sunlit, marshy meadows, bogs, and wet pastures
Mollusk	Threatened	*Patera clarki nantahala*	Noonday Globe	cliffs; cool, wet areas under vegetation and leaf litter
Insect	Sensitive	*Callophrys irus*	Frosted Elfin	open woods and borders, usually in dry situations; host plants - lupines(Lupinus) and wild indigos (Baptisia)
Insect	Sensitive	*Cicindela ancocisconensis*	A Tiger Beetle	high elevation forests, >4,000 feet

Group	Designation	Scientific Name	Common Name	Habitat
Mammal	Sensitive	*Corynorhinus rafinesquii rafinesquii*	Rafinesque's Big-Eared Bat	roosts in old buildings, caves, and mines, under loose bark, usually near water
Amphibian	Sensitive	*Desmognathus santeetlah*	Santeetlah Dusky Salamander	Headwaters, seepage in hardwood, coves and spruce-fir, generally higher than 2220 feet
Liverwort	Sensitive	*Drepanolejeunea appalachiana*	A Liverwort	Acidic Cove, Montane Oak-Hickory, Serpentine Woodland, Serpentine Forest
Insect	Sensitive	*Euchlaena milnei*	Milne's Euchlaena	unknown
Amphibian	Sensitive	*Eurycea junaluska*	Junaluska Salamander	Streams; wider, base level portions of streams below 2395'
Bird	Sensitive	*Haliaeetus leucocephalus*	Bald Eagle	mature forests near large bodies of water
Hornwort	Sensitive	*Megaceros aenigmaticus*	A Hornwort	Stream
Insect	Sensitive	*Melanoplus divergens*	Divergent Melanoplus	glades and balds, 1800' - 4717'; no records
Insect	Sensitive	*Melanoplus serrulatus*	Serrulate Melanoplus	valleys and lower slopes
Mammal	Sensitive	*Microtus chrotorrhinus carolinensis*	Southern Rock Vole	rocky areas in spruce-fir, n. hardwoods and grassy balds; above 3200'
Mammal	Sensitive	*Myotis leibii*	Eastern Small-Footed Bat	hemlock forests, rock crevices, caves, mines or buildings, above 2000 ft
Insect	Sensitive	*Nesticus cooperi*	Lost Nantahala Cave Spider	caves

Group	Designation	Scientific Name	Common Name	Habitat
Insect	Sensitive	*Nesticus sheari*	Cave Spider	high elevation, n-facing rocky slopes, also rich cove forest at all aspects; no records
Insect	Sensitive	*Nesticus silvanus*	Cave Spider	high elevation, n-facing rocky slopes, also rich cove forest at all aspects; no records
Mollusk	Sensitive	*Pallifera hemphilli*	Black Mantleslug	high elevation forests, mainly spruce-fir
Mollusk	Sensitive	*Paravitrea placentula*	Glossy Supercoil	under leaf litter on wooded hillsides and ravines
Lichen	Sensitive	*Peltigera venosa*	An Aquatic Lichen	Stream
Liverwort	Sensitive	*Plagiochila caduciloba*	A Liverwort	Spray Cliff, Streamside, Rock Outcrop in Acidic Cove Forest in Gorge
Liverwort	Sensitive	*Plagiochila sharpii*	A Liverwort	High Elevation Rocky Summit, Rock Outcrop in Acidic Cove Forest in Gorge
Liverwort	Sensitive	*Plagiochila sullivantii var. sullivantii*	Sullivant's Leafy Liverwort	Spray Cliff, Spruce-Fir Forest
Amphibian	Sensitive	*Plethodon aureolus*	Tellico Salamander	Mixed forest;hardwood forests with fallen logs, leaf litter and organic soil
Amphibian	Sensitive	*Plethodon teyahalee*	Southern Appalachian Salamander	moist forests at all elevations
Liverwort	Sensitive	*Radula sullivantii*	A Liverwort	Spray Cliff, Rock Outcrop in Acidic Cove Forest in Gorge
Insect	Sensitive	*Scudderia septentrionalis*	Northern Bush Katydid	in the treetops of edges of broadleaved forests

Group	Designation	Scientific Name	Common Name	Habitat
Insect	Sensitive	*Semiothisa fraserata*	Fraser Fir Angle	spruce-fir forests with fraser fir
Mammal	Sensitive	*Sorex palustris punctulatus*	Southern Water Shrew	streambanks 12-15' wide w/rhododendron cover in n. hardwood or spruce-fir forests; known from > 3000', mostly over 4000'
Insect	Sensitive	*Speyeria diana*	Diana Fritillary	mature deciduous and pine woodlands near streams; mostly along roadsides incoves below 4000'; nectar - joe-pye-weed, ironweed, butterflyweed; host plants - violets
Bird	Sensitive	*Thryomanes bewickii altus*	Appalachian Bewick's Wren	woodland borders or openings at high elevations
Insect	Sensitive	*Trechus luculentus unicoi*	A Ground Beetle	beneath rocks and moss in wet ravines and near seeps and springs > 3000'
Aquatic Species				
Crayfish	Sensitive	*Cambarus parrishi*	Hiwassee Headwaters Crayfish	headwaters of the Hiwasee River

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Appendix C: 2010 Sound Test Report

Noise Evaluation of Two Firing Range Sites in the Nantahala National Forest

September 20, 2010

By:

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Champaign, Il 61821

We evaluated two potential shooting-range sites designated as Chestnut Gap and Perry Creek. Their coordinates are given in Tables 1 and 2, respectively. The specific noise concerns are hikers on the Chunky Gal trail and nearby private residences. We did all calculations for the worst case hour which includes 150 rounds of rifle fire and 150 rounds of pistol fire. The rifle was a M/87 using cal .308 Winchester Match ammunition, and the pistol was a Beretta 9mm M92 F compact using Norma 9mm Luger safety ammunition. Source data were taken from a measured set of European data that contains octave-band spectra for 8 directions around the weapon (Table 3). Propagation from the range to the receiving locations was calculated using ISO 9613 Part 2. The A-weighted Sound Exposure Level (SEL) was calculated from the octave-band spectrum at each receiver location. Hourly LEQ were calculated from the single event A-weighted SEL. In accordance with ANSI S12.9 Part 4 and ISO 1996 Part 1, a 12 dB penalty is added to small arms noise. This results in very stringent criteria. Our criterion for compatibility with residential land use is that the hourly LEQ be less than 35 dB. A criterion for the noise level acceptable for hikers is not well established, but it is expected that the A-weighted SEL threshold of noticeability is between 50 and 60 dB.

For Chestnut Gap we evaluated two positions on the Chunky Gal trail, and three private residences. The three private residences includes the one and only residence to the north northeast and two residences chosen from a small group of residences to the east. These are shown in Figure 1. Calculation results are given in Table 1.

For Perry Creek we evaluated one position on the Chunky Gal trail, and four of the nearer residences out of a moderately large group of residences. Two of the residences are to the northwest and two are to the west. These are shown in Figure 2 and calculation results are given in Table 2.

For each of the ten receiving locations a terrain elevation profile was developed for the direct cut from the range to that location. These ten profiles are contained in Annex A. Examination of the data from Annex A shows that all the residences except for the residence north of the Chestnut Gap site have a substantial barrier between the range and the residence and are relatively far from the range. As a result, only this one residence will experience any noise impact whatsoever and this impact is marginal.

The Chunky Gal trail will experience clearly noticeable, possibly bothersome gunfire noise from either of the proposed ranges. As Figures 1 and 2 show the pertinent Chunky Gal trail evaluation locations are approximately straight east of the Perry Creek site or west northwest of the Chestnut Gap site. The single-event, A-weighted SEL generated by the Perry Creek site at the Chunky Gal trail are calculated to be at least 5 dB higher than the single-event A-weighted SEL generated by the Chestnut Gap Site. One should note that the predictions of the single-event, A-weighted SEL generated by the Perry Creek site at the Chunky Gal trail may be 2 - 3 dB high due to the forest area near to the trail (see Figure A6). Also the predictions of the single-event, A-weighted SEL generated by the Chestnut Gap site at the Chunky Gal trail may be as much as 5 dB low due to the big valley between the range site and the receiving location (see Figure A2).

Either range site will impact the Chunky Gal trail about equally, and at times gunfire will be heard along the trail. The Perry Creek range site is our recommended choice. It is recommended because no private residences are impacted and because the gunfire noise on Chunky Gal trail will drop off quickly as one moves in either direction away from the point of closest approach of the Chunky Gal trail to the Perry Creek site. For example, when one is a half mile along the trail from the point of closest approach, the A-weighted SEL will be about 8 dB lower than at the point of closest approach. This decrease occurs because the directivity of the weapon drops by 5 dB or more (Table 3), and level drops by 3 dB because of the increase in distance between the range site and the hiker's position.

Table 1. Chestnut Gap Data and Calculation Results*

	Site		Trail C2	Trail C1**	House 5***	House 6	House 7
Range Position	Longitude	Degrees	83	83	83	83	83
		Decimal minutes	38.0648	38.0648	38.0648	38.0648	38.0648
	Latitude	Degrees	35	35	35	35	35
		Decimal minutes	4.7917	4.7917	4.7917	4.7917	4.7917
	Elevation	Elevation	4040	4040	4040	4040	4040
Receiver Position	Longitude	Degrees	83	83	83	83	83
		Decimal minutes	38.0055	38.9297	37.4842	34.1548	33.8705
	Latitude	Degrees	35	35	35	35	35
		Decimal minutes	4.0885	5.0781	5.8073	5.2734	5.6120
	Receiver	Distance from start	4654	4691	6336	19536	21120
		Elevation gain	-90.2	105	-727	-621	-738
		Elevation	3949.8	4145	3313	3419	3302
		Angle from line of fire	180	45	45	90	90
Barriers	Highest peak	Distance from start	1944	na	116	15312	14784
		Elevation	4355	na	4054	4380	4464
	Second highest peak	Distance from start	3458	na	na	8976	19536
		Elevation	4221	na	na	4229	4068
Results	Pistol	ASEL per round	25.3	58.9	54.6	25.1	23.5
		1hr LEQ	11.5	45.1	40.8	11.3	9.7
	Rifle	ASEL per round	30.1	62.5	58.6	29.6	28.1
		1hr LEQ	16.3	48.7	44.8	15.8	14.3
		Total 1 hr LEQ	17.6	50.3	46.2	17.1	15.6

*DNL is approximately the 1hr LEQ minus 10

** No Ground Attenuation

*** No Ground or Barrier Attenuation

Table 2. Perry Creek Data and Calculation Results*

	Site		Trail P1**	House 1	House 2	House 3	House 4
Range Position	Longitude	Degrees	83	83	83	83	83
		Decimal minutes	39.5024	39.5024	39.5024	39.5024	39.5024
	Latitude	Degrees	35	35	35	35	35
		Decimal minutes	5.4557	5.4557	5.4557	5.4557	5.4557
	Elevation	Elevation	2844	2844	2844	2844	2844
Receiver Position		Degrees	83	83	83	83	83
	Longitude	Decimal minutes	39.0442	40.8452	40.9558	41.1927	41.6035
		Degrees	35	35	35	35	35
	Latitude	Decimal minutes	5.5990	6.5495	6.2240	5.8464	5.5469
		Distance from start	2441	9504	8448	8976	10560
		Elevation gain	1154	-167	-354	-531	-648
		Elevation	3998	2677	2490	2313	2196
	Receiver	Angle from line of fire	0	135	135	180	180
Barriers		Distance from start	na	2601	2562	6336	7920
	Highest peak	Elevation	na	3334	3072	2783	2727
		Distance from start	na	6336	6336	2288	na
	Second highest peak	Elevation	na	3087	2964	2762	na
Results		ASEL per round	67.9	26.5	31.7	29.0	26.2
	Pistol	1hr LEQ	54.1	12.7	17.9	15.2	12.4
		ASEL per round	67.1	32.4	37.5	33.4	30.9
	Rifle	1hr LEQ	53.3	18.6	23.7	19.6	17.1
		Total 1 hr LEQ	56.7	19.6	24.7	20.9	18.4

*DNL is approximately the 1hr LEQ minus 10

** No Barrier Attenuation

Table 3. European data of Gun Noise based on Directionality

Degree of Directionality	Octave Band center Frequency (Hz)	Beretta 9mm M92 F compact (dB)	Rifle M/87 (precision) (dB)
0	63	84.0	95.7
	125	93.2	104.1
	250	101.7	109.1
	500	108.5	109.9
	1000	109.4	108.0
	2000	104.4	104.9
	4000	100.5	101.7
	8000	97.5	98.3
	LAE	112.5	112.6
	Lp,peak	150.1	151.2
45	63	80.7	93.3
	125	89.4	101.1
	250	97.2	105.6
	500	103.4	108.7
	1000	104.9	106.3
	2000	98.8	102.9
	4000	94.9	99.4
	8000	92.4	96.5
	LAE	107.6	110.8
	Lp,peak	144.9	149.3
90	63	75.4	84.6
	125	84.3	93.3
	250	92.4	98.8
	500	98.3	102.2
	1000	98.1	101.7
	2000	93.2	101.2
	4000	93.3	97.9
	8000	93.2	96.5
	LAE	102.3	107.2
	Lp,peak	143.7	146.7

Table 3. cont. European data of Gun Noise based on Directionality

Degree of Directionality	Octave Band center Frequency (Hz)	Beretta 9mm M92 F compact (dB)	Rifle M/87 (precision) (dB)
135	63	73.1	79.6
	125	80.4	89.0
	250	84.6	92.9
	500	90.8	96.0
	1000	90.0	96.1
	2000	88.8	95.1
	4000	87.8	94.2
	8000	86.3	91.4
	LAE	95.8	101.6
	Lp,peak	136.3	139.8
180	63	68.3	77.5
	125	77.0	86.0
	250	83.6	91.9
	500	86.4	92.1
	1000	90.1	91.6
	2000	89.1	94.1
	4000	82.5	90.7
	8000	83.5	90.4
	LAE	94.4	99.1
	Lp,peak	130.6	135.5

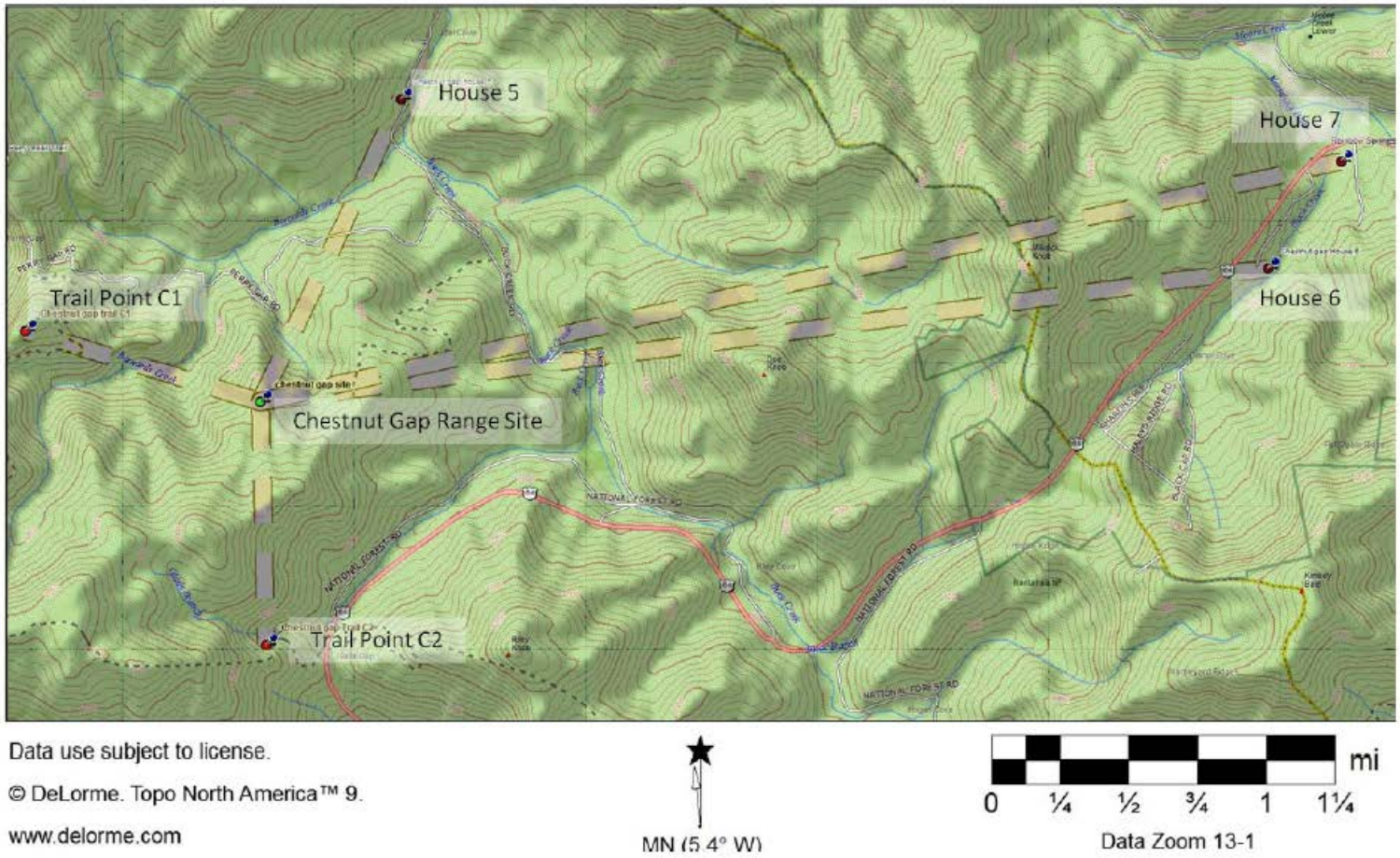


Figure 1. Position of the Chestnut Gap Range Site and the 5 positions at which noise prediction were made.

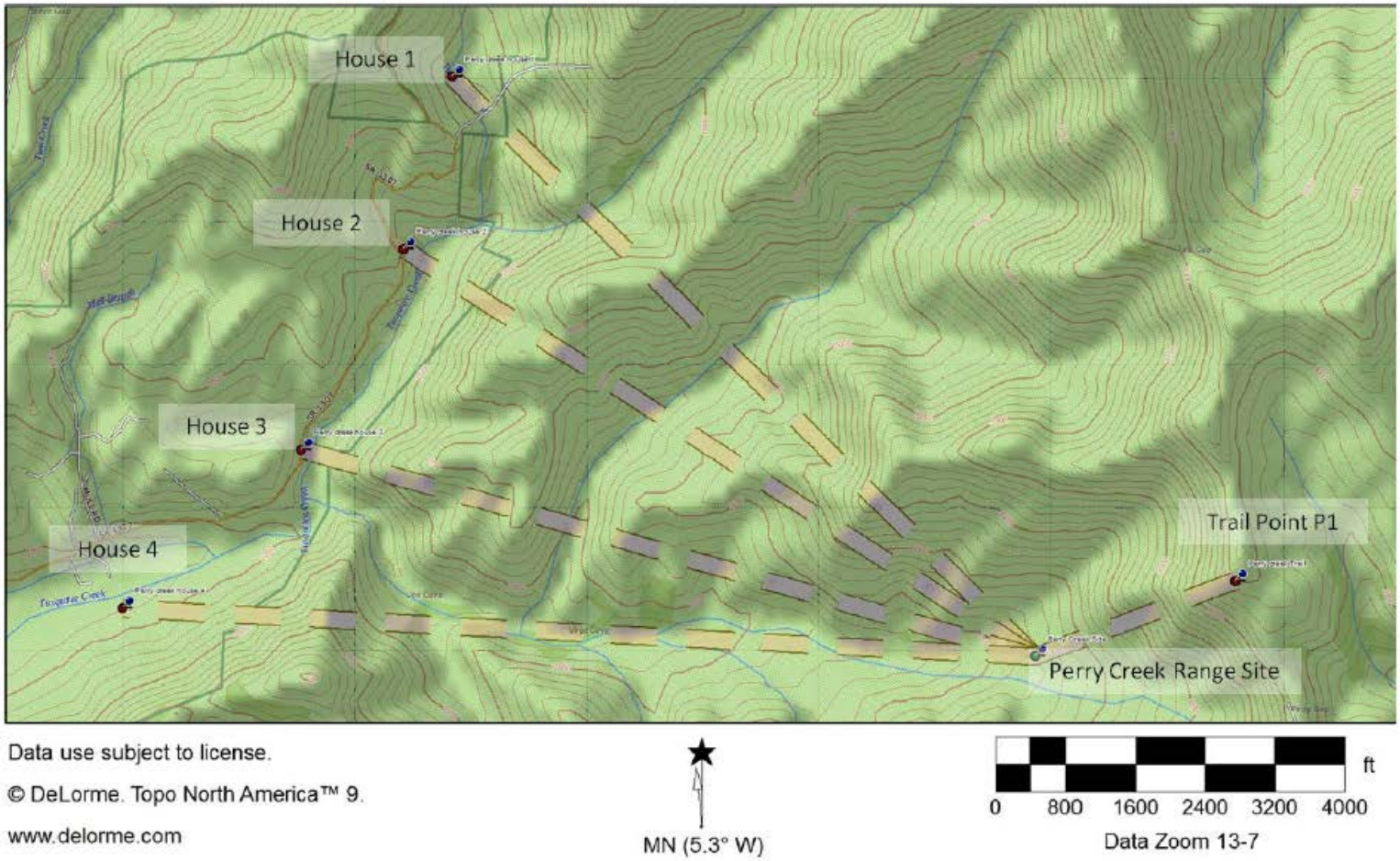
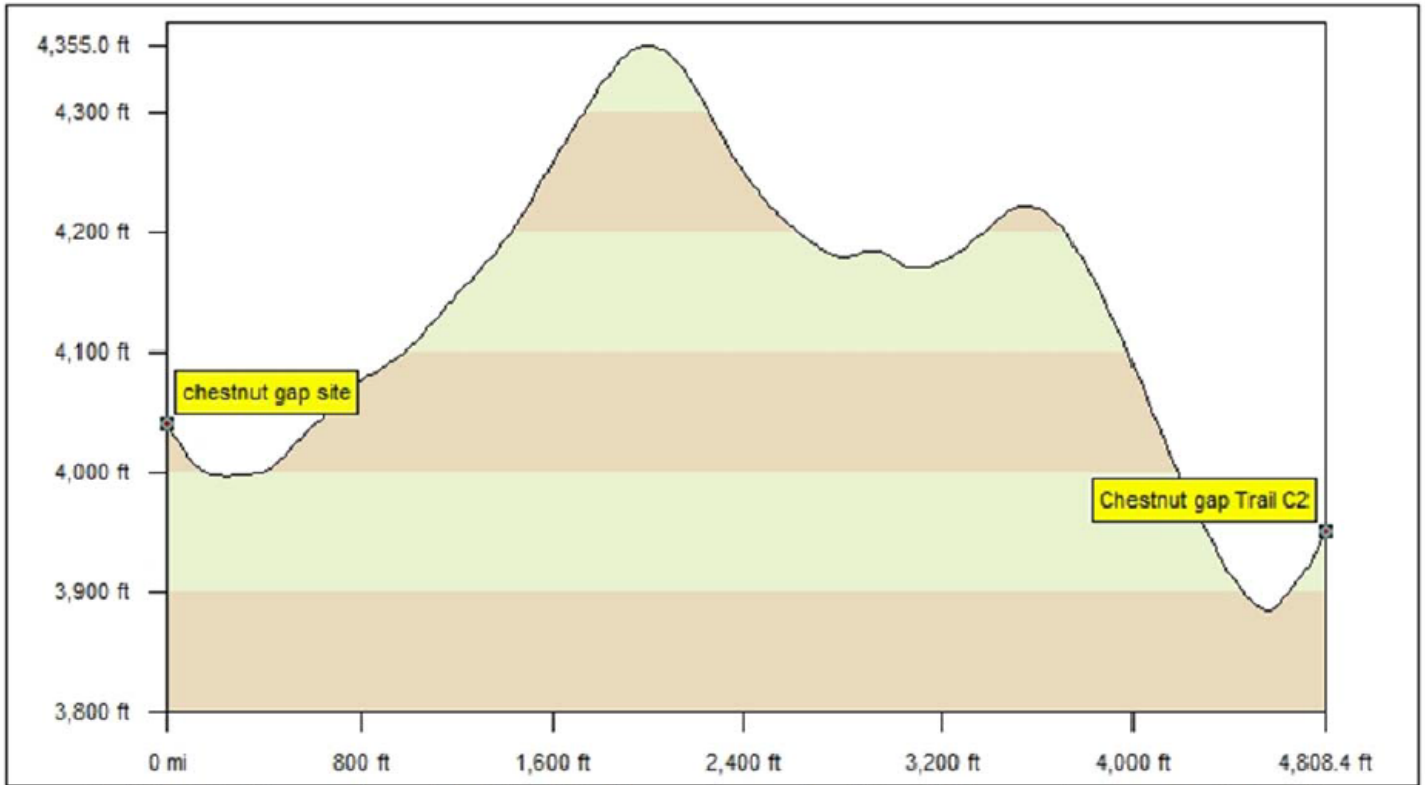


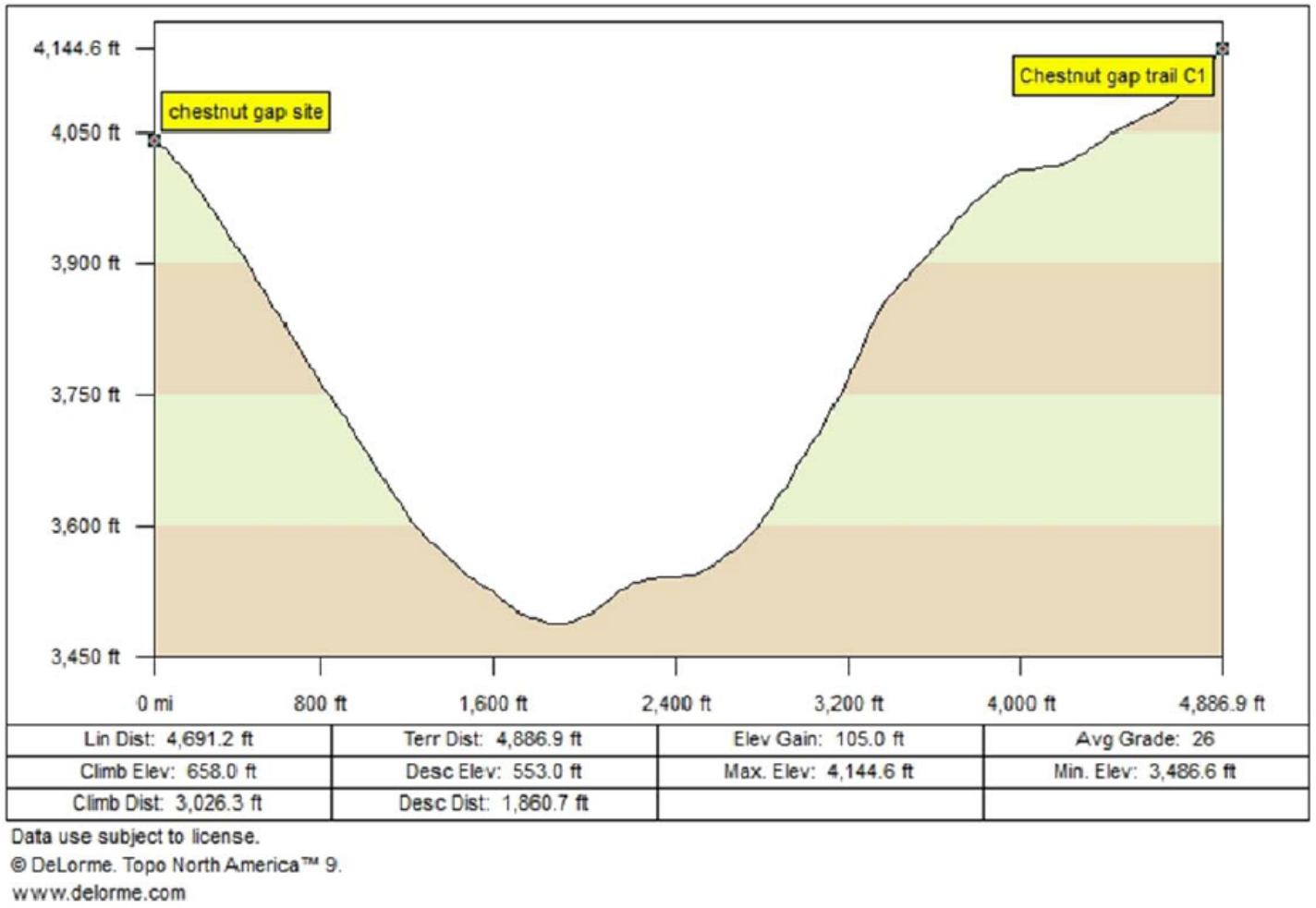
Figure 2. Position of the Perry Creek Range Site and the 5 positions at which noise prediction were made.

Annex A: Profiles of the terrain elevation from Range sites to receiver locations.



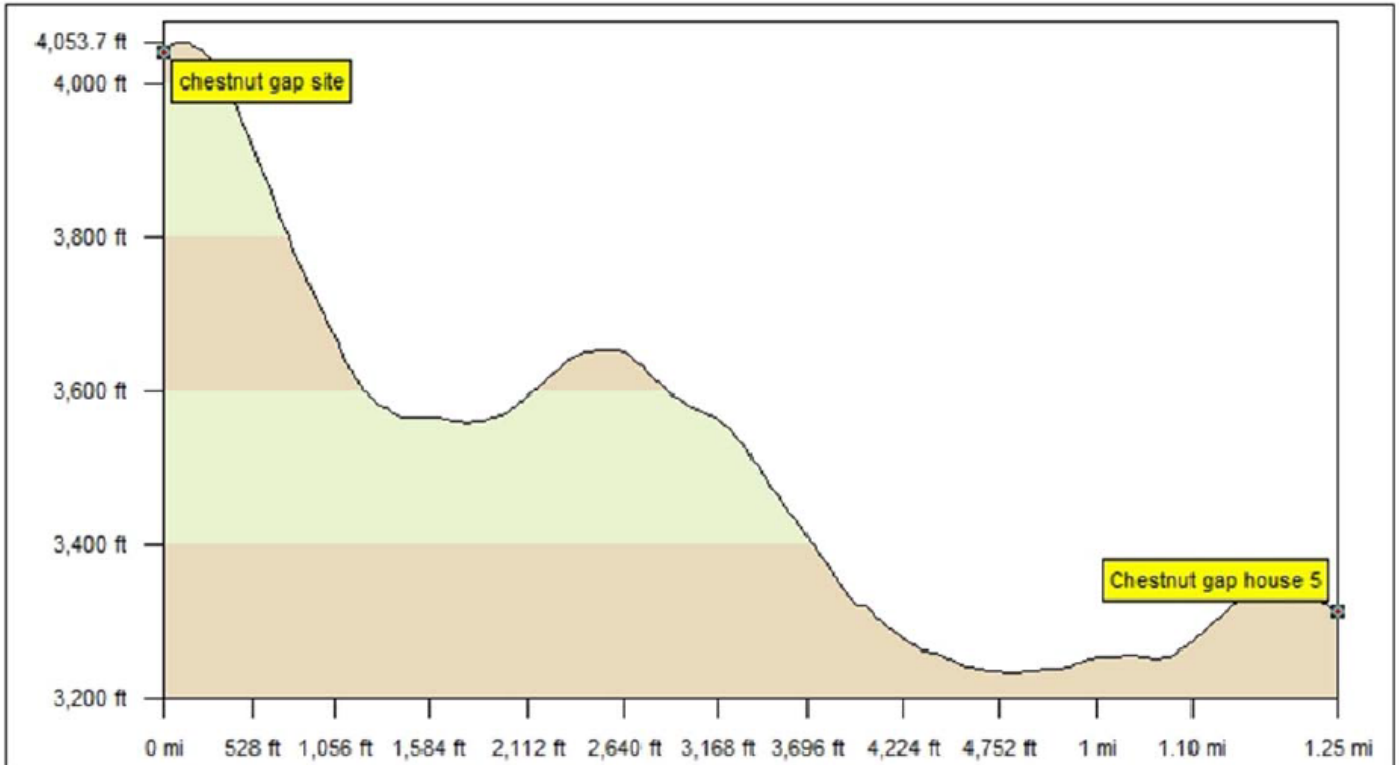
Lin Dist: 4,653.5 ft	Terr Dist: 4,808.4 ft	Elev Gain: -90.2 ft	Avg Grade: 23
Climb Elev: 481.6 ft	Desc Elev: 571.8 ft	Max. Elev: 4,355.0 ft	Min. Elev: 3,883.2 ft
Climb Dist: 2,546.3 ft	Desc Dist: 2,262.1 ft		

Figure A1: Profile from Chestnut Gap range site to Trail Point C2 on the Chunky Gal Trail. (See Figure 1)



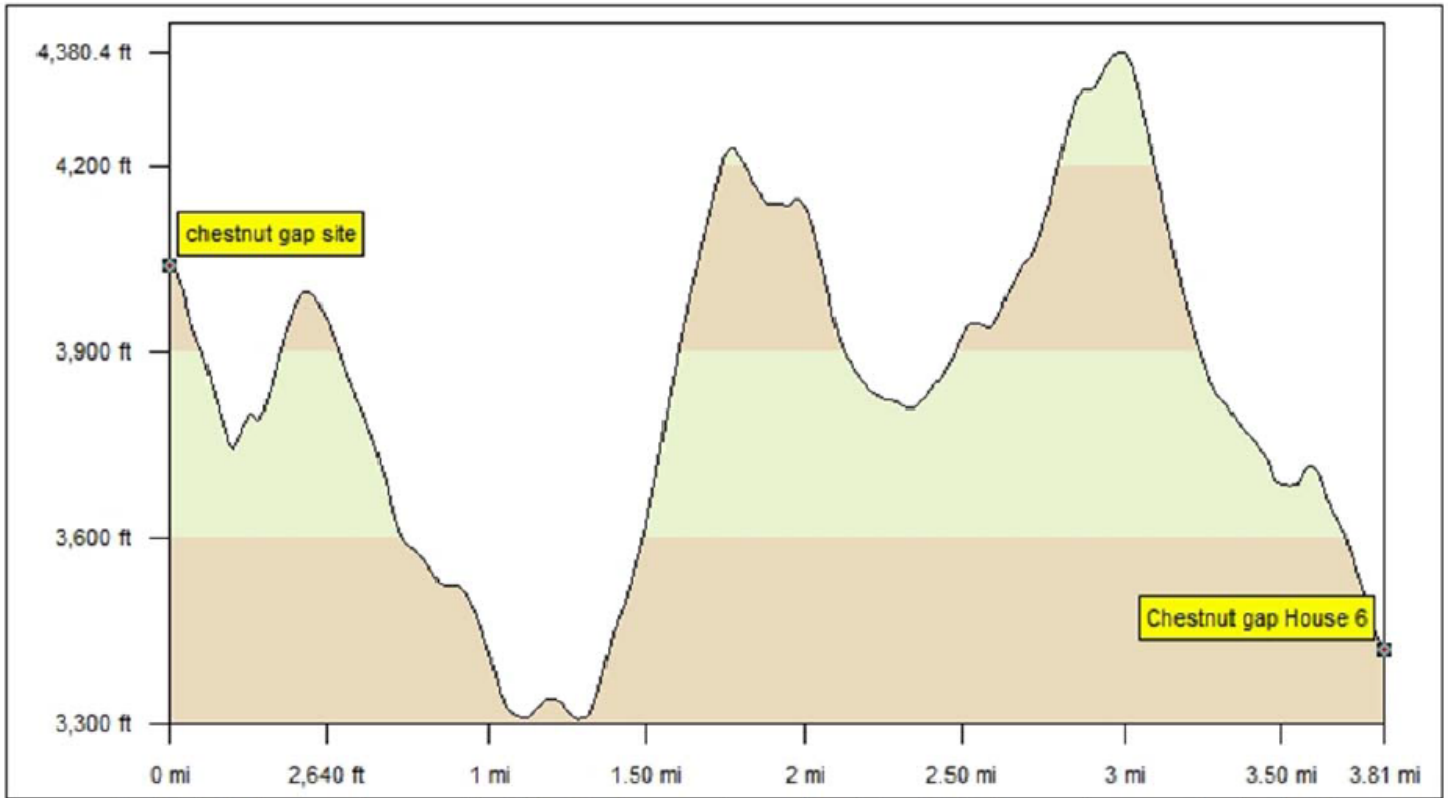
Lin Dist: 4,691.2 ft	Terr Dist: 4,886.9 ft	Elev Gain: 105.0 ft	Avg Grade: 26
Climb Elev: 658.0 ft	Desc Elev: 553.0 ft	Max. Elev: 4,144.6 ft	Min. Elev: 3,486.6 ft
Climb Dist: 3,026.3 ft	Desc Dist: 1,860.7 ft		

Figure A2: Profile from Chestnut Gap range site to Trail Point C1 on the Chunky Gal Trail. (See Figure 1)



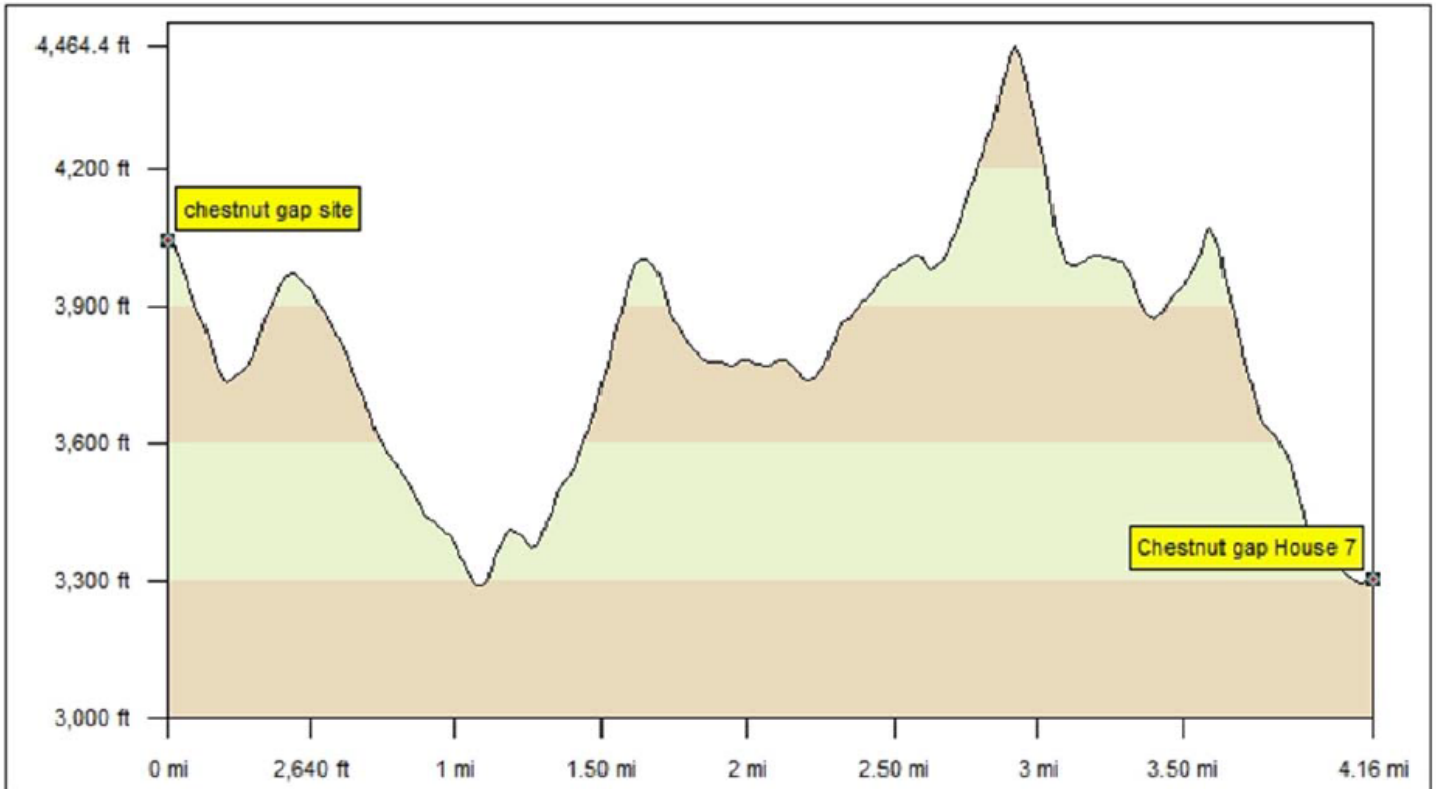
Lin Dist: 1.2 mi	Terr Dist: 1.2 mi	Elev Gain: -726.9 ft	Avg Grade: 18
Climb Elev: 219.2 ft	Desc Elev: 946.1 ft	Max. Elev: 4,053.7 ft	Min. Elev: 3,232.9 ft
Climb Dist: 2,364.4 ft	Desc Dist: 4,220.4 ft		

Figure A3: Profile from Chestnut Gap range site to House 5. (See Figure 1)



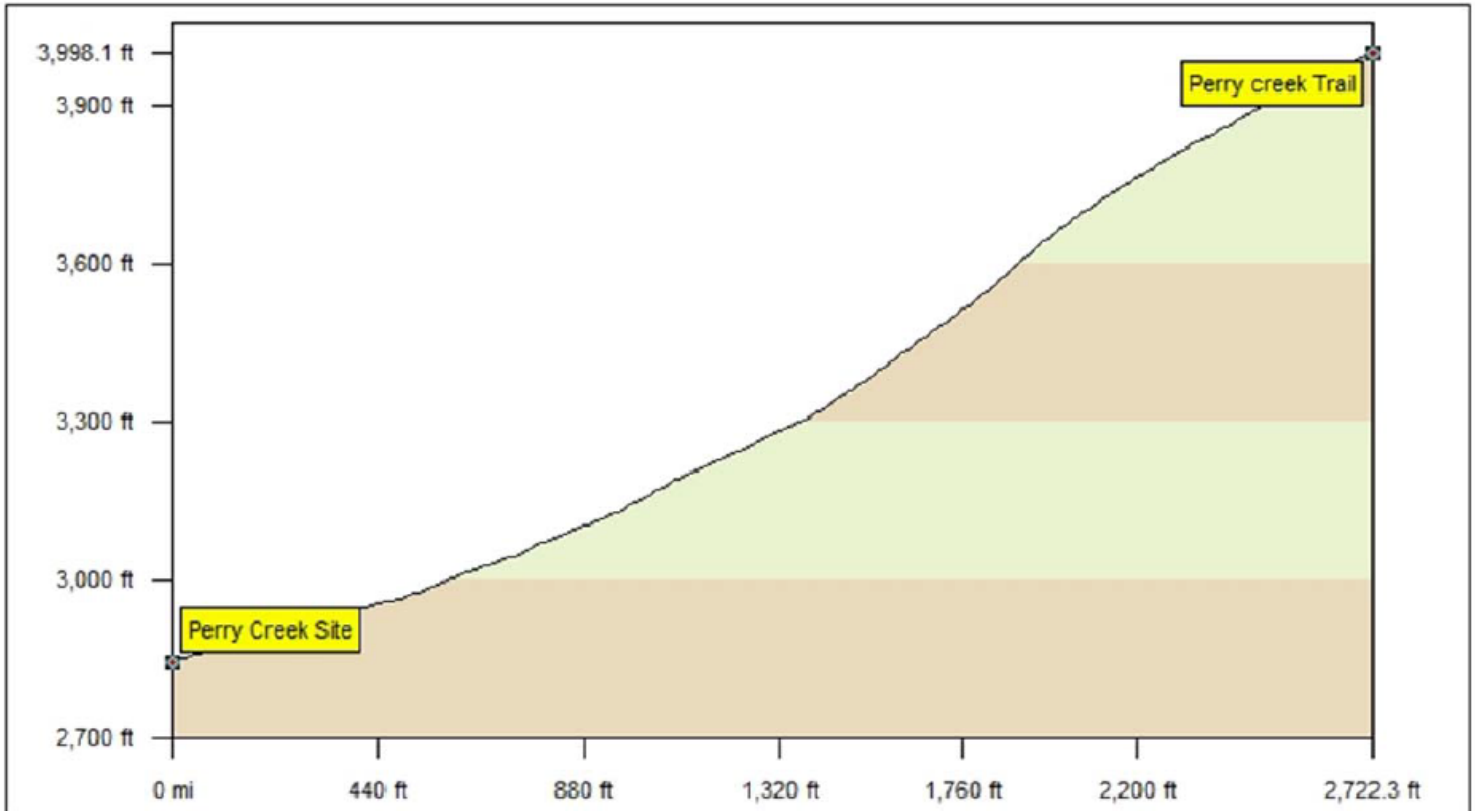
Lin Dist: 3.7 mi	Terr Dist: 3.8 mi	Elev Gain: -620.9 ft	Avg Grade: 22
Climb Elev: 1,842.9 ft	Desc Elev: 2,463.8 ft	Max. Elev: 4,380.4 ft	Min. Elev: 3,306.2 ft
Climb Dist: 1.5 mi	Desc Dist: 2.3 mi		

Figure A4: Profile from Chestnut Gap range site to House 6. (See Figure 1)



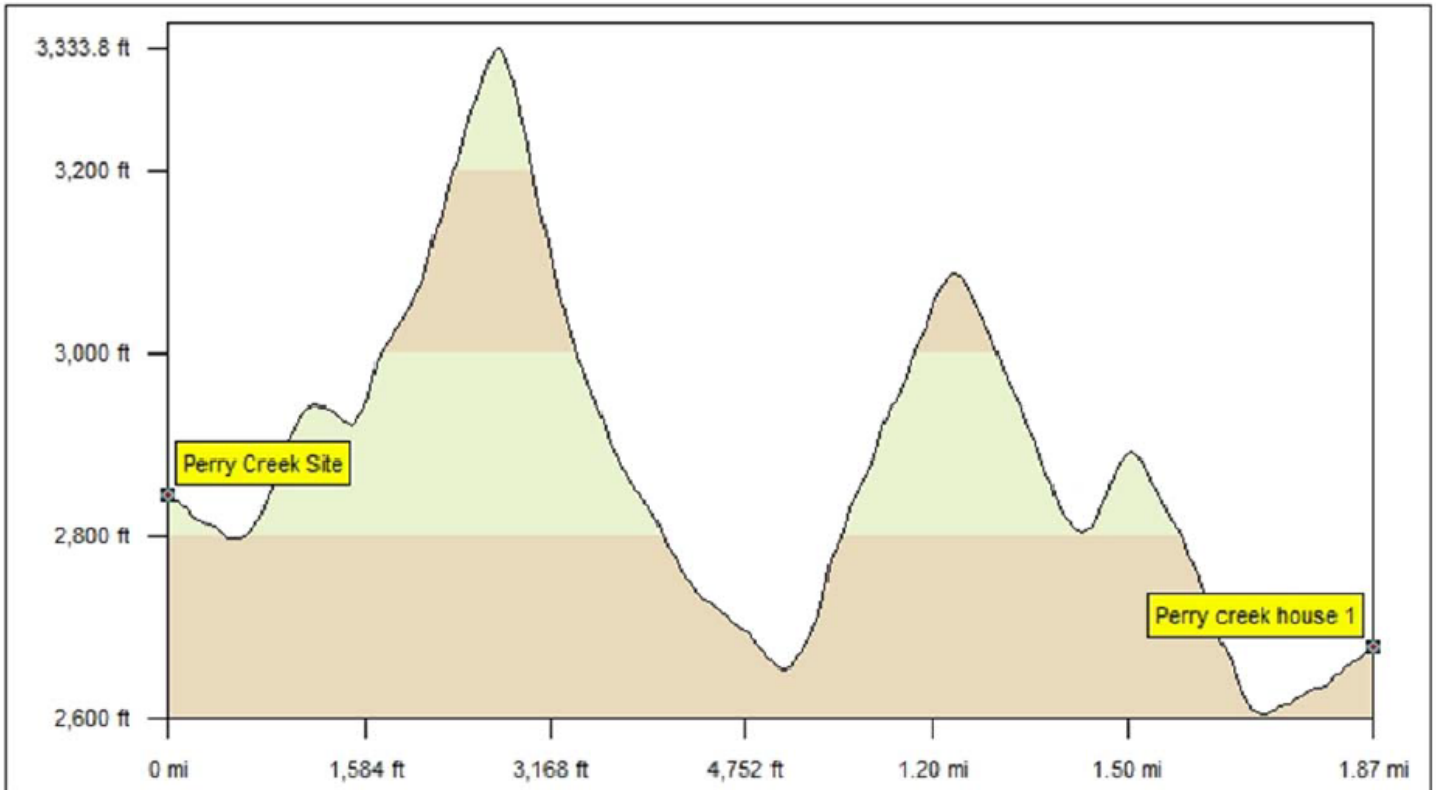
Lin Dist: 4.0 mi	Terr Dist: 4.2 mi	Elev Gain: -738.4 ft	Avg Grade: 23
Climb Elev: 2,012.1 ft	Desc Elev: 2,750.5 ft	Max. Elev: 4,464.4 ft	Min. Elev: 3,286.7 ft
Climb Dist: 1.8 mi	Desc Dist: 2.4 mi		

Figure A5: Profile from Chestnut Gap range site to House 7. (See Figure 1)



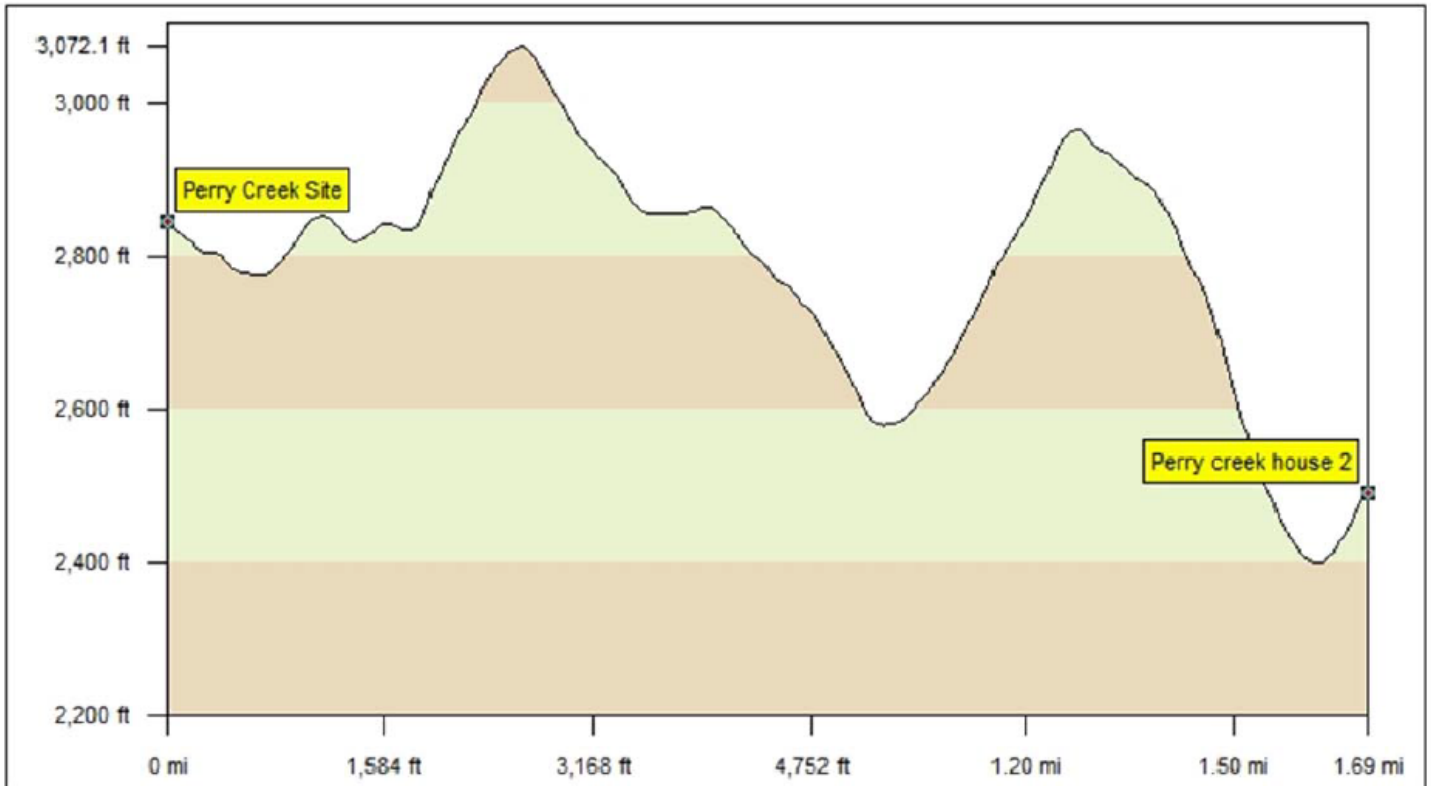
Lin Dist: 2,440.5 ft	Terr Dist: 2,722.3 ft	Elev Gain: 1,154.4 ft	Avg Grade: 48
Climb Elev: 1,154.4 ft	Desc Elev: 0.0 ft	Max. Elev: 3,998.1 ft	Min. Elev: 2,843.8 ft
Climb Dist: 2,722.3 ft	Desc Dist: 0.000 mi		

Figure A6: Profile from Perry Creek range site to Trail Point P1 on the Chunky Gal Trail. (See Figure 2)



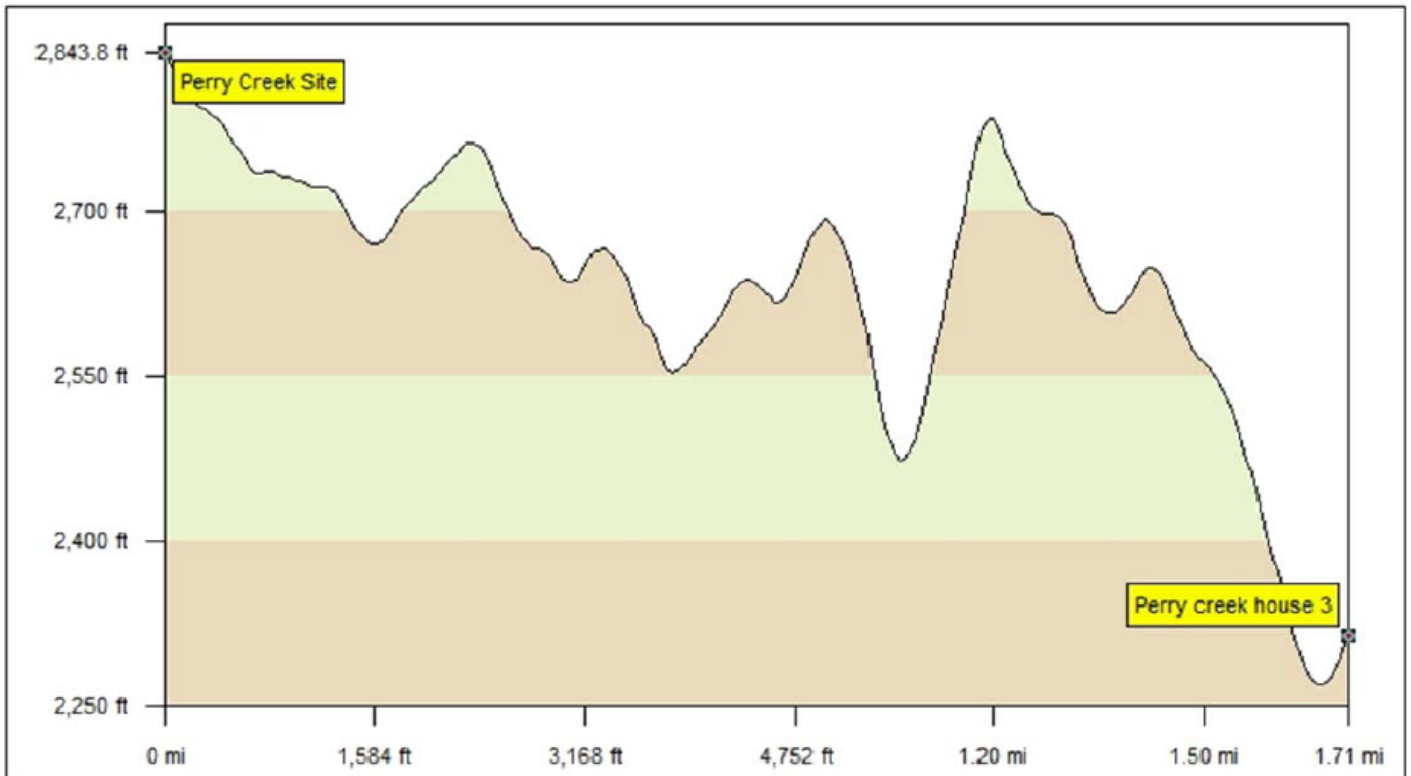
Lin Dist: 1.8 mi	Terr Dist: 1.9 mi	Elev Gain: -166.5 ft	Avg Grade: 26
Climb Elev: 1,154.5 ft	Desc Elev: 1,321.0 ft	Max. Elev: 3,333.8 ft	Min. Elev: 2,603.2 ft
Climb Dist: 4,601.2 ft	Desc Dist: 5,246.5 ft		

Figure A7: Profile from Perry Creek range site to House 1. (See Figure 2)



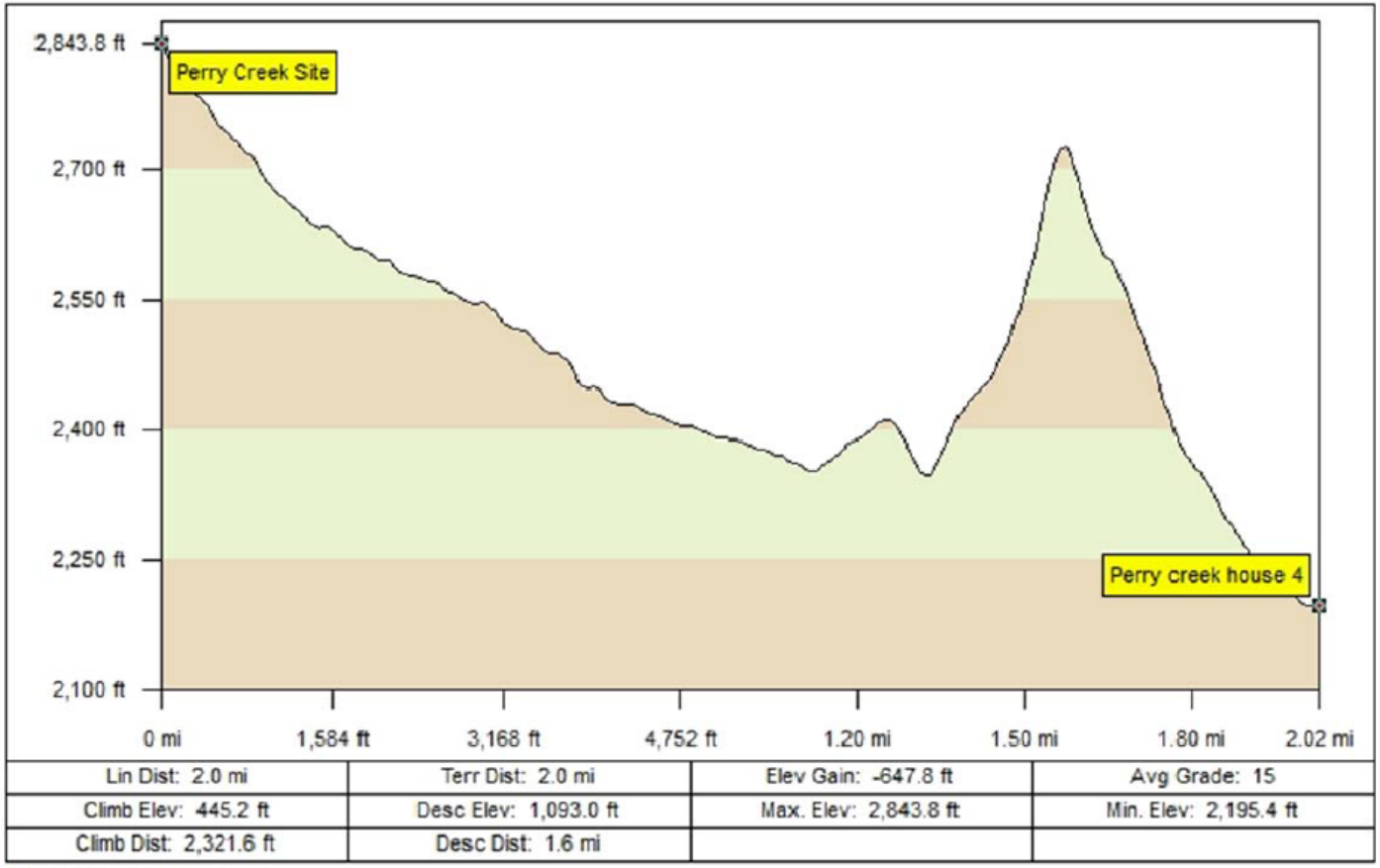
Lin Dist: 1.6 mi	Terr Dist: 1.7 mi	Elev Gain: -354.0 ft	Avg Grade: 23
Climb Elev: 825.7 ft	Desc Elev: 1,179.6 ft	Max. Elev: 3,072.1 ft	Min. Elev: 2,397.9 ft
Climb Dist: 3,695.4 ft	Desc Dist: 5,228.2 ft		

Figure A8: Profile from Perry Creek range site to House 2. (See Figure 2)



Lin Dist: 1.7 mi	Terr Dist: 1.7 mi	Elev Gain: -530.6 ft	Avg Grade: 22
Climb Elev: 680.5 ft	Desc Elev: 1,211.1 ft	Max. Elev: 2,843.8 ft	Min. Elev: 2,269.1 ft
Climb Dist: 3,286.4 ft	Desc Dist: 1.1 mi		

Figure A9: Profile from Perry Creek range site to House 3. (See Figure 2)



Lin Dist: 2.0 mi	Terr Dist: 2.0 mi	Elev Gain: -647.8 ft	Avg Grade: 15
Climb Elev: 445.2 ft	Desc Elev: 1,093.0 ft	Max. Elev: 2,843.8 ft	Min. Elev: 2,195.4 ft
Climb Dist: 2,321.6 ft	Desc Dist: 1.6 mi		

Figure A10: Profile from Perry Creek range site to House 4. (See Figure 2)

Appendix D: Airborne Dust Analysis

UNIV. OF THE SOUTH, DEPARTMENT OF FORESTRY & GEOLOGY

Modeling and Suppression of Fugitive Road Dust With Respect to a Potential Increase in Traffic on Nelson Ridge Road

Nathan Bowman

3/14/2012

Abstract: Particulate Matter (PM) is recognized as a hazardous pollutant in certain concentrations. The concern of local residents in Tusquittee, North Carolina, that an increase in traffic on Nelson Ridge Road could cause an unhealthy increase in PM10 and PM2.5 emissions led to this study. Modeling was conducted with AERMOD using site specific data and variables artificially biased towards overestimation in an attempt to find an absolute worst-cast scenario. The modeling results show that an increase in excess of the EPA NAAQS of 150ug/m^3 would require extreme amounts of traffic at speeds almost impossible on this road. However, given that airborne dust settling on structures, vehicles, vegetation, and other outdoor surfaces is a currently a nuisance to residents who live near the road, some simple suppression measures are recommended for the Forest Service to consider:

1.) Reducing posted speed limit from 55mph to 25mph,
2.) Placing speed bumps above each house to ensure compliance in critical locations,
3.) Capping average daily traffic below 100 cars.

Chemical treatments could be used as well when needed, specifically a sprayed application of Calcium Chloride annually or when construction work is predicted.

Introduction

Particulate Matter (PM) emissions are an area of concern in public health primarily in urban areas (World Health Organisation 2003). They are often thought of as mainly originating from tailpipes, but highway PM emissions are actually only about 1.2% of PM emissions – industry and other fuel combustion add another 24%, leaving the remaining three quarters of PM emissions to be made up by "emissions such as from forest fires and other kinds of burning, various agricultural activities, fugitive dust from paved and unpaved roads, and other construction and mining activities, and natural sources" (National Emissions Inventory (NEI) Air Pollutant Emissions Trends Data, 2008). As part of those potential sources, rural PM emissions can make up to a significant proportion of total PM emissions – in some studies; dust from unpaved roads is blamed for over 30% of total suspended PM (Barnard et al., 1992)

In the case of the proposed Nelson Ridge Road rifle range, concerns have been raised by residents about road dust from a potential increase in traffic on Nelson Ridge Road because of the Clay County Shooting Range Project. That road is immediately uphill of all concerned residents and currently is a troublesome source of PM (Personal communication with homeowners). In informal interviews, the residents expressed concerns about health impacts of breathing suspended PM, the impact of settling dust, and the potential leaching of chemical dust suppressants into their wells. The aim and intent of this report is threefold:

1.) Review of the scientific literature surrounding road dust and human health
2.) Quantify the estimated emissions and concentrations for various levels of traffic and speeds on the publicly accessible section of Nelson Ridge Road
3.) Present options to suppress or mitigate the effects of fugitive dust emission

A Primer on Particulate Matter

Particulate Matter (PM) refers to any mass that is discrete, minute and suspended in the air. PM can be liquid droplets, mineral or chemical particles or other materials. In terms of air pollution and concentration, there are two main categories to be interested in – particulate matter that is 10μm or less in diameter and particulate matter that is 2.5μm or less in diameter. Particulate matter that is 10μm or less in diameter (PM10) is roughly the same as respirable particulates, and particulate matter that is 2.5μm or less in diameter (PM2.5) is the category of PM that is able to penetrate more deeply into the lungs and potentially into the bloodstream (Pope and Dockery 2006). Generally speaking, PM that is greater than 10μm in diameter is not considered a health risk, because it cannot be inhaled and enter the more vulnerable parts of the body. In the literature there seems to be little consideration given to the composition of the PM, simply the size class, though crystalline silica PM is specifically associated with silicosis (Tran et al. 2005).

Suspended road dust can be made up of a large fraction of PM10 and PM2.5, especially at distances greater than seven meters, as the majority of larger particles (approx. 30+μm) entrained from unpaved roads are deposited no further than that from their origin (Jones 1984). Beyond that range it is likely that the majority of suspended PM will be of the sort that is considered potentially hazardous, but Edvardsson found that almost no PM10 was found beyond 45m (2010).

Airborne PM matter is blamed for ailments ranging from aggravated hay fever and allergies to lung cancer, silicosis and asbestosis (Sanders et al. 1997, Pope and Dockery 2006, Duzgoren-Aydin 2008, World Health Organization 2003, numerous others). As well, PM2.5 has been shown to be more strongly associated with decreased respiration than PM10 (Schwartz and Neas 2000) and increases in

PM2.5 concentrations of 10μm/m^3 over two days have been associated with a 1.68% increase in respiratory death rates in the United States (Zanobetti and Schwartz 2009). In the past, studies concentrated on occupational exposures (Silvestri 2004), but much recent work has concentrated on environmental exposure, especially of urban dwellers (Krzyzanowski et al. 2005).

Particulate Matter is the only of the so called "criteria pollutants" to not include a chemical description in the EPA standards (National Ambient Air Quality Standards (NAAQS), 2011). Neither is a regulatory differentiation made between particulate compositions – all particulates within a given size class are assumed to be of similar toxicity (Interim Report of the Committee on Changes in New Source Review Programs for Stationary Sources of Air Pollutants, 2005). This is not a reflection of available scientific data, but rather the lack thereof – there is not enough information available to make compositional regulations.

The current EPA standards for PM concentrations are all available in the National Ambient Air Quality Standards (NAAQS) for Particulate Matter (2006) and all figures and commentary given in this paragraph are taken directly from there (Table 1 in NAAQS). The current EPA standard for a 24-hour concentration of PM10 is 150μg/m^3, not to be exceeded more than once per year over a three year average (2006). This standard was changed from the 2004 standard of 50μg/m^3 annual arithmetic mean for PM10, to reflect the non-existence of evidence showing a connection between long term exposure to PM10 particles at lower ambient levels and health problems. However, PM2.5 concentration standards were revised downwards from 65μg/m^3 in one 24-hour period to 35μg/m^3 in one 24-hour period, while maintaining an annual mean of 15μg/m^3 over three years. This is in recognition of the health risks associated with both short and long term exposure to PM2.5 and the need to adequately protect the public health. North Carolina Ambient Air Quality Standards are the same for PM10 as the NAAQS (North Carolina 2010a).

In many urban centers, including 17 out of 20 large international cities profiled in a 1992 WHO study, PM concentrations exceed the WHO recommendations, which essentially parallel the EPA recommendations, by a factor of 2 or more (*Urban Air Pollution in Megacities of the World* 1992). In those cities, average concentrations range from 200-600μg/m^3 annually, with peaks well over 1000μg/m^3. These elevated concentrations are given as comparison to the most recent United States PM10 nationwide average of 59.7μg/m^3 in 2009 ("Our Nation's Air - Status and Trends through 2008," 2010).

Nelson Ridge Road Site Description

The publicly accessible section of road winds 2975 feet from Cold Branch Road past five houses up to the locked Forest Service gate. Since there are no houses beyond the gate marking the border, the most significant area of PM emissions and concentrations is between Cold Branch Road and the Forest Service Gate (Figure 1). That section of road is and is 10-14 feet wide. The paving material is a siliceous gneissic gravel that is commonly available (Personal Communications with Steverson Moffat), not limestone or sandstone. The slope of the road is between 6-9%, and it has many curves. It is lined with intermittent vegetation, from 80' oaks (*Quercus sp.)* to scrubby greenbriar (*Smilax sp.)*. The larger trees are clustered more towards the gate-end of the road, while there are more breaks in the vegetation towards Cold Branch Drive. Two of the houses do not have significant vegetation between them and the road – H3 and H4.

Topography in the area is extremely steep – the sloping south side of the road is better described as a cliff and can have a gradient of 40-60+% in places. The five houses of greatest concern are all downhill from Nelson Ridge Road, and their minimum distance from the road ranges from approximately 20-450' (Figure 1). There are a small number houses uphill of Nelson Ridge Road, but they are not considered in this paper – with concentration estimation both of maximum values and of

values at downhill houses, sufficient modeling is done in this report to ascertain if larger geographic modeling parameters are required to be sure of no violation of NAAQS limits.

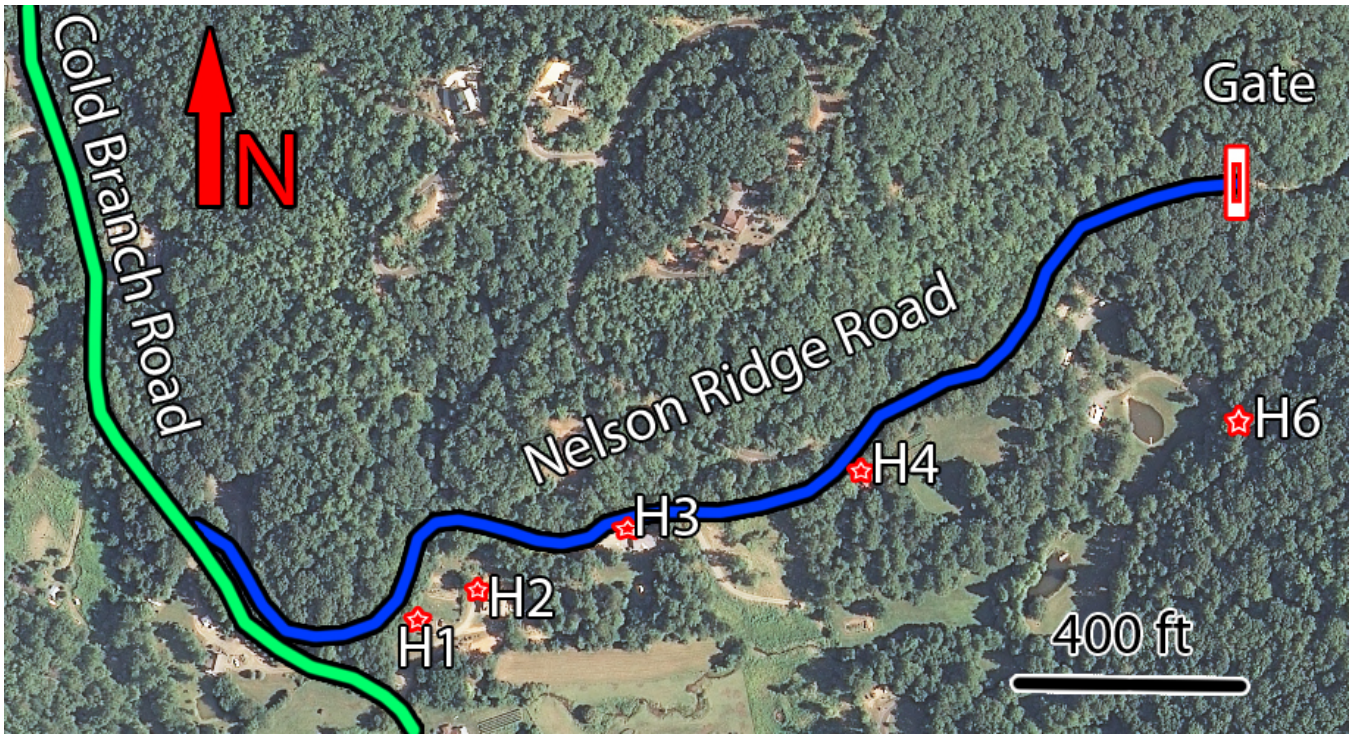


Figure 1: An aerial photograph showing a highlighted Nelson Ridge Road running from southwest to northeast. Houses are marked and numbered. Aerial photograph from USGS seamless viewer, High-Res Orthoimagery layer. Date of photography is unknown; locations on map were inputted by GPS location. Scale is approximate. Data available from U.S. Geological Survey

Sample Collection and Emissions Modeling Methods

All modeling was done by using AERMOD in accordance with the EPA's standards as described in AP-42 and in the AER-MOD Implementation Guide (EPA 1995, EPA 2009). Meteorological data was obtained from the North Carolina Department of Air Quality and topographical data was obtained from the USGS seamless viewer, in the "Shooting Creek" quadrant (Gesch et al 2002). Traffic data was collected by placing a magnetically activated traffic counter on the road from June 2011 to December 2011.

All reference points were mapped with a tape and compass and with a GPS unit. A 7.5 minute Digital Elevation Map of the "Shooting Creek" quadrant was obtained from the USGS and meteorological screening data was obtained from the N.C. Department of Air Quality Meteorological division (Anderson 2012, Gesch et. al 2007). Some aerial photographs were used to confirm receptor location and road positioning, part of the High-Res Orthoimagery layer of the USGS seamless data viewer (Data available from U.S. Geological Survey).

Surface soil collections were taken on Feb 24th, 2012 using the methods described in AP-42 Appendix C.1. Four samples were taken along the 2975 feet of roadway (Figure 2). A sample was taken above each house and also at the Forest Service gate at the end of the area of study. A 12 inch wide segment stretching across the roadway was marked out (Figure 3), and all topload sediment was gently swept into airtight containers for moisture analysis. Special care was given that bedload was not dislodged, only loose sediments on top of the hardpacked surface (Figure 4). A total of approximately

10+ lbs. was collected among the sites. Samples of two sites were kept separate in individual airtight containers for moisture analysis and the rest were mixed into a single, large plastic container.

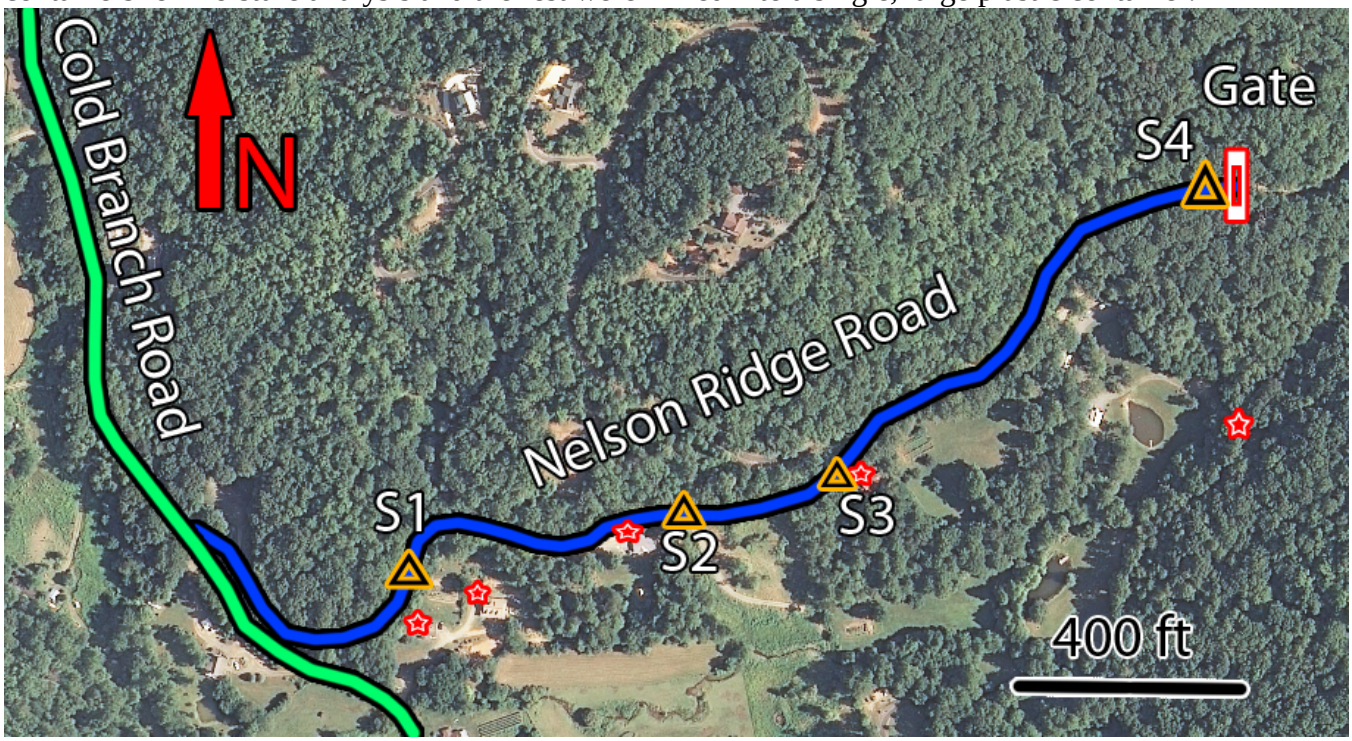


Figure 2 An aerial photograph showing the location of the four samples collected from the Nelson Ridge Road site, Feb 24th, 2012. Samples are marked with triangles, houses with stars. Note that a sample was taken above each house, as well as at the top of the road. Data available from U.S. Geological Survey.

The samples for moisture analysis were weighed before placing them into a drying oven at 80C with the lids removed for 48 hours. They were weighed again afterwards and the soil moisture content calculated.

The large container was vigorously mixed and then a small subsample of the larger sample was selected by coning and quartering the sample as directed in AP-42 Appendix C.2 until a manageable sample size was obtained. The percentage of the soil that was silt was found by using stacked screens, mechanically sieving the sediments for 20 minutes, and taking all sediments that passed a #200 screen as silt.

Total PM emissions were calculated using equation 1b given in the Chapter 13, Section 13.2.2 of the updated 2006 AP-42 *Compilation of Emission Factors* EPA publication:

$$E = \frac{k * (s/12)^a (S/30)^d}{(M/0.5)^c} - C$$

where a, d, c and k are EPA supplied empirical constants for specific PM size classes and road types and

E = size-specific emission factor (lb/VMT)
s = surface material silt content (%)
M = surface material moisture content (%)
S = mean vehicle speed (mph)
C = emission factor for 1980's vehicle fleet exhaust, brake wear and tire wear (From EPA 2006).

Figure 3 Sample Site 4, with sampling site marked out. Tapes extend from one side of the gravel to the other, but do not extend onto the shoulder. Distance between tapes is 12". Picture taken Feb 24th, 2012 at Nelson Ridge Road, Tusquittee NC.

Figure 4 Example of the results of sample collection. Non collected sediments are on the left of the tape, the collection site is on the right. The tape was moved slightly to the left of center before taking this picture, the actual edge of collection site is approximately 1" to the right. Picture taken Feb 24th, 2012 at Nelson Ridge Road, Tusquittee NC.

From the emissions calculated with equation 1b from AP-42, a grams per second rate was calculated by first converting the total emissions into grams/kilometer, then dividing the entire length of the road into 47 approximately 15m long segments and calculating the fraction of the total emissions that each segment was responsible for, by dividing the total emissions by 47. The effect of precipitation was included at this point, by applying equation 2 from AP-42 Chapter 13.2, assuming 140 days of precipitation > 0.01in as indicated by Figure 13.2.2-1 from that same chapter. Then, the rate of emission per second was calculated if all of the cars passed by in the same hour, and finally the model was calibrated to simulate 30% of the traffic in the morning, between 8-9am, 20% from 3-4pm, 20% 4-5pm, and 30% from 5-6pm. This roughly represents the results of the traffic counter.

When a non-obvious choice of modeling parameters was required, the choice was made with a conscious bias towards overestimation. This was intended to give an absolute worst-case scenario that would indicate if further resolution in data analysis would be required – a 'screening procedure.' As well, neither the vegetation between the road and the houses/receptor locations or of the observed prevailing winds trending northwest – uphill away from the houses – were included in the model.

The AERMOD program requires a series of sources and receptors, or emitters and receivers. The sources were calculated using the latest best operating practice recommendations currently in use (Fox et al 2012). Each of the 15m segments described above were treated as volume sources, essentially pre-diffused point sources, with dimensions derived from an average automobile height placed at 2m (the first of the variables biased towards overestimation). Then the emissions rates calculated using the method described above were used as their constant emission rates. All sources were assumed to be emitting – representing every car driving the entire length of the road (the second of the biased variables). The weather data used was a screening set, assuming worst case weather (the third of the biased variables).

To include terrain height in the model, Digital Elevation Map (DEM) data was acquired from the USGS seamless viewer (Gesch et. al 2007), and pre-processed using AERMAP, a companion program to AERMOD designed to obtain source and receptor heights and terrain effects and format them for inclusion in an AERMOD model. At this time, a local co-ordinate reference grid was created and anchored to a set location, to facilitate the input of small scale co-ordinates (Appendix A).

450 receptors were arrayed in a 600m x 300m grid, with terrain heights as automatically specified by AERMAP, spaced equidistantly every 20m. 5 additional receptor locations were placed at the closest point to the road at each house location, as measured and agreed with landowners. The flagpole option was used, to sample concentrations at 1.5m above the ground, approximately at inhalation height. The simulations were run with 12 different sets of variables, with the number of cars beginning at approximately 160% of the daily traffic shown by the traffic counter, and speeds from 10-55mph (Table 1). A 24 hour average concentration, the standard used by the EPA for NAAQS compliance checks, was estimated. Concentrations were calculated using the no stack tip downwash non-default regulatory option, and were then copied into SurGE to extrapolate concentration maps and isolines (Dressler 2011).

The AERMOD parameters used for the modeling are appended to this report as Appendix A. By combining those parameters with the source emission rates used (Table 1), the modeling can be duplicated or manipulated for greater resolution if desired.

Table 1: Summary of the Variables used in the 12 models run of PM10 emissions on Nelson Ridge Road.

Model Name	Silt (%)	Number of Trips/day	Speed (mph)	Source Emission Rate (g/s)
NLSNRD1	5.77	100	10	0.022915
NLSNRD2	5.77	200	10	0.045829
NLSNRD3	5.77	100	20	0.032406
NLSNRD4	5.77	200	20	0.064813
NLSNRD5	5.77	100	35	0.042869
NLSNRD6	5.77	200	35	0.085739
NLSNRD7	5.77	100	55	0.05374
NLSNRD8	5.77	200	55	0.107479
NLSNRD9	5.77	300	55	0.161219
NLSNRD10	5.77	400	55	0.214959
NLSNRD11	5.77	500	55	0.268698
NLSNRD12	5.77	1000	55	0.537397

Results

The decision was made to concentrate on PM10 modeling, because the AP-42 formula for PM2.5 emissions is 10% of the PM10 emissions formula – and so if the PM10 modeling passes, then the PM2.5 must pass by default, because the annual average allowable is 15ug/m^3 and so 10% of the PM10 24 hour average(North Carolina 2010a). Therefore, it is found that any result of PM10 concentration can be interpreted at 10% for the PM2.5 concentration.

The models NLSNRD1-NLSNRD10 all showed increases in maximum 24 hour concentrations of PM10 below 150ug/m^3 (Tables 2 and 3). NLSNRD11 was barely over that threshold at 150.50380 ug/m^3 and NLSNRD12, the extreme scenario of 1000 cars traveling at 55mph, showed a maximum PM10 concentration of 301 ug/m^3(Table 4). A potential, if unlikely, scenario shown by NLSNRD5, showed that even by tripling the traffic on Nelson Ridge Road an increase in maximum concentration of only 24.01 ug/m^3 is estimated (Table 2).

The concentrations of PM10 tended to be highest uphill of the road, and clusters of high concentration can be found on the interior of curves in the road (Figure 5). It is hypothesized that concentrations are elevated on elevated terrain because the plume is compressed into a smaller space as the floor rises, but whether this bears out in the real world or is merely an artifact of the modeling algorithm is unknown. Elevated concentrations are estimated for at least 60-80m downhill of the road, and can be found in NLSNRD12 at least as far away as 140m, in contradiction of Edvardsson's empirically derived, and more substantial, results showing elevated levels of PM10 subside within 45m of the roadway (Figure 5) (2010).

At the house receptor sites, some of which are located less than 20m from the roadway, the only model that showed a concentration above 150ug/m^3 was NLSNRD12. All others, even NLSNRD11, showed concentrations ranging from approximately 7 ug/m^3 at the low end to 107 ug/m^3(Figure 6).

Table 2: Maximum estimated concentrations from models NLSNRD1-6, with silt 5.77%.

	NLSNRD1	NLSNRD2	NLSNRD3	NLSNRD4	NLSNRD5	NLSNRD6
# of Cars	100	200	100	200	100	200
Average Speed (mph)	10	10	20	20	35	35
Estimated Maximum 24hr PM10 Concentration (ug/m³)	12.84	25.51	18.15	36.30	24.01	48.02

Table 3: Maximum estimated concentrations from models NLSNRDDFINAL7-12, with silt 5.77%. Concentrations exceeding the NAAQS are highlighted.

	NLSNRDD7	NLSNRDD8	NLSNRDD9	NLSNRDD10	NLSNRDD11	NLSNRDD12
# of Cars	100	200	300	400	500	1000
Average Speed (mph)	55	55	55	55	55	55
Estimated Maximum 24hr PM10 Concentration (ug/m³)	30.10	60.20	90.30	120.40	**150.50**	**301.01**

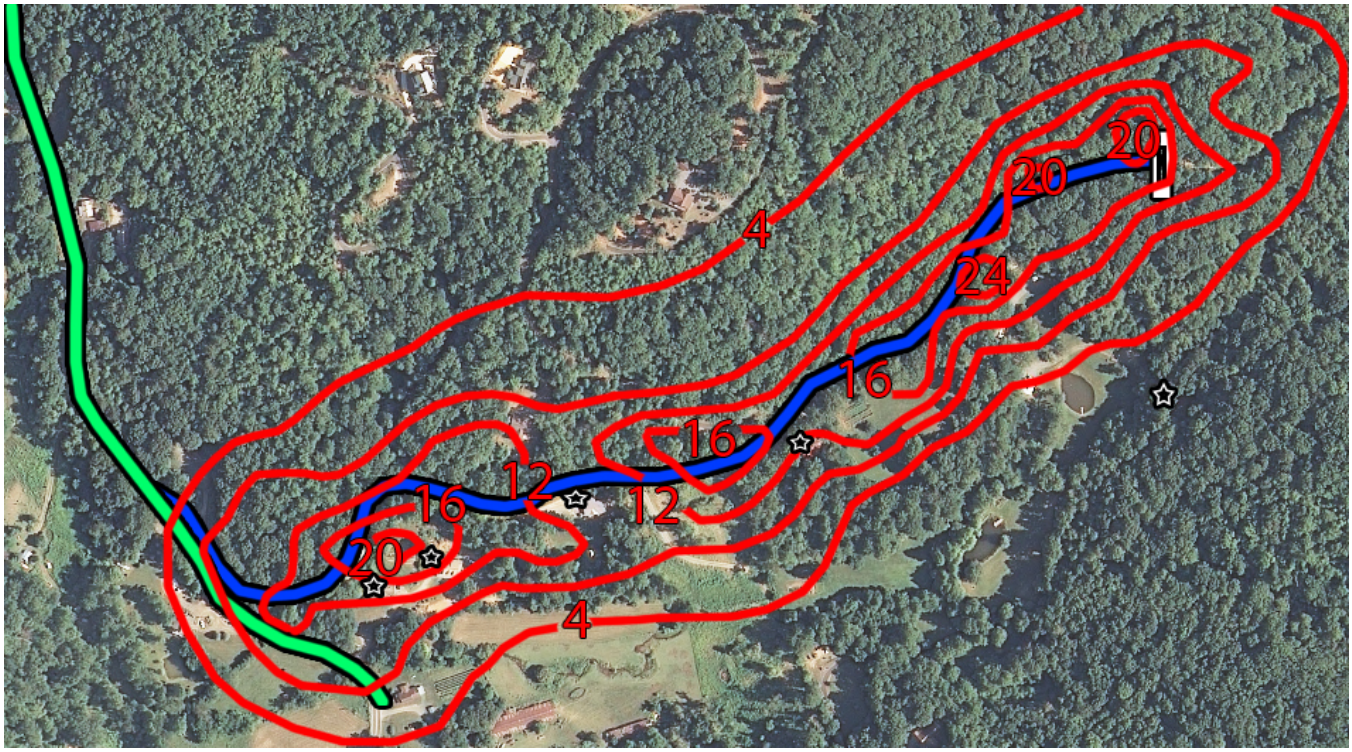


Figure 5: An overlay of isolines generated by inputting data from the results of NLSNRD5 into SurGE. Estimated concentrations are given in ug/m^3. House locations are indicated by stars, Nelson Ridge Road trends NW-SE. Aerial photography data available from the U.S. Geological Survey.

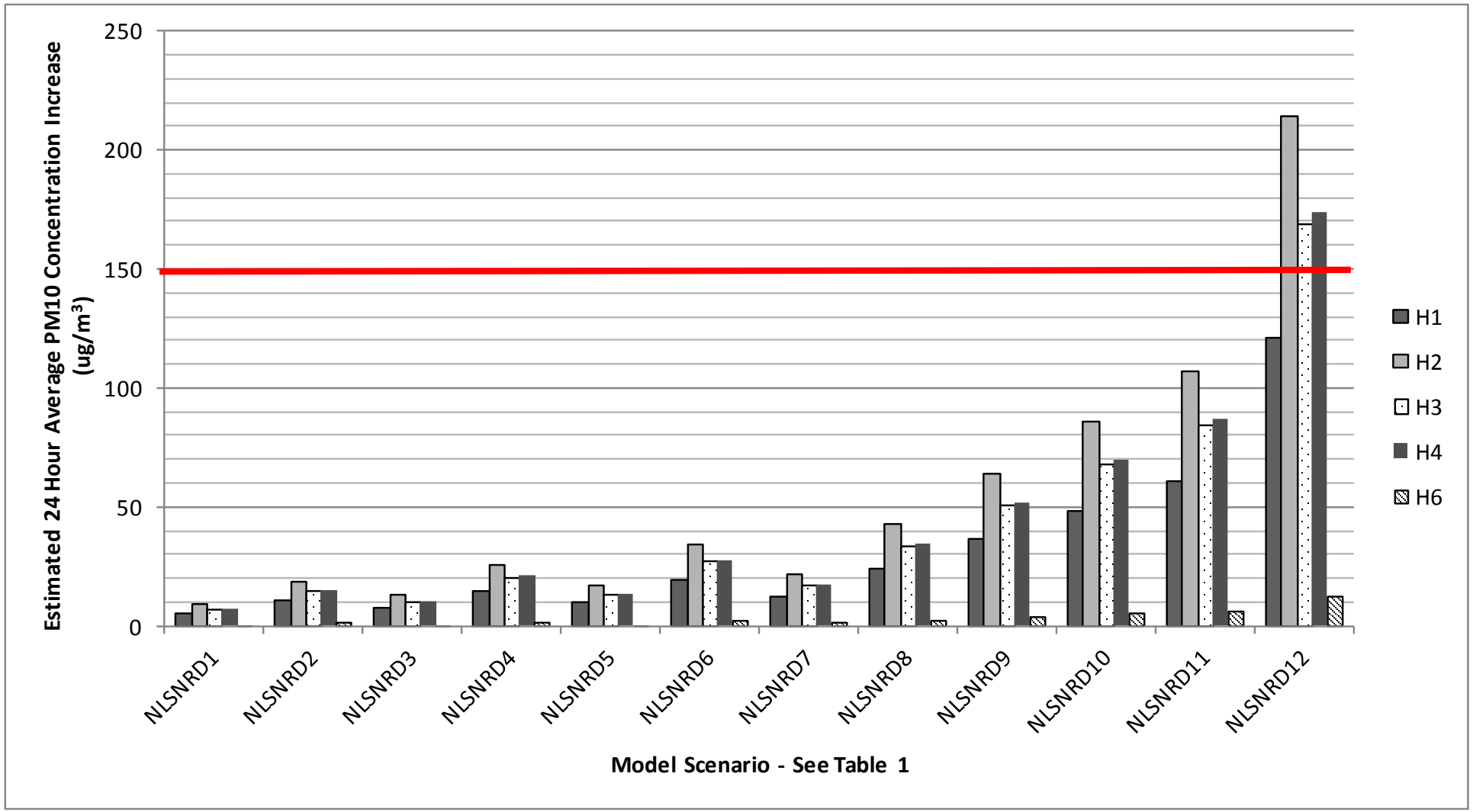


Figure 6: Estimations of PM10 concentrations at 5 houses on Nelson Ridge Road, not including background levels. The NAAQS of 150 ug/m^3 is indicated. Addition of Clay County assumed average of 13.4 ug/m^3 does not put any house past the NAAQS other than NLSNRD12. PM2.5 compliance to NAAQS is shown by taking 10% of all estimated concentrations and NAAQS.

Discussion of Modeling

The results of the model only reflect estimations of concentrations specifically related to the sources included, and do not represent a cumulative total. Background levels of PM10 are not included in the results, and therefore are very important to the net concentrations. There is no monitoring station currently maintained by the EPA in Clay County, but Henderson County is most representative, at 13.4 ug/m^3 (Buckler 2012). Since no current PM10 average is available for Clay County, the PM10 concentration of Clay County will be assumed to be equal to that of Henderson County.

When compared to the results of the least outlandish but still unlikely modeled scenario, NLSNRD6, the maximum concentrations reached are still well within standards – 48.02 ug/m^3. No model that passed the standards is found out of bounds when added to the presumed baseline PM10 concentrations – only the two most extreme scenarios that were originally outside of the standards remain as such.

It is possible that on some days a local 24hr average PM10 concentration could be reached that is higher than the surrounding countryside. However, it is known that in rural settings PM10 sources are more capable of releasing elevated levels of fugitive dust emissions – and so it is that areas of wildfires, farming, drought or construction could result in elevated PM10 concentrations higher than the county average as well. Localized pockets of mildly elevated fugitive dust emissions are not uncommon, nor are they likely to result in NAAQS violations. Much more in depth study would be needed if more precise analysis of local concentrations is desired.

The variables chosen as the independent variables in the model scenarios presented were set arbitrarily high, not in an effort to determine actual current emissions, but rather to ascertain if the minimal increase in road traffic anticipated by construction of a rifle range would lead to enough of an increase to warrant further consideration.

The average number of cars that traveled Nelson Ridge Road over a seven month period was 38.5 – just over a third of the number of cars that the modeling scenarios began with. Of those cars, on average, about 8 were Forest Service vehicles and the rest only drove the private road – which means that they were not driving the entire length of the road (unlike the model). A separate model of just these conditions resulted in an estimated average 24hr PM10 concentration of 7.81 ug/m^3 from traffic on Nelson Ridge Road, not including background levels. Even by almost tripling the number of cars per day, at speeds higher than likely, in the author's opinion, as in NLSNRD5, a conservatively high maximum concentration of only 24.01ug/m^3 is estimated, about the same as the average concentration in Charlotte (Cornelius et al 2011). When combined with the average PM10 concentration for Clay County, assumed to be 13.4 ug/m^3 (North Carolina 2010b, Buckler 2012), the estimated concentration reaches a net maximum of less than 38 ug/m^3 - 10ug/m^3 *lower* than Mecklenburg county. This concentration is about 25% of the NAAQS and North Carolina Ambient Air Quality Standards for PM10 concentration, and is calculated very conservatively.

In short, the number of cars per day it would take to raise the PM10 concentrations above the NAAQS levels would almost mandate a paved road well before those numbers were reached (Skorseth and Selim 2000).

The results of the modeling show that any proposed increase in traffic on Nelson Ridge Road will not raise the 24 hour average PM10 concentration above the federal standard of 150 ug/m^3, as long as the total number of cars remains below 500 and their average speed remains less than 55mph (Table 2).

Possible source of error in the model scenarios have, for the most part, been identified and artificially biased towards over-estimation, as mentioned above. The only sources that have not been so manipulated are: percentage of surface material silt, wind data in AERMET screening data files, and statistical inconsistencies with the data derived from the traffic counter. However, for the first, all procedures were performed as indicated in Appendices C.1 and C.2, and potential, localized, random inconsistencies in samples are corrected for by combining multiple samples and taking the average silt content. The second and third are issues beyond the scope of this report, as they have to do with data provided by outside sources, not generated, measured or collected in the course of the writing of this report. Therefore, though there is absolutely no evidence or indication of any major error in either of these sources, possible corrections could be indicated if further study is desired.

Discussion of Mitigation Options

There are many different methods of reducing PM emissions – but they all work by reducing the factors included in emitting PM. The most important factors are the wind speed at the road surface (mainly vehicle speed), the number of vehicles, the silt content of the topload, the resistance to entrainment of the topload and the climate (chiefly moisture) (Foley et al., 1996). These are not listed in any order, because they interact with each other and specific combinations with varying levels of importance are unique to individual sites. That being said, in terms of the impact that the Clay County Shooting Range Project could have on Nelson Ridge Road, the most important factors are those that have the most potential to maximize the reduction of fugitive dust emission at a minimum of cost.

The first, and most obvious method of reducing fugitive dust emission is by establishing a reduced speed limit on the road. There are no posted speed limits on the road at all, and during informal interviews, local residents indicated that they believed the speed limit to be 55mph, which is both clearly unsafe and likely to be the cause of a large fraction of the current PM emissions. At 55mph, even the current, non-increased traffic would emit something like 11.58ug/m^3 – close to the emissions of three times the number of cars moving at 10mph (Table 2). A significantly reduced speed limit might cause local unhappiness, but could reduce emissions from 50-85% (Foley et al., 1996, Table 2 in this report). Increased enforcement would be necessary to ensure the speed limit was obeyed, but perhaps a series of speed bumps could be emplaced, especially directly above the houses – to enhance the chances of maintaining a lower average speed.

The next method of reducing emissions is putting a cap on vehicle traffic – perhaps no more than 100 cars per day, or only permitting limited parking space to be built at the rifle range. There are difficulties with this, mostly with ensuring compliance, but if an agreement with the permit applicants could be reached, this would be another simple and cost-effective method of reducing emissions. Most likely, this would need to be written into the permit agreement – to prohibit competitions that could draw large numbers of crowds for example.

The third most cost-efficient measures are actually the most expensive initially – chemical treatments designed to increase the topload's resistance to entrainment. There are a number of these available on the market, and many studies have been conducted to find the most effective (Foley et al., 1996, Johnson and Olson 2009, Sanders et al. 1997, numerous others). These treatments come in four basic categories: Chlorides, Resins/Polymers/Lignosulfates, Biologically Derived Treatments (e.g. soybean oil) and other commercial treatments. Dust suppression treatments work one of two ways, either by attracting moisture, encouraging

flocculation of smaller particles, and thereby retaining the soil (Chlorides) or by binding the soil particles together to increase the particle size and reduce their ability to become suspended (Resins, Natural Treatments) (Edvardsson 2010). The major concerns of applications are the cost, the effectiveness and the potential environmental consequences.

Most applications are done annually or biannually, typically with a sprayer truck. Initial costs can be high, but the direct benefits of the application are potentially fivefold:

1.) Reduced Dusting
2.) Reduced Aggregate Loss
3.) Reduced Maintenance/Blading
4.) Increased Road Stability and Driving Comfort
5.) Potential Reduction in total annual maintenance cost

(From Skorseth and Selim, 2000 and Sanders et al. 1997)

Sanders et al. established that in some situations, a 30-46% reduction in maintenance costs could be possible – depending on the average daily traffic and the cost of aggregate, treatments, and labor (1997). When the fines are kept from becoming suspended and re-deposited offsite, they help to lock in the larger rocks and keep the road from breaking down so quickly. This means fewer trucks of replacement gravel have to be brought in, and fewer trips with the grader and moldboard – even though a chemical application may cost more, it is less frequent and only requires a single truck. While Sanders et al. did show that the cost-effectiveness threshold for dust control treatments required approximately 120 cars per day (1997), this was a purely economic analysis and did not take into account the negative consequences associated with not applying dust controls (i.e. dust and gravel emissions, driving discomfort).

Of the options available – the most suited to the specific concerns of this site is an annual application of Calcium Chloride in the early springtime, when the most moisture is available in the soil (Monlux and Mitchell 2007, Edvardsson 2010, Johnson and Olson 2009).

Chlorides overall showed the best overall control in the several studies listed above, and because of the multiple curves in the road which increase surface fracturing and the residents' concerns of well water contamination, lignosulfonates and natural or synthetic oils would not be suitable for application at this site. Those types of treatments have the effect of 'armoring' the road surface in order to reduce impaction and entrainment from automobile tires, but can be broken down more quickly on roads that are curved and require constant changes in acceleration and direction (for more on this see section 2.4 of Edvardsson 2010). Lignosulfonates in particular tend to leach out of the roadbed and are more suited for dry climates not near potable water wells. This necessitates a more frequent (and more costly) application regime to maintain a similar level of effectiveness (Edvardsson 2010).

Magnesium chloride, a possible alternative (Richardson 2012), has been found to require up to 50% more of an initial application, which despite potentially being cheaper per unit volume means more of an overall investment annually (Enkell 2003, from Edvardsson 2010). Both types of chlorides are highly water soluble, but subsurface soil water test have shown leached concentrations that would not flavor drinking water, and at most could cause some pipe erosion (Edvardsson 2010). However, various other commercial dust suppressants available have been shown to be similar to water-only control uses (EPA 2008). In short, groundwater contamination due to leaching is of minimal concern and should be considered only with respect to specific

products being considered for application, not as a general disbenefit of dust suppressant application overall.

Dust suppression measures have been found to be more successful on soils with lower sand content and greater number of particles that pass a #200 screen (Johnson and Olson 2009). The silt content of this road is approximately 5.7%, higher than the federally published default average for North Carolina of 4.7% (EPA 2003). This would mean that the estimates given for effectiveness for the options presented above should be considered as conservative estimates. Instead of seeing chloride effectiveness in the 40-70% range, as indicated by Sanders et al. (1997), it could be more similar to the range reported by Foley et al. 40-98% (1996).

Therefore, an application of calcium chloride is suggested if adequate emissions control through other means is unobtainable or unsustainable and if sufficient community support and funding can be obtained.

If the average daily traffic is found to be above 125 cars, unlikely though that may be, the application of a chemical dust suppressant is highly recommended, and if the average daily traffic is found to be above 250 cars, paving the road would be the indicated procedure (Skorseth and Selim 2000, Edvardsson 2010).

It is very important to remember though, that this model only takes into account the effects of passenger vehicles, it does not represent an increase in large, commercial vehicles or construction equipment – during the construction of the rifle range, for example, though it would be unlikely to increase the level of PM10 emissions it would be appropriate to reduce speed as much as possible in inhabited areas to reduce PM10 emissions. Chemical suppressants might also be included in the cost of the initial construction as a one-time event to alleviate the additional emissions that heavy equipment on the road might lead to.

Conclusion

An increase in traffic on Nelson Ridge Road will almost certainly not lead to an increase in PM10 emissions above the standards given by the EPA. Modeling conducted with AERMOD shows that this increase would require traffic and speeds very unlikely to be found on the road, but given that airborne dust settling on structures, vehicles, vegetation, and other outdoor surfaces is a currently a nuisance to residents who live near the road, some simple suppression measures are recommended for the Forest Service to consider. The three recommended measures are:

1.) Reduced speed from 55mph to 25mph
2.) Placing speed bumps above each house to ensure compliance in critical locations
3.) Capping average daily traffic below 100 cars

As well, if there is funding and commitment available, an annual application of a Calcium Chloride dust suppressant could be appropriate, but regular application would be necessary for reliable performance (Edvardsson 2010, Richardson 2012, numerous others).

The implementation of these measures should be undertaken prior to increased construction traffic and should be conducted in consultation with a professional familiar with these products and measures suggested.

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Appendix A: AERMOD Input File Used for PM10 Modeling on Nelson Ridge Road

```
CO STARTING
CO TITLEONE Projections of increased PM10 concentrations on Nelson Ridge Road
CO MODELOPT CONC NOSTD NOCHKD
CO AVERTIME 24 PERIOD
CO POLLUTID OTHER
CO FLAGPOLE 1.5
CO RUNORNOT RUN
CO ERRORFIL errors.msg
CO FINISHED

** These are the sources – volume sources spaced approximately every 15m
** Initial Sigma z, Sigma y, Top of Plume Height, Release Height, and plume width
** are all taken from the current Best Operating Practices from the EPA working group
** on haul road modeling, based on an average automobile height of 2m.  Emission
** rates are described in the Emissions Modeling Methods
SO STARTING
SO ELEVUNIT METERS
SO LOCATION  VR1          VOLUME          75.00       -194.00        686.04
SO SRCPARAM  VR1          0.022914684        1          4.18           1.58
SO LOCATION  VR2          VOLUME          81.00       -203.00        688.69
SO SRCPARAM  VR2          0.022914684        1          4.18           1.58
SO LOCATION  VR3          VOLUME          87.00       -213.00        691.47
SO SRCPARAM  VR3          0.022914684        1          4.18           1.58
SO LOCATION  VR4          VOLUME          94.00       -221.00        693.83
SO SRCPARAM  VR4          0.022914684        1          4.18           1.58
SO LOCATION  VR5          VOLUME         105.00       -222.00        697.17
SO SRCPARAM  VR5          0.022914684        1          4.18           1.58
SO LOCATION  VR6          VOLUME         115.00       -221.00        700.20
SO SRCPARAM  VR6          0.022914684        1          4.18           1.58
SO LOCATION  VR7          VOLUME         125.00       -215.00        703.00
SO SRCPARAM  VR7          0.022914684        1          4.18           1.58
SO LOCATION  VR8          VOLUME         132.00       -208.00        703.77
SO SRCPARAM  VR8          0.022914684        1          4.18           1.58
SO LOCATION  VR9          VOLUME         136.00       -197.00        700.64
SO SRCPARAM  VR9          0.022914684        1          4.18           1.58
SO LOCATION  VR10         VOLUME         138.00       -187.00        697.18
SO SRCPARAM  VR10          0.022914684       1          4.18           1.58
SO LOCATION  VR11         VOLUME         144.00       -179.00        696.40
SO SRCPARAM  VR11          0.022914684       1          4.18           1.58
SO LOCATION  VR12         VOLUME         153.00       -176.00        699.30
SO SRCPARAM  VR12          0.022914684       1          4.18           1.58
SO LOCATION  VR13         VOLUME         163.00       -178.00        702.98
SO SRCPARAM  VR13          0.022914684       1          4.18           1.58
SO LOCATION  VR14         VOLUME         172.00       -183.00        706.55
SO SRCPARAM  VR14          0.022914684       1          4.18           1.58
SO LOCATION  VR15         VOLUME         183.00       -187.00        711.25
SO SRCPARAM  VR15          0.022914684       1          4.18           1.58
SO LOCATION  VR16         VOLUME         195.00       -186.00        715.27
SO SRCPARAM  VR16          0.022914684       1          4.18           1.58
SO LOCATION  VR17         VOLUME         205.00       -180.00        718.41
SO SRCPARAM  VR17          0.022914684       1          4.18           1.58
SO LOCATION  VR18         VOLUME         214.00       -175.00        722.10
SO SRCPARAM  VR18          0.022914684       1          4.18           1.58
SO LOCATION  VR19         VOLUME         224.00       -172.00        726.25
SO SRCPARAM  VR19          0.022914684       1          4.18           1.58
SO LOCATION  VR20         VOLUME         235.00       -172.00        730.46
SO SRCPARAM  VR20          0.022914684       1          4.18           1.58
SO LOCATION  VR21         VOLUME         246.00       -172.00        734.42
SO SRCPARAM  VR21          0.022914684       1          4.18           1.58
SO LOCATION  VR22         VOLUME         256.00       -171.00        737.93
SO SRCPARAM  VR22          0.022914684       1          4.18           1.58
SO LOCATION  VR23         VOLUME         266.00       -166.00        740.25
SO SRCPARAM  VR23          0.022914684       1          4.18           1.58
SO LOCATION  VR24         VOLUME         276.00       -161.00        741.78
SO SRCPARAM  VR24          0.022914684       1          4.18           1.58
SO LOCATION  VR25         VOLUME         285.00       -157.00        742.80
SO SRCPARAM  VR25          0.022914684       1          4.18           1.58
SO LOCATION  VR26         VOLUME         299.00       -149.00        742.62
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SO SRCPARAM  VR26          0.022914684         1          4.18          1.58
SO LOCATION  VR27          VOLUME          307.00       -143.00        741.84
SO SRCPARAM  VR27          0.022914684         1          4.18          1.58
SO LOCATION  VR28          VOLUME          307.00       -132.00        738.32
SO SRCPARAM  VR28          0.022914684         1          4.18          1.58
SO LOCATION  VR29          VOLUME          315.00       -121.00        736.93
SO SRCPARAM  VR29          0.022914684         1          4.18          1.58
SO LOCATION  VR30          VOLUME          321.00       -121.00        738.53
SO SRCPARAM  VR30          0.022914684         1          4.18          1.58
SO LOCATION  VR31          VOLUME          333.00       -117.00        740.95
SO SRCPARAM  VR31          0.022914684         1          4.18          1.58
SO LOCATION  VR32          VOLUME          342.00       -113.00        742.25
SO SRCPARAM  VR32          0.022914684         1          4.18          1.58
SO LOCATION  VR33          VOLUME          351.00       -107.00        742.24
SO SRCPARAM  VR33          0.022914684         1          4.18          1.58
SO LOCATION  VR34          VOLUME          357.00       -100.00        740.11
SO SRCPARAM  VR34          0.022914684         1          4.18          1.58
SO LOCATION  VR35          VOLUME          361.00        -91.00        737.20
SO SRCPARAM  VR35          0.022914684         1          4.18          1.58
SO LOCATION  VR36          VOLUME          363.00        -81.00        733.42
SO SRCPARAM  VR36          0.022914684         1          4.18          1.58
SO LOCATION  VR37          VOLUME          366.00        -72.00        729.82
SO SRCPARAM  VR37          0.022914684         1          4.18          1.58
SO LOCATION  VR38          VOLUME          372.00        -64.00        726.09
SO SRCPARAM  VR38          0.022914684         1          4.18          1.58
SO LOCATION  VR39          VOLUME          380.00        -59.00        723.68
SO SRCPARAM  VR39          0.022914684         1          4.18          1.58
SO LOCATION  VR40          VOLUME          390.00        -55.00        725.04
SO SRCPARAM  VR40          0.022914684         1          4.18          1.58
SO LOCATION  VR41          VOLUME          398.00        -52.00        726.54
SO SRCPARAM  VR41          0.022914684         1          4.18          1.58
SO LOCATION  VR42          VOLUME          407.00        -49.00        728.64
SO SRCPARAM  VR42          0.022914684         1          4.18          1.58
SO LOCATION  VR43          VOLUME          417.00        -46.00        732.73
SO SRCPARAM  VR43          0.022914684         1          4.18          1.58
SO LOCATION  VR44          VOLUME          427.00        -43.00        737.20
SO SRCPARAM  VR44          0.022914684         1          4.18          1.58
SO LOCATION  VR45          VOLUME          438.00        -44.00        742.40
SO SRCPARAM  VR45          0.022914684         1          4.18          1.58
SO LOCATION  VR46          VOLUME          448.00        -44.00        745.45
SO SRCPARAM  VR46          0.022914684         1          4.18          1.58
SO LOCATION  VR47          VOLUME          456.00        -45.00        747.92
SO SRCPARAM  VR47          0.022914684         1          4.18          1.58
SO EMISFACT VR1-VR47  HROFDY 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.3 0.0 0.0 0.0 0.0
SO EMISFACT VR1-VR47  HROFDY 0.0 0.0 0.2 0.2 0.3 0.0 0.0 0.0 0.0 0.0 0.0 0.0
SO SRCGROUP ALL
SO FINISHED
** This is the beginning of the defining of the receptor locations
**  They are arrayed in a 600x300m grid, spaced 20m apart, and also at
** each house location.  They are located relative to a user-defined origin
** to make it easier to input all the locations (as were the sources).
RE STARTING
RE ELEVUNIT METERS
   GRIDCART grid1 STA
   GRIDCART grid1 XYINC 0 30 20 0 15 -20
   GRIDCART GRID1    ELEV    1    651.7    654.3    655.0    654.9    654.3    654.1
   GRIDCART GRID1    ELEV    1    655.1    657.2    661.7    668.5    677.3    689.3
   GRIDCART GRID1    ELEV    1    698.7    705.8    709.8    711.3    710.4    707.2
   GRIDCART GRID1    ELEV    1    708.3    713.3    721.9    729.0    734.7    736.8
   GRIDCART GRID1    ELEV    1    740.6    745.7    746.3    745.9    745.0    750.5
   GRIDCART GRID1    ELEV    2    647.6    648.9    649.2    649.2    649.1    652.5
   GRIDCART GRID1    ELEV    2    656.3    660.4    665.5    672.3    680.7    692.3
   GRIDCART GRID1    ELEV    2    701.6    708.8    714.1    717.0    717.8    715.4
   GRIDCART GRID1    ELEV    2    714.5    715.3    723.6    731.7    739.6    742.9
   GRIDCART GRID1    ELEV    2    746.8    751.2    753.5    754.3    754.0    756.8
   GRIDCART GRID1    ELEV    3    644.7    645.1    645.3    646.3    648.1    653.6
   GRIDCART GRID1    ELEV    3    659.4    665.3    671.6    678.8    686.7    696.2
   GRIDCART GRID1    ELEV    3    704.4    711.5    717.5    721.7    724.3    722.5
   GRIDCART GRID1    ELEV    3    720.5    718.7    725.5    733.7    742.9    748.1
   GRIDCART GRID1    ELEV    3    752.7    756.9    760.4    762.4    763.3    764.4
   GRIDCART GRID1    ELEV    4    643.1    643.1    643.8    646.9    652.1    658.1
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GRIDCART GRID1    ELEV    4    664.8    672.1    680.6    688.5    695.8    701.3
GRIDCART GRID1    ELEV    4    707.5    714.2    720.2    725.4    729.7    728.3
GRIDCART GRID1    ELEV    4    726.2    723.9    728.1    735.1    744.3    752.2
GRIDCART GRID1    ELEV    4    758.3    762.9    766.9    770.1    772.6    773.3
GRIDCART GRID1    ELEV    5    644.5    645.0    646.0    649.5    654.9    661.3
GRIDCART GRID1    ELEV    5    669.6    679.4    687.2    694.5    701.3    706.7
GRIDCART GRID1    ELEV    5    711.8    716.8    722.4    727.7    732.6    733.8
GRIDCART GRID1    ELEV    5    733.3    731.6    731.8    736.1    743.8    751.8
GRIDCART GRID1    ELEV    5    759.3    766.5    772.1    777.1    781.4    784.1
GRIDCART GRID1    ELEV    6    646.5    648.8    650.1    653.0    657.2    663.9
GRIDCART GRID1    ELEV    6    673.2    684.6    692.3    699.7    706.7    712.2
GRIDCART GRID1    ELEV    6    717.0    721.2    725.3    730.1    735.4    738.8
GRIDCART GRID1    ELEV    6    740.0    739.2    737.2    740.0    746.7    754.3
GRIDCART GRID1    ELEV    6    761.8    769.2    776.1    782.6    788.6    792.2
GRIDCART GRID1    ELEV    7    649.2    654.8    656.1    657.5    659.2    665.9
GRIDCART GRID1    ELEV    7    675.5    687.3    695.9    704.2    712.0    718.0
GRIDCART GRID1    ELEV    7    723.3    727.7    729.2    732.8    738.1    743.4
GRIDCART GRID1    ELEV    7    746.1    746.5    744.5    747.3    754.0    760.7
GRIDCART GRID1    ELEV    7    766.3    771.3    778.6    786.2    793.9    796.6
GRIDCART GRID1    ELEV    8    652.1    659.6    662.6    664.9    666.8    670.5
GRIDCART GRID1    ELEV    8    678.3    689.4    699.3    707.7    714.9    722.6
GRIDCART GRID1    ELEV    8    728.9    733.8    736.4    739.6    743.3    748.2
GRIDCART GRID1    ELEV    8    751.5    753.3    752.6    755.2    760.6    766.9
GRIDCART GRID1    ELEV    8    772.3    777.0    784.0    790.1    795.2    794.5
GRIDCART GRID1    ELEV    9    654.3    663.2    668.4    672.5    675.6    677.6
GRIDCART GRID1    ELEV    9    683.3    692.0    701.4    709.5    716.4    724.9
GRIDCART GRID1    ELEV    9    732.1    738.1    742.5    746.3    749.8    753.2
GRIDCART GRID1    ELEV    9    756.3    758.8    759.4    762.0    766.4    772.0
GRIDCART GRID1    ELEV    9    777.0    781.5    787.6    791.3    792.8    788.5
GRIDCART GRID1    ELEV   10    655.4    665.3    673.2    679.9    685.6    687.6
GRIDCART GRID1    ELEV   10    690.8    695.2    702.0    709.1    716.4    724.4
GRIDCART GRID1    ELEV   10    732.4    740.2    746.8    752.6    757.6    758.4
GRIDCART GRID1    ELEV   10    760.3    762.9    764.8    767.6    771.0    775.7
GRIDCART GRID1    ELEV   10    780.0    784.1    788.8    789.3    785.9    778.1
GRIDCART GRID1    ELEV   11    655.3    666.1    674.5    681.8    688.1    692.7
GRIDCART GRID1    ELEV   11    697.6    702.8    707.4    712.8    718.8    725.2
GRIDCART GRID1    ELEV   11    731.9    739.0    745.3    751.5    757.4    759.0
GRIDCART GRID1    ELEV   11    759.9    760.5    762.1    764.9    768.7    772.5
GRIDCART GRID1    ELEV   11    777.6    783.5    785.2    782.9    777.4    770.3
GRIDCART GRID1    ELEV   12    655.0    666.4    675.3    683.0    689.6    695.6
GRIDCART GRID1    ELEV   12    701.7    707.8    711.1    715.5    720.9    726.2
GRIDCART GRID1    ELEV   12    732.0    738.3    744.5    750.7    756.8    758.0
GRIDCART GRID1    ELEV   12    757.8    756.6    757.2    760.0    764.8    769.4
GRIDCART GRID1    ELEV   12    775.3    782.0    780.8    776.6    770.0    763.5
GRIDCART GRID1    ELEV   13    654.6    666.5    675.8    683.6    690.3    696.3
GRIDCART GRID1    ELEV   13    702.6    709.1    712.4    716.9    722.2    727.5
GRIDCART GRID1    ELEV   13    732.9    738.3    745.0    750.9    756.0    755.4
GRIDCART GRID1    ELEV   13    753.7    751.2    750.0    753.0    759.6    766.8
GRIDCART GRID1    ELEV   13    773.7    779.9    776.0    770.6    764.0    758.0
GRIDCART GRID1    ELEV   14    653.3    663.9    672.8    680.7    687.7    693.3
GRIDCART GRID1    ELEV   14    699.0    704.8    709.0    713.8    719.1    723.5
GRIDCART GRID1    ELEV   14    729.0    735.2    742.7    747.4    749.6    748.5
GRIDCART GRID1    ELEV   14    746.8    744.8    747.7    753.4    761.2    768.2
GRIDCART GRID1    ELEV   14    772.4    774.1    769.2    763.6    757.4    751.4
GRIDCART GRID1    ELEV   15    652.2    661.2    669.3    676.8    683.9    689.4
GRIDCART GRID1    ELEV   15    695.1    700.8    706.0    711.4    716.9    720.9
GRIDCART GRID1    ELEV   15    726.3    732.7    739.3    742.4    742.6    741.1
GRIDCART GRID1    ELEV   15    740.8    741.9    748.5    755.6    763.2    768.2
GRIDCART GRID1    ELEV   15    769.1    766.5    761.4    756.0    750.4    745.0
GRIDCART GRID1    HILL    1    818.0    818.0    818.0    818.0    818.0    818.0
GRIDCART GRID1    HILL    1    818.0    818.0    818.0    818.0    818.0    818.0
GRIDCART GRID1    HILL    1    818.0    818.0    818.0    818.0    818.0    818.0
GRIDCART GRID1    HILL    1    818.0    818.0    818.0    818.0    818.0    818.0
GRIDCART GRID1    HILL    1    818.0    818.0    818.0    818.0    818.0    818.0
GRIDCART GRID1    HILL    2    818.0    818.0    818.0    818.0    818.0    818.0
GRIDCART GRID1    HILL    2    818.0    818.0    818.0    818.0    818.0    818.0
GRIDCART GRID1    HILL    2    818.0    818.0    818.0    818.0    818.0    818.0
GRIDCART GRID1    HILL    2    818.0    818.0    818.0    818.0    818.0    818.0
GRIDCART GRID1    HILL    2    818.0    818.0    818.0    818.0    818.0    818.0
GRIDCART GRID1    HILL    3    818.0    818.0    818.0    818.0    818.0    818.0
GRIDCART GRID1    HILL    3    818.0    818.0    818.0    818.0    818.0    818.0
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   GRIDCART GRID1    HILL    3    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    3    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    3    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    4    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    4    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    4    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    4    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    4    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    5    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    5    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    5    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    5    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    5    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    6    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    6    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    6    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    6    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    6    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    7    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    7    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    7    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    7    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    7    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    8    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    8    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    8    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    8    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    8    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    9    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    9    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    9    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    9    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL    9    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL   10    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL   10    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL   10    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL   10    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL   10    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL   11    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL   11    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL   11    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL   11    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL   11    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL   12    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL   12    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL   12    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL   12    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL   12    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL   13    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL   13    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL   13    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL   13    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL   13    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL   14    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL   14    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL   14    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL   14    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL   14    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL   15    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL   15    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL   15    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART GRID1    HILL   15    818.0    818.0    818.0    818.0    818.0    818.0
   GRIDCART grid1 END
   DISCCART         138.00      -214.00     706.90     818.00
   DISCCART         170.00      -194.00     708.36     818.00
   DISCCART         225.00      -180.00     726.43     818.00
   DISCCART         299.00      -154.00     744.27     818.00
   DISCCART         442.00      -134.00     759.29     818.00
RE FINISHED
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ME STARTING
**  Surface and Profile files were supplied by N.C. Department of Air Quality
**  They are not representative of local data, but are screening files.
**  They will give values more conservatively high than actual.
ME SURFFILE mtns.sfc
ME PROFFILE mtns.pfl
ME SURFDATA 22222 10 sampletest
ME UAIRDATA 22222 10 sampletest2
ME PROFBASE 682
ME FINISHED

OU STARTING
OU RECTABLE 24 1ST-4TH
OU MAXTABLE 24 20
OU DAYTABLE ALLAVE
OU FINISHED
```